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Vertical Trade, Trade Costs and FDI

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VERTICAL TRADE, TRADE COSTS AND FDI

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ABSTRACT

Firms find advantages in sourcing inputs from abroad and in fragmenting their production process. On average, vertical trade represents about one third of total trade among OECD countries. This report describes and illustrates new firm strategies of vertical specialisation and explores the policy implications of new patterns of trade and FDI. It is in services industries that vertical trade has increased the most in recent years. While vertical trade seems to respond to the same determinants as the rest of exports and imports, distance-related trade costs play a more important role in explaining the volume of bilateral trade flows resulting from vertical specialisation. Distance-related costs have a lower impact on foreign direct investment and sales of foreign affiliates but there is a complementary relationship between trade and FDI. Vertical specialisation networks have created new challenges for trade policymakers. In particular, growth of bilateral exchanges between countries depends increasingly on barriers to trade and investment in the rest of the world. Moreover, the impact of a country's own trade barriers on domestic firms is significant in the context of vertical specialisation. The analysis stresses the importance of multilateral negotiations for trade and investment liberalisation.

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***Keywords*:** *Vertical trade, vertical specialization, trade costs, FDI, firm strategies, MNEs, distance, trade liberalization, export platform.*

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EXECUTIVE SUMMARY

There are several new issues to be considered and questions to be answered in a world of differentiated firm strategies and increased vertical trade. This report describes and illustrates new firm strategies, provides explanations as well as new estimates of vertical specialisation, and explores policy implications of those new patterns of international exchanges.

In the first part of the paper we investigate vertical trade conceptually and provide concrete examples of traditional and complex firm strategies, as well as the role of distance in explaining new patterns.

In a general way, vertical trade corresponds to displacement of goods (intermediate or final) associated with an evolution in the production chain. 'Vertically specialised' production is the result of these vertical trade links. The term describes exports being produced using foreign inputs. Apart from the standard distinction between horizontal and vertical exchanges, two complex patterns emerge: (i) the 'export-platform' model, when a country is being used by firms as a 'platform' to serve, through exports, a series of other markets geographically nearby; and (ii) the 'vertical specialisation' pattern when firms exploit efficiency advantages at multiple stages of the production process by linking sequentially facilities at several countries. Numerous hybrid versions of the above models are also being illustrated. As it becomes clear from the analysis, not all modes of FDI are associated with trade. Furthermore, when they do, we observe significant differences in the nature and direction of trade they enhance.

Firms find advantages in producing abroad and in fragmenting their production process, be it by serving foreign markets through arm's length trade or through foreign affiliates. But there are additional costs associated with international production and sourcing. Distance-related trade and FDI costs are costs directly affected by, but also indirectly associated with geographical distance. The latter are based on high correlation of geographical to 'regulatory', and 'cultural distance' between countries, which in turn impact on the cost of trade and FDI in a number of complex modes. The analysis highlights that not all distance-related costs are relevant to all patterns of exchange. It is additionally pointed out that from an empirical, as well as a policy point of view, distance-related costs are more likely to remain unaffected if there is symmetric treatment of all markets.

On average, vertical trade represents about 31% of total trade among OECD countries, accession countries and enhanced engagement economies. While manufacturing industries reveal the highest share of vertical specialisation (35%), it is in services that vertical trade has increased the most in recent years (+50%). Large economies tend to have a smaller share of vertical trade as more inputs are sourced domestically, but we also find variations among OECD countries that are consistent with the plurality of patterns described in part I.

A quantitative analysis is carried out to analyse the role of distance-related trade (and FDI) costs in explaining vertical trade. There are two results to be highlighted. First, vertical trade seems to respond to the same determinants as the rest of imports and exports. Distance-related trade costs play an important role in the volume of bilateral trade: on average a reduction of 10% in these costs is associated with an increase of 9% in vertical trade. FDI distance-related costs are found to be lower and sales of foreign affiliates are also less affected by distance. The results suggest a complementary relationship between

vertical trade, FDI and sales of foreign affiliates as all three variables are negatively affected by the distance between countries and positively by the size of markets. This tends to indicate that vertical specialisation is indeed prevalent as vertical trade and activities of multinationals increase together in countries where distance-related costs do not discourage trade and FDI.

Patterns of interaction between trade and FDI point at specific policy issues discussed in the third part of the paper. Identifying country-specific as well as sector-specific dynamics proves to be essential in guiding policy. Nonetheless, five novel policy issues of general relevance are:

(i) Growth of bilateral exchanges between countries depends increasingly on barriers to trade and investment in the rest of the world. The fact stresses again the importance of multilateral negotiations for trade and investment liberalisation and of the harmonisation of rules in bilateral and regional trade agreements.

(ii) Policy cannot interfere with all types of distance-related costs. Costs associated with spatial and regulatory distance can be influenced by policy, while costs associated with cultural distance are less likely to be impacted. The policy challenge in bringing markets 'closer' consists of balancing costs that cannot be altered, with policies affecting costs that can.

(iii) The impact of a country's own trade barriers on domestic firms is significant in the context of vertical specialisation. Duty drawbacks (that is tax exemptions for imports of inputs used in domestic production) can to a certain extent address this issue. A general policy of trade liberalisation aiming at the elimination of tariffs remains however the first-best response to avoid market distortions.

(iv) Since demand for inputs is increasingly customized to the needs of the final producer, higher monopoly power of input suppliers followed by a potential hold-up problem from the lack of alternative uses of the inputs has an impact on market structures. Governments could address the international dimension of this competition issue.

(v) Lastly, while ultimately improving efficiency should be beneficial to all, the effect of new complex strategies on price levels for final consumption, as well as employment, point to the importance of taking social issues into account. Short-run social costs should be taken into consideration when evaluating benefits from supporting different patterns of exchanges.

VERTICAL TRADE, TRADE COSTS AND FDI

1. The importance of multinational enterprises (MNEs) and foreign direct investment (FDI) has grown dramatically over the two last decades. Apart from contributing to trade through stimulation of economic activity and competition, MNEs generate a significant share of world trade through cross-border interaction of their affiliates specialised in different stages of the production process. The nature of trade they create (in intermediate or final goods) depends on the way firms choose to organise their production across borders, as well as the driving forces in terms of costs and targeted markets.

2. Although many companies are "globalised", borders still exist and empirical studies confirm the role of distance and geography in defining trade patterns and the volume of trade. Distance is in fact a proxy for distance-related trade costs, that is all the costs associated with discovering markets, moving goods and supplying services in a remote country. These costs are likely to be different across and among manufacturing and services sectors. Moreover, these costs are regarded as the main variable that explains the choice between exports and FDI, as well as one of the primary determinants of the vertical specialisation strategy, which has led to new patterns of trade.

3. Vertical specialisation networks have created new challenges for trade policymakers. While vertical trade is now widely discussed in the analysis of trade, the policy conclusions of its recent increase are still unclear. This report contributes to the literature by describing and illustrating new firm strategies of vertical specialisation, by providing new estimates of vertical trade and the role of distance-related trade costs and by exploring the policy implications of new patterns of trade and FDI. In particular, services sectors, which have been less studied, are included in the analysis.

Part I. Understanding vertical trade and complex firm strategies

4. Contrary to basic intuition, the distinction between horizontal and vertical trade is not equivalent to trade in final and intermediate goods. In a general way, vertical trade corresponds to displacement of goods (intermediate or final) associated with an evolution in the production chain. 'Vertically specialised' production is the result of these vertical trade links. The term describes exports being produced using foreign inputs[1]. If vertical specialisation of a series of locations involves also the moving of a final good back to the home country, then that last exchange is also considered vertical (See Box 1 for an illustration).

5. Using the same terminology, we can also easily distinguish between two basic types of MNEs according to the type of FDI they engage in: horizontal and vertical. Taking a broad approach horizontal MNEs can be described as firms whose production process is not fragmented across international borders and vertical MNEs as the opposite case. In other words, a multinational firm that establishes facilities replicating the *entire* production process in a foreign country is classified as horizontal, while a firm that transfers only part of the production process abroad is classified as vertical[2].

1. In our definition of vertical trade we do not exclude inter-industry exchanges since inputs and output of production can also target firms in different sectors.

2. Following Zhang and Markusen (1999) we classify the special case of cross-border separation between headquarters and the entire production facilities also as vertical FDI, as long as production facilities exist only in a foreign country.

Box 1. Vertical trade in East Asia: the example of Toyota, Thailand

The last two decades have witnessed a significant share of world trade moving towards patterns of "vertical specialisation". In East Asia, the "unbundling" of production started in the 1980s with Japanese manufacturers offshoring labour-intensive stages of production to China, Thailand, Malaysia, Indonesia and Vietnam. The automobile industry, together with the electronics and semi-conductors industry, has pioneered this new division of labour where tasks are performed in different nations to minimize costs.

Today, intra-regional differences in wages, productivity and resources lead to further fragmentation within ASEAN countries. This can be illustrated by the subsidiary of the Japanese car manufacturer Toyota in Thailand that produces cars for the ASEAN market using components imported from Indonesia, Malaysia and the Philippines (from other Toyota affiliates or from non-Toyota suppliers), as well as Japan.

A typical passenger car is composed of more than 30,000 parts and Toyota outsources as much as 70% of components. Japanese manufacturers generally organise the production networks into three layers of suppliers. In the first layer are suppliers that are affiliates of Toyota (vertical integration). The second layer is made of suppliers who have close relationships with the car manufacturer ('keiretsu' suppliers) while the third layer includes independent suppliers.

Anukoonwattaka (2007) reports that of over 1,900 imported components used in three different passenger-car models produced by Toyota Thailand, about 16% come from vertically integrated suppliers (other Toyota affiliates in ASEAN countries), 32% from 'keiretsu suppliers' and 52% from independent suppliers. Only ASEAN imports are covered (otherwise between 40% and 70% of the components are imported from Japan). It is thus a relatively low share of inputs that are produced in-house and exchanged between Toyota affiliates. This category covers mainly high-value components that are capital-intensive. The rest of the components come from independent suppliers more than from the core Toyota suppliers ('keiretsu' suppliers). Anukoonwattaka (2007) further indicates that tariff reductions in the ASEAN zone would further increase the outsourcing of imports.

The case of imported inputs in the production of cars that Toyota Thailand exports to other ASEAN countries, is a typical example of vertical trade that involves a firm that is already a subsidiary of an MNE in a pattern mixing export platform FDI (Thailand being the platform country chosen by Toyota to overcome external tariff barriers) and vertical specialisation (within the ASEAN).

Source: Anukoonwattaka (2007), Baldwin (2006), Dyer *et al.* (1998), Takeishi and Cusumano (1995).

6. The link between these two types and the driving forces for establishing production facilities abroad is intuitive: A firm seeking to exploit cross-country productivity differentials will transfer *only* the part of the production process that can be delivered more efficiently in the foreign country. In that case, the output produced abroad is more likely to be shipped back to the country of origin for further processing or consumption. On the other hand, a firm serving a foreign market through exports and seeking to avoid high transportation costs will transfer its entire production process to that market. In the latter case, the final product is more likely to remain in the foreign country for consumption.

7. As it becomes clear, we can distinguish between vertical and horizontal FDI using three elements:

- the fragmentation or not of the production process (fragmented facilities across borders associated with vertical FDI)
- the driving forces for the investment (market-seeking associated with horizontal, as opposed to efficiency-seeking with vertical FDI)
- the market to be served with the final product (destination market other than the country of production associated with vertical FDI).

8. There is no consensus on one single definition for these two modes of FDI. All three approaches can be found in the literature, putting additional weight on the definition of FDI used each time[3].

Vertical trade in the context of complex firm strategies

9. The final product is more likely to be shipped back home when FDI is vertical or remain in the foreign country when horizontal, but it is important to note that this is just the simplest case of MNE strategy. The mode of FDI a firm chooses does not exclude the option of serving markets other than Home in the case of vertical, and other than Foreign in horizontal FDI. The combination of (i) the mode of FDI chosen to produce a final good and (ii) the destination market to be served, gives rise to the so-called 'complex firm strategies' or 'complex FDI'.

10. Trade is generated *during* the production process as well as *after* it is completed. Thus identifying these strategic combinations proves to be central in understanding the nature and volume of trade expected as new exchange patterns prevail. For a long time, the simple horizontal approach dominated the literature: trade and FDI have been described as substitutes with respect to distance. Because a partner country is far and trade costs are high, a company is encouraged to invest and sell goods and services locally. In the context of vertical FDI, trade and investment can be seen as complements rather than substitutes. The further a partner country is, the less important are trade *and* investment flows. From a policy point of view, we focus on how investment and trade-enhancing policies can be coordinated in order to achieve the maximum welfare gain from such complementary interactions.

11. Trade literature so far has identified two complex firm strategies that are of interest: the 'export-platform' and the 'vertical specialisation' pattern.

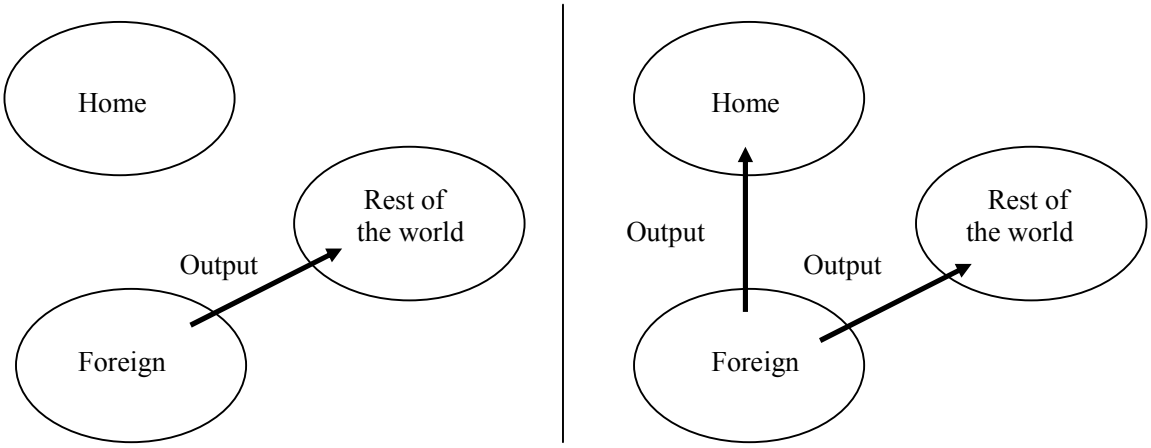
12. The first term corresponds to the case where FDI targets, not only the foreign market chosen for new production facilities, but also its neighbouring markets. In other words, 'export-platform' FDI corresponds to the case where a country is being used as a 'platform' to serve through exports a series of other markets geographically close[4]. The example of Ireland used by US firms to serve other European markets is characteristic[5] (See Box 2 for examples of export-platform in practice). The motivation is simple: to avoid transportation costs for serving a series of spatially close markets, based on one of them. The concept is hence closely linked to horizontal FDI, that is market-seeking investment, although it can also be incorporated in vertical forms of FDI.

