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Intertwined

**FDI IN MANUFACTURING AND TRADE IN
SERVICES**

Jonathan Gage, Molly Lesher

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INTERTWINED: FDI IN MANUFACTURING AND TRADE IN SERVICES

OECD Trade Policy Working Paper No. 25

by Jonathan Gage and Molly Lesher

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ABSTRACT

This study analyses the complex relationship between manufacturing FDI and trade in services. An examination of how recent developments in the economic landscape have resulted in changes in the industrial organisation as well the structure of multinational enterprises is presented. This analysis serves as the foundation for a discussion of fragmentation—and the increased use of traded services in the fragmentation process—in four different manufacturing value chains (apparel, automobiles, semiconductors, and wood furniture). To complement the value chain assessments, the results of empirical work examining the relationship between the liberalisation of services and manufacturing FDI are included. Finally, the study outlines several policy implications that draw upon the analysis. In sum, this study highlights how the increasingly international nature of fragmentation, in part the result of services liberalisation, has redefined the way in which many manufacturing firms use services, interact with service suppliers, and make foreign direct investments.

Keywords: Investment, services, manufacturing, FDI, value chain, fragmentation, outsourcing, off-shoring, trade policy.

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EXECUTIVE SUMMARY

Manufacturing firms have been fragmenting, or dividing their production processes into increasingly smaller components that are then outsourced or off-shored, to increase efficiency, profits, and value for years. Yet recent technological changes—resulting in cheaper transport, telecommunication, and computing costs—as well as trade and investment liberalisation, have rapidly accelerated this fragmentation in many industries. As manufacturers incorporate more services into their value chains, the liberalisation of trade in services has become more important. These changes have redefined the way in which many manufacturing firms use services and interact with service suppliers. Today, fragmentation is characterised by an unprecedented level of complexity, as well as an increasingly international dimension, which compels policymakers to think carefully about its effects on manufacturers and particularly its effect on foreign direct investment (FDI).

Section 2 explores this issue by outlining how recent and rapid developments in the economic landscape have resulted in changes in the industrial organisation. In particular, the paper outlines the motives for modern fragmentation and the increased use of traded services, and explores the dual role that services are playing in the fragmentation process. Moreover, this section analyses changes that have driven multinational enterprises (MNEs) to take on the characteristics of a complex system of partnerships that are linked together not by ownership, but rather by shared information and a common strategy. This section also proposes that small- and medium-sized enterprises (SMEs) are increasingly inserting themselves into fragmenting manufacturing value chains and highlights some of the challenges facing SMEs in the future.

The study continues in Section 3 by exploring four different value chains—apparel, automobiles, semiconductor chips, and wood furniture—with a primary focus on the services and manufacturing interaction. As these manufacturing value chains continue to evolve, domestic and international services, both as links and as stand-alone segments, will play an increasingly important role in the manufacturing process. The value chain analysis highlights the critical role that technology, the internet, technical and process standards, trade rules, flexible manufacturing strategies, and unique approaches to value creation have had on value chain fragmentation in each industry.

To complement the value chain assessments, Section 4 provides a quantitative assessment of the relationship between services and manufacturing FDI. The Secretariat analyses manufacturing FDI and services FDI to assess if a general correlation exists and, if so, if any correlation clusters emerge. This approach is then broadened by regressing both OECD and developing country manufacturing FDI with specific measures of services sector openness. While the results suffer from sparse developing country data for certain variables, thus limiting their explanatory power in some cases, taken together these techniques paint a picture of the interaction between manufacturing FDI and services.

Finally, various trade-related policy implications emerge and are presented in Section 5. These policy implications are presented below.

- *Support liberalisation of the telecommunications sector.* Telecommunications and value-added network services providers are increasingly essential for the efficient functioning of firms operating internationally. The evidence presented in all four manufacturing case studies suggests that internet communication, particularly broadband, has been critical in these value chain fragmentations. The quantitative analysis also highlights that manufacturing FDI correlates

highly with telecommunication services FDI and that a restrictive telecommunications sector is negatively associated with manufacturing FDI.

- *Encourage investment in infrastructure and the liberalisation of related services.* Both the disaggregated correlation table and the regression analysis suggest that liberalisation of infrastructure-related services positively affects manufacturing FDI. Further, reliable and efficient infrastructure contributes to lowering transportation and communication costs, thus stimulating trade in related services. As a result, governments may wish to promote policies that encourage foreign investment in infrastructure to improve infrastructure capabilities.
- *Promote international technical and process standards.* To participate in fragmenting manufacturing value chains, firms must deliver products that conform to technical standards. Technical and process standards are crucial for component parts to be used in downstream assembly and to provide clear rules of the game that enable new firms to insert themselves into fragmenting value chains. Governments should encourage both the formation of international accreditations and provide assistance to SMEs seeking to obtain such accreditations for export.
- *Introduce a coherent innovation policy.* To avoid the ‘commodity trap’ that plagues some manufacturers, firms of all sizes must constantly innovate to maintain and enhance intellectual capital. Because of the different characteristics of goods and services, governments would be well-served to formulate a specific policy framework for innovation in services as well as goods (OECD, 2001b). The use of technology plays a significant role in the innovation process, and thus should be encouraged.
- *Limit trade rules that may prevent fragmentation.* In some cases, rules of origin prevent fragmentation. In part because of rules of origin, firms tend to search for component suppliers not from the most efficient low-cost firms who may be located outside of a particular trade agreement, but rather from suppliers located within a partner country who may be less efficient. This approach removes much of the cost savings associated with specialisation and creates inefficiencies that prevent firms from maximising the gains from trade.
- *Institute complementary competition policies.* Many services that support fragmentation exhibit characteristics of network economies such that economies of scale may encourage natural monopolies. Therefore, competition policy can be critical to ensure access to essential infrastructure and to avoid the abuse of dominance. Anticompetitive practices in services can also discourage manufacturing firms from fragmenting, thus reducing trade in services as international service suppliers cannot enter the value chain.
- *Encourage trade facilitation as timing and costs tighten.* Just-in-time manufacturing streamlines inventories and work-in-progress. As a result, suppliers must be able to respond quickly to developments further down the value chain. Thus, efficient customs procedures and trade facilitation measures are essential to reducing the time and cost of product movements.

INTERTWINED: FDI IN MANUFACTURING AND TRADE IN SERVICES

1. Introduction

1. Manufacturing firms have been fragmenting, or dividing their production processes into increasingly smaller components that are then outsourced or off-shored, to increase efficiency, profits, and value, for years. Yet recent technological changes—resulting in cheaper transport, telecommunication, and computing costs—as well as trade and investment liberalisation, have rapidly accelerated this fragmentation. Today, fragmentation is characterised by an unprecedented level of complexity, as well as an increasingly international dimension. These changes have redefined the way in which many manufacturing firms use services and interact with service suppliers.

2. While not necessarily ubiquitous in all sectors today, the propensity for fragmentation has increased the use of services—both as links and as stand-alone components—in the manufacturing value chain. Manufacturers use many different types of services to produce goods, and they have taken on more importance as a result of fragmentation. In the automobile industry, for instance, research and development, engineering, and quality assessment services represent over half of the cost of manufacturing an automobile. Other infrastructure-related services are also important intermediate inputs in the manufacturing process, including financial, communication, transport, and distribution services. In fact, recent estimates show that trade in parts and components, as well as the use of third-party logistics (3PL) services, such as customs clearance and freight forwarding services, have risen in recent years, clear indications of fragmentation.

3. As manufacturers incorporate more services into their value chains, the liberalisation of trade in services has become more important. For one, successive rounds of regional and multilateral negotiations have reduced tariffs and non-tariff barriers in OECD countries. As barriers to trade in goods have declined, manufacturing firms have been concentrating less on lobbying for further tariff reductions and more on reductions in barriers to trade in the services needed to produce or support those goods. The liberalisation of services decreases the cost of services that link various segments of the production process, as well as the cost of a whole host of other goods and services. For instance, liberalisation in transport services benefits not only the transport services sector itself, but also every other kind of trade that transport services facilitate.

4. The increasing complexity and internationalisation of modern fragmentation compels policymakers to think carefully about its effects on manufacturers, and particularly its effect on foreign direct investment (FDI). Has globalisation, in which outsourcing and off-shoring play a key role, fundamentally changed the structure of the industrial organisation? How has modern fragmentation manifested itself in manufacturing value chains? Is there a quantitative relationship between manufacturing FDI and trade in services? This paper helps fill a void in the existing literature by exploring these questions.

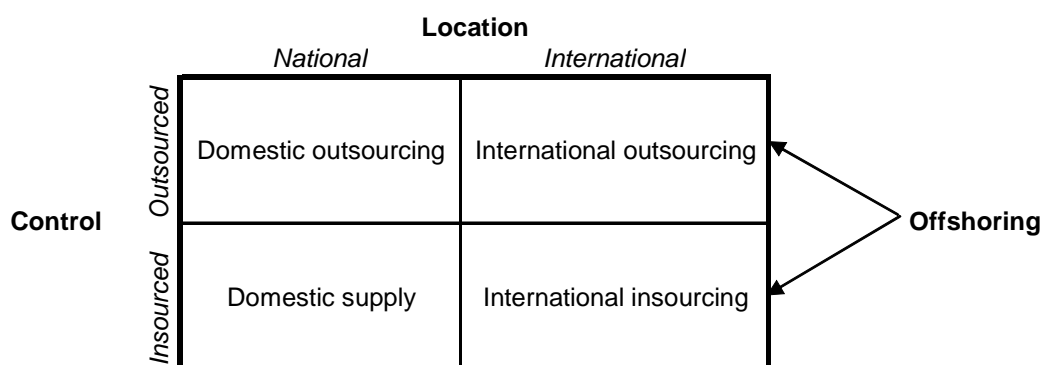
2. The industrial organisation change

5. Fragmentation is an important element of the changing relationship between manufacturing and services. In 1990, trade theorists Ronald Jones and Henryk Kierzkowski developed a general framework of fragmentation. The OECD (2001a), among others, built upon the pioneering work of Jones and Kierzkowski, substantially contributing to our understanding of fragmentation from a trade perspective. An underlying theme of the literature notes that fragmentation benefits both producers and consumers (see

Moran, 2002; Feenstra et. al., 2002). Indeed, firms fragment—or engage in vertical specialisation—to take advantage of cost savings or productivity enhancements gleaned from externally supplied components (outsourcing) or from abroad (off-shoring) (see Box 1).

Box 1. A typology of off-shoring and outsourcing

The globalisation debate has often blurred the concepts of outsourcing and off-shoring and their relationship to fragmentation and vertical specialisation. These concepts can be usefully distinguished in an illustrative typology. Off-shoring occurs when a firm sources inputs either from an unaffiliated foreign supplier or an overseas affiliate. Outsourcing, on the other hand, takes place when a firm sources inputs from a third party supplier located in the firm's domestic economy. Likewise, firms may also source internally via domestic affiliates.



Source: OECD 2005e.

6. While fragmentation has become more common recently, not all firms in every industry are fragmenting. Indeed, other strategies that complement or substitute for fragmentation are prevalent. For instance, firms may choose to concentrate vertically—that is, a firm may own different stages of the production and distribution processes (*i.e.* IKEA owns some aspects of the furniture manufacturing process as well as retail outlets). Alternatively, horizontal concentration may take place as firms engage in mergers and acquisitions with other firms in similar markets. Thus, firms often use a combination of strategies to create value.

Motives for modern fragmentation

7. Table 1 provides a variety of reasons—old, new, and evolving—why a firm may decide to fragment its production process.

Table 1. Motives for fragmenting and the use of services

Motive	Action	Description
Increasing productivity through efficiency	Ensure labour cost efficiencies	Firms create value by capturing wage differentials through the separation of low-skilled and high-skilled components of the value chain. In particular, such a situation may arise in which labour with certain qualifications (e.g. engineers) are in short supply.
	Focus on core competencies	Recently, MNEs have been creating value by focussing on their core competencies and passing non-core activities—particularly services—to specialised subsidiaries or third parties.
	Exploit economies of scale	Companies fragment some services processes to exploit economies of scale (<i>i.e.</i> lower average cost per unit) of one or more segments of the value chain.
	Form strategic alliances	Smaller, specialised entrepreneurs with labour and finance constraints may form strategic alliances to increase value. These entrepreneurs may have little brand recognition, but use their specialised skills, such as marketing and project management, to partner with other firms to manufacture products (OECD, 2001a).
Responding to consumer demand	Offer consumer financing	In the late 1990s, U.S. auto manufacturers successfully offered low interest rate car loans and leases through their subsidiaries to encourage sales. These financing arms now generate much of their parent company's profits.
	Institute a build-to-order system	Some manufacturers, including those in the computer and auto industries, have responded to consumer demand by introducing build-to-order schemes. These schemes allow consumers to custom order a computer or car according to unique specifications. Firms create value by adding on additional service components to the manufacturing value chain.
	Create demand through demonstration	Demonstration effects also allow companies to create value through fragmentation. Ford, for instance, once owned Hertz Rental Car, one of the largest car rental companies world-wide. Through the services offered by Hertz, Ford provided potential customers with an opportunity to try out Ford cars.
Reducing risk	Prototype & use short production runs	Firms often reduce the risks associated with developing new products by prototyping and implementing short production runs. These strategies allow a firm to use external facilities that are more suited to experimental testing and design, thus reducing the amount of capital required.
Minimising taxes	Strategise among subsidiaries	Corporate tax treatment of captive subsidiaries supplying back-office services to MNE parents may result in tax advantages. Further, differences in tax treatment for manufacturing and services entities may influence a firm's decision on how to allocate profits, and thus the associated taxes.
	Be aware of capital taxes	Capital taxes on assets may dissuade a MNE from making a foreign investment if the product can be contract manufactured. To be economically viable, the contractor may either need to hold tax-exempt status or have the ability to spread its own capital taxes over a broad-based clientele list.
	Optimise tax liabilities in the goods/services dichotomy	Taxing services can be more difficult than taxing goods because the latter possess a clearer market value. Indeed, the problems associated with transfer pricing have encouraged MNEs to locate their marketing subsidiaries in off-shore tax havens. In addition, while conceptually VAT/GST taxes should be neutral, there may be jurisdictions that levy VAT/GST taxes on services differently from goods.

8. Some of the motives for modern fragmentation either require, or are more applicable, when relatively free international trade exists. For instance, although wages may differ regionally within a given country, labour cost efficiencies are usually larger across countries. In addition, some manufacturing firms may not be able to achieve economies of scale without relocating abroad. Similarly, certain tax minimisation strategies are only effective when entities are located in different countries.

9. That said, of all of the motives described in Table 1, the ability to focus on core competence has perhaps become the most prevalent motive for fragmenting the manufacturing value chain. Nike, for instance, outsources all of its manufacturing processes to subcontractors that focus almost exclusively on producing Nike goods. Likewise, Cisco manufactures telecommunications products such as routers and switches without a Cisco employee touching the good. This fragmentation has allowed Nike and Cisco to focus on their competitive advantages of designing, branding, and marketing (Van Dusen, 1998; Financial Times, 2004).

10. At least in part, the emphasis on core competence has sprung from the increasing importance that many firms place on intellectual capital relative to physical assets. For example, Nike's share price to book value ratio—a first approximation of historical depreciated asset value per share—rose from 3.0 in 1995 to 4.0 in December 2004, suggesting that intellectual capital is becoming more important. A focus on intellectual capital assets may increase investor ascribed values because the return-on-assets improves as the physical manufacturing assets are stripped out and the focus on core competence reduces the cost of capital.

Services play a dual role in the fragmentation process

11. Services act both as links in the value chain as well as stand-alone production components. In general, four types of services support, complement, or replace manufacturing FDI¹. First, some services support the buyer, such as when a consumer purchases a service complement to a manufactured good (*e.g.* automobile financing). Second, indirect services support, but are not integral to, the manufacturing process. Indirect services include 3PL services such as customs brokerage, warehouse management, transportation, legal, accounting, engineering, telecommunication, and financial services. Third, manufacturers use some direct support services, such as procurement services, that are needed to acquire inputs in the manufacturing process. Fourth, manufacturers utilise sophisticated program management services that facilitate co-ordination among many disparate production components.

