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TRADE IN INTERMEDIATE GOODS AND SERVICES

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ABSTRACT

This study analyses trade flows in intermediate goods and services among OECD countries and with their main trading partners. Combining trade data and input-output tables, bilateral trade in intermediate goods and services is estimated according to the industry of origin and the using industry for the period 1995-2005. Trade in intermediate inputs takes place mostly among developed countries and represents respectively 56% and 73% of overall trade flows in goods and services. Gravity regressions indicate that in comparison to trade in final goods and services, imports of intermediates are more sensitive to trade costs and are less attracted by bilateral market size. Further findings are that the activities of multinational enterprises can be associated with higher trade flows of intermediate inputs and with a higher ratio of foreign to domestic inputs in using industries. Results from production function regressions and from a stochastic frontier analysis suggest that a higher share of imported inputs leads to productivity gains in domestic industries and reduces inefficiencies in the use of technology.

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Keywords: Trade in intermediates, intermediate inputs, parts and components, offshoring, outsourcing, fragmentation, multinational enterprises, FDI, trade and productivity, trade policy.

JEL Classification: D57; F13; F23

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TRADE IN INTERMEDIATE GOODS AND SERVICES

EXECUTIVE SUMMARY

This study finds that intermediate inputs represent 56% of goods trade and 73% of services trade. Trade flows are thus dominated by products that are not consumed but further used in the production of other goods and services. With the fragmentation of production and the increasing importance of outsourcing, trade in intermediate inputs has been steadily growing between 1995 and 2006 at an average annual growth rate of 6.2% for goods and 7% for services (in volume terms). However, trade in final goods and services has increased at the same pace and as a consequence the share of intermediate goods trade has remained constant while the share of intermediate services trade has slightly increased.

To measure trade in intermediates, two methodologies can be applied: the first one relies on a breakdown of disaggregated trade flows at the product level where they can be distinguished according to their use. The United Nations Broad Economic Categories (BEC) classification enables such a treatment of trade data in the case of goods. Another method is based on Input-Output tables that provide directly in their import tables the value of foreign inputs used in the production of domestic goods and services. Both methods have their strengths and weaknesses and the choice made in this study is to combine them in order to create a database on trade in intermediate goods and services for the period 1995-2005. In addition to including very recent data, the novelty of this dataset is that it covers both goods and services and is organised around five dimensions detailing trade flows of intermediates: (i) by reporter country; (ii) by partner country; (iii) by product (at the SITC 5-digit level for goods and according to EBOPS categories for services); (iv) by using industry (based on a classification of 29 sectors derived from ISIC rev. 3) and (v) by year.

This dataset provides some insights on the patterns of trade in intermediate goods and services. This trade is primarily among OECD countries. Very few inputs are sourced from outside OECD and when including accession countries and enhanced engagement economies about 85% of trade flows are accounted for. Asia trades relatively more manufacturing intermediates while North America and Europe trade more services inputs while being also important exporters and importers of intermediate goods. Intra-regional trade (within Asia, Europe and North America) is also more important than inter-regional trade.

A quantitative analysis of the determinants of trade in intermediates as opposed to trade in final goods and services reveals several characteristics of inputs trade. First, intermediate inputs are more sensitive to trade costs, i.e. the impact of distance on trade flows of intermediates is higher than on trade flows of consumption goods or total services trade. Because intermediates are less subject to a “home bias” or to consumers’ preferences, the price-elasticity of their demand tends to be higher and firms switch easily from one supplier to another. Some inputs are also of a bulky nature and are less easily traded across long distances (e.g., raw material inputs). Another characteristic is that the size of the market has a smaller impact on trade than in the case of goods and services destined for final consumption. Despite these

specificities, trade in intermediates responds to the same economic determinants as trade in final goods or services.

Further analysing what determines the choice of foreign inputs over domestic inputs, the role of high trade costs in discouraging imports of inputs is highlighted, not only specific trade costs for intermediates but more generally the impact of overall trade costs. Activities of Multinational Enterprises (MNEs), through foreign investment or sales of foreign affiliates in services sectors, are associated with higher trade flows of intermediate inputs and a higher ratio in the use of foreign inputs over domestic inputs. Not only inward FDI and sales of foreign affiliates encourage imports of intermediates (from the parent company or its network of suppliers) but also outward stocks and sales of foreign affiliates promote imports of intermediates, highlighting the importance of vertical specialisation networks.

There is evidence that higher trade flows of intermediates lead to productivity gains or at least are correlated with higher productivity. Through an analysis at the country and industry level (29 industries in 11 OECD countries), it can be shown that the impact of trade in intermediates on productivity is twofold. First, there is some evidence that trade in intermediate goods and services can have a positive impact on the total factor productivity of industries. This can be explained by the fact that foreign inputs embody the foreign technology (and are bought when this technology is more productive than the one embodied in domestic inputs). Furthermore, an analysis distinguishing between technological change and efficiency change also gives support to the thesis of a positive impact of trade in intermediates on the reduction of inefficiency.

While important changes have occurred in world production in terms of unbundling, rise of outsourcing, offshoring and vertical specialisation, trade data on intermediates give a more balanced and nuanced picture of what is happening. New sourcing strategies of MNEs have not fundamentally altered trade patterns. The ratio of intermediate to final goods trade has not changed over the past years implying that trade in intermediates increases at the same pace like trade in final goods. Hence, when the production of inputs is outsourced and intermediates are imported rather than being domestically produced, countries will specialise more in the production of certain inputs and export these then to a greater extent. Trade in intermediates has globally improved the productivity of the world economy without increasing as a percentage of total trade. We observe however an important increase in FDI relatively to trade.

Bearing in mind the specificities of trade in intermediates and in particular their higher sensitivity to trade costs, including both transport costs and trade barriers, a higher degree of trade liberalisation is required for countries wishing to promote trade in intermediates and the integration in global production networks. It is however important to avoid any tariff escalation and trade liberalisation should be uniform among goods at different stages of processing. Complementarities with FDI and sales of foreign affiliates suggest that investment liberalisation (including in services sectors) should be part of a policy focusing on intermediates trade. Regional initiatives and agreements are relevant as trade in intermediates is mainly intra-regional but this should not add extra costs for third countries in which final consumers or other users of inputs might be found.

For developing countries and emerging economies, trade in intermediates is often a first step onto world markets. Emerging economies are more specialised in the production of intermediate inputs than OECD countries and for them trade in intermediates can be seen as a means of integrating into the world economy. Barriers to imports of intermediates in the context of observed pressure for new protectionist policies would be particularly detrimental not only for developing countries but for the industrialised world as a whole due to the important linkages between industries in different countries resulting from the complex sourcing strategies of firms.

I. Introduction: the international dimension of the exchange of intermediate inputs

1. Trade in intermediate inputs has been steadily growing over the last decade. However, despite the internationalisation of production and the increasing importance of outsourcing and foreign investment, some studies have found little rise in intermediate goods trade as a share of total trade[1]. More than half of goods trade is however made up of intermediate inputs and trade in services is even more of an intermediate type with about three quarters of trade flows being comprised of intermediate services. Trade in intermediate goods and services thus deserves special attention from trade policymakers and so far few studies have investigated how it differs from trade in consumption goods or services[2].

2. An intermediate good can be defined as *an input to the production process that has itself been produced and, unlike capital, is used up in production*[3]. The difference between intermediate and capital goods lies in the latter entering as a fixed asset in the production process. Like any primary factor (such as labour, land, or natural resources) capital is *used* but not *used up* in the production process[4]. On the contrary, an intermediate good is used, often transformed, and incorporated in the final output. As an input, an intermediate good *has itself been produced* and is hence defined in contrast to a primary input. As an output, an intermediate good is used to produce other goods (or services) contrary to a final good which is consumed and can be referred to as a "consumption good".

3. Intermediate inputs are not restricted to material goods; they can also consist of services. The latter can be potentially used as an input to any sector of the economy; that is for the production of the same, or other services, as well as manufacturing goods. Symmetrically, manufacturing goods can be potentially used to produce the same, or other manufacturing goods, as well as services.

4. An important question we can ask is how to identify inputs among all goods and services produced in an economy. Many types of goods can be easily distinguished as inputs, when their use excludes them from final consumption. Notable examples include chemical substances, construction materials, or business services. The exact same type of good used as an input to some production process can however be destined to consumption. For instance, oranges can be sold to households as a final good, as well as to a factory as an input for food preparation. Telecommunication services can be sold to individuals or to business services firms as an intermediate input for their output. The United Nations distinguish commodities in each basic heading on the basis of the *main* end-use (United Nations, 2007). It is however recognized that many commodities that are traded internationally may be put to a variety of uses. Other methodologies involve the use of input-output (I-O) tables to distinguish between intermediate and consumption goods.

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1. See for example Chen *et al.* (2005). Trade in all types of goods (intermediate and final) has been growing at a faster pace than output in the last decade but the share of trade in intermediate goods in total trade does not show any significant increase. Table 6 in Annex 2 provides statistics on the growth rate of trade in intermediates in OECD countries and confirms this result.

2. A recent contribution to the detailed analysis of trade flows in intermediate goods is Egger and Bergstrand (2008). The authors note that "because of a well-known absence of any comprehensive data set decomposing world trade flows by end-use –that is, final versus intermediate goods- economists have little systematic knowledge about the actual pattern of flows of final versus intermediate goods around the world". A recent paper by Johnson and Noguera (2009) addresses this issue by linking trade in intermediates to production sharing and to trade in value added.

3. Definition provided by Deardorff (2006) in his *Glossary of International Economics*.

4. Capital may however deteriorate and depreciate with use due to usage, passage of time or technological obsolescence.

5. The importance of intermediate goods and services in the economy and trade is associated with a number of developments in the last decades. Growth and increased sophistication of production has given birth to strategies involving fragmentation and reorganisation of firm's activities, both in terms of ownership boundaries, as in terms of the location for production. In what follows, the international dimension of the exchange of intermediate goods and services is explored by clarifying terms and concepts as well as the links between trade in intermediate inputs and FDI.

Sourcing strategies

6. Some of the most fundamental decisions producers of final goods have to make concern organisational forms. In order to operate, firms make choices on (i) locations for the production of intermediate inputs and on the (ii) ownership structure of their production. Headquarters are always located in the so-called 'home country'. Intermediate inputs on the other hand, can be produced at home, or in a foreign country. The production of intermediates can also be owned by the final-good producer or by an independent supplier. In other words, inputs can be produced and used within the same firm; or produced by one firm, and then sold to and used by another one. Trade is recorded when the good-in-process crosses international borders, but data does not distinguish between in-house (intra-firm) and arm's length (inter-firm) transactions.

7. 'Sourcing' is a term that has been used in different ways in the economic literature. In this paper we adopt the use of sourcing in a dynamic context; that is, as an indicator of a *change* in the supply of intermediate inputs to the production process of a firm[5].

Box 1. The internationalisation of the supply of inputs: a typology

Global sourcing: the production of an input previously assigned to an external specialised supplier in the domestic market, is now assigned to a specialised foreign supplier based abroad. The boundaries of the firm buying the input are not altered with such a development. The only change we observe is in the location of the external supplier.

International outsourcing: the production of an input previously held within the boundaries of the firm in the domestic market, is now assigned to a specialised foreign firm abroad. The production of the input has been moved from within the firm to an independent external supplier abroad.

Offshoring: the production of an input previously held within the boundaries of the firm in the domestic market, is now assigned to an affiliated firm abroad. Offshoring of inputs involves only a change in the geographic location but not in the firm's boundaries.

8. Following the previous analysis, the input supply can change with respect to two factors: (i) the boundaries of the firm and (ii) the location of production. The term 'out' refers to a change in the boundaries of the firm, that is an assignment of the production of intermediate inputs to an independent supplier, outside the firm. The term 'in' (as in 'insourcing') is symmetrically used to indicate the opposite

5 . The same terminology has been used in Kleinert (2003), Bhagwati (2004) as well as others, applying however the concept only to services. Marin (2006) distinguishes between 'offshoring' and 'international outsourcing'. The author defines 'international outsourcing' as the relocation of activity outside the firm to an independent input supplier. Offshoring is defined as a relocation of activity abroad, which however remains inside the firm. In the literature the term 'sourcing' has also been used as an indicator of the *static nature* of the supply of intermediate inputs. For instance, the way we define it, 'international outsourcing' indicates a change (from intra-firm domestic supply, to arm's length international supply). In a non-dynamic context, the term could simply refer to the status of the outcome that is just 'arm's length' (inter-firm) international supply, without designating any change.

movement: a firm starting to produce its own inputs, previously bought from external sources. None of the two cases of sourcing excludes the option of the traded goods crossing borders. An intermediate input produced and used by the same firm could cross borders when the firm owns several establishments at different locations internationally, each specialised in some part of the production process. In order to incorporate the location of production in our terminology, we thus distinguish between 'domestic sourcing', standing for a change in the supply of intermediate inputs inside the domestic country, and 'international' referring to the same change but across borders.

9. The most complex change involves an adjustment in both factors: that is the case of '*international outsourcing*', where the production of an input previously held within the boundaries of the firm in the domestic market, is now assigned to a specialised firm in another country. The production of the input has been moved from within the firm to an independent external supplier. A smaller degree of complexity involves the switch from an outside supplier within the domestic country, to an international supplier: that is the case of '*global sourcing*'. The boundaries of the firm buying the input are not altered with such a development. The only change we observe is in the location of the external supplier.

Table 1. Sourcing strategies: interactions between location and ownership

Columns indicate the location of production and rows indicate the boundaries of the firm. Vertical arrows represent a change in the boundaries of the firm. Horizontal arrows represent a change in the location of production. Dashed lines correspond to vertical FDI.

	Domestic country	**Foreign country**
Production of the input inside the firm	Offshoring; International Outsourcing; Domestic Outsourcing; Vertical Integration abroad	
Production of the input outside the firm	International Insourcing; Global Sourcing	

10. Table 1 summarises changes in firms' choices on the location and ownership pattern of production of intermediate goods while Box 2 provides some examples of the strategies described. Foreign investment occurs, in general, in a horizontal or a vertical form; the former referring to a replication of the entire production facilities in a foreign country to serve domestic consumers, and the latter to the relocation of part of the firm's facilities abroad focusing on segments of the production process. There are three cases of changes in the supply of intermediate inputs involving vertical FDI: in particular (i) when there is fragmentation and relocation of parts of the production chain abroad, without altering the boundaries of the firm ('*offshoring*') (ii) after a decision to stop buying inputs domestically and produce them through an

affiliate abroad, in which case the boundaries of the firm are altered ('*international insourcing*') (iii) after a decision to acquire an international supplier ('*vertical integration*' abroad). All three developments involve movement of capital to a foreign country, that is FDI.

Incentives to reorganise production

11. Growth and increased sophistication of production have been the main driving forces for reorganising the production process. Firms are constantly exposed to new opportunities for cutting costs and increasing their productivity by altering their boundaries, and focusing solely on the activities of their comparative advantage. Intermediate inputs they need can be provided by external sources. High integration of the world economy creates furthermore opportunities arising from cross-country differences in factors of production.

Box 2. Global sourcing, international outsourcing and vertical integration: some examples

The distinction between 'international outsourcing' and 'global sourcing' is made on the basis of the *initial* organisation structure of the enterprise. In the first case, the firm was producing an input within its own boundaries, while in the second case the input is supplied by an external supplier within the same country. While the automotive industry has been more vertically integrated in the past, e.g. in the US the auto part supplier Delphi Corporation has started out as a unit of General Motors, nowadays it offers a good example of 'global sourcing'. Because of the degree of complexity of the final product, the automotive industry typically relies on external suppliers of inputs. Their multi-layered production systems involve thousands of firms, including parents, subsidiaries and subcontractors, initially located inside the domestic country. It can hence be used to illustrate 'global sourcing 'as opposed to 'international outsourcing'. The average Japanese automaker's production system comprises 170 first-tier, 4,700 second-tier, and 31,600 third-tier subcontractors. Japanese automobile manufacturers actually reconstituted many aspects of their home-country supplier networks in North America.

On the other hand, the apparel industry offers a classic example of 'international outsourcing' since the degree of complexity of the final product is lower than cars. Initially firms engaged both in the production and the design and marketing of final output. Feenstra (1998) points that apparel products are being imported into the United States at increasingly advanced stages of processing, which suggests that US firms may have been substituting away from these processing activities at home. According to US customs data, retailers such as *JC Penney, Walmart, The Limited, Kmart* and *Sears* account for 48% of the value of apparel imports; another 22% go to apparel designers such as Liz Claiborne, Donna Karan, Calvin Klein and Ralph Lauren; while domestic producers make up an additional 20% of the total. Most clothing companies design the products in one location, manufacture it at a different one, and hire an advertising agency to sell it in stores. There are however, notable examples of enterprises following the opposite strategy. *American Apparel* is a USD 250 million, 5,000-employee for-profit company, growing in the youth fashion market. The company's approach is that more efficiency can be achieved without outsourcing. On the other hand, the US based *Nike* provides an example of the 'international outsourcing' strategy: it subcontracts most of its manufacturing to independent producers in Thailand, Indonesia, Cambodia, and Vietnam.

Standard examples of vertical integration revolve around large MNEs such as *Intel Corporation.* The firm provides an example of the 'offshoring' strategy: it assembles most of its microchips in wholly owned subsidiaries in China, Costa Rica, Malaysia, and the Philippines. Oil companies, both multinational (such as the US *ExxonMobil*, the Netherlands-based *Royal Dutch Shell*, or *British Petroleum,* and the Malaysian *Petronas*) often adopt a vertically integrated structure. This means that they become active all the way along the supply chain from locating crude oil deposits, drilling and extracting crude, transporting it around the world, refining it into petroleum products such as petrol/gasoline, to distributing the fuel to company-owned retail stations, where it is sold to consumers.

*Source*s: Antràs and Helpman (2004); Hill et al. (1989); Florida and Kenney (1991); Feenstra (1998); Gereffi (1999).

12. While the process of outsourcing seems intuitively justified by the principle of comparative advantage, the opposite shift of insourcing (vertical integration) could prove profitable in terms of productivity as well as market structure. In particular, the motivation for vertical integration could be two-fold: (i) to exploit a productivity advantage of an upstream firm at some stage of the production process,

while (ii) eliminating oligopolistic distortions in vertical transactions (see Box 3 for a description of vertical integration and the price of the final good).

Box 3. Vertical integration and the price of the final good

Integrated companies are united under a structure of common ownership. Further to that structure, *vertically* integrated firms specialise at a different stage of a production process yielding one common final good. The term is contrasted with horizontally integrated firms, producing different final goods under a structure of common ownership. For instance, vertical Integration occurs when a firm previously using inputs bought from an external source, acquires its supplier, or the opposite (if the supplier acquires the buyer). The process can take place domestically or internationally, and is directly associated with in-sourcing, that is an expansion of the boundaries of the firm. Furthermore, integration occurring abroad corresponds to vertical FDI with fragmented production facilities. That type of integration offers a number of advantages to firms, among which a solution to the so-called 'double marginalisation' problem.

In particular, double marginalisation occurs when we have multiple *imperfectly* competitive firms in a vertical relationship. The problem arises from the exercise of market power at successive vertical layers in a supply chain. Suppose that all firms in a vertical relationship are monopolists. Each firm buys an input, transforms and sells it to the next one in the sequence. Due to their monopoly power, each firm adds a mark-up over the competitive price of its output in order to maximize its own profits. The good-in-process becomes more and more expensive as it goes through the production chain, with the risk of being too expensive when it reaches its final customers. In that case, final quantity demanded might be eliminated making losses for all firms in the chain. The sequence of mark-ups leads to a higher price for final goods and lower combined profit for the supply chain than would arise if the firms were vertically integrated. Consider what would happen if the firms integrated into one. The new firm would now face the same final demand curve, but at an equilibrium price significantly lower without the addition of internal mark-ups. Consumers would pay less and consume more. Producers symmetrically would sell more in total, and would earn more profits.

13. Motivations for vertical integration across borders can be of the same nature as in domestic in-sourcing: gain possession of productivity advantages of an upstream foreign firm, while eliminating oligopolistic distortions in vertical international transactions. The source of productivity advantages in the case of international insourcing are however expected to be more related to a country's instead of a firm's characteristics. The principle is clearer in both the cases where the firm relocates part of its production facilities abroad ('international insourcing' or 'offshoring'). The new facilities by default cannot possess technology advantages with respect to the rest of the firm. The exploitation of country-specific characteristics such as market resources and price differences in factors of production, justify the transfer entirely.

14. The choice between vertical integration and outsourcing is also driven by the hold-up problem arising from the specificity of intermediate inputs and incomplete contracts (see Helpman, 2006, and World Trade Report 2008 for literature reviews). If the supplier of intermediate inputs has to make a relationship-specific investment and if contracts are not enforceable, the final goods producer may hold-up the supplier at the time of delivery offering a lower price than foreseen by the contract. However, the supplier may anticipate this behaviour and, as a result, will underinvest in the production of intermediate inputs. If integration alleviates the hold-up problem, a firm will prefer integration to outsourcing if the hold-up problem is strong

15. However, the hold-up problem might persist also in a vertically integrated firm. In such a case, the choice between integration and outsourcing depends on the relative investment made by the supplier and the final goods producer. Assume that the production of a final good requires headquarter services and components with the former being produced by the final goods firm and the latter by the supplier. The decision of whether to produce the component within or outside the firms depends on the intensity in headquarters services relative to components. A firm will choose integration if its production is headquarter intensive and outsourcing if its production depends heavily on the investment in components

made by the supplier. The intuition is that outsourcing implies a transfer of bargaining power to the supplier and hence reduces the underinvestment problem. In his seminal paper Antras (2003) models headquarter services as being capital intensive and components as being labour intensive. As a result, industries with integrated firms are capital intensive, while industries with many outsourcing firms are labour intensive. The model predicts that there will be more intra-firm trade in capital-intensive industries and more arm's length trade in labour intensive industries. Furthermore, Antras (2003) shows that the share of intra-firm trade in total U.S. trade is positively correlated with the capital abundance of the exporting country.