3 . In the recent literature, Blonigen *et al.* (2007) use the firm's driving forces for distinguishing between horizontal and vertical FDI, while Baltagi *et al.* (2007) uses the destination market for the final product. Zhang and Markusen (1999) as well as Aizenman (2001) use international fragmentation of the firm as a criterion for distinguishing between horizontal and vertical MNEs.

4 . The pattern was first analysed by Hanson *et al.* (2001) and was further elaborated by Ekholm *et al.* (2003). Following the latter 'export-platform' does not only involve exports to the rest of the world; it could also include exports back to the home country. Ekholm *et al.* (2003) use also the terms "third-country EP" FDI to refer to production solely for export to third countries, "global EP" FDI for balanced exports to both parent and third countries, and "home country EP" FDI for exports back to the parent only.

5 . See Ruane *et al.* (2004)

Figure 1. Export-platform FDI



Box 2. Export-platform in practice: the electronics industry in Central Europe

As measured by gains in their shares in international exports, Hungary, the Czech Republic and Poland have successfully become export platforms for investors. Central and Eastern Europe, when compared with other regions, has specialized its export-oriented FDI on selected knowledge-intensive industries and activities, serving mostly the western European market.

The US technology firm Dell has a general policy of manufacturing its products close to its customers, implementing just-in-time (JIT) manufacturing: a term used in business to describe a strategy to improve the return on investment of a firm by reducing in-process inventory and its associated carrying costs. Apart from factories to serve the North-American market, Dell assembles computers for the European and Middle East markets at Limerick in the Republic of Ireland in two units. In 2006 the company has started the construction of a third unit in Łódź, Poland. Commenting, Paul Bell, Senior Vice President, Dell EMEA, said "Proximity to a large base of Dell customers, the significant opportunity for growth promised by the Central and Eastern European economies, and the availability of a well-educated Polish workforce were key factors in our decision".

Earlier, in 1995 Japanese TDK Electronics founded TDK Electronics Hungary Ltd. and established a greenfield production facility in Rétság, Hungary. The main purpose of this investment was to find a regional solution to the growing demand for transformers and ferrite on European markets and to reduce both logistics and shipping costs and company response times.

Following the same strategy a global leader in contract manufacturing in the electronics industry, the Singapore-based company Flextronics established two manufacturing industrial parks in Hungary and one in Poland. As announced by the company, "positioned in low cost regions of all major world markets, Flextronics Industrial Parks diminish the cost of production. Products can be produced on site and shipped directly from the Industrial Park to the OEMs (Original Equipment Manufacturers) end users, greatly reducing freight costs of incoming components and outgoing products". The company operates plants also in Mexico, Brazil, India and China.

Source: Kalotay (2002), DELL, Chikara and Weiss (1995), Flextronics.

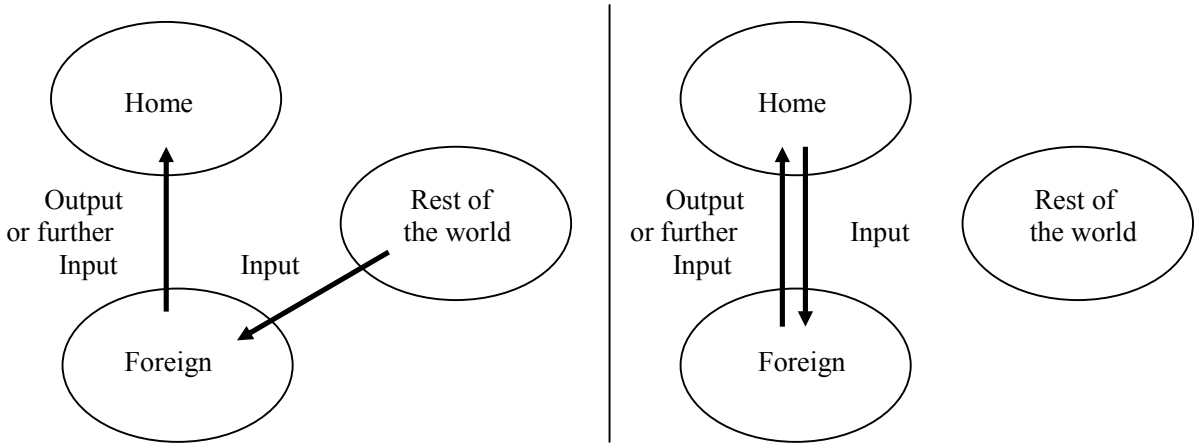
13. In figure 1 we graphically illustrate two types of export-platform FDI. Headquarters of the investing firm are at Home. Production facilities exist in the foreign country, optionally selling at the

foreign market itself. If these production facilities are used to manufacture output further exported, then we classify the investment as 'export-platform'.

14. Contrary to export-platform, 'vertical specialisation' is solely associated with vertical FDI, that is investment seeking to exploit cross-country productivity differentials. The term becomes relevant when firms exploit efficiency advantages at multiple stages of the production process by linking sequentially facilities at several countries.[6]. To be more precise, 'vertically specialised' production is the one using foreign inputs, but whose output is *not* to be used or consumed in the domestic market. We can easily notice the difference between vertical specialisation, and simple trade in intermediate goods: In the former case there is trade in intermediate goods bringing inputs inside the country but also trade in intermediate or final goods taking the outcome beyond the borders. The central element in defining 'Vertical Specialisation' is the fact that the outcome does not remain within the borders of the local market.

15. The motivation for vertical specialisation is again simple: to exploit location-specific productivity advantages at one of the stages of the production process. Efficiency gains might be generated from factors like tradition in the manufacture of some specific input (know-how); local abundance of skilled labour; profusion of natural resources; or even regulatory framework reducing significantly the cost of an otherwise identical, production process. Firms exploiting such advantages are not targeting a specific location for its market/consumption potential; that is why the output in a vertically specialised production is not coming from, neither does it remain within the borders of the local market. For vertically specialised production to take place the good has to cross international borders twice, a definition which subsequently corresponds to production whose *sole* purpose is efficiency-improving. Any production organisation could, among other motivations, include efficiency; however the condition of crossing the border twice ensures that efficiency is the sole driving force for production within the country.

Figure 2. Vertical specialisation



16. In figure 2 we illustrate the two benchmark cases for vertical specialisation (the first one involving three or more countries, while the second just two). It is important to note that, contrary to the

6 . Balassa (1967) and Findlay (1978) were the first ones to note this phenomenon. Later studies like Sanyal and Jones (1982) or Dixit and Grossman (1982) incorporated and analysed the concept into the theoretical trade literature. Hummels *et al.* (2001) is the first to develop a concrete methodology to identify and quantify vertical specialisation in developed countries using OECD data.

export-platform case, headquarters of the firm could be anywhere. Who owns the firm is not important for vertically specialised production to occur. The export-platform pattern is defined under the condition of a link (ownership or enhanced cooperation) between the firm at home, and the foreign firm producing abroad for third markets. On the other hand, vertical specialisation does not require an ownership link between firms at different countries. Importing inputs of production (from any firm) and exporting the output (to any destination) is the sole condition defining the pattern.

17. The export-platform pattern can be incorporated in more general modes of horizontal and vertical FDI (the latter further distinguished to vertical FDI with fragmented production facilities or not), yielding six complex patterns of interaction between trade and investment. Almost all these patterns have a second version with vertically specialised production. We illustrate graphically in Annex I thirteen possible models of interaction rising from traditional and complex firm strategies.

18. As it becomes clear, not all modes of FDI are associated with trade. Furthermore, when they do, we observe significant differences in the nature and direction of trade they enhance. Modes can all exist simultaneously inside a market because of producers' heterogeneity. In other words, apart from a general country or sector-specific trend, producers' motivations are not identical and can lead to the adoption of different patterns even for the production or sales of the same good[7]. Table 3 in Annex I demonstrates trade implications of all patterns for intermediate and final goods.

Box 3. Vertical specialisation in practice: Mexico's maquiladoras and Finnish telecoms

Export-oriented manufacturing units of MNEs do not use entirely domestically produced inputs. Factories in electronics or the car industry often assemble various components, produced in other parts of the world. These firms contribute to increasing vertical specialization of the domestic economy, provided that most of the output is afterwards exported to foreign markets.

In Mexico, the 'maquiladoras' refer to foreign-owned production plants that complete processing or secondary assembly of imported components explicitly for export. Maquiladora plants benefit from Mexican laws that exempt parts and materials imported from Mexican tariffs. Also, US components of maquiladora-made goods exported back to the States are exempt from US tariffs.

A characteristic example on the other side of the Atlantic: the Finnish telecommunications firm Nokia, operates a portable-telephone factory in Komárom, Hungary, and R&D centres in Budapest and Debrecen. The portable-telephone factory in Komárom employs more than 1,300 people and its output targets mostly the needs of the European market. At the same time, in 2002, only about 10-15% of the components of each mobile phone were supplied by Hungarian companies.

Source : Kalotay (2002); Hummels et al. (2001)

19. It is important to note that the patterns of trade we analyse in this framework are clearer in the case of manufactured goods. The equivalent patterns for trade in services are not so lucid[8]. Services include sectors of the economy where the output is not necessarily material. Those could be sales of information, banking or education. In such sectors identifying intermediate goods constituting inputs of production, as well as measuring the exact foreign content of the final output is particularly challenging. Human capital (in other words knowledge and skills as an input of production) is already in most cases of manufacturing

7 . On firm heterogeneity in international trade, see Bernard *et al.* (2007).

8 . See Pain and van Welsum (2004) for a discussion of the impact of international production relocation on trade in services.

sector studies not measured accurately, or not at all. In services sectors, human capital dominates the entire production process.

20. Patterns of interaction between trade and FDI are not only of academic interest. They point at specific policy issues to be discussed as MNE strategies are inextricably associated with specific trade patterns; they cannot be delivered otherwise. For example, a firm will engage in export-platform FDI, as long as there are no impediments to trade between the chosen platform and its targeted countries. The same principle applies to the vertical specialisation pattern of FDI. In other words, given any investment-promoting policies, different modes of FDI depend on trade barriers for their growth. Equivalently, policies encouraging investment enhance trade, given any existing impediments between countries.

The role of distance

21. Entering a foreign market with trade or FDI is a decision associated with a number of additional costs. Some of them can be reduced by the policy-maker, while other ones cannot. Distance-related costs have been empirically confirmed to play a very significant role in trade and at the same time they are to a large extend affected by policy. They therefore deserve special attention.

22. What do we mean exactly by distance-related costs? The term is used to capture costs directly affected by, but also indirectly associated with geographical distance. Remoteness between two locations affects 'technical' costs of trade, like expenses for transportation of goods or communication[9]. On the other hand, taking into account that economic integration across countries is not spatially random[10] we could also point to distance as positively correlated to trade protection costs. In a more general approach, 'regulatory distance' (that is apart from trade protection: dissimilarity in market regulations, national business law, government policies) has a similar effect in isolating a market from the rest of the world. Geographical distance is also strongly correlated to what we call 'cultural distance' (that is, the degree of resemblance in languages, history, customs) which is in turn associated with several costs of trade and investment, such as the difficulty of maintaining production facilities and distribution networks in a foreign country. Lastly, on the demand side, high cultural distance reflects high dissimilarity in consumer preferences which can increase trading costs. The different effects of distance on trade are summarised in Table 1 below.

23. Empirically, the effect of distance on trade, investment and other types of economic flows is captured using gravity models; that is, models where the distance between interacting agents is included as an independent variable in the equation of determinants of bilateral flows to be estimated. It is important to note that since geographical, spatial and regulatory distance are all highly correlated we capture their entire effect using just *one* variable: geographical distance. The variable is hence used as a proxy for all distance-related costs. If not impossible, it is nonetheless difficult to disentangle and credibly quantify the different components of the distance effect; that is why we can only make hypotheses about the weights of each component in the composition of the distance effect or their evolution across time.

24. It is essential to clarify that by 'distance-related' we refer to the *additional* cost borne by firms for producing and selling in a distant market; additional with respect to the level of the same type of cost borne for markets closer to home. Consequently, when addressing, for example, trade protection in the context of distance, rather than focusing on tariffs as such, we focus on the difference in tariffs between

9 . Transportation costs have not declined in the last 50 years (Hummels, 2007). One can just notice a rise in the speed of trade following technological progress and a reduction in the cost of air shipping.

10 . Most economic agreements and cooperation takes place between countries spatially close (see Frankel *et al.*, 1996)

nearby and remote markets. From an empirical, as well as a policy point of view, distance-related additional cost is most likely to remain unaffected if there is symmetric treatment of all markets[11].

Table 1. Distance-related costs

			associated with			
			Cultural distance	Spatial distance	Regulatory distance	Complex patterns[1]
Demand side	Dissimilarity in consumer preferences		×			1,4,9, (2,3,5-8,10,11)
Supply side	Variable costs	Transportation		×		2,3,5-13
		Communication	×	×		All
		Trade protection			×	2,3,5-13
		Maintaining production / sales[2]	×		×	All
	Fixed costs	Establishing production / sales[3]	×		×	All

1. See Annex I for graphical representation of patterns
2. Includes additional cost for interaction with non-native labour force, foreign clientele, and for meeting output requirements from domestic regulations.
3. Includes cost in the identification of input suppliers, distribution networks, external support services, and administrative fees for sales/production (like product licensing, for the patterns involving consumption in the foreign country).