12. Manufacturing and services have become increasingly intertwined in several respects. For one, it is increasingly difficult to categorise many firms as either strictly manufacturers or service providers. In fact, automotive companies earn much of their profits by providing financial services (*e.g.* vehicle leasing or loan financing). Moreover, many manufactured products rely upon complementary services. For instance, the commercial success of mobile phone manufacturers depends upon the existence of specialised software and cellular network services. Further, the distinction between manufactured goods and services can hinge upon the method of delivery, particularly for digital products. QuickTax, a tax preparation software, represents one example of a “good” that may be purchased over-the-counter, by downloading the software from a website, or by accessing the website directly. In essence, all three methods embody the same program.

Box 2. Definitions of a service: Accountants, economists, statisticians, and trade practitioners

Is contract-manufacturing a service? Consider a seamstress who stitches a shirt for Nike. If Nike owns the cloth, thread, and buttons, and the seamstress owns the sewing machine and applies the labour, is the activity a service or is it manufacturing? The entire set of activities — Nike and the seamstress entering into the contract, the transmission of the specifications, the movement of input materials, and the execution of the order — creates the product.

The accountants focus on who owns title and bears the risk. If Nike owns the input and output and bears the risk, then accountants will likely deem the seamstress production activity a service. As a result, the seamstress's revenue reflects the net contract amount rather than the value of the shirt. It is unclear how many contract manufacturers use this type of “service” contract rather than source their inputs and incur the risks associated with manufacturing. For this reason, this paper assumes that contract manufacturing is not a service.

Traditionally, economists have attempted to define services largely by contrast with goods, emphasising the intangibility and invisibility of services, as well as the fact that a service interaction requires simultaneous production and consumption. Yet, the complexity of the modern services sector means that there are certain services that do not fit into this rubric. Thus, no satisfactory definition of services exists (Trebilcock, 2000).

In 1991, the GATT Secretariat classified services that were generally used for the GATS schedules negotiated in the Uruguay Round (W/120). The GATT based these classifications on the Central Product Classification (CPC) system of the United Nations. Sections CPC 5 through 9 are generally considered services. But services have evolved in the intervening years, and a comparison of W/120, used during the Uruguay Round, and subsequent versions 1.0 and 1.1 of the CPC, reveals many changes. As a result, one could say that the statisticians are addressing a moving target, and so it is not surprising that statistics for services contract manufacturing are rare. Indeed, the comparison presented below shows that Division 88 in v1.1 for *Manufacturing services on physical inputs owned by others* and Division 86 in v1.0 as *Production services on a fee or contract basis* had no concordance with any category 15 years ago except Group 884 *Services incidental to manufacturing including manufacturing on a fee or contract basis*.

¹. While accountants consider contract manufacturing a service under certain conditions, we explicitly exclude it from this discussion (see Box 2).

Box 2. Definitions of a service: accountants, economists, statisticians, and trade practitioners (continued)

CPC Provisional (1989)	CPC v1.0 (1997)	CPC v1.1 (2002)
Business services; agricultural, mining and manufacturing services	8 - Business and production services	8 - Business and production services
81 - Financial intermediation services and auxiliary services	81 - Research and development services	81 - Research and development services
82 - Real estate services	82 - Professional, scientific and technical services	82 - Legal and accounting services
83 - Leasing or rental services without operator	83 - Other professional, scientific and technical services	83 - Other professional, technical and business services
84 - Computer and related services	84 - Telecommunications services; information retrieval and supply services	84 - Telecommunications services; information retrieval and supply services
85 - Research and development services	85 - Support services	85 - Support services
86 - Legal, accounting, auditing and book-keeping services; taxation services; market research and public opinion polling services; management and consulting services; architectural, engineering and other technical services	86 - Production services, on a fee or contract basis	86 - Services incidental to agriculture, hunting, forestry, fishing, mining and utilities
87 - Business services n.e.c.	87 - Maintenance and repair services	87 - Maintenance, repair and installation (except construction) services
88 - Agricultural, mining and manufacturing services (incidental services)		88 - Manufacturing services on physical inputs owned by others
89 - Intangible assets		89 - Other manufacturing services

From a trade perspective, it may make little difference whether goods are manufactured using a service contract or by a manufacturer who acquires and transfers title. Customs officials assess import duties on the inputs no matter how firms organise the manufacturing process. Moreover, any import or export duties that the product incurs in transit to its destination market will not take into account the type of contracts used in the manufacturing process. Hence, from a trade practitioner's point of view, the distinction may be moot.

Source: United Nations CPC classifications; Trebilcock and Howse, 2000; *The Regulation of International Trade*, 2nd edition.

13. The changing role of services in the manufacturing process has driven firms to find new ways to create value. Today, a consumer can purchase the same refrigerator from a low-cost discounter or an up-market retailer who charges more. Why would anyone buy the more expensive refrigerator? Market imperfections that lead to asymmetries of information could be one reason. But it could also be the case that the up-market retailer offers a package of services—it delivers the refrigerator from warehouse to home, connects it, and takes away the old one. If the refrigerator breaks, the retailer will send a repairman to fix it. Thus, the discounter and the up-market retailer increasingly compete less on the basis of manufactured goods and more on the package of services that come with the good. Today, services embody the very idea of emerging forms of value creation.

The landscape of services commitments at the multilateral level

14. In the framework of the World Trade Organisation (WTO), services may be supplied in any one of four modes of delivery (see Box 3), of which Mode 3 (commercial presence) represents services FDI.

Box 3. The modes of supplying services under the GATS

In the realm of the WTO, the General Agreement on Trade in Services (GATS) defines the four modes through which services may be traded:

Mode 1 – Cross-border supply: The supply of a service “from the territory of one Member into the territory of any other Member”. In Mode 1, the service crosses the border, but both the provider and the consumer stay at home.

Mode 2 – Consumption abroad: The supply of a service “in the territory of one Member to the service consumer of any other Member”. In Mode 2, the consumer physically travels to another country to purchase the service.

Mode 3 – Commercial presence: The supply of a service “by a service supplier of one Member, through commercial presence in the territory of any other Member”. In Mode 3, a firm invests across the border through the establishment of a branch, agency, or subsidiary.

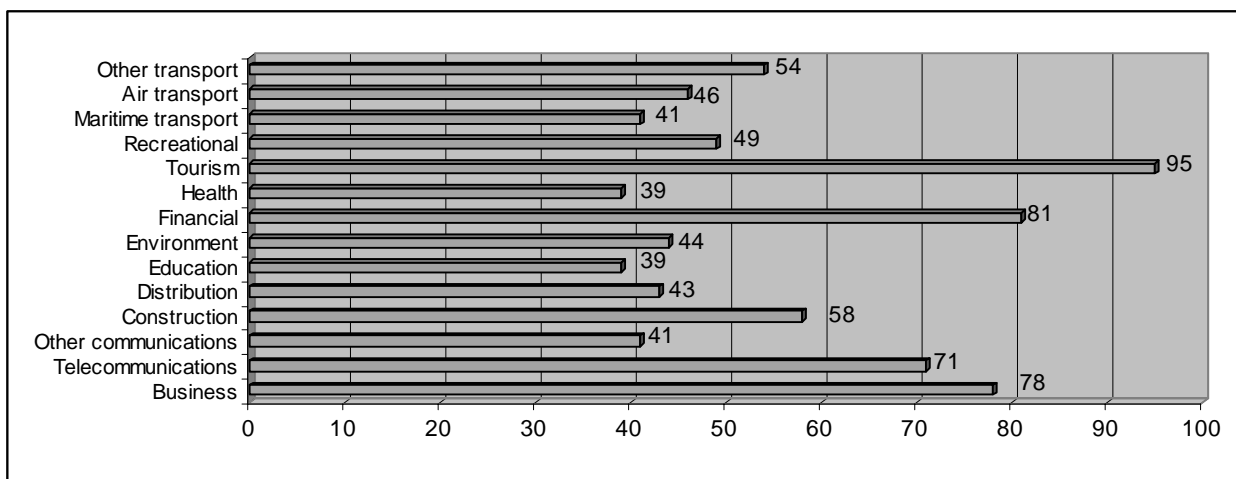
Mode 4 – Presence of natural persons: The supply of a service “by a service supplier of one Member, through presence of natural persons of a Member in the territory of any other Member”. In Mode 4, private parties temporarily cross the border to provide a service.

For instance, a bank may establish a branch office (Mode 3) to provide financial services in a WTO Member country that has scheduled the relevant GATS commitments. The foreign bank will likely also transfer specialists and managers to the branch (Mode 4). Or, a patient may travel to a country that has scheduled commitments in medical services (Mode 2). Likewise, a call centre may sell its services to a private party in a foreign country that has scheduled telecommunications commitments (Mode 1).

Source: OECD, 2002d; United Nations, 2002.

15. It is inherently challenging to assess the extent of services liberalisation in WTO members’ GATS commitments; indeed, any exercise that transforms qualitative information into a quantitative measure suffers from the introduction of some degree of subjectivity. Nonetheless, it is useful to gain some sense of the current level of services liberalisation. The following analysis draws upon Adlung and Roy (2005), who assess the degree of GATS liberalisation for all WTO Member countries as of March 2005.

Figure 1. Percentage of WTO Membership with at least one commitment in selected services sectors

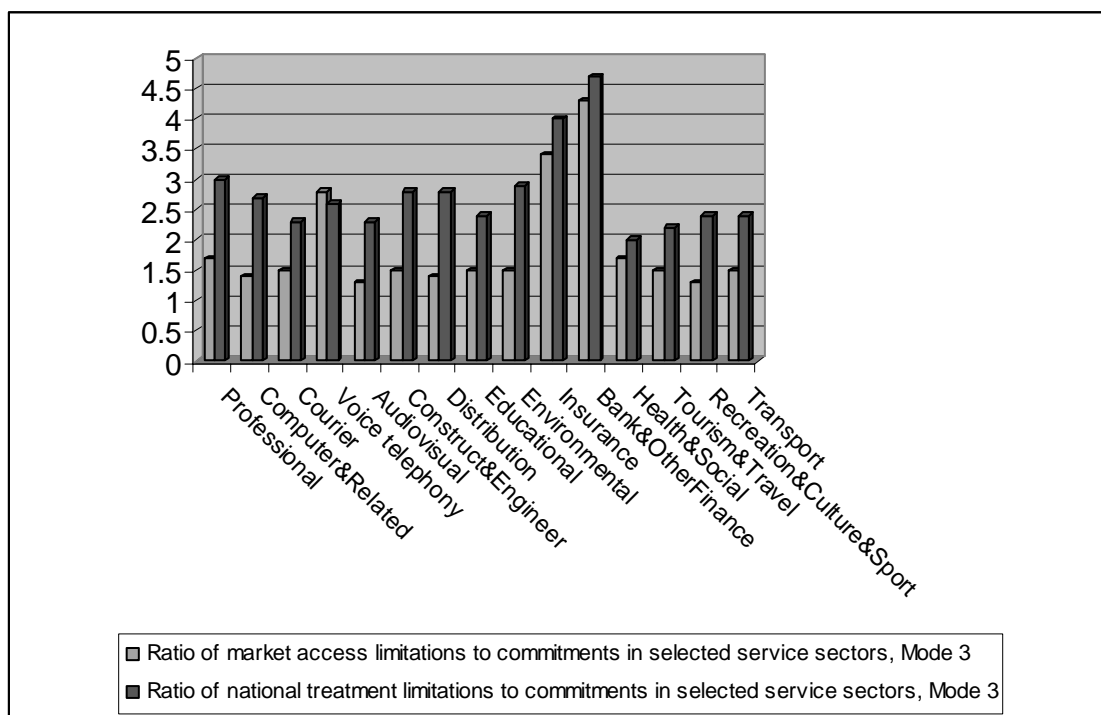


Source: Adlung and Roy, 2005.

16. While assessing the number of WTO Members that have made at least one commitment in a services sector provides some sense of GATS commitments to date, it does not paint the entire picture. It is also important to factor in the number of exceptions countries have scheduled in relation to those commitments. Adlung and Roy (2005) calculate the ratio of WTO Member limitations on market access and national treatment to scheduled commitments for Mode 3². These data are presented in Figure 2 below.

² Limitations include both horizontal and sectoral limitations that are applicable to a given sector.

Figure 2. A comparison of GATS limitations to commitments, selected services sectors, as of March 2005



Source: Adlung and Roy, 2005.

17. Taken together, these data suggest that while progress has been made in liberalising services at the multilateral level, more can be done. In particular, the ratios of commitments to limitations in Figure 2 suggest that Mode 3 liberalisation has been hampered by the number of exceptions scheduled. Further GATS liberalisation would facilitate manufacturers in reaping the full benefits from trade liberalisation.

Changing times and changing roles for multinational enterprises?

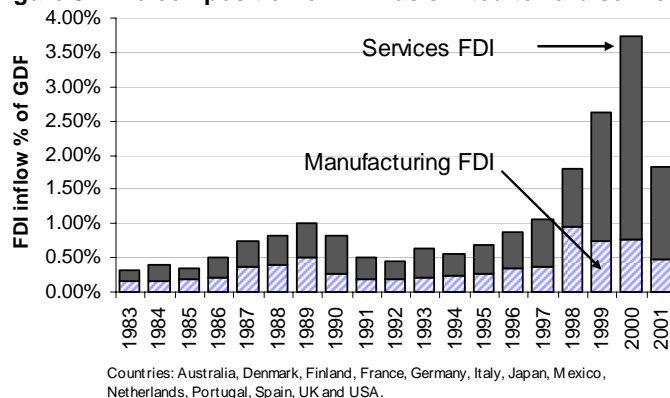
18. The increase in the use of services in manufacturing may also be forcing economists to revisit certain aspects of established trade theory. The 'new trade theory' augmented traditional comparative-advantage models of international trade by focusing attention on scale, imperfect competition, and product differentiation as a way to explain why significant two-way trade in similar products exists between similarly endowed developed countries. This theory assumes that economies of scale pertain to a single plant, national firm. An extension of the new trade theory assumes that firm-level and sector-level scale economies are more important relative to plant-level scale economies. Thus, the 'convergence hypothesis' emerged, suggesting that multinational enterprises (MNEs) become more important relative to national firms as countries become more similar in size, endowments, and technologies (Markusen, 1995).

19. Until 2000, the convergence hypothesis was at least partially validated on an aggregate level as total FDI had grown considerably faster than international trade among developed countries. Some economists made the case that this data supported the argument that MNE FDI was displacing national firms and trade as countries converged (Barrios, 2000). But if that were true before, times may have changed.

20. A review of all of the continuous data available for OECD countries suggests that the role of MNEs may be evolving. In the period 1983-2001, FDI inflows to developed countries dramatically increased. Many researchers considered this increase as further evidence of the convergence hypothesis. But a closer

look reveals a substantial change in the composition of FDI, particularly in the late 1990s. Figure 3 shows that the dramatic increase was due mainly to services FDI rather than to manufacturing FDI.

Figure 3. The composition of FDI has shifted toward services



Note: Weighted average of 13 OECD countries with continuous data.

Source: OECD International Direct Investment Statistics Yearbook, 2003.

21. The recent drop in FDI inflows into developed countries could be statistical noise as the data are sensitive to mergers and acquisitions. But, it may also reflect a more significant trend. Multinationals are best explained when transport costs, tariffs, and incomes are high, and when firm-level scale economies are more important than plant-level economies of scale (Markusen, 1995). These conditions may hold less well today than they did in the past and, simultaneously, their importance may have also diminished.

22. For one, technological advances, such as containerisation and inter-modal transport, coupled with deregulation, have generally reduced the cost of transporting goods and improved the timeliness and consistency of deliveries. Decreasing transport costs have facilitated just-in-time manufacturing, increasing efficiency in many industries. In addition, average tariff rates have also fallen. For instance, the average U.S. tariff has fallen from around 60% in the early 1930s to about 5% in the early part of the 2000s (Krugman, 2003).

23. Further, firm-level scale economies may have become less important. For one, technological innovations, coupled with lower costs, have enabled even the smallest firms to connect to international partners. In addition, firms now have better access to financing options. Small firms gain the most from more accessible finance as they can more easily manage the flow of funds for work-in-progress and receivables for products bound for international clients. Further, tighter intellectual property laws have allowed some industries to license—rather than depend upon wholly-owned subsidiaries—to use intellectual property without fear of infringement. In essence, the importance of the ownership, location, and internalisation (OLI) rubric for MNEs first put forth by Dunning (1993) may have changed.