16. Vertical FDI can be associated directly with three types of sourcing; in particular, offshoring, international insourcing, and vertical integration abroad (see the dashed lines in Table 1). Any choice to transfer, replicate or fragment production facilities using FDI will be associated with (or have an impact on) the location for the production of intermediate inputs used by the firm.

17. The first question to answer is how the decision to invest affects the *direction* of trade in inputs between countries. Investment by definition involves new production facilities for the firm, at a new location abroad. The facilities can be created or acquired. Moreover, they can cover the entire production process, or a part of it.

18. Firms have links with certain suppliers at their home country, and by engaging in FDI they have to choose suppliers for their new facilities. Changing suppliers incurs an additional switching cost, but potentially involves also an extra benefit from the choice of more competitive partners. Therefore, we could assume that (i) it pays off for the firm to supply its new facilities with inputs from the *same* suppliers it was using before. This assumption is based on the additional switching cost outweighing the benefit from the choice of more competitive partners. If this positive 'network effect' of multinational enterprises[6] holds, the impact on intermediate goods flows is ambiguous: new flows of goods can be created to the new facilities; or the former flows from abroad can be replaced with flows from inside the foreign country. In the opposite case where this effect does not hold (ii) it pays off for the firm to supply its new facilities with inputs from *different* suppliers than the ones it was using before. In that second case, the volume and direction of new flows cannot be predicted.

19. Summarising, FDI cannot only generate new directions for existing trade flows in intermediate goods; it can also create trade, which did not exist at all beforehand. Certain types of FDI can also act in the opposite direction, substituting for trade in intermediate goods and services.

20. While the foreign investment decision is likely to affect patterns of trade in intermediates, the relationship can also work in the opposite way. Trade decisions can have an impact on the pattern of FDI. For instance, if there is a change in exogenous factors favouring trade in intermediates, e.g. a tariff reduction, firms will trade more intermediates and consequently may alter their FDI strategies. Any sourcing decision associated with a change in the intermediate goods and services trade can have an impact on the productivity advantage of a firm relative to its rivals, based on technology, resources or location of production. A change in sourcing strategies can enhance competition, stimulates sales and impacts heavily on the price of the good or service traded.

6 . The effect has also appeared in the theoretical literature as the 'MNE network hypothesis' (see Kleinert, 2003).

Box 4. Examples of outsourcing strategies in services

In 2001, the German firm *Siemens Business Services* made revenue of 6 billion Euros and employed 36,200 employees. The company engaged in different types of outsourcing ranked by degree of complexity: selective outsourcing; full information and communications outsourcing; transitional outsourcing; business process outsourcing; or responsibility for total customer process. The company provides services to major international customers like *AMCOR* (operating in 36 countries), or *NS&L* based in the United States. Referring to our diagram in Table 1, these activities would be considered 'international outsourcing' from the rest of the world to Germany.

Examples of 'domestic outsourcing' are equally common in developed countries. In a different sector, we can refer to *Siemens IT solution* operating under the same principle of assuming responsibility for Information Technology networks at different companies. Its latest partnership was established recently with *Ernst Klett AG,* one of the largest publishers in Germany. Beginning January 2009, the latter will outsource IT services for the service desk, networks, desktop services and take over server services to Siemens. The case is considered 'domestic outsourcing' since both companies are based in Germany. Another similar partnership was established with the international construction service provider *Hochtief*, for Germany, Austria and Luxembourg.

Human Resources is another case of a services sector where outsourcing is widespread. Due to the particularity of the service provided, the sector could be expected more to involve 'domestic' rather than 'international' or 'global outsourcing'. There are examples of companies showing the opposite. The Illinois-based *Hewitt Associates* is one of the world's largest providers of human resources outsourcing and consulting services. The company administers human resources, health care, payroll and retirement programs on behalf of 350 companies to millions of employees and retirees worldwide. Located in 35 countries, Hewitt employs approximately 22,000 associates.

It is interesting to note that such intermediate services can be equally used by firms operating at very different industries. AMCOR, Ernst Klett AG, Hochtief are characteristic examples of the diversity of clientele engaging in outsourcing.

Source: Siemens, Hewitt Associates, AMCOR, NS&L.

21. The rest of the study is organised as follows. Part II gives a brief overview of the methodology used to estimate trade flows of intermediate goods and services and discusses some of the issues involved. Part III captures the stylised facts of trade in intermediate goods and services as they emerge from the dataset created for this study. In Part IV an econometric analysis is conducted to analyse the determinants of trade in intermediates, how it differs from trade in consumption goods or services and to shed light on the trends identified in Part III. Part V concludes and looks at the trade policy implications of the analysis.

Box 5. Firm level studies on trade in intermediates and sourcing strategies

Studies using firm level data have found that multinational enterprises (MNEs) account for a large share of trade flows but at least for the case of U.S. multinationals the overall share of trade due to MNEs has not increased in recent years[1]. Furthermore, studies find that the operational strategies of firms are often rather complex involving both horizontal and vertical motivations. Regarding the choice of how to source intermediate inputs, studies find that vertical FDI, i.e. offshoring, international insourcing or vertical integration, is a major sourcing strategy for MNEs which occurs not only between developed and developing countries but also to a large extent between developed countries. However, this does not imply that the sourcing through an external supplier, i.e. international outsourcing or global sourcing is less important.

Mataloni and Yorgason (2006) describe the main results from the 2004 benchmark survey on the operations of U.S. MNEs conducted by the Bureau of Economic Analysis. Exports of MNEs account for a large share in total U.S. exports but it has declined over time from 67% in 1994 to 52% in 2004. U.S. exports to majority owned foreign affiliates consisted mainly of intermediates in the sense that exports were intended for further manufacture. In 2004 in manufacturing 117,783 Million USD or 94% of overall US exports to majority owned affiliates consisted of intermediates intended for further manufacture.

Feinberg and Keane (2006) analyse the growth in trade of multinational enterprises by using data on U.S. multinationals for the period 1983 to 1996. They point out that the sourcing strategies of U.S. parents and their Canadian affiliates are rather complex. Only few firms can be identified as purely horizontal (12%) or vertical (19%), while most firms follow more complex strategies (69%) involving intermediates trade flows in both directions between affiliate and parent firm. These bi-directional trade flows involve not only intra-firm trade but also arm's-length trade for 39% of firm pairs (U.S. parent – Canada affiliate).

Marin (2006) finds a considerable amount of offshoring investment from Austrian and German firms to affiliates in Eastern European countries. By comparing investment data from a firm level survey with overall FDI data, she estimates that about 45% of German investment to Eastern Europe in the period 1996 to 2000 was offshoring investment in the sense that the parent firm exported intermediate inputs to its Eastern European affiliate and then imported processed goods back. Furthermore, Marin also estimates the share of intra-firm trade as a percentage of total trade with Eastern Europe. On average, 12% of German exports to Eastern European countries are intra-firm, while the respective share of intra-firm imports is 22%.

Alfaro and Charlton (2008) combine firm level data from the WorldBase dataset of Dun and Bradstreet with input-output tables of the United States in order to distinguish horizontal and vertical subsidiaries. Consistent with industry level data they find that most of FDI is between developed countries. However, in contrast to traditional views, they find a large amount of vertical FDI activity not only between developed and developing countries but also within developed countries. In their dataset they identify 112,939 vertical, 104,057 horizontal and 50,000 complex subsidiaries, with the latter combining both vertical and horizontal characteristics. Alfaro and Charlton argue that firms source inputs that require high skills and are used in later stages of production through vertical FDI, i.e. through offshoring, international insourcing or international vertical integration; and inputs that rely on lower skills and are used more at the beginning of the production chain through arms-length transaction, i.e. through international outsourcing or global sourcing. Hence, instead of engaging in international outsourcing, parent firms tend to keep production stages which are very close to their own, i.e. firms tend to keep core activities at the upper end of the production chain within the boundaries of the firm.

1. This development may be different for emerging economies, where many new MNEs came into being in recent years (for the case of China see for instance Boie and Gugler, 2009).

II. Methodology used to assess trade in intermediate goods and services

22. For the analysis of trade in intermediates at the industry level, combining trade statistics with information from input-output (I-O) tables offers two advantages. First, it allows for the estimation of bilateral trade in intermediate services. Contrary to trade in goods, no classification exists for trade in services that allows the breakdown into final and intermediate services. Second, trade in intermediate goods and services can be assessed by both the industry of origin and the using industry.

23. Sources for trade data are the OECD International Trade by Commodity Statistics (ITCS) database for goods and the OECD Trade in Services by Partner Country database as well as the United Nations Service Trade Statistics Database for services. I-O tables are taken from the 2009 edition of the OECD I-O database. In the following, the characteristics in measuring trade in intermediates of both trade statistics and I-O tables are described. Thereafter, the methodology for combining trade data with imported input shares from I-O tables is shortly explained. All technical details and related issues are outlined in Annex 1[7].

Trade in intermediates in trade statistics

24. Trade in intermediate goods is assessed using the United Nation's Broad Economic Categories (BEC) classification. The BEC classification groups commodities according to their main end use into capital goods, intermediate goods and consumption goods, which are the three basic classes of goods in the System of National Accounts (SNA)[8]. The traded commodities themselves are defined in terms of the Standard International Trade Classification, Revision 3 (SITC Rev.3). Hence, BEC assigns SITC Rev.3 commodities to 19 basic categories of goods, eight of which are categories of intermediate goods (see Table 2 in Annex 1).

25. An unavoidable drawback of BEC is that the allocation of commodities according to their main use is based on expert judgment, which is by nature subjective. Many goods might be both final and intermediate depending on the context. For instance, wheat flour belongs to BEC 121 - Processed food and beverages mainly for industry - and is hence classified as intermediate. Despite being an important input for the food industry, flour is also a consumption good for many households.

26. In a recent study, Bergstrand and Egger (2008) use the BEC classification to capture trade in intermediate goods. While describing trade patterns for intermediates between 1990 and 2000, the focus of their study is on the growth of FDI relative to trade. A similar approach has been taken by Yeats (2001). He provides his own breakdown of the SITC classification into final and intermediate goods in order to assess trade in parts and components.

27. The advantage of trade data as compared to I-O tables is that it allows for the analysis of bilateral trade patterns in intermediate goods at a highly disaggregated level. However, two weaknesses in trade statistics constrain the analysis of trade in intermediates. First, trade data are collected according to the industry of origin and give therefore no indication of the using industry, i.e. the industry that is actually using the intermediate input in its production process. Intermediate goods and services are to a large extent not only used within the same industry at higher stages of the production chain, but also as by other industries. For instance, steel from the steel industry is used as an intermediate input in the motor vehicles industry. Similarly, if a car firm seeks advice from external business consultants on how best to sustain a negative shock in consumer demand, they acquire intermediate business services.

7 . In this study, the words intermediate and input are used as synonyms. The term intermediate is more often used when speaking about trade data and the term input is frequent in the nomenclature of I-O tables.

8 . See UN (2007).

28. Second, while the BEC classification enables the identification of intermediate goods, no similar classification is available for trade in services. The reason for this is the high level of aggregation in services trade data. For instance, the EBOPS category for telecommunication services does not distinguish between private and business calls. Furthermore, while goods trade data are based on customs declarations allowing the identification of goods at a highly disaggregated level, services trade data are based on a variety of information such as business accounts, administrative sources, surveys, and estimation techniques (Manual on Statistics of International Trade in Services, 2002).

29. A related point is that for services as compared to goods it might be even more difficult to identify intermediate and final use. However, some services categories do probably consist mostly of intermediate services, such as 'reinsurance services' (EBOPS 257) or 'business and management consulting and public opinion polling' (EBOPS 278). Unfortunately, the weak country coverage prevents the identification and analysis of intermediate services at this level of aggregation. For instance, in the case of reinsurance services, data is available for only 15 OECD countries and a large share of trade is not allocated to partner countries. Annex 1 explains how the information from I-O tables can help to decompose bilateral trade in services into final and intermediate services trade.

Trade in intermediates in input-output tables

30. Country I-O tables are presented in matrix format and contain information about the use of intermediate goods and services as inputs in different industries. In particular, they show how much of the output of one industry is used as an input by another industry. Furthermore, I-O tables generally consist of a domestic and an import table indicating the use of domestic and imported inputs respectively. The strength of I-O tables, as compared to trade data, is that they allow the identification of both the industry of origin and the using industry. Hence, I-O tables contain information on the share of imports from industry *p* used as input in industry *k*. However, I-O tables are not bilateral, that is they do not reveal any information regarding trade partners[9].

31. Table 3 in Annex 1 gives an overview of the year and country coverage of OECD I-O tables[10]. The data covers 39 countries and different years from 1993 to 2005. I-O tables are typically released every five years, so that for many countries three tables are available, i.e. 1995, 2000 and 2005. One reason for this time interval between publications is that I-O tables describe the structure of the economy. Their coefficients are therefore not subject to large fluctuations across years as are trade flows for instance. In order to obtain data for missing years, import coefficients are interpolated[11].

32. While OECD I-O tables cover 48 industries in their original format, many countries actually report fewer industries (see Yamano and Ahmad, 2006). In order to ensure the comparability of countries in the analysis, some industries are aggregated[12]. Table 4 in Annex 1 shows the 29 goods and services

9 . Notable exceptions are the US-Japan bilateral Input-Output tables from the Japanese Ministry of Economy and Trade and Industry and the database from the Japanese Institute of Developing Economies (IDE-Jetro), which has constructed international I-O tables for USA and Asian countries incorporating bilateral trade flows. Furthermore, there are currently initiatives to develop international I-O tables for a larger set of countries.

10. Yamano and Ahmad (2006) describe the construction and coverage of OECD I-O tables. Furthermore, they provide details on country specificities regarding the aggregation of industries in tables.

11 . Data are interpolated up to for four years and extrapolated for no more than three years with the same value as in the last table available (the oldest and the most recent).

12 A further reason for aggregation of some industries is the limited availability of FDI and FATS data that are used in the analysis presented in Section IV.

industries used in this study, including their correspondences in terms of original I-O industries and underlying ISIC Rev.3 categories.

Combining trade data with I-O tables

33. The advantage of combining trade data and I-O tables is that the dimension of the using industry *k* is added to the trade data. Hence, imports of intermediate goods and services will have five dimensions: importer *i*, exporter *j,* industry of origin *p*, using industry *k* and year *t*. This is achieved by multiplying bilateral imports of *p* (as measured by trade data) by the share of imported intermediates *p* that is used as input in industry *k* (obtained from I-O tables). In Annex 1 the methodology and its underlying assumptions are outlined in more detail. The Annex also describes the slightly different methodology used for services, necessitated by the fact that services trade data do not distinguish between final and intermediate use. It furthermore explains how trade data have been converted from product classifications (EBOPS for services, SITC Rev.3 for goods) to the ISIC Rev.3 based industry classification used in I-O tables.

III. The stylised facts of trade in intermediate goods and services

34. In this section, we describe trade in intermediate goods and services as revealed by the dataset that was created along the lines presented in the previous section. Descriptive statistics regarding imports of intermediate goods and services are presented in Annex 2. While tables involving services trade required both information from trade statistics and from I-O tables, data regarding trade in intermediate goods are based entirely on trade data. Apart from capturing the most recent statistics released by OECD Members and associated countries, this dataset is quite unique as it identifies trade in intermediate goods and services broken down by: (i) reporting country; (ii) partner country; (iii) product; (iv) using industry; and (v) year.

Trade in intermediates has increased but its share in total trade has remained constant

35. Trade in intermediates represents 56.2% of trade in goods and 73.2% of trade in services in OECD countries[13]. World trade flows are mainly comprised of inputs rather than final consumption goods or services. Taking into account capital goods, which represent 17% of total trade in goods, it is interesting to see that the share of consumption goods is, at 21%, rather low. Services that are not intermediate inputs account for about 27% of total trade in services.

36. The growth rate of trade in intermediates has been significant over the last decade in OECD countries. For goods, the average annual growth rate between 1995 and 2006 has been 6.2% (in volume), a rate higher than output growth. For cross-border trade in services, a slightly higher average growth rate (7%) is observed over the period 1999-2005[14]. There is no marked difference in the growth rates of the different categories of goods (intermediate, consumption, capital goods). They have been following the general increase in total trade. The story is different for services with a higher growth rate for intermediate services as opposed to final services.

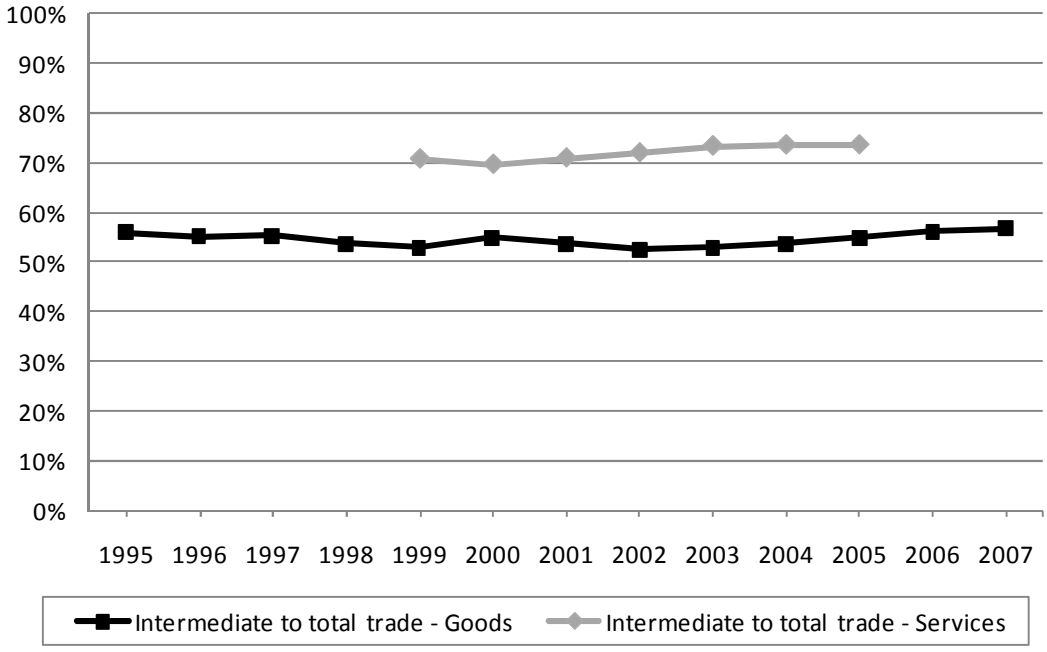
13 . Table 6 in Annex 2 includes detailed statistics for OECD countries, as well as accession and enhanced engagement economies. The figures presented in this section are calculated on the basis of imports (for which we have data for both services and goods). Exports of goods are also included in the dataset and figures would be similar for exports as the dataset covers all trade flows.

14 . For services, trade statistics are less readily available and figures presented in this section are for some countries between 1999 and the latest year available. When calculating OECD averages for 2005, trade flows of 2003 or 2004 have been used for countries missing data for 2005. Also, it should be noted that cross-border trade in services is analysed here. In section IV, the quantitative analysis is also based on FDI stocks and Foreign Affiliate Trade in Services (FATS) data.

37. As a consequence, the share of trade in intermediates in total trade has remained largely unchanged (see Figure 1). We explore in the next section the reasons and consequences of this unchanged ratio and how it can be understood in a decade characterised by globalisation, outsourcing and the fragmentation of world production. But at the outset of the analysis, it should be highlighted that an apparent explanation to this paradox is that both trade in final and intermediate goods has been boosted by the internationalisation of production.

38. In the case of services sectors, there is a slight difference between the growth rate of total trade and trade in intermediates leading to an increase of the share of intermediate services traded. But this trend needs to be confirmed as the variation is very small. It suggests, however, that outsourcing in services has indeed increased[15].

Figure 1. Share of intermediate trade in total trade for OECD countries (1995-2007)



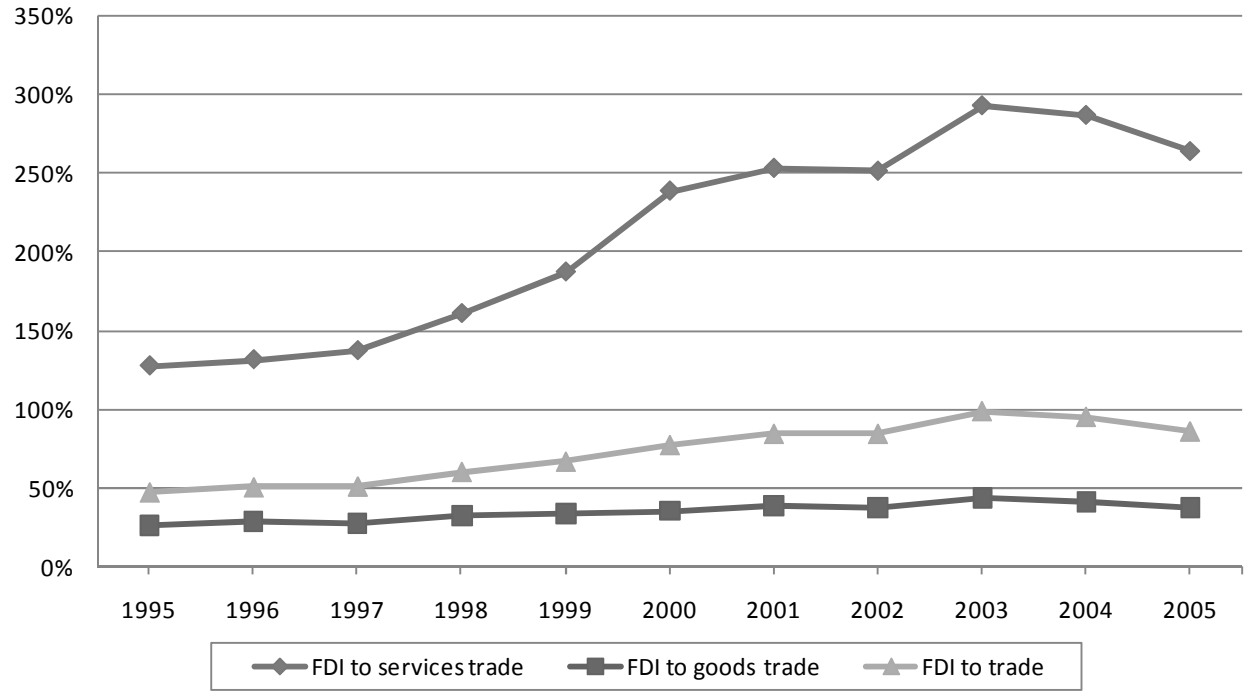
39. The ratio that has seen an impressive change over the last decade is the one relating FDI to trade, as emphasised by Helpman (2006) and Bergstrand and Egger (2008). Figure 2 below illustrates the increase in the ratio between inward FDI stocks and imports for total trade (goods and services), trade in goods and trade in services. In ten years, FDI has almost doubled as compared to trade, with this ratio increasing from 0.48 in 1995 to 0.86 in 2005. Investment in services has particularly increased, as emphasised in the *2004 World Investment Report*.

