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Intra-Firm Trade

PATTERNS, DETERMINANTS AND POLICY IMPLICATIONS

Rainer Lanz, Sébastien Miroudot

JEL Classification: F13, F23, L22

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Abstract

INTRA-FIRM TRADE: PATTERNS, DETERMINANTS AND POLICY IMPLICATIONS

by

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The emergence of global value chains and the expansion of activities of multinational enterprises have increased the value of intra-firm trade flows. Despite growing attention from policymakers, few data are collected on trade transactions between related parties. Available evidence suggests that intra-firm trade represents a significant share of world trade but differs widely across countries and industries. Trade statistics and firm-level data point out that intra-firm trade and vertical integration occur predominantly among OECD countries and that firm behaviour and relationships between buyers and suppliers explain the patterns of intra-firm trade. The report analyses the implications of intra-firm trade for trade liberalisation, transfer pricing and the transmission of macroeconomic shocks. It finds that for trade policymakers, the rise of intra-firm trade underscores the benefits of trade liberalisation when domestic firms have affiliates abroad and foreign firms are established in the domestic economy. Trade policy should remain neutral with respect to firms' sourcing strategies but trade agreements should increasingly take into account vertical relationships between buyers and suppliers. Analysing the role of intra-firm trade during the 2008-09 trade collapse, the report furthermore highlights that while the role of global value chains was questioned in the transmission of the crisis, vertically integrated production networks can be more resilient in the context of an economic downturn.

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JEL classification: F13, F23, L22

Keywords: Intra-firm trade, related party trade, transfer-pricing, multinational enterprises, foreign affiliates, vertical FDI, sourcing strategies, global value chains, global production networks, trade liberalisation.

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Executive Summary

Intra-firm trade corresponds to international flows of goods and services between parent companies and their affiliates or among these affiliates, as opposed to arm's length trade between unrelated parties (inter-firm trade). Thus, intra-firm trade arises only when firms invest abroad. On the other hand, offshoring – the relocation of activities abroad – captures not only intra-firm trade, but also arm's length trade with independent suppliers.

The organisation of multinational firms has dramatically changed over the last two decades with the emergence of "global value chains" which has increased the importance of intra-firm trade flows. Interest of policymakers in this form of trade has also increased because trade policy objectives are likely to be different when considering trade flows between domestic companies and foreign companies on the one hand, and trade flows within multinational enterprises (MNEs) headquartered in the domestic economy on the other. Intra-firm trade is also of interest for competition and tax authorities with regard to customs valuation and transfer pricing. For all these reasons, there is a need to better understand intra-firm trade and provide data on its importance in a greater number of countries than those for which statistics are already available.

Most countries collect few statistics on intra-firm trade or none at all. Intra-firm trade statistics (collected through customs) are available only for the United States where, in 2009, such trade accounted for 48% of US goods imports and about 30% of US goods exports. Available statistics on the activities of multinational enterprises allow comparing the share of intra-firm trade in total manufacturing exports for nine OECD countries only but are often limited to the exports of foreign affiliates (and do not include the exports of parent companies to their affiliates).

From available data, six stylised facts emerge on the patterns of intra-firm trade:

1. First, a large share of world trade is between "related parties", that is companies that are linked through ownership. It is difficult to provide an average share for world trade, as data are available for very few countries. But for the nine OECD countries mentioned above, intra-firm exports of foreign affiliates already represent 16% of total exports. Adding the exports of parent companies to their affiliates abroad, one could come close to the figure of one third as measured in US trade statistics.

2. However, this average masks wide differences; for example, the share of intra-firm exports in total manufacturing exports is 51% in Sweden and 10% in Japan. Canada, Poland and Sweden are the countries where the share of intra-firm trade is the highest. There are also wide differences across sectors. The share of intra-firm trade is especially high in the automobile, pharmaceuticals and transport equipment industries.

3. Data on intra-firm trade in services is even rarer. According to US balance of payments data, in 2008, the share of intra-firm trade in total US private services trade was 22% for imports and 26% for exports.

4. In the case of the US economy, the share of intra-firm trade in total trade has remained more or less unchanged over the past 10 years, while the share of intra-firm trade in services has increased. For other countries, there is evidence of an increase in intra-firm trade in both goods and services industries.

5. Intra-firm transactions are more common among OECD countries than among emerging economies. In 2009, 58% of US goods imports from OECD countries were intra-firm, while only 29% of US goods imports from Brazil, the Russian Federation, India, Indonesia, China and South Africa (BRIICS economies) occurred between related parties. This is consistent with the fact that the bulk of foreign direct investment (FDI) is among OECD countries.

6. While intra-firm trade is mainly in intermediate goods, connecting the different stages of global value chains, there are also significant intra-firm trade flows for final goods. This is explained by the importance of distribution networks in international production chains.

Differences in the share of intra-firm trade among OECD countries can be explained by traditional trade determinants, such as market size and capital or skill intensity, but also by new determinants at the firm level. In particular, product contractibility has been identified as an important driver of intra-firm trade decisions. The easier it is for firms to negotiate contracts for inputs, the more they will favour arm's length trade over intra-firm trade. This is because the "hold-up" problem, which leads to under-investment and delays in delivery and payments, is less pronounced for "contractible" products, thus promoting firms' preferences to turn to independent suppliers and arm's length trade. On the other hand, the share of intra-firm imports is higher in capital and skilled labour intensive industries. These industries require relatively more relationship-specific investments (investments which have little or no value outside the relationship) so that parent firms prefer to vertically integrate with their suppliers.

The main policy implications of the report are the following:

1. The gains from intra-firm trade are part of the gains stemming from offshoring and the reorganisation of firms in global value chains. They are similar to the gains from outsourcing and arm's length trade. Trade policy should therefore remain neutral with respect to firms' sourcing strategies. Depending on the industry and firms characteristics, the ratio of intra-firm trade to arm's length trade can increase or decrease and there is no reason for trade policy to encourage or discourage vertical integration as opposed to outsourcing.

2. There are challenges in the measurement of new gains from trade associated with offshoring and intra-firm trade but these gains appear to be large when taking into account selection effects, the increase in variety and the full benefits of global value chains. Developing statistics on intra-firm trade and statistics at the firm-level are key to a deeper understanding of the benefits of trade liberalisation.

3. Firms redraw their boundaries under trade liberalisation. The least productive firms exit the market, while more productive firms engage in outsourcing and/or vertical integration (or other forms of partnerships with foreign suppliers). Both theories and empirical evidence confirm the existence of heterogeneous firms: in the same industry firms with different levels of productivity and different sourcing strategies coexist.

Concretely, this means that MNEs can coexist with domestic companies that are less productive but still profitable and that outsourcing and vertical integration can happen at the same time at home and abroad (offshoring). Trade liberalisation should therefore not be understood as unambiguously moving some activities abroad while keeping others at home. However, as some firms exit the market and others reorganise their production, there is an impact on the domestic economy that should be addressed by the relevant policies to minimise restructuring costs and ensure a smooth transition to the more efficient structure of production.

4. The data collected on intra-firm trade highlight that vertical integration occurs primarily among OECD countries. Offshoring does not seem to be mainly motivated by low labour costs in developing economies as most affiliates of OECD MNEs are created in other OECD economies and often in high-cost countries. Firms tend to favour the vertical integration strategy for high-value activities that are intensive in knowledge. The challenge for developing economies is to become attractive locations for this type of activities as well and not to be confined to low-value activities.

5. For trade policymakers, the rise of intra-firm trade should underscore the benefits of trade liberalisation for domestically-owned affiliates located abroad and foreign-owned companies in the domestic economy. Taking into account investment can change some of the traditional results of the political economy of trade and provides new incentives for trade liberalisation. Investment liberalisation is not only a substitute for trade liberalisation but can also encourage further trade opening. This justifies dealing with both trade and investment in the same agreements, as is now the case in most regional trade agreements signed by OECD countries.

6. In addition to traditional market access concerns, trade agreements should take into account vertical relationships between buyers and suppliers. Maximising the gains from trade implies not only ensuring non-discrimination in the treatment of foreign and domestic producers but also fair bargaining conditions between buyers and suppliers. This is how the impact of the hold-up problem on intermediate trade can be mitigated. To what extent trade agreements can deal with the new competition issues arising in this vertical relationship should be given more thought. The issue may also be addressed through national competition law, while recognising its strong international dimension. There are other policy areas more traditionally covered in trade agreements, such as standards, that should also be re-examined in light of the buyer-supplier relationship.

7. Because in this buyer-supplier relationship the two companies can be either goods manufacturers or services providers, there is no rationale for covering only goods in trade agreements or for having a separate set of rules on “goods” and on “services” to deal with the issues of vertical trade.

8. Global value chains should not be regarded as a source of macroeconomic instability or the cause of higher trade elasticities during a crisis. Intra-firm trade illustrates rather the opposite, the fact that vertically integrated production networks can be more resilient in the context of an economic downturn.

1. Introduction: the new boundaries of multinational firms and their trade implications

Intra-firm trade corresponds to international flows of goods and services between parent companies and their affiliates or among these affiliates, as opposed to arm's length trade which is trade between unrelated parties (inter-firm trade). Intra-firm trade is the consequence of activities of multinational enterprises (MNEs) that move goods and services across borders during the production process and provide final products to customers through their foreign affiliates.

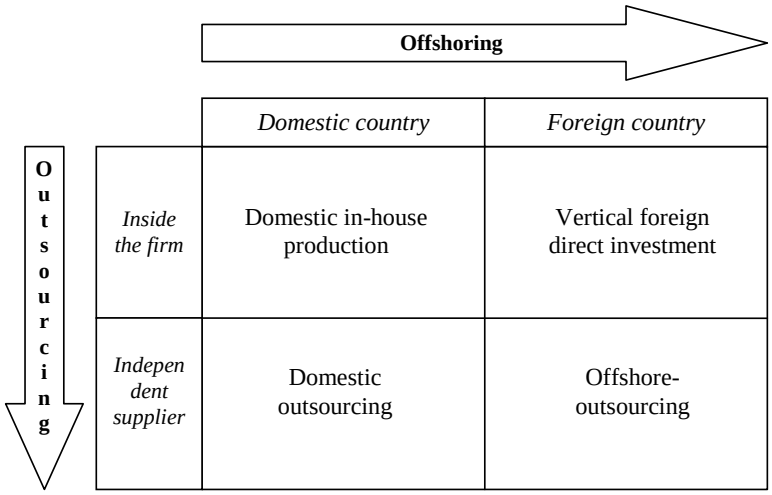
The organisation of multinational firms has changed dramatically over the two last decades. This is not only a quantitative change with an increase in the scale of global operations of MNEs but also a qualitative change. MNEs were initially companies operating in several countries but with headquarter activities concentrated in their home economy. In the 1990s, a first qualitative change has been the development of vertical foreign direct investment (FDI) and the fragmentation of production. Instead of using foreign subsidiaries to access new markets and circumvent trade policy barriers in the context of horizontal FDI, firms have increasingly relied on offshoring to specialise vertically and to spread the production process over several countries based on their respective advantages in terms of trade costs and production factors.

This transformation has already thrown into question the "national identity" of MNEs when a large share of the production process is offshored. The "decentering" of MNEs (Desai, 2009) has been accentuated by an even more recent trend which is the offshoring of some headquarter activities and an increase in trade in business services. The analysis of trade and investment flows now takes place in the context of "global value chains", a concept that encompasses the full range of activities that are required to bring a good or service to the final consumer, from the provision of raw materials to the final assembly and delivery (Cattaneo *et al.*, 2010).

The boundaries of firms have changed both organisationally and geographically. To reduce costs, firms have started to redefine their activities and to disaggregate them into those that should be performed in-house and those that should be outsourced to independent contractors. This decision is based on transaction costs and whether it is better for the firm to retain control or not over the activity. In addition, firms have expanded geographically and relocated activities abroad to seize the opportunity of differences in costs and resources across countries and achieve a more efficient production process. The location and organisation of value chains is not static. Firms constantly adapt their strategies to changes in their competitive advantages (through innovation, technological spillovers and catch-up) as well as the comparative advantage of countries (Mudambi and Venzin, 2010).

These two dimensions are represented on Figure 1 illustrating the different sourcing strategies of firms. When the supply of an input is outsourced, it can be produced by an independent supplier, either at home ("domestic outsourcing") or abroad ("foreign outsourcing" or "offshore outsourcing"). Similarly, when the input is produced within the firm, this can be either carried out in the domestic economy ("in-house production") or in a subsidiary abroad ("vertical foreign direct investment"). In the latter case, there is intra-firm trade, for example when the input produced in the foreign subsidiary is exported to the parent company in the domestic economy. Box 1 provides a more comprehensive typology of FDI motives and the type of intra-firm trade implied.

Figure 1. Typology of sourcing strategies



Box 1. Motives for foreign direct investment and potential for intra-firm trade

In the typology developed by J. Dunning, there are four types of MNE activity that can explain foreign investment. We explain below the four types and give an indication of the type of intra-firm trade flows that can be expected from these activities. It should be noted that in practice MNEs are pursuing multiple objectives and the same investment may combine several of the motives described below.

1. Resource-seeking FDI

The firm engages in FDI to have access to specific resources in the host economy (e.g. natural resources, material inputs or human resources). This is an example of vertical FDI (i.e. where the subsidiary is an input supplier to the parent company).

Intra-firm trade? Yes, raw material or the resource once processed is shipped to the parent company or sister firms (i.e. other affiliates). Local human resources can be used as well to produce goods or services traded intra-firm.

2. Market-seeking FDI

The objective of the firm is to supply goods or services in the host market (or in adjacent countries in the case of "export-platform FDI"). This is the main type of horizontal FDI (i.e, where the subsidiary produces the same good or service as the parent company).

Intra-firm trade? No, the subsidiary is created to sell the product in the local market. However, there might be intra-firm imports of inputs or of complementary finished products by the affiliate.

3. Efficiency-seeking FDI

The intention is to take advantage of different factor endowments to arbitrage cost and price differentials in order to improve the global efficiency of the firm by concentrating production in a limited number of locations. As with resource-seeking FDI, this is a type of vertical FDI. The difference is that resource-seeking FDI is a motive for initial FDI while efficiency-seeking FDI corresponds to sequential FDI. Once the firm has invested in different places, it rationalises the whole production process and focuses on the most efficient locations in a global strategy.

Intra-firm trade? Yes, processed inputs are shipped to the parent company or to another affiliate in the global production network.

4. Strategic asset-seeking FDI

The objective is to acquire assets, such as knowledge, technology or information on local markets, to promote the long-term objectives of the firm and to increase its competitiveness. To the extent that the asset can be regarded as an input, this type would be considered vertical FDI but it is better to describe it as neither horizontal nor vertical.

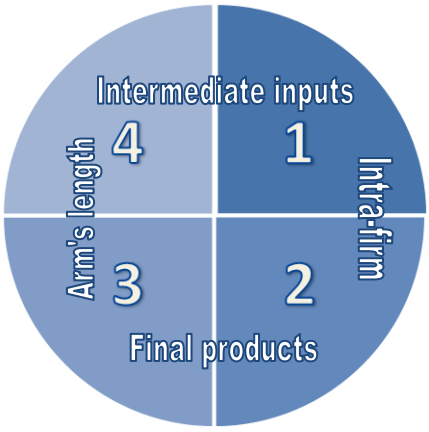
Intra-firm trade? No, there is no material input shipped to the parent company but transfers of knowledge may imply intra-firm trade in services.

Source: Dunning and Lundan (2008); Ivarsson and Johnsson (2000).

Foreign outsourcing also increases trade flows of intermediate goods and services, as the input produced by the independent supplier abroad is shipped to the buyer in the domestic economy. But intra-firm trade is not limited to inputs trade. There are also intra-firm flows of final goods and services. As illustrated in Figure 2, trade flows can be on the one-hand decomposed into arm's length trade (between independent companies) and intra-firm trade (between related parties), and on the other hand split between intermediate inputs and final products.

While cost reduction appears as the main motivation for firms to reorganise their production internationally, one should not underestimate related strategic drivers that can also explain firm strategies. One of them is access to knowledge. With the growing complexity of products and services, even the largest companies have to rely on external expertise (Contractor *et al*., 2010). Knowledge about foreign markets is also key for firms to expand internationally. To access external knowledge or for other strategic reasons, firms can engage into "strategic-asset seeking FDI" (Dunning and Lundan, 2008).

Figure 2. Arm's length vs. intra-firm trade and trade in intermediate inputs vs. final goods



Source: Bardhan and Jaffee (2005)

But there are also looser forms of partnerships, such as alliances, that can also have an impact on trade but are not captured in FDI statistics. One should not limit the analysis to outsourcing and vertical integration strategies, the international activities of firms also take the form of licensing agreements, partnerships and long-term contracts with suppliers, resulting in a more complex and nuanced picture of global value chains. The term "related parties" covers such partnerships in the measurement of trade with related parties (as opposed to arm's length trade). Box 2 gives a concrete example of vertical integration in the mobile phone industry and illustrates the "heterogeneity" of firms, i.e. the fact that they adopt different sourcing strategies.

An OECD study from 1993 noted that little is known about intra-firm trade and that "the literature on the subject is still relatively limited and recent" (Bonturi and Fukasaku, 1993). Seventeen years later, this assessment remains valid. Despite many studies on the internationalisation of production and the role of MNEs in trade, data on intra-firm trade are sparse and few studies look at trade flows across firms. Recently, there have been

efforts to measure trade in intermediate goods and services[1] but the decomposition of trade flows between affiliated and unaffiliated companies is available only in goods trade statistics collected by the United States. Some other countries collect data on intra-firm trade through business surveys on the Activities of Multinational Enterprises (AMNE) but disaggregated information on industries and partners remains scarce.[2]

Box 2. Intra-firm trade in the mobile handset industry: the example of Nokia

Nokia, a company headquartered in Finland, is the largest firm in the mobile handset industry. In 2009, it shipped more than 400 million mobile devices to over 160 countries. To do so, it handled more than 100 billion parts that are manufactured in 10 factories around the world. Some of these plants are in OECD countries (Finland, Germany, Mexico and the United Kingdom) while others are in emerging economies (Brazil, China and India). While companies such as Apple, Motorola and Ericsson have largely outsourced part of the value chain, the choice of Nokia is to remain vertically-integrated (another example of a vertically-integrated firm in the industry is Samsung).

Handling a huge volume of intra-firm trade represents important challenges in terms of logistics and Nokia has to support the cost of managing affiliates that are geographically dispersed. But the company finds several advantages in being vertically integrated. First, it enables the company to control closely the production process and to customise products rapidly. Recently, mobile service providers such as Vodafone or AT&T have put pressure on mobile device manufacturers to install software and customise features before the handsets leave the factory. The production process is thus divided into the production of raw generic devices that are then customised to the requirements of markets and customers in a second process. Retaining a high degree of control on the manufacturing accelerates the customisation, as basic handsets can be transformed into build-to-order phones in a matter of days.

While Nokia manufactures semiconductors, microprocessors, memory devices and displays in its 10 factories, the company also imports inputs from independent suppliers. But these represent a small share of overall inputs (about 20%).

Source: Lesser (2008), Mudambi and Venzin (2010), Nokia website.

Intra-firm trade is of interest for policymakers because trade policy objectives are likely to be different when considering trade flows between domestic companies and foreign companies on the one hand, and trade flows within MNEs headquartered in the domestic economy on the other hand. Whether trade is intra-firm or inter-firm presumably has an impact on the benefits from trade and the impact of firm strategies on the parent and host countries in terms of jobs and the location of activities. Intra-firm trade is also of interest for competition and tax authorities with regard to customs valuation and transfer pricing. Lastly, the role of intra-firm trade and global production networks was also scrutinised in the explanation of the 2008-09 trade collapse. For all these reasons, there is a need to better understand intra-firm trade and provide data on its importance in a greater number of countries than those for which statistics are already available.

The report is organised as follows. Section 2 provides some stylised facts on intra-firm trade and highlights what we know about it and what we do not. Section 3 analyses the determinants of intra-firm trade and why the share of intra-firm trade differs across countries and industries. The rest of the document is dedicated to some of the policy implications of intra-firm trade. Section 4 looks at the gains from intra-firm trade, Section 5 addresses the question of transfer pricing and Section 6 presents new evidence

1. See Miroudot *et al.* (2009), as well as Johnson and Noguera (2009) and Daudin *et al.* (2009).

2. In Annex A, we provide an overview of available statistics and discuss data issues. Annex B includes estimates of sales of vertical affiliates as a proxy for the prevalence of intra-firm trade.

on the role of firms in the transmission of international macro-economic shocks in the context of the 2008-09 trade collapse. Section 7 concludes.

2. Stylised facts on the share and growth of intra-firm trade in goods and services

There are very few data available on intra-firm trade. Only the United States collects detailed trade statistics distinguishing between trade with related parties (intra-firm trade) and trade with non-related parties (arm's length trade). There is some information available in statistics on activities of multinational enterprises (AMNE) for a few more countries (9 in the case of the OECD Activities of Foreign Affiliates [AFA] database) but the coverage is not comprehensive. Annex A describes in more detail the characteristics and the coverage of intra-firm trade in AMNE statistics and in trade statistics. This section presents evidence on the prevalence and patterns of intra-firm trade based on this limited information. Annex B complements the following descriptive analysis by discussing estimates of the number and sales of vertical affiliates based on the OECD Orbis firm level dataset.

Stylised fact one: a large share of world trade is intra-firm

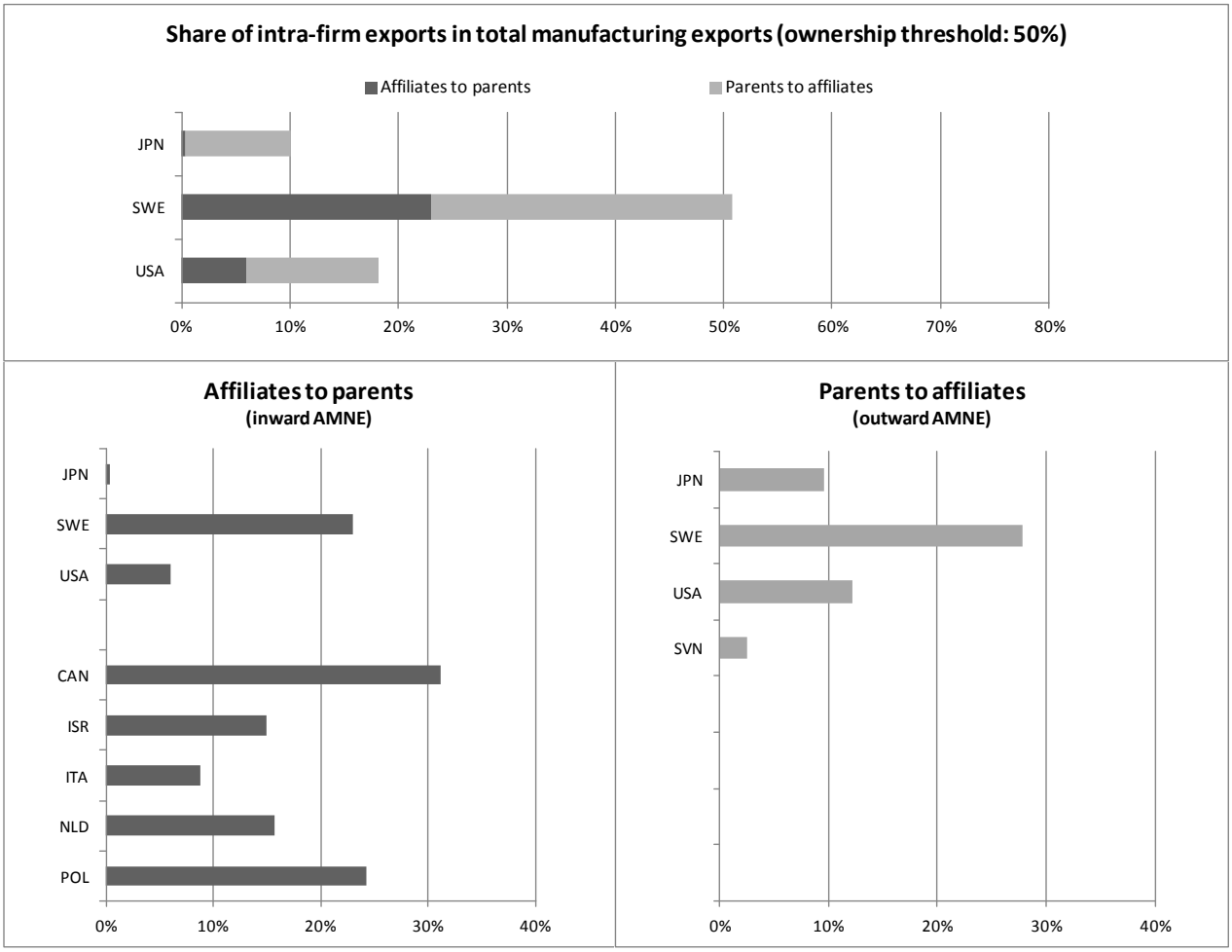
The first question that comes to mind when thinking about intra-firm trade is: how important is it? This question is difficult to answer for two reasons. First, we do not have data for enough countries to properly assess the share of intra-firm trade in world trade. Second, the importance of intra-firm trade depends on the ownership criteria that is applied to classify a given trade transaction as "intra-firm". In the case of the US economy, trade statistics and statistics on activities of MNEs report a different share of intra-firm trade because the former are based on a low ownership threshold (6% for imports and 10% for exports) while the latter are based on a 50% ownership criterion.[3]

Nonetheless, there is evidence that intra-firm trade accounts for a large share of world trade. In the case of the United States, intra-firm transactions represent 48% of imports and 30% of exports in 2009 (on the basis of trade statistics). Figure 3 reports the share of intra-firm exports in total manufacturing exports for up to nine OECD countries as measured by AMNE statistics. Only three of them provide data for both the exports of foreign affiliates and parent companies. In most countries, only the exports of foreign affiliates are covered. On average, these intra-firm exports already represent 16% of total exports. Assuming that on average parents export a similar volume to their affiliates, this is how one can come close to the broad estimation of one third of world trade being intra-firm.