24. As a result of this changing landscape, MNEs—particularly those in industries in which commercial confidentiality is relatively less critical to the core business, such as manufacturing and non-financial services—may be engaging in more arm's-length trade than FDI. Instead of creating a subsidiary, for example, firms may be participating in additional strategic alliances with local companies or engaging in more licensing activities. If this were the case, one would expect inflows of FDI to drop and trade flows to increase. One would also expect companies to continue to outsource and off-shore some segments of the production process, but these activities would no longer take the form of FDI.

25. As the environment has changed, so too have MNEs. Today, MNEs are more often characterised by a complex system of partnerships that are linked together not by ownership, but rather by shared information and a common strategy. The implications of this paradigm shift are two-fold. First, MNEs may

co-ordinate and co-operate in value chains and yet compete in a game-theoretic approach (Brandenburger, 1998). Thus, the strategy of owning overseas subsidiaries may be in decline. Second, if strategy and information bind the value chain, then manufacturing MNEs can concentrate on their core competences. So, as the costs of using international services declines, and knowledge of global suppliers and legal systems rises, it is less necessary for MNEs to manage some segments in the manufacturing process under the multinational umbrella.

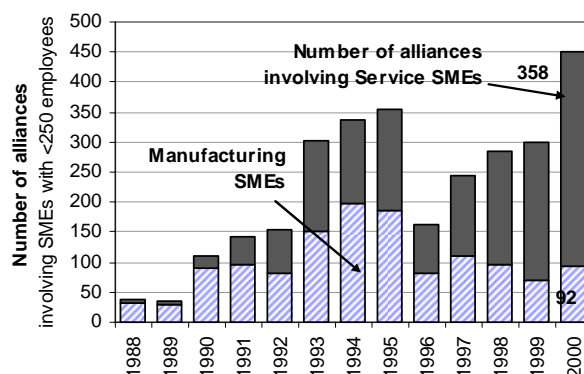
Small- and medium-sized enterprises can potentially play a greater role

26. As fragmentation slices the value chain into more finely-tuned production components, new firms emerge and existing firms adapt to manage the new production blocks. These firms may also begin to supply other firms, including competitors, with their products and services, thus creating additional economies of scale (Jones and Kierzkowski, 2001). Some MNEs have spun off divisions only to see those divisions become MNEs themselves. This happened when Phillips, a semiconductor company, divested itself of ASML, a producer of equipment used to make chips. ASML later became a MNE in its own right. But the reverse is also true. In 1999, General Motors (GM) spun off its Delco parts division. The resulting company, renamed Delphi, still owes most of its revenues to GM (60% in 2003). But Delphi also supplies more and more parts to some of GM's competitors, and has branched out into the market for non-auto mechanical parts.

27. Increasingly, several studies suggest that small- and medium-sized enterprises (SMEs) are following Delphi's lead by taking advantage of the opportunity to insert themselves into the global manufacturing marketplace. Indeed, in the 1990s smaller firms saw their share of both OECD FDI (inflows and outflows) and imports grow (Acs, Morck, and Yeung, 2001). Some data suggest that a full one-quarter of manufacturing SMEs are internationally competitive today. Further, about one-fifth of manufacturing SMEs draw between 10-40% of their turnover from cross-border exchange. SMEs also contribute between 25-35% of the world's manufactured exports (OECD, 2001a). To be sure, fragmentation in manufacturing companies and the subsequent increase in the use of services are pushing these numbers higher, and will likely continue to do so as countries become more interconnected through trade and investment.

28. Small firms are particularly adapted to fragmentation because they can respond more readily to changing market conditions, evolving consumer preferences, and shortened product life cycles by customising and differentiating products (OECD, 2001a). Reduced firm-level economies of scale and improved access to financing options can also help to explain the increased influence of SMEs, either in co-operation or in competition with MNEs. Although the data are limited, Figure 4 reveals an upward trend for SMEs, and in particular SMEs supplying services, to engage in cross-border strategic alliances.

Figure 4. SMEs supplying services increasingly engage in cross-border alliances



Source: OECD 2002c based on Thomson Financial.

29. Another reason for the growing presence of SMEs in manufacturing value chains involves increasing access to technology. Key inputs in the manufacturing process, such as computer-aided design

software (CAD), have become more accessible for smaller firms. A few years ago, some versions of “CAD light” could be bought off of the internet for as little as USD 25 (Sakkas, Malkewitz, and Apostolou, 1999). Advances in internet and telephony infrastructure have also brought down costs and improved communication access for SMEs. In the 1990s, Cranefield International, a lumber ‘manufacturer’, employed ten workers located in various parts of Canada and the United States. Cranefield allocated each employee a desk, mobile phone, and computer. Noticeably absent was any manufacturing facility. Yet, its program managers purchased logs, arranged transportation to the saw mill, oversaw the log cutting and sorting process, and then sold the output locally or, more often, internationally. Advances in technology made Cranefield, and many other SMEs, possible.

30. The internet also increases a firm’s ability to sell products internationally with low capital and fixed costs. Indeed, eBay has made many entrepreneurs rethink the need for a traditional brick-and-mortar shop (see Box 4).

Box 4. eBay has revolutionised the way some SMEs do business

Most people recognise eBay as an online auction website. Yet, for SMEs, eBay represents a critical medium in which to sell their products world-wide. eBay has provided millions of entrepreneurs with instant access to larger domestic and international markets. Indeed, in a 2003 survey funded by eBay, almost half a million individuals reported that they derive most of their income from eBay transactions. To be sure, the survey is likely biased upward, but other evidence also suggests that the number is substantial. At the end of 2004, there were 254,000 online stores—including many SMEs—registered on eBay, representing 30% of eBay’s gross merchandise value. And ‘wholesale lots’—designed for small retailers to acquire stock quickly or manufacturers to unload excess inventory—represents one of eBay’s fastest growing categories.

eBay matches a global source of suppliers with global buyers. On any given day, millions of items across thousands of categories are for sale on eBay. No high street or online store could ever hold such inventory. eBay’s Paypal service, used in about half of all eBay transactions, makes payment convenient across currencies and borders. And while there is faith and a sense of fair-play when trading online both at home and abroad, there is some risk for the buyer. As a result, eBay has instituted self-policing mechanisms such as a rating for seller reliability, bulletin boards for posting personal comments, and a formal dispute resolution process.

eBay is an example of a disruptive technology—that is, a low-performance, cheaper process that gains a foothold in a low-end, less-demanding part of an existing market. A disruptive technology moves successively up-market through performance improvements until it eventually displaces the market incumbents. Will eBay move up the technology ladder to influence the business practices of mid-to-large sized firms? While no one can tell the future, it is possible, particularly if banking fees for international cross-currency wire transfers remain high. With its network economies, eBay could unseat many incumbents.

Source: Financial Times 29 December 2004 and 9 March 2005; Economist 15 May 2004; USA Today 17 March 2004 and 2 February 2005; Aftermarket Business October 2003; eBay website.

What challenges lie ahead for SMEs?

31. Yet, while much potential exists for SMEs to participate in international manufacturing value chains, they nonetheless face challenges. Smaller firms are often more innovative than larger ones, particularly MNEs, which usually have less scope to test radical new ideas. Since SMEs possess fewer resources than MNEs, it is more difficult for SMEs to internationalise their innovations. As a result, the development and mass marketing of radical ideas are usually done by larger firms, especially MNEs. SMEs may need to complement their innovative capacity with the market access opportunities of a MNE, thus creating a partnership to effectively bring innovative products to market (Acs et. al., 1997).

32. There is some evidence to suggest that SMEs that have been effective internationally have also lobbied their governments for assistance in exporting to global markets (Kaplinsky and Morris, 2001). As SMEs become more active in international trade, issues concerning payment and the financing of working capital become more important. In particular, very small SMEs lacking in-house credit facilities must find a way to finance working capital. Stand-by letters of credit (LCs) serve this function, lending a degree of

confidence and security to international transactions. In some jurisdictions, LCs can be used as collateral for an operating loan. Hence, LCs can allow SMEs to trade internationally.

33. However, LCs have some inherent problems. For one, LCs are still based upon a paper exchange. Banks must physically exchange documents (such as invoices, bills of lading, and sanitary and phytosanitary clearances, among many others). In a world of electronic exchange, the execution of a LC is time- and labour-intensive and, as a result, expensive. LCs are also problematic to execute. In a survey of 500 LC transactions, Mann (2000) notes that 20% of the 500 transactions constituted a contractual default, and roughly half of the transactions required renegotiation because of defective execution. Moreover, certain jurisdictions restrict the use of LCs as collateral for a working capital loan. SMEs need this type of financing if they are to participate in fragmenting value chains.

34. Probably more demanding for the truly small SMEs and their entrepreneurs is that venture capitalists now require global strategies—including immediate fragmentation—for some start-ups. Nearly 40% of software start-ups hire overseas engineers, marketing staff, and analysts, among others, concurrently with their counterparts in North American operations (USA Today, 10 February 2005). The internet allows overseas workers to communicate effectively and efficiently, contributing to the trend for venture capitalists to insist that start-ups develop a global strategy before financing the venture (Financial Times, 23 February 2005).

35. It is also particularly difficult for developing country SMEs to participate in fragmenting value chains. Not only do the obvious infrastructure-related constraints serve as disadvantages, but SMEs in the developing world also face international environmental, technical, and labour standards. Often, developing country SMEs do not have the necessary resources, such as skilled personnel, equipment, and raw materials, to both adequately meet international standards and obtain the necessary accreditations. For instance, the International Organization for Standardization (ISO), an entity that develops many of the international agreements on standards, employs a complex set of procedures for firms to attain various industry accreditations. The process of obtaining ISO accreditation does not depend on firm size—that is, each firm must perform the same steps independent of resources, such as trained personnel—thereby creating a disadvantage for SMEs, particularly those in the developing world. Yet, while many challenges face SMEs as they integrate into fragmenting value chains, empirical and anecdotal evidence suggest that they are playing a key and growing role in the manufacturing process.

3. Value chain assessments

36. Fragmentation allows manufacturers to achieve various goals: increasing efficiency, responding to consumer demand, reducing risk, and minimising taxes. Economies of scale and scope play an important role in fragmentation as they affect a firm's ability to gain competitiveness. Managers of a value chain strive to both increase value and optimise costs. The extent of fragmentation in a given market depends upon the number of firms in the industry as well as geographical location, and it can be present on the buyer side, the seller side, or both.

37. Value chains can be roughly divided into two groups: producer-driven and buyer-driven chains. In producer-driven value chains, MNEs play a primary role in the overall organisation of the manufacturing process, including all forward and backward linkages. In addition, producer-driven value chains often manufacture relatively complicated goods—such as automobiles and semiconductor chips—and they significantly control forward linkages, such as distribution and retailing, as well as backward linkages, such as the provision of raw materials and components (Gereffi, 1999). Firms in producer-driven value chains make most of their profits from economies of scale, advances in technologies, and sheer volume.

38. Alternatively, buyer-driven value chains generally operate in competitive production networks that are situated in many locations around the world. Firms in buyer-driven chains are often smaller than in producer-driven chains. Large manufacturers with substantial brand name recognition, or large marketing firms or retailers, are the key players in establishing decentralised production strategies in many countries—often in developing and least developed countries—for export. Buyer-driven value chains are characterised by labour-intensive industries that produce consumer goods such as apparel, toys, footwear, and wood furniture. Firms in buyer-driven value chains make most of their profits through a particular combination of design, marketing, sales, and consumer research, with firms becoming tacticians that connect factories in the developing world with the rapidly changing niches in the primary consumer markets. These branders, marketers, and sales associates hold a great deal of power in influencing consumption (Gereffi, 1999).

39. This section explores four different value chains—apparel, automobiles, semiconductor chips, and wood furniture—with a primary focus on the services and manufacturing interaction. As these manufacturing value chains continue to evolve, domestic and international services, both as links and as stand-alone segments, will play an increasing important role in the manufacturing process.

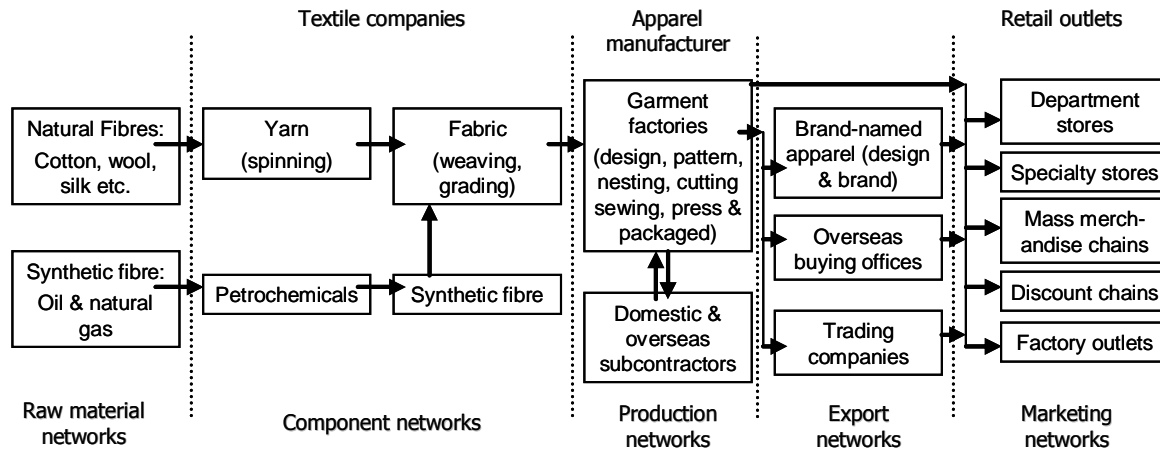
Apparel

40. The apparel industry has been fragmenting for many years. Apparel manufacturers in the developed world first began to relocate to Japan in the 1950s, but through the years assembly of particularly low-value added products moved to lower wage countries—first to Hong Kong, China in the 1960s and then on to South Korea and Taiwan in the 1970s. These countries became significant exporters in the late 1970s and 1980s, but increased wage rates, quota restrictions, currency appreciations, and labour shortages forced firms in these countries to relocate to a new generation of countries, particularly China and certain African and Latin American countries (Grazani, 2001).

41. Apparel manufacturers have fragmented their value chains by identifying sources of competitive advantage—design, marketing, and branding—and then disaggregating the overall manufacturing process into distinct, strategically pertinent components. Today, for instance, an increasingly smaller share of a Benetton shirt is manufactured in Italy, and an increasingly larger share of that shirt is outsourced and off-shored to firms in Eastern Europe, Asia, and Latin America (Grazani, 2001). Benetton now focuses on its core competence of design, cutting, quality inspections, and distribution.

42. Conceptually, the apparel value chain is segregated into five stages, progressing from raw material networks to retail outlets (Figure 5). The apparel value chain tends to be buyer-driven by retailers like Walmart or brand-name apparel companies such as Benetton and Nike. These firms not only design and market their products, but they also use their buyer clout as they orchestrate and manage the vast value chain network. Retailers and brand-name apparel companies generally exert considerable control over backward and forward linkages, including the provision of materials and the logistics of how, when, and where manufacturing takes place.

Figure 5. The apparel value chain from raw material to retailer



Source: Modified from Gereffi, 2003.

43. The apparel value chain can be further divided according to the type of garment being produced. The first type of value chain involves fashion-conscious designers (*e.g.* Burberry), who need to respond quickly to fashion trends. This sub-type of the apparel value chain is characterised by flexible manufacturing facilities located close to large markets, smaller production runs to minimise risk, and quick, low-cost transportation. Thus, it's not surprising that some apparel manufacturers in the United States have relocated to Mexico and, similarly, that E.U. apparel manufacturers have flocked to Eastern Europe and North Africa. The second value chain sub-type involves apparel firms that produce more standard-issue products, such as white shirts or black socks, and thus are not influenced by passing fads. This value chain does not require the increased flexibility, quick responsiveness, or other geographic considerations needed by the fashion-conscious chains.

44. Yet, while large retail clothing manufacturers have been fragmenting for years, a significant trend is emerging. Not only have important trade policies such as the Multi-fibre Agreement (MFA) changed, but technology is rapidly evolving. In particular, firms can now easily fragment many digital aspects of production into a service that may be traded across borders. These phenomena are influencing the way in which apparel manufacturers are fragmenting their value chains.