25. Not all distance-related costs are relevant to all complex exchange patterns. Demand-side benefits become relevant when a foreign market is targeted for consumption of the final output, while transportation costs become significant in complex patterns that involve trade. However, costs of setting up and maintaining production facilities abroad, as well as costs of communication between headquarters and firms' affiliates are by definition relevant to any form of FDI.

26. Costs are also likely to be different between manufacturing and services sectors[12]. Transportation and communication costs become relevant for modes where the provider or consumer travels between the two countries; trade protection costs when a service involves transportation of materials; and costs associated with production facilities abroad only when material production does take place in a foreign country. Similarly to the case of trade in manufacturing, consumer preferences are important only when the consumer is a foreigner.

11. For instance if technology leads to a symmetric reduction in transportation costs across all trade destinations, then the *additional* costs for trade with a remote market might remain relatively unaffected. Equivalently, coefficients of any distance variables in an econometric specification might not change either. For a thorough discussion see Buch *et al.* (2004).

12 . In services sectors, FDI is assimilated to the mode of supplying services through commercial presence (mode 3).

27. In what follows, we first use econometrics over a new OECD dataset, to illustrate the complementarities between trade and FDI in complex patterns, focusing on the role of distance-related costs. We then discuss trade policy issues that are of direct relevance.

Box 4. Prevalence of new MNE strategies: evidence from French firms

Not all firms engage in international trade. According to Eaton *et al.* (2004), only 17.4% of French firms are exporters. What is the prevalence of patterns of trade and FDI among French firms that are involved in vertical trade (being both exporters and importers)? Jabbour (2008) studies the sourcing strategies of 4,367 manufacturing firms located in France that realise 299,752 exports and imports transactions.

French firms that are involved in vertical trade import most of their inputs from independent suppliers (67.7% of the transactions). This illustrates the fact that most of vertical trade is through arm's length trade, with no ownership relationship between the firm and its suppliers. The firm located in France can however be a foreign affiliate (this is the case for 2,023 companies in the dataset).Vertical integration (where the supplier is an affiliate) represents only 32.3% of the transactions. There are very few transactions with developing countries: 4.7% of the transactions through outsourcing (no ownership relationship) and 2.1% through vertical FDI.

The analysis provided by Antràs and Helpman (2004) can explain why outsourcing is generally preferred to vertical FDI. Because of higher fixed costs, only the most productive firms can invest abroad and engage in vertical integration. For less productive firms, arm's length trade is less costly. In addition to firms' productivity, the intensity of capital and headquarter services play a role in the choice of the strategy. Vertical FDI is more prevalent in capital intensive industries and firms making an intensive use of headquarter services (such as R&D, management or advertising).

Source : Antràs and Helpman (2004), Eaton *et al.*, (2004), Jabbour (2008).

Part II. Measuring vertical trade and analysing its determinants

28. Vertical specialisation is traditionally measured through the import content of exports[13]. This approach was pioneered by Hummels *et al.* (2001). It relies on input-output tables that describe how inputs are used in the different sectors of the economy to produce intermediate and final goods or services. As defined by Hummels *et al.*, vertical trade involves the use of a foreign intermediate input to produce a good or service that is then exported.

29. To analyse vertical trade, we use the 2009edition of the OECD Input-Output Tables where the most recent year covered is 2005. We calculate the vertical specialisation share as suggested by Hummels *et al.* (2001) with an indicator that measures both the direct and indirect import content[14]. It includes foreign inputs used to produce domestic inputs that are then incorporated in exported goods. Foreign inputs can be embodied in goods that are processed and transformed several times within the domestic economy before being exported.

30. The vertical specialisation shares derived from the input-output tables are then applied to trade data on bilateral exports to obtain values of vertical trade at the bilateral and industry level. The dataset

13 . See De Bakker and Yamano (2007) for a review of globalisation indicators. The import content of exports is adequate to measure vertical trade as we defined it in Part I. It is however not a measure of the fragmentation of production. See Inomata (2008).

14 . See Annex II for the technical details on the calculation of vertical trade and a description of the data used.

covers 29 OECD countries[15] and 11 emerging economies (Argentina, Brazil, China, Chinese Taipei, Estonia, India, Indonesia, Israel, Russia, Slovenia and South Africa).

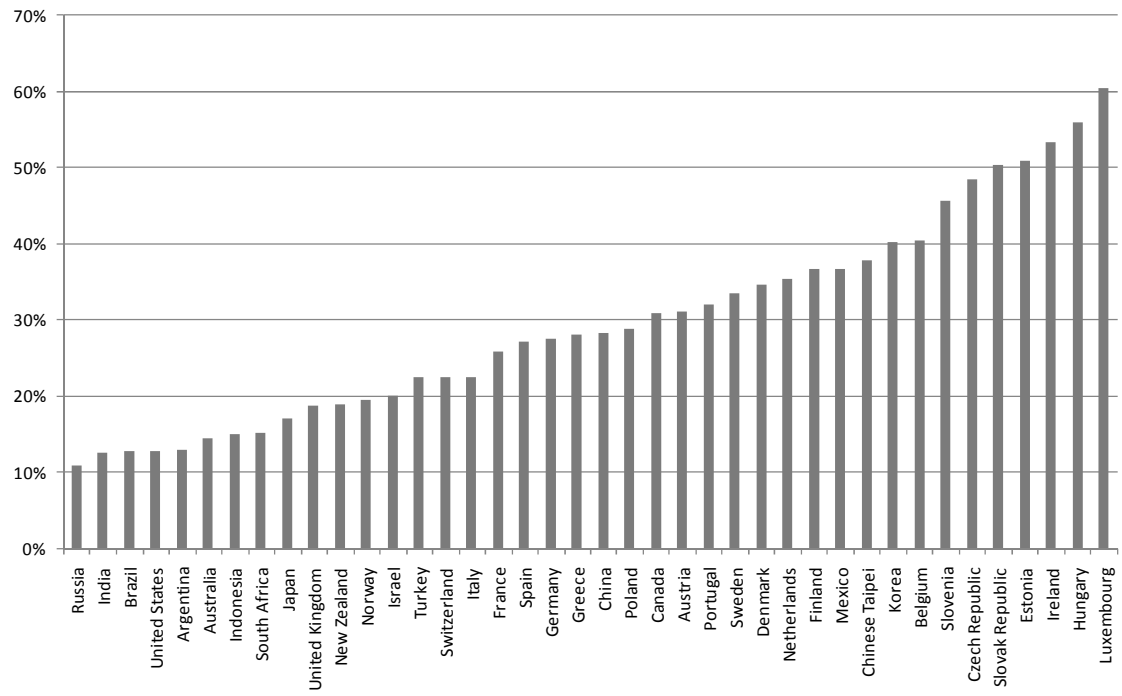
31. The first section presents descriptive statistics on vertical trade and how it has evolved between 1995 and 2005, while the second section provides a quantitative analysis of its determinants and how it relates to foreign direct investment and sales of foreign affiliates (FATS statistics both for services industries and for activities of multinationals in the primary and manufacturing sectors).

Vertical specialisation across countries, sectors and time

32. Figure 3 below reports the share of vertical specialisation calculated for the countries in the dataset for the latest year available (2005 for most countries). The share of vertical specialisation in exports ranges from 10% in Russia to 60% in Luxembourg.

33. The average share of vertical specialisation in the dataset is 31%[16]. Small countries tend to have a higher share of vertical specialisation as compared to large countries where more inputs are domestically produced. Russia, India, Brazil and the US are among those countries with a relatively low import content of exports, while Estonia, Ireland, Hungary and Luxembourg are at the other end of Figure 3 with more than half of their exports being composed of imported inputs.

Figure 3. Share of vertical specialisation in trade (import content of exports) for the latest year available



Source : Calculated by the authors using the 2009 OECD input-output database.

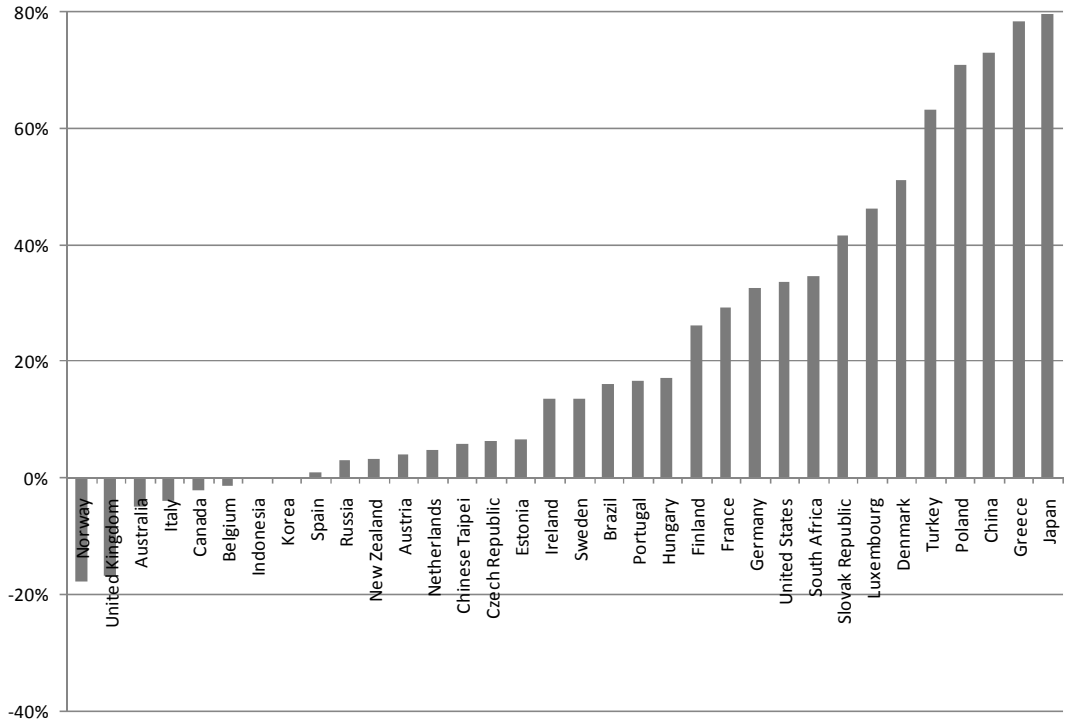
15 . All OECD countries with the exception of Iceland.

16 . Simple average not weighted by the size of countries or trade flows.

34. One can however note that a large country like China has a quite large vertical specialisation share (about 28%) reflecting its specialisation in parts and components. Israel illustrates the opposite case: a small economy that has a relatively low share of vertical trade. In addition to economic size, the geographical position of countries also matters. Countries geographically close (like for instance in Central Europe) are more likely to receive FDI for vertical specialisation since exploiting national comparative advantages at different stages of production comes at significantly lower transportation costs for the evolution in the production chain. On the other hand, using local know-how at one stage of the production process in countries relatively isolated from the core (like Israel) is constrained by significantly higher transportation cost for intermediate inputs[17].

35. The next figure (Figure 4) indicates the percentage change in vertical specialisation between 1995 and 2005 (for countries where data are available). With the exception of Norway, the UK, Australia, Italy, Canada and Belgium, the share of vertical trade has increased in all the countries of the dataset. On average, it was 26% in 1995 and has risen to 30.5% in 2005 among the countries represented on Figure 4. The increase is especially high for Japan, Greece, China, Poland and Turkey where vertical specialisation in trade has increased by more than 60%.

Figure 4. Percentage change in the share of vertical specialisation (1995/2005)[18]



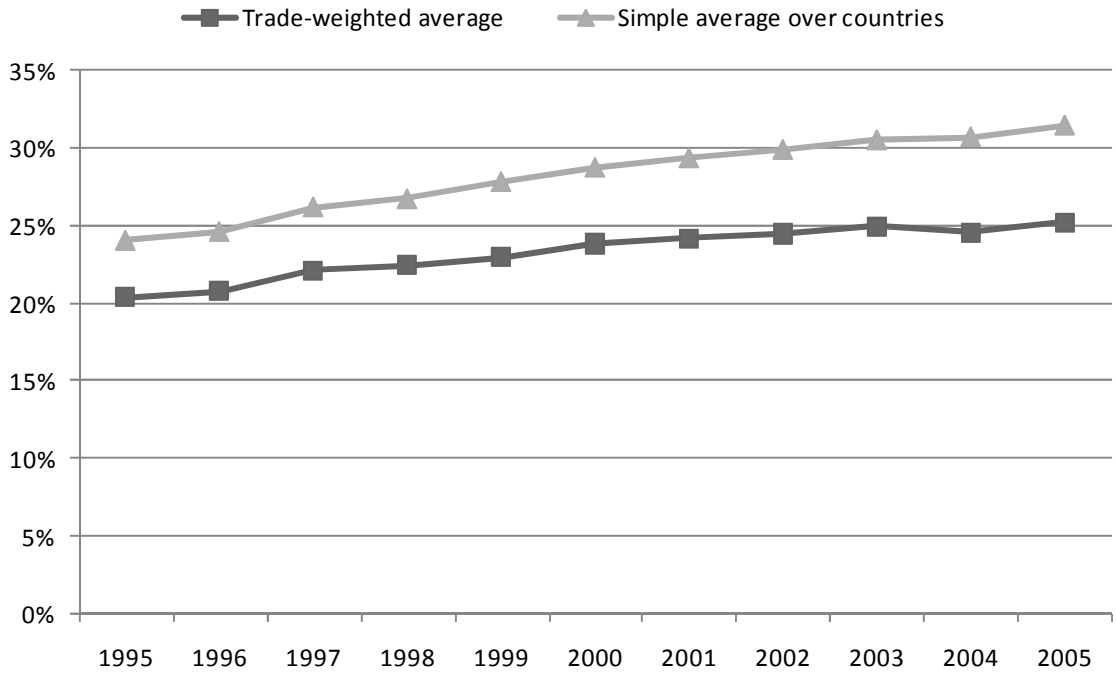
Source : Calculated by the authors using the 2009 edition of the OECD input-output tables.

17 . As pointed out by Blonigen *et al.* (2007).

18 . For some countries, the percentage change is calculated on a slightly different time period (*i.e.*, plus or minus two years). We explain in Annex II how we have recreated time series for input-output coefficients on the basis of available years.

36. The evolution of the average share of vertical specialisation in trade for countries in the dataset can be seen on Figure 5 below. There is a difference between the trade-weighted average and the simple average over countries, but in both cases we see a clear increase in the use of foreign inputs in exports.