40. In the patterns described above, there is no major difference between OECD and non-OECD economies (at least for the ones included in our analysis). Emerging economies have generally a higher growth rate of trade (both for goods and services) and in some cases they trade more intermediate inputs than OECD economies. But the share of trade in intermediates in total trade has also been stable in the last ten years. Even for China, our results are similar to Feenstra and Wei (2009) who note that the share of

15 . The share of intermediate to total trade in services is based on 20 OECD countries for which data on trade in intermediate services is available for the entire period 1999-2005.

processing trade has not changed in overall trade despite an average annual growth rate of 25% in the last seven years.

Figure 2. The ratio of FDI to trade (1995-2005)



The regional dimension of trade in intermediates

41. Imports of intermediate goods for 2006 and imports of intermediate services for 2005 are presented in the maps of Figures 3 and 4 below. The coverage and regional classification of countries regarding goods trade is shown in Table 6. While descriptive statistics for goods trade are based on more than 150 importing countries, trade in intermediate services could only be calculated for countries which have I-O tables available (see Table 3).

42. The largest value of transactions is recorded within and among three regions: Europe, North America and Asia. The maps reveal some patterns of specialisation. For example, Asia is a net exporter of intermediate goods to Europe and to North America. Between Europe and North America, the pattern is the opposite for goods and services. Europe imports more intermediate services from North America but exports more intermediate goods. Some of the flows reported on Figure 3 are related to exchanges of primary resources, such as oil or gas (in the case of Middle East & North Africa and the Commonwealth of Independent States). The largest inter-regional flow for intermediate goods trade is actually exports from the Middle East & North Africa to Asia. But overall trade in intermediate inputs is mostly between developed countries and flows with regions with developing economies are very small.

43. Intra-regional imports are generally higher than inter-regional imports. The most important value for intra-regional trade is observed in Europe. However, all trade flows between EU countries are recorded in the dataset, thus increasing significantly the value of trade for Europe. High values are nonetheless also found for Asia and North America. In the case of intermediate goods imports, the ratio of European to

North American intra-regional trade is close to four. For trade in consumption goods (not shown), a similar pattern can be observed with the ratio being even higher, i.e. 6.5.

44. In Annex 2, we present the variations of trade in intermediates relative to aggregate trade flows for the cases of different industries and countries. In order to do so, we use two main measures: the share of a region's intermediates trade in *world intermediates trade* (e.g. for a particular industry), and the share of a region's intermediates trade in the *region's total trade*. Three main factors could explain differences among values and shares by region: 1) the industrial specialisation of economies; (2) the size of markets; and (3) the income level of the region.

Figure 3. Intra and inter-regional imports of intermediate goods (Billion USD, 2006)

The map represents imports of intermediate goods *above 20 billion USD*. Circles stand for intra-regional imports and arrows for inter-regional imports. Arrows and circles are proportional to the value of the flows.

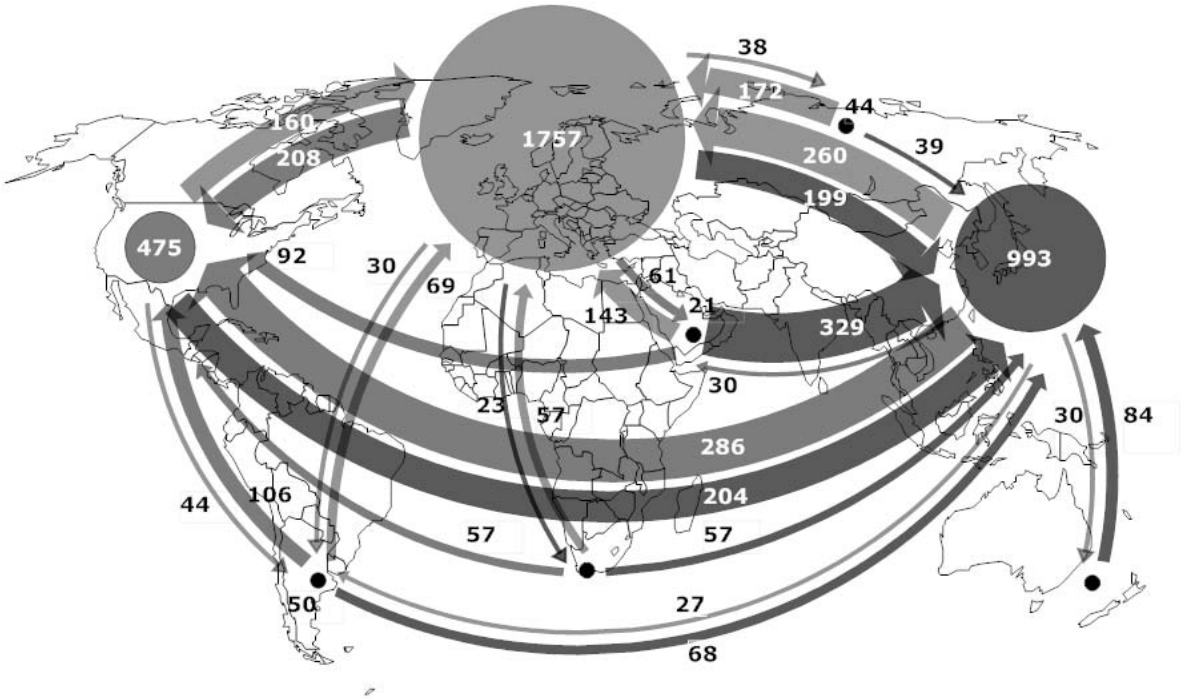
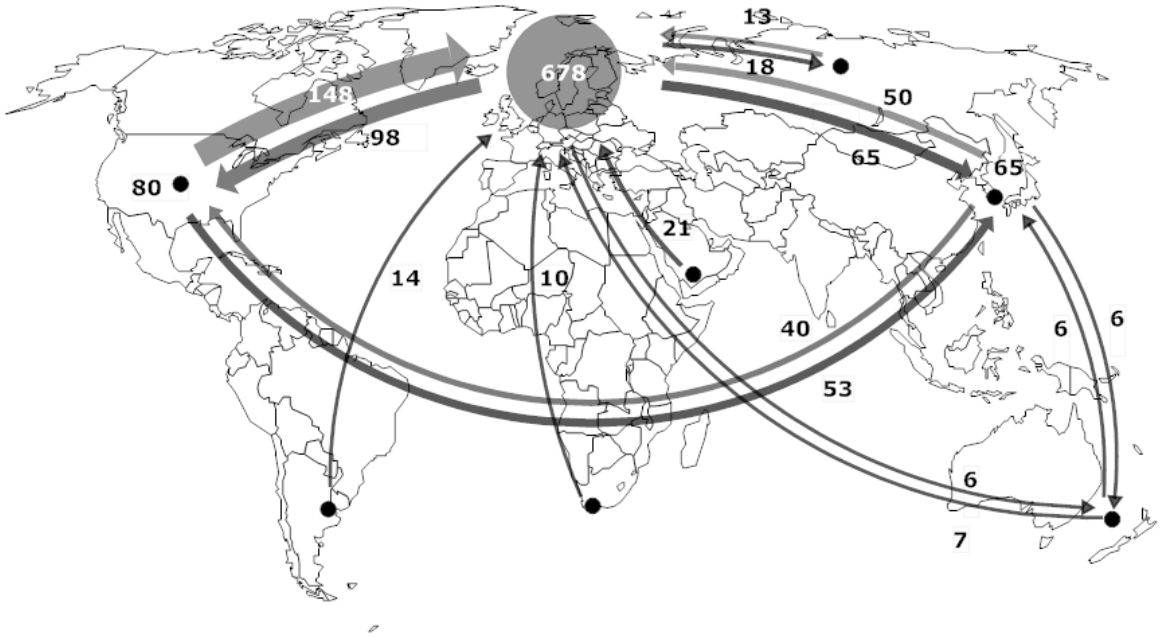


Figure 4. Intra and inter-regional imports of intermediate services (Billion USD, 2005)

The map represents imports of intermediate services *above 5 billion USD*. Circles stand for intra-regional imports and arrows for inter-regional imports. Arrows and circles are proportional to the value of the flows.



45. Figures 5 and 6 present regions' shares in world intermediate goods imports and exports by industry. Each sector is captured by one axis on the radargram. It gives a more detailed overview of the specialisation patterns in Asia, Europe and North America. This time we have excluded intra-EU trade. This explains why Europe is the largest trader in intermediates in only few industries of the radargrams. The fact that stands out most is the specialisation of Asian countries in the four industries 'Medical, precision and optical instruments', 'Radio, TV and communications equipment', 'Office machinery and computers' and 'Textiles and wearing apparel'. The high shares of Asia, not only in exports but also in imports of intermediate goods in these industries, point to the importance of intra-regional production networks. Figure 7 shows regions' shares in world intermediate services imports. Europe is the largest importer of intermediate services in almost all services industries.

Figure 5. Share of regions in world intermediate goods imports (2006)

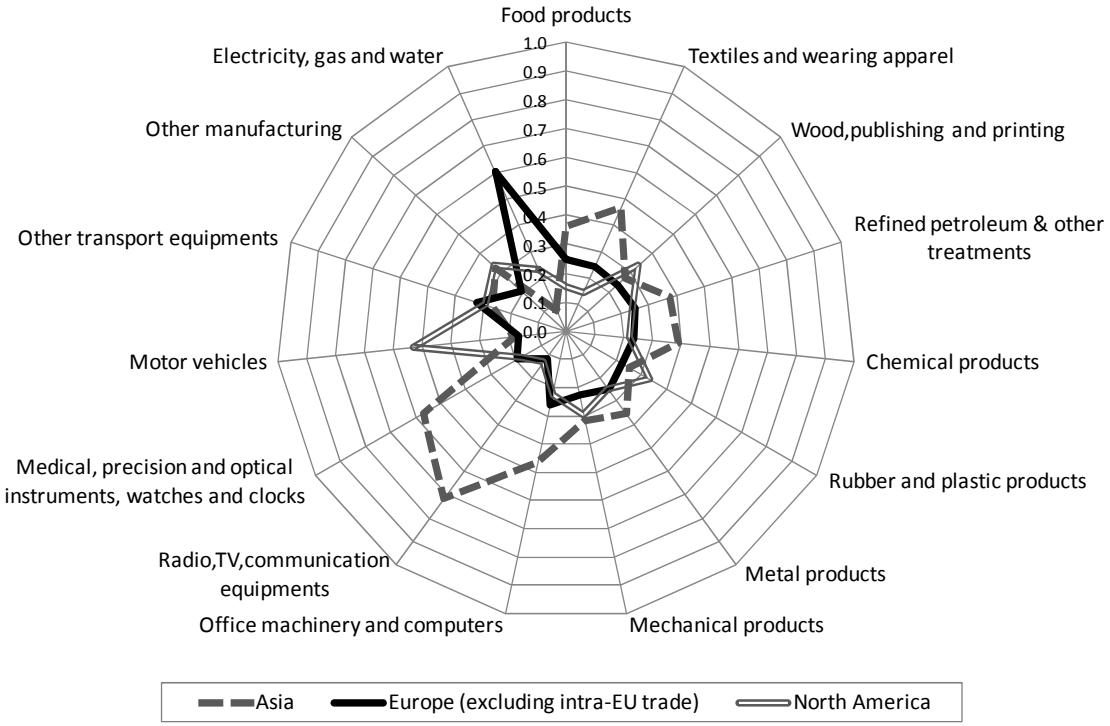


Figure 6. Share of regions in world intermediate goods exports (2006)

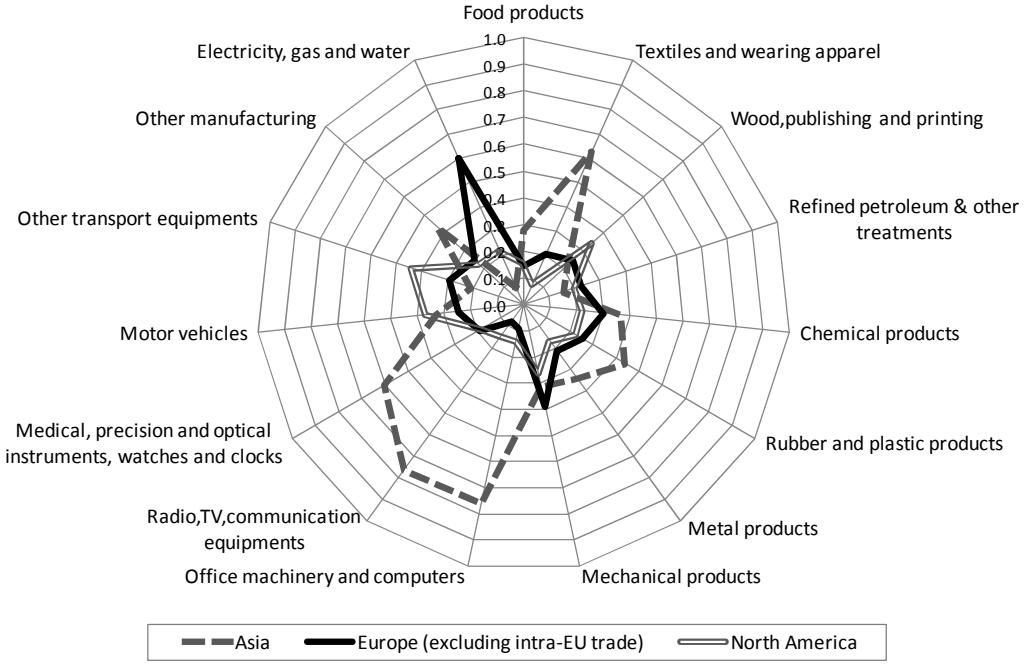
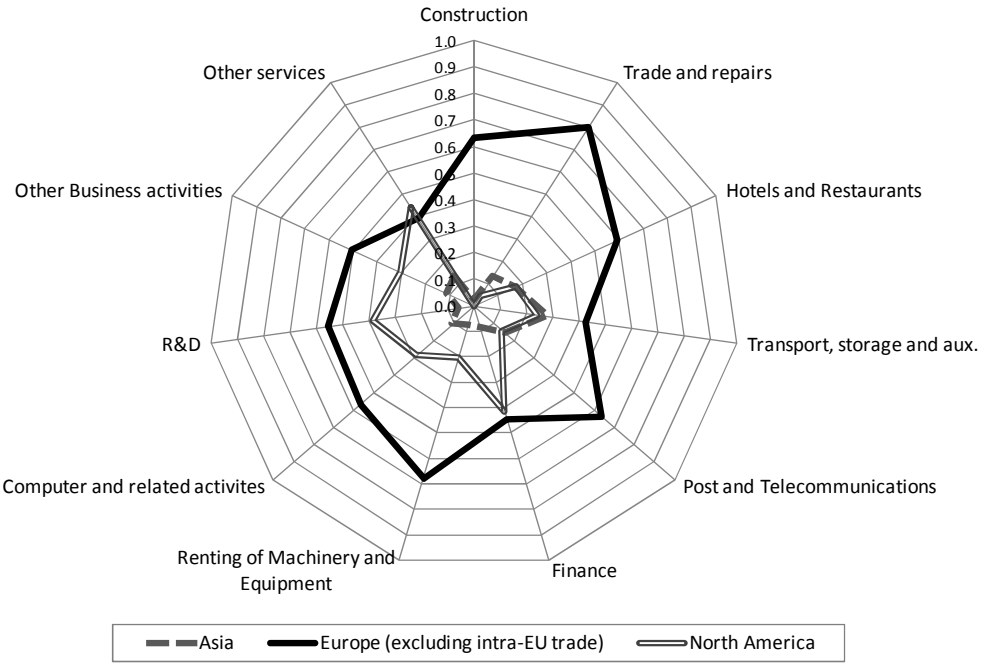


Figure 7. Share of regions in world intermediate services imports (2005)

For countries where 2005 data were not available for services, we use data for the latest year available at 2005 prices.



Trade in intermediates according to the using industry

46. Table 13 in Annex 2 shows which industries are the main users of the imported inputs. Take the example of OECD countries and imports of agriculture and fishing products: these are used as intermediate inputs for 60% in the food products, beverages and tobacco sector and to a lesser extent (13.6%) in the agriculture and fishing sector and the wood, publishing and printing industry (8.1%). Table 13 thus gives an overview of the input-output relationships between sectors for imports of intermediate goods and services.

47. One can see in Table 13 that manufacturing inputs or inputs from the primary sector are often used in services industries. For example, imports of refined petroleum products are used mainly in transport services. One services sector appearing often in the list of the top 3 industries using imported inputs is the "other services" sector that includes education, health and social services. This large sector appears as a large importer of: food products, textiles and wearing apparel, refined petroleum products, office machinery and computers, medical, precision and optical instruments, other manufacturing (a category that includes electrical machinery and furniture), electricity, gas and water, construction services, hotels and restaurants, post and telecommunications, renting of machinery and equipment, computer activities, research and development as well as other business services. Hence, Table 13 gives an overview of the important interrelationships between services and goods trade in intermediate inputs.

48. The second part of Table 13 reports figures for the accession and enhanced engagement economies with I-O tables available: Brazil, China, Estonia, India, Indonesia, Israel, Russia, Slovenia and South Africa. No striking difference with OECD countries in the structure of flows of imported inputs stands out. The same industries are generally seen with slight differences in the ranking of sectors. These economies are not structured in a different way and if differences exist they are at a more disaggregated level than the one illustrated in Table 13

49. A last comment is that it is often the case that foreign inputs are mainly used within the same industry (i.e. the foreign industry which produces the intermediate input is the same as the one using it in the importing country). In 17 of the 29 industries listed in Table 13, more than one third of total imports of inputs are used within the same sector.

Trade in intermediates and tariffs on intermediate versus final goods

50. Finally, to see to what extent trade in intermediate and final goods may differ, we have compiled data on average tariff rates according to BEC categories. Table 14 in Annex 2 provides simple average tariff rates by industry for the year 2005 and the percentage change in the average rate between 1996 and 2005.

51. Tariffs are lower for intermediate goods than for final goods in all industries except food products, wood, paper and publishing and medical and precision instruments. This is an expected outcome as tariffs on intermediate inputs are more likely to hurt domestic producers. The difference between tariffs on intermediate and final goods gives an indication on the effective cost of protection as the protectionist impact of tariffs is higher when inputs are subject to lower tariffs than final goods. This is clearly the case along the food production chain with tariffs becoming increasingly higher for processed food and beverages.

52. The average applied tariff rate decreased for all industries between 1996 and 2005. In the textiles and wearing apparel industry or in the radio, TV and communications equipment industry, a larger decrease is observed for intermediate goods, but for other sectors such as agriculture and fishing, food products or chemicals the decrease is more important for final goods than for intermediate inputs. It suggests that trade policies have not facilitated the exchange of intermediates in all sectors and that trade liberalisation has not been uniform among the different categories of goods.

IV. Analysis of the determinants of trade in intermediates and its impact on productivity

53. The descriptive statistics presented in Section III are useful to understand the nature of trade flows in intermediates but they do not provide information on the motivations for firms to trade or establish abroad that would explain the patterns observed. Moreover, these synthetic indicators often aggregate countries and sectors and do not take advantage of the disaggregated level at which the dataset presented was created.

54. To provide some insights on the determinants of trade in intermediate goods and services and also on the economic benefits associated to such trade, four types of regressions have been run. In order to keep the Section non-technical, all the details of the econometric analysis can be found in Annex 3. In what follows, we go quickly through the results and summarise what can be learned from the analysis as well as outstanding issues.

The determinants of trade in intermediate goods and services: gravity regressions

55. Trade flows between nations can be explained by two simple variables: trade costs – that is all the costs supported by exporters and importers when they engage in international trade – and the size of markets. Empirically, trade costs can be proxied by the distance between countries while the Gross Domestic Product (GDP) of trading partners can be used to approximate their demand for goods and services (the size of the market). Trade analysis now often relies on this framework known as the 'gravity model'.

56. In order to identify differences in trade in intermediates and trade in final goods and services, the gravity model with fixed effects can be used at the industry level. Table 15 in Annex 3 presents the results

from regressions using all industries (Columns 1-2), only goods industries (Col. 3-7) and only services industries (Col. 8-11). Gravity regressions for the period 1995 to 2005 are based on the sample of importing countries for which I-O tables are available. This facilitates comparing results for inter-industry and intra-industry imports as well as between goods and services industries[16]. The details of the econometric analysis are also to be found in Annex 3.