To get further indication of the significance of intra-firm trade for the operations of MNEs, Figure 4 reports how much of the exports of majority-owned affiliates is intra-firm. Across nine OECD countries, intra-firm exports constitute about half of affiliate exports on average.

3. In addition, the trade data are collected at the product level while AMNE statistics are based on industries.

Figure 3. Share of intra-firm exports in manufacturing exports of OECD countries



Notes: Data are for the year 2007 for Israel, Italy, Japan, Poland, Slovenia and the United States, 2002 for the Netherlands, 1999 for Sweden and 1994 for Canada. To calculate the intra-firm trade shares at the country level, intra-firm trade data from the OECD AFA database have been combined with manufacturing exports and imports from the OECD STAN BTD. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

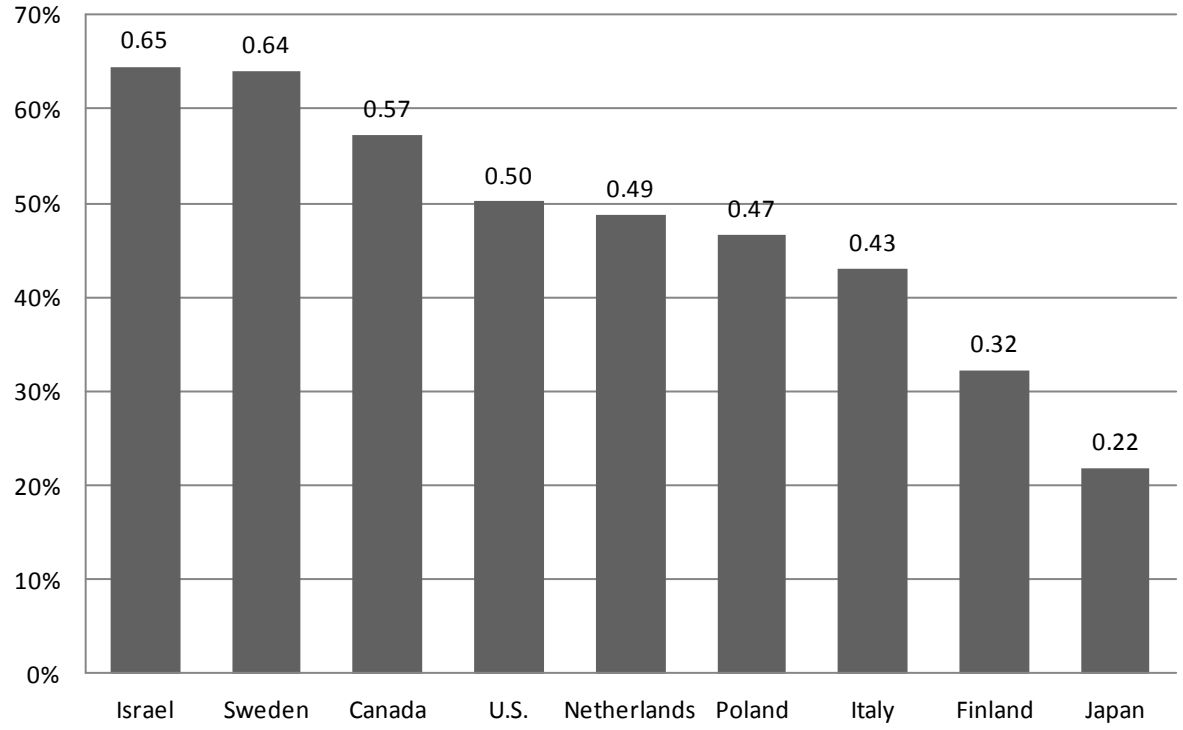
Source: OECD AFA and AMNE Database, OECD STAN Bilateral Trade Database (BTD)

Stylised fact two: the share of intra-firm trade in total trade shows a great variation across countries and industries

As can be seen in Figure 3, the relative magnitude of intra-firm trade differs significantly across countries. While in Sweden the share of intra-firm exports in total manufacturing exports is 51%, the share is respectively 18% in the United States and 10% in Japan. Figure 4 points out that large variations are also observed across countries for the share of intra-firm trade in total trade of affiliates. For instance, while intra-firm transactions account for 65% of exports of foreign affiliates operating in Israel, only 22% of exports of affiliates in Japan are intra-firm. These variations in the prevalence of intra-firm trade likely reflect both differences in the industry composition of foreign affiliates and country characteristics such as market size.

Using the OECD AFA database and the OECD STAN Bilateral Trade Database, Tables A.2 and A.3 in Annex A provide an overview of the importance of intra-firm imports and exports by industry. Generally, the shares of intra-firm trade in total trade of affiliates differ widely across both countries and industries. Italy has its highest shares of intra-firm imports in affiliate imports (85%) in natural resources industries ("Mining and quarrying" and "Refined petroleum and coal products"). Also, the Netherlands has a high share of intra-firm imports in affiliate imports in the mining and quarrying industry (80%), but even a higher one (100%) in office, accounting and computing machinery. Japan has the highest share of intra-firm imports in affiliate imports in basic and fabricated metal products (93%), while the United States has the highest share in drugs and medicines (93%). On average, the sectors with high shares of intra-firm trade are automobile, pharmaceutical and transport equipment industries.[4]

Figure 4. Share of intra-firm exports in affiliate exports for 8 OECD economies



Notes: Data are for the year 2008 for Italy and the United States; 2007 for Israel, Japan, and Poland; 2006 for Finland; 2002 for Sweden and the Netherlands; 1994 for Canada. Data for Israel and Poland refer to the manufacturing sector only.

Source: OECD AFA Database, Statistics Finland.

Stylised fact three: intra-firm trade in services is also important, in particular for services supporting the activities of MNEs

Data on intra-firm trade in services are even less widely collected than for goods and is available only for Canada and the United States. The share of intra-firm exports in private US services exports was 26% in 2008, while the respective share for intra-firm imports was 22%. One reason for these somewhat low shares is that the services

4. See also Table A.4 in Annex A for US trade statistics broken down by HS2 product chapter.

classified under "Travel" and "Passenger fares" can by definition not be traded intra-firm.[5] On the other hand, in the aggregate category "Other private services", intra-firm transactions accounted for 32% of exports and 40% of imports, respectively. In Canada, intra-firm transactions accounted for 42% of exports and for 54% of imports of commercial services[6] in 2003 (Statistics Canada, 2006).

Table A.5 in Annex A provides a detailed sector breakdown of US intra-firm trade for "Other private services". Services which are used as inputs by both services and manufacturing MNEs, and which are therefore crucial for the operations of global value chains, are traded to a large extent within the boundaries of firms. The share of intra-firm trade is highest in "Management and consulting services" (88% for exports, 86% for imports), which are essential for the production and distribution networks of MNEs, and in "Research and development and testing services" (83% for exports, 73% for imports), which often form the basis for success of MNEs. Furthermore, the category "Computer and information services" has a high share of intra-firm imports with 77%, but a lower share of 43% for intra-firm exports. The industry pattern is very similar for Canada, where intra-firm trade shares in 2003 were high for "Management services" (76% for exports, 80% for imports) and "Research and development" (73% for exports, 61% for imports), but less so for "Computer and information services" (26% for exports, 32% for imports).

Box 3 provides a closer look at recent developments in the banking industry and explains banks' strategies regarding which activities to outsource and which activities to keep inside the firm.

Box 3. Intra-firm trade in services: the example of the banking industry

As very few data are available on intra-firm trade in services, vertical integration in services industries is less well documented. Most of the papers on the fragmentation of production and vertical trade have focused on manufacturing industries. There are however global value chains in services sectors also and the banking industry is a good example of how the value chain can also be sliced up in the case of services activities. In the firm-level data analysed in Section 2, about 10% of the affiliates in a vertical relationship with their parent company are in the banking industry.

Some banks are now highly internationalised. For example, Citigroup is present in 100 countries and serves over 200 million client accounts with a full range of financial services. HSBC, headquartered in London, has 8,000 offices in 87 countries. Recently, banks from emerging economies have also expanded their international network, such as the Industrial and Commercial Bank of China (ICBC) which is now the largest bank in the world in terms of market capitalisation. In 2007, ICBC acquired 20% of South Africa's Standard Bank, a company with many clients in emerging countries. ICBC has 162 overseas subsidiaries at the end of 2009.

Most of banking activities are easy to disaggregate and to be supplied cross-border due to their high degree of digitalisation. Tangibles (IT backbone, branch offices) are only needed at the end of the chain, involving contacts with the customer. Other services can be decomposed and operated in remote places due to their digital component and the fact that they do not require physical resources. The difference with manufacturing value chains is that banking activities cannot be represented in the form of a linear sequential value chain. Value-creating activities are undertaken in financial services hubs (such as London or New York) and in offshored locations with skilled human resources and processing capabilities.

5. The US trade in services statistics distinguish the following five broad categories: "Travel", "Passenger fares", "Other transportation", "Royalties and licence fees" and "Other private services".

6. Canadian services trade statistics distinguish four major categories: travel, transportation, commercial services and government services.

Some of these activities are outsourced and do not result in any intra-firm trade. For example, equity research business process outsourcing (BPO) and knowledge process outsourcing (KPO), as well as software development and call centres can be outsourced. Many Indian companies have been successful in developing such services. There are however activities that banks prefer to keep within their subsidiaries, in particular to link competencies to knowledge-intensive activities in research & development. The Unicredit Group, an Italian financial services company, is a good example of how vertical integration can apply to the banking sector. The firm has created competence centres that can be seen as "global factories" located in diverse places to provide group-wide services by leveraging local skills, market conditions and scale effects. Core banking competences are located in Italy, asset management in Ireland, investment banking in Germany, loans and mortgages in Austria, credit cards in Turkey and payments in the Czech Republic.

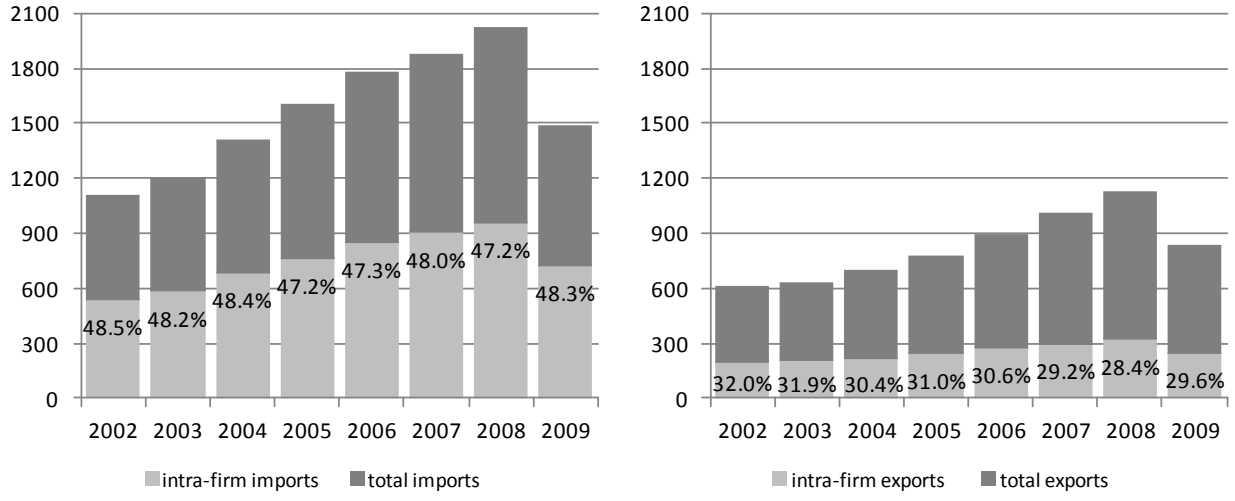
Source: Mudambi and Venzin (2010), Venzin (2009).

Stylised fact four: the share of intra-firm trade has increased but mainly for services

Figure 5 shows the evolution of US intra-firm trade over time. Total imports and exports grew continuously in value from 2002 to 2008 before plunging in 2009, reflecting the so-called "trade collapse" during the economic crisis. The share of intra-firm imports in total imports has been stable over this period implying that intra-firm imports have been growing in line with total trade. For intra-firm exports, a slight downward trend can be observed with the share in total trade declining from 32% in 2002 to 29.6% in 2009.

Figure 6 shows the trend of intra-firm trade shares of services imports over the period 1992 to 2008. The share of intra-firm exports in total private services exports has increased by 6 percentage points from 20% in 1992 to 26% in 2008. The respective increase in the share of intra-firm imports was by 9 percentage points from 13% to 22%. The main driver of these increases was a composition effect arising from the faster growth of trade in "Other private services" compared to other aggregate services categories.

Figure 5. Total US goods trade and the share of intra-firm trade (Bill. USD, 2002-2009)

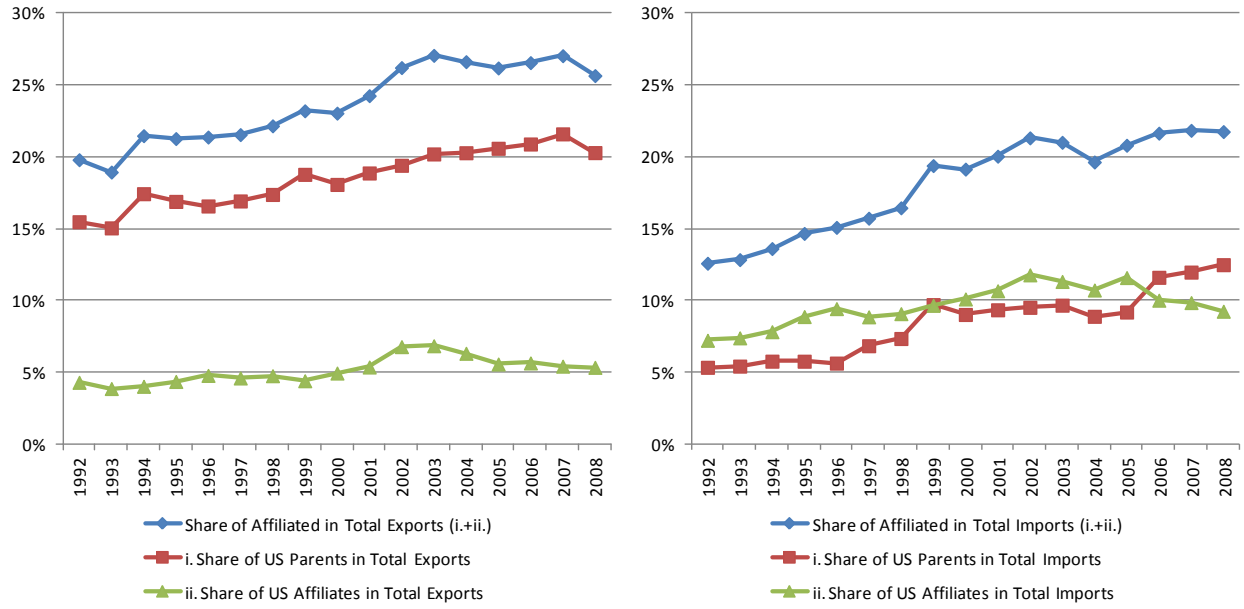


Source: US Census Bureau, Related Party Database

Stylised fact five: The share of intra-firm trade for goods is higher among OECD economies, but less differences are observed between OECD and emerging economies regarding intra-firm trade in services

Table A.6 in Annex A shows that the share of intra-firm transactions in trade between the United States and other OECD countries (34% for exports, 58% for imports) is twice as high as compared to trade between the United States and five emerging economies[7] (15% for exports, 29% for imports). This is consistent with the fact that the bulk of FDI is among OECD countries. While intra-firm transactions are also less common in services exports to developing countries, US services imports from developing countries occur to a large extent between related parties (Table A.7, Annex A). For instance, intra-firm transactions account for 43% of US imports from the European Union compared to 67% of US imports from emerging countries.

Figure 6. Share of intra-firm transactions in private services imports and exports for the United States



Source: US Bureau of Economic Analysis

Figures A.1-A.4 in Annex A answer a slightly different question, namely which economies account for most of intra-firm trade with the United States. The European Union accounts for about half of intra-firm trade of the United States. While 45% of exports of US parents go to affiliates in the European Union (Figure A.1), 54% of exports of US affiliates go to EU parents (Figure A.2). The strength of India as an offshoring location is reflected by the fact that it accounts for large shares of US intra-firm imports, i.e. 8% for imports of US parents (Figure A.3) and even 15% for imports of US affiliates (Figure A.4). On the other hand, India does not belong to the major destinations of intra-firm exports of the United States.

7 . These five emerging economies are Brazil, China, India, Indonesia, South Africa.

Stylised fact six: Intra-firm trade is important not only for connecting production stages of global value chains but also for trade in final goods

Trade in intermediate goods connects the different production stages of global value chains. Table 1 shows that the share of intra-firm transactions in US imports of intermediate goods is 46%, while the respective intra-firm export share of intermediate goods is 27%. It also shows that trade in final goods, i.e. in consumption and capital goods, occurs to a significant degree between related parties. This indicates that MNEs operate not only production networks, but also distribution networks and that distribution firms source and distribute goods through wholesale trade affiliates.[8]

Table 1. Decomposition of 2009 US imports and exports by main end use and ownership

Main end use (BEC classification)	*Number of HS6 lines*	*Value in Mill. USD*	*Total trade (%)*	*Intra-firm trade (%)*	*Arm's length trade (%)*
			Imports		
Total Imports	4 984	1 491 534	100.0%	48.3%	50.6%
Intermediate	3 106	713 347	47.8%	46.1%	51.8%
Consumption	1 210	358 478	24.0%	35.6%	64.4%
Capital	640	272 108	18.2%	57.0%	43.0%
Not classified	28	147 601	9.9%	74.2%	25.8%
			Exports		
Total Exports	5 012	835 839	100.0%	29.6%	68.8%
Intermediate	3 125	499 773	59.8%	27.1%	71.3%
Consumption	1 217	126 852	15.2%	31.3%	65.9%
Capital	643	142 055	17.0%	28.4%	70.2%
Not classified	27	67 158	8.0%	47.1%	52.8%

Notes: The UN Broad Economic Categories (BEC) classification is used to decompose US imports and exports along the "main end use" dimension into intermediate, consumption and capital goods in addition to the ownership dimension. Data do not include trade flows of HS special classification provisions since no HS6-BEC correspondence exists. If these data are included, total imports (exports) amount to 1 549 163 mil. USD (936 503 mil. USD) of which 47.8% (27.9%) are intra-firm and 50.1% (68.6%) are at arm's length. The shares of intra-firm and arm's length trade do not sum up to 100% because some flows lack ownership information.

Source: US Census Bureau, Related Party Database

3. The determinants of intra-firm trade

As described in Section 2, intra-firm trade shares vary considerably across countries and industries. Theoretical trade models and empirical studies provide an explanation for this. A detailed literature review is provided in Annex C. The rest of this section summarises the main results, including our own regression analysis (see Annex C).

Intra-firm trade is by definition related to the emergence of MNEs and their increasing importance in international trade. Declining trade and investment costs, as well as the growth of markets (in particular in emerging economies), have driven the development of global value chains. Countries with a high share of intra-firm trade have a higher number of foreign affiliates per headquarter company. More fundamental

8. See also Zeile (1997 and 2003) for the importance of wholesale trade affiliates in US intra-firm trade.

determinants, such as the capital and skill intensity, explain why a country is the host of many foreign affiliates or a high number of parent companies.

However, these determinants of trade and investment that can explain the growing importance of MNEs in international trade cannot fully account for the observed differences in the prevalence of intra-firm trade in OECD economies. This is why the recent literature has emphasised additional determinants at the firm level and in particular the role of the so-called "hold-up problem" for the international sourcing decisions of firms, i.e. whether to source intermediate inputs intra-firm through a foreign affiliate or at arm's length through an independent supplier (Antràs, 2003; Antràs and Helpman, 2004 and 2008).

The "hold-up problem" refers to the situation where the parties to a contract underinvest because they fear that the counterparty will not comply with the contract but try to take advantage of them. It emerges if two conditions exist. First, contracts are not fully enforceable or incomplete, i.e. it is not possible to specify all possible details in a contract. Second, the investment undertaken by one or both contracting parties is relationship-specific, i.e. has no or only limited value outside the relationship.

For instance, in the relationship between a final goods producer and the supplier of an intermediate input, the final goods producer may require the supplier to customise the input according to his needs. Since the investment of the supplier will be relationship-specific and contracts are incomplete, the final goods producer can "hold-up" the supplier after the latter has made the investment and then renegotiate the expected surplus. Normally, the supplier will foresee such behaviour of the final goods producer and will underinvest in the first place to keep the relationship-specificity of his investment low. However, not only the supplier but also the final goods producer may face a hold-up problem if the latter makes a relationship-specific investment as well. In this case, there is a two-sided hold-up problem and both parties, final goods producer and supplier, will underinvest.

According to property rights models such as Antràs (2003) and Antràs and Helpman (2004), the contracting party which has to shoulder the greater burden of the relationship-specific investment should obtain the property rights, i.e. ownership rights, to the investment. Since the party with the property rights to the investment will be able to capture a greater share of the surplus because it has more bargaining power, it will have a greater incentive to invest in the first place. For the relationship between the final goods producer and the supplier, this means that the final goods producer will choose integration as the organisational form, if his investment is more important relative to the investment of the supplier. On the other hand, the final goods producer will choose outsourcing if the supplier makes the larger relationship-specific investment.

Hence, conclusions can be drawn regarding the product, industry and country characteristics that make firms prefer sourcing goods intra-firm compared to at arm's length.[9] Findings show that a strong rule of law makes it more likely for firms to invest and hence intra-firm trade to occur. Furthermore, firms will prefer to integrate in countries if the rule of law is weak. The share of intra-firm trade is found to be higher in

9. Annex C includes the results of our own regression analysis that confirm the main findings of the literature. Using intra-firm trade data from the US Census Bureau at the HS6 level, we assess the determinants of the share of intra-firm trade in total trade following closely on the empirical estimation strategy of Bernard *et al.* (2010).

capital and skill-intensive sectors, because these sectors typically require more relationship-specific investment from the parent firm.