The technology changes

45. Traditionally, the segments of the apparel value chain have been distinct. Capital-intensity characterised textile manufacturing while labour-intensity and relatively easily transportable capital characterised apparel manufacturing. Yet, modern technologies, such as Computer-Aided Design (CAD) software and Computer-Assisted Methods (CAM) of production, have fragmented the apparel value chain, resulting in modifications to the old paradigm. The cost of transporting fabric and fibres, combined with economies of scale, has spurred some garment factories to move upstream into textiles and fibres. Technology, including the internet, makes trade in apparel-related services increasingly possible.

Table 2. Technology drives apparel chain fragmentation further into services

Value Segment		Description	The promotion of services in the fragmenting apparel value chain
Retailing/ Branding	Distribution	Distribution and other logistic services—such as transportation—represent key inputs in the apparel-making process.	Currently, bar coding allows faster and more accurate distribution of parcels, as well as the ability to track packages over the internet. In the future, radio frequency identification will likely improve the current bar coding systems. At least some of these services may be competitively traded internationally, which provides scope for increased trade in distribution-related services.
	Marketing	Marketing services often include branding as well. International marketers are skilled labourers who orchestrate complex advertising and promotional campaigns.	The internet is emerging as an important channel for marketers to reach consumers with promotions and advertising. While marketing and brand building are generally key competences of MNEs (e.g. Benetton), some firms may hire other firms to do this work.
	Design	Designers represent highly skilled labour that is differentiated by fashion segment. Design is most often kept in-house in large retailers or firms with brand recognition, but garment manufacturers sometimes perform the design function.	CAD continues to improve the design process as both a tool for design (testing colour, fabric, etc.) and as a tool for collaboration. Similar to the marketing segment, design is often a key competence of MNEs.
Garment Manufacturing	Pattern Making	The pattern making process transforms a three-dimensional design into two-dimensional cloth segments.	Today, the pattern-making, grading, and nesting and marking processes are usually performed by highly-trained CAD operators. Modern CAD allows almost instantaneous grading and greatly improves cloth utilisation. In addition, modern CAD has allowed these processes to be transformed into digital services that may be transferred by the internet, representing an important source of efficiency-enhancing fragmentation.
	Grading	Grading involves the tedious production of different sized patterns from an initial pattern.	
	Nesting & Marking	Nesting and marking involves arranging graded patterns on a master pattern sheet.	
	Cutting	Highly-skilled labour cuts fabric according to the master pattern. This segment tends to be more capital-intensive than the segments before or after.	CAM has improved tagging and bundling in the cutting segment. Yet, unlike other goods, such as rigid auto body parts, the use of full robotics remains unlikely because the cloth segments are limp and thus more difficult to manipulate mechanically. Automated procedures have made only minor inroads in the sewing segment. Because of the necessary interaction between these segments, fragmentation into a service, as defined in this paper, is unlikely.
	Sewing	Sewing garments is labour-intensive and represents the core of the production process.	
	Inspecting, Pressing, & Packaging	The finishing process is particularly important for the higher-value brand-name segments.	New pressing units are highly automated, improving speed and rectifying some types of garment defects. Yet this segment is unlikely to be physically separated from the cutting and sewing processes because repairing defects may require cutting and re-sewing. However, it may be possible for audit services to be fragmented.

Source: OECD Secretariat based on OECD, 2004d and Gereffi, 2003.

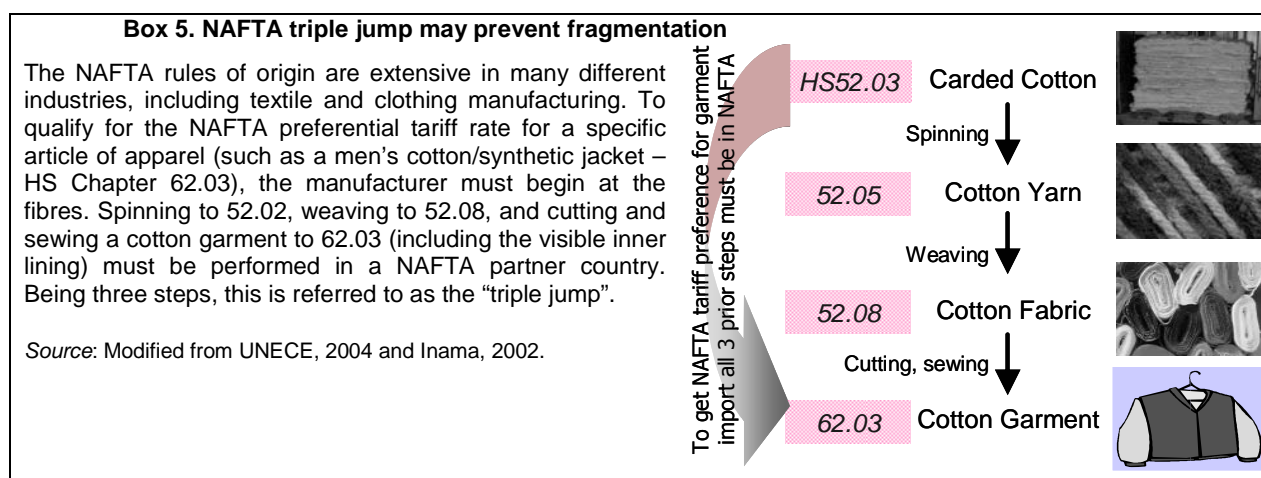
46. To be sure, technological advances imply further fragmentation of the apparel chain. Several segments of the apparel value chain are beginning to fragment because of technological advances. For example, radio frequency identification (distribution services), enhanced CAD software (pattern making, grading, and nesting and marking services), and the increased capacity of the internet (all services) are playing a role in the increased use and tradability of services related to the apparel value chain.

Trade policies further influence the trend toward fragmentation

47. Pursuant to the WTO's Agreement on Textiles and Clothing, WTO Members phased out quantitative restrictions imposed by the MFA such that in December 2004 essential quotas were removed (OECD, 2004d). In the long-run, the elimination of these quotas may drastically change the apparel value chain insofar as technological efficiencies that were once pre-empted by quota considerations may now drive changes in the value chain. In other words, the technology considerations described in Table 2 may become more influential.

48. In addition, the demise of the MFA, coupled with the increasing trend of rationalising the physical movements of products by integrating the spinning, weaving, cutting, and sewing segments into textile/garment complexes, has diminished the need for trade distorting outward processing programs (OPPs) in the apparel industry. OPPs employ two-way shipments whereby firms ship fabric from a particular country to receive tariff preferences for importing into that country. For example, some estimates of two-way shipments between the United States and Hong Kong, China versus one-way shipments suggest that the additional cost may constitute 12% of the imported U.S. value of the garment (OECD, 2004d). A movement toward freer trade will likely imply that more competitive—and perhaps international—services will be incorporated into the apparel value chain.

49. Rules of origin can also prevent fragmentation. Officials usually assess origin in one of three ways: (1) a change in tariff classification; (2) a minimum amount of domestic value added; or (3) a specific manufacturing process (Brenton, 2003). The latter method can prevent fragmentation in apparel manufacturing (see Box 5).



50. Rules of origin require a vertical model of multi-processing manufacturing stages that are conducted in the same country or, if applicable, in a country party to the regional trade agreement. These rules can negatively affect prospective investors who must invest in manufacturing goods that are either unprofitable or in which the firm does not have a competitive advantage to comply with particular rules of origin (Inama, 2002). Since MFA quotas have been abolished and fragmentation has grown, this issue may become more important for the global competitiveness of firms. Moreover, the country of origin issue has taken on a new flavour in recent years. As a globalisation backlash gains ground in some developed countries, more and more firms are keeping services activities, such as call centres, that they wanted to off-shore for economic reasons in the home country. While in the short-run this strategy may achieve public relations success, it nonetheless prevents fragmentation (Brodowsky, Tan, and Meilich, 2004).

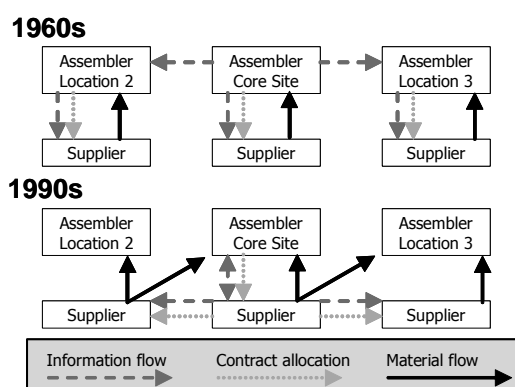
Automobiles

51. The automobile industry is a relatively mature industry, and fragmentation has played a role in its evolution. Indeed, Volkswagen (VW)’s strategy highlights the extent to which the automobile industry has fragmented. VW established a truck ‘factory’ in Resende, Brazil, but VW does not actually manufacture vehicles in the traditional sense at the plant. Instead, VW has created a fragmented production network in which independent suppliers source materials, hire workers, and assemble the trucks under VW’s roof (Baldwin and Clark, 2000). In addition, VW manages the links between the segments in the production process, sets standards, and monitors quality at each stage of the production process (Baldwin and Clark, 2000). The auto industry is an example of a producer-driven value chain, and as can be seen in the VW case, the manufacturer has considerable control over the organisation of the value chain and the backward and forward linkages.

52. The industry started out with numerous small manufacturers that eventually were bought by larger firms or went bankrupt. Much of this consolidation was dictated by economies of scale; first by the introduction of the moving assembly line by Ford in 1907 and then compounded by the pressed-steel monocoque body by Budd in the 1920s. But the increasing ability to trade, combined with the current economic size for plants—250,000 units in assembly and two to three million in body panel units per year per plant—has meant fewer large independent manufacturers—from 28 in 1980 to a dozen in 2004 (The Economist, 2004a).

53. Since the 1960s, parts suppliers have become more important in the automobile value chain. In fact, approximately 60% of the material value of a new car assembled in the United States represents parts from foreign sources (roughly one quarter each is made up of Canadian, Mexican, Asian, and European material) (AT Kearney, 2004). And although parts still physically move up from suppliers to assemblers, albeit with more cross-supplying, both the contracts and the flow of information, including the designs, have changed (Figure 6). Since the 1990s, designs have flowed in two ways between the assembler and its key supplier. Indeed, in many cases the key supplier now owns the design, which has created partnerships instead of conflict. Today, the key supplier is responsible for transferring the design to a partner—such as a subsidiary, affiliate, or licensee—in other locations. This process is referred to as ‘follow-on sourcing’ for the assembler.

Figure 6. The changing nature of the auto industry value chain



Source: Modified from Humphrey, 2003.

54. As a result of fragmentation from the 1960s to the 1990s, assemblers have increasingly sourced products from foreign suppliers. In part, tariff reductions have played a role in encouraging this off-shoring, particularly in regional trade agreements. For example, a Mexican auto parts manufacturer will ship to a U.S. or Canadian assembly plant (or vice versa) more frequently because of a smaller tariff wedge. This increase in off-shoring reflects the efficiency gains from economies of scale and wage

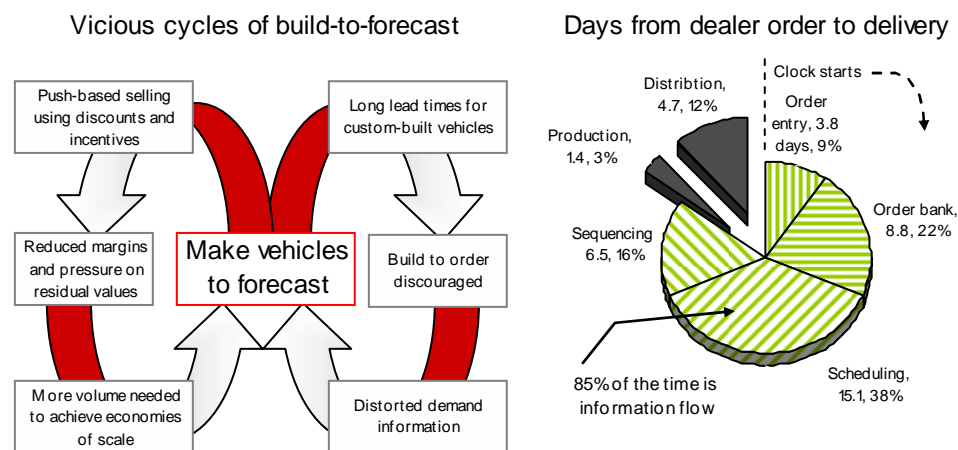
differentials. Increased off-shoring has also been facilitated by the increased use of services—lower costs of transporting parts and logistics are possible because of trade in transportation and information technology services. But, to date, rationalisation has been limited simply because of the physical size and weight of the parts, as well as rules of origin in regional trade agreements such as the NAFTA.

Build-to-forecast or build-to-order?

55. Going forward, automobile manufacturers face the fundamental question of whether they should use a build-to-forecast or a build-to-order approach. Both strategies imply different degrees of fragmentation in the automobile manufacturing value chain.

56. In the build-to-forecast approach, the auto assembler makes a forecast of the number of units required for each vehicle and then builds them in conjunction with suppliers. Thus, the auto assembler depends upon a network of dealers to sell vehicles. To date, build-to-forecast has been the norm, principally because of the production technology. The strong economies of scale involving moving-assembly lines and pressed-steel monocoque bodies drive the need for volume (Figure 7, left loop). In addition, the impractically long lead times for custom-built vehicles distorts demand information (right loop). Dealer-order fulfilment—the time from order to delivery—takes an average of about 40 days, of which only 20-60 hours is spent in the manufacturing process. And from order entry to scheduling and sequencing, 85% of the time is lost in information—rather than physical product—flow.

Figure 7. The considerations of build-to-forecast auto manufacturing



Source: Modified from Holweg, 2004.

57. In contrast, the build-to-order approach begins with the consumer. The consumer defines the characteristics of a particular automobile and on the basis of that specification, the assembler custom-builds the car. The build-to-order strategy responds to the modern consumer's craving for choice and diversity. Indeed, several industry analysts have recently noted the upward trend in the proliferation of auto body styles, colours, and options. Even with long lead times, 62% of cars purchased in Germany are built-to-order, the highest percentage in any of the major markets. Yet, 24% of German consumers indicated that they felt that they had compromised on their vehicle's specifications (Holweg, 2004). This evidence points to increasing demand for build-to-order in the auto industry which, if it becomes more commonplace, will lead to increasing fragmentation.

Implications of fragmentation in the automobile industry

58. The automobile industry needs to restructure, as significant consolidation and the success of many firms in capturing value through the fragmentation of the design segment of the value chain have failed to

significantly improve returns on invested capital (McKinsey, 2005a; McKinsey, 2005b). Fragmentation will clearly play a role in this process. There is much debate concerning how the automobile value chain will fragment in the future. The April 2005 S&P downgrade of Ford and GM bonds—including their profitable financing arms—to junk status heightened this debate as auto firms increasingly need to find ways to create value.

59. The automobile industry faces four main challenges: customisation, complexity, competition, and excess global capacity (Walters and Lancaster, 2000). Auto manufacturers must therefore become leaner and more efficient, and fragmentation can play a role. Technology is at least one part of the solution. Similar to the apparel value chain, CAD software can help improve efficiency by decreasing the time that engineers spend on research and development. Auto manufacturers must also create more effective services links among their suppliers, designers, and assemblers. Increased use of information technology can help create more efficient links by decreasing the amount of complexity in the value chain. Perhaps even more importantly, information technology is essential in the build-to-order framework. In fact, Audi has already established a facility to handle customised orders, and has installed special ‘kiosks’ in some dealerships that allow consumers to custom order a vehicle directly via kiosk (Walters and Lancaster, 2000).

60. The internet has and will continue to play a major role the fragmentation of the auto industry. Consumers increasingly use the internet to research automobile models, creating opportunities for marketers to reach potential customers. Ford, in particular, has shifted more of its marketing budget into internet-related activities. In the future, automobile manufactures that use the build-to-order approach will rely more upon the internet to transit specifications from customer to factory. And the internet, coupled with advances in CAD software, will continue to contribute to the fragmentation of the design segment of the value chain in the 1990s. Design is now often mutually generated and owned among the auto assembler and the first tier suppliers.

61. In addition, firms may fragment because of technological advances. For instance, advances in space-frame construction technology has allowed manufacturers of small cars to more efficiently use smaller production runs (*i.e.* less than 100,000 bodies per year per plant) (The Economist, 2004b). Finally, changes at the core of the automobile industry—such as the potential shift from the internal combustion engine to electric or hybrid alternatives—may pave the way for firms specialising in alternative fuel cell technologies to insert themselves into the value chain. In sum, the automobile value chain is fragmenting, services are being segregated and, as a result, the pressure to focus on core competence will grow.