57. Table 15 shows that flows of intermediate and final goods or services are on average submitted to the same type of frictions and respond positively to the same determinants. The gravity model explains successfully both types of trade flows. However, the impact of trade costs and market size differs for intermediate imports as well as between goods and services industries.

58. A notable difference between trade in intermediates and trade in final goods deals with the coefficient observed on market size (the sum of the log of GDP in Table 15). Final goods are traded more according to the size of the market than intermediate goods (compare Columns 4 and 5). It is not a surprising result as companies export to sell to a large number of final consumers while inputs can be very specialised and profitable to export to smaller markets from where final products may then be shipped to third countries.

59. Regressions also include two dummy variables indicating whether a country pair is part of the EU or NAFTA capturing the economic integration of these two free trade areas. While their coefficients are positive and significant for all industries and for goods industries, coefficients are generally not significant in estimates for services industries. The impact of the EU dummy is larger for consumption imports than for intermediate imports underpinning the importance of intra-EU trade for serving final consumers.

60. Distance is a proxy for trade costs between two countries. These trade costs consist to a large part of transport costs for goods but also of other distance-related costs. Miroudot and Ragoussis (2009) point out that distance captures also regulatory differences (e.g., trade policies, market regulations, national business laws) as well as cultural differences between countries. The importance of distance-related trade costs other than transport costs can be seen by the impact of distance on services imports, which is often larger than for goods imports.

61. Distance has a negative and significant impact on both goods and services imports of total, intermediate and final products. There are however differences in the strength of coefficients. Columns 1 and 2 reveal that distance has a more pronounced impact on intermediate than on total imports. It is especially trade in intermediate goods (Col. 4) that is more sensitive to trade costs as compared to consumption goods (Col. 5). A 10% increase in distance between two countries decreases intermediate goods imports by 8.2% as compared to 7% and 5.3% for consumption and capital goods imports respectively. While distance is also more important for intermediate than for final services imports, the difference in coefficients is rather small.

62. In order to disentangle the effect of transport costs and trade policy barriers, two alternative variables are used instead of distance: the ratio of the cif to fob trade values as a proxy for transport costs, and simple averages of applied bilateral tariffs as a proxy for trade barriers.[17] The results are presented in

16 . Intra-industry imports and intermediate services imports are only available for this smaller sample of reporting countries. Regression results for trade in intermediate goods using the entire sample of reporting countries (not presented) confirm the qualitative results discussed in this section.

17 . We do recognise that using simple average tariffs is not ideal (see for example, Kee, Nicita and Olarreaga. 2009). On the other hand, trade weighted tariffs might underestimate the impact of tariffs, since higher tariffs will reduce imports which will then result in a lower weight in the aggregation.

Table 16. Notice that the sample size in Table 16 is smaller than the one in Table 15 due to the limited availability of cif-fob factors and bilateral tariffs. The coefficient of the cif-fob variable is negative and highly significant for all variables except for consumption imports. The negative impact of transport costs as measured by the cif-fob ratio on imports is largest for intermediate goods. Bilateral tariffs have a negative impact on all type of imports. In particular, the effect of tariffs is larger on trade in intermediates than on total trade and on trade in consumption goods. Hence, Table 16 supports the result that trade in intermediates is very sensitive to trade costs.

63. This higher sensitivity of intermediates imports to trade costs, including both transport costs and trade barriers, can be interpreted in several ways. First, companies engage in global sourcing or outsourcing to cut costs and improve their productivity. They can source inputs from different countries (and also domestically) so that an increase in these sourcing costs can quickly encourage companies to switch to another supplier. Intermediate inputs are less differentiated than final goods and the price-elasticity of their demand is higher.

64. A second explanation is that production networks are submitted to geographic and time constraints and more than for final goods or services distance can have a detrimental impact on the decision to trade. We have seen in the previous section the importance of regional trade in intermediates. When assembling complex goods or resorting to high skilled services, being remote is more a handicap than when it comes to supply consumers with a given good or service. In particular, because more interactions are observed between companies and their suppliers than with final consumers. "Just in time" production and other "lean" production processes are less able to accommodate hazards introduced by distance. Perhaps because they are of a more durable nature and less prone to short term costs, capital goods are, on the other hand, the goods for which the elasticity of distance to trade is found to be the lowest.

65. A third explanation is that some intermediate inputs are of a bulky nature. This is the case for raw material inputs whose value is low as compared to their weight. For such goods, the impact of distance is higher simply because transport costs are too high for these goods to be traded from a remote location.

66. In Table 17, the results are provided for the primary, manufacturing and services sectors. In primary industries, there are only small differences in intermediate and final goods trade. The high coefficients reflect both the characteristics of the products (bulky mining products or fresh or fragile agricultural goods less easy to transport) and the restrictive nature of trade policies in the agriculture sector. In the services sector as well, no important difference is observed. It is therefore in the manufacturing sector that the difference between consumption goods and intermediate goods is the most relevant in terms of the impact of distance and the role of the size of the market.

The determinants of the ratio of foreign to domestic inputs

67. Taking advantage of the OECD I-O tables, we can calculate at the bilateral, product and industry level the ratio of imported inputs to domestic inputs. This ratio has a value of zero when no foreign inputs are used and tends to infinity if all intermediates are imported[18]. We look at the impact of the following variables on the share of foreign inputs: distance, common border, common language, past colonial relationship, size of the combined market, transport costs for all goods, transport costs for intermediate goods, investment costs, inward and outward FDI stocks, inward and outward Foreign Affiliate Trade in Services (FATS). What we try to explain is how the choice between foreign and domestic inputs is determined.

18 . This latter case is however not observed.

68. Table 18 in Annex 3 shows the results of the analysis. As trade in intermediates is the numerator in the ratio calculated, there are similar findings with the previous gravity regressions. The geographic distance between countries has a negative impact on the decision to source internationally rather than domestically, less pronounced when the countries share a common language or a common border. The size of the combined market (both of the reporting economy and its partner) has a positive role in global sourcing or outsourcing (inputs are more likely to be sourced from and to bigger economies).

69. Regarding transport costs (measured by the difference between cif import values and fob export values for the same trade flows), the results are less clear as signs change in the different specifications, which might be because the distance variable captures already most of trade costs. In two out of the four specifications presented, transport costs of intermediates are found with negative and significant coefficients, which is the relationship expected.

70. Coming to FDI and FATS, this is where the analysis becomes especially interesting as it can tell us something about sourcing strategies in relation to investment and sales of foreign affiliates. Both inward and outward FDI have a positive coefficient and the same is observed when FATS variables are introduced in the regression. Foreign investment and activities of foreign affiliates in services sectors are associated with a higher use of foreign inputs. For inward FDI and FATS, it can be explained by imports of intermediates from the parent company or from suppliers in the country of the parent company (or from third countries that are part of the supplier network). In the case of outward FDI and FATS, it can be understood as evidence of vertical production networks with companies processing an intermediate input and shipping it to other countries for further processing. It could be also explained by the fact that domestic companies that invest abroad are the most productive and there is a positive correlation between productivity and the use of foreign inputs (see below).

71. In order to further investigate the role of investment in trade flows of intermediates, further analysis is provided in the next section looking this time at the direct relationship between trade flows of intermediates and FDI flows.

Trade in intermediates and its relation to operations of Multinational Enterprises (MNEs)

72. Economic literature has generally found a positive relationship between MNE activity and trade in intermediates. Head and Ries (2001) look at 932 Japanese manufacturing firms for the period 1966-1990. They find that FDI of vertically integrated firms tend to increase more firms' exports than FDI of firms that are not vertically integrated. Blonigen (2001) uses product level data to show that Japanese-owned automobile production in the United States is positively related to U.S. imports of automobile parts from Japan. However, he also finds that Japanese owned-production of automobiles parts in the U.S. replaces imports of Japanese parts.

73. To analyse the relationship between the operations of MNEs and trade in intermediates, we follow the approach taken by Kleinert (2003). He tests for sourcing strategies of MNEs by including inward and outward FDI stocks as explanatory variables in a regression explaining trade in intermediates. By relying on aggregate trade and FDI data of six OECD countries, Kleinert finds some evidence that inward FDI stocks have a significant positive impact on trade in intermediates as measured by I-O tables. Differently, he finds no robust effect of outward FDI on intermediate imports of goods industries.

74. However, as rightly pointed out by Bergstrand and Egger (2008), FDI and trade in intermediates are simultaneously determined by decisions of MNEs based on absolute factor endowments, trade costs and investment costs. This means that estimated coefficients of simple OLS regressions will be biased. In order to address this endogeneity problem, it is necessary to find an instrumental variable that explains FDI stocks but not trade in intermediates apart from its impact through FDI.

75. The new data used in this paper allow an analysis of how bilateral FDI impacts bilateral trade in intermediates at the industry level. Moreover, it can account for a crucial but often disregarded difference between FDI and trade data: while FDI stocks are collected according to the using industry *k*, trade data are measured in terms of the industry of origin *p.* Here, the combination of trade data with I-O tables develops its full potential by allocating imports of industry *p* across using industries *k*. This makes it possible to distinguish the impact of bilateral FDI on intra-industry ($p=k$) and inter-industry imports ($p\neq k$) of industry *k*.

76. How may bilateral FDI affect bilateral imports of intermediate goods and services[19]? In the case of vertical inward FDI, a foreign MNE decides to locate a stage of its production process in the importing country. If the affiliate relies on inputs from its parent company, then imports in form of bilateral intra-firm trade will increase[20]. The sourcing strategies of either offshoring or international insourcing as presented in Table 1 will have such an effect. Furthermore, vertical inward FDI might also increase bilateral inter-firm trade, if the affiliate sources intermediates from an independent supplier of the foreign country. For instance, if a firm moves parts of its production abroad, existing local suppliers will have to export their inputs to the respective country.

77. When considering outward FDI, the perspective of the importing country changes: a domestic MNE locates a stage of production abroad to reduce costs. In this case, the effect on bilateral imports is less clear. Bilateral imports will increase if the intermediate output of the foreign affiliate is shipped back home. However, if the output of the foreign affiliate is shipped to a third country, the imports of the home country will remain unaffected. Moreover, if outward FDI is seeking proximity to foreign suppliers, bilateral imports of intermediates might even decrease, because foreign suppliers will stop shipping their products to the home country.

78. According to the above reasoning, inward FDI should lead to an increase in imported inputs, while the impact of outward FDI is less clear. Apart from vertical, the motive for FDI might also be mainly horizontal, i.e., market seeking. Under such circumstances, only inward FDI may result in an increase in imported inputs but not outward FDI. Since the output of a horizontal affiliate is sold in the foreign or to third markets, no intermediate goods will be shipped back to the home country.

79. As mentioned before, a problem in the econometric analysis is that FDI is likely to be endogenous in a gravity regression explaining trade in intermediates. In order to take this endogeneity into account, we rely on a two-stage least-squares (2SLS) instrumental variable regression. Thereby, we use lagged changes in FDI stocks as instruments[21]. Changes in FDI stocks in the past will be correlated to current FDI stocks. In order to be valid instruments, changes in FDI stocks in the past should have no direct impact on today's trade in intermediates but only an indirect one through its impact on today's FDI stocks.

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19 . It is important to point out that the analysis focuses on the effect of FDI on trade for a given country pair. In practice however, bilateral FDI might not only affect imports from the same partner country, but also imports from affiliate or unaffiliated suppliers located in third countries. For instance, assume that a British MNE builds a production plant in Italy. Assume further that the transferred production stage needs inputs from a supplier located in Germany. FDI from the United Kingdom to Italy will therefore cause Italy to import more inputs from Germany. Such third-country effects are not captured in the regressions.

20 . Vertical FDI might be in form of Greenfield investment or acquisition of an existing domestic firm. While in the former case changes in trade patterns occur at the extensive margin, in the latter case changes occur at the intensive margin, e.g. the acquired affiliate might rely more heavily on imported inputs than the domestic company before.

21 . That is, lags of $\ln(FDI_t/FDI_{t-1})$.

80. Table 19 in Annex 3 provides results for gravity models including bilateral inward and outward FDI stocks as additional explanatory variables. The first two Columns show OLS and 2SLS regression results when bilateral intra-industry imports of industry *k* are used as dependent variable. Differently, models estimated in Columns three to five have inter-industry imports as dependent variables, i.e., imports of inputs that have been produced by industries other than *k*. These are all inter-industry imported inputs (3), only manufacturing inputs (4) and only services inputs (5).

81. Bilateral inward FDI is found to have positive effect on bilateral intermediate imports. The coefficient is significant in all models. Not surprisingly, the magnitude of the coefficient for inward FDI is rather small as compared to standard gravity variables, whose coefficients have the expected sign and magnitude: According to model (2), a 1% increase in inward FDI increases imported inputs by 0.016%, while a 1% increase in distance leads to a 1.1% decrease in intra-industry imports.

82. Conclusions regarding the impact of outward FDI are less clear. While its coefficient is significant and positive for intra-industry imports (Col. 1 and Col. 2), it is negative (positive) for inter-industry manufacturing (services) inputs. Hence, results confirm our theoretical expectations that while inward FDI should have a robust positive impact on imported intermediates, the impact of outward FDI should be weaker and less clear.

83. Another interesting finding is that the effect of inward FDI is more than twice as large for intra-industry as compared to inter-industry imports. This might indicate that MNEs are more disposed to employ the sourcing strategies of offshoring or international insourcing (as captured by FDI data) for parts of the production process within the same industry. This may be seen as evidence of vertical integration.

The relationship between trade in intermediate inputs and productivity gains

84. The trade and growth literature has focused on the role of capital goods in explaining differences in productivity levels across countries (Nordås *et al*, 2006). Lee (1995), for example, shows that the ratio of imported to domestically produced capital goods in the composition of investment has a positive effect on per capita growth rates. According to Eaton and Kortum (2001), 25% of productivity differences among countries are explained by differences in the relative price of capital equipment. They estimate that half of this share can be attributed to barriers to trade in capital goods.

85. As explained by Jones (2008), intermediate goods or services can be seen as just another form of capital, one that depreciates fully in production. There is a productivity multiplier through intermediate inputs, that is higher productivity in upstream sectors increases the productivity in downstream industries. As the same industry can be "upstream" or "downstream" depending on the good or service supplied, there is a multiplier effect similar to the one associated with capital accumulation in the growth literature. The example given by Jones (2008) is the following: higher productivity in electric power generation can reduce costs in the construction sector. In turn, it will be cheaper to build new dams or electric power plants, hence further reducing the cost of electric power generation with further productivity gains in downstream sectors.

86. Assuming that foreign intermediates provide higher productivity than domestic inputs, one can expect a positive relationship between productivity gains and the ratio of foreign inputs to domestic inputs. This is what is tested in the subsequent quantitative analysis. Not all imported inputs are more technologically advanced and more productive than domestic ones, but one can reasonably assume that if they are imported they have some type of advantage over domestic inputs and that in most cases they are used to increase the productivity of domestic firms.

87. How can foreign inputs improve the productivity of the economy (as opposed to domestic inputs)? A first explanation is that imported intermediate goods and services embody foreign technologies. Assuming that better technologies are available in the foreign country, switching from a domestic supplier to a foreign supplier can allow indirect access to better technologies[22] without any need to know these technologies or to support a cost for adopting them. Not only IT goods or services are likely to incorporate new technologies but also any intermediate input, including basic raw materials, to the extent that it is provided at a cheaper price, in a timelier manner or more in line with the specifications given by the importing company. The characteristics of the intermediate good or service will reflect the better technology used by the foreign company and domestic companies using it in their production process will see an improvement in their productivity.

88. In addition to productivity gains related to an access to new technologies embodied in intermediate goods and services, trade in intermediates can also help companies to improve their own technologies and have an impact on how efficiently domestic companies use factors of production (labour and capital). If one assumes that all countries share the same "production frontier", defined as the maximum output that can be achieved with a given amount of factors of production, the use of foreign inputs can help countries to move closer to the frontier. Intermediate goods and services that "embody" foreign technologies are those produced at the frontier with "frontier technologies". To incorporate them in the production process is the first source of productivity gains. But a second source can come from different spillover effects arising from the use of foreign inputs or from the interaction between foreign suppliers and domestic buyers.

89. Using product level data for Hungarian manufacturing firms during 1992-2003, Halpern, Koren and Szeidl (2009) find that a higher share of imported inputs increases the productivity of firms. They identify and disentangle two possible channels through which imported inputs may increase productivity. They find that 40% of the total productivity gain are due to better quality or technology of foreign inputs, while the remaining 60% of productivity gains come from what they call a complementarity channel referring to the idea that the combination of different inputs is more than their sum. This latter channel can result from imperfect substitution of inputs.

90. Further firm level evidence on imported inputs and productivity is provided by Amiti and Konings (2007) for Indonesian manufacturing firms for the period 1991 to 2001. They find that firms that import any input are on average 9.2% more productive than firms importing none of their inputs. Furthermore, they show that trade liberalisation of intermediates might lead to large productivity gains of domestic firms. Estimates predict that a 10% decrease in input tariffs increases the productivity of Indonesian firms that import inputs by 12%, as compared to 3% for firms not using imported inputs.

91. For services such as training services, computer services, research and development, it is the aim of the service to improve the productivity of the firm. It is also true for a large array of other services such as transport services, logistics services, professional services or financial services. Goods as well can have a direct impact on the total factor productivity of firms (e.g., office and machinery equipments) beyond their cheaper price or higher quality that reflects the embodied foreign technology.

92. Whether the foreign technology is "embodied" or the intermediate good or service leads to efficiency gains, what is expected at the end is higher productivity for firms where foreign inputs are more widely used. Of course, not all foreign intermediates are made with better technologies or can lead to productivity spillovers. The domestic economy can be the one using the "frontier technology" and producing the best inputs.

22 . A better technology is widely defined here as any source of improvement in the production process leading to a higher output –including in terms of "quality"- at a lower cost.

93. Even in this case, one can however expect some gains from the use of foreign inputs, in particular if one looks for gains not at the firm level but at the sector level (or for the whole economy). First, competition effects can also lead to productivity gains because prices for inputs are more competitive and suppliers have more incentives to tailor inputs to the needs of buying companies. The best technology can be in the domestic economy but the incentive to maximise productivity can come from the competition of foreign inputs.

94. Moreover, what international trade brings at the macro level is specialisation. The use of foreign inputs means that domestic producers of inputs can focus on intermediates where the economy has a comparative advantage and export these intermediates to foreign countries as well as supplying the domestic economy. The basis of comparative advantage is relative productivity and thus even an economy producing all inputs with better technologies would still have an advantage in trading some as it will be relatively more efficient in the production of some of them. The same argument applies if comparative advantage is based on different relative factor endowments across countries. A country specialises in the production of intermediates that uses predominantly the factors it is relatively abundant in and will import intermediates that require factors it is relatively scarcely endowed with.

95. This is why a positive relationship between the ratio of foreign intermediates to domestic intermediates is expected across the board and to hold despite differences among countries and sectors. However, whether there are indeed such productivity gains from the use of foreign intermediate goods and services remains an empirical question as the growth literature has often shown that it is difficult to empirically find a relationship between trade variables and productivity growth[23].

A simple test of the contribution of trade in intermediates to output growth

96. A very simple way of testing this relationship is to introduce a variable reflecting the use of foreign inputs in a production function. For a given country and a specific sector, the production function estimates the contribution of production factors (capital, labour and intermediate inputs) to gross output. Using the 2008 edition of the OECD STAN database, we can estimate production functions for 10 OECD econmies[24] at the sector level (using the 29 sectors of our trade dataset). The regression provides the following results[25]:

23 . See Nordås *et al.* (2006).

24 . Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Norway and Sweden. Only these countries provide the required data on real output, capital stocks, compensation of employees, intermediate inputs at the industry level we use in the trade analysis.

25 . Estimated coefficients and standard errors are reported. The details of the econometric analysis can be found in Annex 3, with additional regressions to check the robustness of the relationship.

$$\text{Real gross output}_{ikt} = 0.183\ \text{Capital}_{ikt} + 0.164\ \text{Labour}_{ikt} + 0.635\ \text{Interm.Inputs}_{ikt}$$

$$(0.007) \qquad (0.007) \qquad (0.010)$$

$$+ 0.017\ \text{Foreign\_share}_{ikt} + 0.018\ \text{Inward FDI}_{ikt}$$

$$(0.009) \qquad (0.004)$$

97. From the above equation, one can see that real gross output is predominantly explained by the contribution of intermediate inputs, but also the production factors capital and labour make a large contribution. The two other variables which are the share of foreign inputs over domestic inputs and the inward FDI stock also contribute positively to the growth of output. Because the use of capital, labour and intermediate inputs has been controlled for, their role can be understood as a positive impact on the productivity of the factors of production (the total factor productivity).

98. We find the expected relationship which is a positive and significant contribution of the share of foreign intermediate inputs to productivity. The more an industry makes use of foreign inputs the larger the output for a given amount of production factors. Since the share of foreign intermediate inputs is likely to be positively correlated with the level of foreign-controlled firms in the economy, it is important to include also inward FDI stocks in the regression in order to distinguish the impact of both variables. Foreign-controlled companies might namely not only increase output through a higher use of foreign inputs, but also through better management. Hence, the impact of the foreign share of intermediates can be attributed to trade in intermediates and is not confounded with FDI effects. FDI stocks also show a positive correlation with output.

99. This is a very simple regression that illustrates the role of intermediate trade in goods and services in fostering growth in a dataset pooling sectors and OECD economies. More regressions can be found in Table 20 in Annex 3 and in particular a dynamic panel estimation that takes into account potential endogeneity issues in the above equation.

The role of foreign intermediates in the reduction of inefficiency effects: a stochastic frontier analysis

100. It was previously mentioned that in addition to the technology gain offered by foreign inputs, an improvement in the use of technologies was also likely to stem from trade in intermediate goods and services. To analyse whether available statistics can give some evidence of this happening, we proceed with another trade and growth analysis relying on "stochastic frontier analysis" (SFA). SFA is an econometric technique that allows the decomposition of productivity gains into technological change and efficiency change. In the previous regression, we have found a positive correlation between output growth and trade in intermediate inputs but it is not clear whether the impact comes from technology or is due to a more efficient use of available inputs for a given technology (efficiency change).