An important determinant of intra-firm trade is the contractibility of products. A higher contractibility decreases the share of intra-firm trade: if products are easy to contract, the hold-up problem is less severe so that firms rely more on outsourcing as compared to integration. Inversely, products which are difficult to contract are traded more intra-firm.

4. Intra-firm trade and the benefits of trade liberalisation

Intra-firm trade raises questions for trade policy in several ways. When accounting for the fact that "domestic companies" can produce through affiliates abroad or be foreign-owned, trade policy makers cannot look at imports and exports with the traditional mercantilist approach where exports are good and imports a threat for the domestic economy. Intra-firm trade and more generally the increasing importance of FDI and sales of foreign affiliates have blurred the lines between "Us" and "Them".[10] This section first reviews the gains from trade and how they should be understood in the context of vertical integration and intra-firm trade. Then it examines the implications of intra-firm trade for trade policy and the negotiation of trade agreements.

Gains from trade in the context of offshoring and heterogeneous firms

While the gains from trade have been known and discussed for a couple of centuries, some theories have recently highlighted "new" gains that become significant in the context of recent changes in world production and the organisation of firms.

Two types of "new" gains from trade can be highlighted in the context of offshoring and heterogeneous firms. First, the gain from the fragmentation of production is the direct consequence of lower trade costs and services trade liberalisation (Jones and Kierzkowski, 1990). The reason why international trade involving fragmented production blocks yields extra gains for producers is that service inputs linking internationally dispersed production units can lower the total production cost: each "block" is produced in the country where the marginal cost is the lowest. As long as this cost advantage can offset the additional fixed costs of the fragmentation of production (the service cost to link the blocks), the production process is more efficient than if performed in a single country. There is also an "optimal" number of blocks, as increasing fixed costs to manage a production split up across several countries at some point offset the gains from further fragmentation.

These gains exist both with international outsourcing (with each block being an independent firm) or in a vertically integrated structure (a single firm) with intra-firm trade. The "services inputs" that link the blocks are services such as communication, transport and logistics services, but also financial and business services. There is no "global value chain" without these services and the gain from offshoring is directly related to their efficiency. A case study by the Swedish National Board of Trade indicates

10. These expressions refer to the questions asked by Robert Reich at the beginning of the 1990s in two articles of the *Harvard Business Review:* "Who is Us?" and "Who is Them?" (See Reich 1990 and 1991). His point was that a foreign firm established in the domestic economy may better serve the nation's interests than a domestic firm with most of its operations abroad.

that a Swedish manufacturer needs over 40 different services to establish abroad and uphold the supply chain.[11]

The second type of gains comes from intra-industry reallocation of market shares among heterogeneous firms, i.e. firms of different productivity levels, following the liberalisation of trade. As described by Melitz (2003), trade liberalisation forces the least productive firms to exit the market while the most productive firms increase their market share. The result is a productivity increase at the aggregate industry level. One consequence of the changes in the boundaries of the firm and of international production is that more than before firms are heterogeneous. Depending on their organisation and size, they have different levels of productivity. Firms that are relatively less productive and not involved in offshoring can coexist with MNEs in the same industry because of the plurality of cost-efficient strategies focusing on competing advantages in terms of location, size and organisational choices. As illustrated in the next sub-section, trade liberalisation does not lead to a unique type of firm and has a mixed impact on the choice between outsourcing and vertical integration.

Other new sources of gains can be mentioned as well, such as the increase in product variety or technological spillovers that can be related to the interaction between FDI and trade. Quantifying these new gains from trade is not straightforward and traditional CGE models used to measure welfare gains are not yet able to fully capture them. Analysing the European Union, Corcos *et al*. (2009) find that gains from trade are much larger when accounting for selection effects (i.e. the reallocation of market shares towards the most productive firms). Blonigen and Soderbery (2009) show that by accounting for product variety, welfare gains from trade are also much larger. They are related to FDI as some varieties are created by foreign-owned affiliates. An important challenge for trade modellers will be to provide new tools to capture these gains, so that the policy debate is correctly informed on potential gains of trade liberalisation.

Trade liberalisation and intra-firm trade

Another important implication of the analysis of intra-firm trade is that trade liberalisation has an impact on the boundaries of firms. Trade liberalisation means lower trade costs, a reduction in the costs faced by companies when they trade goods or services (including tariffs and various non-tariff barriers, as well as transport and communication costs). A reduction in trade barriers leads to lower variable costs for firms that source their intermediate inputs from abroad. Hence, some firms which have previously sourced the input domestically will now find it profitable to source the input from abroad thereby increasing trade.

As described by Diez (2010), tariffs have an asymmetric effect on intra-firm trade and sourcing strategies. In a North-South theoretical framework where firms from the North offshore part of the production to the South, trade liberalisation in the North increases the incentives for offshoring (because the firms that produce abroad face a lower tariff on their intra-firm imports). Lower tariffs in the North thus encourage intra-firm trade. The opposite happens when tariffs decrease in the South. The lower cost (lower tariffs) is now to the advantage of firms exporting to the South. There is no specific gain for firms already producing in the South (the firms that have offshored their production). Trade liberalisation in the South is thus expected to reduce intra-firm trade because the domestic

11. "At your service. The importance of services for manufacturing companies and possible trade policy implications", Kommerskollegium, 2010:2.

firms not engaged in intra-firm trade have a higher market share. This simple model finds empirical support when looking at US data. Diez (2010) finds a positive relationship between US tariffs and the share of US intra-firm imports, as well as a negative relationship between tariffs abroad and US intra-firm imports.

However, does trade liberalisation affect vertical FDI and international outsourcing equally, leaving the ratio of intra-firm to arm's length trade unchanged? Antràs and Helpman (2004) predict that trade liberalisation will increase international outsourcing relatively more than vertical FDI. In component-intensive sectors, all firms that source inputs from abroad will tend to choose international outsourcing over vertical FDI (see Annex C). Hence, trade liberalisation will increase international outsourcing and arm's length trade but not intra-firm trade. In headquarter intensive sectors, firms engage in both international outsourcing and vertical FDI. After trade liberalisation, some firms that have previously sourced the input domestically will now source it through international outsourcing, while some firms that have already been engaged in international outsourcing, will find it now profitable to source the input through a foreign affiliate. Antràs and Helpman (2004) show that the first effect is bigger, i.e. more firms will switch from domestic production to international outsourcing than from international outsourcing to vertical FDI. Hence, trade liberalisation will lead to a decrease in the share of intra-firm trade relative to arm's length trade in both component- and headquarter-intensive sectors.

Despite the complexity of the relationships described, this simple theoretical framework is far from reproducing all the intricacies of firms' sourcing strategies and the different types of interactions between domestic and international markets of final products and intermediate inputs.[12] This is however a useful framework to illustrate the trade-offs involved and to understand the impact of trade liberalisation.

In all types of sectors, trade liberalisation implies the exit of firms that are not productive enough in the domestic market. As previously highlighted, this intra-industry reallocation is an important source of productivity gains associated with trade liberalisation (Melitz, 2003). For the supply of inputs, trade liberalisation encourages offshoring in general and international outsourcing in particular. Depending on sector-specific characteristics, vertical integration abroad can be the preferred strategy of the most productive firms. But in the absence of FDI liberalisation or other policies that can affect the fixed costs of international investment, trade liberalisation is not expected to increase vertical integration and consequently intra-firm trade. Bernard *et al.* (2010) find for example no strong correlation between the share of intra-firm trade and trade liberalisation in their econometric analysis of the determinants of intra-firm trade.

While policymakers should be concerned about the impact on efficiency and welfare of high trade costs, there is no specific reason to consider a lower share of intra-firm trade as the sign of policy failure. The theory suggests that with trade liberalisation this share should on the contrary be lower and the ratio of intra-firm trade to arm's length trade reflects strategic options for companies that are sector-specific and can lead to higher productivity through vertical integration as well as outsourcing.

The gains from intra-firm trade are not specifically the consequence of trade flows within companies but are part of a larger set of gains related to a more efficient

12. See Alfaro *et al.* (2010) for another mechanism through which trade liberalisation leads to outsourcing and higher tariffs to vertical integration.

organisation of world production in global value chains. Similar gains can be achieved through outsourcing. The first policy implication of the analysis is that trade policy should favour the efficient reorganisation of firms. This can be achieved by providing equal opportunities to independent foreign suppliers and affiliated companies and by letting economic determinants (rather than policy determinants) decide the optimal sourcing strategy of firms. This implies that market access should involve both trade and investment liberalisation (and in the case of services trade, both cross-border and commercial presence commitments).

Intra-firm trade and trade agreements

The literature on outsourcing has emphasised that trade in intermediate inputs introduces new challenges in trade policy as opposed to the standard representation of trade flows in terms of final goods. Section 3 has described the "hold-up problem" in international trade arising from specialised inputs and contracts with foreign suppliers that are hard to enforce. The international hold-up issue can create distortions and lead to an inefficient outcome with a low volume of inputs trade (Wes, 2000). Some authors have suggested that new types of active trade policies could encourage a return to an efficient level of trade in intermediates, through for example subsidies to trade in intermediate inputs combined with free trade in final goods (Antràs and Staiger, 2008). However, such policy options are not very realistic and would introduce distortions between inputs and final products leading to changes in the effective rate of protection.

Through vertical integration and intra-firm trade, firms can to some extent solve the hold-up problem. When the buyer is the owner of the supplier (or vice-versa), the nature of the bargain is different and one party cannot really "threaten" the other as the two parties are under the control of the same entity. It could therefore be argued that vertical integration mitigates the implications of the international hold-up problem and brings trade policy back to the standard models. Still, final goods producers and their suppliers must make relation-specific investments. This is true both for the integrated firm and the arm's length relationship. Bargaining issues are of a different nature but still exist in integrated firms (Antràs and Helpman, 2004; Antràs and Staiger, 2008).

Moreover, the presence of foreign owned companies in the domestic economy as well as domestic investors abroad has an impact on trade agreements. Blanchard (2006) shows that cross-border ownership alters the role of trade agreements and the way governments negotiate. First, in the context of international investment, the traditional terms of trade externality through which large countries can extract rents from their trading partners should be re-examined in light of the fact that "domestic welfare" includes the revenue of foreign-owned affiliates and some of the "rents" are extracted from domestic producers who produce abroad (through custom duties on intra-firm trade). The consequence is that the "optimal tariff" should be lower in the presence of international vertical integration.

There are several implications for this "FDI-terms of trade effect". First, providing market-access to foreign investors can reduce the overseas tariff barriers faced by the investment-host country's export sector (Blanchard, 2007). For example, country A allows investors from country B to establish. Once country B is aware of having foreign affiliates in country A, it should lower its tariffs for country A (as its optimal tariff is now lower because of the revenues of foreign affiliates). This is a benefit of FDI not often highlighted that could explain why FDI is more often allowed in export sectors than in import-competing industries. A corollary is that FDI liberalisation may be not only a substitute for tariffs liberalisation (tariff-jumping FDI) but can also lead to unilateral liberalisation because of its terms of trade effect. The larger the stock of (vertical) FDI the

lower is the optimal tariff for a country. Investment liberalisation can thus encourage trade liberalisation.

One should however be cautious with this implication, as the reverse would happen in impor-competing sectors where investment should encourage higher tariffs and these higher tariffs in turn increase incentives for tariff-jumping FDI in a vicious circle. Moreover, the relationship between increased FDI at home and lower tariffs abroad faced by domestic exporters can also be a rationale for discriminatory preferential trade agreements departing from the first best solution of non-discriminatory multilateral trade liberalisation.

In addition, international ownership introduces two other cost-shifting effects. By influencing the local price relative to the world price, trade policy can shift rents from local producers (who are partly foreign-owned) to domestic consumers. The local relative price can then be manipulated to shift rents across sectors, from those with a relatively high degree of foreign ownership to those mainly domestically owned.

There is no evidence that in practice governments have been tempted to use trade agreements to introduce such manipulations of prices (or have been successful in doing so). But the point is that the whole political economy of trade negotiations can be reassessed by taking into account international investment. One concern among trade policymakers should be to look not only at the impact of trade agreements on the "country" welfare but also on the revenues of affiliates abroad and on the revenues of local foreign-owned companies (who also participate in "domestic" welfare). This tends to complicate the task of trade agreements and the job of policymakers.

Another implication from the rise of offshoring (whether through outsourcing or vertical integration) is that more attention should be given to the relationship between suppliers and buyers. The hold-up problem and the bargaining issues pointed out in the new trade literature suggest that trade agreements should go beyond traditional market access concerns and focus also on domestic measures that can influence bargains between suppliers and buyers (Antràs and Staiger, 2008). We saw in Section 3 that the rule of law was a significant determinant of intra-firm trade. Concretely, what can matter is the legal protection afforded to companies, the law of contracts and some elements of competition policy. This is a new intersection between trade policy and competition policy. In addition to ensuring fair competition between domestic and foreign suppliers, trade agreements in the future may also have to take into consideration the bargaining conditions between suppliers of specialised inputs and buyers.

An interesting implication is that the impact of trade liberalisation on these bargaining conditions can explain a new type of benefit from free trade. Ornelas and Turner (2008) show that the standard hold-up problem is aggravated when trade incurs a tariff. Lower tariffs help to solve the hold-up problem in two ways. First, they increase the incentives of foreign suppliers to undertake cost-reducing investments. A lower cost translates into higher input trade flows (closer to the efficient level). Second, trade liberalisation has an impact on the organisational form and encourages vertical integration where the hold-up problem is less severe. There will be more vertical integration because it becomes advantageous for the firm to incur the fixed cost of investment in the context of lower trade costs. Trade liberalisation can thus be seen as a solution to the hold-up problem and

this is an additional gain from free trade (correcting for the externality of the hold-up problem).[13]

Lastly, a category of trade barriers that matter for firms decisions in the context of global value chains are standards (Kaplinsky, 2010). Whether set by governments or the private sector, standards can be seen as part of the lock-in costs supported by suppliers when they invest to meet the requirements of buyers. On the one hand, standards can create competition issues (for example by ruling out local suppliers) and should not become new trade barriers or a source of under-investment. On the other hand, standards can be promoted by lead firms (global buyers) and benefit suppliers by helping them to upgrade and develop capacities. This is another area where policymakers should focus their attention in the context of global value chains and intra-firm trade.

5. Transfer pricing issues

Another important issue for policy makers that arises in the context of intra-firm trade is transfer pricing, which refers to the pricing of goods, services or other assets in transactions between affiliated enterprises. Since the pricing of intra-firm transactions occurs off the market, MNEs may face difficulties in determining the comparable market price but may also consciously under- or over-price transactions in order to maximise their income. From a trade policy perspective, the most crucial question is then how transfer pricing affects the measurement of trade: Does the pricing of intra-firm trade distort the actual trade patterns between countries? And to what extent is intra-firm trade over- or underestimated? Building on Ping and Silberztein (2007), the following paragraphs describe in more detail transfer pricing and the policy issues at stake.

Transfer pricing is of interest to governments because it affects their revenues from both direct and indirect taxes. Transfer prices affect the income of the selling and the purchasing enterprise and hence the direct income taxes they have to pay in the two respective tax jurisdictions. Furthermore, transfer pricing also affects the revenues from indirect taxes such as tariffs and value-added tax (VAT). From an income tax perspective, MNEs might have an incentive to shift profits from high-tax to low-tax countries. Hence, an affiliate situated in a high-tax country might under-price exports and over-price imports in order to lower taxable income. From a tariff perspective, MNEs might have an incentive to under-price goods that are traded inside the firm in order to reduce tariff payments. Furthermore, if the calculation of the VAT is based on the customs value, a mispricing of goods will also distort this tax revenue.

Since the pricing strategy of affiliated enterprises might be different for income tax and for customs reasons, tax and customs authorities can have opposing interests. Customs authorities are interested in collecting more duties and are hence generally interested in detecting under-estimations of prices. On the other hand, tax authorities are interested to collect more income taxes and will try to detect over-estimations of prices

13. Antràs and Helpman (2004) and Ornelas and Turner (2008) provide two opposite views on the impact of trade liberalisation, as it should increase outsourcing for the first and encourage vertical integration for the second. We have shown in the econometric analysis that there is no robust relationship between trade liberalisation and the share of intra-firm trade. The theories point out different competing mechanisms and are based on different assumptions, which is consistent with the empirical finding of no robust relationship in one direction or the other between trade liberalisation and the choice between outsourcing and vertical integration.

for intra-firm imports. Tax authorities face the challenge to find the right balance between protecting the national tax base and avoiding double taxation that would hamper international trade.

National tax and customs authorities follow two different sets of international rules. Tax authorities base their regulation regarding transfer pricing on the OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations,[14] while customs authorities are bound by the World Trade Organization (WTO) Customs Valuation Agreement. While the activities of tax and customs authorities are governed by these two different sets of rules, they follow the same basic principle, namely that the price of the transaction must not be affected by the relationship between the parties involved.

Customs authorities follow the WTO Customs Valuation Agreement when assessing the values of intra-firm trade transactions. To determine the value of intra-firm transactions, customs authorities rely on values of goods that are traded between unrelated parties. To assess whether the transaction value is acceptable, customs authorities use the "circumstances of sale" approach or the "test values" approach. While the former approach evaluates whether the price is influenced by the relationship of the parties, the latter approach compares the transfer price to one of three types of test values. If customs authorities find that the transaction value is not acceptable, they determine the customs value by relying on the following five methods listed in terms of hierarchy: i) transaction value of identical goods, ii) transaction value of similar goods, iii) deductive method, iv) computed method and v) fall-back method.[15]

The OECD Transfer Pricing Guidelines for Multinational Enterprises establish the arm's length principle as the basic rule for transfer pricing. The arm's length principle demands that transactions between associated enterprises are priced like i) a comparable transaction occurring ii) between independent enterprises and iii) in comparable circumstances.[16] The arm's length principle treats each affiliate of an MNE group as a separate entity (separate entity approach). This ensures that both associated and independent enterprises are treated equally and hence no type of enterprise suffers a disadvantage in terms of taxation.

However, in practice, the application and the monitoring of the arm's length principle is subject to some difficulties. For instance, in contrast to many goods transactions, for intangibles, services or specialised goods it may be difficult to find comparable transactions between independent enterprises under comparable circumstances. Another challenge in the context of transfer pricing is the high administrative burden that both public authorities and enterprises face. Tax authorities may be involved in the costly verification process of the correct application of the arm's length principle to certain transactions. On the other hand, enterprises can face significant costs that arise by the administrative requirements from tax and customs authorities in two different jurisdictions. Many MNEs seek advice of auditing firms that offer comprehensive

14. While the first edition of the Transfer Pricing Guidelines dates back to 1995, the most current version was published in 2010.

15. These methods are described in detail on the internet site of the WTO regarding technical information on customs valuation: www.wto.org/english/tratop_e/cusval_e/cusval_info_e.htm#4

16. The arm's length principle is defined in Article 9 of the OECD Model Tax Convention.

advisory services regarding transfer pricing strategies in order to manage and fulfil the requirements of tax authorities of the countries in which MNEs operate. The fact that most of these advisory services aim at meeting demand regarding taxation, suggests that tariff considerations play only a secondary role in the transfer pricing strategies of multinational enterprises.

Despite these challenges, the regulation of transfer prices is of great importance to countries since a considerable amount of tax revenue is at stake. In particular, the application of the arm's length principle ensures the correct distribution of MNE income across countries. Hence, it allows countries to capture the correct amount of tax revenue from MNEs and warrants that unaffiliated firms are not put at a disadvantage.

Are transfer prices generally lower or higher than arm's length prices?

Given the lack of data on intra-firm trade, only few studies exist that actually compare prices of arm's length and intra-firm transactions. While Clausing (2003) and Bernard *et al.* (2008) use price data for the United States, most other studies assess transfer pricing using indirect evidence by looking not at prices but at other variables such as profits (for a survey, see Hines, 1997). In the following, only the first two studies are discussed since they allow direct conclusions regarding the transfer prices of intra-firm goods compared to prices of arm's length goods.

Clausing (2003) uses monthly data on US trade prices for the years 1997, 1998 and 1999 from the International Price Program (IPP) of the US Bureau of Labour Statistics (BLS) in order to assess the impact of tax rates on intra-firm versus arm's length trade prices. To capture the effect of tax rates on intra-firm prices compared to arm's length prices, she interacts an intra-firm dummy variable with the tax rate of the foreign country. She finds that intra-firm prices are significantly lower than arm's length prices for products exported to low tax countries. Similarly, for imports from low tax countries she finds that intra-firm prices are significantly higher than arm's length prices. In particular, she finds that a 1% lower tax rate in the foreign country is associated with prices for US intra-firm trade that are 1.8% lower for exports and 2% higher for imports compared to arm's length prices. Furthermore, she finds that intra-firm prices are generally higher than arm's length prices for both exports and imports. This surprising result also points to the weakness of her study, namely that the dummy indicating intra-firm prices does not achieve the arm's length principle, i.e. the dummy does not identify "comparable price" prices but just compares intra-firm and arm's length prices in general across countries and industries.

Thanks to firm level data, Bernard *et al.* (2008) are able to define a "comparable price" and to calculate the price wedge between the intra-firm and the comparable arm's length price. For their analysis, Bernard *et al.* (2008) use the Linked/Longitudinal Firm trade Transaction Database (LFTTD) that links trade data with individual firms in the United States. Their database spans over the period 1993 to 2000 and includes information on intra-firm and arm's length trade at the HS10 digit level. They calculate the export price for a HS10 good as the unit value of the transaction. Their comparable arm's length price is the price that the same firm charges to an unrelated party for the same HS10 good, in the same country, in the same month and shipped by the same mode of transport.[17] They then define the price wedge between arm's length trade and intra-firm

17. Since more comparable arm's length prices can exist, they use the average of these comparable prices.

trade as the difference between the logarithms of the comparable arm's length price and the intra-firm price.

Bernard *et al.* (2008) find that for a given good, US export prices for intra-firm transactions are significantly lower than comparable export prices for arm's length transactions. Interestingly they find that this wedge is positive in all cases meaning that the comparable arm's length price is in all cases higher than the intra-firm price with the mean difference being 0.43 log points, i.e. 54%. Furthermore, while this gap is on average only 8.8% for undifferentiated goods it is 66.7% for differentiated goods. [18]

Results from their econometric analysis suggest that transfer prices are influenced by both tax and tariff considerations of MNEs. In particular, they find that a higher tax rate in the foreign country increases the prices of intra-firm transactions relative to the comparable arm's length prices. Hence, high taxes in the destination country give incentives to US MNEs to lower profits in that country. Furthermore, they find a significant negative relationship between tariffs and the price wedge. This is also in line with expectations, since higher tariffs give stronger incentives to MNEs to underprice intra-firm trade and hence increasing the wedge between arm's length and intra-firm trade. In terms of elasticity they find that a 1 percentage point increase in tariffs of the importing country increases the price wedge by about 0.6 percentage points.

Results from the studies described above provide some answers for the questions raised at the beginning of this section, namely whether transfer pricing issues distort the trade patterns between countries and whether trade flows are generally over- or underestimated. In particular, existing research finds that tariffs and especially taxes influence the prices of intra-firm goods transactions and hence may distort trade patterns. Furthermore, Bernard *et al.* (2008) find that transfer prices for intra-firm goods transactions are generally lower than for comparable arm's length transactions. However, one must be very cautious in drawing conclusions regarding the way taxes or tariffs may distort trade statistics at a broader international level given the lack of available studies and data.

6. Intra-firm trade and macroeconomic shocks

As a consequence of the financial and economic crisis that started to unfold in 2008, world trade "collapsed" between the third quarter of 2008 and the second quarter of 2009. In the OECD area, real GDP fell by 3.2% in the second quarter of 2009, while volumes of exports and imports were down respectively by 14.7% and 12.8% (OECD, 2010). The drop in domestic demand was the primary reason for trade to fall. The discrepancy between the decrease in demand (GDP) and the decrease in trade can be explained by a composition effect as the shock affected specific industries that represent a higher share of trade than GDP. However, global production networks and the shortage of trade finance have been identified as alternative explanations for the trade collapse (OECD, 2010; Cheung and Guichard, 2009; Levchenko *et al.*, 2010; Baldwin, 2009).