Semiconductor chips

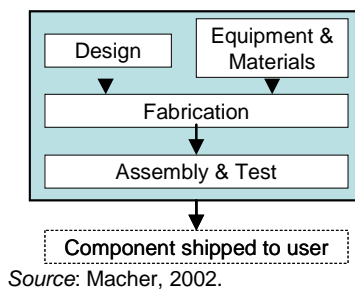
62. The semiconductor industry is similar to the automobile industry in that it is characterised by a producer-driven value chain. Some semiconductor chips are sold directly to end-users, but they are most often used as intermediate inputs in electronic systems that vary from the expected—telecommunications equipment, computers, stereos, and other electronic goods—to the surprising—automobiles and elevators, among other mechanical products.

63. The emergence of the semiconductor—the first integrated circuit—in 1959 sparked a revolution in manufacturing as integrated circuit technology greatly improved efficiency and technical possibilities. Throughout the 1960s and 1970s, semiconductor production was largely the domain of the major integrated producers such as IBM and ATT. Yet, during this time, ‘merchant’ manufacturers appeared on the scene, specialising in the development of chips and applications specific to various electronic systems. Specialised producers of semiconductor manufacturing equipment also emerged. Then, in the 1980s and 1990s, the value chain began to fragment. In particular, the fabrication segment separated from the design segment, and fabrication-less (fabless) firms emerged. Today, semiconductor chips are big business.

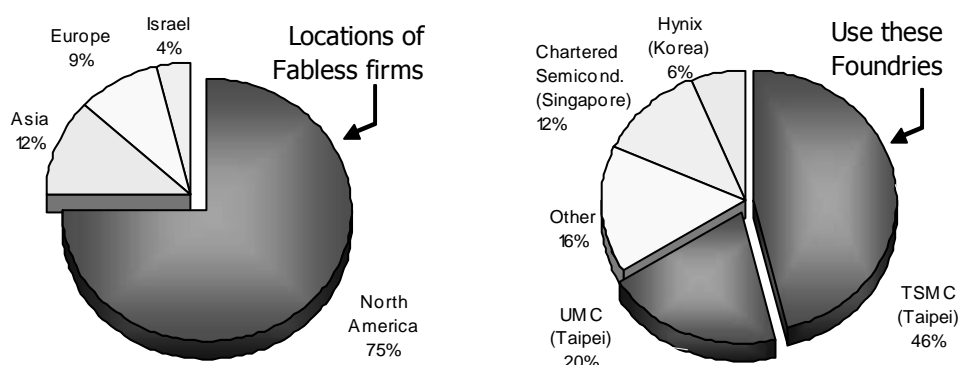
64. Fabless firms focus on the design and marketing components of the value chain, and rely on contract manufacturers (foundries) to produce their designs. Similar to the apparel industry, fabless semiconductor firms rely upon intellectual capital, such as knowing one's customers, understanding the capabilities of suppliers, and identifying the appropriate designs (frequently, patented intellectual property). Fabless firms, in fact, owe much of their value to intellectual capital, and now serve many rapidly growing industries by offering more innovative designs and shorter delivery times than the larger, traditional merchant manufacturers.

65. The semiconductor chip value chain appears simple (Figure 8), but the manufacturing process is quite complex. Highly-trained engineers create chip designs with technical computer software programs. Then, technicians fabricate the chip using an intricate series of processes involving chemicals, gases, materials, and specialised equipment. The end result—a wafer—contains a large number of 'die', each of which forms the basis of a semiconductor chip. Technicians then cut individual die from the fabricated wafers, test them for defects, and assemble them into complex 'packages'. These packages combine the component pieces with wire contacts and insulating material to form a finished semiconductor chip (Macher, 2002).

Figure 8. The semiconductor industry value chain appears simple



66. To a large degree, the semiconductor value chain has fragmented internationally. In a 2004 survey of electronics manufacturers, 64% identified information technology, including circuit boards, as the good that they most often source from off-shore providers (EIU, 2004). A comparison of the percentage of fabless firms compared to the foundries those fabless firms use also suggests significant international trade (Figure 9).

Figure 9. North American fabless firms primarily use Chinese Taipei foundries

Source: Fabless Semiconductor Association.

The drivers of fragmentation in the semiconductor chip value chain

67. Many of the drivers of fragmentation in the semiconductor chip value chain are similar to those in the apparel and automobile case studies. For one, scale economies play an important role. The high capital costs of foundries reinforce the need for specialisation, and foundries must spread these high costs over large volumes of a limited array of chips. Firms strive to lower production costs through economies of scale and, as consumer prices decline, manufacturers hope that demand for the chips will expand the range of their potential use.

68. Likewise, advances in technology have not only facilitated the fragmentation of the apparel and automobile manufacturing value chains, but also the semiconductor chip value chain. For instance, improvements in Engineering Design Application (EDA) software—one of the primary programs used to design semiconductor chips—have shortened the duration of the design stage of production, as well as eased the complexity of the design process. Because the design process has been simplified and requires only a small initial investment, individual stages within the overall design segment can now be separated out. Similar to the automobile industry, the design stage now moves in both directions. There is some anecdotal evidence that fabricators have been active in design methodology changes and Silicon-on-Ceramics (SoC) patents that improve productivity and performance. These synergies result in global data networks that, through the exchange of intellectual capital, result in long-term supplier/user relationships fundamentally different from arm's length contract manufacturing.

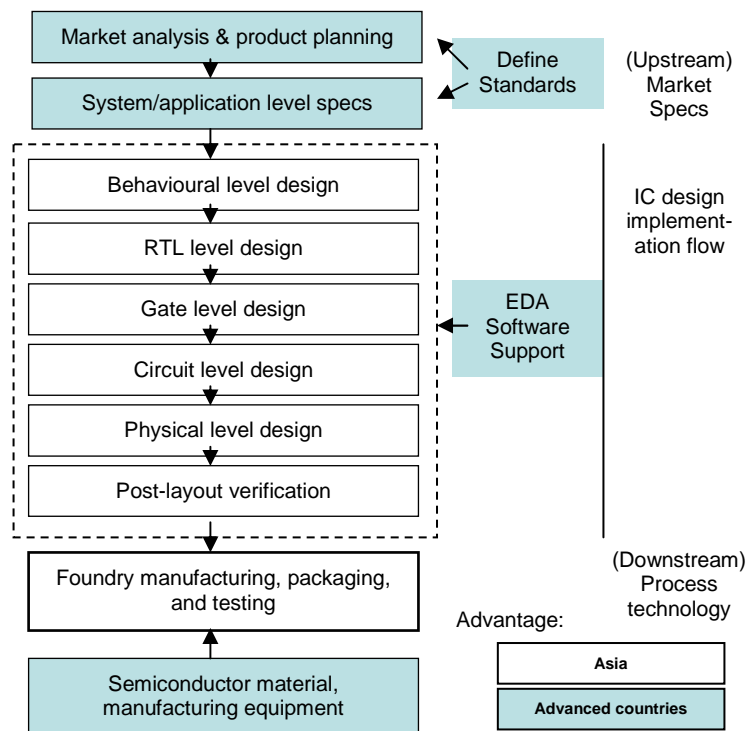
69. In addition, advances in information technology—especially the internet—have facilitated fragmentation. Today, the internet allows design services to be easily delivered via internet. The internet has also increased the efficiency of procurement in the semiconductor chip value chain, particularly in the realm of electronic business-to-business (e-B2Bs) exchanges. Studies have shown that e-B2B transactions disproportionately benefit MNEs relative to their suppliers (The Economist, 2001).

70. Yet, while trends in the semiconductor chip value chain share many similarities to those observed in the apparel and automobile industries, there are also some differences. One of the most significant differences concerns the design segment, which has been a strong value creator, involving high and rising cognitive complexity. The fragmentation of design in the semiconductor industry has been influenced by the unusually high cost of labour. Annual wage, benefit, and structural costs for semiconductor chip design engineers are relatively steep across countries—USD 300,000 in the United States; USD 150,000 in Canada; USD 75,000 in Ireland; and USD 30,000 in India (PMC-Sierra, 2002). These costs, coupled with a declining number of developed country undergraduates enrolling in engineering, reflect a shortage of trained engineers that will likely only grow (The Economist, 2004b). The shortage in highly trained engineers in the developed world is expected to lead to an increase in trade in engineering services via Mode 4 (movement of natural persons) with developed countries, where university enrolments have been proportionally much higher.

71. Another unique characteristic of design fragmentation in the semiconductor industry involves exploratory design services. Until recently, the benefits of concentrated in-house research for fabless firms outweighed the advantages of fragmenting the design process through outsourcing or off-shoring. But beginning in 2002, some semiconductor manufacturers subcontracted out exploratory design services to specialised firms or research institutions, primarily in Asia (Ernst, 2005). The exploratory design segments, from behavioural-level design to post-layout verification, are part of the research and development (R&D) process (see Figure 10).

72. The feasibility of off-shoring this activity represents a classic example of value creation according to competitive advantage. It is clear that certain specialised firms and research institutes in Asia possess a remarkable combination of speed, quality, flexibility, and cost attributes that are instrumental in the exploratory design process. In contrast, firms in the developed world are better suited to performing the market analysis, product planning, and system and application specifications because they are closest to the end consumers. Developed country firms also have competitive advantages in EDA software, as well as the production of manufacturing equipment.

Figure 10. Semiconductor design value chain now fragmenting



Source: Ernst, 2005.

73. Is the even more finely sliced fragmentation of the design segment of the semiconductor chip value chain one of the first true tests of the feasibility of fragmenting R&D over distance and among third parties? Perhaps, although it could also be true that this type of fragmentation falls closer to the development side of the R&D partnership, and thus possesses more of a commodity than an innovative orientation. Either way, the process of segmentation and off-shoring represents a new phase in how the semiconductor industry is using traded services and interacting with international service suppliers.

74. Another important difference relevant to the semiconductor industry involves standards. Fragmentation works if standards—both technical and managerial—allow the intermediary goods or services to integrate into the value chain. In the semiconductor chip value chain, there is a trend toward

standardisation of the manufacturing process for ‘plain vanilla’ semiconductor chips. For the most basic chips, the manufacturing process has standardised around the Complementary Metal Oxide Semiconductor (CMOS) method. One advantage inherent in this standardisation is that both designers and process engineers can focus on fine-tuning specific aspects of the production process, thus making production more efficient.

75. On the other hand, standards have a potential downside. If the component provider supplies an intermediate product that is well-specified to the point of becoming a ‘commodity’, then competition will drive prices down. Thus, price and hence the value of the chain captured by the component supplier will reflect the marginal cost of the component industry. The MNE orchestrating the value chain and holding the intellectual capital will at least initially benefit from sourcing the components more cheaply. In a competitive final product, though, that initial value will eventually flow to the consumer.

76. Is it possible that a product that was once as innovative and revolutionary as the semiconductor chip could become a commodity? The Singapore Exchange offers futures contracts in DRAM chips that closely resemble futures for the wheat and pigs contracts available on the Chicago Mercantile Exchange. Thus, firms must be careful not to fall into the so-called ‘commodity trap’ by focussing on innovation. Many MNEs already use lean, just-in-time, total quality management manufacturing to improve productivity. FDI in particular brings organisational know-how and expertise to the local market and may play an important role in future innovation among firms. Going forward, firms face the challenge of how to remain innovative. Likewise, governments face the task of crafting an effective and efficient innovation policy (Wah, 1999).

Wood furniture

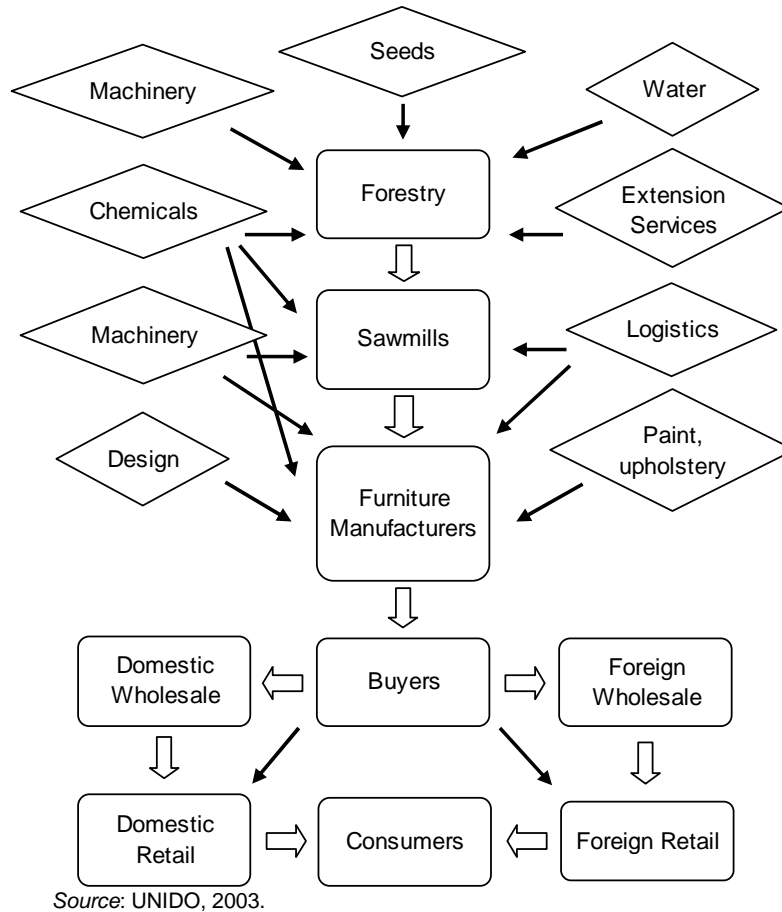
77. Recently, the wood furniture industry has been growing faster than many other manufacturing industries. During the period 1995-2000, the wood furniture industry grew by 36%, more than other labour-intensive products such as apparel (32%) as well as the average of all merchandise trade (26.5%) (UNIDO, 2003). Strong growth is due in part to rising competition, which has reduced prices for mass produced wood furniture and increased trade. Moreover, the popularity of do-it-yourself furniture kits that can be shipped in flat packs has also boosted trade. Flat packs radically reduce transport costs and have contributed to fragmentation in the industry.

78. There are several different market segments in the wood furniture industry (UNIDO, 2003). First, there are large retailers, such as IKEA. IKEA owns outlets world-wide, sources from over 50 different countries, and deals with about 2,000 individual suppliers (UNIDO, 2003). Second, there are highly specialised medium-sized retailers. These retailers do business with as many as 1,500 individual suppliers, but they sell their products in only a few countries or regions (UNIDO, 2003). Third, there are small retailers, who buy furniture from few suppliers and sell in only a handful of countries.

79. Like the apparel industry, the wood furniture industry is characterised by a buyer-driven value chain. The wood furniture industry is both resource- and labour-intensive. The production of wood furniture begins with raw materials, namely wood logs. The logs then move to a saw mill, which cuts and shaves the wood for building material. In the case of self-assembly furniture production, the lumber will then shift to a ‘remanufacturer’, who refines it into rough finger-jointed or veneer-laminated particle board. Next, the lumber or particle board is shipped to a furniture manufacturer. The furniture manufacturer uses designs (in-house or through a design service firm) and other materials, such as paints, stains, and adhesive, among others, to produce furniture components. These components are then shipped in flat packs to buyers—who sell the components to wholesalers or retailers—or directly to furniture wholesalers and retailers. Consumers then purchase the end product at wholesale or, more commonly, retail outlets.

80. Figure 11 represents the wood furniture value chain, as outlined by UNIDO (2003).

Figure 11. The wood furniture value chain



81. Figure 11 reveals that distribution services have taken on an increasingly important role in the wood furniture value chain. The systemisation of flat pack shipping in the mid-1950s revolutionised the wood furniture industry by dramatically reducing costs. As in the apparel industry, a trend has emerged in which MNEs in the wood furniture industry focus on the design, branding, marketing, and after-sales services segments of the value chain, and outsource or off-shore the manufacturing segments (UNIDO, 2003). As a result, efficient independent producers have emerged. Through fragmentation and a high degree of co-ordination management, the self-assembly wood furniture value chain ‘manufactures’ wood furniture that is likely sourced from components world-wide, thus exploiting competitive advantages at many levels.