101. In stochastic frontier analysis, it is assumed that all countries have access to the best technologies and that they share a common "technology frontier" that defines the maximum output they can reach (for a given amount of capital and labour). What distinguishes countries is how far they are from the frontier. A random distribution of countries behind the frontier is assumed but the distribution has some specific properties. We assume that whether countries trade intermediate inputs or not has some impact on the distribution of countries behind the frontier and on their "technical inefficiency" (the further from the frontier, the higher the technical inefficiency). What is tested is the impact of the share of foreign inputs over domestic inputs in the inefficiency effects.

102. The results of the stochastic frontier analysis can be found in Table 21 in Annex 3. The coefficient estimated for the contribution of capital and labour to real output are in line with the previous

regressions and very significant. The two first regressions test the assumptions of the model of Battese and Coelli (1995) and whether we can distinguish between the impact of our variables on technological change and inefficiency effects. This is the case and the two last Columns of the table look at the role of intermediate input trade on technological inefficiency. The ratio of foreign to domestic inputs is the same than the one previously tested and is significant in the inefficiency model. It has a negative sign meaning that the more foreign inputs are used in one industry the less important is the observed inefficiency. In the distribution of countries and industries behind the technology frontier, trade in intermediates is found to account negatively for the distance to the frontier, implying that it has a positive effect on the reduction of inefficiency. As in the previous analysis, adding inward FDI flows to control for foreign capital accumulation does not change the significance of the intermediate trade variable. It reduces the strength of its contribution to the reduction of inefficiency but it is still significant with the expected sign.

103. To conclude, there is evidence of a positive correlation between the use of foreign inputs and the productivity of industries. It is a correlation measured over a large number of industries and countries and it does not mean that this is universally the case. Moreover, one can also discuss whether it is a causality relationship or some correlation explained by other variables such as more productive industries requiring more sophisticated inputs that are more specialised and produced internationally. But even in this case, the analysis would still highlight the fact that efficient industries go together with trade in intermediate goods and services.

104. From the analysis presented in this section, the impact of trade in intermediates on productivity is twofold. First, it appears to have a direct contribution to output growth as part of the "total factor productivity" measured in growth analysis. It suggests a direct impact on the technology of production, which can be explained by the technology embedded in foreign inputs. Second, when distinguishing between technological change and efficiency change, the ratio of foreign to domestic input is also found to have a positive role in the reduction of inefficiency. It gives support to the idea that through trade in intermediate inputs there is also an indirect impact on productivity that enables countries to reduce inefficiencies. Thus, trade in intermediates is likely to both expand the technology frontier and to help countries and industries come closer to the new expanded frontier.

V. Concluding remarks and policy implications

Main results of the analysis

105. This study confirms some of the recent trends in world trade and production that have been pointed out in the policy debate on globalisation: the higher interdependence between economies, the rise in trade of intermediates and outsourcing, the role of vertical specialisation networks, the complementary relationship between trade and investment and the important role of MNEs in explaining trade patterns.

106. However, the report provides stylised facts that depart sometimes from the popular assessment of globalisation and nuance the scope of the changes that have taken place. The fact that intermediate goods (and to a lesser extent services) trade has not increased as a share of total trade does not mean that the fragmentation of production has not occurred but it offers several insights:

- First, we can assume that the increase in FDI and production abroad implies sourcing strategies that both increase and decrease trade in intermediate inputs. While the vertical specialisation networks create additional trade flows of goods and services that are sequentially processed in different countries, firms are also likely to switch from foreign to local suppliers for some of the inputs required. Sourcing from more competitive local suppliers while avoiding trade costs is often a motivation for fragmenting and offers an explanation of why the unbundling of

production does not lead to a significant increase in trade in intermediates as a share of total trade.

- Second, as this constant share is explained by the concomitant increase in overall trade and intermediate inputs trade, the internationalisation of production appears to be to the benefit of all producers and all countries (whether specialised in inputs or consumption goods and services). While the fragmentation of production creates new trade flows of intermediates, there are also new trade flows of final goods and services at the end of the global value chain. The rationale for fragmenting is an increase in productivity that in the end benefits the final good or service which is then exported to a greater extent with a higher level of specialisation for all economies.

- Third, there is no widespread evidence of outsourcing occurring in all industries and all countries. It is difficult to distinguish between 'global sourcing' and 'outsourcing' but the evidence presented in this study on flows of intermediates within the same sector and on the role of FDI and FATS in explaining trade in inputs does not corroborate the idea of a massive migration of (high skill) jobs from OECD to developing countries. This would imply a change in the patterns of trade flows of intermediates that so far is not found in the data.

- On the contrary, the dataset and the results of the quantitative analysis point to the positive impact of imported inputs on productivity. Recent trade literature has also highlighted the diversity of firm strategies when it comes to sourcing and the heterogeneity of producers (in terms of productivity). As a result, and without underestimating the breadth of current changes in production patterns, there are no new imbalances in world trade flows that could be associated with the unbundling of production (i.e. all countries benefit from these changes).

Policy implications

107. Policymakers should always keep in mind that trade in intermediate goods and services is first and foremost decided at the firm level where sourcing strategies are determined. Any decision made by firms regarding their operations and production methods can have an impact on trade in intermediates. In particular, a firm's decision to (i) simply engage in trade of final goods (ii) engage in sourcing of different types or (iii) engage in FDI, can all be associated with changes in the direction and volume of trade in intermediate goods and services. Furthermore, the location decision of a multinational enterprise may also influence the location decision of its suppliers and hence also affects trade. Consequently, government policy affecting any of these decisions will have an impact on trade in intermediates[26].

108. More specifically, increased trade in final goods, when targeting a larger number of international markets, will require more inputs; hence as long as vertical links exist, exchanges of intermediates will grow. On the other hand, a decision to alter the boundaries of the firm by vertically integrating or establishing partnerships with foreign firms will also affect trade in intermediates. Vertical FDI is directly linked to sourcing and therefore will by definition alter the direction and nature of trade in intermediates. A decision to serve a foreign market through horizontal FDI is nevertheless also expected to have an impact on trade in intermediates. The choice of replicating facilities abroad will involve some provision for inputs. The direction and volume of trade will change.

26 . Policies affecting the location decision of multinational enterprises are for instance tax preferences, intellectual property rights rules or preferential trade agreements. Despite their relevance, it is outside the scope of this study to provide a thorough analysis of the interaction of these different policies, the location decision of firms and trade in intermediates.

109. What are the implications of these observations? A wide range of policies, not initially targeting intermediate goods and services, are expected to have an indirect impact on such trade. Apart from sourcing, any policy affecting FDI, or trade in final goods can have an indirect impact on trade in intermediates. In the rest of this section we focus on what is new in the context of this paper; that is what directly affects trade in intermediates, abstracting the discussion from policies for trade in final goods, or investment.

Restricting trade in intermediate goods and services can have a very negative impact on growth

110. The positive relationship found between the use of foreign inputs and productivity means that discouraging imports of intermediate goods and services can have a detrimental impact on growth. One should keep in mind the multiplier effect that is involved. A less efficient domestic input will not only diminish the productivity of using industries but also the productivity of all other industries to which the using industry is providing inputs.

111. Input-output tables, studied together with trade flows, help to understand the consequences of protectionist policies in other industries of the economy. While domestic producers shielded from foreign competition may benefit, producers of other industries of the economy will be negatively affected. Protectionist policies are often presented as a trade-off between the wealth of consumers and the income of domestic producers. The input-output analysis shows that many domestic producers in other industries can also be hurt in addition to consumers.

112. The relationship between trade, FDI and strategies of firms highlighted in this study further weaken the protectionist reasoning as the lines between "domestic" producers and "foreign" producers are blurred. The foreign producer can be a subsidiary of a domestic MNE and the domestic producer a subsidiary of a foreign firm.

Trade in intermediates and outsourcing

113. The rise of outsourcing as a business strategy has created important policy challenges. The issue has been discussed in many countries, where long debates on policies encouraging it or not still take place. Though not new as a phenomenon, its expansion to services and its international dimension have received particular attention.

114. From a trade perspective, outsourcing is associated with the same type of costs and benefits as any other type of arm's length trade with a potential loss for import-competing sectors and an overall gain for the economy. The advantages of outsourcing lie primarily at the firm level. New opportunities for cutting production costs by altering firms' boundaries, and focusing solely on the activities of firms' comparative advantage, is the main driving force for the phenomenon. More opportunities rise from cross-country differences in prices and quality of factors of production. Types of sourcing involving vertical integration act also in the direction of eliminating oligopolistic distortions in vertical international transactions. For these reasons the phenomenon has been primarily approached as a *competitiveness* issue.

115. Moreover, at the aggregate economy level, outsourcing can stimulate competition and hence contribute to reducing prices of final goods, as well as to higher quality of output. The size of economic activity expands for the country as a whole. The analysis presented in Section IV has pointed to the productivity gains arising from outsourcing and more generally trade in intermediate inputs. On the other hand, since the phenomenon affects by definition factors of production, employment and wage patterns are not expected to remain the same. There are segments of the society potentially gaining and others losing from its expansion. Studies conducted by the OECD on the impact of outsourcing on employment patterns

sometimes find a negative impact on labour demand in sectors exposed but such impact is generally modest (OECD, 2007; Hill *et al.*, 2008).

116. Outsourcing is associated with the process of 'creative destruction', a term referring to the evolution of market structure and employment patterns when radical innovations are introduced in the economy[27]. Outsourcing (together with strategies of offshoring) introduces a novel organisation of the production process with new ownership structures across firms. Though a continually innovating economy generates new opportunities for workers to participate in more productive enterprises (provided they can acquire the necessary skills), 'creative destruction' can cause some hardship in the short term. The overall assessment of the process should however take into account (i) productivity gains for the domestic economy; (ii) gains for domestic consumers; and (iii) the pace at which employment is affected and the potential for adjustment.

Trade in intermediates as means of economic integration

117. Although the study has stressed that it is mainly between OECD countries that intermediates trade takes place, it is in emerging economies that the highest growth rates are observed. Trade in intermediate goods and services can be approached through a different perspective in recently developed and developing economies. The report has highlighted that emerging economies such as Brazil, China, India or Indonesia are more specialised in trade of intermediate inputs than OECD countries. One reason is that trade in intermediates can for some countries offer better means of economic integration into the global economy than final goods trade.

118. This observation is based on the fact that, contrary to intermediates, sales of final goods and services are subject to choices made by final consumers. Their preferences, customs and habits determine largely their selection from the variety of options they are exposed to. From the side of the producers, advertising and promotion of *final* products adds fixed costs to firms increasing their presence in foreign markets, through either trade in final goods or FDI. *Intermediate* goods are not traded in such a context. Sales of intermediates still occur on the production, and not the consumption side of the economy. As long as the good or service provided from abroad is appropriate to the production process of some final output, then it can be more easily promoted beyond the preferences and habits of final consumers. In the economic literature, this has been described through the "home market bias" which is less pronounced for intermediates than for final goods and services.

119. While there is no 'one-size-fits-all' development strategy, the experience of newly industrialised countries suggests that emphasising trade in intermediates can be effective to integrate in the world economy. Final goods from remote locations may prove unsuccessful in the international markets because of consumer habits and tastes imposing significant barriers to market entry. Such barriers are less pronounced for intermediate goods, where a country can fully exploit its comparative advantage. Once foreign firms are known and have more experience with the destination market, they can switch to the production of the final goods or services. For example, computer manufacturers of South East Asia started by exporting parts and components to US and Japanese manufacturers and now have moved on to sell hardware to final consumers under their own brand.

27 . The term 'creative destruction' appears in Joseph Schumpeter's book *Capitalism, Socialism and Democracy* (1942). It describes the process of transformation of an economy that accompanies radical innovation. It was further used referring to the evolution of a number of market elements such as competition, employment, and growth following technological shocks. In Schumpeter's vision, innovative entry by entrepreneurs was the force that sustained long-term economic growth, even as it destroyed the value of established companies.

Trade policies targeting trade in intermediate goods and services

120. Three of the characteristics of trade in intermediates highlighted in this report should inspire trade policies aimed at facilitating their exchange:

- Trade in intermediates is more sensitive to trade barriers. It suggests that trade policies aiming at fully benefiting from international production networks should reach a higher degree of liberalisation. This does not mean that barriers to trade in final goods and services should be higher than for intermediates. Tariff escalation should be avoided and uniform liberalisation is recommended. Furthermore, policies should aim to reduce the time of transport for goods so that firms can save on time costs which are critical for production networks.

  A corollary is that companies with international production networks are likely to quickly anticipate any perceived risk of new barriers. This implies that countries tempted by any form of protectionism will quickly pay the cost of such policies with a reduction in intermediate trade and a negative multiplier effect in the entire economy for local companies indirectly depending on such trade.

- Trade in intermediates has an important regional dimension. Keeping in mind that trade in intermediates is more sensitive to trade barriers, it is in the context of regional strategies where trade liberalisation can go further and where investment and trade in services are also likely to be liberalised that trade flows can be the most encouraged. It does not mean that the relevant level of trade negotiation is regional rather than multilateral. On the contrary, multilateral liberalisation is fully needed for trade in final goods and services and for inputs that are sourced from other regions. But the regional nature of certain production networks suggests that regional policies or initiatives are relevant.

- Trade in intermediates depends less on the size of the market and on the "home bias" of consumers. As we have highlighted before, this represents a chance for emerging economies and more generally for small economies that can specialise in inputs and attract foreign suppliers for their own companies. There is less of a disadvantage for small economies when it comes to inputs trade.

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ANNEX 1. METHODOLOGY USED TO CALCULATE TRADE FLOWS OF INTERMEDIATE GOODS AND SERVICES

This Annex explains the methodology used to combine trade statistics with information from I-O tables. Before outlining the calculations made and their underlying assumptions, we describe how trade statistics and I-O tables have been converted to a common industry classification.

Converting trade statistics from product classifications to the industry classification of I-O tables

A major challenge in combining trade statistics with I-O tables is that imports have to be converted into the industry classification used in I-O tables. While I-O tables are classified according to industrial activity in terms of ISIC Rev. 3, trade data are compiled according to product classifications, i.e. SITC Rev.3 for goods and EBOPS for services. Table 4 provides the industry classification of I-O tables, its underlying ISIC categories, and the correspondences used. The quality of the correspondence is responsible for how well bilateral imports match the industry of origin in I-O tables. The more blurred the correspondence is, the more trade will be misallocated across industries, and hence the less adequate will be the import values assigned to using industries.

In the case of goods, the correspondence between SITC Rev. 3 and BEC Rev. 3 allows identifying bilateral flows of intermediate products at the SITC 5-digit level. Then, the SITC-ISIC correspondence from the United Nations is used to identify trade in intermediate goods by industry. Since the latter correspondence is based on much disaggregated commodities, i.e. 5- and 4-digit SITC lines, we expect goods to match industries rather well. Industries are further aggregated into the ISIC based industry classification used in I-O tables. Table 5 below shows the number of SITC commodities corresponding to our industry classification. Furthermore, it provides the breakdown regarding intermediate, consumption and capital goods. The table illustrates well that the number of traded intermediate goods is far higher as compared to consumption or capital goods.

In the case of services, bilateral imports are converted from EBOPS to the industry I-O classification based. The EBOPS-ISIC correspondence, which has been adopted from the Manual on statistics of international trade in services (2002), is shown in Table 4. The aggregate level of services trade data causes some difficulties for finding a suitable correspondence. For instance, some EBOPS codes correspond to more industries as defined by ISIC. Therefore, some I-O industries needed to be aggregated, i.e. 44 to 48 (containing health and education services among others). Furthermore, for the industry 'Other business activities' more than one suitable correspondence is possible and was consequently used in order increase number of observations for which data is available.

However, we do not expect trade data to fully match imports as reported in I-O tables. One main reason is that while trade data is recorded at consumer prices, I-O tables are evaluated at producer prices. There are also other differences such as the treatment of re-exports, scrap metal, waste products and second hand goods or unallocated trade data[28].

28 . See Guo *et al.* (2009) for a review of these issues.

Combining trade statistics with import shares from I-O tables

By combining bilateral imports of intermediates from trade data with the information on the usage of intermediate imports found in I-O tables, the dimension of the using industry is added to flows. Hence, obtained import flows have five dimensions: importer *i*, exporter *j,* industry of origin (intermediate input) *p*, using industry *k* and year *t*. The imports of intermediate input *p* from country *j* by using industry *k* in country *i* can be expressed formally as:

$$I_{ijpkt} = \alpha_{ipkt}.m_{ijpt}$$

where α_{ipkt} is the share of imported inputs *p* by using industry *k* in overall imported inputs *p* of country *i* (as calculated from I-O tables) and m_{ijpt} are the imports of input *p* of country *i* from country *j* (as measured by trade data using the BEC classification).

This allocation of bilateral intermediate imports across using industries assumes that import coefficients are the same for all trade partners. For instance, the research and development industry of Spain has a share of 0.03% in overall intermediate paper imports in 2004. This coefficient is then applied to intermediate paper imports from both Finland and Poland[29]. Hence, the bilateral pattern of imported intermediates from industry *p* is the same across all using industries *k*. However, it is different from the bilateral pattern of total imports from industry *p* because trade data (m_{ijpt}) allows distinguishing bilateral imports of intermediates from final good imports in industry p.

As mentioned already, for services trade data no classification exist distinguishing final and intermediate services. Hence, m_{ijp} are total imports of service *p (both final and intermediate)* of country *i* from country *j*. By making an additional assumption and adjusting the share α_{ipkt} in the above formula, it is however possible to calculate trade in intermediate services. In the case of services imports, α_{ipkt} is the share of imported service inputs *p* used by industry *k* in *total* imports of *p (both final and intermediate)* of country *i*.

Besides the assumption that all trading partners have the same distribution of intermediate imports *p* across using industries *k*, it is furthermore required that the share of intermediate services in overall bilateral services imports of country *i* is the same across all partner countries *j*. For instance, imagine that the transport industry consists of passenger and freight transport only. If France has a share of imported transport inputs (freight) in overall transport imports (passenger plus freight) of 79%, then it is assumed that this share applies to all partner countries. Hence, France transport imports from both the United States and Japan are assumed to consist to 79% of freight services.

The assumption that the share of intermediate services is the same across partner countries implies that the bilateral variation is the same for trade in intermediates and for total services trade. I-O tables are multilateral, which means that they do not alter the geographic pattern when combined with bilateral trade data. In the case of goods, final and intermediate goods trade follow a different bilateral pattern, because the BEC classification allows distinguishing intermediate from final goods trade. But since bilateral services trade data do not distinguish between final and intermediate use, the bilateral variation stays unchanged.

If the assumptions made are violated, then trade in intermediates for services and trade in intermediates by using industry for goods are measured with error. Hence, in gravity regressions there

29 . Notice that the value of bilateral intermediate paper imports is directly measured by trade data. I-O coefficients allow distributing these bilateral imports across using industries, with the distribution being the same for all partner countries.

would be measurement error in the dependent variable leading to a larger variances of residuals, and hence to larger asymptotic variances of estimated coefficients. However, measurement error causes mainly concerns if it is additionally correlated with some of the explanatory variables. In that case there would be endogeneity bias in estimated coefficients[30].

Table 2. Broad Economic Categories classification of goods according to main use

Classification by Broad Economic Categories (BEC)	Basic classes of goods in the System of National Accounts (SNA)
1 Food and beverages	
11 Primary	
111 Mainly for industry	Intermediate
112 Mainly for household consumption	Consumption
12 Processed	
121 Mainly for industry	Intermediates
122 Mainly for household consumption	Consumption
2 Industrial supplies not elsewhere specified	
21 Primary	Intermediate
22 Processed	Intermediate
3 Fuels and lubricants	
31 Primary	Intermediate
32 Processed	
321 Motor spirit	Not classified
322 Other	Intermediate
4 Capital goods (except transport equipment), and parts and accessories thereof	
41 Capital goods (except transport equipment)	Capital
42 Parts and accessories	Intermediate
5 Transport equipment, and parts and accessories thereof	
51 Passenger motor cars	Not classified
52 Other	
521 Industrial	Capital
522 Non-industrial	Consumption
53 Parts and accessories	Intermediate
6 Consumer goods not elsewhere specified	
61 Durable	Consumption
62 Semi-durable	Consumption
63 Non-durable	Consumption
7 Goods not elsewhere specified	Not classified

30 . Wooldridge (2002) gives a good illustration of measurement errors in dependent variables. Santos Silva and Tenreyro (2006) show that the bias introduced through a rounding error in the dependent variable is rather small for the Poisson maximum likelihood estimator which is used in gravity regressions relative to other estimators.

Table 3. Country and year coverage of OECD I-O tables

Country	Code	Years with I-O tables
Argentina	ARG	1997
Australia	AUS	1998/99, 2004/05
Austria	AUT	1995, 2000, 2004
Belgium	BEL	1995, 2000, 2004
Brazil	BRA	1995, 2000
Canada	CAN	1995, 2000
Switzerland	CHE	2001
China	CHN	1995, 2000, 2002, 2005
Czech Republic	CZE	2000, 2005
Germany	DEU	1995, 2000, 2005
Denmark	DNK	1995, 2000, 2004
Spain	ESP	1995, 2000, 2004
Estonia	EST	1997, 2000, 2005
Finland	FIN	1995, 2000, 2005
France	FRA	1995, 2000, 2005
United Kingdom	GBR	1995, 2000, 2003
Greece	GRC	1995, 1999, 2005
Hungary	HUN	1998, 2000, 2005
Indonesia	IDN	1995, 2000, 2005
India	IND	1993/94, 1998/99
Ireland	IRL	1998, 2000
Israel	ISR	1995
Italy	ITA	1995, 2000, 2004
Japan	JPN	1995, 2000, 2005
Korea	KOR	2000
Luxembourg	LUX	1995, 2000, 2005
Mexico	MEX	2003
Netherlands	NLD	1995, 2000, 2004, 2005
Norway	NOR	1995, 2000, 2001
New Zealand	NZL	1995/96, 2002/03
Poland	POL	1995, 2000, 2004
Portugal	PRT	1995, 1999, 2000, 2005
Russia	RUS	1995, 2000
Slovak Republic	SVK	1995, 2000
Slovenia	SVN	2005
Sweden	SWE	1995, 2000, 2005
Turkey	TUR	1996, 1998, 2002
Chinese Taipei	TWN	1996, 2001
United States	USA	1995, 2000, 2005
South Africa	ZAF	1993, 2000

Source: OECD Input-Output tables, 2009 release.