18. In transfer pricing practice, it is more common to analyse profit margins of firms operating at the same stage of the supply chain. Such an approach is called "functional analysis" and considers the functions performed, assets used and the risks assumed by each party to a transaction. A functional analysis takes into account whether transactions occur between the producing firm and a distributor or between the producing firm and an end-user customer. Since data availability is better for profits than for goods prices, functional analyses typically compare profit margins of related and unrelated firms.

The role of intra-firm trade has not been examined so far, but the transmission of shocks along production chains implies that it might play a role. Given the high share of intra-firm trade observed for some countries, it is important for policymakers to know whether intra-firm trade reacts differently to economic shocks than arm's length trade, and to understand in which contexts intra-firm trade may react differently. Global value chains (GVCs) may be more or less sensitive to economic shocks depending on how much the production chain is vertically integrated. Furthermore, in times of economic and financial crisis, importers and exporters may be more inclined to grant trade credit if the counterparty is an affiliate.

Intra-firm trade and arm's length trade during the 2008-09 trade collapse

Bernard *et al.* (2009) is one of the few studies that analyses intra-firm trade during times of economic crisis. Assessing the pattern of US trade during the 1997 Asian financial crisis, they find that intra-firm trade was more resilient to the crisis compared to arm's length trade. US arm's length exports to Asia declined 26% between 1996 and 1998 while intra-firm exports declined by only 4%. Furthermore, intra-firm transactions were more resilient at both the extensive and the intensive margin of trade. The extensive margin, i.e. the number of exporting firms fell by 16% for arm's length trade and by 7% for intra-firm trade, while the intensive margin, i.e. the development in trade due to surviving firms fell by 8% for arm's length exports and increased by 9% for intra-firm exports.

Recent data on US intra-firm trade from the US Census Bureau allow a similar comparison of intra-firm and arm's length trade for the 2008-09 trade collapse. Figure 5 shows that at the aggregate level, a noteworthy change in the share of intra-firm trade in total trade did not occur. Table D.1 in Annex D reports a slightly higher resilience of US intra-firm imports at the aggregate level, dropping 24% compared to arm's length imports which dropped 27%. In the case of U.S. exports, intra-firm and arm's length transactions both declined 20%.

However, Table D.1 also shows that these aggregate numbers mask more heterogeneity at the country and industry level. For trade with OECD countries, a higher resilience of intra-firm imports can be observed not only for total imports and exports but also for imports of major product categories, i.e. "Non-railway vehicles", "Machinery computers and instruments" and "Articles of apparel and clothing accessories". On the other hand, intra-firm exports of "Non-railway vehicles" to the OECD area fell 36% while respective arm's length exports fell a bit less, i.e. 33%. Regarding US trade with major emerging economies, the decline in intra-firm imports (9%) was less than the decline in arm's length trade (18%), but in the case of exports arm's length flows fell less (11%) than intra-firm flows (15%).

Tables D.2 and D.3 in Annex D report the twenty product categories which experienced the largest absolute and relative declines in imports and exports in 2009. The economic crisis hit especially hard sectors which belong to, or are organised as, global value chains such as "Non-railway vehicles" and "Iron and steel". The sector "Non-railway vehicles" is characterised by high vertical integration, i.e. 83% of US imports were intra-firm in 2009. On the other hand, only 39% of imports of "Iron and steel" were between related parties. While intra-firm and arm's length imports both fell around 30% in the case of "Non-railway vehicles", the 64% decline in arm's length imports of "Iron and steel" was much more severe than the respective 56% decline of intra-firm imports. Does this mean that intra-firm trade can help GVCs to better deal with macroeconomic shocks? This question will be addressed in the following.

The trade collapse, global value chains and intra-firm trade

Global value chains (GVCs) played a prominent role in the discussion on the causes for the trade collapse and its synchronised nature. While some scholars argued that vertical linkages provide a transmission mechanism for economic shocks (Bems *et al.*, 2009), others have argued that trade within GVCs has been more resilient than other trade (Altomonte and Ottaviano, 2009). The question arises why within GVCs intra-firm trade may react differently compared to arm's length trade. Inventory effects offer an explanation for how intra-firm trade may render GVCs more resistant to final demand shocks.

Trade within global value chains may react more intensively to demand shocks because of inventory effects (Escaith *et al.*, 2010), including the so-called "bullwhip effect". In many supply chains, the further a firm is away from the consumer, the more it faces uncertainty in demand and the more it holds inventories. If a final demand shock prompts downstream firms to run down their inventories and to reduce orders, the demand shock will be amplified along the supply chain as upstream firms hold more and more inventories. Vertical integration reduces the uncertainty of demand so that the sizes of orders and inventories will be more similar along the supply chain. Hence, in response to a demand shock, trade within GVCs may decline more than trade in final goods, but the more vertically integrated the GVC, the less important the inventory effects will be and trade will decline less.

Table D.4 in Annex D reports results of regression analysis explaining the decline in US imports from the second quarter of 2008 to the second quarter of 2009 using measures of GVCs and of intra-firm trade at the HS6 product level as explanatory variables among others. To capture GVCs, two variables are used. Downward linkages are calculated using input-output tables and they capture the extent to which a product is used as an input for final products. An intermediate goods dummy is used as a second more direct measure for trade within GVCs. On the other hand, the importance of intra-firm trade is measured by its share in total imports of a product.

Results provide only limited evidence that GVCs and intra-firm trade by themselves can explain the decline in US imports when controlling for the fall in demand at the same time (columns 1 and 4 of Table D.4).[19] However, results show that it is the interaction of GVCs and intra-firm trade that matters in times of crisis, i.e. intra-firm trade within GVCs is a significant determinant of the trade collapse. Products which are more traded intra-firm than at arm's length within GVCs experienced a significant lower decline in US imports. In other words, the trade collapse was less severe for intermediate inputs that were traded intra-firm. This indicates that intra-firm trade can indeed mitigate inventory effects and be a stabilising force when final demand shocks hit GVCs.

The trade collapse, trade credit and intra-firm trade

While the term trade finance covers formalised short term credits and insurances that firms obtain from financial institutions, trade credit refers specifically to the inter-firm financing of transactions between trading partners. In open account transactions, the exporter provides credit to the importer, where the payment by the importer is typically

19. Using the same measure of downward linkages as used in Column (1), Levchenko *et al.* (2009) find that both exports and imports fell systematically more in sectors that are used intensively as intermediate inputs. We obtain the same result, if the variables controlling for the fall in demand are not included.

made within 30 and 90 days after the goods have been delivered. In cash-in-advance transactions, the importer provides credit to the exporter making an upfront payment for the goods to be delivered in the future. In the fourth quarter of 2007 before the crisis started, bank-intermediated finance covered 37.5% of trade, while open accounts and cash-in-advance covered 44.1% and 18.4%, respectively (Korinek *et al.*, 2009).

Various papers have looked at the impact of tightening trade finance conditions on trade during the recent financial crisis. Research found evidence that tighter trade financing conditions in countries had a general effect on trade during the crisis (Korinek *et al.*, 2009), and, more specifically, that the trade financing conditions at the country level matter for sectors that rely heavily on trade financing (Chor and Manova, 2010, Iacovone and Zavacka, 2009).

The reliance on trade credit may affect trade positively or negatively during times of financial crisis. If trade financing through banks becomes more costly, trade may decline less for sectors that rely more intensively on trade credit than on formal trade financing. Chor and Manova (2010) find that countries with tight financing conditions exported more in sectors that have greater access to trade credit. On the other hand, the recent economic crisis was international in nature affecting both exporting and importing firms albeit situated in different countries. The consequent increase in counter-party risk actually prompted firms to move away from trade credit to more formal forms of bank-intermediated trade finance (Mora and Powers, 2009; Korinek *et al.*, 2009).

According to findings of Levchenko *et al.* (2010), the reliance on trade credit at the sector level did not play a role for the decline in US imports and US exports during the trade collapse. Similar results are obtained from regression analysis presented in Annex D that explains the decline in US imports from the second quarter of 2008 to the second quarter of 2009. At the sector level neither open-accounts (*Payables*) nor cash-in-advance (*Receivables*) played a significant role in the decline of US imports during the trade collapse (columns 1 and 3 of Table D.5). While an industry's reliance on trade credit per se did not aggravate or attenuate the trade collapse, one could expect that access to trade credit is generally easier between affiliated firms than between unaffiliated firms which could have helped to sustain trade. However, econometric results do not support the hypothesis that the decline in trade was significantly different for firms that relied on trade credit to finance their intra-firm trade (columns 2, 4 and 5 of Table D.5).

7. Conclusion

This report has provided an overview of intra-firm trade flows, summarised what we know so far on the determinants of intra-firm trade and discussed some important policy implications. Some of the key findings are the following.

Despite the lack of data on intra-firm trade, there is evidence that with new sourcing strategies of firms and the emergence of global value chains, vertical integration and intra-firm trade have increased. The increase is clear in the case of services. In the case of goods, the share of US intra-firm trade has remained rather constant but as is the case with trade in intermediate goods, this is explained by a similar growth rate for both arm's length trade and intra-firm trade. This is consistent with the theory and the fact that new firm strategies involve both outsourcing and vertical integration.

Trade liberalisation, including the liberalisation of services trade, has been one of the main drivers of the reorganisation of firms, as international outsourcing or vertical integration abroad is cost efficient only if goods and services can be moved relatively

freely across borders. This new organisation of production has in turn changed the nature of trade flows with an increase in trade in intermediate inputs and more trade flows within MNEs leading to intra-firm trade, as well as higher trade flows of final products. This explains why the volume of trade has multiplied by three over the two last decades, while GDP (in volume) has increased (only) 1.5 times.

Even if relatively little data are available for non-OECD countries, intra-firm transactions seem more common among OECD countries than among emerging economies. In 2009, 58% of US goods imports from OECD countries were intra-firm, while only 29% of US goods imports from emerging economies occurred between related parties. This is consistent with the fact that the bulk of FDI is among developed countries. Offshoring does not seem to be mainly motivated by low labour costs in developing economies as most affiliates of OECD MNEs are created in other OECD economies and often in high-cost countries. Firms tend to favour the vertical integration strategy for high-value activities that are intensive in knowledge. The challenge for developing economies is to become attractive locations for this type of activities as well and not to be confined to low-value activities.

Our analysis of intra-firm trade confirms theoretical predictions and existing empirical results regarding product and industry determinants of intra-firm trade. A higher contractibility of products decreases the share of intra-firm trade because the possibilities of contracting parties to "exploit" each other are limited and confidence is greater with independent suppliers on an arm's length basis. Furthermore, the share of intra-firm imports is higher in capital and skilled labour intensive industries. These industries require relatively more relationship-specific investments of parent firms which therefore prefer to integrate. Results regarding the impact of trade and investment liberalisation on the share of intra-firm trade seem to confirm theoretical predictions that trade liberalisation increases outsourcing relative to vertical FDI and investment liberalisation increases vertical FDI relative to outsourcing. However, this is not a robust result. Some theories predict that trade liberalisation should encourage vertical integration and evidence in the case of French firms supports this opposite assumption.

The vertical integration strategies of firms give rise to several issues of particular interest to policymakers. First, there are additional gains from trade liberalisation in the context of offshoring, both for arm's length and intra-firm trade. The fragmentation of production and the emergence of "global value chains" are the by-product of trade liberalisation, as well as of other decreases in trade costs. Lower trade costs and the liberalisation of services trade have made it profitable to split the production process. Of particular importance are lower costs for services linking the different production stages such as communication, transport and logistics services, but also financial and business services, which enable firms to locate production stages in countries with lower marginal costs. Furthermore, trade liberalisation forces the least productive firms out of the market and reallocate market shares towards the more productive firms in an industry. The reallocation of market shares towards the most productive firms increases the aggregate productivity level of the industry and is hence a source of welfare gains. This new international division of labour leads to higher productivity levels.

Both theories and empirical evidence confirm the existence of heterogeneous firms: in the same industry firms with different levels of productivity and different sourcing strategies coexist. Concretely, this means that MNEs can coexist with domestic companies that are less productive but still profitable and that outsourcing and vertical integration can happen at the same time at home and abroad (offshoring). Trade

liberalisation should therefore not be understood as unambiguously moving some activities abroad while keeping others at home. However, as some firms exit the market and others reorganise their production, there is an impact on the domestic economy that should be addressed by the relevant policies to minimise restructuring costs and ensure a smooth transition to the more efficient structure of production.

There are challenges in the measurement of new gains from trade associated with offshoring and intra-firm trade but these gains appear to be large when taking into account selection effects, the increase in variety and the full benefits of global value chains. Developing statistics on intra-firm trade and statistics at the firm-level are key to a deeper understanding of the benefits of trade liberalisation. As welfare gains can arise from both international outsourcing (arm's length trade) and vertical FDI (intra-firm trade), trade policy should remain neutral with respect to these two approaches to offshoring. The preference for one or another will depend on a sector's characteristics and firms' strategies. There is no reason for trade policy to encourage vertical integration over outsourcing.

The rise of intra-firm trade also means that trade policymakers need to take into account the benefits of trade liberalisation both for domestically-owned affiliates located abroad and foreign-owned companies in the domestic economy. Taking into account investment can change some of the traditional results of the political economy of trade liberalisation. For example, FDI liberalisation can lead to further trade liberalisation because of its terms of trade effect. When a country has many domestically-owned affiliates abroad, maximising the benefits of trade implies lower tariffs (because tariffs hurt the domestic parent firms engaged in intra-firm imports).

Policy makers thus have new incentives to liberalise trade with partner countries as well as to undertake FDI liberalisation alongside trade liberalisation. This justifies dealing with both liberalisation of trade and investment, including of services, in the same agreements, as is now the case in most regional trade agreements signed by OECD countries.

Trade policymakers also have a role to play in mitigating the "hold-up problem" arising from relationship-specific investments, i.e. situations where buyers and/or suppliers under-invest because they become vulnerable to a termination of the contract for inputs that are highly specialised, Trade liberalisation, including services trade liberalisation, has an impact on the buyer-supplier relationship and can contribute to solving the "hold-up problem" as it can correct for the externality of under-investment by providing new incentives to suppliers to invest. Attention should be given in trade agreements not only to market access and non-discrimination between domestic and foreign producers but also to the contracting environment between buyers and suppliers. These new competition issues in vertical relationships can be addressed through domestic regulation and national competition law but also have an important international, trade, dimension in the context of global production networks. There are other policy areas more traditionally covered in trade agreements, such as standards, that should also be re-examined in the light of the buyer-supplier relationship. Because in this relationship the two companies can be either goods manufacturers or services providers, there is no rationale for covering only goods in trade agreements or for having a separate set of rules on "goods" and on "services" to deal with the issues of vertical trade.

Lastly, one concern following the 2008-09 financial crisis was that global value chains could have played a role in the "trade collapse" (i.e. the fact that trade dropped three or four times more than GDP during the crisis). The analysis of the role of US

intra-firm trade during 2008-09 trade collapse shows that intra-firm trade played a significant role as a stabiliser of global value chains as captured in trade in intermediate goods: In response to a demand shock, trade in intermediate goods may decline more than trade in final goods, but this decline will be less severe for intermediate goods that are traded intra-firm. One explanation could be that vertically integrated production networks can better anticipate the impact of the fall in demand and better adjust their inventories. Intra-firm trade would thus reduce the magnification effect that was observed in some global value chains where a decrease in demand for the final good translates into higher reductions in the demand for intermediate inputs along the value chain. Another explanation would be that the tightening of trade credit has less impact on intra-firm trade, but the quantitative analysis carried out in the report does not support this assumption.

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Annex A – Statistics on intra-firm trade

There are very few statistics available on intra-firm trade and this is why the few available studies focus on a limited number of countries where these statistics are collected. There are currently several initiatives to improve the availability of intra-firm trade statistics and the topic is discussed in various OECD bodies in charge of statistics. Firm-level data offer new opportunities to measure intra-firm trade, as is illustrated in Annex B. An alternative way forward to obtain better information on intra-firm trade can be the linking of business registers with trade data.

Sources for intra-firm trade data are trade statistics (as collected by customs authorities), balance of payments and surveys on the Activities of Multinational Enterprises (AMNE). However, most countries collect few statistics on intra-firm trade or none at all. Hatzichronoglou (2007) provides an overview of measurement issues in the collection of AMNE statistics outlining a possible framework for the collection of trade data. Bertrand and Hatzichronoglou (2009) provide definitions and examples of intra-firm trade that are relevant for the collection through AMNE surveys. Maurer and Degain (2010) assess the possibilities of intra-firm trade data being collected in trade statistics or in the balance of payments. Regarding the latter, they highlight issues regarding the determination of economic ownership of the traded good or service, the need for price estimation and the treatment of services.

This Annex explains in more detail how intra-firm trade is measured. In particular, it provides an overview of the coverage of intra-firm trade statistics in the OECD Activities of Foreign Affiliates (AFA) Database. Furthermore, it describes the measurement of intra-firm goods and services trade in US trade statistics. The comparison of intra-firm trade as measured by AMNE statistics and intra-firm trade as measured by US goods trade statistics is made difficult by the following issues: (i) Since AMNE statistics are based on firm surveys and the response rate of firms is often rather limited, they will tend to underestimate intra-firm trade. In contrast, the related party database of the US Census Bureau covers intra-firm trade in goods as collected through customs authorities and hence comprises the full population of importing and exporting firms. (ii) While AMNE statistics rely on a 50% ownership threshold to identify affiliates, US goods trade statistics use lower ownership thresholds (6% for imports, 10% for exports) to identify related parties. (iii) US trade statistics cover both US and foreign parents. On the other hand, inward AMNE statistics cover trade between affiliates operating in the domestic economy with their foreign parents, while outward AMNE statistics cover trade between domestic parents and their affiliates abroad. Total intra-firm trade is hence given by the sum of trade flows of inward (foreign parents) and outward statistics (domestic parents). iv) Trade in AMNE statistics is recorded by industry, while trade statistics are collected according to the Harmonized System (HS) product classification.

Statistics on Activities of Multinational Enterprises (AMNE)

Business surveys that include information on intra-firm trade are collected by several OECD countries and are accessible through the OECD Activities of Foreign Affiliates (AFA) Database.[20] Table A.1 provides an overview of intra-firm trade data in inward and outward AMNE statistics in the OECD AFA database. Inward AMNE statistics cover the activities of foreign-owned affiliates in the domestic economy. Outward AMNE statistics cover the activities of domestically-owned affiliates in foreign countries. Eight countries collect data on intra-firm trade of foreign affiliates operating in their territory, i.e. Canada, Israel, Italy, Japan, Netherlands, Poland, Sweden and the United States. Data coverage is best for Japan and the United States. Both countries report bilateral intra-firm imports and exports for a long time span and for disaggregated sectors. Only five countries collect data on intra-firm trade in their outward AMNE statistics, i.e. Israel, Japan, Slovenia, Sweden and the United States. Data coverage is best for the United States and in recent years for Slovenia. Both countries report intra-firm trade at the industry level and on a bilateral basis.

Table A.1. Coverage of intra-firm trade in the OECD AFA database

	Canada	Israel	Italy	Japan	Netherlands	Poland	Slovenia	Sweden	United States
Inward AMNE statistics									
Years	1991-94	2006-07	2005-08	1991-2007	1997-2002	2004-07		1990-2002	1977-2008
Intra-firm exports	yes	yes	yes	yes	yes	yes		yes	yes
Intra-firm imports	no	yes	yes	yes	yes	yes		no	yes
Bilateral data	yes	no	no	yes	yes	yes		yes	yes
Outward AMNE statistics									
Years		2002-07		2005-07			2007-09	92,93,96,99	1983-2008
Intra-firm exports		yes		yes			yes	yes	yes
Intra-firm imports		yes		yes			yes	no	yes
Bilateral data		no		no			yes	no	yes

Notes: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

In the European Union, the Regulation (EC) No 716/2007 has established a common framework for the collection of statistics on the activity of foreign affiliates defining the geographical breakdown, the activity breakdown and the list of variables that should be collected by EU countries. The regulation neither requires the collection of data on exports and imports nor on intra-firm exports and imports of foreign affiliates. As foreseen by the regulation, these trade variables were collected in pilot studies to assess the feasibility and benefits of obtaining the data against the costs of collection.[21] Serious quality problems and low response rates in the pilot studies led to the conclusion that the collection of intra-firm trade data in AMNE statistics is not feasible in most countries but seven and will hence not be added to the list of variables which are mandatory to collect.

20. The OECD has contributed to the development of statistics on intra-firm trade through its *Handbook on Economic Globalisation Indicators* (2010). The *Manual on Statistics of International Trade in Services*, developed with the UN, Eurostat, IMF, UNCTAD and WTO, also recommends the collection of such data.

21. After having sent requests to the countries that have conducted such pilot studies, the OECD Secretariat has obtained additional data on intra-firm trade from Finland for the year 2006.

Trade Statistics

The new International Merchandise Trade Statistics (IMTS; UN, 2010), approved by the UN Statistical Commission in February 2010, recommends the collection of intra-firm trade data in customs-based merchandise trade statistics. However, to our knowledge, the United States is the only country that collects data on intra-firm trade in goods through customs authorities. In particular, importers and exporters have to report whether transactions occur between related or unrelated parties.

In the United States, import transactions are recorded as occurring between related parties if either of the parties owns or controls 6% of the outstanding voting stock or shares. For exports the respective threshold is 10% corresponding to the threshold used for the definition of FDI. Because of this difference in ownership thresholds, import transactions are more likely to be classified as occurring between related parties. The US Census Bureau gathers intra-firm trade data in its related party database. This study uses data on intra-firm imports and exports for the years 2002 to 2009 at the Harmonized System 6-digit (HS6) level. While these trade statistics have the advantage of being at a disaggregated level, they have the drawback that they do not reveal whether the US firm or the foreign firm is the parent.

Services trade is recorded in the balance of payments. However, with the exception of the United States and Canada, countries generally do not break down services trade by affiliation. For the United States, intra-firm imports and exports of services are available for the period 1992-2008. While bilateral data on intra-firm trade are reported for aggregate services categories only, total US intra-firm imports and exports are collected for disaggregated services items. Since services trade is an element of the balance of payments statistics, the definition of an affiliated party is the same as in the case of FDI, i.e. applying a 10% ownership threshold.