The shift to self-assembly drives fragmentation

82. Fragmentation in the wood manufacturing value chain is particularly evident in large retailers such as IKEA. Ingvar Kamprad, an unconventional Swedish entrepreneur, founded IKEA in 1943. The slogan, ‘Not for the rich, but for the wise’, represents the guiding principle at IKEA, and it is as a consequence of this philosophy that IKEA pioneered the creation of stylish, standardised, and self-assembly furniture. To date, the shift to the self-assembly concept has driven much of the fragmentation in the wood furniture value chain.

83. Today, IKEA contracts out the manufacturing component of more than 90% of the products it sells to about 2,300 suppliers located in over 60 countries (Natrass and Altomare, 1999). In true buyer-driven

value chain tradition, wood furniture MNEs co-ordinate a complicated network of globally sourced suppliers. IKEA, for example, is characterised by a hybrid structure, similar to that of the Italian apparel manufacturer Benetton. In this type of hybrid organisation, the MNE performs the function of a contractor by orchestrating the services links in the value chain, and relies upon agreements negotiated externally rather than upon internal management (Lancaster and Walters, 2000).

84. IKEA also shares a similarity with the automobile industry in that fragmentation has created strong partnerships between MNEs and suppliers. For example, IKEA persuaded a shirt maker in the Czech Republic to produce furniture cushions for IKEA (Ramirez, 1999). To facilitate this process, IKEA provided logistical support in the form of advice on the selection of equipment, raw materials, and delivery options, as well as financial support to reconfigure the production plant and train workers (Ramierz, 1999). IKEA also partners with its supply links when formulating an entry strategy into the supply link's home country. These approaches encourage partnerships and create value for IKEA and for its suppliers in the same way that collaborating on design forged partnerships in the auto industry between MNEs and their suppliers.

85. Moreover, technology and the internet—key drivers of fragmentation in all of the value chains presented in this paper—have also spurred fragmentation in the self-assembly wood furniture industry. IKEA uses cutting-edge technology, together with other just-in-time concepts, to ensure that an adequate supply of IKEA's most popular items are always in stock at their retail outlets. Just-in-time strategies are also evident in IKEA's sophisticated network of global service links in the distribution segment of the value chain. Moreover, the internet has influenced fragmentation in the self-assembly wood furniture value chain. IKEA notes that while its catalogue remains its primary marketing channel, customers are increasingly using the internet to gather product information. And while internet sales represent a small share of total IKEA sales, that share is growing steadily. Since IKEA makes most of its profits on volume rather than on margins, reaching the maximum number of potential consumers is essential.

86. One of the most striking features of the self-assembly wood furniture value chain is the extent to which it has incorporated the customer into the manufacturing process. Indeed, the customer supplies labour and time as she assembles the furniture in her home. This strategy has transformed the relationship between MNE and customer. Normann and Ramirez note, "Today, strategy is no longer a matter of positioning a fixed set of activities along that old industrial model, the value chain... The key strategic task is to reconfigure roles and relationships among a constellation of actors—suppliers, partners, customers—in order to mobilise the creation of value by new combinations of players" (Normann and Ramirez, 1993). Increasing fragmentation in the self-assembly wood furniture value chain both encourages and demands that the consumer participate in the value chain.

Standards greatly influence how wood furniture firms fragment

87. Technical standards frequently define whether and how a manufacturer can fragment its value chain. To participate in the self-assembly wood furniture value chain, suppliers must deliver parts that can be correctly assembled with the components sourced from other global manufacturers. Standardisation at the firm level in the self-assembly wood furniture value chain is critical to the ability of the MNE to produce relatively inexpensive products. Standardisation serves two primary purposes. For one, standardisation allows MNEs to carefully design component pieces for tight packaging, thereby dramatically decreasing transport costs. Moreover, standardisation facilitates efficient sourcing by using the same part for many different products. For instance, IKEA designs a range of furniture—from bookcases to desks to wardrobes—to be constructed using the same type of joint. Technical standards are so critical, that in the last few years IKEA has bought certain manufacturing facilities from its suppliers to serve as training facilities to enforce strict technical specifications, as well as other standards and production techniques (Natrass and Altomare, 1999).

88. Similar to the semiconductor industry, process standards that set out agreed upon ‘rules of the game’ can help alleviate the asymmetric information that curtails fragmentation. To the extent that countries encourage consistency, internationally recognised standards can help firms to participate in manufacturing value chain fragmentation. But standards in the wood furniture value chain are not without costs. Beginning in the mid-1980s, wood furniture manufacturers saw one type of barrier to exports decline (tariffs), but the growth of process standards emerged as a new hurdle (UNIDO, 2003). Quality standards (ISO9000), labour standards (SA8000), and environmental standards (ISO14000 and Forestry Sustainability Council guidelines) have all affected wood furniture manufacturers and the way in which their value chains have fragmented (UNIDO, 2003).

89. At the same time, both governments and consumers began to demand that firms institute environmental standards. In 1981, the Danish government created a law limiting the amount of formaldehyde emissions allowed in furniture production. After tests, the Danish government found that some IKEA products had slightly higher levels of emissions than was allowed. As a result of the bad publicity, IKEA sales in Denmark slid 20% in the following months (Natrass and Altomare, 1999). Other environmentally-related issues also began to plague IKEA and other wood furniture manufacturers, such as the use of PVC plastic packaging. The resulting bad publicity and declining sales forced IKEA to insist that its suppliers meet ISO+ standards for environmental friendliness both in production processes and transportation. Since a cost, as well as an environmental calculation, is now driving IKEA’s choice of transportation services suppliers, IKEA has increased the amount of traded transportation services that it uses.

Key takeaways from the value chain assessments

90. The apparel, automobile, semiconductor chip, and wood furniture value chains have fragmented internationally. Going forward, each value chain will continue to fragment. Several key takeaways from the value chain assessments are provided below to help policymakers understand the nature of current fragmentation in these manufacturing industries and the implications of that fragmentation in the future.

- Technology has played a role in the fragmentation of all of the value chains. Enhanced CAD and EDA software has allowed the design segment of the automobile and semiconductor chip value chains to fragment. Improvements in CAD software have also facilitated the fragmentation of certain aspects of the garment manufacturing process in the apparel value chain. And sophisticated warehouse management technologies, coupled with just-in-time strategies, have allowed large wood furniture MNEs to fragment some distribution-related services.
- To date, the internet has significantly facilitated fragmentation in all four manufacturing value chains and boosted trade in many manufacturing-related services. For instance, global e-B2B suppliers have created efficiencies in many services areas, including procurement.
- Standards have also acted as an influential force in the way in which value chains have fragmented. On one hand, technical and process standards—such as those for IKEA’s component suppliers—facilitate the insertion of new firms into manufacturing value chains by providing clear rules of the game. On the other hand, technical standards can create a ‘commodity trap’ for firms, who must constantly innovate to remain competitive. In addition, process standards can also serve as a hurdle for developing country SMEs who lack the capacity to implement complicated certification procedures.
- Trade rules have influenced fragmentation. The assessment of the apparel value chain, for example, suggests that trade rules that assess origin according to manufacturing process may prevent fragmentation, thus reducing the competitiveness of some manufacturers. Moreover, manufacturing industries benefit from the liberalisation of services, particularly

telecommunication services, logistics services, and transport services. As manufacturers are able to access these services on a more competitive basis, they become more productive internally.

- Certain value chains may experience increased fragmentation as manufacturers establish more flexible manufacturing facilities located close to large markets. In the apparel value chain, for instance, fashion-sensitive manufacturers increasingly locate in developing countries that border developed country markets (such as Mexico-U.S. and Eastern Europe-E.U. strategies). In the automobile value chain, a shift to build-to-order may imply that smaller, local production facilities are more likely to emerge. In both cases, reducing delivery times will become even more critical, and trade in transport and logistic services could increase.
- Each value chain is unique, and firms will find new ways to create value. IKEA has incorporated the customer into the value chain. The semiconductor value chain has created value by fragmenting exploratory design services from the core design segment, perhaps becoming one of the first industries to fragment R&D. And while the automobile industry is producer-driven and wood furniture is buyer-driven, fragmentation has encouraged partnership relationships between MNEs and suppliers.

91. To be sure, the trends highlighted do not exist in isolation and, in fact, interact to further influence the fragmentation process. For one, it is clear that the value of intellectual capital has, and will continue to, increase. The strategic choice by manufacturers to focus on core competencies and seek to understand the needs of both suppliers and consumers allows firms to innovate, thus creating real value. Moreover, innovation and deregulation in distribution and logistic services—for instance, the systemisation of flat pack shipping (wood furniture) or the improvement in radio frequency identification (apparel)—have enabled fragmentation across all four value chains, increasing efficiency and providing scope for more trade in distribution-related services. Further, the standards-technology nexus, particularly evident in computer software, has significantly encouraged the fragmentation of those services that can be effectively supplied via the internet. The tradability of these services thus becomes more feasible, creating efficiencies among all segments of the value chain.

4. Quantitatively relating manufacturing FDI and services

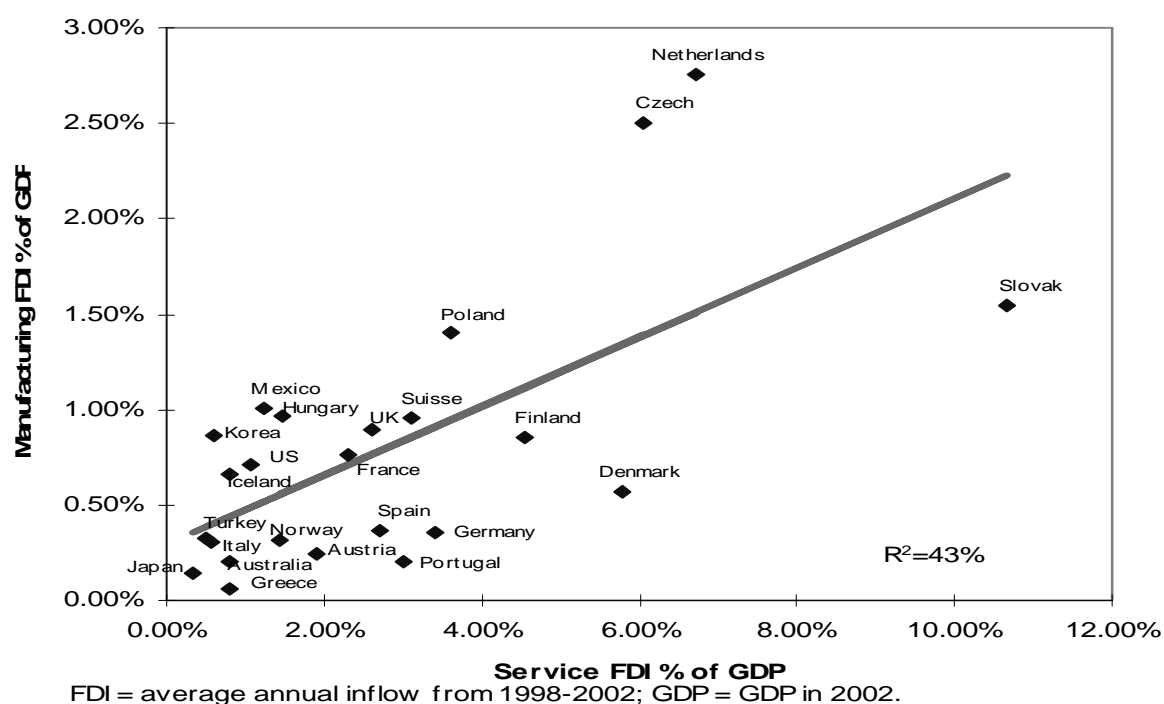
92. To complement the value chain analysis, the Secretariat considers the quantitative relationship between manufacturing FDI and services. While data limitations and measurement problems make it difficult to assess the quantitative relationship between trade in services and manufacturing FDI, the OECD Working Party on Statistics notes several techniques useful in analysing the interaction (OECD, 2004e). For the most part, the preliminary results suggest that services positively contribute both directly and indirectly to the economy. This section complements these initial findings by using two approaches to focus on the trade and investment interrelationships.

93. The analysis begins by correlating manufacturing FDI and services FDI to assess if a general correlation exists and, if so, if any service sectors emerge in which one observes a correlation among several manufacturing sectors ('correlation clusters'). This approach is then broadened by regressing both OECD and developing country manufacturing FDI with specific measures of service sector openness. While the results suffer from sparse developing country data for some variables, thus limiting their explanatory power in some cases, taken together these techniques paint a picture of the interaction between manufacturing FDI and services. The section concludes by suggesting that future work on this topic could benefit from a consideration of input-output tables.

Manufacturing and services FDI correlate

94. Correlation analysis is a first step in any attempt to study the interrelationships among variables. Using data on average annual inflows of FDI (1998-2002) and GDP (2002) in 24 OECD countries, Figure 12 shows a positive correlation between total manufacturing and services FDI. Yet care should be taken in extrapolating too much from the chart, as the data suffer from the small sample size and the inclusion of large mergers and acquisitions. In the Slovak Republic, for instance, the 2002 data reflects the 49% privatisation (USD 2.7 billion) of Slovenský Plynárenský Priemysel, one of the world's largest natural gas transport and distribution companies.

Figure 12. Manufacturing FDI and services FDI positively correlate



Source: OECD International Direct Investment Statistics Yearbook 2003 and World Bank World Development Indicators, 2004. See Annex A for details on the dataset.

95. The disaggregated data show a positive correlation of 66% between total service and manufacturing FDI (Table 3). Yet across sectors, the variation is high. The matrix shows correlation clusters between some form of financial services and manufacturing FDI in every sector except for textiles and wood. The matrix also shows an 85% correlation between service FDI in transport and communications and manufacturing FDI in textiles and wood. Other interesting results include a 94% correlation between services FDI in utilities and manufacturing FDI of metals and machinery, and a relatively strong correlation between FDI in real estate services and manufacturing FDI of food, telecommunications, and computers. These correlations are important because they provide some insight into the types of services sectors that may relate closely with manufacturing FDI. While these correlations could be driven either by a real relationship between services and manufacturing FDI or the influence of a third unmodelled variable, the results may suggest that manufacturing FDI relates particularly closely to FDI in certain service sectors, especially infrastructure-related activities such as financial services, telecommunications, and transportation.

Table 3. Correlation between manufacturing and services FDI in various sectors

Services	Manufacturing						
	Mfg Total	Food	Textiles/ Wood	Petrol/ Chemicals/ Plastic	Metal/ Machinery	Telecom/ Computers	Vehicles/ Transport
Services Total	0.66	0.53	0.65	0.43	0.71	0.23	(0.18)
Utilities	0.30	0.03	0.39	0.19	0.94	(0.09)	(0.37)
Construction	0.24	0.33	0.36	0.10	(0.02)	0.21	0.30
Repairs	0.41	0.57	0.37	0.23	0.25	0.23	0.02
Hospitality	0.43	0.34	0.54	0.13	0.25	0.18	0.49
Transport/Comm	0.65	0.43	0.85	0.32	0.54	0.20	0.29
Transport	0.54	0.36	0.63	0.28	0.29	0.47	0.57
Communications	0.55	0.32	0.76	0.25	0.58	0.06	0.09
Financial	0.74	0.80	0.59	0.54	0.39	0.56	0.04
Monetary	0.26	0.43	0.57	(0.10)	0.24	0.14	0.67
Other	0.60	0.57	0.24	0.65	0.24	0.71	(0.16)
Holdings	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Insurance	0.66	0.73	0.37	0.63	0.63	0.59	0.028
Other	0.59	0.61	0.22	0.64	0.10	0.71	(0.07)
Real Estate/Other	(0.10)	(0.10)	(0.13)	(0.11)	(0.20)	(0.20)	(0.17)
Real estate	0.73	0.72	0.51	0.58	0.16	0.68	0.09
Other	0.04	(0.03)	(0.06)	(0.02)	0.21	(0.01)	(0.13)

Note: Negative numbers in parentheses. Numbers in bold indicate significant correlations.

Source: OECD International Direct Investment Statistics Yearbook 2003 and World Bank World Development Indicators, 2004. Not every country reports in each sector. See Annex A for details on the dataset.