Figure 5. Average share of vertical specialisation in trade for OECD countries and selected emerging economies (1995-2005)



Source : Calculated by the authors using the 2009 edition of the OECD Input-Output tables.

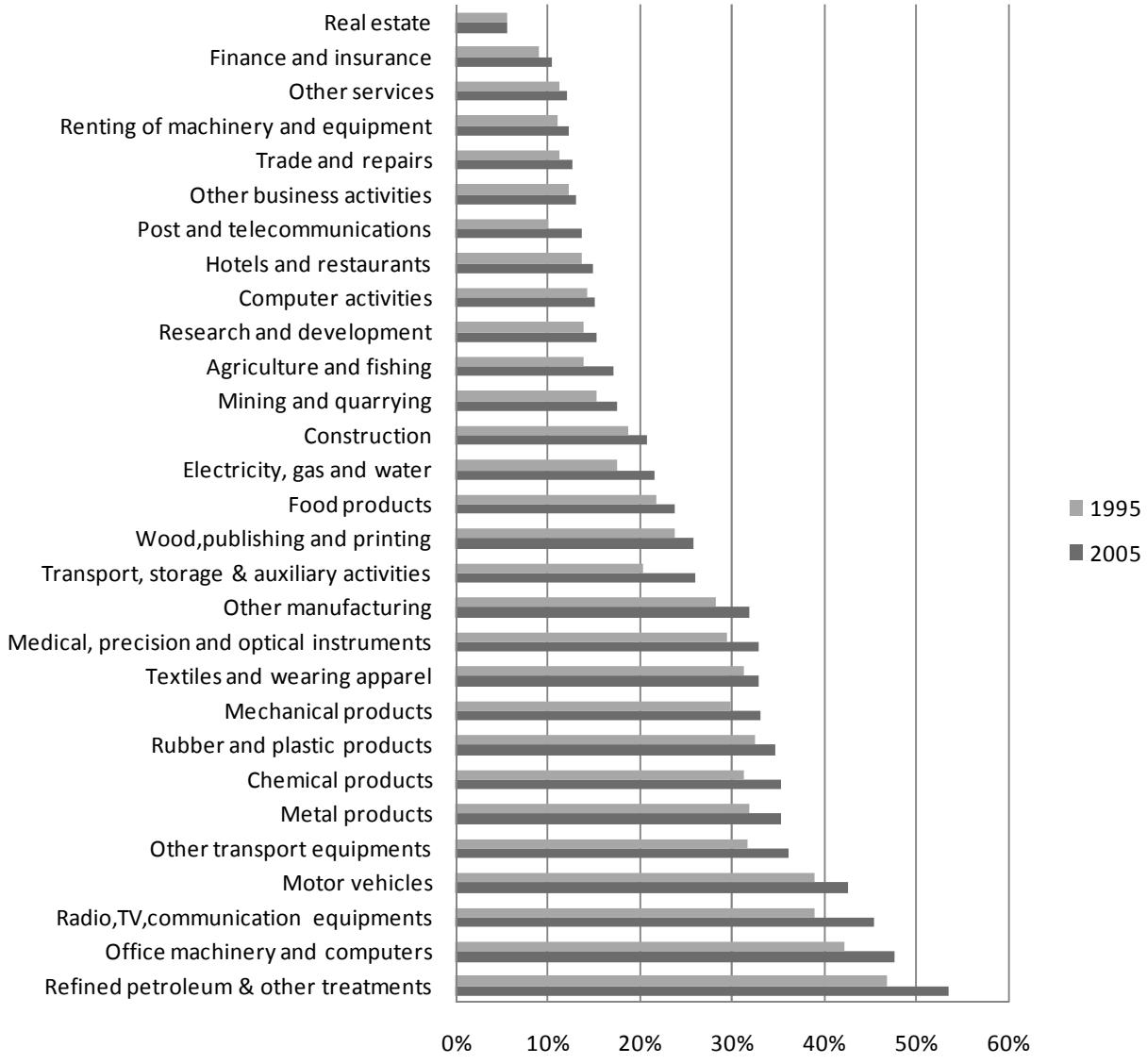
37. Table 6 in Annex II provides a break down by sector. Vertical trade has slightly increased in the agriculture and fishing sector (+1.7%) and more clearly in the manufacturing sector (+16.9%), but it is in services industries that the highest percentage change is found (+50.5%). It highlights that fragmentation of production is not limited to the manufacturing sector. Vertical specialisation is also important in services.

38. Figure 6 below further decomposes the share of vertical trade in 29 sectors by showing the average share observed in the dataset in 1995 and 2005 for each industry. One can see that manufacturing sectors generally use more imported inputs, especially in sectors like 'motor vehicles', 'radio, TV and communication equipments', or 'office machinery and computers'. These are industries where vertical specialisation is the highest and trade in parts and components has increased.

39. Services industries, although generally less vertically specialised, also show an upward trend, especially in the post and telecommunications sector. Construction is the sector where the import content of exports is the highest. It is not surprising as the share calculated includes goods as inputs (such as construction materials). However, many services can be vertically specialised with a fragmented production process involving trade in services inputs (*e.g.* business services). The share of vertical trade

between services industries is certainly under-evaluated as services tend to be recorded often as a value added when they "cross" several borders[19].

Figure 6. Average share of vertical specialisation in 29 sectors (1995 and 2005)



Source : Calculated by the authors using the 2009 edition of the OECD Input-Output tables..

40. Averages presented in the previous figures can mask some significant changes that have occurred in particular countries. For example, in the 'office machinery and computers' sector where an important increase in the share of vertical specialisation is seen on Figure 5, Brazil, Finland, France and the US have experienced a percentage decrease in the share of vertical trade, while Austria, Canada, the Slovak Republic and Turkey explain most of the increase between 1995 and 2005 in the average. As MNEs switch between suppliers, create or sell affiliates and change the way they produce, some variation can be

19 . See Chen *et al.* (2005).

observed at the country and industry level. The next section provides insights on the economic determinants of vertical trade.

The role of bilateral distance-related costs in explaining patterns of vertical trade and FDI

41. To analyse the determinants of vertical trade and how it relates to FDI and sales of foreign affiliates, an econometric analysis is carried out in Annex III. We look at trade flows among countries represented in Figure 3, measuring both bilateral exports and vertical trade over the period 1995-2005. Vertical trade is simply calculated by applying the share of vertical specialisation described in Section 1 to bilateral exports. We complete the dataset with bilateral data on FDI stocks and sales of foreign affiliates[20].

42. As discussed in Part I, there is a cost when companies service foreign markets (whether through arm's length trade or foreign investment) and this cost is related to the (geographic) distance between the two partner countries, as well as the size of their respective markets. This is why the trade and FDI literature relies on "gravity equations" to assess the impact of trade and FDI costs on imports and investment. The "gravity model" mimics the gravity equation of Newton by explaining trade flows through essentially two variables: the distance between countries (a proxy for trade costs) and their 'economic mass' (proxied by the GDP of the exporting and importing economies). It was first applied to trade flows but also works well for investment flows or stocks, as well as sales of foreign affiliates[21]. We use an extended version of the gravity model that accounts additionally for the role of relative GDP and relative skill endowments (how the two countries compare in terms of income and human capital)[22].

43. Through this model, we are able to estimate the impact of distance-related costs on four variables of interest: bilateral exports (for goods and services), vertical trade (the value of imported inputs used in exports of goods and services, calculated using input-output tables and trade data), foreign investment stocks and sales of foreign affiliates (FATS). As our dataset is at the sector level, we can provide estimates of distance-related costs associated with trade, vertical trade, FDI and sales of foreign affiliates for 29 industries[23].

Aggregate level analysis

44. Figure 7 below summarises the results at the aggregate level. Table 8 in Annex III has the detailed results of the regressions and provides more information on the model and its estimation technique. The first question that we try to answer in this analysis is the following: to what extent distance-related costs differ between trade, vertical trade, FDI and activities of foreign affiliates. We can answer this question by looking at the coefficient found for the distance variable in the model. This coefficient (which is used in Figure 7) can be interpreted as the elasticity of exchange intensity to distance. It is negative as distance is a barrier to trade or FDI and its magnitude gives an indication of the extent to which trade or

20. A description of the dataset can be found in Annex II.

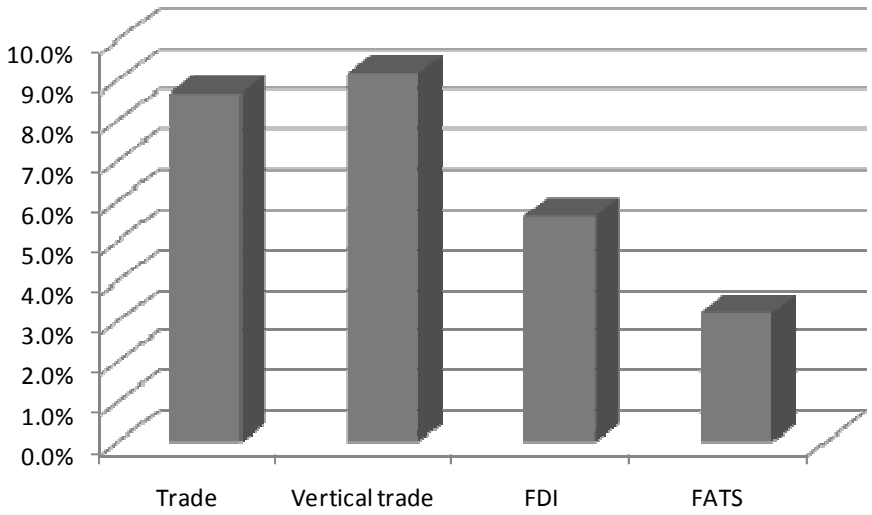
21 . Bergstrand and Egger (2007) provide a theoretical foundation for the use of gravity equations in the estimation of FDI stocks and FATS with distance as a proxy for the trade or investment costs. The quantitative analysis presented in this section builds on their work.

22 . The model is known as the "knowledge-capital" model of trade and FDI and was developed by Carr, Markusen and Maskus (2001). We use a simplified version for empirical purposes similar to Egger and Merlo (2007).

23. Strictly defined, FATS are sales of services foreign affiliates (Foreign Affiliate Trade in Services). The OECD dataset on activities of multinationals however includes sales of affiliates in the primary and manufacturing sectors. At the bilateral level, we have only data on aggregate sales in these two activities (primary and manufacturing sectors).

FDI is diminished with remoteness (*i.e* when trade and FDI costs increase). For example, at the aggregate level, we find that a 10% increase in distance would all else being equal diminish trade by about 9% (as indicated by the coefficient -0.868)[24].

Figure 7. By how much is trade or FDI decreased when there is a 10% increase in distance-related costs?



Source : Regression results from Table 8 in Annex III.

45. Of course, one should be cautious in interpreting this distance coefficient. We do not expect countries to "move" (despite continental drift). As emphasised in Part I, the distance in kilometres between countries is a proxy for the costs that firms have to overcome to serve foreign markets. One could also debate to what extent it is a good proxy (in particular because it has no time dimension while trade costs are expected to have one[25]). It gives us an approximation of the "distance" effect for comparison purposes between sectors and modes of supply of goods and services. The volume of trade or FDI that would "disappear" with the increase in distance-related costs is also "fictional". It is based on the empirical observation of the relationship between distance and trade volumes but the model is not adequate to tell us what would exactly happen if by chance trade costs were falling or increasing (as "all else" would not stay unchanged). The idea is to give an order of magnitude of the impact of trade (or FDI) costs on trade flows (or investment positions). We will not call it a "distance effect" as it is often done in the literature as we have insisted on the fact that regulatory or cultural differences explain a large share of the impact.

46. Notwithstanding these caveats, Figure 7 and Table 8 illustrate an interesting relationship between distance-related costs and trade, vertical trade, FDI and sales of foreign affiliates. At the aggregate level, we find a small difference in the impact of distance on imports and vertical trade. On average, costs faced for exporting intermediate inputs (or the final goods and services where these foreign inputs are embodied) are a bit higher.

24. This is a relatively standard coefficient. Disdier and Head (2006) find that on average the elasticity of trade with respect to distance is 0.9 based on meta-analysis of 1,467 distance effects estimated in 103 empirical studies.

25. See Buch, Kleinert and Toubal (2004) who point out that distance is time-invariant and as such cannot measures trade costs over time (implying that the evolution of trade costs over time is captured by other variables of the gravity equation). For this reason we stick in this paper to a comparison between sectors.

47. When controlling for transport and insurance costs (measured through cif-fob factors), we find lower coefficients than on Figure 7. However, there is still the same difference between the coefficient found for total exports and vertical trade. The impact of insurance and freight costs is lower than "distance", confirming that these costs are only one part of what we capture through the geographic distance between countries. Transport costs seem to be similar for both types of exports (resulting from vertical trade or not). It should not be more costly to deliver a given good or service on the basis of the nationality of the inputs it incorporates. However, one would expect more differences in terms of the cultural or regulatory distance mentioned in Table 1. For example, one would think that intermediate inputs are less differentiated on the basis of their country of origin (with consumers more inclined to buy the 'national' product) or that some regulatory trade barriers (distance related) are more pronounced for horizontal trade (imports that compete with domestic products) rather than vertical trade (imports used to produce exports). In the last part of Table 8 in Annex III, we also control for tariffs and see that that they play a minor role in explaining bilateral trade flows, whether resulting from vertical specialisation or not. Part of the impact of trade policy is likely to be captured by the distance variable[26], as previously suggested.

48. Looking at the coefficients for other variables, we find that sharing a common border or a common language increases vertical trade (with a similar effect than for exports). The size of the market (measured by joint GDP) is the other important determinant of vertical trade after distance.

49. Turning now to the values found for the impact of distance-related costs on FDI and FATS, we find smaller values. This is as expected, since one motivation for FDI (and sales through foreign affiliates) is to overcome some of the distance barriers by producing directly in the destination market. However, firms also face different costs when they establish abroad and these costs are also often related to the distance of the foreign market. On average, these costs are however smaller than trade costs as indicated by the smaller coefficient represented on Figure 6. The fact that we find a negative coefficient for the impact of distance on both trade and FDI supports the assumption that they are complements rather than substitutes.