Table A.2. Percentage share of intra-firm imports in affiliate imports and in industry imports for 4 OECD economies

		Share of Intra-Firm Imports in Affiliate Imports				*Share of Intra-Firm Imports in Industry Imports*			
ISIC	Industry	Italy	Japan	Netherlands	United States	Italy	Japan	Netherlands	United States
10 to 14	Mining and quarrying	85.11	n.a.	0.80	71.06	0.11	n.a.	0.01	0.69
15 to 16	Food, beverages and tobacco	47.08	49.81	42.61	71.87	8.15	0.02	21.42	5.77
17 to 19	Textiles, wearing apparel, leather, footwear	10.30	n.a.	38.85	61.61	0.37	0.07	1.05	0.24
20	Wood and wood products, except furniture	46.00	n.a.	0.00	25.30	0.53	n.a.	0.00	1.03
21 to 22	Paper and products, printing and publishing	19.36	41.65	41.86	88.81	3.14	0.22	12.55	8.71
23	Refined petroleum and coal products	85.41	18.76	41.75	47.44	87.45	0.13	45.71	26.57
24	Chemical products	49.32	9.28	34.58	88.14	17.39	1.31	15.49	18.46
24-23	Drugs and medicines	n.a.	4.81	27.07	93.04	n.a.	2.36	11.47	28.42
25	Rubber and plastic products	52.36	28.16	33.38	74.93	13.46	0.75	4.31	13.44
26	Non-metallic mineral products	71.21	13.43	43.64	81.53	14.85	0.38	11.87	9.99
27 to 28	Basic and fabricated metal products	36.33	93.07	19.81	74.56	6.98	3.95	4.16	3.85
29	Machinery and equipment n.e.c.	40.40	23.59	20.50	77.16	8.84	0.44	2.15	7.20
30	Office, accounting and computing machinery	n.a.	9.58	99.98	90.99	n.a.	0.57	3.56	2.12
30 to 33	Electrical and optical equipment	43.42	n.a.	78.51	n.a.	6.90	3.52	8.36	n.a.
31	Electrical machinery and apparatus n.e.c.	n.a.	76.79	71.80	63.17	n.a.	19.23	25.75	3.86
32	Radio, TV and communication equipment	n.a.	n.a.	6.14	61.90	n.a.	0.12	0.05	4.22
33	Medical, precision, opt. instruments	n.a.	4.59	78.92	81.82	n.a.	0.09	19.88	5.89
34	Motor vehicles	n.a.	2.80	42.35	81.27	n.a.	0.53	10.72	20.02
34 to 35	Transport equipment	54.29	n.a.	42.48	81.91	4.71	0.32	9.77	18.02
35	Other transport equipment	n.a.	n.a.	43.69	91.21	n.a.	0.04	5.25	7.89
36 to 37	Furniture, recycling and manufacturing n.e.c.	32.22	19.94	11.67	34.87	2.52	0.03	0.42	0.62

Notes: Data are for the year 2007 for the United States, Japan, Italy; 2002 for the Netherlands. To calculate shares of intra-firm trade at the industry level, data on intra-firm trade from the OECD AFA Database have been combined with industry trade data from the OECD STAN Bilateral Trade Database. For the United States the following industry shares refer to other years: 1996: Medical, precision, opt. instruments and Furniture, recycling and manufacturing n.e.c.; 2006: Textiles, wearing apparel, leather, footwear, Paper and products, printing and publishing, Office, accounting and computing machinery and Radio, TV and communication equipment; 2001: Wood and wood products, except furniture. For Japan the following industry shares refer to other years: 2004: Paper and products, printing and publishing; 2006: Refined petroleum and coal products, Furniture, recycling and manufacturing n.e.c.

Source: OECD AFA Database, OECD STAN Bilateral Trade Database (BTD).

Table A.3. Percentage share of intra-firm exports in affiliate exports and in industry exports for 5 OECD economies

		Share of Intra-Firm Export in Affiliate Exports (in %)					*Share of Intra-Firm Export in Industry Exports (in %)*				
ISIC	Industry	Italy	Japan	Netherlands	Sweden	United States	Italy	Japan	Netherlands	Sweden	United States
10 to 14	Mining and quarrying	24.07	100.00	12.79	16.20	32.84	0.97	10.57	2.05	1.76	11.54
15 to 16	Food, beverages and tobacco	73.15	2.90	59.22	63.30	47.41	9.15	0.01	19.41	17.00	11.87
17 to 19	Textiles, wearing apparel, leather, footwear	55.78	n.a.	41.54	23.38	45.69	2.77	n.a.	2.59	4.09	0.94
20	Wood and wood products, except furniture	33.33	n.a.	64.22	45.31	n.a.	0.48	n.a.	3.56	10.72	n.a.
21 to 22	Paper and products, printing and publishing	33.94	14.58	45.51	14.52	37.30	6.71	0.19	22.33	4.31	2.15
23	Refined petroleum and coal products	89.68	80.73	47.99	15.90	n.a.	13.71	0.24	16.32	2.85	n.a.
24	Chemical products	44.58	14.54	57.62	79.15	62.45	19.34	0.34	30.69	55.63	12.00
24-23	Drugs and medicines	n.a.	4.09	67.42	110.29	80.84	n.a.	0.33	43.86	82.14	22.63
25	Rubber and plastic products	58.76	7.29	50.21	38.16	41.13	16.46	0.06	13.70	9.02	5.37
26	Non-metallic mineral products	65.38	n.a.	30.20	45.51	30.71	7.95	n.a.	16.61	30.85	4.23
27 to 28	Basic and fabricated metal products	45.51	7.74	35.67	61.21	32.54	8.56	0.06	16.16	17.96	3.06
29	Machinery and equipment n.e.c.	41.87	5.30	24.74	60.86	47.74	8.51	0.02	4.32	18.17	4.00
30	Office, accounting and computing machinery	n.a.	1.61	97.74	29.46	13.19	n.a.	0.02	3.78	2.83	0.21
30 to 33	Electrical and optical equipment	43.87	n.a.	46.60	49.89	n.a.	11.60	1.08	5.37	9.98	n.a.
31	Electrical machinery and apparatus n.e.c.	n.a.	52.03	5.60	60.58	23.61	n.a.	5.15	2.58	29.05	1.63
32	Radio, TV and communication equipment	n.a.	n.a.	1.38	22.59	45.81	n.a.	0.01	0.03	0.99	3.68
33	Medical, precision, opt. instruments	n.a.	7.29	67.15	46.56	48.33	n.a.	0.02	14.26	18.34	5.10
34	Motor vehicles	n.a.	1.15	82.13	90.89	48.16	n.a.	0.17	28.40	59.20	12.38
34 to 35	Transport equipment	25.12	1.15	75.80	89.06	43.91	4.66	0.14	22.07	49.95	6.93
35	Other transport equipment	n.a.	0.80	13.82	43.87	18.35	n.a.	0.00	1.58	5.56	0.87
36 to 37	Furniture, recycling and manufacturing n.e.c.	32.12	3.79	39.93	51.12	43.88	1.72	0.01	2.11	6.35	5.99

Notes: Data are for the year 2007 for the United States, Japan, Italy; 2002 for Sweden and the Netherlands. To calculate shares of intra-firm trade at the industry level, data on intra-firm trade from the OECD AFA Database have been combined with industry trade data from the OECD STAN Bilateral Trade Database. For the United States the following industry shares refer to other years: 1996: Medical, precision, opt. instruments and Furniture, recycling and manufacturing n.e.c.; 2006: Textiles, wearing apparel, leather, footwear, Paper and products, printing and publishing, Office, accounting and computing machinery and Radio, TV and communication equipment; 2001: Wood and wood products, except furniture. For Japan the following industry shares refer to other years: 2004: Paper and products, printing and publishing; 2006: Refined petroleum and coal products, Furniture, recycling and manufacturing n.e.c.

Source: OECD AFA Database, OECD STAN Bilateral Trade Database (BTD)

Table A.4. Top 20 and bottom 20 HS chapters according to US intra-firm trade in 2009

HS2	Chapter	Imports in Mill. USD.	Intra-Firm (%)	Arm's Length (%)	HS2	Chapter	Exports in Mill. USD.	Intra-Firm (%)	Arm's Length (%)
Top 20 Intra-Firm Import Shares					Top 20 Intra-Firm Export Shares				
87	NonRailway vehicles	131 887	83	17	37	Photographic goods	2 619	69	30
30	Pharmaceutical products	56 027	80	20	9	Coffee, tea, spices	615	61	35
29	Organic chemicals	49 615	76	24	24	Tobacco	1 650	54	46
75	Nickel and articles thereof	1 867	72	28	30	Pharmaceutical products	38 416	48	52
31	Fertilisers	4 194	70	30	87	NonRailway vehicles	68 741	45	53
37	Photographic goods	1 360	66	34	18	Cocoa	1 031	44	55
90	Instruments	49 566	65	35	19	Cereals, flour, milk	2 827	42	56
25	Salt; earths and stone	3 362	63	37	34	Soap, waxes, candles	4 938	42	55
38	Misc. chemical products	7 480	61	39	40	Rubber and articles thereof	8 937	41	54
32	Tanning or dyeing extracts	2 422	59	41	32	Tanning or dyeing extracts	5 562	40	57
84	Nuclear reactors, machinery	202 079	59	41	27	Mineral fuels, oils, waxes	54 574	40	60
35	Starches, glues, enzymes	1 739	58	42	21	Misc. edible preparations	4 885	38	61
40	Rubber and articles thereof	15 380	58	42	90	Instruments	55 906	38	61
91	Clocks and watches	3 000	58	42	36	Explosives	589	37	63
85	Electrical machinery	212 100	57	43	56	Wadding, yarns, ropes, cables	1 641	37	62
45	Cork articles	209	54	46	38	Misc. chemical products	17 249	37	62
33	Oils; perfumery	7 342	54	46	33	Oils; perfumery	7 577	37	60
59	Textile fabrics	1 472	47	53	59	Textile fabrics	1 249	35	63
76	Aluminum and articles thereof	11 339	46	54	35	Starches, glues, enzymes	2 135	35	63
54	Manmade filaments	1 606	45	55	39	Plastics and articles thereof	41 361	35	63
Bottom 20 Intra-Firm Import Shares					Bottom 20 Intra-Firm Export Shares				
42	Leather; saddlery and harness	8 093	13	87	3	Fish, crustaceans	3 306	10	89
58	Woven fabrics; tapestries	542	12	88	47	Pulp of wood	6 699	10	90
61	Knitted or crocheted apparel	33 333	12	88	52	Cotton	4 880	10	90
26	Ores, slag and ash	2 597	12	88	4	Dairy produce; honey	1 929	9	91
41	Raw hides, skins, leather	450	11	89	64	Footwear, gaiters	620	9	83
50	Silk	141	11	89	6	Trees and plants	355	8	78
46	Straw; basketware	346	10	90	7	Vegetables	2 972	8	81
14	Vegetable products	95	9	91	2	Meat	10 552	6	94
10	Cereals	2 062	9	91	71	Pearls, precious metals, coin	27 512	6	94
78	Lead and articles thereof	459	9	91	91	Clocks and watches	356	6	87
60	Knitted or crocheted fabrics	652	9	91	41	Raw hides, skins, leather	1 811	5	95
52	Cotton	818	9	91	67	Feathers and down articles	58	4	73
3	Fish, crustaceans	9 990	9	91	53	Vegetable textile fibres	18	4	88
80	Tin and articles thereof	529	8	92	8	Fruit and nuts	7 694	4	95
65	Headgear and parts thereof	1 357	6	94	5	Animal products	772	4	96
97	Works of art, antiques	5 036	5	95	45	Cork articles	33	2	91
64	Footwear, gaiters	17 666	5	95	14	Vegetable products	60	2	97
66	Umbrella, walkingsticks	385	4	96	50	Silk	21	2	90
67	Feathers and down articles	1 261	3	97	1	Live animals	785	2	98
1	Live animals	2 004	1	99	97	Works of art, antiques	4 589	2	98

Source: US Census Bureau, Related Party Database

Table A.5. Cross-border trade in other private services for the United States in 2008

(In millions of US dollars, 2008)

	Exports			Imports		
	Total	Affiliated	Share	Total	Affiliated	Share
A. Other private services	233 529	74 551	0.32	153 267	60 762	0.40
1. Education	17 796	[1]	[1]	5 204	[1]	[1]
2. Financial services	60 190	9 723	0.16	19 143	7 636	0.40
3. Insurance services	10 756	[2]	[2]	42 939	[2]	[2]
4. Telecommunications	9 163	3 916	0.43	7 193	(D)	
5. Business, professional, and technical services	113 525	55 483	0.49	76 284	50 603	0.66
Computer and information services	12 599	4 124	0.33	16 139	12 417	0.77
Computer and data information services	8 044	3 495	0.43	15 214	11 962	0.79
Database and other information services	4 555	629	0.14	925	455	0.49
Management and consulting services	26 942	23 705	0.88	21 565	18 529	0.86
Research and development and testing services	17 139	14 292	0.83	14 885	10 877	0.73
Operational leasing	7 942	2 412	0.30	958	517	0.54
Other business, professional, and technical services	48 901	10 952	0.22	22 736	8 263	0.36
Accounting, auditing, and bookkeeping services	1 399	809	0.58	2 269	518	0.23
Advertising	4 019	2 832	0.70	2 194	822	0.37
Architectural, engineering, and other technical services	5 918	1 097	0.19	1 086	411	0.38
Construction	1 679	652	0.39	827	205	0.25
Industrial engineering	3 776	609	0.16	1 603	714	0.45
Installation, maintenance, and repair of equipment	9 661	1 386	0.14	4 945	2 648	0.54
Legal services	7 269	136	0.02	1 902	153	0.08
Mining services	3 080	1 159	0.38	728	8	0.01
Trade-related services	6 112	1 626	0.27	1 047	741	0.71
Training services	1 414	45	0.03	779	37	0.05
6. Other services	22 099	5 428	0.25	2 505	(D)	
Film and television tape rentals	13 598	5 428	0.40	1 878	(D)	

Notes: Millions of US Dollars; (D) - Suppressed to avoid disclosure of data of individual companies.

[1] Education consists of expenditures for tuition and living expenses by students studying in foreign countries, so these are transactions between unaffiliated parties.

[2] Most insurance services transactions are deemed to be unaffiliated even when they are between affiliated companies, because the services are deemed to be provided to the policyholders who pay the insurance premiums and who are unaffiliated with either company.

Source: US Bureau of Economic Analysis.

Table A.6. Intra-firm trade for the United States by partner country in 2009

Country	*Imports*				*Exports*			
	Number of HS6 lines	Total (Mill. USD)	Intra-firm (Mill. USD)	Intra-firm (%)	Number of HS6 lines	Total (Mill. USD)	Intra-firm (Mill. USD)	Intra-firm (%)
Australia	2 285	7 998	2 837	35.5	3 789	18 244	4 978	27.3
Austria	2 139	5 984	3 670	61.3	1 887	2 365	240	10.1
Belgium	2 598	13 736	8 547	62.2	3 076	19 407	8 572	44.2
Canada	4 260	224 584	107 315	47.8	4 796	171 695	71 478	41.6
Chile	945	6 047	997	16.5	3 154	8 694	2 173	25.0
Czech Republic	1 623	1 897	885	46.7	1 705	841	152	18.1
Denmark	1 938	5 553	3 964	71.4	2 176	1 890	352	18.6
Estonia	379	144	77	53.4	745	173	13	7.5
Finland	1 421	3 963	2 402	60.6	2 018	1 539	233	15.2
France	3 603	33 961	18 991	55.9	3 499	24 367	6 749	27.7
Germany	3 969	69 790	45 000	64.5	3 963	40 229	11 902	29.6
Greece	776	848	247	29.2	1 897	2 410	175	7.3
Hungary	1 171	2 232	1 314	58.8	1 427	987	275	27.9
Iceland	261	179	60	33.2	934	342	102	30.0
Ireland	1 413	28 102	23 808	84.7	2 380	6 969	2 118	30.4
Israel	2 015	18 743	10 957	58.5	3 168	6 237	1 724	27.6
Italy	3 576	26 232	10 255	39.1	3 427	11 202	2 224	19.9
Japan	3 722	96 002	73 859	76.9	4 085	47 074	15 038	31.9
Korea	3 141	38 770	24 778	63.9	3 854	27 074	4 594	17.0
Luxembourg	309	435	233	53.7	699	964	246	25.6
Mexico	3 507	176 309	100 935	57.2	4 690	105 718	39 653	37.5
Netherlands	2 810	15 820	10 187	64.4	3 474	29 169	15 784	54.1
New Zealand	1 359	2 536	1 152	45.4	2 728	2 049	326	15.9
Norway	1 307	5 660	2 768	48.9	2 045	2 645	427	16.2
Poland	1 686	2 018	945	46.8	2 070	2 181	381	17.5
Portugal	1 339	1 487	606	40.7	1 551	1 013	213	21.0
Slovak Republic	780	621	443	71.4	799	193	48	25.1
Slovenia	730	385	198	51.3	869	224	26	11.5
Spain	2 792	7 797	2 881	37.0	2 975	8 382	1 307	15.6
Sweden	2 237	8 193	5 445	66.5	2 521	4 078	796	19.5
Switzerland	2 627	16 204	9 547	58.9	2 717	15 365	2 229	14.5
Turkey	1 801	3 649	1 108	30.4	2 573	6 898	568	8.2
United Kingdom	3 755	47 019	27 952	59.4	4 144	41 990	9 913	23.6
OECD Members	**4 944**	**872 897**	**504 360**	**57.8**	**4 988**	**612 608**	**205 010**	**33.5**
Brazil	2 505	19 612	5 899	30.1	3 527	22 135	4 843	21.9
China	4 286	295 545	84 829	28.7	4 097	65 124	8 954	13.7
India	3 244	21 228	6 023	28.4	3 272	14 629	1 264	8.6
Indonesia	1 766	12 917	3 040	23.5	2 329	4 970	400	8.1
South Africa	1 447	5 877	2 372	40.4	2 875	4 203	823	19.6
EE5 countries	**4 567**	**355 178**	**102 163**	**28.8**	**4 524**	**111 061**	**16 286**	**14.7**
Argentina	1 313	3 821	1 005	26.3	2 792	4 768	1 186	24.9
Russian Federation	1 074	17 420	5 707	32.8	2 178	5 160	652	12.6
Saudi Arabia	395	21 366	16 179	75.7	2 929	10 235	590	5.8
Rest of the World	**4 279**	**278 481**	**111 067**	**39.9**	**4 917**	**192 672**	**37 473**	**19.4**
Total	**4 993**	**1 549 163**	**740 481**	**47.8**	**5 024**	**936 503**	**261 196**	**27.9**

Source: US Census Bureau, Related Party Database

Table A.7. Share of intra-firm trade in other private services trade for the United States by partner country

(In millions of US dollars, 2008)

	Imports				*Exports*			
	Total	Share of Intra-Firm Trade	By US parents from foreign affiliates	By US affiliates from foreign parents	Total	Share of Intra-Firm Trade	By US parents to foreign affiliates	By US affiliates to foreign parents
Total	153 267	0.40	0.27	0.12	233 529	0.32	0.22	0.10
Canada	11 412	0.44	0.23	0.21	17 502	0.27	0.21	0.07
Europe	74 851	0.39	0.25	0.14	98 902	0.41	0.26	0.15
Belgium-Luxembourg	2 751	0.72	0.58	0.13	3 553	0.35	0.19	0.16
France	4 818	0.51	0.30	0.21	7 584	0.30	0.19	0.11
Germany	11 442	0.40	0.20	0.20	10 089	0.42	0.15	0.26
Ireland	7 594	0.12	0.10	0.02	8 653	0.86	0.82	0.04
Italy	1 955	0.42	0.29	0.13	3 481	0.27	0.23	0.04
Netherlands	4 394	0.62	0.18	0.43	8 765	0.44	0.24	0.20
Norway	445	0.41	0.06	0.34	1 197	0.29	0.08	0.21
Spain	1 558	0.33	0.29	0.04	3 397	0.21	0.20	0.01
Sweden	908	0.49	0.20	0.29	2 785	0.53	0.09	0.43
Switzerland	10 309	0.18	0.07	0.11	6 981	0.54	0.29	0.25
United Kingdom	24 645	0.46	0.34	0.12	31 949	0.35	0.23	0.12
Other	4 032	0.41	0.32	0.09	10 468	0.25	0.11	0.14
Latin America and Oth. West. Hemisphere	31 037	0.17	0.15	0.02	46 007	0.26	0.22	0.04
South and Central America	9 535	0.42	0.38	0.04	23 675	0.23	0.21	0.02
Argentina	588	0.57	0.54	0.03	1 291	0.39	0.38	0.00
Brazil	3 045	0.68	0.67	0.01	5 192	0.42	0.41	0.01
Chile	332	0.26	0.23	0.03	786	0.25	0.16	0.09
Mexico	3 204	0.31	0.24	0.07	10 671	0.12	0.10	0.02
Venezuela	220	0.55	0.54	0.02	1 638	0.38	0.37	0.01
Other	2 146	0.16	0.14	0.02	4 097	0.19	0.15	0.04
Other Western Hemisphere	21 502	0.05	0.04	0.01	22 332	0.28	0.22	0.06
Bermuda	15 292	0.02	0.02	0.00	5 574	0.43	0.27	0.16
Other	6 210	0.15	0.11	0.03	16 757	0.23	0.20	0.03
Africa	2 442	0.26	0.26	0.01	6 245	0.29	0.28	0.02
South Africa	675	0.60	0.59	0.01	895	0.16	0.15	0.01
Other	1 767	0.13	0.13	0.01	5 350	0.32	0.30	0.02
Middle East	2 612	0.47	0.44	0.03	9 231	0.20	0.08	0.12
Israel	1 451	0.74	0.71	0.04	968	0.21	0.19	0.03
Saudi Arabia	238	0.01	0.01	(*)	3 195	0.36	0.07	0.29
Other	922	0.16	0.14	0.02	5 069	0.09	0.07	0.03
Asia and Pacific	30 892	0.62	0.45	0.17	52 918	0.27	0.18	0.09
Australia	2 874	0.41	0.36	0.05	5 263	0.23	0.20	0.03
China	2 835	0.62	0.59	0.03	6 756	0.19	0.16	0.02
Hong Kong	2 660	0.79	0.73	0.06	3 043	0.44	0.35	0.08
India	8 877	0.71	0.39	0.32	4 663	0.12	0.09	0.03
Indonesia	199	0.03	0.03	(*)	957	0.27	0.21	0.06
Japan	5 975	0.72	0.47	0.26	14 691	0.39	0.16	0.23
Korea, Republic of	955	0.26	0.23	0.02	4 784	0.10	0.09	0.02
Malaysia	865	0.84	0.83	0.02	1 246	0.30	0.17	0.13
New Zealand	258	0.19	0.18	0.00	638	0.21	0.21	0.00
Philippines	1 068	0.54	0.50	0.04	694	0.15	0.13	0.02
Singapore	2 052	0.74	0.55	0.19	4 216	0.40	0.36	0.04
Taiwan	770	0.40	0.35	0.05	2 145	0.13	0.10	0.03
Thailand	792	0.24	0.24	0.00	1 005	0.30	0.27	0.04
Other	714	0.07	0.07	0.01	2 817	0.11	0.10	0.00
International organisations and unallocated	22	(*)	(*)	(*)	2 725	0.00	0.00	(*)
Enhanced engagement countries (EE5)	15 631	0.67	0.48	0.19	18 463	0.24	0.22	0.02
European Union	62 688	0.43	0.28	0.15	86 578	0.41	0.26	0.15

Note: (*) Less than USD 500 000.