Table 4. Industry classification and correspondences with I-O tables and trade data

Sector	Label	Industry	I-O industry	ISIC Rev.3	EBOPS
1	AGF	Agriculture and fishing	1	1, 2, 5	
2	MIQ	Mining and quarrying	2, 3	10, 11, 12, 13, 14	
31	PRI	PRIMARY SECTOR			
3	FOD	Food products	4	15, 16	
4	TEX	Textiles and wearing apparel	5	17, 18, 19	
5	WPP	Wood,publishing and printing	6, 7	20, 21, 22	
6	RPT	Refined petroleum & other treatments	8	23	
7	CHM	Chemical products	9, 10	24	
8	RPP	Rubber and plastic products	11	25	
9	MET	Metal products	13, 14, 15	27, 28	
10	MEC	Mechanical products	16	29	
11	OMC	Office machinery and computers	17	30	
12	RTV	Radio,TV,communication equipments	19	32	
13	MED	Medical, precision and optical instruments, watches and clocks	20	33	
14	MVH	Motor vehicles	21	34	
15	OTE	Other transport equipments	22, 23, 24	35	
16	OMF	Other manufacturing	12, 18, 25	26, 31, 36, 37	
17	EGW	Electricity, gas and water	26, 27, 28, 29	40, 41	
32	MAN	MANUFACTURING			
18	CST	Construction	30	45	249
19	TRR	Trade and repairs	31	50, 51, 52	269
20	HRS	Hotels and restaurants	32	55	236
21	TRA	Transport, storage & auxiliary activities	33, 34, 35, 36	60, 61, 62, 63	205
22	PTT	Post and telecommunications	37	64	245
23	FIN	Finance	38	65, 66, 67	253, 260
24	REA	Real estate	39	70	
25	REN	Renting of machinery and equipment	40	71	272
26	CMP	Computer activities	41	72	263
27	RAD	Research and development	42	73	279
28	OBU	Other business activities	43	74	273-279
29	OTS	Other services	44, 45, 46, 47, 48	75, 80, 85, 90-93	264, 287, 291
33	SER	SERVICE SECTOR			

Notes: For Computer activities and Other business activities alternative correspondences are used if services trade data do not allow above correspondence, i.e. EBOPS code 262 for Computer activities and EBOPS code 273 or 268-269-272 for Other business activities.

Table 5. Number of SITC commodities lines following the SITC-BEC-ISIC correspondence

	Number of SITC commodities lines (classified according to main use)				
Industry	Overall	Intermediates	Consumption	Capital	Other
1. Agriculture and fishing	193	112	79	2	0
2. Mining and quarrying	75	75	0	0	0
3. Food products	299	113	186	0	0
4. Textiles and wearing apparel	375	205	169	0	1
5. Wood,publishing and printing	152	117	35	0	0
6. Refined petroleum & other treatments	17	15	0	1	1
7. Chemical products	483	446	37	0	0
8. Rubber and plastic products	70	58	12	0	0
9. Metal products	373	323	21	28	1
10. Mechanical products	395	108	28	252	7
11. Office machinery and computers	30	4	1	25	0
12. Radio,TV,communication equipments	70	33	6	31	0
13. Medical, precision and optical instruments, watches and clocks	130	42	26	62	0
14. Motor vehicles	33	16	2	14	1
15. Other transport equipments	56	14	14	26	2
16. Other manufacturing	281	170	80	30	1
17. Electricity, gas and water	3	3	0	0	0

ANNEX 2. DATA ON TRADE IN INTERMEDIATE GOODS AND SERVICES

Table 6. Reporting countries of trade in intermediate goods by region

North America
Bermuda
Canada
Mexico
United States

Asia
Bahrain
Bangladesh
Brunei Darussalam
China
Chinese Taipei
Hong Kong, China
India
Indonesia
Japan
Korea, Rep.
Macao, China
Malaysia
Maldives
Mongolia
Pakistan
Philippines
Singapore
Thailand
Vietnam

Middle East & North Africa
Algeria
Egypt, Arab Rep.
Iran, Islamic Rep.
Israel
Jordan
Morocco
Oman
Qatar
Saudi Arabia
Syrian Arab Republic
Tunisia
United Arab Emirates
Yemen, Rep.

Europe
Albania
Austria
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Faeroe Islands
Finland
France
Germany
Greece
Greenland
Hungary
Iceland
Ireland
Italy
Latvia
Lithuania
Luxembourg
Macedonia, FYR
Malta
Netherlands
Norway
Poland
Portugal
Romania
Serbia
Slovak Republic
Slovenia
Spain
Sweden
Switzerland
Turkey
United Kingdom

Latin America
Anguilla
Antigua and Barbuda
Argentina
Aruba
Bahamas, The
Barbados
Belize
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Dominica
Ecuador
El Salvador
Grenada
Guatemala
Guyana
Honduras
Jamaica
Montserrat
Nicaragua
Panama
Paraguay
Peru
St. Kitts and Nevis
St. Lucia
St. Vincent and the Grenadines
Suriname
Trinidad and Tobago
Uruguay
Venezuela, RB

CIS
Armenia
Azerbaijan
Belarus
Georgia
Kazakhstan
Kyrgyz Republic
Moldova
Russian Federation
Ukraine

Sub-Saharan Africa
Botswana
Burundi
Cameroon
Cape Verde
Comoros
Côte d'Ivoire
Ethiopia
Gabon
Gambia, The
Ghana
Kenya
Madagascar
Malawi
Mali
Mauritania
Mauritius
Mayotte
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Seychelles
South Africa
Sudan
Swaziland
São Tomé and Principe
Tanzania
Uganda
Zambia
Zimbabwe

Oceania
Australia
Fiji
French Polynesia
New Caledonia
New Zealand
Samoa
Solomon Islands
Tonga
Tuvalu
Vanuatu
Wallis and Futuna

Table 7. Main trends in trade in intermediate goods and services

	Trade in goods (2006) - Values in mio USD							Average annual growth rate in volume				Trade in services (2005 or last year available) - Values in mio USD						Average annual growth rate in volume		
	Total	Intermediate goods		Consumption goods		Capital goods		Trade in goods (1995-2006)				Year of data	Total	Intermediate services		Final services		Trade in services (1999-last avail.)		
	Value	Value	%	Value	%	Value	%	Total	Interm.	Consumpt.	Capital		Value	Value	%	Value	%	Total	Interm.	Final
Australia	124,421	53,973	43.4%	29,322	23.6%	31,197	25.1%	7.54%	6.57%	9.53%	7.26%	2005	30,513	15,885	52.06%	14,628	47.9%	6.47%	3.85%	9.96%
Austria	123,992	71,575	57.7%	26,171	21.1%	19,410	15.7%	4.16%	4.99%	2.79%	4.42%	2005	45,287	38,623	85.29%	6,664	14.7%	5.09%	3.15%	32.52%
Belgium	325,218	189,375	58.2%	82,044	25.2%	32,249	9.9%	5.89%	5.18%	8.02%	5.72%	2005	51,190	46,211	90.27%	4,979	9.7%	9.97%	9.78%	11.82%
Canada	331,578	177,055	53.4%	65,438	19.7%	65,864	19.9%	5.05%	4.36%	6.75%	5.44%	2003	52,319	44,750	85.53%	7,569	14.5%	4.55%	5.42%	0.32%
Switzerland	131,317	63,895	48.7%	39,437	30.0%	21,385	16.3%	2.78%	3.08%	3.52%	2.32%	2004	21,233	16,623	78.29%	4,610	21.7%	8.23%	8.23%	8.23%
Czech Republic	88,235	56,774	64.3%	14,976	17.0%	14,313	16.2%	12.38%	13.93%	11.64%	9.09%	2005	10,246	7,198	70.25%	3,048	29.7%	7.71%	2.97%	35.56%
Germany	837,817	491,658	58.7%	156,908	18.7%	147,087	17.6%	7.20%	8.08%	4.09%	9.29%	2005	210,524	191,416	90.92%	19,108	9.1%	4.48%	4.67%	2.82%
Denmark	78,292	35,976	46.0%	22,820	29.1%	15,616	19.9%	4.43%	3.33%	5.39%	5.87%	2005	37,637	29,760	79.07%	7,878	20.9%	10.11%	9.91%	10.96%
Spain	307,298	168,555	54.9%	67,302	21.9%	47,111	15.3%	8.32%	7.31%	9.13%	9.93%	2005	67,164	58,181	86.63%	8,983	13.4%	10.72%	10.66%	11.10%
Finland	63,488	37,655	59.3%	11,225	17.7%	10,843	17.1%	6.30%	5.90%	6.99%	6.20%	2005	15,194	11,994	78.94%	3,200	21.1%	9.40%	9.17%	10.85%
France	500,436	275,142	55.0%	119,113	23.8%	77,720	15.5%	7.72%	7.84%	7.55%	7.82%	2005	105,658	83,685	79.20%	21,973	20.8%	6.42%	12.20%	-4.66%
United Kingdom	506,111	238,366	47.1%	137,602	27.2%	93,673	18.5%	5.69%	4.14%	8.03%	6.87%	2005	164,674	128,484	78.02%	36,190	22.0%	6.88%	9.15%	1.20%
Greece	59,354	28,327	47.7%	17,407	29.3%	10,095	17.0%	6.85%	6.59%	6.51%	9.97%	2005	14,748	11,305	76.66%	3,443	23.3%	6.28%	15.47%	-7.38%
Hungary	66,774	43,204	64.7%	9,662	14.5%	11,224	16.8%	13.68%	13.93%	12.60%	13.69%	2005	11,479	9,741	84.86%	1,738	15.1%	13.86%	12.78%	24.66%
Ireland	67,783	34,155	50.4%	16,566	24.4%	13,418	19.8%	8.13%	6.96%	10.09%	9.02%	2003	54,426	51,806	95.19%	2,620	4.8%	17.95%	21.49%	-0.91%
Iceland	5,455	2,133	39.1%	1,215	22.3%	1,723	31.6%	9.24%	8.06%	5.61%	15.50%	-	-	-	-	-	-	-	-	-
Italy	390,426	224,762	57.6%	84,513	21.6%	49,293	12.6%	2.95%	2.35%	4.40%	3.18%	2005	90,051	75,072	83.37%	14,979	16.6%	5.41%	3.41%	24.10%
Japan	547,850	361,728	66.0%	111,880	20.4%	66,372	12.1%	3.60%	4.97%	0.63%	4.82%	2005	134,271	89,791	66.87%	44,480	33.1%	0.82%	4.21%	-4.25%
Korea	287,267	215,677	75.1%	23,369	8.1%	45,901	16.0%	7.38%	7.65%	12.12%	6.49%	2003	40,381	29,472	72.99%	10,908	27.0%	8.46%	8.46%	8.46%
Luxembourg	15,025	6,868	45.7%	4,067	27.1%	2,424	16.1%	4.81%	5.92%	5.82%	1.16%	2005	24,619	24,134	98.03%	486	2.0%	23.11%	23.66%	3.85%
Mexico	239,478	154,757	64.6%	28,591	11.9%	46,840	19.6%	10.39%	9.92%	8.62%	11.87%	2005	21,439	17,801	83.03%	3,639	17.0%	1.85%	1.85%	1.85%
Netherlands	308,361	176,436	57.2%	62,801	20.4%	59,872	19.4%	5.95%	6.08%	5.07%	7.90%	2005	84,482	59,600	70.55%	24,883	29.5%	6.24%	2.07%	29.32%
Norway	61,251	29,841	48.7%	14,459	23.6%	12,439	20.3%	6.59%	6.07%	6.92%	6.80%	2004	22,622	16,159	71.43%	6,463	28.6%	6.56%	6.94%	5.67%
New Zealand	24,309	10,390	42.7%	6,349	26.1%	5,575	22.9%	5.16%	4.59%	6.69%	5.17%	2005	8,228	7,222	87.77%	1,007	12.2%	8.23%	9.45%	1.87%
Poland	115,211	72,318	62.8%	18,588	16.1%	20,116	17.5%	11.78%	11.46%	11.72%	12.28%	2005	14,346	9,457	65.92%	4,890	34.1%	10.49%	14.96%	4.48%
Portugal	60,076	34,200	56.9%	14,716	24.5%	7,601	12.7%	3.57%	3.36%	4.63%	3.36%	2005	10,469	8,958	85.57%	1,511	14.4%	3.92%	2.75%	23.51%
Slovak Republic	42,378	27,133	64.0%	6,241	14.7%	7,711	18.2%	13.92%	14.16%	12.84%	15.42%	2003	3,050	2,532	83.04%	517	17.0%	11.23%	11.98%	8.10%
Sweden	116,217	64,105	55.2%	26,313	22.6%	19,635	16.9%	4.29%	3.86%	5.47%	3.59%	2005	32,513	29,605	91.06%	2,908	8.9%	3.90%	5.09%	-4.59%
Turkey	116,287	77,430	66.6%	10,958	9.4%	23,606	20.3%	10.87%	10.30%	16.86%	10.57%	2005	11,376	7,016	61.67%	4,360	38.3%	3.47%	13.60%	-4.00%
United States	1,760,514	905,958	51.5%	399,427	22.7%	316,081	18.0%	7.04%	7.27%	7.61%	6.80%	2005	315,661	169,763	53.78%	145,898	46.2%	5.55%	5.96%	5.08%
OECD	***7,702,219***	***4,329,419***	***56.2%***	***1,629,480***	***21.2%***	***1,296,393***	***16.8%***	***6.06%***	***6.20%***	***5.87%***	***5.99%***	***2005***	***1,765,666***	***1,292,242***	***73.19%***	***473,424***	***26.8%***	***6.79%***	***7.04%***	***6.31%***
																		-	-	-
Chile	31,892	17,750	55.7%	5,492	17.2%	7,251	22.7%	6.87%	7.59%	7.38%	5.90%	-	-	-	-	-	-	-	-	-
Estonia	10,224	5,192	50.8%	2,146	21.0%	1,994	19.5%	13.21%	12.44%	10.43%	17.32%	2005	2,164	1,878	86.80%	286	13.2%	15.62%	13.07%	66.25%
Israel	45,103	30,420	67.4%	6,191	13.7%	6,783	15.0%	3.51%	4.15%	4.03%	2.29%	-	-	-	-	-	-	-	-	-
Russia	128,188	45,157	35.2%	34,329	26.8%	36,041	28.1%	11.77%	8.48%	10.68%	15.46%	2003	27,122	22,703	83.71%	4,419	16.3%	17.01%	17.65%	14.12%
Slovenia	20,408	12,133	59.5%	3,823	18.7%	3,303	16.2%	5.95%	6.34%	6.53%	5.92%	2005	2,852	1,986	69.64%	866	30.4%	15.27%	15.27%	15.27%
																		-	-	-
Brazil	86,103	62,632	72.7%	7,750	9.0%	13,782	16.0%	1.33%	3.46%	-3.15%	-0.29%	2003	15,378	10,324	67.14%	5,054	32.9%	0.61%	1.10%	-0.33%
China	753,180	567,235	75.3%	25,143	3.3%	153,797	20.4%	15.78%	16.91%	11.44%	13.60%	2005	83,796	72,897	86.99%	10,898	13.0%	15.03%	20.53%	3.58%
India	171,146	136,032	79.5%	7,247	4.2%	27,560	16.1%	16.50%	16.15%	16.43%	20.28%	2002	21,039	10,068	47.85%	10,971	52.1%	4.63%	4.63%	4.63%
Indonesia	48,409	35,321	73.0%	3,661	7.6%	8,956	18.5%	1.76%	1.85%	5.55%	2.63%	2005	22,049	12,818	58.14%	9,230	41.9%	7.86%	8.58%	6.94%
South Africa	59,823	32,671	54.6%	8,728	14.6%	14,061	23.5%	8.47%	8.12%	10.83%	7.44%	2003	8,045	3,987	49.56%	4,058	50.4%	8.30%	8.19%	8.42%

Notes: Import price deflators from the IMF International Financial Statistics are used for the calculation of growth rates of goods imports. GDP deflators are used to deflate goods imports if import deflators are not available (Luxembourg, Chile, Slovak Republic, Russia, Austria, Switzerland, China, Chzech Republic, Estonia, Indonesia, Mexico, Portugal, Slovenia) and also for services imports of all countries.

Table 8. Trade in intermediate goods by region: value of imports and exports (2006)

Partner / Reporter	Value of intermediate goods imports (2006) - billion of USD							
	Asia	CIS	Europe	Latin America	Middle East & North Africa	North America	Oceania	Sub-Saharan Africa
Asia	992.6	38.6	199.2	67.5	328.5	203.6	83.7	57.3
CIS	13.1	44.5	37.8	2.4	0.8	3.0	0.4	1.0
Europe	259.1	171.5	1,756.5	69.4	143.1	160.0	13.1	56.7
Latin America	27.0	2.3	29.5	49.9	5.6	44.1	1.2	8.9
Middle East & North Africa	30.9	6.7	60.9	5.0	20.6	15.6	2.3	2.6
North America	286.3	17.1	208.5	106.0	91.6	475.3	6.4	56.9
Oceania	29.5	0.1	12.7	0.8	3.6	10.3	7.1	0.5
Sub-Saharan Africa	15.3	1.0	23.3	2.7	11.7	6.4	1.7	15.3
Partner / Reporter	**Value of intermediate goods exports (2006) - billion of USD**							
	Asia	CIS	Europe	Latin America	Middle East & North Africa	North America	Oceania	Sub-Saharan Africa
Asia	1,067.7	14.7	230.0	29.9	53.7	239.4	30.2	19.7
CIS	27.1	31.6	158.5	3.0	10.2	7.9	0.1	0.5
Europe	174.1	52.6	1,780.4	32.9	82.8	195.3	12.4	27.5
Latin America	47.2	1.9	61.5	54.4	6.9	94.5	0.6	3.3
Middle East & North Africa	215.3	1.1	94.7	4.8	21.2	64.3	1.5	5.3
North America	173.8	2.9	169.8	55.1	22.8	493.2	9.4	6.4
Oceania	59.3	0.1	12.3	0.8	1.5	4.0	5.8	0.8
Sub-Saharan Africa	22.8	0.2	43.3	3.6	3.0	37.6	0.7	21.0

Table 9. Trade in intermediate services by region: value of imports (2005)

Data are estimated for countries for which the year 2005 is not available.

Partner / Reporter	Value of intermediate services imports (2005) - billion of USD							
	Asia	CIS	Europe	Latin America	Middle East & North Africa	North America	Oceania	Sub-Saharan Africa
Asia	65.1	0.8	43.9	0.3	1.0	53.0	6.4	0.2
CIS	1.0	3.3	18.2	0.7	1.7	2.4	0.0	0.0
Europe	50.1	13.4	678.0	13.7	21.2	148.0	7.3	10.3
Latin America	0.7	0.0	3.9	-	-	4.3	-	-
Middle East & North Africa	0.1	0.1	2.1	-	-	1.7	-	-
North America	40.2	1.7	98.1	3.7	1.7	80.2	3.9	0.7
Oceania	5.6	0.0	6.2	0.0	-	4.1	3.1	0.1
Sub-Saharan Africa	0.2	0.0	3.1	-	-	0.8	0.1	0.1

Table 10. Share of intermediate to total trade flows by industry and region (2006)

Industry	*Exporting Region*							
	Asia	**CIS**	**Europe**	**Latin America**	**Middle East North Africa**	**North America**	**Oceania**	**Sub-Saharan Africa**
Primary	0.89	0.99	0.82	0.88	0.99	0.90	0.96	0.96
Manufacturing	0.49	0.82	0.52	0.62	0.70	0.55	0.59	0.70
Services	0.57	0.55	0.64	0.66	0.72	0.50	0.60	0.73
Agriculture and fishing	0.65	0.85	0.47	0.57	0.28	0.71	0.76	0.66
Mining and quarrying	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Food products	0.29	0.21	0.14	0.42	0.15	0.20	0.22	0.33
Textiles and wearing apparel	0.20	0.45	0.32	0.27	0.13	0.43	0.72	0.26
Wood,publishing and printing	0.69	0.95	0.73	0.93	0.57	0.78	0.87	0.93
Refined petroleum & other treatments	1.00	0.90	0.92	0.99	1.00	0.97	1.00	0.82
Chemical products	0.85	0.96	0.68	0.80	0.87	0.79	0.59	0.83
Rubber and plastic products	0.63	0.90	0.76	0.84	0.71	0.70	0.70	0.76
Metal products	0.91	0.99	0.94	0.99	0.97	0.95	1.00	0.99
Mechanical products	0.29	0.36	0.38	0.30	0.41	0.42	0.33	0.25
Office machinery and computers	0.42	0.51	0.31	0.85	0.39	0.38	0.52	0.36
Radio,TV,communication equipments	0.65	0.66	0.44	0.57	0.55	0.65	0.54	0.47
Medical, precision and optical instruments	0.25	0.15	0.16	0.07	0.18	0.16	0.09	0.14
Motor vehicles	0.30	0.31	0.35	0.39	0.39	0.37	0.35	0.24
Other transport equipments	0.33	0.30	0.45	0.06	0.46	0.48	0.35	0.17
Other manufacturing	0.44	0.72	0.62	0.66	0.83	0.65	0.58	0.79
Electricity, gas and water	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Construction	0.15	0.32	0.38	0.54	0.17	0.31	0.34	0.48
Trade and repairs	0.21	0.92	0.39	0.96	0.95	0.62	0.95	0.97
Hotels and restaurants	0.27	0.33	0.60	0.23	0.44	0.35	0.49	0.67
Transport, storage & auxiliary activities	0.56	0.59	0.59	0.62	0.69	0.48	0.54	0.65
Post and telecommunications	0.39	0.35	0.52	0.33	0.55	0.36	0.58	0.65
Finance	0.60	0.63	0.55	0.47	0.62	0.46	0.72	0.36
Renting of machinery and equipment	0.62	0.45	0.30	0.31	0.61	0.53	0.40	0.24
Computer activities	0.59	0.43	0.48	0.55	0.73	0.51	0.66	0.53
Research and development	0.78	0.77	0.85	0.90	0.98	0.56	0.86	0.97
Other business activities	0.77	0.68	0.64	0.51	0.77	0.59	0.80	0.75
Other services	0.56	0.30	0.54	0.65	0.55	0.47	0.56	0.62

Note: Services trade data are from the year 2005 or from the latest year available. The shares for services (goods) industries are calculated using 40 (159) importing countries.