50. From a policy perspective, there are several ways of interpreting these results. The relative similarity between the impact of distance-related costs for trade and vertical trade suggests that trade policies do not really discriminate between the two. Such a situation can happen when barriers are in any case low for all types of trade flows (and there is then nothing to worry about). But it can also reflect impediments to vertical trade with the risk of missing welfare-enhancing opportunities. Part III discusses the policy implications of the analysis and the kind of policies that can encourage vertical trade as a source of additional gains from trade.

51. Concerning foreign investment and sales of foreign affiliates, the relatively high negative value reported points out that there are still important FDI barriers between the countries of the dataset (that are mostly OECD countries). Investment does not imply a "transport" or "communication" cost, so the distance coefficient here essentially reflects cultural costs (dissimilarity between preferences), fixed costs (discovering markets, establishment, infrastructure costs) and regulatory barriers (to the extent that they are distance-related). While OECD countries have important commitments for the removal of barriers to investment (for example through the OECD code of liberalisation of capital movements), empirical data suggests that important distance-related costs still exist. The difference between the coefficients found for FDI and FATS also suggests that barriers related to distance have a higher impact on the movement of capital than on the operations of services subsidiaries once companies are established.

26 . While in theory protective measures should not be related to distance, it is often the case that protectionism increases with distance. A consequence is that in the gravity equation the distance coefficient often captures part of the impact of tariffs or other trade policy instruments.

52. The difference between trade costs and investment costs that we empirically confirm explains the trade-off that firms face when fragmenting their production process and choosing between outsourcing and vertical integration. While the distance-related costs are mainly variable costs (that increase with the quantity of goods and services produced or traded) and are lower in the case of vertical integration, establishing abroad has important fixed costs (including 'sunk costs' that are not recovered when exiting the market). Only very productive firms can choose this strategy, as suggested in the analysis of Antràs and Helpman (2004).

Analysis at the industry level

53. At the industry level, Table 9 first reports aggregate results for the primary, manufacturing and services sectors. We note the following differences in aggregate results. In the primary sector, trade costs are generally higher than in other sectors, reflecting either higher transport costs for bulky products (products for which the weight/value ratio is larger such as in the mining and quarrying sector), higher cultural barriers (taste for different varieties, consumers differentiation of agricultural goods according to their country of origin) or higher regulatory barriers (trade protection in the agriculture sector). Vertical trade is however not as much affected by distance-related trade costs. Intermediate inputs in the primary sector are perhaps less subject to trade barriers and less prone to differentiation according to their country of origin.

54. In the manufacturing sector, results are closer to the aggregate level, with a slight difference between exports and vertical trade. The impact of distance-related costs on sales of foreign affiliates is slightly lower than the one estimated for FDI. Regarding services, we find a coefficient to a small extent higher for vertical trade as opposed to exports.

55. It is however in Table 10 with regressions run for 29 sectors that results are the most interesting. To facilitate the comparison between the coefficients found for distance-related costs, Figures 8 and 9 in Annex III illustrate graphically the differences among industries (respectively for vertical trade and FDI). A first remark is that there is a larger variation among the coefficients estimated for FDI. Results are more homogenous in the case of vertical trade, but still significant differences are found among industries, in particular in the services sector. For example, distance-related trade costs are small for 'other business activities' but high for computer services. The comparison between the vertical trade and FDI values gives an indication of the type of choice faced by services suppliers in the international supply of services (through Mode 1 or Mode 3).

56. In some cases, distance-related trade costs are similar for vertical trade and FDI (*e.g.*, 'other business activities'), while in other cases they are at the opposite end of the spectrum (*e.g.*, 'other services'). Some sectors illustrate the motivations for producing in the host economy rather than trading, such as in the case of 'wood, publishing and printing' where distance-related trade costs discourage more vertical trade than FDI. There is no general relationship that holds for all sectors. Trade and FDI can be complements or substitutes, sometimes both (within the same broad activity). It explains the complex patterns identified in Part I and why different firms can choose different sourcing strategies or modes of supply for foreign markets.

Insights on the relationship between vertical trade and FDI/FATS

57. While the previous analysis has relied on the observation of distance coefficients in separate gravity regressions of trade, vertical trade, FDI and FATS, it is also interesting to look at the role of distance-related trade and investment costs in the bilateral ratio of vertical trade to FDI or FATS. The question that can be addressed through this methodology is whether decreasing trade costs encourage more

vertical trade or foreign direct investment and whether vertical trade is associated with vertical FDI. These issues have been recently discussed in Bergstrand and Egger (2008) and Neary (2009).

58. From Table 11 in Annex III,, one can see that the ratio of vertical trade to FDI and FATS is negatively correlated to distance-related trade costs and positively to market size. The same results are observed for sales of foreign affiliates in services sectors. Assuming that vertical FDI is associated with vertical trade and that horizontal FDI should not be correlated with vertical trade, this result can be interpreted in the following way: higher trade costs tend to discourage vertical specialisation of firms. When trade costs are high, FDI is more likely to be of a horizontal type, as suggested by the "concentration-proximity trade-off". In order to overcome high trade barriers, firms produce directly in the destination market. This result gives support to the standard theory where trade and investment are substitutes.

59. At the same time, this result needs to be reconciled with the previous analysis that pointed out that FDI (and sales of foreign affiliates) tend to decrease with distance-related costs. One way to solve the paradox is to consider export-platform FDI, in particular in the context of regional trade liberalisation. Neary (2009) suggests that horizontal FDI in trading blocs is encouraged by intra-bloc liberalisation as foreign firms establish plants in one country as export platforms to serve the bloc as a whole. It would explain why FDI tends to decrease with distance and why the ratio of vertical trade to FDI also shows a negative correlation with distance.

60. Overall, the results show the kind of ambivalent relationship between vertical trade and FDI/FATS that was alluded to in Part I. While there is evidence of a strong complementary relationship between trade and FDI (Egger and Pfaffermayr, 2004; Bergstrand and Egger, 2007), we can see also that distance-related trade costs and the size of markets is likely to influence the patterns of trade and investment through different strategies involving vertical FDI or export-platform FDI, a result consistent with the assumption of complex FDI and producers' heterogeneity.

Part III. Exploring the trade policy implications of increased vertical trade

61. There are several new challenges and issues to be considered by policy-makers in a world of differentiated firm strategies. Arguments in favour of trade and investment liberalisation are of direct relevance to this study, since trade is enhanced as a whole through vertical exchanges. Proposals in that direction have however been stressed numerous times in the past; therefore in this section we will focus on what is *new* for policy in the context of the current study, keeping in mind that the list of issues to be considered is not exhaustive.

62. The first clear challenge for each individual country is to empirically reveal the traditional and complex patterns on the rise, and the ones receding. For example, outward export-platform FDI might appear very dynamic in the case of a certain country. Should this be a trend, the *direction* and the *nature* of trade to facilitate becomes clearer: policy could focus on possible barriers to trade of final goods from its 'platforms' to its targeted markets. In other words, identifying country-specific as well as sector-specific dynamics proves to be essential in guiding policy. Without losing their specificity, country-sector dynamics do however resemble each other, since there are many similarities in production capacity, efficiency as well as targeted markets, especially across OECD members.

Box 5. Vertical trade and the gains from trade liberalisation

What is the impact of trade reforms on welfare? Economists rely on applied trade models to estimate the gains of trade liberalisation. Simulations of the outcome of successful trade negotiations are increasingly used by policymakers in the decision process. However, results from such studies have been recently criticized as gains differ quite widely across simulations and tend to be small in the context of the Doha Development Agenda.

These studies take an approach that cannot fully measure the gains from trade liberalisation related to vertical specialisation and complex FDI. To simulate the impact of changes in trade costs in a general equilibrium model, one has to know how inputs are used to produce intermediate and final goods. With complex FDI strategies and the expansion of MNEs networks, it is precisely the structure of production and use of inputs that changes after trade liberalisation and this cannot be easily simulated.

Moreover, a typical assumption made in applied trade models is that goods are different according to their place of origin (consumers value differently a good produced at home and the same good produced abroad). This is known as the "Armington approach". With vertical trade, a large share of trade is made of intermediate inputs for which the Armington approach is less likely to apply because companies do not differentiate inputs according to their place of origin as final consumers may do. It can introduce a potential bias underestimating gains from trade liberalisation. For example, Feltenstein and Plassman (2008) simulate the impact of the entry of China and the Republic of Korea in the Asean Free Trade Area (AFTA) and find larger welfare gains when they include intermediate goods treated as perfect substitutes.

Source : Feltenstein and Plassmann (2008), Hess and von Cramon-Taubadel (2008).

63. Five novel policy issues can be addressed when analysing complex patterns of trade and FDI, namely: (i) policies targeting the rest of the world, (ii) treatment of distance-related costs, (iii) new forms of trade liberalisation, (iv) response to changing market structures, and (v) issues related to the social impact of the reorganisation of production.

64. A central feature of the analysis presented in Part I and II is that growth of bilateral trade and FDI between countries depends also on barriers between markets in the rest of the world; that is markets outside the system of two trading countries. For example, a firm from Germany will engage in vertical FDI at multiple stages in South-East Asia, as long as there are no impediments to trade of intermediate goods between these countries. Trade barriers between Asian countries now directly affect trade and investment

from Germany to any of the markets in the region. The strongest policy conclusion hence derived from this analysis stresses again the importance of multilateral negotiations for trade liberalisation between countries.

65. In the context of our analysis, the distortion of full investment potential in the presence of restrictions to trade (between trading countries or in the rest of the world), can also be inversed. In the presence of investment barriers (again between trading countries or the rest of the world), trade does not reach its full potential. In other words, FDI contributes to a trade-multiplication effect, which does not occur in the presence of investment constraints. FDI barriers in the form of formal restrictions on foreign ownership, screening and approval procedures, or constraints on foreign personnel and operational freedom have diminished substantially in the last decades inside the OECD (see OECD, 2003). There are however sectors where constraints still apply, and countries where non-official barriers to investment are still significant. It becomes thus important to re-evaluate their benefits by taking into account their growing cost in terms of trade.

66. A second issue that needs to be addressed by policy makers concerns distance-related costs. In Table 1 we summarize the types of costs involved in trade which are affected by distance. Policy cannot equally interfere with all of them. Taking a very broad approach, costs associated with spatial and regulatory distance can be more influenced by policy, while costs associated with cultural distance less. Concerning the latter, one could reasonably argue that the process of globalisation leads to a convergence of consumption patterns[27]. Since globalisation as a process can be subject to favourable treatment by governments or not (for instance through the adoption of internationally-minded education, or the financing of student exchanges), there exists a link between policy and cultural distance costs, yet only in the long run. Reductions in administrative fees; facilitation of product licensing; but mainly an effort to simplify the logistics of trade in terms of time and procedural hurdles (like quality, value, origin and sanitary controls of products crossing borders), could be initiatives in the direction of reducing regulatory distance. Policy initiatives to reduce spatial distance could include financing of infrastructure projects, but also cooperation for the design of networks linking international commercial poles, and harmonisation of traffic and rail standards (often being the source of problems in long-distance transport)[28].

67. The policy challenge in bringing markets ‘closer’ consists of balancing costs that cannot be altered by policy with treatment of costs that can. For instance, a country might disassociate itself from a core group because of high language dissimilarity. Its labour force however might offer highly specialised know-how in the manufacture of specific inputs, otherwise expensive in the rest of the group. Cultural remoteness in terms of language is one of the distance components the least influenced by policy. The challenge in that case consists of balancing the additional cost, with reductions *explicitly* for that market in distance-related components which can be influenced by policy: regulatory fees for production in the country or transportation costs. It is important to note that there needs to be a specific motivation for bringing a market ‘closer’ to others, as well as a thorough identification of the reasons for its remoteness and the ultimate policy targets in terms of effectiveness.

68. A third issue to be addressed by policy concerns the impact of a country’s own trade barriers on domestic firms. Vertical specialisation involves, by definition, imports of intermediate goods. Duty drawbacks (that is tax exemptions for imports of inputs used in domestic production) have been exploited so far to reduce the added anti-export bias that raising tariffs on intermediate and capital goods imposes. Many countries employ them to allow exporters duty-free access to imported intermediates (which acts as an incentive to specialise ‘vertically’), as well as to facilitate investment from foreign firms using non-

27 . In terms of nutrition, clothing, housing, or means of private transport.

28. Transportation costs however can be subject to many factors less influenced by policy, like fluctuations in petrol prices.

domestic inputs in their production process. Since this instrument is used for a very specific purpose, the trade literature has not well developed its study; neither does it seem to have reached a consensus concerning its benefits. According to Tarr (2001) the principal problem with duty drawback schemes is that their administration can be very costly, and lead to cumbersome procedures and delays when tariffs are high. Drawbacks appear to reduce the anti-export bias of exports but do so at the expense of administrative complexity.

69. In the context of vertical specialisation a number of other own trade barriers might work against the interests of domestic firms. For instance, when domestic firms engage in vertical FDI, after treatment abroad at one or multiple stages, a certain volume of *final* goods is also returning to the home country for consumption. These are goods produced by affiliates of domestic firms, yet abroad, and hence subject to import duties when returning to the home country. Tariffs for such imports hurt domestic firms, and therefore act as impediments to their expansion abroad.

70. Overall, the discussion of duty drawbacks in light of new developments in vertical trade has drawn special attention on the administrative complexity of the instrument. New instruments such as tax exemptions for imports of final goods by affiliates of domestic firms are also put forward for consideration. It is important to emphasize however that the above are second-best solutions, overcoming barriers to trade under several conditions. A general policy of trade liberalisation aiming at the elimination of tariffs is the first-best response and the most appropriate to avoid distortions in the market.

71. A fourth challenge faced by governments concerns evolving market structures. In order to explain the effect of vertical specialization on market structures, it is useful to return to its principal cause: the need for highly specialized but also less expensive inputs in a production process increasingly sophisticated in order to survive competition. The foreign suppliers of such inputs might already have monopoly power which eventually increases through higher demand for their product in the world market. In the opposite case, higher demand leads to an increase in competition for input supply. The structure of the world market in both cases gradually transforms[29].