Source: US Bureau of Economic Analysis

Figure A.1. Share of intra-firm exports in other private services exports of US parents to foreign affiliates in 2008

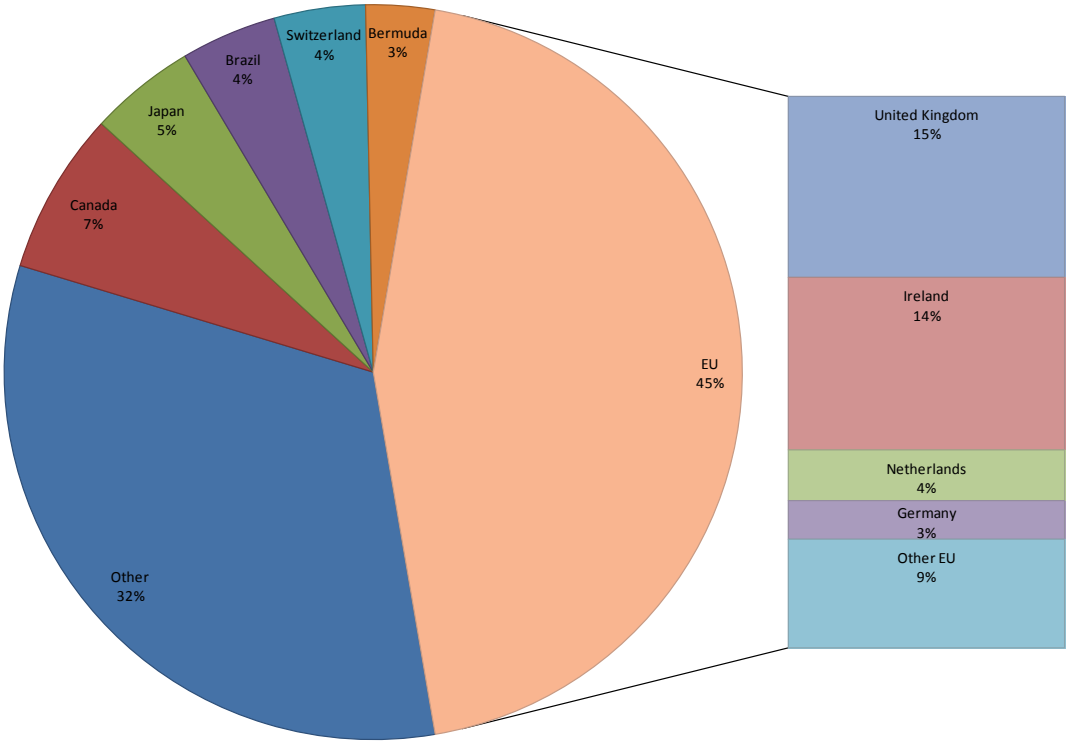


Figure A.2. Share of intra-firm exports in other private services exports of US affiliates to foreign parents in 2008

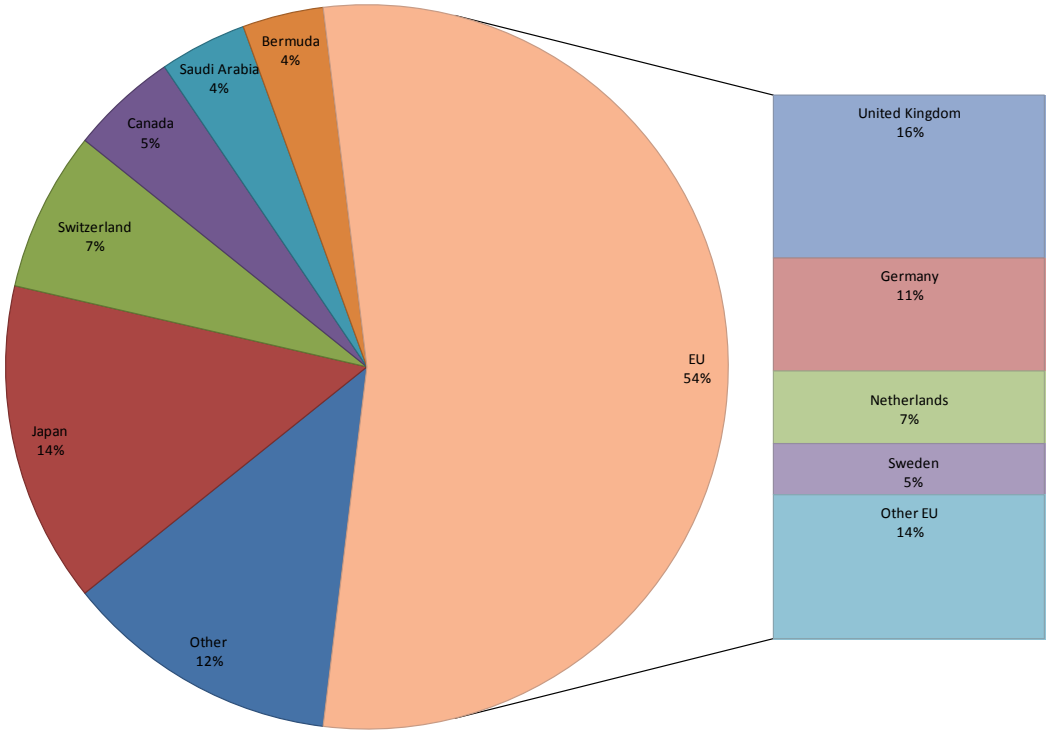


Figure A.3. Share of intra-firm imports in other private services imports of US parents from foreign affiliates in 2008

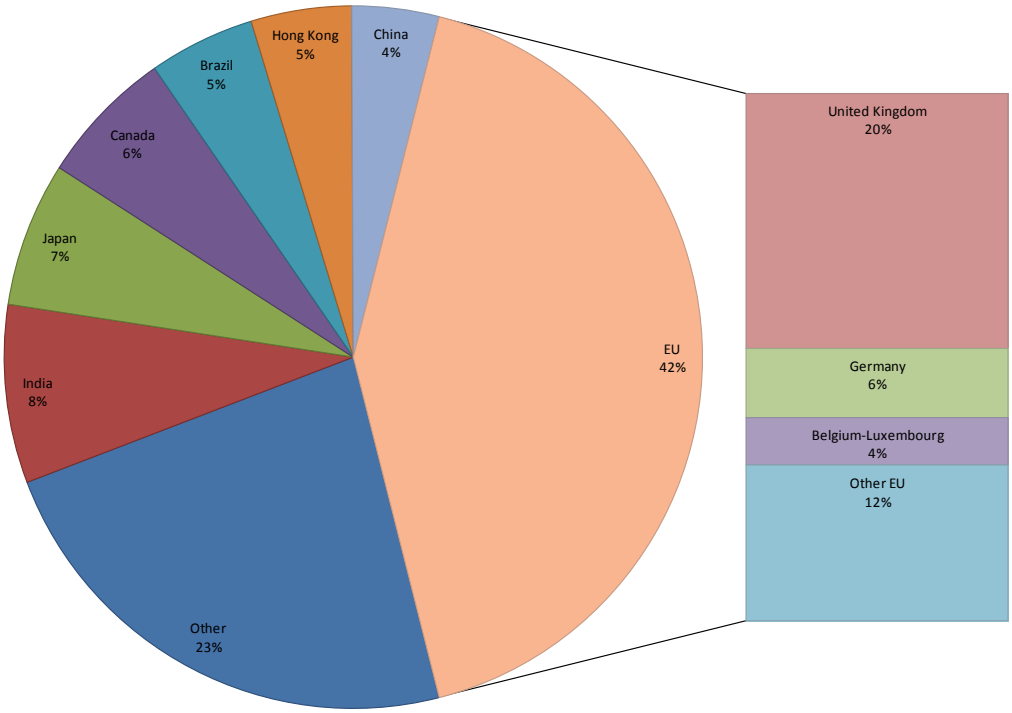
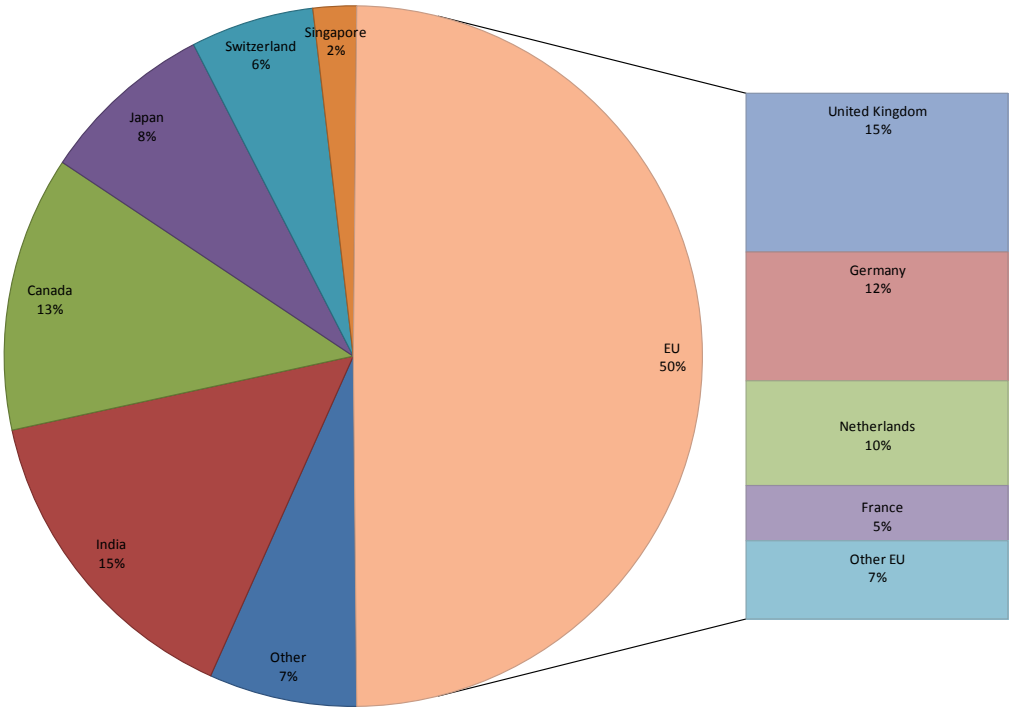


Figure A.4. Share of intra-firm imports in other private services imports of US affiliates from foreign parents in 2008



Annex B – Sales of vertical foreign affiliates: Estimates based on firm-level data

In view of the dearth of detailed data on intra-firm trade, firm-level analysis provides an alternative for the measurement of trade flows of MNEs. In this Annex, the methodology of Alfaro and Charlton (2009) is applied to the OECD ORBIS firm-level dataset to assess the importance of vertical foreign affiliates. The activities of vertical foreign affiliates are closely linked to intra-firm trade, since vertical foreign affiliates produce intermediate inputs that are shipped to the parent firm.

In this Annex, we find empirical support for some of the stylised facts presented in Section 2 of the report:

1. Vertical production networks contribute to a significant share of world trade. We see a high number of foreign affiliates that are in a vertical relationship with their parent company and these subsidiaries have significant sales that are likely to correspond to intra-firm trade flows when they produce an input shipped to the parent company.

2. FDI appears to be mainly horizontal only when the analysis is conducted at the aggregate level. At the two-digit level, Alfaro and Charlton (2009) find that 70% of FDI in manufacturing industries is horizontal and their share drops to 48% at the four-digit level. Our analysis is carried out at an even more disaggregated level and we have found an even smaller share of horizontal FDI (39%).

3. There are important differences across countries in the prevalence of vertical integration. The share of vertical foreign affiliates in the total number of foreign affiliates ranges from 9% to 25% in OECD countries (counting only the "pure" vertical affiliates).

4. There are more vertical foreign affiliates in services industries than in goods industries and expressed as shares of cross-border trade, vertical services sales are generally higher. This highlights the importance of intra-firm trade in services and the role of services in supporting activities of MNEs.

5. The prevalence of vertical foreign affiliates and the value of their sales are higher in OECD economies than for large emerging economies. This suggests that offshoring is mainly among OECD countries, in line with the fact that FDI flows are largely between OECD economies. However, the importance of emerging economies in vertical FDI can also be observed with a number of vertical foreign affiliates close to the OECD average.

Description of the methodology

Intra-firm trade can be directly measured at the firm level in datasets that indicate whether import transactions are with related parties. This is the case for example of the US Linked/Longitudinal Firm Trade Transaction Database (LFTTD) that was used in Bernard *et al.* (2010) to analyse the determinants of intra-firm trade. However, such

datasets can only be built if the country collects information on intra-firm trade, either through trade statistics or through surveys. Most firm-level datasets, however, do not report information on trade flows with related parties.

Alfaro and Charlton (2009) nonetheless propose to infer intra-firm trade from three types of variables that are usually found in firm-level datasets: (1) the links between parent companies and foreign affiliates (based on ownership information); (2) the sales of foreign affiliates; and, (3) the comparison of the industry of the parent company and its subsidiary to characterise the type of FDI involved (whether this is vertical, horizontal or complex). Alfaro and Charlton (2009) apply this methodology to a dataset of 625 427 affiliates reporting to 72 978 parent firms. They use the WorldBase dataset compiled by Dun & Bradstreet for the year 2005.

This methodology is promising but on the recognition that it can only provide estimates for intra-firm trade flows on the basis of assumptions made regarding the sales of foreign subsidiaries. For the sake of clarity, we will refer in the rest of this Annex to the sales of vertical foreign affiliates, which is precisely what the methodology measures. These sales should be regarded as a proxy for intra-firm trade, recognising that they do not give an accurate measure of intra-firm trade flows.

Our analysis is based on Bureau Van Dijk's ORBIS database. There is no direct measure of intra-firm trade in the ORBIS dataset. Our strategy consists in identifying horizontal and vertical links between parent companies and their affiliates to give an indication of the potential for intra-firm trade at the country level. These data are also useful to understand the role of countries in global value chains and to assess the prevalence of vertical production networks.

The OECD ORBIS dataset has been recently updated and includes financial information on about 66 million companies around the world. Most of these companies are in the OECD area (see Table B.1 below). Subsidiaries of foreign companies can be identified on the basis of the ownership information that includes in particular the country of origin of the "ultimate owner". But such information is not available for all companies in the dataset. Ownership information enabled us to identify 624,257 subsidiaries of foreign companies.[22] The information is collected for the year 2009.

We use the dataset to first identify horizontal and vertical links with their parent companies. Following Alfaro and Charlton (2009), we define horizontal FDI as the activity of foreign-owned subsidiaries in the same industry as their parent, and vertical FDI as the activity of foreign-owned subsidiaries in industries upstream from the parent company (see Table B.2 below). A comparison between the North American Industry Classification System (NAICS) codes of the parent company and its subsidiary determines whether there is a horizontal link. If the NAICS 6-digit code is the same, we assume that the purpose of the subsidiary is to replicate the production process of the parent company to sell final goods (or services) in the destination market.

Horizontal FDI can take place, for example, when there are important trade barriers in the destination market and the parent company can circumvent trade protection by directly producing in the foreign country. High transport costs can be another form of trade costs that can justify horizontal FDI. Another motivation for horizontal FDI can be a need to adapt the product or service to the taste of local consumers.

22. The ownership threshold for identifying the ultimate owner is 25.01% in all the links between the subsidiaries and their parent companies.

Table B.1. Overview of companies and affiliates by country in the OECD ORBIS dataset

	Number of companies in ORBIS	Number of foreign affiliates identified	Number of parent companies identified
Australia	42 847	7 129	9 903
Austria	731 611	7 518	5 818
Belgium	587 573	3 626	8 760
Canada	1 293 861	33 420	23 233
Chile	56 522	1 438	257
Czech Republic	471 063	10 897	1 227
Denmark	280 340	9 158	11 663
Estonia	89 079	3 022	736
Finland	194 938	2 486	5 790
France	9 533 333	17 673	40 286
Germany	1 806 992	51 004	38 297
Greece	63 200	2 941	2 510
Hungary	489 902	1 568	722
Iceland	28 986	1 668	1 435
Ireland	186 100	9 175	6 312
Israel	4 237	485	1 688
Italy	1 006 224	32 710	10 689
Japan	3 488 634	15 123	30 096
Korea	865 589	1 282	1 931
Luxembourg	35 950	4 608	12 927
Mexico	351 286	6 034	2 698
Netherlands	2 198 402	1 529	17 808
New Zealand	9 161	1 584	1 102
Norway	926 395	7 919	3 859
Poland	251 551	11 052	1 535
Portugal	350 712	5 182	1 824
Slovak Republic	27 356	2 600	394
Slovenia	66 842	877	418
Spain	2 275 261	18 292	13 695
Sweden	1 064 248	4 817	16 889
Switzerland	383 566	4 616	30 069
Turkey	35 264	2 116	2 145
United Kingdom	2 753 491	77 154	44 296
United States	18 362 028	109 220	96 004
Total OECD members	**50 312 544**	**469 923**	**447 016**
Argentina	382 129	2 109	144
Brazil	3 938 738	4 523	790
China	406 005	12 545	3 940
India	29 876	2 396	3 689
Indonesia	50 803	1 333	77
Russian Federation	5 368 332	67 371	650
Saudi Arabia	1 859	308	327
South Africa	708 127	2 415	2 054
Total other major economies	**10 885 869**	**93 000**	**11 671**
Other countries	4 824 676	61 334	101 615
Total	**66 023 089**	**624 257**	**560 302**

Source: Authors' calculations using Bureau Van Dijk's ORBIS database - OECD ORBIS dataset.

If the 6-digit code corresponds to the code of an upstream industry, as identified in the input-output matrix, we assume that there is vertical FDI and that the subsidiary has been set up to produce an input that is shipped to the country of the parent company. We are interested in the sales of such affiliates that are part of global production networks and have been set up to fragment the production process and take advantage of differences among countries in terms of costs and technologies. When the affiliate ships all of its output to the parent company, the sales can be regarded as intra-firm imports (from the point of view of the home economy where the parent company is established). In practice, affiliates tend also to sell products to third countries or in their host economy. This is why in the end vertical sales of foreign affiliates can only be taken as a proxy for intra-firm trade flows.[23]

Table B.2. Typology of activities of MNEs in the firm-level data

Type of FDI	Identification in the dataset	Included in the estimation of sales of vertical foreign affiliates?
Horizontal	The foreign-owned affiliate and the parent company share at least one identical 6-digit NAICS code.	No
Vertical	The foreign-owned affiliate has at least one 6-digit NAICS code which is an input for the industry of the parent company (according to the input-output matrix). Additionally, there is no domestic ultimate owner with a vertical link.	Yes
Complex	There is both a horizontal and a vertical link (at least one identical 6-digit NAICS code and one that corresponds to an upstream industry).	Partly vertical, but cannot be measured (and is ignored)
Neither	None of the previous connections.	No

As we work with several industry codes for each company and both horizontal and vertical links can be found at the same time, we end up with four categories of companies. "Complex" FDI occurs when we find both a horizontal and a vertical link between the subsidiary and its parent company. We have also a category "neither" for cases where none of the above connections exist. For example, this is the case when a subsidiary is in a different industry than the parent company but without any input-output relationship.

In addition, as suggested by Alfaro and Charlton (2009), we exclude from the sample of vertical affiliates foreign-owned subsidiaries that are in the same country as another subsidiary in a downstream industry. For example, if a car manufacturer has a subsidiary in a foreign country producing auto parts and components and at the same time another subsidiary producing cars, one can assume that at least part of the auto parts and

23. Like Alfaro and Charlton (2009), we only identify upstream links from affiliates to their parents. Naturally, it is also possible that the parent company is the upstream company shipping inputs to its affiliate. Hanson *et al.* (2005) analyse such parent-to-affiliate input trade using US AMNE statistics. Affiliates in downstream industries are often created for distribution purposes and our data are less suited for identifying such FDI motives.

components will be sold to the other subsidiary and not to the parent company. In this case, the sales are excluded from our calculation.

Ideally, we should use a different input-output table for each parent country. Finding detailed and comparable input-output information for a large number of countries is however a challenging task and we were able to work only with the US BEA 2002 Benchmark I-O Table for which we have a detailed concordance with NAICS codes at a disaggregated level. The concordance is not perfect as BEA input-output tables are based on BEA six-digit industry codes that do not always match NAICS codes. But this is the best tool available at present. Industry *j* is regarded as an input supplier to industry *k* when more than 3% of the inputs used by industry *k* are bought from industry *j*. Up to eight industry codes are used for each firm in the identification of vertical links (to cover all the activities of firms that operate in several 6-digit industries). The 3% threshold was picked after having experimented with different thresholds (from 1 to 10%). The number of vertical affiliates identified is sensitive to this threshold (the higher the threshold to define an "essential input supplier", the lower the number of vertical affiliates). This is an additional reason to exercise due caution when examining the results.

As compared to Alfaro and Charlton (2009), we work at a more disaggregated level in identifying vertical and horizontal links (6-digit NAICS codes as opposed to 4-digit SIC codes).[24] Another difference is that the Alfaro and Charlton's study reports information at the establishment level using Dun & Bradstreet's WorldBase database, while ORBIS is at the firm level. The two datasets have a different coverage in terms of countries and companies; this is why we do not expect results to be fully comparable. There are more companies in ORBIS but our sample of foreign affiliates is of a similar size. It should be noted that due to the nature of ownership information on firms, we cannot identify all the foreign affiliates. Our results are based on a sample, which is large but nonetheless prone to some selection bias.[25]

Number of horizontal, vertical and "complex" affiliates

Table B.3 provides an overview of the types of affiliates identified in the database, according to the motive for FDI (horizontal, vertical or complex).[26] We have distinguished affiliates in goods industries and services industries. According to this analysis, 39% of the subsidiaries producing goods are found in a horizontal relationship with their parent company. For services, the number is lower (about 30%).

Horizontal FDI was generally assumed to be the main motivation for international investment. For example, Glass (2008) indicated that "the bulk of FDI is horizontal rather than vertical". This result is contradicted by firm-level data. As emphasised by Alfaro and Charlton (2009), FDI appears to be mainly horizontal only when the analysis is conducted

24. The NAICS classification was introduced in the US 2002 Benchmark I-O Table to replace SIC codes. The new classification is more detailed, in particular for high-tech industries and services.

25. We work with all the firms for which we have information and at this stage no particular sampling technique has been applied. There is ongoing work within STD to compare ORBIS with the OECD Structural and Demographic Business Statistics (SDBS) database and assess the representativity of the sample of firms.

26. The percentage is calculated for subsidiaries that we could identify as resulting from vertical, horizontal or complex FDI. There are no subsidiaries that have been identified as either in a vertical or in a horizontal relationship with their parent company. See Table A.3.

at the aggregate level. The parent company and the affiliate often appear to be in the same sector just because this sector is too broadly defined. At the two-digit level, they find that 70% of FDI in manufacturing industries is horizontal, but at the four-digit level their share drops to 48%. Our analysis is carried out at an even more disaggregated level (6-digit industry codes) and we have found an even smaller share of horizontal FDI (39%).

Table B.3. Distribution of affiliates in ORBIS according to the type of FDI (percentage, 2009)

	Percentage of affiliates
Manufacturing industries	
Horizontal FDI	39.2%
Vertical FDI	28.1%
Complex FDI	32.7%
Services industries	
Horizontal FDI	30.6%
Vertical FDI	32.5%
Complex FDI	36.9%

Source: Authors' calculations based on Bureau Van Dijk's ORBIS database – OECD ORBIS dataset.

Among affiliates identified in our sample, about one third of FDI is not horizontal but vertical and another third is "complex" indicating that both horizontal and vertical motives are at play. Vertical FDI occurs when firms locate different stages of the production process in different countries to benefit from location-specific advantages (such as relatively lower production costs). For a long time, vertical FDI was assumed to take place in theoretical models but not well measured empirically (Bergstrand and Egger, 2009). From the data in Table B.3, we can see that vertical FDI can be identified for many subsidiaries on the basis of the comparison between industry codes and information from an input-output matrix that tells us whether the affiliate is in an upstream industry that generally provides an input to the industry of the parent company. It is only at a disaggregated level that these relationships appear, explaining why earlier literature had some difficulties in identifying vertical MNEs.

Table B.4 provides a breakdown by country. One should keep in mind that not all countries have the same coverage in the ORBIS dataset and the percentages can be calculated on the basis of a relatively small number of firms for the least represented economies (see Table B.1). The share of vertical FDI highlights different patterns across OECD countries. The Czech Republic, Hungary, Ireland, the Netherlands and Slovak Republic have higher shares of vertical affiliates confirming that these EU countries are the main recipients of vertical FDI. Outside the OECD area, Russia and to a lesser extent India have the highest share of vertical FDI. The OECD and non-OECD averages are however quite close. Contrary to what is often assumed offshoring does not occur mainly in developing countries where production costs are lower. Vertical FDI is even more prevalent within the OECD area.

Another important result from Table B.3 deals with services affiliates. Little emphasis in the literature on vertical FDI has been put on services despite FDI occurring largely in services industries. Our analysis shows a slightly higher share of vertical affiliates for services. While many services are likely to be provided through Mode 3 (commercial presence) with horizontal motives for FDI, one should also keep in mind that services are

essential inputs into all sectors of the economy. On the basis of the input-output matrix used to identify vertical links, there are many manufacturing sectors where the input requirement is high for different types of business services. Services are also produced with other services inputs. Hence a high number of vertical links exist between parent companies and services suppliers resulting in a high number of vertical foreign affiliates in services industries. The fact that data on intra-firm trade in services are even less available than for goods certainly explains why the focus has been more on "outsourcing in services" rather than intra-firm trade in services. There is evidence in firm-level data that vertical integration is also prevalent in services industries and that manufacturing firms rely on services affiliates.