Table 11. Share of intermediate to total imports by country and industry (2006)

Importing Country	*Aggregate industry*		
	Primary	**Manufacturing**	**Services**
Argentina	0.94	0.55	0.65
Australia	0.96	0.38	0.52
Austria	0.89	0.55	0.85
Belgium	0.90	0.52	0.90
Brazil	0.97	0.67	0.67
Canada	0.86	0.50	0.86
Switzerland	0.77	0.47	0.78
Chile	0.98	0.43	-
China	0.99	0.71	0.87
Chinese Taipei	0.98	0.69	-
Czech Republic	0.89	0.62	0.70
Germany	0.89	0.54	0.91
Denmark	0.62	0.45	0.79
Spain	0.92	0.47	0.87
Estonia	0.71	0.50	0.87
Finland	0.95	0.51	0.79
France	0.89	0.49	0.79
United Kingdom	0.83	0.42	0.78
Greece	0.94	0.37	0.77
Hungary	0.92	0.63	0.85
Indonesia	0.95	0.66	0.58
India	0.97	0.68	0.48
Ireland	0.85	0.48	0.95
Iceland	0.54	0.39	-
Israel	0.99	0.57	-
Italy	0.92	0.52	0.83
Japan	0.97	0.51	0.67
Korea	0.98	0.65	0.73
Luxembourg	0.52	0.45	0.98
Mexico	0.90	0.63	0.83
Netherlands	0.88	0.51	0.71
Norway	0.66	0.48	0.71
New Zealand	0.92	0.37	0.88
Poland	0.88	0.60	0.66
Portugal	0.90	0.50	0.86
Russia	0.49	0.34	0.84
Slovak Republic	0.94	0.59	0.83
Slovenia	0.77	0.59	0.70
Sweden	0.83	0.51	0.91
Turkey	0.98	0.61	0.62
United States	0.95	0.43	0.54
South Africa	0.99	0.44	0.50

Note: Services trade data are from the year 2005 or from the latest year available. The sign "-" indicates that no services trade data are available for the respective country.

Figure 8. Share of intermediate to total trade flows by region (2006) - Goods[31]

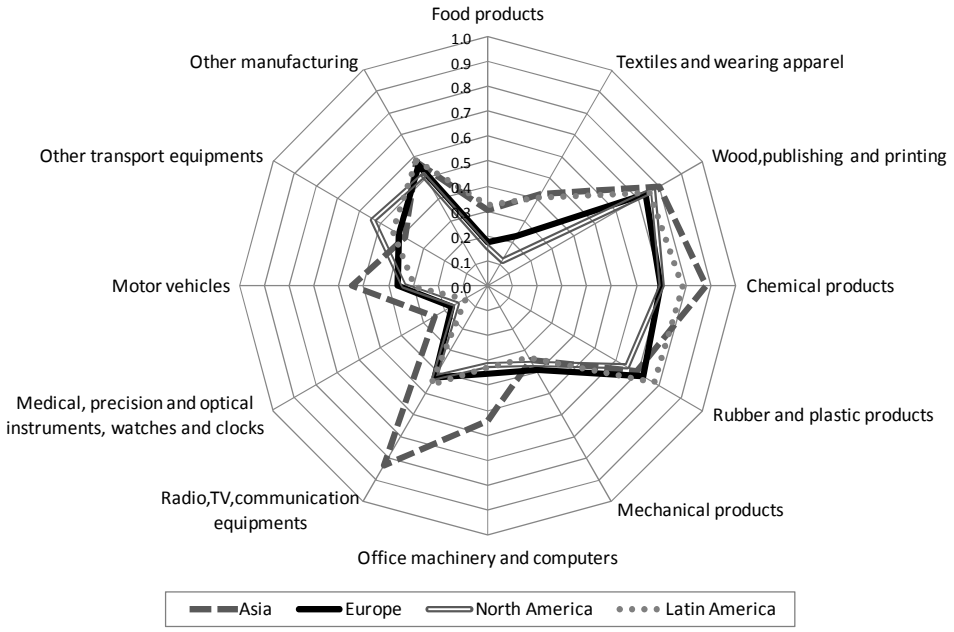
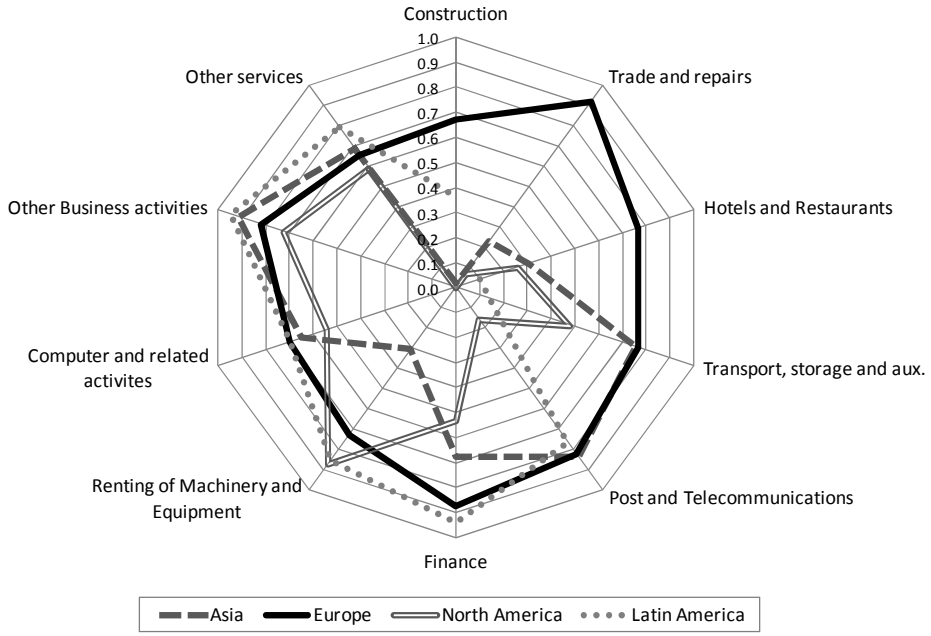


Figure 9. Share of intermediate to total trade flows by region (2005) – Services[31]



31 . Figure 8 - Manufacturing industries not shown: refined petroleum products; metal products; electricity, gas and water supply. Figure 9 - Services industries not shown: research and development.

Table 12. Share of intermediate to total trade flows by partner region (2006) - Goods

	Exporting Region							
Importing Country	Asia	CIS	Europe	Latin America	Middle East North Africa	North America	Oceania	Sub-Saharan Africa
Argentina	0.51	0.99	0.58	0.57	0.77	0.52	0.92	0.95
Australia	0.42	0.83	0.35	0.58	0.88	0.43	0.63	0.31
Austria	0.31	0.91	0.57	0.50	0.89	0.59	0.56	0.92
Belgium	0.46	0.98	0.57	0.63	0.87	0.62	0.74	0.82
Brazil	0.67	0.99	0.64	0.76	0.97	0.70	0.90	1.00
Canada	0.34	0.91	0.55	0.75	0.93	0.55	0.51	0.90
Switzerland	0.40	0.92	0.47	0.62	0.64	0.56	0.25	0.93
Chile	0.29	0.39	0.48	0.70	0.57	0.50	0.82	0.99
China	0.74	0.93	0.54	0.98	0.99	0.68	0.95	1.00
Czech Republic	0.51	0.98	0.64	0.47	0.56	0.50	0.78	0.69
Germany	0.37	0.96	0.60	0.66	0.83	0.54	0.58	0.78
Denmark	0.30	0.86	0.48	0.70	0.29	0.43	0.15	0.54
Spain	0.35	0.98	0.51	0.59	0.88	0.58	0.70	0.86
Estonia	0.33	0.84	0.51	0.29	0.35	0.37	0.32	0.41
Finland	0.40	0.98	0.55	0.78	0.58	0.56	0.91	0.85
France	0.32	0.97	0.56	0.76	0.81	0.59	0.70	0.80
United Kingdom	0.37	0.97	0.45	0.65	0.69	0.58	0.49	0.76
Greece	0.18	0.99	0.39	0.74	0.97	0.40	0.18	0.42
Hungary	0.60	0.97	0.63	0.76	0.44	0.64	0.39	0.80
Indonesia	0.70	0.99	0.54	0.89	0.99	0.71	0.86	0.89
India	0.67	0.94	0.68	0.90	0.98	0.58	0.96	0.95
Ireland	0.56	0.92	0.49	0.48	0.60	0.49	0.33	0.74
Iceland	0.23	0.64	0.45	0.78	0.42	0.26	0.18	0.18
Israel	0.55	0.98	0.63	0.67	0.79	0.63	0.65	0.71
Italy	0.41	0.97	0.51	0.79	0.91	0.61	0.88	0.91
Japan	0.54	0.85	0.44	0.81	0.99	0.60	0.86	0.89
Korea	0.70	0.88	0.53	0.90	0.99	0.63	0.89	0.98
Luxembourg	0.56	0.62	0.42	0.74	0.21	0.34	0.10	0.53
Mexico	0.58	0.92	0.57	0.60	0.68	0.70	0.68	0.91
Netherlands	0.41	0.99	0.58	0.76	0.91	0.47	0.47	0.73
Norway	0.24	0.88	0.48	0.85	0.65	0.68	0.36	0.88
New Zealand	0.38	0.73	0.36	0.41	0.98	0.36	0.49	0.42
Poland	0.49	0.97	0.62	0.54	0.69	0.53	0.52	0.55
Portugal	0.50	0.85	0.51	0.84	0.97	0.67	0.40	0.86
Russia	0.27	0.65	0.33	0.32	0.21	0.25	0.55	0.76
Slovak Republic	0.42	0.98	0.64	0.60	0.55	0.49	0.73	0.74
Slovenia	0.44	0.99	0.59	0.82	0.92	0.52	0.88	0.95
Sweden	0.34	0.97	0.55	0.82	0.67	0.53	0.70	0.56
Turkey	0.50	0.98	0.61	0.80	0.97	0.60	0.84	0.94
Chinese Taipei	0.73	0.98	0.52	0.93	0.99	0.64	0.88	0.99
United States	0.33	0.94	0.50	0.74	0.90	0.59	0.43	0.95
South Africa	0.34	0.96	0.44	0.67	0.97	0.48	0.76	0.93

Table 13. Top 3 industries where imported intermediate inputs are used, by sector (2005)

Imported intermediate input industry	Top 3 user industries and percentage of total imports for that input (2005)			
	OECD countries	%	Accession and enhanced engagement countries	%
1. Agriculture and fishing	3. Food products, beverages and tobacco	60.0%	3. Food products, beverages and tobacco	43.9%
	1. Agriculture and fishing	13.6%	1. Agriculture and fishing	20.6%
	5. Wood, publishing and printing	8.1%	4. Textiles and wearing apparel	10.5%
2. Mining and quarrying	6. Refined petroleum & other treatments	61.3%	9. Metal products	42.5%
	17. Electricity, gas and water	20.6%	6. Refined petroleum & other treatments	28.5%
	9. Metal products	5.4%	7. Chemical products	7.4%
3. Food products, beverages and tobacco	3. Food products, beverages and tobacco	45.3%	3. Food products, beverages and tobacco	46.6%
	20. Hotels and restaurants	27.9%	1. Agriculture and fishing	23.2%
	29. Other services	8.0%	20. Hotels and restaurants	17.6%
4. Textiles and wearing apparel	4. Textiles and wearing apparel	52.6%	4. Textiles and wearing apparel	68.1%
	29. Other services	9.8%	29. Other services	6.4%
	16. Other manufacturing	7.4%	14. Motor vehicles	5.3%
5. Wood, publishing and printing	5. Wood, publishing and printing	38.8%	5. Wood, publishing and printing	34.9%
	18. Construction	12.9%	29. Other services	10.1%
	16. Other manufacturing	7.8%	16. Other manufacturing	8.3%
6. Refined petroleum & other treatments	21. Transport, storage & auxiliary activities	23.1%	21. Transport, storage & auxiliary activities	33.5%
	7. Chemical products	17.2%	7. Chemical products	9.1%
	29. Other services	11.9%	9. Metal products	8.1%
7. Chemical products	7. Chemical products	37.6%	7. Chemical products	34.7%
	29. Other services	14.9%	29. Other services	8.7%
	8. Rubber and plastic products	12.5%	4. Textiles and wearing apparel	6.6%
8. Rubber and plastic products	14. Motor vehicles	13.5%	18. Construction	31.8%
	18. Construction	12.6%	14. Motor vehicles	14.0%
	8. Rubber and plastic products	10.4%	11. Office machinery and computers	10.8%
9. Metal products	9. Metal products	42.9%	9. Metal products	32.4%
	10. Mechanical products	10.4%	18. Construction	17.2%
	14. Motor vehicles	10.2%	10. Mechanical products	11.5%
10. Mechanical products	10. Mechanical products	33.4%	10. Mechanical products	24.2%
	14. Motor vehicles	10.6%	14. Motor vehicles	10.6%
	18. Construction	10.4%	18. Construction	9.3%
11. Office machinery and computers	11. Office machinery and computers	33.4%	11. Office machinery and computers	66.5%
	29. Other services	18.0%	28. Other business activities	7.3%
	19. Trade and repairs	6.6%	22. Post and telecommunications	4.6%
12. Radio, TV, communication equipments	12. Radio, TV, communication equipments	39.5%	12. Radio, TV, communication equipments	70.8%
	14. Motor vehicles	11.0%	19. Trade and repairs	7.1%
	22. Post and telecommunications	8.4%	16. Other manufacturing	4.8%
13. Medical, precision and optical instruments	29. Other services	38.1%	18. Construction	15.9%
	13. Medical, precision and optical instruments	20.8%	17. Electricity, gas and water	12.8%
	10. Mechanical products	8.7%	29. Other services	11.2%
14. Motor vehicles	14. Motor vehicles	70.2%	14. Motor vehicles	56.6%
	19. Trade and repairs	13.5%	21. Transport, storage & auxiliary activities	11.7%
	29. Other services	4.5%	19. Trade and repairs	10.0%
15. Other transport equipments	15. Other transport equipments	49.5%	21. Transport, storage & auxiliary activities	38.7%
	29. Other services	31.5%	15. Other transport equipments	36.7%
	21. Transport, storage & auxiliary activities	12.7%	18. Construction	7.2%
16. Other manufacturing (includes non-metal products, electrical machinery, recycling and furniture)	18. Construction	21.4%	11. Office machinery and computers	18.1%
	16. Other manufacturing	20.0%	16. Other manufacturing	17.5%
	29. Other services	11.3%	18. Construction	10.3%

Table 13. Cont.

Imported intermediate input industry	Top 3 user industries and percentage of total imports for that input (2005)			
	OECD countries	%	Accession and enhanced engagement countries	%
17. Electricity, gas and water	17. Electricity, gas and water	36.6%	17. Electricity, gas and water	21.4%
	29. Other services	12.6%	9. Metal products	13.9%
	19. Trade and repairs	6.3%	7. Chemical products	8.9%
18. Construction	18. Construction	64.0%	29. Other services	33.2%
	24. Real estate	8.3%	28. Other business activities	10.5%
	29. Other services	5.6%	24. Real estate	9.8%
19. Trade and repairs	19. Trade and repairs	30.7%	21. Transport, storage & auxiliary activities	85.2%
	3. Food products, beverages and tobacco	6.7%	7. Chemical products	2.2%
	9. Metal products	6.0%	3. Food products, beverages and tobacco	2.1%
20. Hotels and restaurants	21. Transport, storage & auxiliary activities	18.3%	21. Transport, storage & auxiliary activities	37.7%
	29. Other services	18.3%	29. Other services	14.2%
	19. Trade and repairs	17.4%	28. Other business activities	6.3%
21. Transport, storage & auxiliary activities	21. Transport, storage & auxiliary activities	42.3%	21. Transport, storage & auxiliary activities	21.2%
	19. Trade and repairs	13.5%	18. Construction	7.7%
	29. Other services	9.1%	9. Metal products	7.4%
22. Post and telecommunications	22. Post and telecommunications	46.5%	22. Post and telecommunications	33.4%
	23. Finance	11.3%	18. Construction	12.7%
	29. Other services	9.5%	29. Other services	8.6%
23. Finance	23. Finance	54.3%	21. Transport, storage & auxiliary activities	21.0%
	24. Real estate	7.7%	23. Finance	12.9%
	19. Trade and repairs	6.3%	19. Trade and repairs	8.3%
25. Renting of machinery and equipment	21. Transport, storage & auxiliary activities	17.4%	21. Transport, storage & auxiliary activities	78.0%
	18. Construction	11.5%	18. Construction	4.8%
	29. Other services	11.5%	29. Other services	2.9%
26. Computer activities	29. Other services	19.6%	18. Construction	14.8%
	26. Computer activities	14.9%	19. Trade and repairs	11.2%
	23. Finance	11.2%	23. Finance	8.9%
27. Research and development	7. Chemical products	20.8%	7. Chemical products	16.1%
	29. Other services	17.3%	28. Other business activities	9.5%
	27. Research and development	8.9%	16. Other manufacturing	7.8%
28. Other business activities	28. Other business activities	28.1%	23. Finance	14.5%
	29. Other services	13.5%	28. Other business activities	11.9%
	19. Trade and repairs	11.0%	19. Trade and repairs	9.7%
29. Other services (includes education, health, social and personal services)	29. Other services	50.8%	29. Other services	21.7%
	22. Post and telecommunications	12.0%	19. Trade and repairs	9.6%
	28. Other business activities	6.7%	3. Food products, beverages and tobacco	7.9%

Table 14. Simple average applied tariff rates for intermediate, consumption and capital goods and change between 1996 and 2005

Industry	All goods	96-05	Intermediate goods	96-05	Consumption goods	96-05	Capital goods	96-05
Agriculture and fishing	6.5	-24%	5.9	-3%	7.1	-36%	8.8	100%
Mining and quarrying	1.2	-85%	1.2	-85%				
Food products	13.8	-27%	14.8	-15%	13.4	-30%		
Textiles and wearing apparel	10.2	-30%	7.3	-39%	11.9	-28%		
Wood,publishing and printing	3.4	-46%	3.6	-47%	3.1	-43%		
Refined petroleum & other treatments	1.9	-35%	1.9	-36%			2.7	67%
Chemical products	3.6	-32%	3.4	-31%	4.7	-38%		
Rubber and plastic products	6.3	-29%	6.1	-27%	6.9	-35%		
Metal products	4.6	-31%	4.2	-33%	6.8	-26%	5.7	-26%
Mechanical products	3.5	-39%	3.5	-33%	6.3	-40%	3.1	-43%
Office machinery and computers	1.5	-63%	1.1	-65%	3.3	-61%	1.6	-63%
Radio,TV,communication equipments	2.9	-57%	2.1	-58%	6.3	-45%	3.2	-59%
Medical, precision and optical instruments	2.9	-39%	3.3	-34%	3.7	-34%	2.5	-45%
Motor vehicles	6.3	-36%	5.8	-31%	6.2	-33%	6.5	-36%
Other transport equipments	3.0	-31%	1.6	-33%	4.6	-32%	3.8	-25%
Other manufacturing	5.1	-32%	5.2	-29%	5.5	-35%	4.2	-39%

Notes: Industry averages have been calculated for countries with tariff data in both 1996 and 2005: Argentina, Australia, Brazil, Canada, China, Chinese Taipei, European Union, Indonesia, Japan, New Zealand, Russia, South Africa, Switzerland, United States.

Source : Tariff data come from the UNCTAD TRAINS database.

ANNEX 3. ECONOMETRIC ANALYSIS AND REGRESSION RESULTS

Gravity regressions

The model used in the analysis of bilateral trade flows is a standard gravity equation estimated with country specific, time and (when relevant) industry fixed effects. The results are Poisson Maximum Likelihood estimates in order to take into account trade flows that are equal to zero (see Santos Silva and Tenreyro, 2006). It is important to correct for this bias as bilateral imports of intermediates comprise more zeros than it is the case for total trade.

The equation estimated is:

$$Trade_{ijpt} = \beta_0 + \beta_1 \log distance_{ij} + \sum_{n=2}^{4} \beta_n dummy_{ij} + \beta_5 sumlogGDP_{ijt} + \beta_6 EU + \beta_7 Nafta + \gamma_i + \eta_j + \lambda_t + \kappa_p + \varepsilon_{ijpt}$$

where*:*

Trade is bilateral imports of total, intermediate or consumption goods/services

Distance is the geographic distance between *i* and *j*

Dummy refers to a set of dummy variables indicating whether the two countries have: (i) a common border; (ii) a common language and (iii) past colonial relationships

sumlogGDP is the sum of the (log of) the reporter and partner country GDP

γ = reporter country fixed effects

η = partner country fixed effects

λ = year fixed effects

κ = industry fixed effects

i = reporter country subscript

j = partner country subscript

p = product subscript

t = year subscript

In Table 16 cif-fob ratios and applied bilateral tariffs (simple average) are used instead of the distance variable:

Cif-Fob = ln[(cif-fob)/fob] ; cif-fob ratios proxy for transport costs.