72. The literature has pointed out that since demand for inputs is increasingly customized to the needs of the final producer, the first scenario of higher monopoly power of input suppliers does not deviate from reality[30]. The standard theoretical response to the problem involves vertical integration. Without foreign investment, one faces inter-firm trade of inputs across borders, with a call for policy response to the hold-up problem in order to bring the volume of trade to an efficient level. When vertical FDI overcomes the problem naturally, inter-firm trade is replaced by intra-firm trade of inputs, without a need for such policy treatment. Nevertheless, in some cases there will be a necessity to address the competition policy issue related to highly specialized or intangible assets.

73. The policy treatment of changes in market structures is inscribed in the frame of general political economy issues to which vertical specialization gives rise to, such as competition policy. There are two additional issues to be considered by policy-makers in that frame. The increase in intermediate input prices is directly linked to price level for final consumption, which in turn creates supplementary burdens for households, and social pressure for intervention. The same kind of pressure can also be the result of

29 . In a more general approach, the issue of changing market structure becomes important in any evolution of trade patterns. The particularity of vertical specialisation in that context lies in its impact on the intermediate goods market, as well as in relevant issues solely associated with input supply, such as the hold-up problem (see Box 6).

30. Furthermore, a hold-up problem from the inexistence of alternative uses of the inputs is likely to cause inefficiently low volume of vertical trade. A recent paper by Antràs and Staiger (2008) offers a theoretical analysis of the issue.

employment changes from transfer of domestic firms' production facilities abroad. The economic arguments in favour of such actions include gains in productivity and the gradual transfer of human resources to sectors where they are more efficiently used. It is nevertheless important for policy-makers to take into consideration, not only the long-run benefits from supporting such trends, but also the short-run social costs[31].

Key messages and concluding remarks

74. This report has illustrated current changes in production and trade patterns resulting from differentiated firm strategies.

75. It is important to underline that there is not one single approach to treating these issues. The study highlights the issues that need to be considered by policy-makers in the context of increasing vertical specialisation and complex firm strategies. A reliable identification of country-sector dynamics of new trade and FDI patterns, complemented by social dynamics and government priorities proves to be essential in guiding policy for the case of each country.

76. The key messages of the report are the following:

- One of the main changes in world trade in the last decade has been the increase in trade flows resulting from vertical specialisation of firms. Vertical trade now represents about 31% of total trade in OECD countries.

- Vertical trade represents a higher share of total trade in manufacturing sectors (35%) but it is in services industries that it has increased the most in recent years (+50%).

- Firms follow complex strategies that have an important impact on trade and investment flows as well as implications for trade policy-making.

- In particular, as several countries are usually involved in complex trade and FDI patterns, barriers to trade and FDI between partner countries and third countries become as important as bilateral restrictions. This fact stresses the importance of multilateral negotiations for trade and investment liberalisation and of the harmonisation of rules in bilateral and regional trade agreements

- Welfare gains from trade liberalisation in traditional simulation exercises are likely to be underestimated as vertical trade and FDI are not taken into account.

- There is a complementary relationship between trade and FDI implying that both trade and FDI liberalisation are needed to fully benefit from efficiency gains related to vertical specialisation.

- Distance-related trade costs are still high between OECD countries. On the other hand, FDI distance-related costs and costs of sales by foreign affiliates are found to be lower than trade expenses, yet not negligible. Part of these costs is explained by the increase in consumer preferences and language dissimilarity with geographical distance. Some are also the consequence of regulatory differences being correlated to remoteness of markets.

31. Ossa (2008) models extensively production-relocation externalities of trade on consumer prices and employment and shows how they can be internalised in the frame of trade negotiations. Antràs and Staiger (2008) also develop a variation of their benchmark model to take into account degrees of importance governments assign to the welfare of producers.

- There are policies that can reduce distance-related trade costs such as reductions in administrative fees, an effort to simplify the logistics of trade in terms of time and procedural hurdles, financing of large scale infrastructure projects, or cooperation in the design of networks.

- It is important to note that there needs to be a specific motivation for bringing a market 'closer' to the rest, as well as a thorough identification of the reasons for its remoteness and the ultimate policy targets in terms of effectiveness.

- Long-run market structure evolution resulting from increased monopoly power of input suppliers, as well as short run social issues following changes in prices of final consumption or alteration of employment patterns, all need attention by policy-makers in the context of vertical specialisation. Ultimately, efficiency gains should however be to the benefit of all.

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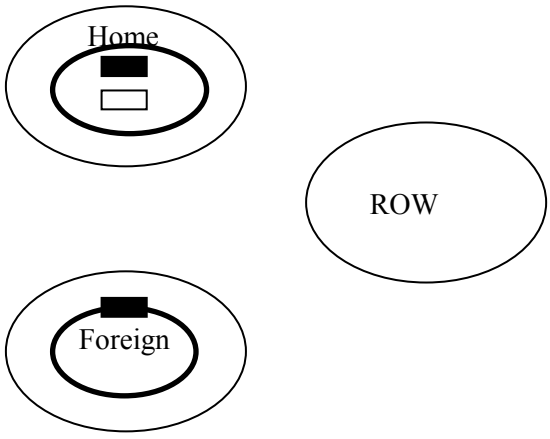
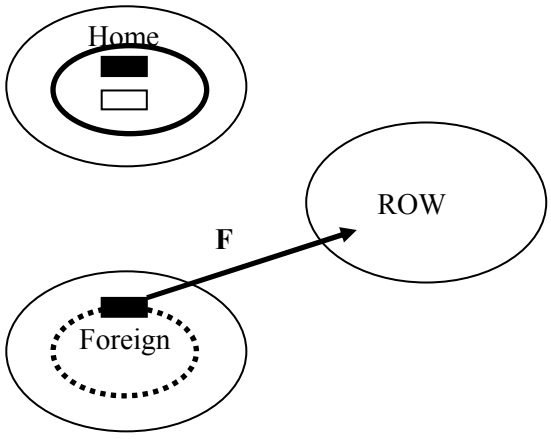
ANNEX I – TRADITIONAL AND COMPLEX INTERACTION PATTERNS BETWEEN FDI AND TRADE

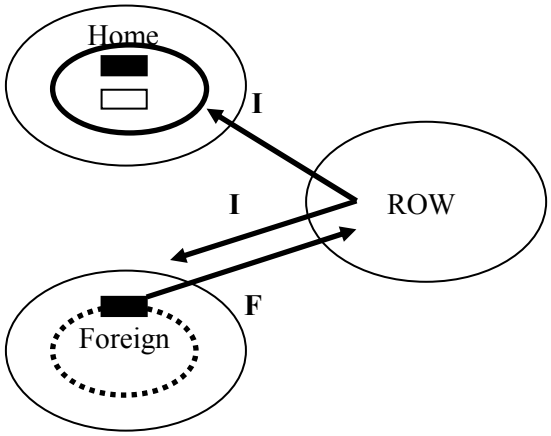
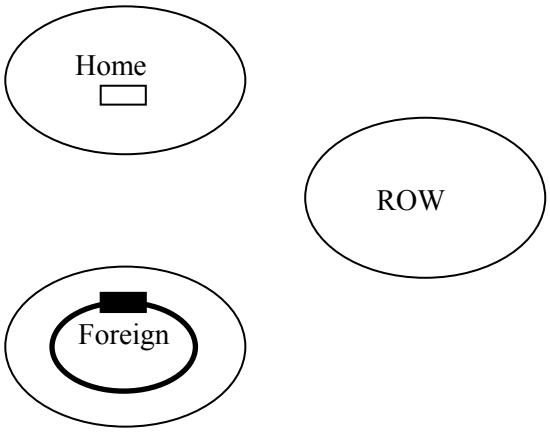
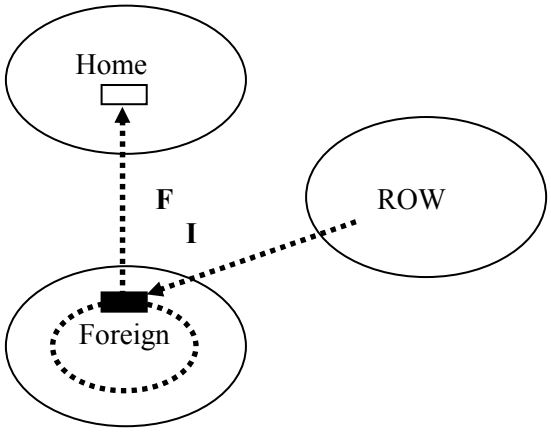
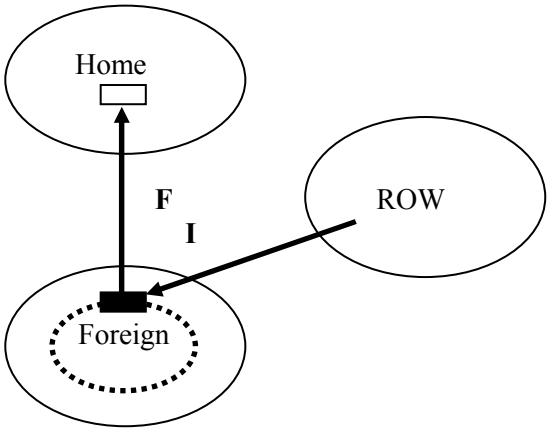
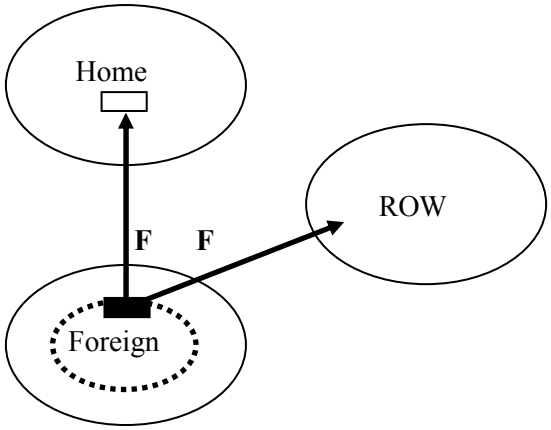
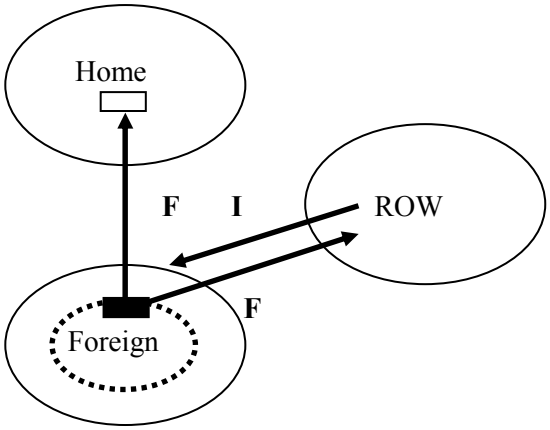
Key:

▭	Headquarters
▬	Complete production facilities
▥	Part of the production facilities
→	Trade involved in the pattern according to the definition (**F** for 'final good' and **I** for 'intermediate good')
⇢	Trade optionally involved in the pattern (**F** for 'final good' and **I** for 'intermediate good')
⬭	Sales in the domestic market from domestic production
⬭	Optional Sales in the domestic market from domestic production
ROW	Rest of the world (standing for multiple countries)

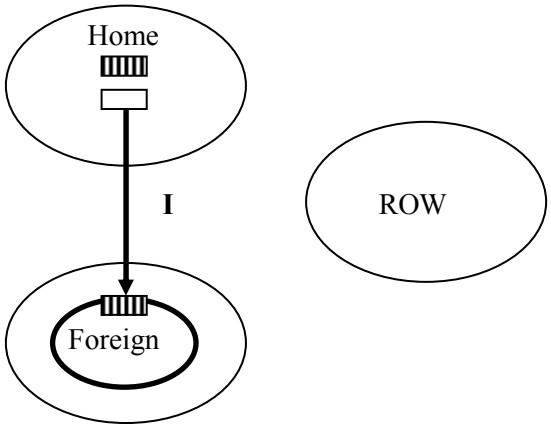
Note: If the patterns are to be extended to firm producing intermediate goods as their final outputs, then replace all 'Horizontal' FDI with 'Vertical' and all indications of **F** (Final goods) with **I** (Intermediate goods)**.** Also if headquarters are considered to be providing (costly) services to the rest of the same firm then any form of FDI is associated with trade in services from Home to the Foreign country.