Table B.4. Distribution of foreign affiliates according to the type of FDI - By country (2009)

	FDI motives (vertical linkages threshold=0.03)			
	Horizontal	Vertical	Complex	Neither/Not identified
Australia	19.1%	9.1%	16.5%	55.4%
Austria	11.4%	10.4%	10.5%	67.7%
Belgium	13.4%	13.5%	16.7%	56.4%
Canada	22.4%	9.7%	22.5%	45.4%
Chile	16.5%	8.2%	13.7%	61.6%
Czech Republic	9.7%	26.8%	11.9%	51.6%
Denmark	13.1%	14.4%	9.5%	63.0%
Estonia	15.4%	10.3%	6.6%	67.7%
Finland	11.5%	12.3%	6.9%	69.2%
France	9.9%	13.1%	10.8%	66.3%
Germany	9.5%	15.9%	15.0%	59.5%
Greece	16.0%	8.8%	12.8%	62.4%
Hungary	11.4%	24.8%	17.7%	46.1%
Iceland	0.0%	0.0%	20.0%	80.0%
Ireland	8.7%	19.7%	13.9%	57.7%
Israel	50.0%	12.5%	0.0%	37.5%
Italy	11.0%	8.1%	6.7%	74.2%
Japan	13.9%	11.7%	9.9%	64.5%
Korea	17.0%	8.1%	7.7%	67.1%
Luxembourg	8.3%	19.0%	26.9%	45.8%
Mexico	15.6%	9.3%	9.2%	66.0%
Netherlands	10.6%	21.7%	24.3%	43.4%
New Zealand	14.0%	11.2%	3.7%	71.0%
Norway	10.9%	13.3%	7.9%	67.9%
Poland	10.8%	11.1%	7.4%	70.7%
Portugal	13.1%	13.4%	9.9%	63.6%
Slovak Republic	16.3%	20.1%	12.9%	50.7%
Slovenia	10.0%	9.0%	7.0%	74.0%
Spain	13.6%	13.1%	11.3%	62.1%
Sweden	12.3%	15.5%	10.6%	61.6%
Switzerland	13.9%	12.3%	12.1%	61.6%
Turkey	16.5%	11.6%	10.7%	61.2%
United Kingdom	8.6%	14.4%	11.9%	65.1%
United States	13.0%	11.7%	17.2%	58.1%
Total OECD members	**12.8%**	**12.9%**	**14.8%**	**59.5%**
Argentina	18.6%	8.5%	14.0%	58.9%
Brazil	14.9%	9.0%	9.4%	66.7%
China	20.1%	7.3%	11.0%	61.6%
India	21.6%	12.8%	13.1%	52.5%
Indonesia	33.8%	10.8%	18.5%	36.9%
Russian Federation	13.3%	18.0%	9.8%	58.9%
Saudi Arabia	25.0%	0.0%	0.0%	75.0%
South Africa	21.5%	11.5%	8.7%	58.2%
Total other major economies	**16.2%**	**12.3%**	**10.5%**	**60.9%**
Other countries	19.7%	9.8%	10.8%	59.7%
Total	**13.2%**	**12.7%**	**14.6%**	**59.5%**

Source: Authors' calculations using Bureau Van Dijk's ORBIS database - OECD ORBIS dataset.

The last type of FDI identified in Table B.2 is "complex FDI": the firm level data reveals evidence of both vertical links and horizontal links between parent companies and their foreign affiliates. The share of complex FDI illustrates that lines between horizontal and vertical FDI are often blurred and the structure of production networks more intricate than suggested by the simple horizontal/vertical dichotomy. Affiliates can have multiple activities and supply inputs while producing also the same good or service as their parent company.

As shown in Table B.4, a large share of foreign affiliates is neither vertical nor horizontal, nor even complex, and remains unidentified. This results on the one hand from insufficient data or limitations in the methodology. But the high share of affiliates involved also suggests that the distinction between horizontal and vertical FDI in the theoretical literature cannot fully explain the patterns of FDI observed. There is room for further analysis and refinement in the determinants of foreign investment. Some of these determinants highlighted in the literature are strategic or related to taxation issues. Firms also tend to diversify into a variety of related activities in order to increase their competitiveness. FDI is often motivated by the acquisition of knowledge and know-how and this is not reflected in the input-output matrix.

Estimation of the sales of vertical foreign affiliates (a proxy for intra-firm trade)

The next step in the analysis is to estimate sales of vertical foreign affiliates on the basis of the links identified in the firm-level data. The estimates that we have calculated for each country appear in Table B.5 and are expressed in millions of US dollars. For comparison purposes, Table B.5 also reports the sales of vertical foreign affiliates expressed as a share of cross-border trade (distinguishing between goods and services). But one should bear in mind that the total trade figure comes from aggregate trade statistics where all firms are accounted for, whereas our estimates are based on a sample of firms in ORBIS.

As the analysis is carried out for the year 2009, some of the aggregate trade data (in particular for trade in services) are not yet available. For OECD countries, sales of vertical affiliates amount to USD 863 billion, with a bit more than half of this value coming from affiliates in goods industries and a bit less than half in services industries. As a share of total trade, this represents about 6% of total imports in the case of goods. One should keep in mind that this is an indication of potential intra-firm trade in only one direction (from the affiliates to the parents) and only on the basis of a sample of firms. The estimation is therefore in line with the aggregate figures presented in Section 2, par. 13-15. If we look at the US economy, the estimate of USD 257 billion is close to the data reported by the Bureau of Economic Analysis for the year 2008 (USD 276 billion). As we have emphasised, the sales of vertical foreign affiliates can only be seen as a proxy for intra-firm trade and results in Table B.5 are more or less reliable depending on the sample of firms studied (which varies across countries as shown in Table B.1).

Table B.5. Sales of vertical foreign affiliates, estimates based on firm-level data (2009)

	Sales of vertical foreign affiliates			*As a share of cross-*	
	Total (Mill. USD)	Goods ind. (Mill. USD)	Services ind. (Mill. USD)	Goods (%)	Services (%)
Australia	7 633	3 444	4 189	2.2%	-
Austria	7 840	4 362	3 478	3.2%	9.4%
Belgium	31 499	794	30 704	0.2%	41.9%
Canada	21 135	4 448	16 687	1.4%	21.2%
Chile	69	63	6	0.2%	0.1%
Czech Republic	57	49	8	0.0%	0.0%
Denmark	4 154	825	3 329	1.0%	6.5%
Estonia	76	0	76	-	3.0%
Finland	9 954	8 136	1 818	13.4%	-
France	95 825	54 317	41 508	10.0%	-
Germany	70 369	48 406	21 963	5.2%	-
Greece	363	4	359	0.0%	-
Hungary	1 245	831	414	1.1%	-
Iceland	664	14	650	0.4%	-
Ireland	16 854	14 408	2 446	23.0%	-
Israel	174	0	174	-	1.0%
Italy	29 766	21 500	8 266	5.2%	-
Japan	53 763	15 954	37 809	2.9%	25.4%
Korea	583	155	428	0.0%	-
Luxembourg	26 492	23 349	3 142	125.2%	-
Mexico	720	386	335	0.2%	-
Netherlands	10 830	5 135	5 695	1.5%	-
New Zealand	48	0	48	-	-
Norway	9 468	9 120	349	13.4%	-
Poland	59	46	13	0.0%	-
Portugal	626	23	603	0.0%	-
Slovak Republic	229	156	73	0.3%	-
Slovenia	495	58	437	0.2%	-
Spain	27 032	12 972	14 060	4.5%	-
Sweden	16 414	5 785	10 629	4.8%	-
Switzerland	107 403	96 585	10 818	62.2%	-
Turkey	44	1	44	0.0%	-
United Kingdom	53 946	4 435	49 510	0.9%	-
United States	257 192	115 232	141 961	7.2%	-
Total OECD members	**863 024**	**450 995**	**412 029**	**5.6%**	**-**
Argentina	125	65	61	0.2%	-
Brazil	337	330	7	-	0.0%
China	82	0	82	-	-
India	29 079	23 589	5 491	8.9%	10.2%
Indonesia	-	-	-	- -	-
Russian Federation	311	118	193	0.1%	0.3%
Saudi Arabia	612	380	232	0.4%	-
South Africa	531	37	494	0.1%	3.4%
Total other major economies	**31 078**	**24 519**	**6 559**	**1.5%**	**-**
Other countries	20 360	3 891	16 469	0.4%	-
Total	**914 462**	**479 405**	**435 057**	**4.4%**	**-**

Source: Authors' calculations using Bureau Van Dijk's ORBIS database - OECD ORBIS dataset.

Annex C – Determinants of Intra-Firm trade: Theory and empirics

Theoretical models - Incomplete contracts and the hold-up problem

Antràs (2003) assumes that the final goods producer and the supplier share the capital investment required for the production of an intermediate input, while the supplier provides additionally all of the labour required. If the production of the intermediate is capital-intensive, the final goods producer will therefore decide to produce it in-house, i.e. to integrate with the supplier, because he has to shoulder the burden of a large share of the investment. On the other hand, if the production of the intermediate is labour intensive, the final goods supplier will choose to outsource the production to the supplier, because the latter needs to be given incentives to invest. Antràs (2003) embeds this property rights approach in a factor proportions model in which production and trade are determined by comparative advantage in production factors, i.e. capital abundant countries will export relatively more in capital intensive industries. Hence, Antràs (2003) predicts that the share of intra-firm imports in total imports is higher for capital intensive industries (due to the hold-up problem) and from capital abundant countries (due to the comparative advantage pattern of trade).

In the model of Antràs and Helpman (2004), the production of a final good requires an intermediate input which is provided by a supplier and headquarter services which are provided by the final goods firm itself. Their model explains how final goods firms of different productivity levels choose between the four sourcing strategies of intermediate inputs outlined in Figure 1, i.e. domestic in-house production, domestic outsourcing, vertical FDI and offshore outsourcing.

In particular, they assume that final goods firms face two different trade-offs with respect to the supply of inputs. The first one is related to the location of the production of the input. Either the input is produced at home where variable costs are high but fixed costs are low, or the input is imported from a country where variable costs are lower (for example from a developing country with lower production costs) but fixed costs are higher (the costs associated with international offshoring). In particular, the model predicts that only firms with high productivity will offshore the production of the input to a foreign country because only these firms are able to overcome the higher fixed cost associated with offshore-outsourcing and vertical FDI compared to domestic in-house production and domestic outsourcing.[27]

The second trade-off deals with the integration or outsourcing decision. Once a final goods firm has decided to offshore the production of the input, it then has to choose whether to import the input from an independent supplier (offshore outsourcing) or from an affiliate (vertical FDI). Outsourcing entails lower fixed costs (setting up the relationship with the independent supplier) but a larger fraction of the revenue will be

27. Firms with higher poductivity will be bigger and make higher profits allowing them to cover higher fixed costs

given to the supplier because his property rights over the input increase his bargaining power. On the other hand, integration leads to higher fixed costs (the investment costs) but now the final goods firm has more bargaining power and is able to capture a larger share of the revenue. The driving force for the decision between integration and outsourcing is the strength of the hold-up problem each party faces.

If sectors are component-intensive (inputs are more important for profits than headquarter services), the supplier needs to be given more incentives not to underinvest in the first place. Hence, final goods firms will choose outsourcing and firms will not vertically integrate. On the other hand, in a sector intensive in headquarter services,[28] the headquarter services of the final goods firm are more important for profits than the input of the supplier. Hence, efficiency dictates that more incentives to invest are given to the final goods firm than to the supplier. However, not all final goods firms will choose vertical FDI as compared to offshore outsourcing. In particular, only the most productive firms will choose vertical FDI because only they can face the high fixed costs implied by this choice.[29]

Summarising, Antràs (2003) and Antràs and Helpman (2004) provide predictions of intra-firm trade at the product (industry) level: integration and hence intra-firm trade will be more prevalent in capital and headquarter intensive industries,[30] because the relationship-specific investments of parent firms are higher in these industries.

The contracting environment is crucial in these models since the hold-up problem arises only if it is not possible to specify all details in a contract or if contracts are not enforceable. If the writing of contracts is complete, there is no need for integration. Predictions regarding improvements in the contracting environment differ across models. For instance, Grossman and Helpman (2003) argue that a better contracting environment increases outsourcing relative to vertical integration since less investment tasks are left to the discretion of the supplier. On the other hand, in Antràs and Helpman (2008) an improvement in the contracting environment can increase either intra-firm or arm's length trade, depending on whether the investment undertaken by the final goods producer or by the supplier benefits more. If relatively more contractual details can be specified regarding the headquarter services provided by the final goods producer, then arm's length trade will increase because the final goods producer is affected less by the hold-up problem. On the other hand, if the input provided by the supplier experiences an increase in contractibility, the supplier needs fewer incentives compared to the final goods producer and hence integration and intra-firm trade will increase.

Empirical findings on the determinants of intra-firm trade

Given the scarcity of data on intra-firm trade, few empirical papers exist on the topic. Only recently some papers have used either firm level data (Jabbour, 2008; Corcos *et al.*, 2009; Marin, 2006) or trade data on intra-firm imports from the US Census Bureau (Bernard *et al.*, 2010; Nunn and Trefler, 2008: Costinot *et al.*, 2011) to test the predictions of new trade models. Box C.1 summarises the results of a survey based on French firm-level data.

28. In the model, only inputs can be offshored but not headquarter services.

29. The model predicts the following order of sourcing strategies depending on the productivity of firms: domestic outsourcing (firms with lowest productivity), domestic in-house production, offshore-outsourcing and vertical FDI (firms with highest productivity).

30. Headquarter intensity is typically proxied with skilled labour intensity.

Bernard *et al.* (2010) and Nunn and Trefler (2008) find that intra-firm imports are higher in both capital and skill intensive industries confirming predictions from Antràs (2003) and Antràs and Helpman (2004). Similarly, Yeaple (2006) finds that the R&D intensity of the industry increases the share of intra-firm imports of US parents in total US imports from emerging and developed countries and Marin (2006) shows that the R&D intensity of German parent firms increases the probability of integration relative to outsourcing as sourcing strategy from Eastern Europe.

Using a firm level dataset for French firms, Corcos *et al.* (2009) find that highly productive, capital-, skill- and headquarter-intensive firms are more likely to engage in intra-firm trade. However, in contrast to Bernard (2010) and Antràs (2003), Corcos *et al.* (2009) find that French firms are more likely to engage in intra-firm imports from capital-scarce countries. These different findings highlight that firms in different countries do not necessarily follow the same patterns of intra-firm trade and that the firm and not the industry is the appropriate level of disaggregation to explain trade decisions.

Most of recent empirical research has shown that intra-firm trade increases if products (industries) are more complex or more difficult to contract. Building on the Rauch (1999) classification, Corcos *et al.* (2009) find that higher product complexity increases the likelihood of intra-firm sourcing. Costinot *et al.* (2011) find that the share of US intra-firm imports is higher in less routine sectors. Bernard *et al.* (2010) use a new index of revealed product contractibility based on the degree of a good being imported by wholesale traders. They find that the share of intra-firm imports is lower for products that are easy to contract and that this effect is more pronounced for countries with weak governance. In other words, if a product is difficult to contract, relatively more imports will be intra-firm, especially from countries with weak governance. In contrast, Nunn and Trefler (2008) find that intra-firm imports are higher in relationship-specific industries from countries with a strong rule of law. According to the property rights model of Antràs and Helpman (2008), this would imply that an improvement in the contracting environment affects primarily the investment undertaken by the supplier and that therefore more incentives need to be given to the final goods producer increasing integration.

Using intra-firm trade data of Austrian MNEs, Egger and Pfaffermayr (2005) find that market size and unit labour costs are significant determinants of intra-firm exports, as predicted by the Knowledge Capital Model (Markusen, 2002). Hanson *et al.* (2005) analyse vertical production networks by assessing the determinants of intra-firm exports of intermediate inputs from US parents to their foreign affiliates. They find that low trade costs, low wages for unskilled workers and a small host market increase the share of intra-firm trade in the revenues of affiliates. On the other hand, low wages for skilled workers decrease the share of intra-firm trade.

Box C.1. Firm-level evidence on intra-firm trade: the French intra-group trade survey

In 1999, the French ministry of economy conducted a survey on the international activities of French firms and their intra-firm trade ("Enquête sur les échanges intra-groupe"). The survey covers 4 305 firms representing 55% of French imports and 61% of French exports. Firms had to report the share of their international transactions conducted with affiliates and partners (related parties) on the one hand, and independent suppliers on the other hand. The results were the following: 68% of the transactions of French firms are with third-parties (arm's length trade), while 32% are intra-firm. The 32% of intra-firm trade transactions can be further decomposed into 29.9% with affiliates in developed countries (mainly in the European Union and the United States) and 2.1% with affiliates in developing countries.

Answering questions on the motivations for intra-firm trade, French firms rank first quality control of the production process and second reduction in organisational costs. The third motivation is stability in supply at a lower cost. For 80% of intra-firm imports, the same products are not produced in France by the firm.

On the basis of these firm-level data, Jabbour (2008) provides an econometric analysis of the determinants of intra-firm trade. The results indicate that capital intensity at the firm level is positively associated with FDI over outsourcing, as predicted by theory. As in Antràs and Helpman (2004), the decision to outsource or vertically integrate depends on the hierarchy of fixed costs and firms heterogeneity. However, the survey finds that the organisational costs associated with FDI are lower and as a consequence the most productive firms engage in outsourcing rather than vertical integration. Moreover, the influence of relationship-specific investment on the organisational form of firms is confirmed, as well as the prevalence of vertical integration in activities intensive in headquarter services.

Source: Jabbour (2008).

Estimation strategy and data used in regression analysis

The estimation strategy that we use to assess the determinants of intra-firm trade follows closely Bernard *et al.* (2010). Probit regressions are used to assess the extensive margin of intra-firm trade, i.e. whether there is intra-firm trade or not. In probit regressions the dependent variable takes the form of a dummy D_{pi} that is one if there is intra-firm trade between the United States and the exporting country i in HS6 product p. If no intra-firm trade is observed, the dummy is zero. The intensive margin of intra-firm imports relates to the volume of intra-firm trade relative to total trade and is assessed using OLS regressions. The dependent variable is the share S_{pi} of US intra-firm imports (exports) in total US imports (exports) of HS6 digit product p from country i. The estimation specification used for both Probit and OLS regressions is the following:

$$y_{pi} = c + \alpha_1 intermediation_k + \beta_1 RuleofLaw_i + \alpha_2 capital_k + \beta_2 K/L_i + \alpha_3 skill_k + \beta_3 H/L_i + \beta_4 Population_i + \beta_5 TradeCosts_{ki} + \beta_6 InvestmentCosts_i + \gamma(X_k X_i) + \varepsilon_{pi}$$

The dependent variable y_{pi} denotes respectively either D_{pi} or S_{pi} for the year 2006 depending on whether Probit or OLS regressions are used.c is a constant; $X_k X_i$ are interaction terms of industry *k* and country *i* characteristics and ε_{pi} denotes the error term. Following predictions of Antràs (2003) and Antràs and Helpman (2004), capital intensity $capital_k$ and skilled labour intensity $skill_k$ of industry *k* are included to proxy for headquarter intensity. Using data from the NBER-CES Manufacturing Industry Database for the year 2005, $capital_k$ is the natural log of the total real capital stock per worker and $skill_k$ is the share of non-production workers in total employment. While intra-firm trade shares are observed at the HS6 product level *p* capital and skilled labour intensity are only available at the NAICS6 industry level *k*. To account for this difference in aggregation between dependent and explanatory variables, we estimate standard errors clustered at the NAICS6 level. The variable $intermediation_k$ is the contractibility index of Bernard at al. (2010) at the HS2 level. $RuleofLaw_i$ is an indicator taken from the World Bank

Worldwide Governance Indicators 2009 and measures the quality of the rule of law, which comprises the quality of contract enforcement, of country *i* in the year 2006. Data on endowments of capital K/L_i and human capital H/L_i of country *i* are taken from Hall and Jones (1999) and are measured by the natural logs of the capital stock per worker and the human capital stock per worker for the year 1988. From the World Development Indicators 2010, the natural logarithm of the population of country *i* ($Population_i$) is used to measure country size. To capture trade costs ($TradeCosts_{ki}$) and investment costs ($InvestmentCosts_i$) two measures are used in each case. In one specification, following Bernard *et al.* (2010), restrictiveness indices of trade (HFI_trade) and investment ($HFI\_investment$) taken from the Heritage Foundation Economic Freedom Indices are used. In the second specification, bilateral trade costs are calculated on the basis of the ratio of domestic to international trade using the methodology proposed by Novy (2010), while investment costs are captured using the OECD FDI regulatory restrictiveness index.

Results of regression analysis

Table C.1 reports results from the regression analysis. Columns (1) and (2) correspond closely to the specification used in Bernard *et al.* (2010) and hence gives similar results. A higher contractibility of products (*Intermediation*) decreases the share of intra-firm trade (Col. 2). If products are easy to contract, the hold-up problem is less severe so that firms rely more on outsourcing as compared to integration. Improvements in the contracting environment (*RuleofLaw*) increases the probability that intra-firm trade takes place (column 1) but decreases the share of intra-firm imports once a foreign affiliate has been established. The positive interaction term of product contractibility and the contracting environment (column 2) indicates that the contractibility of products is more important in countries with a poor contracting environment. In particular, products which are difficult to contract are traded more intra-firm in all countries, but even more so in countries with a low quality of the rule of law.

Furthermore, the finding that the share of intra-firm imports is higher in capital (*capital*) and skilled labour (*skilled labour*) intensive industries (column 2) confirms Antràs (2003) and Antràs and Helpman (2004). Capital and headquarter intensive industries require more relationship-specific investment of parent firms which prefer to integrate in order to alleviate the hold-up problem they face.

In columns (1) and (2), trade and investment costs are measured as in Bernard *et al.* (2010) using trade (*HFI_trade*) and investment (*HFI_investment*) restrictiveness indices from the Heritage Foundation Economic Freedom Indices. While a reduction in trade costs decreases the share of intra-firm trade (column 2), a reduction in investment costs has the opposite effect. This is in line with theoretical predictions. Antràs and Helpman (2004) predict that, while a reduction in trade costs will increase foreign sourcing overall, it will increase international outsourcing (arm's length trade), relative to vertical FDI (intra-firm trade). On the other hand, a reduction in international investment barriers will reduce the costs of FDI relative to domestic investment so that vertical FDI becomes more profitable compared to international outsourcing and hence the share of intra-firm trade will increase. Summarising, trade liberalisation increases outsourcing relative to vertical FDI and investment liberalisation increases vertical FDI relative to outsourcing.

In columns (3) and (4), alternative measures for trade and investment costs are used. In particular, bilateral trade costs (*Trade Cost*) are now micro-founded estimates derived from international trade and domestic output data, while investment costs are measured using the OECD FDI Restrictiveness Index (*FDI Restrictiveness*). Column (4) shows that

the co-efficients of these alternative variables have opposite signs to the ones used in column (2), that is they are contrary to the theoretical predictions. Besides differences in the way the variables capture trade and investment restrictiveness, another explanation for this result might be that the sample changes considerably, i.e. the number of countries that are included in the regression drops from 103 to 26.

Columns (5) to (8) report regression results for the determinants of intra-firm exports. While results are similar to the regressions for intra-firm imports, some important differences are noteworthy. First, while the rule of law variable has a significant negative impact on the share of intra-firm imports, it has no significant impact on the share of intra-firm exports. Second, while the population has a significant negative impact on the share of intra-firm imports, the respective co-efficient is positive and significant in the case of exports.