Services liberalisation and manufacturing FDI: Evidence from developed and developing countries

96. The liberalisation of trade in services has become more important for manufacturing firms both because fragmentation has increased the use of services in the manufacturing value chain and because countries have reduced barriers to trade in goods. As a result, the Secretariat analyses whether there is a relationship between services liberalisation and manufacturing FDI for all modes, but in particular for Mode 3 (FDI). The regression analysis that follows uses the evidence found in the correlation matrix as a guide in identifying the services sectors in which manufacturing FDI may associate closely (*i.e.* transport services, telecommunications services, and financial services).

97. Data for 52 developed and developing countries during the period 1996-2000 is used to test whether services liberalisation in specific services sectors relates to manufacturing FDI. The equation used to model manufacturing FDI borrows from a review of the literature and assumes that manufacturing FDI (*mfgfdi*) depends upon four primary factors: GDP (*gdp*); country risk (*icrg*) as measured by a composite index of political, financial and economic risk; education (*edu*) as measured in years of schooling in the population over age 15; and infrastructure quality (*mobile*) as measured by the number of mobile phones per 1,000 people. Various services liberalisation measures are then added to the base model to test their relationship to manufacturing FDI. Annex A contains additional detail regarding methodology and cross-sectional data.

Table 4. Does services liberalisation relate to manufacturing FDI? The global evidence

Dependent variable: lnmgfdi	Base	Service Trade Openness	GATS Land Transport Index	GATS Telecom Index	Telecom Index (APC)	Banking Index (APC)	Telecomm & Banking Indexes (APC)	Architecture Index (APC)
lngdp	0.816** (8.81)	0.817** (8.68)	1.052** (6.26)	0.818** (6.25)	0.718** (8.59)	0.968** (4.31)	0.830** (4.21)	0.905** (4.61)
lnicrg	4.317* (1.92)	4.284 (1.89)	4.005 (1.21)	3.648 (1.11)	3.287 (1.52)	2.943 (0.60)	1.525 (0.37)	4.548 (0.64)
lnedu	0.884 (1.02)	0.864 (0.91)	1.963 (1.27)	1.764 (1.29)	0.868 (1.05)	1.992 (0.86)	1.727 (0.99)	1.525 (0.80)
lnmobile	-0.177 (0.94)	-0.173 (0.86)	-0.309 (1.07)	-0.300 (1.07)	-0.249 (1.30)	-0.412 (1.12)	-0.611** (2.40)	-0.176 (0.54)
tradeopen		0.024 (0.08)						
gatsland95			0.237 (0.78)					
btelmarko				-1.985 (1.04)				
telecomindex					-2.080** (2.20)		-3.606** (2.44)	
bankindex						-1.563 (0.67)	-0.891 (0.58)	
architectindex								-5.252* (1.96)
R ²	0.723	0.722	0.636	0.675	0.750	0.535	0.622	0.57
Observations	51	51	34	41	50	29	29	26

Notes: Data for each category was not available for every country. All regressions were run with robust standard errors. Absolute values of t-statistics are in parentheses. Values marked (**) and (*) are significant at the 5% and 10% levels, respectively. For more information about data and methodology, see Annex A. APC stands for the Australian Productivity Commission.

Trade-in-services openness

98. The first regression examines the relationship between the liberalisation of a country's services regime overall and manufacturing FDI. Trade openness can reduce FDI by decreasing the incentives for horizontal FDI (*i.e.* tariff-jumping projects in which a firm produces the same product in both host and home country). Yet, lower tariff barriers can also stimulate FDI by making imports of intermediate inputs less expensive, thus expanding vertical FDI. So, while both positive and negative effects come into play, overall the available evidence suggests that trade openness increases FDI. As a result, many FDI models include an openness variable. Since more open countries trade more, a frequently used measure of trade openness is the exports-to-GDP ratio (Jaumotte, 2003). The services imports-to-GDP ratio is not included because it strongly correlates with the services exports-to-GDP ratio.

99. Following this precedent, general services sector openness is proxied as the services exports-to-GDP ratio, controlling for country size³. For this sample, the regression result for the services exports-to-GDP coefficient is insignificant. This result is consistent with the correlation table in the sense that the data do not suggest a one-to-one correlation between manufacturing FDI and exports in all services sectors. On one hand, the insignificance of general services openness is not surprising in the sense that it is likely that not all services sectors support manufacturing. For instance, it is intuitive that openness in hospitality services, such as hotels and restaurants, may not be relevant for manufacturing firms. On the other hand, the services

³ Some researchers have found that country size negatively affects trade openness measures in a way unrelated to trade policy. As a result, this paper controls for country size in the services exports-to-GDP measure (see Barro-i-Martin, 1999 and Jaumotte, 2003). To control for country size, the Secretariat regressed the logarithm of the services exports-to-GDP ratio on the logarithms of country population, area, and a constant. The services sector openness measure is the resulting intercept term plus the exponential of the residual.

exports-to-GDP ratio may not adequately measure services sector openness. For example, numerous empirical studies have found that services openness positively affects economic growth, so one could expect that overall services sector openness would positively affect manufacturing FDI. But, as a result of the analysis in this paper, one cannot say for certain how general services openness impacts manufacturing FDI.

Liberalisation in GATS commitments and manufacturing FDI

100. The analysis continues with a consideration of how GATS commitments, which indicate a given country's attitude toward services liberalisation, have affected manufacturing FDI in the sample. While few scholars have quantified commitments made in the GATS schedules, Hoekman broke new ground with the publication of his indexes in 1995. Marko (1998) is another notable exception. Four different measures of GATS liberalisation in infrastructure services, as well as the support services incidental to manufacturing⁴, are used to gauge the interaction. (Detail regarding these indexes is provided in Annex A.)

101. Curiously, the result for Hoekman's land transportation index shows a very small, positive coefficient. This may at first appear surprising given that one often assumes that transportation services would be a key concern for many manufacturing firms that ship intermediate and final products from factory to market. But the poor result may reflect that land transportation has traditionally been a domestic business (*e.g.* local trucking companies and railways), as in the past there was minimal opportunity to trade these services internationally. In addition, the coefficient is characterised by low explanatory power, so the lack of a strong result could be at least partially caused by the data issues associated with the sample. Thus, further tests of transport-related services are needed.

102. The results using Marko's telecommunications restrictiveness index are more significant and robust. However, the explanatory power suffers somewhat because of the diverse countries in the Marko dataset and the small sample size (33 countries). And while the coefficient is larger and more significant than the land transportation measure, statistically the result does not confer much confidence. However, the direction of the coefficient is encouraging, and more finely-tuned measures of telecommunications restrictiveness provided in subsequent regressions shed additional light on the relationship.

103. The Secretariat also tested other GATS indexes as well, including Hoekman's water transport index and the Secretariat's measure of GATS commitments in "services incidental to manufacturing". Neither the individual nor the joint test produced robust results (see Annex A for regression results). The poor result for the water transport index could be at least partially caused by the data issues associated with the sample. For instance, some of the countries in the dataset are land-locked and the sample size is small. In addition, the index measuring restrictiveness in services incidental to manufacturing is also characterised by significant data problems. Only 6 out of the 46 countries in the dataset have made such commitments (Austria, Bulgaria, Canada, Iceland, Nicaragua, and Norway). Unfortunately, a useful GATS-only index of financial services liberalisation is unavailable.

Broader measures of the openness of certain infrastructure services

104. As suggested in the correlation matrix and hinted at in the regression using Marko's telecommunication index, infrastructure services may relate closely with manufacturing FDI. Hence, the analysis continues by testing openness measures in certain infrastructure services that move beyond GATS analysis by incorporating information on a broader range of restrictions.

⁴ While the GATS does not set out a concrete definition of "services incidental to manufacturing", several WTO Members have identified consulting services provided to manufacturers as constituting one such service.

105. The Australian Productivity Commission built upon the work of Hoekman to create a set of restrictiveness indices for several services sectors in the late 1990s. The scores range from “0” for an open market to “1” for a very restricted market. A significant advantage of using these indices is that the data reflect actual policies rather than legal structures. Thus, the indexes provide a comprehensive assessment of services sector liberalisation and cover countries at all levels of development.

106. When the telecommunications index is regressed alone, the coefficient is significant and the regression has strong explanatory power. This represents evidence that countries with more liberal telecommunications regimes are associated with a higher level of manufacturing FDI. Policymakers should be cautious, however, in inferring too much from the precise value of the coefficient. Instead, it is best to focus on the strength of the association of an open telecommunications regime with higher levels of manufacturing FDI. This association is emblematic of the potential advantages that may accrue by liberalising the telecommunications sector.

107. In contrast, when the banking index is regressed alone, the coefficient is insignificant. Curiously, this result does not support the more general findings of other studies (see OECD, 2005d, among others). Perhaps the insignificant result obtained here could reflect the complementary—and at times substitution—effects of loans and financial services on manufacturing FDI. For instance, as banking services become more open, some foreign manufacturers may be enticed into new projects, thereby instigating FDI. But, at the same time, a firm may need to provide only a fraction of the capital to finance its manufacturing investment. So, project debt financing may reduce the required FDI investment of the manufacturing company. As a result, it could be that an open banking service sector encourages manufacturing, just not as measured by FDI. Or, alternatively, perhaps the smaller sample (29 countries), consisting of primarily OECD countries, has led to the insignificant result.

108. The results from the regression of the architecture index are also interesting. The coefficient on the architecture variable was strongly negative and significant at the 10% level. However, the other explanatory variables lose power in the regression. While one can imagine that architecture services would be important for manufacturers who wish to build a new plant, it is somewhat curious that architecture services represent the only professional service in which the Secretariat observes a significant result. Thus, additional study of this interrelationship is warranted.

109. The analysis also considers the combined effect of the restrictiveness indexes which could result in a stronger overall effect than the simple addition of each index’s single effect. For instance, a country that has liberalised multiple services sectors would likely be viewed more favourably from a FDI perspective than a country with restrictive services sector regimes in all areas but one or two. Since the OECD (2005d) identified the telecommunications and banking sectors as areas in which protection particularly impedes innovation, competition, and technology transfer, the Secretariat regresses the two indexes together. Interestingly, the telecommunications coefficient becomes larger and more significant (*i.e.* one observes an even greater association between manufacturing FDI and a liberal telecommunications sector). Yet the banking services index, while insignificant when regressed alone, losing even more explanatory power.

110. Other indexes constructed by the Australian Productivity Commission were also tested in the model, both alone and in specific combinations. These indexes, which measure restrictiveness in distribution, legal, maritime, and engineering services, produced insignificant results. While it is curious that the distribution services result was not robust, it could reflect the fact that not all modes of supplying distribution services relate to manufacturing FDI. Further, the results could also suggest that apart from architecture services, liberalisation in professional services (*e.g.* legal and engineering services) does not associate particularly well with manufacturing FDI. (See Annex A for the regression results and analysis of these measures.)

Services liberalisation and manufacturing FDI: Evidence from OECD countries

111. In an effort to gather additional evidence about the relationship between services liberalisation and manufacturing FDI, the Secretariat conducts similar analysis using a different dataset comprised solely of OECD countries. This dataset provides additional data in which to test alternative services restrictiveness indexes that build upon the work of the Australian Productivity Commission. The data used comes from the OECD International Direct Investment Statistics Yearbook on FDI inflows in total manufacturing for 23 OECD countries for the period 1998-2000. Data for the primary explanatory variables—market size, education, country risk, and infrastructure—are taken from the larger data set, modified to reflect the time period and countries of interest.

Table 5. Does services liberalisation relate to manufacturing FDI? Evidence from the OECD

Dependent variable: <i>lnmfgfdi</i>	Base	Telecom Index	Mfg Index	Distribution Index	Air Transport Index	Architect Index	Engineer Index
<i>lngdp</i>	0.806** (8.21)	0.737** (6.97)	0.626** (5.86)	0.705** (5.92)	0.815** (9.68)	0.720** (7.31)	0.712** (7.24)
<i>lnicrg</i>	-0.067 (0.02)	-3.578 (0.90)	-2.687 (0.93)	-3.271 (0.86)	-1.646 (0.52)	-0.688 (0.21)	-0.576 (0.18)
<i>lnedu2000</i>	2.906 (1.73)	3.989** (2.07)	3.320** (2.37)	2.980 (1.89)	3.699** (2.44)	2.864 (1.83)	2.763 (1.82)
<i>lnmobile</i>	-0.519 (1.17)	-0.461 (1.14)	-0.054 (0.12)	-0.246 (0.43)	-0.529 (1.04)	-0.531 (0.92)	-0.525 (0.90)
<i>oecdtelecom</i>		-1.713* (1.94)					
<i>oecdmfg</i>			-8.059** (2.93)				
<i>oecddistrib</i>				-4.844* (1.95)			
<i>oecdair</i>					-2.967** (2.47)		
<i>oecdarchitect</i>						-4.348* (1.97)	
<i>oecdengineer</i>							-4.632** (2.14)
R ²	0.738	0.767	0.828	0.791	0.809	0.779	0.787
Observations	22	22	22	22	22	22	22

Notes: Data for each category was not available for every country. All regressions were run with robust standard errors. Absolute values of t-statistics are in parentheses. Values marked (**) and (*) are significant at the 5% and 10% levels, respectively. For more information about data and methodology, see Annex A.

112. The OECD indexes differ from those of the Australian Productivity Commission in several important ways. First, the OECD indexes focus exclusively on FDI restrictions. Therefore, the OECD indexes primarily include restrictions on Mode 3 (FDI), and to a lesser extent Mode 4 (movement of natural persons). Second, the OECD indexes use a somewhat different set of criteria and weighting scheme than the Australian Productivity Commission. For example, the OECD indexes include a measure for screening and approval. Third, the OECD indexes cover OECD countries only, whereas the Australian Productivity Commission considered a wider range of countries. Fourth, the OECD and the Australian Productivity Commission cover a slightly different set of service sectors.

113. The analysis with the new dataset begins by regressing the OECD restrictiveness index on manufacturing FDI to assess how well the model fits. The coefficient is strongly negative and significant at the 5% level, providing some measure of comfort in the other results given the small sample size. Then, several indexes are tested both separately and in particular combinations. When regressed alone, the results using measures for openness in telecommunications, distribution, air transport, architecture, and engineering services were all significant at least at the 10% level. These results provide support for the

hypothesis that openness in infrastructure- and distribution-related services is positively associated with manufacturing FDI.

114. Alternatively, the results using measures of legal, road transport, water transport, and financial services were all insignificant (see Annex A for these regression results). Moreover, combining the indexes did not provide any additional insight into the relative importance of each measure. It is not completely clear why these measures of services openness were insignificant, although it could be that the data limitations contributed to the insignificant findings. For example, the data set contains land-locked countries, which may have contributed to the poor result with respect to water transport services. Moreover, it may be that professional services—apart from architecture services—are not positively associated with manufacturing FDI. The road transport measure also proved insignificant, although this could be derived from the fact that road transportation has been traditionally a local business until relatively recently. If the OECD indexes were updated to include additional countries, more robust results would surely emerge.

Implications of the quantitative analysis

115. What do these results indicate? The most robust finding is that a liberal telecommunications and architectural services sector is positively associated with manufacturing FDI. Further, unlike the results found using the Australian Productivity Commission indexes, the OECD measures of distribution and engineering services show a significant negative coefficient at the 10% level. This could mean that a liberal distribution and engineering services regime for FDI (Mode 3, primarily) relates positively with manufacturing FDI, while a liberal regime in other modes (for example, Modes 1 and 2) does not associate positively with manufacturing FDI. Finally, the OECD results indicate that an open air transportation sector is positively associated with manufacturing FDI. Since the Australian Productivity Commission did not study this sector, it is impossible to draw conclusions about the different modes of supply with respect to air transport services.

116. Of course, the OECD data set is limited and, like the other regression results, does not take into account any dynamic interactions between a potential policy change and FDI. And while the differences in the methods of calculating the OECD and Australian Productivity Commission indexes makes direct comparisons somewhat suspect, the OECD approach of disaggregating the modes of supply is interesting. If indexes on the other modes were developed, then the comparison across modes could be useful for trade negotiators as they focus their efforts in the current round of GATS negotiations.