Table 2. Patterns of FDI and trade

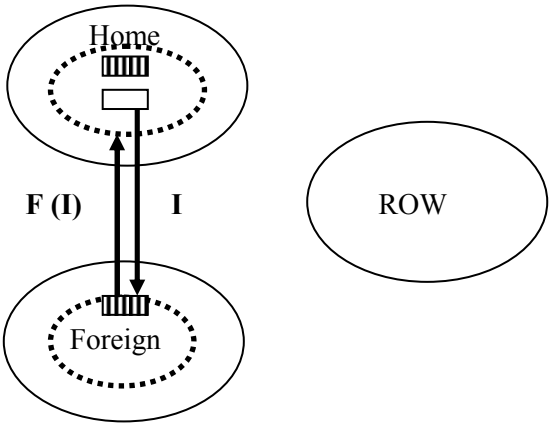
1. Horizontal FDI not involving trade	2. Horizontal FDI involving trade Export-Platform
	

3. Horizontal FDI involving trade Export-Platform Vertical Specialisation of foreign country	4. Vertical FDI not involving trade
	
5. Vertical FDI involving trade	6. Vertical FDI Vertical Specialisation of foreign country
	
7. Vertical FDI Export Platform	8. Vertical FDI Export Platform Vertical Specialisation of foreign country
	

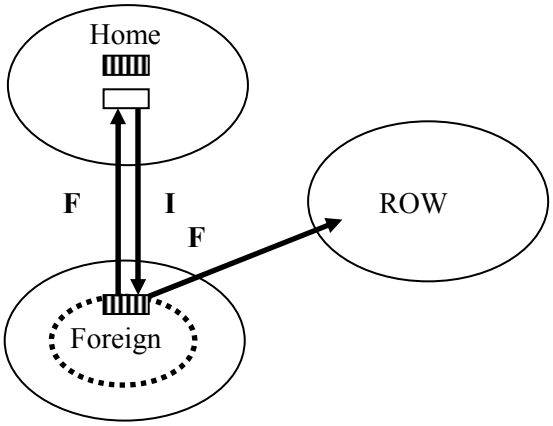
9. Vertical FDI with fragmented production facilities



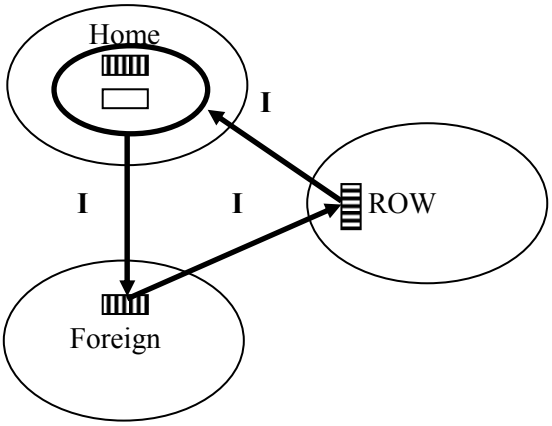
10. Vertical FDI with fragmented production facilities/ Vertical Specialisation of foreign country



11. Vertical FDI with fragmented production facilities/ Vertical Specialisation of foreign country/ Export platform



12. Vertical FDI with fragmented production facilities/ Vertical Specialisation of foreign country and ROW



13. Vertical FDI with fragmented production facilities/ Vertical Specialisation of foreign country and ROW/ Export-platform in the ROW

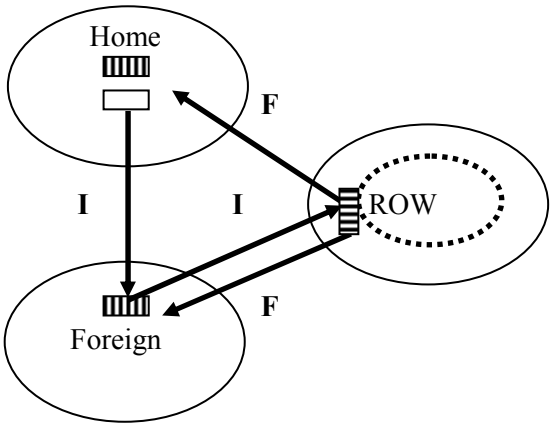


Table 3. Trade implications for complex FDI patterns

Horizontal FDI		Trade in Final goods	Trade in Intermediate goods
Standard form	Simple		(optional)[1]
	With Vertical Specialisation		
Export-platform[2]	Simple	✖	
	With Vertical Specialisation	✖	✖

1. ROW → Home, or ROW → Foreign
2. Only towards the ROW

Vertical FDI **Entire production facilities**		Trade in Final goods	Trade in Intermediate goods
Standard form	Simple	(optional)[1]	(optional)[2]
	With Vertical Specialisation	✖	✖
Export-platform[2]	Simple	✖	
	With Vertical Specialisation	✖	✖

1. Foreign → Home
2. ROW → Foreign (only if the final product is also to be consumed in the foreign country)

Vertical FDI **Fragmented production facilities**		Trade in Final goods	Trade in Intermediate goods
Standard form	Simple		✖
	With Vertical Specialisation	(optional)	✖
Export-platform[2]	Simple		
	With Vertical Specialisation	(optional)	✖

ANNEX II – DESCRIPTION OF THE DATA AND CALCULATION OF VERTICAL TRADE

The dataset is comprised of 29 OECD countries and 11 emerging economies ((Argentina, Brazil, China, Chinese Taipei, Estonia, India, Indonesia, Israel, Russia, Slovenia and South Africa). The inclusion of countries was driven by data constraints related to the availability of input-output tables.

Table 4. Countries included in the dataset and years with input-output tables available

Country	Years with I-O tables
Argentina	1997
Australia	1998/99, 2004/05
Austria	1995, 2000, 2004
Belgium	1995, 2000, 2004
Brazil	1995, 2000
Canada	1995, 2000
Switzerland	2001
China	1995, 2000, 2002, 2005
Czech Republic	2000, 2005
Germany	1995, 2000, 2005
Denmark	1995, 2000, 2004
Spain	1995, 2000, 2004
Estonia	1997, 2000, 2005
Finland	1995, 2000, 2005
France	1995, 2000, 2005
United Kingdom	1995, 2000, 2003
Greece	1995, 1999, 2005
Hungary	1998, 2000, 2005
Indonesia	1995, 2000, 2005
India	1993/94, 1998/99
Ireland	1998, 2000
Israel	1995
Italy	1995, 2000, 2004
Japan	1995, 2000, 2005
Korea	2000
Luxembourg	1995, 2000, 2005
Mexico	2003
Netherlands	1995, 2000, 2004, 2005
Norway	1995, 2000, 2001
New Zealand	1995/96, 2002/03
Poland	1995, 2000, 2004
Portugal	1995, 1999, 2000, 2005
Russia	1995, 2000
Slovak Republic	1995, 2000
Slovenia	2005
Sweden	1995, 2000, 2005
Turkey	1996, 1998, 2002
Chinese Taipei	1996, 2001
United States	1995, 2000, 2005
South Africa	1993, 2000

Input-Output Tables, trade, FATS and FDI data need to share the same sector classification in the dataset. We use 29 sectors that are compatible with ISIC Rev. 3 trade data and FDI statistics (see Table 5). For some of these sectors there are, however, no consistent trade and FDI data because of classification issues or too few observations for a robust estimation.

Table 5. Classification of sectors

Sector	Industry	ISIC Rev. 3
	PRIMARY	
1	Agriculture and fishing	1+2+5
2	Mining and quarrying	10+11+12+13+14
	MANUFACTURING	
3	Food products	15+16
4	Textiles and wearing apparel	17+18+19
5	Wood, publishing and printing	20+21+22
6	Refined petroleum and other treatments	23
7	Chemical products	24
8	Rubber and plastic products	25
9	Metal products	27+28
10	Mechanical products	29
11	Office machinery and computers	30
12	Radio,TV,communication equipments	32
13	Medical, precision and optical instruments, watches and clocks	33
14	Motor vehicles	34
15	Other transport equipments	35
16	Other manufacturing	26+31+36+37
17	Electricity, gas and water	40+41
	SERVICES	
18	Construction	45
19	Trade and repairs	50+51+52
20	Hotels and restaurants	55
21	Transport, storage & auxiliary activities	60+61+62+63
22	Post and telecommunications	64
23	Finance and insurance	65+66+67
24	Real estate	70
25	Renting of machinery and equipment	71
26	Computer activities *	72
27	Research and development	73
28	Other business activities	74
29	Other services	75+80+85+90-93

* For some country pairs, it was not possible to exclude information services (ISIC Rev. 3 category 8512-01) from the computer activities category.

Vertical trade calculations

To obtain estimates of vertical trade in select OECD and Non-member countries, we use trade data from COMTRADE (available in ISIC Rev.3 classification) for goods and data from the OECD Trade in Services by Partner (TISP) database for cross-border trade in services. These data are then combined with information from the 2006 edition rev. 1 of the OECD input-output tables to calculate measures of vertical trade. Importantly, we are able to calculate measures of vertical trade in 29 sectors in a panel of countries for the period 1995-2005.

Formally, vertical trade is defined *à la* Hummels *et. al.* (2001):

$$Share\ of\ Vertical\ Trade = [u * Am * (I - Ad)^{-1}] * X/X_k$$

In this equation, u represents a 1*n vector of 1s, Am symbolizes the input-output coefficients in the import matrix, I denotes the identity matrix, Ad represents the input-output coefficients in the domestic matrix, X denotes a 1*n vector of sector exports, and X_k signifies total country exports. We use a sectoral decomposition of the share of vertical trade to produce estimates of bilateral flows by industry.

The shares of vertical trade in each sector are calculated for the periods for which input-output table data exist. Most of the countries in the dataset have input-output data for two periods, and for these countries, we apply a country's earliest vertical trade share to the period 1995-1999, and a country's later vertical trade share to the trade data for 2000-2005[32]. Bilateral trade data for agriculture and manufacturing comes from COMTRADE for the period 1995-2005[33]. The bilateral services data comes from the OECD TISP database for the period 1999-2005 (earlier data are unavailable)[34].

Combining trade data with input-output tables introduces different issues that are discussed in Guo *et al.* (2008). Trade data found in the input-output tables are very different from the trade statistics because of differences in the compiling methodology. To minimise the bias in our analysis we use shares of exports calculated from the I/O tables that are then applied to trade data. We use the COMTRADE database that takes into account for certain reporters re-exports (a source of discrepancy between I/O tables and trade statistics).

32 . For countries for which only one year's vertical trade share is available, we apply this share to all of the trade data. For Norway and Portugal, which have three years of input-output data, we apply the earliest trade share to the period 1995-1998/9, the middle value to the exact year, and the latest value to all years afterwards. There are year and country fixed effects in the subsequent regressions to correct for the potential bias introduced in using the same coefficient for different years.

33 . We use net exports. These data are reported in thousands of USD and converted to millions for 1995-2005.

34. The data are reported in millions of USD. The data for Germany as a reporter country are compiled according to the country of origin principle, which means that data are attributed to the actual country of origin, rather than the country of consignment. The other EUROSTAT countries compile their data according to the country of consignment.

Table 6. Percentage change in the share of vertical trade (1995/2005)

Country	Percentage change in the share of vertical trade (1995-2005)		
	Primary	Manufacturing	Services
Australia	-28.1%	-9.1%	33.2%
Austria	24.6%	-6.3%	110.6%
Belgium	-9.9%	-8.6%	36.3%
Brazil	118.7%	10.3%	21.3%
Canada	-2.0%	-2.8%	7.3%
China	-26.1%	69.5%	187.4%
Czech Republic	9.1%	12.1%	-41.0%
Germany	3.0%	32.4%	38.8%
Denmark	-8.4%	-12.1%	510.0%
Spain	-13.3%	-7.2%	109.3%
Estonia	-40.8%	21.2%	-27.0%
Finland	-14.0%	27.5%	8.0%
France	-16.5%	27.7%	57.2%
United Kingdom	22.8%	-25.1%	20.7%
Greece	-26.5%	23.5%	197.9%
Hungary	-24.0%	16.8%	38.4%
Indonesia	0.0%	0.0%	0.0%
Ireland	-15.4%	9.4%	78.0%
Italy	0.8%	-2.2%	-20.3%
Japan	113.4%	88.2%	41.4%
Korea	0.0%	0.0%	0.0%
Luxembourg	-53.6%	-42.3%	77.9%
Netherlands	7.4%	-3.4%	45.6%
Norway	-5.1%	-30.4%	-6.5%
New Zealand	72.1%	-4.3%	3.1%
Poland	-55.9%	138.9%	-20.8%
Portugal	65.2%	12.5%	44.3%
Russia	15.2%	2.4%	4.2%
Slovak Republic	-59.0%	53.1%	5.5%
Sweden	0.3%	10.3%	37.1%
Turkey	-39.6%	99.6%	-18.1%
Chinese Taipei	10.6%	5.3%	11.8%
United States	9.6%	30.0%	70.1%
South Africa	23.5%	38.1%	56.1%
Average	**1.7%**	**16.9%**	**50.5%**

Source : Calculated by the authors using the 2009 edition of the OECD input-output tables.

ANNEX III – ECONOMETRIC ANALYSIS

The econometric analysis consists in theestimation of extended gravity equations based on the knowledge-capital model (Carr, Markusen and Maskus, 2001) for trade and FDI. We however use vertical trade in addition to exports as a dependent variable. In addition to FDI, we also test sales of foreign affiliates (Mode 3 trade in the case of services). We follow Bergstrand and Egger (2007) who provide a theoretical foundation for using gravity equations for FDI and foreign affiliate sales, as well as Bergstrand and Egger (2008) for some robustness checks and an assessment of the relationship between trade and FDI. We use Poisson regressions to address the issues associated with a significant number of zeros in the dataset (Santos Silva & Tenreyro, 2006). Fixed-effects control for unobserved variables at the country or sector level, as well as unobserved time-series variation.

The model specification is expressed mathematically as:

$$Flow_{ijkt} = \alpha + \beta_1 Dist_{ij} + \beta_2 \sum Dum_{ij} + \beta_3 GDP\_jo\,\mathrm{int}_{ijt} + \beta_4\,\mathrm{Re}\,lGDP_{ijt} + \beta_5\,\mathrm{Re}\,lSkill_{ijt} + \kappa_k + \lambda_t + \gamma_i + \upsilon_j + \varepsilon_{ijkt}$$

Where:

Flow is bilateral exports, vertical trade, FDI stocks or sales of foreign affiliates

α = constant

γ = reporter country fixed effects

η = partner country fixed effects

κ = industry fixed effects

λ = year fixed effects

i = reporter country subscript

j = partner country subscript

k = industry subscript

t = year subscript

ε = the error term

All other elements of the equation are defined in Table 7 below.

Table 7. Variables definition

Variable	Description	Source
Exports (*Exports*)	Bilateral exports	COMTRADE (goods) and OECD TISP database (services)
Vertical trade (*VT*)	Vertical trade (exports)	Calculated by the Authors using COMTRADE, the OECD TISP database, and the 2006 rev. 1 OECD Input-Output Database
FDI (*FDI*)	Bilateral FDI stocks	Derived from the OECD FDI dataset
FATS (*FATS*)	Bilateral sales of foreign affiliates (turnover)	OECD, Eurostat and national sources
Joint GDP (*Joint_GDP*)	The sum of the logs of reporter and partner country GDP	World Bank Development Indicators
Relative GDP (*Rel_GDP*)	The log of the ratio of reporter to partner country GDP	World Bank Development Indicators
Relative skill endowment (*Rel_skill*)	The log of the ratio of reporter to partner country tertiary school enrolment (% gross).	World Bank Development Indicators
Distance (*Dist*)	The distance between reporter and partner country (great circle method)	CEPII
Border (*dummies*)	A binary variable to indicate whether a reporter and partner country share a common border	CEPII
Common official language (*dummies*)	A binary variable to indicate whether a reporter and partner country share a common official language	CEPII
Trade costs	The log of the CIF-FOB trade factors, calculated as: CIF value minus FOB value, divided by FOB value.	Calculated by the Authors using COMTRADE.
Tariffs	The log of bilateral trade-weighted average tariff rates (by industry)	TRAINS

In the above equation, distance can be interpreted as a proxy for all distance-related trade costs (or FDI costs, FATS costs in the case of the FDI or FATS equation). Table 1 and the discussion in Part 1 describe what concretely these costs are. Costs related to trade barriers (*e.g.*, tariffs), legal or cultural barriers that are specific to a country are in theory captured by the country specific fixed effects. To a certain extent some of these costs are however distance-related (for example the cultural barrier increases with distance) and are also captured by the distance variable.