Tariff = ln(0.01+tariff rate); tariff rates smaller or equal to 0.01 have been set to 0.01.

Alternatively, the same regression can be run for $Trade_{ijkt}$ which corresponds to trade flows aggregated at the using industry level (*k*) rather than the product level (*p*). The same specification is used.

Ratio of foreign inputs to domestic inputs

In addition, a model is run with the ratio of foreign to domestic inputs (for product *p* in industry *k*) as the dependent variable and additional variables such as the trade and investment cost or inward and outward stocks of FDI or sales of foreign affiliates (FATS):

$$Foreign\ ratio_{ijkt} = \beta_0 + \beta_1 \log distance_{ij} + \sum_{n=2}^{4} \beta_n dummy_{ij} + \beta_5 sumlog GDP_{ijt} + \beta_6 Cif\text{-}Fob\ tot_{ijkt} + \beta_7 Cif\text{-}Fob\ int_{ijkt} + Inv\ cost_{it} + Inward\ FDI_{ijkt} + Outward\ FDI_{ijkt} + \gamma_i + \eta_j + \lambda_t + \kappa_k + \varepsilon_{ijpt}$$

where in addition to previous variables:

Foreign ratio is the ratio of foreign to domestic inputs (at the bilateral and using industry level)

Cif-Fob tot are the transport costs for total trade, measured by the cif-fob factors

Cif-Fob int are the transport costs for intermediate goods, measured by the cif-fob factors

Inv cost are the investment costs in the importing economy as measured by the foreign investment index of the *Index of Economic Freedom*

Inward FDI and *Outward FDI* are the inward and outward bilateral investment stocks. We use also the inward and outward bilateral FATS (Foreign Affiliate Trade in Services).

Trade in intermediates and its relation to operations of Multinational Enterprises (MNEs)

In order to analyse the impact of the operations of MNEs on trade in intermediate imports, inward and outward foreign direct investment stocks are added to gravity regressions. Different to main gravity regressions, intermediate imports are not measured by industry of origin *p* but have been aggregated by using industry *k*. The following regression model is estimated for intra-industry imports (p=k) and for inter-industry imports (p≠k).

$$Trade_{ijpkt} = \beta_0 + \beta_1 Inward\ FDI_{ijk} + \beta_2 Outward\ FDI_{ijkt} + \beta_3 \log distance_{ij} + \sum_{n=4}^{6} \beta_n dummy_{ij} + \beta_7 sumlog GDP_{ijt} + \gamma_i + \eta_j + \lambda_t + \kappa_k + \varepsilon_{ijkt}$$

The model is estimated by Ordinary Least Squares (OLS) and by 2-Stage-Least-Squares (2SLS) using lagged changes of FDI stocks, i.e. lags of $\ln(FDI_t/FDI_{t-1})$ as instruments for current levels of FDI stocks.

Estimation of production functions at the country and industry level

To assess the relationship between trade in intermediate inputs and productivity growth, production functions are estimated at the sector level (using the industry classification presented in Table 4). The analysis starts with a pooled OLS regression where in addition to primary inputs (capital and labour) the

share of foreign intermediate inputs used in the production process is included as an independent variable. The function estimated is:

$$\log PRDK_{ikt} = \beta_0 + \beta_1 \log CNPK_{ikt} + \beta_2 \log LABR_{ikt} + \beta_3 \log INTK_{ikt} + \beta_4 foreign\_int_{ikt} + \varepsilon_{ikt}$$

where:

PRDK is real gross output

CNPK the net capital stock (in volumes)

LABR labour costs (compensation of employees)

INTK intermediate input (in volumes)

foreign_int the share of foreign inputs in total inputs (calculated from the I/O tables)

and where the subscripts *ikt* stand for country *i,* industry *k* at time *t.* In a specification, fixed effects are introduced in the three dimensions of the panel (country, time and industry).

The data on production, labour costs and capital stocks come from the OECD STAN database (edition 2008). For the period of interest (1995-2005), these data are available for 10 OECD countries (out of 26 in the database).

To correct for heteroscedasticity, the OLS estimation is run with robust standard errors. There is however another bias that we need to correct for in the estimation: the "simultaneity bias" related to the endogeneity in the selection of inputs. While some authors use corrections such as the "Olley-Pakes" or "Levinsohn and Petrin" approach (using a proxy for productivity shocks), we resort to a dynamic panel estimation *à la* Arellano-Bover/Blundell-Bond[32]. This is a GMM estimation where the lagged output is introduced as an instrument and that includes lagged variables correcting for the endogeneity in input selection.

Stochastic frontier analysis

Stochastic frontier analysis was first introduced by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). It assumes a stochastic frontier that bounds production and is common to all countries in a given period. It considers a production function where the error term has two components, one to account for random effects and one to account for technical inefficiency.

Battese and Coelli (1995) have developed a stochastic production function to work with panel data and where inefficiency effects can be explained by additional variables. The model estimated is:

$$\log PRDK_{ikt} = \beta_0 + \beta_1 \log CNPK_{ikt} + \beta_2 \log LABR_{ikt} + \beta_3 year_t + v_{ikt} - u_{ikt}$$

where PRDK is real output, CNPK the capital stock and LABR the compensation of employees (as in the previous estimation). A trend is added (*year*) to account for Hicksian neutral technological change (a uniform shift in the production possibility frontier). u_{ikt} are non-negative random variables which are assumed to account for technical inefficiency in production and are assumed to be independently

32. Arellano and Bover (1995), Blundell and Bond (1998). See also Olley and Pakes (1996) and Levinsohn and Petrin (2003).

distributed as truncations at zero of a normal distribution. There is the following relationship between u_{ikt} and technical efficiency:

$$TE_{ikt} = \exp(-u_{ikt})$$

The technical inefficiency effects are assumed to be defined by:

$$u_{ikt} = \delta_0 + \delta_1 InFDI_{ikt} + \delta_2 foreign\_int_{ikt} + w_{ikt}$$

where *InFDI* is the stock of foreign direct investment and *foreign_int* is the ratio of foreign inputs on domestic inputs (calculated from the input-output tables) and *w* a random term. These two variables are assumed to impact the efficiency of country *i* in its use of inputs (labour and capital). While technological progress is defined by the production frontier for all countries and increases each year at the rate measured by the total factor productivity (measured by the variable *year*), countries are close or far from the frontier depending on how efficient they are in the use of their inputs. The distribution of countries behind the frontier is analysed as a truncation of normal distributions with constant variance with means that are a linear function of the two above variables: the foreign direct investment stock and the share of foreign intermediate inputs in total intermediate inputs. What the regression measures is how these variables influence the distribution of countries behind the frontier (how "inefficiency effects" are distributed).

To estimate the above functions, the FRONTIER software (version 4.1) developed by Tim Coelli is used. Results are reported in Table19. The two first Columns check whether the stochastic frontier analysis works in the case of our dataset. In the first specification, time-invariant inefficiency effects are assumed (eta restricted to zero). The gamma coefficient which measures the proportion of total variability associated with technical inefficiency has a high value and is very significant. It implies that technical inefficiency can explain cross-country variations in real output. In the second specification, with time-variant inefficiency effects, the eta parameter is significant. It captures the rate of decline of inefficiency over time (and hence the improvement in productivity due to efficiency). These results indicate that it is worth testing the inefficiency model proposed above and that the assumptions of Battese and Coelli (1995) are satisfied. It is done in Columns (3) and (4) of the Table.

Table 15. Pooled gravity regressions

	All industries		Goods industries					Services industries			
	Total	Inter-mediates	Total	Inter-mediates	Cons-umption	Capital	Intra-industry interm.	Total	Inter-mediates	Final	Intra-industry interm.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Distance	-0.711***	-0.817***	-0.701***	-0.818***	-0.698***	-0.525***	-0.811***	-0.754***	-0.770***	-0.734***	-0.772***
	(0.033)	(0.033)	(0.034)	(0.035)	(0.050)	(0.040)	(0.032)	(0.053)	(0.052)	(0.062)	(0.052)
Common border	0.317***	0.299***	0.343***	0.335***	0.336***	0.320**	0.343***	0.21	0.191	0.216	0.052
	(0.072)	(0.070)	(0.075)	(0.073)	(0.090)	(0.110)	(0.079)	(0.112)	(0.107)	(0.141)	(0.113)
Common language	0.219**	0.258***	0.166*	0.202**	0.255**	0.098	0.157*	0.332**	0.370***	0.217	0.342**
	(0.070)	(0.071)	(0.076)	(0.078)	(0.096)	(0.094)	(0.075)	(0.106)	(0.104)	(0.115)	(0.111)
Past colonial rel.	-0.097	-0.28	-0.091	-0.299	0.542**	0.088	-0.189	0.027	0.06	-0.049	-0.249
	(0.188)	(0.199)	(0.198)	(0.212)	(0.167)	(0.196)	(0.184)	(0.191)	(0.212)	(0.169)	(0.150)
GDPi*GDPj	0.579***	0.516***	0.591***	0.534***	0.646***	0.788***	0.442***	0.528***	0.613***	0.292	0.661***
	(0.040)	(0.038)	(0.042)	(0.039)	(0.053)	(0.086)	(0.044)	(0.063)	(0.085)	(0.156)	(0.118)
EU	0.304***	0.207**	0.372***	0.259**	0.449***	0.323**	0.318***	-0.04	-0.08	0.031	-0.284*
	(0.081)	(0.078)	(0.085)	(0.081)	(0.132)	(0.108)	(0.081)	(0.141)	(0.129)	(0.181)	(0.141)
Nafta	0.773***	0.620***	0.940***	0.788***	0.787***	1.104***	0.842***	-0.252	-0.226	-0.318	-0.390*
	(0.114)	(0.118)	(0.120)	(0.126)	(0.190)	(0.161)	(0.123)	(0.165)	(0.163)	(0.202)	(0.154)
Pseudo R-squared	0.742	0.725	0.746	0.729	0.799	0.822	0.774	0.817	0.807	0.767	0.783
Number of obs.	650,019	650,019	572,416	572,416	529,244	336,953	572,416	77,603	77,603	77,603	77,603

Notes: Poisson maximum likelihood regressions including country, time and industry fixed effects. Clustered standard errors inside parentheses allow interdependence of observations within country pairs. *significant at 5%, **significant at 1%, ***significant at 0.1%

Table 16. Gravity regressions using cif-fob factors and tariffs

	Total	Intermediate	Consumption	Capital
	(1)	(2)	(3)	(4)
Common border	1.512***	1.478***	1.523***	1.595***
	(0.132)	(0.124)	(0.168)	(0.152)
Common language	0.078	0.208	0.051	0.002
	(0.101)	(0.107)	(0.143)	(0.119)
Past colonial rel.	0.450**	0.263	0.840***	0.359
	(0.146)	(0.178)	(0.163)	(0.201)
GDPi*GDPj	0.639***	0.536***	0.587***	0.976***
	(0.079)	(0.070)	(0.073)	(0.126)
Cif-Fob (total)	-0.117***			
	(0.022)			
Tariff (total)	-0.173***			
	(0.049)			
Cif-Fob (interm.)		-0.140***		
		(0.017)		
Tariff (interm.)		-0.187***		
		(0.053)		
Cif-Fob (cons.)			-0.051	
			(0.030)	
Tariff (cons.)			-0.166**	
			(0.059)	
Cif-Fob (capital)				-0.073***
				(0.021)
Tariff (capital)				-0.323***
				(0.074)
R-squared	0.698	0.657	0.735	0.776
Number of obs.	200,229	169,428	127,295	62,628

Notes: Poisson maximum likelihood regressions including country, time and industry fixed effects. Clustered standard errors inside parentheses allow interdependence of observations within country pairs. *significant at 5%, **significant at 1%, ***significant at 0.1%

Table 17. Gravity regressions by broad industry

	Primary			Manufacturing			Services		
	Total	Intermediates	Intra-industry interm.	Total	Intermediates	Intra-industry interm.	Total	Intermediates	Intra-industry interm.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance	-1.330***	-1.403***	-1.354***	-0.698***	-0.785***	-0.862***	-0.775***	-0.782***	-0.830***
	(0.069)	(0.080)	(0.088)	(0.035)	(0.033)	(0.035)	(0.045)	(0.045)	(0.054)
Common border	0.256	0.313	0.391*	0.321***	0.325***	0.279***	0.217*	0.188	0.350**
	(0.143)	(0.177)	(0.189)	(0.080)	(0.077)	(0.074)	(0.102)	(0.099)	(0.120)
Common language	0.175	0.199	0.023	0.169*	0.207**	0.265***	0.327***	0.366***	0.319***
	(0.176)	(0.191)	(0.198)	(0.075)	(0.072)	(0.070)	(0.081)	(0.083)	(0.086)
Past colonial rel.	0.521	0.397	1.061***	0.028	-0.086	0.209	0.106	0.167	0.353
	(0.269)	(0.298)	(0.304)	(0.201)	(0.195)	(0.249)	(0.164)	(0.172)	(0.269)
GDPi*GDPj	0.549***	0.538***	0.723***	0.624***	0.537***	0.384***	0.622***	0.594***	0.452***
	(0.058)	(0.061)	(0.091)	(0.054)	(0.053)	(0.064)	(0.061)	(0.057)	(0.118)
EU	0.043	-0.311	-0.366	0.382***	0.301***	0.168*	0.094	0.097	0.005
	(0.212)	(0.233)	(0.206)	(0.090)	(0.083)	(0.084)	(0.115)	(0.111)	(0.124)
Nafta	0.046	-0.231	0.234	0.880***	0.728***	0.706***	-0.191	-0.188	-0.358*
	(0.261)	(0.298)	(0.297)	(0.121)	(0.122)	(0.118)	(0.146)	(0.145)	(0.165)
Pseudo R-squared	0.835	0.831	0.788	0.96	0.955	0.914	0.935	0.933	0.826
Number of obs.	49,738	49,738	49,738	59,912	59,912	59,912	17,845	17,845	17,845

Notes: Poisson maximum likelihood regressions including country, time and industry fixed effects. Clustered standard errors inside parentheses allow interdependence of observations within country pairs. *significant at 5%, **significant at 1%, ***significant at 0.1%

Table 18. Regressions on the ratio of foreign to domestic inputs

	Dependent variable: Ratio of foreign to domestic inputs				
	(1)	(2)	(3)	(4)	(5)
Distance	-1.248***	-1.261***	-1.061***	-0.792***	-0.777***
	(0.033)	(0.031)	(0.042)	(0.084)	(0.094)
Common border	0.436***	0.360**	0.211	0.512**	0.592**
	(0.118)	(0.123)	(0.138)	(0.191)	(0.203)
Common language	0.238**	0.261***	0.331***	-0.08	-0.2
	(0.073)	(0.069)	(0.085)	(0.134)	(0.140)
Past colonial rel.	1.126***	0.894***	-0.164	-0.934***	-1.127***
	(0.142)	(0.159)	(0.398)	(0.245)	(0.313)
Sum of log of GDP	0.441***	0.352***	0.328***	0.298	0.414
	(0.043)	(0.041)	(0.069)	(0.189)	(0.211)
Cif-Fob (total)		-0.015*	-0.002	0.055	0.05
		(0.007)	(0.011)	(0.036)	(0.033)
Cif-Fob (interm.)		0.042***	-0.035**	-0.066	-0.069*
		(0.006)	(0.012)	(0.034)	(0.034)
Investment cost		-0.429***	-0.231*	0.465	-0.108
		(0.074)	(0.096)	(0.451)	(0.561)
Inward FDI			0.024***		0.011
			(0.004)		(0.008)
Outward FDI			0.013**		0.015
			(0.004)		(0.010)
Inward FATS				0.068***	0.074***
				(0.019)	(0.020)
Outward FATS				0.061***	0.043*
				(0.016)	(0.017)
R-squared	0.645	0.683	0.746	0.888	0.882
Number of obs.	1,613,721	825,772	81,496	1,190	937

Notes: OLS regressions including country, time and industry fixed effects. Clustered standard errors inside parentheses allow interdependence of observations within country pairs. *significant at 5%, **significant at 1%, ***significant at 0.1%

Table 19. Regression results for FDI and inter- and intra-industry trade

	Intra-industry imports		Inter-industry imports		
	OLS	2SLS	All	Manuf.	Services
	(1)	(2)	(3)	(4)	(5)
Inward FDI	0.070***	0.016**	0.007*	0.006*	0.011*
	(0.003)	(0.007)	(0.004)	(0.004)	(0.006)
Outward FDI	0.044***	0.012*	-0.005	-0.008**	0.012**
	(0.003)	(0.006)	(0.004)	(0.004)	(0.006)
Distance	-1.112***	-1.111***	-0.988***	-1.044***	-0.731***
	(0.012)	(0.017)	(0.010)	(0.009)	(0.014)
Common border	0.432***	0.493***	0.434***	0.386***	0.514***
	(0.027)	(0.035)	(0.021)	(0.021)	(0.031)
Common language	0.349***	0.406***	0.400***	0.421***	0.635***
	(0.026)	(0.035)	(0.021)	(0.020)	(0.032)
Past colonial rel.	-0.064	0.164	0.121	-0.036	0.513***
	(0.085)	(0.126)	(0.077)	(0.071)	(0.064)
Sum of log of GDP	0.562***	0.568***	0.416***	0.472***	0.803***
	(0.051)	(0.089)	(0.048)	(0.045)	(0.092)
R-squared	0.67	0.67	0.763	0.795	0.676
Number of obs.	78,038	35,621	36,284	36,294	33,763

Notes: Robust standard errors inside parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. All models have been estimated using reporter, partner, year and industry fixed effects. While model (1) is a simple OLS regression, models (2) to (5) are estimated by 2SLS using changes in FDI stocks of the previous three years as instruments. This also explains the smaller number of observations in 2SLS regressions as compared to the OLS regression. Overidentification tests did not reject the hypothesis of the validity of instruments in any specification.

Table 20. Production function estimates - OLS and dynamic panel regressions

	OLS regression			Fixed effects			Dynamic panel estimation		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Labour	0.159***	0.166***	0.164***	0.098***	0.101***	0.059*	0.239***	0.240***	0.275***
	(0.006)	(0.006)	(0.007)	(0.020)	(0.021)	(0.027)	(0.003)	(0.003)	(0.002)
Capital	0.169***	0.174***	0.183***	0.216***	0.220***	0.250***	0.064***	0.063***	0.036***
	(0.005)	(0.006)	(0.007)	(0.018)	(0.019)	(0.020)	(0.002)	(0.002)	(0.002)
Intermediate inputs	0.672***	0.662***	0.635***	0.712***	0.708***	0.695***	0.689***	0.693***	0.704***
	(0.007)	(0.007)	(0.010)	(0.016)	(0.016)	(0.017)	(0.002)	(0.002)	(0.001)
Share of foreign interm.		0.019***	0.017		0.018***	0.039**		0.004***	0.006***
		(0.005)	(0.009)		(0.005)	(0.013)		(0.000)	(0.000)
Inward FDI			0.018***			0.012***			-0.005***
			(0.004)			(0.003)			(0.000)
Output (lag)							0.854***	0.837***	0.826***
							(0.002)	(0.002)	(0.002)
Labour (lag)							-0.219***	-0.214***	-0.236***
							(0.003)	(0.003)	(0.002)
Capital (lag)							-0.058***	-0.052***	-0.033***
							(0.002)	(0.003)	(0.002)
Intermediate inputs (lag)							-0.565***	-0.562***	-0.561***
							(0.001)	(0.002)	(0.002)
Number of observations	2,299	2,214	1,698	2,299	2,214	1,698	2,090	2,034	1,566
R-squared	0.986	0.986	0.984	0.991	0.991	0.991	-	-	-
Specification tests (p-values)									
- 2nd order autocorrelation							0.31	0.57	0.80
- Sargan Over identification							0.25	0.24	0.71

Notes: The dependent variable is output in all models. Fixed effects regressions include country, year and industry dummies. Standard errors inside parentheses. * significant at 5%; ** significant at 1%: *** significant at 0.1%

Table 21. Results of the stochastic frontier analysis

	Spec. 1	Spec. 2	Spec. 3 - Inefficiency effects model (Battese & Coelli, 1995)	
	Time-invariant inefficiency effects	Time-varying inefficiency effects	Ratio of foreign to domestic intermediates	Controlling for Inward FDI
	(1)	(2)	(3)	(4)
Stochastic Frontier				
β_1 (Capital)	0.483***	0.478***	0.353***	0.352***
	(0.023)	*(0.022)*	*(0.022)*	*(0.010)*
β_2 (Labour)	0.450***	0.459***	0.555***	0.506***
	(0.022)	*(0.021)*	*(0.013)*	*(0.011)*
β_3 (Year)	0.004***	0.018***	14.101***	-2.669
	(0.001)	*(0.004)*	*(0.282)*	*(8.214)*
Inefficiency Model				
δ_1 (Foreign interm.)			-0.100**	-0.034*
			(0.036)	*(0.016)*
δ_2 (Inward FDI)				-0.072***
				(0.007)
Log(likelihood)	870.67	878.95	-1,062.66	-544.74
Sigma-Squared	-1.318***	-1.254***	0.225***	0.162***
Gamma	2.966***	3.044***		
Mu	1.902***	1.990***		
Eta	Restr. to zero	-0.007***		
Number of Obs.	1727	1727	1578	1068

Standard errors inside parentheses. * significant at 5%; ** significant at 1%: *** significant at 0.1%