Table C.1. Determinants of bilateral US intra-firm trade at the extensive (Probit) and the intensive (OLS) margin

	Imports				Exports			
	Probit	OLS	Probit	OLS	Probit	OLS	Probit	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intermediation	-1.639***	-0.483***	-1.970***	-0.460***	-1.709***	-0.074***	-2.237***	-0.137***
	(0.161)	(0.049)	(0.205)	(0.066)	(0.198)	(0.023)	(0.287)	(0.039)
RuleofLaw	0.179***	-0.028***	0.113***	0.038***	-0.044***	0.002	0.043**	0
	(0.011)	(0.003)	(0.023)	(0.007)	(0.007)	(0.002)	(0.017)	(0.004)
Interm. X RuleofLaw	-0.542***	0.122***	-0.501***	0.074**	-0.391***	-0.056***	-0.592***	0.018
	(0.090)	(0.032)	(0.165)	(0.032)	(0.059)	(0.012)	(0.116)	(0.023)
capital	-0.111***	0.073***	-0.114***	0.074***	-0.046*	0.017***	-0.074***	0.022***
	(0.023)	(0.007)	(0.028)	(0.010)	(0.025)	(0.005)	(0.028)	(0.006)
K/L	0.163***	0.072***	0.312***	0.032***	0.196***	0.019***	0.061***	0.012***
	(0.013)	(0.004)	(0.027)	(0.008)	(0.008)	(0.002)	(0.018)	(0.004)
capital x K/L	0.062***	0.010*	0.093***	0.030***	0.011	0.012***	-0.109***	0.011*
	(0.012)	(0.005)	(0.026)	(0.011)	(0.008)	(0.002)	(0.019)	(0.007)
skilled labour	0.423**	0.120**	-0.024	0.007	0.935***	0.090***	0.345	0.011
	(0.174)	(0.051)	(0.229)	(0.059)	(0.197)	(0.025)	(0.255)	(0.034)
H/L	0.200***	-0.065***	-0.057	-0.081***	0.190***	-0.024***	-0.003	-0.072***
	(0.040)	(0.013)	(0.064)	(0.022)	(0.023)	(0.006)	(0.054)	(0.010)
skilled labour x H/L	0.366	-0.461***	0.825	-0.376***	0.976***	0.210***	0.41	0.145
	(0.354)	(0.107)	(0.554)	(0.145)	(0.198)	(0.045)	(0.397)	(0.090)
Population	0.244***	-0.034***	0.214***	-0.031***	0.157***	0.013***	0.240***	0.018***
	(0.007)	(0.002)	(0.012)	(0.003)	(0.006)	(0.001)	(0.013)	(0.002)
HFI_trade	-0.457***	0.293***			0.392***	0.092***		
	(0.054)	(0.019)			(0.049)	(0.011)		
HFI_investment	-0.162***	-0.034**			-0.333***	-0.032***		
	(0.036)	(0.014)			(0.033)	(0.005)		
Trade Cost			-0.867***	-0.128***			-1.336***	-0.210***
			(0.097)	(0.025)			(0.105)	(0.015)
FDI Restrictiveness			0.033	0.565***			1.581***	0.257***
			(0.145)	(0.043)			(0.114)	(0.019)
Constant	-3.773***	0.948***	-2.585***	1.016***	-2.836***	-0.102***	-3.537***	-0.064
	(0.125)	(0.030)	(0.247)	(0.057)	(0.089)	(0.015)	(0.263)	(0.045)
Pseudo R-squared	0.089		0.079		0.06		0.127	
R-squared		0.101		0.078		0.022		0.086
Observations	134 139	80 619	55 905	39 309	196 007	158 432	60 958	49 040
Countries	107	103	26	26	107	107	26	26
HS6 Goods	4 663	4 476	4 499	4 240	4 647	4 622	4 525	4 468
NAICS6 Industries	383	383	383	383	384	384	384	384

Notes: The dependent variable in probit regressions is a dummy indicating whether there is intra-firm trade in a HS6 product between two countries or not, while in OLS regressions it is the share of intra-firm trade if the latter is positive. All variables entering interactions terms have been centered at the mean so that co-efficients of main effects can be interpreted at sample means. Robust standard errors clustered at the 6-digit NAICS level are reported in brackets. * significant at 10%; ** at 5%; *** at 1%.

Annex D – Intra-firm Trade and Macroeconomic Shocks

Descriptive tables

Table D.1. US intra-firm and arm's length trade during the trade collapse

A. US imports

	Total Trade						Non-railway vehicles (HS87)					
	US imports in 2009			*Change in 2009 (%)*			*US imports in 2009*			*Change in 2009 (%)*		
Country	Value (Mill. USD)	Intra-firm (%)	Arm's length (%)	Total	Intra-firm	Arm's length	Value (Mill. USD)	Intra-firm (%)	Arm's length (%)	Total	Intra-firm	Arm's length
OECD Members	872 897	57.8	39.1	-25.5	-23.0	-27.1	122 252	86.7	13.3	-33.3	-32.5	-37.8
EE5 countries	355 178	28.8	70.4	-15.2	-9.2	-17.5	7 319	31.0	69.0	-24.4	-36.0	-17.7
World	1 549 163	47.8	50.1	-25.9	-24.1	-26.8	131 887	82.6	17.4	-32.6	-32.5	-33.1

	Machinery, computers, instruments (HS 84,85,90)						Articles of apparel and clothing accessories (HS 61,62)					
	US imports in 2009			*Change in 2009 (%)*			*US imports in 2009*			*Change in 2009 (%)*		
Country	Value (Mill. USD)	Intra-firm (%)	Arm's length (%)	Total	Intra-firm	Arm's length	Value (Mill. USD)	Intra-firm	Arm's length	Total	Intra-firm	Arm's length
OECD Members	252 052	64.4	35.6	-19.9	-18.6	-22.3	6 204	47.3	52.7	-24.6	-19.7	-28.5
EE5 countries	147 134	47.1	52.9	-9.0	-2.2	-14.2	31 108	2.5	97.5	-0.2	6.0	-0.4
World	463 745	58.9	41.1	-16.3	-14.8	-18.4	64 224	12.7	87.3	-12.0	-12.5	-12.0

B. US exports

	Total Trade						Non-railway vehicles (HS87)					
	US exports in 2009			*Change in 2009 (%)*			*US exports in 2009*			*Change in 2009 (%)*		
Country	Value (Mill. USD)	Intra-firm (%)	Arm's length (%)	Total	Intra-firm	Arm's length	Value (Mill. USD)	Intra-firm (%)	Arm's length (%)	Total	Intra-firm	Arm's length
OECD Members	612 608	33.5	62.3	-21.0	-20.1	-21.9	52 340	55.7	41.2	-34.4	-36.3	-33.2
EE5 countries	111 061	14.7	84.2	-11.5	-14.5	-10.7	3 066	17.0	83.0	-21.5	-42.2	-15.4
World	936 503	27.9	68.6	-19.9	-20.1	-20.0	68 741	44.5	53.1	-33.5	-36.4	-31.7

	Machinery, computers, instruments (HS 84,85,90)						Articles of apparel and clothing accessories (HS 61,62)					
	US exports in 2009			*Change in 2009 (%)*			*US exports in 2009*			*Change in 2009 (%)*		
Country	Value (Mill. USD)	Intra-firm (%)	Arm's length (%)	Total	Intra-firm	Arm's length	Value (Mill. USD)	Intra-firm	Arm's length	Total	Intra-firm	Arm's length
OECD Members	163 601	36.9	60.2	-25.8	-24.3	-27.3	1 748	16.1	65.6	-3.3	1.9	-6.5
EE5 countries	31 587	22.4	77.6	-19.8	-21.0	-19.4	37	8.2	91.8	-10.3	-8.2	-10.5
World	269 645	31.6	66.7	-24.5	-24.7	-24.7	2 397	18.2	68.5	-6.9	-5.1	-9.2

Source: US Census Bureau, Related Party Database. The EE5 countries are Brazil, China, India, Indonesia and South Africa, which are part of the OECD enhanced engagement programme.

Table D.2. HS chapters with the largest absolute and relative declines in US imports 2009

					Absolute Change in Mill. USD		
HS2	Chapter	Imports in Mill. USD.	Intra-Firm (%)	Arm's Length (%)	Overall	Intra-Firm	Arm's Length
27	Mineral fuels, oils, waxes	257 735	40	54	-212 254	-79 195	-115,989
87	NonRailway vehicles	131 887	83	17	-63 818	-52 470	-11 346
84	Nuclear reactors, machinery	202 079	59	41	-44 580	-17 163	-27 414
85	Electrical machinery	212 100	57	43	-38 289	-25 351	-12 942
72	Iron and steel	12 378	39	61	-19 693	-6 056	-13 637
29	Organic chemicals	49 615	76	24	-13 502	-8 861	-4 641
73	Articles of iron or steel	24 223	33	67	-13 429	-4 555	-8 873
71	Pearls, precious metals, coin	38 495	19	81	-11 031	-1 287	-9 744
94	Furniture; prefab buildings	30 064	20	80	-8 272	-2 520	-5 752
90	Instruments	49 566	65	35	-7 446	-4 845	-2 601
39	Plastics and articles thereof	28 163	36	64	-7 305	-3 520	-3 785
28	Inorganic chemicals+Z77	11 422	45	55	-6 555	-1 947	-4 608
76	Aluminum and articles thereof	11 339	46	54	-5 814	-3 690	-2 123
74	Copper and articles thereof	6 407	15	85	-5 293	-754	-4 539
40	Rubber and articles thereof	15 380	58	42	-4 924	-2 978	-1 945
62	Apparel, not knitted or crocheted	30 891	13	87	-4 793	-761	-4 031
44	Wood articles; wood charcoal	9 806	23	77	-4 336	-880	-3 454
31	Fertilisers	4 194	70	30	-4 242	-2 095	-2 147
95	Toys, games	27 576	39	61	-4 203	-910	-3 292
61	Knitted or crocheted apparel	33 333	12	88	-3 993	-407	-3 586

					Relative Change in Percentage		
HS2	Chapter	Imports in Mill. USD.	Intra-Firm (%)	Arm's Length (%)	Overall	Intra-Firm	Arm's Length
72	Iron and steel	12 378	39	61	-61	-56	-64
53	Vegetable textile fibres	132	24	76	-53	-11	-59
75	Nickel and articles thereof	1 867	72	28	-50	-54	-39
31	Fertilisers	4 194	70	30	-50	-42	-63
25	Salt; earths and stone	3 362	63	37	-46	-44	-49
74	Copper and articles thereof	6 407	15	85	-45	-45	-45
81	Other base metals	1 587	40	60	-45	-42	-47
27	Mineral fuels, oils, waxes	257 735	40	54	-45	-43	-46
50	Silk	141	11	89	-42	-38	-42
47	Pulp of wood	2 441	34	66	-39	-47	-34
78	Lead and articles thereof	459	9	91	-38	-36	-38
28	Inorganic chemicals+Z77	11 422	45	55	-36	-28	-42
73	Articles of iron or steel	24 223	33	67	-36	-36	-35
80	Tin and articles thereof	529	8	92	-35	-56	-33
26	Ores, slag and ash	2 597	12	88	-35	-37	-34
41	Raw hides, skins, leather	450	11	89	-35	-32	-35
76	Aluminum and articles thereof	11 339	46	54	-34	-41	-26
51	Wool, woven fabric	199	21	79	-33	-47	-29
87	NonRailway vehicles	131 887	83	17	-33	-32	-33
97	Works of art, antiques	5 036	5	95	-32	-3	-34

Source: US Census Bureau, Related Party Database.

Table D.3. HS chapters with the largest absolute and relative declines in US exports 2009

					Absolute Change in Mill. USD		
HS2	Chapter	Exports in Mill. USD.	Intra-Firm (%)	Arm's Length (%)	Overall	Intra-Firm	Arm's Length
84	Nuclear reactors, machinery	127 240	27	71	-56 569	-16 500	-39 724
87	NonRailway vehicles	68 741	45	53	-34 669	-17 516	-16 966
85	Electrical machinery	86 500	35	63	-25 317	-11 111	-14 078
27	Mineral fuels, oils, waxes	54 574	40	60	-21 445	-7 645	-13 643
10	Cereals	17 323	17	83	-11 495	-1 421	-10 002
71	Pearls, precious metals, coin	27 512	6	94	-10 169	-820	-9 263
39	Plastics and articles thereof	41 361	35	63	-8 431	-2 814	-5 588
72	Iron and steel	14 957	12	87	-8 146	-647	-7 292
29	Organic chemicals	30 147	31	69	-6 751	-3 395	-3 247
90	Instruments	55 906	38	61	-5 385	-298	-5 048
38	Misc. chemical products	17 249	37	62	-4 503	-953	-3 535
73	Articles of iron or steel	12 612	25	70	-3 648	-683	-2 863
76	Aluminum and articles thereof	8 025	16	83	-3 574	-765	-2 802
31	Fertilisers	3 515	13	87	-3 283	-122	-3 157
26	Ores, slag and ash	3 420	13	87	-3 030	-702	-2 293
28	Inorganic chemicals+Z77	10 721	16	84	-2 739	-474	-2 264
74	Copper and articles thereof	4 886	13	86	-2 086	-253	-1 828
48	Paper; articles of paper pulp	13 307	29	69	-1 855	-176	-1 644
40	Rubber and articles thereof	8 937	41	54	-1 852	-953	-896
94	Furniture; prefab buildings	5 983	22	66	-1 773	-280	-1 397

					Relative Change in Percentage		
HS2	Chapter	Exports in Mill. USD.	Intra-Firm (%)	Arm's Length (%)	Overall	Intra-Firm	Arm's Length
31	Fertilisers	3 515	13	87	-48	-21	-51
26	Ores, slag and ash	3 420	13	87	-47	-61	-44
80	Tin and articles thereof	86	24	75	-45	-57	-40
60	Knitted or crocheted fabrics	891	33	67	-42	-29	-47
4	Dairy produce; honey	1 929	9	91	-41	19	-44
10	Cereals	17 323	17	83	-40	-32	-41
89	Ships, boats, etc.	1 907	12	88	-39	-41	-38
43	Furskins and artificial fur	204	19	80	-39	-34	-40
75	Nickel and articles thereof	1 252	21	79	-38	-9	-43
72	Iron and steel	14 957	12	87	-35	-26	-36
81	Other base metals	1 697	15	85	-35	-31	-35
79	Zinc and articles thereof	177	21	77	-34	-39	-33
50	Silk	21	2	90	-34	-5	-35
87	NonRailway vehicles	68 741	45	53	-34	-36	-32
76	Aluminum and articles thereof	8 025	16	83	-31	-37	-30
84	Nuclear reactors, machinery	127 240	27	71	-31	-33	-30
41	Raw hides, skins, leather	1 811	5	95	-30	-56	-28
74	Copper and articles thereof	4 886	13	86	-30	-29	-30
54	Manmade filaments	1 118	32	66	-30	-24	-32
5	Animal products	772	4	96	-29	-19	-29

Source: US Census Bureau, Related Party Database.

Estimation strategy for regression analysis

To assess the product and industry characteristics that help explaining the trade collapse, the empirical estimation strategy of Levchenko *et al.* (2010) is used. In particular, the following two models are estimated to explain the decline in US imports during the trade collapse from an intra-firm trade perspective:

$$y_p = \alpha + \beta_1 IFT_p + \beta_2 GVCs_p + \beta_4 IFT_p xGVCs_p + \beta_z X_k + \varepsilon_p \quad (1)$$

$$y_p = \alpha + \beta_1 IFT_p + \beta_3 TradeCredit_k + \beta_4 IFT_p xTradeCredit_k + \beta_z X_k + \varepsilon_p \quad (2)$$

The dependent variable y_p indicates the percentage change in US imports of HS6 product *p* during the trade collapse. The variables of main interest are the following: IFT_p is the intra-firm trade share of HS6 product p in 2008 that tests whether the decline in trade was larger for products that are traded more intra-firm. The variables $GVCs_p$ and $TradeCredit_k$ in model 1 and model 2 test respectively whether products that are traded intensively within global value chains (GVCs) or sectors that use intensively trade credit have experienced larger percentage drops in trade. To assess whether intra-firm trade matters in the contexts of GVCs and trade credit financing, interaction terms are included. $IFT_p xGVCs_p$ tests whether the decline in trade was more or less pronounced for products that are part of GVCs and that are traded to a greater extent intra-firm. $IFT_p xTradeCredit_k$ assesses whether the effect of trade credit on trade differs if a large share of trade is intra-firm.

Detailed description of variables and their source

y_p is the year-to-year percentage change in US imports of HS6 product *p* from the second quarter of 2008 to the second quarter of 2009, i.e. $y_p=(M_{2q,2009}-M_{2q,2008})/M_{2q,2008}$. Data are obtained from the interactive tariff and trade DataWeb of the US International Trade Commission (US ITC).

IFT_p indicates the share of intra-firm trade in trade of HS6 product *p* in 2008 and is obtained from the US Census related party database.

$GVCs_p$ stands for variables measuring global value chains. A simple direct measure is a dummy for intermediate goods. A second GVCs variable captures the downstream linkages of product *p*. Downward linkages are constructed using the supplementary commodity-by-commodity table of the US BEA 2002 benchmark input-output accounts, which contains estimates of the inputs for each product that are directly and indirectly required to deliver a dollar of the product to final user. Downward linkages capture to what extent product *p* is used as input for other products and are measured as the average use of *p* as an input required to produce 1 USD across all products.[31]

$TradeCredit_k$ captures the use of trade credit by firms in 6-digit NAICS sectors. Two measures are used. $Payables_k$ proxy for open-account transactions and measures the degree to which importing firms are granted credits by their exporting counterparts. $Payables_k$ is calculated as the ratio of the debt to suppliers and contractors to turnover.

31. Using the US BEA concordance, the measures of downward and upward linkages are converted from the input-output commodity classification to the HS6 classification. If two or more input-output commodity codes correspond to one HS6 code, the measures of down- and upward linkages have been averaged using as weights the imports of the input-output commodities taken from the import matrix from the 2002 Benchmark Input-Output Accounts.

$Receivables_k$ proxies for cash-in-advance and measure the degree to which importing firms provide credit to their exporting counterparts. $Receivables_k$ is calculated as the ratio of trade receivables from clients and customers only to turnover. A drawback of these measures is that they cover not only the financing of international trade transactions, but also the financing of domestic trade transactions, i.e. the debt payable to domestic suppliers and the credit receivable from domestic customers. The trade credit variables for the United States are constructed using the OECD ORBIS database. Ratios are first computed for each firm in each year, then for each firm the median is calculated across the years 2004 to 2008. Finally, the industry measure is calculated as the median of the firm ratios if there are at least 8 firms in the respective industry.

X_k captures a set of additional control variables. To control for changes in domestic demand and prices during the crisis, data on industry shipments from US BEA annual industry accounts are used, i.e. the 2008 to 2009 changes in volumes and prices of shipments of NAICS 6-digit industries. To control for market size, the import share of the HS6 product in total imports for the period 2004-07 is included. Finally, variables for capital and skill intensity of 6-digit NAICS industries for the year 2005 are constructed using data from the NBER-CES manufacturing industry database. Capital intensity is measured as the natural log of real capital stocks per worker and skill intensity as the share of non-production workers to total workers, respectively.

Results of regression analysis

Table D.4 reports OLS regression results for model 1. The main determinant of the trade collapse was the decline in domestic demand during the economic crisis. This explanation is reflected by the positive and highly significant co-efficients of the variables measuring the volume and price changes of domestic shipments during the economic crisis. After controlling for the effect of this demand shock, products that are traded to a larger extent between related parties (IFT_p) did not experience a significantly different decline in US imports. There is some evidence that global value chains contributed to the trade collapse, but this finding depends on the variable used. While the decline in US imports was not significantly related to trade in products with strong downward linkages, intermediate goods fell more compared to final goods.

Results provide strong evidence that the vertical integration of GVCs helped stabilising trade, which follows from the significant positive co-efficients of the interaction terms between the share of intra-firm trade and downward linkages (column 2) and between the share of intra-firm trade and the intermediate goods dummy (column 4). In response to a demand shock, trade of intermediate goods may decline more than trade in final goods, but this decline will be less severe for intermediate goods that are traded to a large extent between related parties.

Table D.5 reports OLS regression results for model 2. After controlling for the decline in demand, an industries' reliance on trade credit was not significantly related to the trade collapse (*Payables* and *Receivables* in column 1 and 3 respectively). Since trade credit financing may be easier among related parties, we made the hypothesis that trade credit in conjunction with intra-firm trade could have been a stabilizing force for trade during the economic crisis. However, the insignificant interaction terms in columns 3, 4 and 5 suggest that the effect of trade credit on the decline in trade was also not dependent on the extent to which the product is traded between related parties. A last word of caution should be made regarding the interpretation of the trade credit variables, which capture an industry's reliance on trade credit given its characteristics. The trade credit variables do

not measure the availability of trade finance at the country level during the crisis and also not to which extent the availability of trade credit declined during the crisis.[32]

Table D.4. OLS regression analysis: the trade collapse, global value chains and intra-firm trade

	Dependent var: Change in US imports (%)			
	(1)	(2)	(3)	(4)
Domestic shipments: Volume change	0.656***	0.649***	0.593***	0.592***
	(0.079)	(0.079)	(0.084)	(0.082)
Domestic shipments: Price change	1.040***	1.034***	0.941***	0.953***
	(0.139)	(0.136)	(0.141)	(0.136)
Share of HS6 product in total imports	-1.374	-0.726	-3.823	-1.884
	(3.201)	(3.121)	(3.226)	(3.058)
Capital intensity	-0.024**	-0.023*	0.001	0.001
	(0.012)	(0.012)	(0.011)	(0.010)
Skilled labour intensity	-0.092	-0.087	-0.135**	-0.141**
	(0.073)	(0.073)	(0.067)	(0.062)
IFT (Intra-firm trade share, 2008)	-0.024	-0.028	-0.016	-0.139***
	(0.023)	(0.023)	(0.022)	(0.040)
Downward linkages	2.35	1.276		
	(1.598)	(1.773)		
IFTxDownward linkages		11.667***		
		(3.590)		
Intermediate goods dummy			-0.069***	-0.066***
			(0.014)	(0.013)
IFTxIntermediate goods dummy				0.191***
				(0.044)
Constant	0.134	0.12	-0.112	-0.118
	(0.136)	(0.144)	(0.128)	(0.122)
R-squared	0.083	0.087	0.09	0.095
Number of observations	4 064	4 064	4 068	4 068

Notes: The dependent variable is the percentage change in US imports of HS6 products from 2008q2 to 2009q2 (year-to-year). Variables entering interactions terms (IFT, Downward linkages) have been centered at the mean so that co-efficients of main effects can be interpreted at sample means. Standard errors clustered at the 6-digit NAICS level are reported in brackets. * significant at 10%; ** at 5%; *** at 1%.

32. Having access to quarterly data, Levchenko et al. (2010) show that the contraction in trade credit during the crisis was very small for US firms included in the Compustat database.

Table D.5. OLS regression analysis: the trade collapse, trade credit and intra-firm trade

	Dependent var: Change in US imports (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic shipments: Volume change	0.630***	0.625***	0.607***	0.608***	0.617***	0.615***
	(0.084)	(0.084)	(0.086)	(0.086)	(0.084)	(0.085)
Domestic shipments: Price change	0.846***	0.849***	0.849***	0.848***	0.855***	0.855***
	(0.127)	(0.128)	(0.130)	(0.130)	(0.125)	(0.127)
Share of HS6 product in total imports	0.07	-0.095	0.132	0.111	-0.478	-0.681
	(4.090)	(4.114)	(4.228)	(4.240)	(4.047)	(4.144)
Capital intensity	-0.019	-0.018	-0.014	-0.014	-0.020*	-0.019*
	(0.012)	(0.012)	(0.011)	(0.010)	(0.011)	(0.011)
Skilled labour intensity	-0.085	-0.082	-0.054	-0.053	-0.064	-0.062
	(0.080)	(0.080)	(0.082)	(0.083)	(0.079)	(0.081)
IFT (Intra-firm trade share, 2008)	-0.047*	-0.050**	-0.039	-0.039	-0.043*	-0.045*
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Trade credit: Payables	0.612	0.444			0.827*	0.653
	(0.402)	(0.509)			(0.446)	(0.535)
IFTxPayables		1.305				1.164
		(1.270)				(1.377)
Trade credit: Receivables			-0.251	-0.255	-0.434	-0.396
			(0.376)	(0.375)	(0.374)	(0.383)
IFTxReceivables				-0.078		-0.497
				(0.987)		(1.007)
Constant	0.057	0.053	0.04	0	0.088	0.062
	(0.136)	(0.142)	(0.123)	(0.123)	(0.126)	(0.131)
R-squared	0.076	0.076	0.075	0.075	0.077	0.077
Number of observations	3 676	3 676	3 676	3 676	3 676	3 676

Notes: The dependent variable is the percentage change in US imports of HS6 products from 2008q2 to 2009q2 (year-to-year). Variables entering interactions terms (IFT, Payables, Receivables) have been centered at the mean so that co-efficients of main effects can be interpreted at sample means. Standard errors clustered at the 6-digit NAICS level are reported in brackets. * significant at 10%; ** at 5%; *** at 1%.