The interpretation of the distance coefficient in gravity equations has been discussed in the literature, in particular in relation to the debate on the "death of distance". Coe *et al.* (2007) argue that the distance coefficient in theoretical gravity model is a function of the ratio of the marginal cost of trade with respect

to distance to the average cost. In this sense, the ratio can stay the same while trade costs decline, as long as the decline in marginal cost is not faster than the decline in average cost. Moreover, Buch, Kleinert and Toubal (2004) point out that distance is time-invariant and as such cannot measure trade costs over time (implying that the evolution of trade costs over time is captured by other variables of the gravity equation). This is why this analysis provides a comparison of distance coefficients among sectors and not over time. The sector approach also eliminates another potential bias – the aggregation of goods and services that are likely to be affected differently by distance-related trade costs.

Some support for the idea that distance coefficients capture trade costs and FDI costs can be found in Bergstrand and Egger (2007).

Table 8. Pooled regressions (all sectors)

Dependent variable	Country, year and industry fixed effects				Controlling for trade costs (goods)			Controlling for tariffs (goods)		
	Exports	Vertical trade	FDI	FATS	Exports	Vertical trade	FDI	Exports	Vertical trade	FDI
Coefficients	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(5)	(6)	(7)
Distance	-0.868***	-0.918***	-0.564***	-0.323***	-0.796***	-0.896***	-0.602***	-0.763***	-0.748***	-0.576***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Common Border	0.682***	0.635***	0.251***	1.353***	0.734***	0.649***	-0.180***	1.088***	1.168***	0.274***
	(0.000)	(0.000)	(0.001)	(0.004)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.003)
Common Language	0.100***	0.065***	0.497***	-0.187***	-0.056***	-0.039***	0.554***	0.024***	0.142***	0.638***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)
Joint GDP	0.715***	0.611***	0.588***	0.795***	0.783***	0.698***	0.653***	0.711***	0.598***	0.327***
	(0.000)	(0.000)	(0.002)	(0.004)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.003)
Relative GDP	-0.104***	-0.240***	-0.113***	0.061***	-0.005***	-0.219***	0.100***	-0.116***	-0.322***	-0.243***
	(0.000)	(0.000)	(0.002)	(0.004)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.003)
Relative skill	0.227***	0.379***	-0.125***	-0.212***	0.155***	0.345***	-0.172***	0.198***	0.360***	-0.096***
	(0.000)	(0.000)	(0.002)	(0.006)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.003)
Trade costs					-0.177***	-0.168***	-0.079***			
					(0.000)	(0.000)	(0.000)			
Tariffs								-0.003***	-0.001***	-0.053***
								(0.000)	(0.000)	(0.000)
Observations	537,692	537,692	128,314	7,790	86,431	86,431	48,174	79,776	79,776	50,379
Adjusted R-squared	0.793	0.792	0.716	0.875	0.783	0.779	0.679	0.767	0.759	0.696

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

When comparing the distance coefficients in Table 8, one should take into account the difference in the number of observations. There are less data for bilateral FDI stocks and sales of foreign affiliates.However, the results are similar when the regressions are run on the same number of observations (restricting the dataset to non-missing FATS data with 7,790 observations). The coefficients found are the following: -1.006 for exports, -1.171 for vertical trade, -0.506 for FDI and -0.323 for FATS. While the trade coefficients are slightly higher, the ranking is unchanged.

To account for endogeneity in the choice between trade and FDI, we have also tested a joint estimation of (vertical) trade and FDI in the spirit of Egger and Pfaffermayr (2004) but with a Seemingly Unrelated Poisson Regression model (King, 1989). The joint estimation allows efficient estimators in the presence of contemporaneously correlated endogenous variables. The assumption is that both vertical trade and FDI are a function of unobserved exogenous factors (which can be understood as firms' motivations for fragmenting their production). They are uncorrelated, but endogenously determined simultaneously. The Seemingly Unrelated Regression technique controls for the correlation in error terms between the FDI and trade equations. This methodology provides more efficient estimators, but it also has an economic meaning by highlighting the complementary relationship between trade and investment. The joint estimation does not however change the results for the distance coefficients (it has an impact however on signs and significance of the relative GDP and relative skill endowment variables).

Table 9. Regressions by activity (primary, manufacturing, services)

PRIMARY	Exports	Vertical trade	FDI	FATS
	(1)	(2)	(3)	(4)
Distance	-1.288***	-1.236***	-0.673***	-
	(0.000)	(0.000)	(0.002)	-
Common Border	0.397***	0.547***	0.644***	-
	(0.000)	(0.000)	(0.004)	-
Common Language	-0.006***	-0.163***	1.869***	-
	(0.000)	(0.000)	(0.005)	-
Joint GDP	0.505***	0.540***	-0.120***	-
	(0.000)	(0.000)	(0.008)	-
Relative GDP	-0.269***	-0.378***	0.364***	-
	(0.000)	(0.000)	(0.007)	-
Relative skill	0.012***	0.115***	0.380***	-
	(0.000)	(0.000)	(0.008)	-
Observations	26,946	26,946	6,061	-
Adj. R-squared	0.89	0.88	0.91	-
MANUFACTURING	**Exports**	**Vertical trade**	**FDI**	**FATS**
	(1)	(2)	(3)	(4)
Distance	-0.898***	-0.920***	-0.634***	-0.024***
	(0.000)	(0.000)	(0.001)	(0.004)
Common Border	0.725***	0.642***	0.269***	1.562***
	(0.000)	(0.000)	(0.002)	(0.008)
Common Language	0.062***	0.073***	0.665***	0.556***
	(0.000)	(0.000)	(0.001)	(0.004)
Joint GDP	0.733***	0.644***	0.537***	0.307***
	(0.000)	(0.000)	(0.003)	(0.006)
Relative GDP	-0.093***	-0.194***	-0.197***	-0.257***
	(0.000)	(0.000)	(0.002)	(0.006)
Relative skill	0.260***	0.420***	-0.236***	-0.468***
	(0.000)	(0.000)	(0.002)	(0.003)
Observations	35,891	35,891	6,120	868
Adj. R-squared	0.95	0.95	0.89	0.98
SERVICES	**Exports**	**Vertical trade**	**FDI**	**FATS**
	(1)	(2)	(3)	(4)
Distance	-0.747***	-0.760***	-0.577***	-0.486***
	(0.000)	(0.000)	(0.001)	(0.001)
Common Border	0.342***	0.372***	0.322***	1.147***
	(0.000)	(0.000)	(0.002)	(0.003)
Common Language	0.282***	0.270***	0.388***	0.164***
	(0.000)	(0.000)	(0.001)	(0.002)
Joint GDP	0.713***	0.701***	0.801***	1.308***
	(0.000)	(0.000)	(0.003)	(0.004)
Relative GDP	-0.114***	-0.180***	0.070***	-0.205***
	(0.000)	(0.000)	(0.002)	(0.004)
Relative skill	0.133***	0.273***	0.079***	-0.492***
	(0.000)	(0.000)	(0.003)	(0.005)
Observations	13,294	13,294	4,343	1,980
Adj. R-squared	0.93	0.91	0.91	0.97

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 10. Regressions by sector

Distance coefficient in sector:	Exports	Vertical trade	FDI	FATS
	(1)	(2)	(3)	(4)
Agriculture and fishing	-1.178***	-1.248***	-0.693***	-
Mining and quarrying	-1.399***	-1.202***	-0.652***	-
Food products	-1.071***	-1.092***	-0.727***	-
Textiles and wearing apparel	-1.103***	-1.086***	-0.798***	-
Wood,publishing and printing	-1.183***	-1.205***	-0.440***	-
Refined petroleum & other treatments	-0.896***	-0.976***	-0.644***	-
Chemical products	-0.934***	-0.981***	-0.907***	-
Rubber and plastic products	-1.224***	-1.264***	-0.648***	-
Metal products	-1.036***	-1.036***	-0.785***	-
Mechanical products	-0.849***	-0.852***	-0.315***	-
Office machinery and computers	-0.867***	-0.890***	-1.275***	-
Radio,TV,communication equipments	-0.780***	-0.854***	-0.596***	-
Medical, precision and optical instruments	-0.700***	-0.736***	-0.420***	-
Motor vehicles	-1.196***	-1.209***	-0.823***	-
Other transport equipments	-0.184***	-0.295***	-0.893***	-
Other manufacturing	-0.983***	-0.997***	-0.921***	-
Electricity, gas and water	-2.763***	-2.439***	-2.382***	-
Construction	-0.983***	-1.030***	-1.064***	x
Trade and repairs	-1.026***	-1.103***	-0.605***	-0.432***
Hotels and restaurants	-0.967***	-0.979***	-0.452***	-0.278***
Transport, storage & auxiliary activities	-0.601***	-0.607***	-0.933***	x
Post and telecommunications	-0.926***	-0.930***	-1.013***	x
Finance	-0.598***	x	-0.759***	-0.108***
Renting of machinery and equipment	-0.757***	-0.755***	-0.382***	x
Computer activities	-1.015***	-1.006***	-0.538***	x
Research and development	-0.472***	x	-0.463***	x
Other business activities	-0.586***	-0.546***	-0.343***	x
Other services	-0.538***	-0.433***	-0.919***	-1.419***

*** p<0.01, ** p<0.05, * p<0.1 ; 'x' means that no convergence was achieved in the Poisson estimation.

Table 11. Regressions on the ratio of vertical trade to FDI/FATS

Dependent variable Coefficients	Vertical trade / FDI	Vertical trade / FATS
Distance	-0.821***	-0.142***
	(0.000)	(0.002)
Common Border	0.977***	2.563***
	(0.000)	(0.005)
Common Language	-0.669***	-0.052***
	(0.000)	(0.002)
Joint GDP	2.291***	3.390***
	(0.000)	(0.005)
Relative GDP	1.247***	-0.392***
	(0.000)	(0.004)
Relative skill	-1.544***	1.468***
	(0.000)	(0.007)
Observations	88,991	2,727
Adjusted R-squared	0.558	0.930

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 8. Distance-related trade costs by sector (vertical trade)

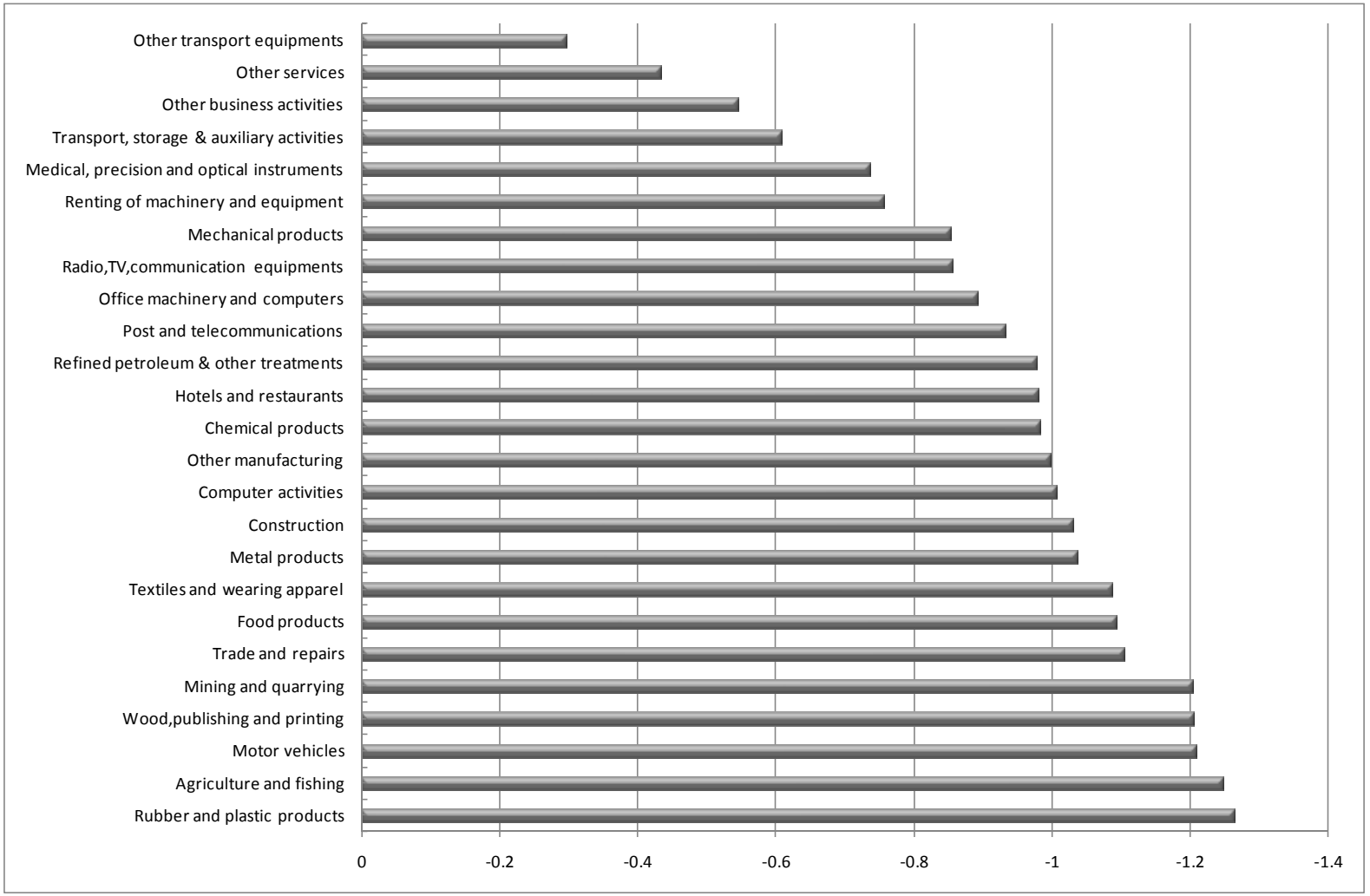


Figure 9. Distance-related FDI costs by sector