Future extension: Input-output tables may provide insight

117. The value chain analysis shows that MNEs are beginning to move away from owning their subsidiaries to orchestrating the movement of intermediary products. For some companies, this strategy includes the use of non-equity, or at least non-FDI, types of arrangements. For example, convertible debentures with or without retraction or redemption options, leases, preferred equity shares and mezzanine financings, among others, represent increasingly common instruments that exhibit mixed equity-debt characteristics (OECD, 2004f). Hence, many forms of co-operation may fall outside of the scope of the ownership requirements that trigger FDI. (A MNE must own 10% or more of the subsidiary for an investment to be considered FDI.) For the same reason, foreign affiliate data may become problematic insofar as the measures will not capture the activity of large manufacturers that orchestrate, rather than own, their value chains.

118. Input-output table analysis may be a useful way to abstract from this data limitation. Input-output tables describe the flows in the value of goods and services between any two sectors of the economy, thus differentiating the role of intermediary products. Once the OECD input-output tables are updated, they could prove an important analytical technique in future analysis of fragmentation in the manufacturing

value chain. And, while there are limitations to input-output analysis—for instance, input-output tables cannot take into account the situation when a subsidiary performs both manufacturing and service functions—it could nonetheless be a useful technique in helping policymakers to better understand the relationship between trade in services and manufacturing.

5. Trade policy-related implications

119. Fragmentation benefits both producers and consumers. Firms fragment to take advantage of cost savings or productivity enhancements gleaned from externally supplied components or from abroad. Thus, governments should not discourage fragmentation. In fact, the increasing complexity and internationalisation of fragmentation in the manufacturing value chain compels decision makers to think carefully about trade policy responses. By examining the changes in the industrial organisation, the way in which fragmentation is manifest in manufacturing value chains, and the quantitative relationship between manufacturing FDI and services, several trade policy-related implications emerge.

Support liberalisation of the telecommunications sector

120. Telecommunications and value-added network service providers are increasingly essential for the efficient operation of firms that do business internationally. Today, the internet permeates all aspects of business, from procurement to scheduling to production and distribution. The evidence presented in all four manufacturing case studies suggests that internet communication, particularly broadband, has been critical in these value chain fragmentations. A survey of firms spending USD 100 million or more on goods shows that 11.7% of intermediary inputs were purchased online in 2003, surpassing the figure for indirect materials such as office supplies (FT/Forester Research, 2003). The increased use of the internet for purchasing intermediary inputs clearly reflects fragmentation facilitated by services. The quantitative analysis also highlights that manufacturing FDI correlates highly with telecommunication services FDI (Table 3) and that a restrictive telecommunication sector reduces manufacturing FDI (Table 4). And while the internet benefits firms of all sizes, SMEs characterised by low capital and fixed costs rely particularly strongly on telecommunications services to sell products internationally. The current Doha round of trade negotiations represents a prime opportunity to further liberalise telecommunication services.

Encourage investment in infrastructure and the liberalisation of related services

121. Both the disaggregated correlation table and the regression analysis suggest that the liberalisation of infrastructure-related services positively affects manufacturing FDI. Telecommunications infrastructure in particular can be critical, especially if other, more traditional, infrastructure services are unreliable. Policymakers may also wish to consider the benefits of liberalising other infrastructure-related services, such as financial services. The disaggregated correlations in this paper showed correlation clusters between some form of financial services and manufacturing FDI in every sector except for textiles and wood. Further, reliable and efficient infrastructure contributes to lowering transportation and communication costs, thus stimulating trade in related services. Thus, governments may wish to promote policies that encourage foreign investment in infrastructure to improve infrastructure capabilities. In fact, OECD simulations suggest that if all OECD countries were to upgrade their infrastructure to the highest level, trade in services in the OECD area would increase by around 60% (OECD, 2003b).

Promote international technical and process standards

122. Standards emerge as important in both producer-driven (semiconductor chip) and buyer-driven (wood furniture) value chains. Indeed, to participate in fragmenting manufacturing value chains, firms must deliver products that conform to technical standards. Technical and process standards are crucial for component parts to be used in downstream assembly and to provide clear rules of the game that enable new firms to insert themselves into fragmenting value chains. To assist firms in entering new markets, governments should encourage the formation of international accreditations, such as those found in the

International Organisation for Standardisation, and provide assistance to SMEs seeking to obtain such accreditations for export. Internationally recognised standards also help reduce ‘agency costs’. That is, clear standards eliminate any asymmetrical information that local suppliers may possess about a given market, thus encouraging more competition in the sourcing of new suppliers in a fragmenting value chain.

Introduce a coherent innovation policy

123. A coherent innovation policy is critical for firms of all sizes. To avoid the commodity trap that plagues some manufacturers, firms of all sizes must constantly innovate to maintain and enhance intellectual capital. On balance, firms participating in global value chains can innovate by product—that is, by improving quality or by introducing new products—or by process—in other words, through increases in efficiency in internal production processes. Innovation in services, as opposed to goods, often comes through small changes in procedures and processes, rather than significant investment in R&D (OECD, 2001b). Because of the different characteristics of goods and services, governments would be well-served to formulate a specific policy framework for innovation in services as well as goods (OECD, 2001b). SMEs may also need more attention, as the recent OECD Community Innovation Survey suggests that SMEs increase innovation when they engage in partnerships (OECD, 2005c). And, as evident from the value chain assessments, the use of technology plays a significant role in innovation, and thus should be encouraged. A recent report highlights the importance of services trade liberalisation in increasing technology transfer (OECD, 2005f).

Limit trade rules that may prevent fragmentation

124. In some cases, rules of origin prevent fragmentation. In part because of rules of origin, firms tend to search for component suppliers not from the most efficient low-cost firms who may be located outside of a particular trade agreement, but rather from suppliers located within a partner country who may be less efficient. This approach removes much of the cost savings associated with specialisation and creates inefficiencies that prevent both firms from maximising the gains from trade. Thus, rules of origin can be quite costly for an economy insofar as they restrict trade and prevent the fragmentation of value chains that need to gain competitiveness.

Institute complementary competition policies

125. Many services that support fragmentation exhibit characteristics of network economies such that economies of scale may encourage natural monopolies. Therefore, competition policy can be critical to ensure access to essential infrastructure and to avoid the abuse of dominance. This can often occur, for example, in transportation, electricity, and telecommunications services. Anticompetitive practices in these services can discourage manufacturing firms from fragmenting, thus reducing trade in services as international service suppliers cannot enter the value chain. Anticompetitive practices can also hamper the international competitiveness of the home country’s services suppliers via cross-border supply (Mode 1), particularly if the anticompetitive practices involve the internet.

Encourage trade facilitation as timing and costs tighten

126. Just-in-time manufacturing streamlines inventories and work-in-progress. IKEA, described in the wood furniture value chain assessment, is a typical example of a firm that has generated value by using just-in-time strategies. As a result, suppliers must be able to respond quickly to developments further down the value chain. Thus, efficient customs procedures and trade facilitation measures are essential to reducing the time and cost of product movements. MNEs using just-in-time strategies will be less likely to work with suppliers in countries with significant red tape. Indeed, if it takes 10 to 14 days for imported parts to clear customs, as is common in many developing countries, when the norm for other countries is around two days, suppliers will have difficulty finding a value chain in which to insert themselves (World Bank, 2004b).

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ANNEX A: QUANTITATIVE ANALYSIS OF MANUFACTURING FDI AND SERVICES

This annex provides more detail on the methodologies used to assess the association between services and manufacturing FDI.

Correlation Analysis

1. The correlation analysis includes data for 24 OECD countries: Australia, Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Japan, Korea, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Switzerland, Turkey, the United Kingdom, and the United States.

2. The remaining six OECD countries were not included in the dataset either because too little data exists or because particular data points represent outliers. For instance, there is no data at all for Ireland and New Zealand, and only very limited data for Canada. Sweden, Belgium, and Luxembourg were removed from the dataset because of concerns that the data are outliers. The Secretariat considers Sweden an outlier because the percentage of manufacturing FDI as a percentage of GDP (4.71%) is much higher than the average of the 26-country sample⁵ (0.96%). Similarly, Belgium-Luxembourg, which is considered one country in the OECD database, has an average amount of services FDI as a percentage of GDP (49.49%) that is considerably higher than the 26-country average (4.55%). The concern over outliers increased when the Secretariat noticed that the inclusion of Sweden and Belgium-Luxembourg altered the regression estimates significantly, a common problem with small-sample regressions.

Annex Table 1. Countries reporting in each sector

Manufacturing	Number of Countries Reporting	Services	Number of Countries Reporting
Total	24	Total	24
Food	22	Utilities	18
Textiles/Wood	23	Construction	22
Petrol/Chemicals/Plastic	23	Repairs	24
Metal/Machinery	23	Hospitality	20
Telecom/Computers	30	Transport/Comm	24
Vehicles/Transport	18	Transport	22
		Communication	19
		Financial	24
		Monetary	18
		Other	18
		Holdings	5
		Insurance	19
		Other	21
		Real Estate/Other	21
		Real Estate	18
		Other	24

⁵ The 24-country data set plus Sweden and Belgium-Luxembourg.

REGRESSION ANALYSIS

The Model

3. The model assumes that manufacturing FDI (*mfgfdi*) is a function of four primary factors: market size, country risk, labour quality, and infrastructure. Data on manufacturing FDI comes from UNCTAD's World Investment Report 2004, World Bank Development Indicators 2004, the OECD STAN database 2005, and the OECD's International Direct Investment Statistics Yearbook. Unless otherwise indicated, all data is an average for the period 1996-2000 for the global dataset and for the period 1998-2000 for the OECD-only dataset.

$$\ln(\text{mfgfdi}_i) = \beta_0 + \beta_1 \ln(\text{gdp}_i) + \beta_2 \ln(\text{icrg}_i) + \beta_3 \ln(\text{edu}_i) + \beta_4 \ln(\text{mobile}_i) + u_i$$

4. **Market Size (*gdp*):** Market size is perhaps the most important determinant of FDI. The larger the domestic market in a potential host economy, the more likely that that economy can provide the support resources needed for a foreign firm to operate effectively. A large host country market can also attract a home country multinational that wishes to sell its product locally. This paper uses GDP in current USD as a proxy for market size. The data comes from the International Monetary Fund, World Economic Outlook Database, April 2005.

5. **Country Risk (*icrg*):** The overall risk of investing in a given country is another important factor in a manufacturing firm's FDI decision. A home country multinational is less likely to invest in a host country that possesses an unstable government or leaders who enact and enforce unfriendly investment policies. This paper uses the International Country Risk Guide composite index of financial, political, and economic risk as a proxy for the overall risk of investing in a given country.

6. **Labour Quality (*edu*):** Labour quality is another important determinant of FDI. Some firms invest overseas either to take advantage of cheap labour or to make use of highly-trained specialists. As a result of these disparate motives, empirical studies have shown both a positive and a negative effect of wage costs on FDI, depending on the type of FDI studied. Nonetheless, a survey of the literature suggests a positive effect of labour quality on FDI. This paper uses the number of years of schooling in the total population aged 15 and over for 1995 (actual) and 2000 (estimated) as a proxy for labour quality. This data comes from Barro and Lee (2000).

7. **Infrastructure (*mobile*):** Researchers have also observed a positive relationship between the level or quality of infrastructure and FDI. It is intuitive that a multinational firm would view a country with reliable and well-functioning infrastructure—such as paved roads, port services, and communication services—as an attractive country in which to invest. Telecommunications infrastructure in particular can be critical, especially if other, more traditional, infrastructure services are unreliable. This paper uses the number of mobile phones per 1,000 people as a proxy for mobile phone network penetration. This data comes from the World Development Indicators, 2004.

8. **Note:** To check for omitted variable bias, the Secretariat calculated Ramsay's regression specification error test (RESET) for each regression. All RESETs were negative (*i.e.* omitted variables bias was not proven), although it is impossible to determine if the model is perfectly specified or if the test lacked explanatory power, perhaps in part because of the relatively small sample size. The Secretariat also calculated the variance inflation factors (VIFs) for each regression to try to assess if any collinearity exists among the explanatory, or independent, variables. Since all of the VIFs calculated were in the range of 2.5-3.1, which is not close to the rule of thumb "threshold" value of 10, the Secretariat assumed that multicollinearity is not a significant data limitation.

Additional regression results: Global dataset

9. The regression analysis includes data for the following 52 OECD and non-OECD countries: Argentina, Armenia, Australia, Austria, Bangladesh, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, El Salvador, Finland, France, Germany, Guyana, Honduras, Hong Kong China, Hungary, Iceland, India, Ireland, Italy, Jamaica, Japan, Kazakhstan, Republic of Korea, Lithuania, Mexico, Netherlands, Nicaragua, Norway, Pakistan, Peru, Philippines, Portugal, Russian Federation, Spain, Sweden, Switzerland, Thailand, the United Kingdom, the United States, Venezuela, and Vietnam. Of the countries included in the data set, the Russian Federation, Vietnam, and Kazakhstan have not yet acceded to the WTO. All available UNCTAD data was included in the dataset.

The GATS Indexes

10. The indexes on services sector restrictiveness in the GATS represent an important first step in understanding the relationship between service openness and manufacturing FDI.

11. **Hoekman's land transport and water transport indexes:** The *gatsland95* and *gatswater95* indexes created by Hoekman (1995) analyse services liberalisation in land transport and water transport services on a three-tiered scale. He ascribes each country one of three values: "0" (open), "0.5" (moderately restrictive) or "1" (very restrictive) for various market access restrictions on services sectors covered in the GATS. Hoekman then estimates "tariff equivalents" for the GATS commitments by multiplying coverage ratios against a series of benchmark tariffs. The higher the value of the index implies the more restrictive the services sector.

12. **Marko's basic telecommunications index:** The *btelmarko* index constructed by Marko (1998) uses a method similar to Hoekman to measure the openness of basic telecommunications services. Marko's index differs from Hoekman insofar as she collects data for each mode of supply separately and does not estimate tariff equivalents. Marko's index shows the number of commitments made in basic telecommunications services as a percentage of the total number of commitments a country could have made. The higher the value of the index implies the more restrictive the service sector.

13. **Services incidental to manufacturing:** The Secretariat constructs a binary variable (*gatsmfg*) indicating whether a country has scheduled significant GATS commitments in the category "services incidental to manufacturing" ("0" (scheduled) or "1" (not scheduled))⁶.

14. These indexes have drawbacks duly acknowledged by their creators, as measuring restrictions on services is more difficult than measuring restrictions on goods. Researchers often use tariff lines to measure restrictions on goods which, while not taking into account certain non-tariff measures, reflect a relatively unbiased way to quantify restrictiveness. Since there is no correlate for services, scholars introduce subjectivity into their calculations as qualitative restrictions are transformed into quantitative data. In addition, the scores do not allow for a high degree of variation among the types of restrictions listed. In Hoekman, for instance, all bound restrictions in the moderately restrictive category were assigned the same value, regardless of how those restrictions impact the market. Further, the indexes do not reflect the actual policy reality, and many researchers have noted that the GATS reflect legal, rather than economic, conditions. Indeed, Greg McGuire from the Australian Productivity Commission found that

⁶ The "services incidental to manufacturing" classification in the GATS is not well-defined. Relatively few countries chose to make significant commitments in this category during the Uruguay Round. However, 14 out of the 20 countries that acceded to the WTO post-Uruguay Round scheduled commitments in this category. The reason for this increase is unclear.

only 23% of Australia's actual restrictions affecting financial services were included in Australia's GATS schedule (OECD, 2000). Limitations aside, these indices represent the best measures of GATS liberalisation to date.

The Australian Productivity Commission Indexes

15. The indexes developed under the auspices of the Australian Productivity Commission (APC) provide even more finely-tuned measures of openness in select services sectors.

16. **APC telecommunications index:** The *telecomindex* was constructed using 1998 survey data from the International Telecommunications Union after the successful completion of the WTO negotiations on the Telecommunications Reference Paper. Key information used to construct the index includes: ownership of the primary carrier and its competitors; the degree of foreign ownership permitted; the degree of market openness; information regarding line leasing and line resale; and callback permission.

17. **APC banking index:** The *bankindex* was created using 1995-1998 data from various sources, including WTO Trade Policy Reviews; Asia Pacific Economic Cooperation Individual Action Plans; the United States Trade Representative's National Trade Estimate Report on Foreign Trade Barriers; the WTO Financial Leaders Group's Common List of Barriers to Financial Services Trade; IMF data; and the TradePort web site, which provides restrictions for most economies.

18. **APC architecture index:** The *architectindex* was developed using 1996-1999 data from the following sources: the GATS, the OECD Inventory of Measures Affecting Trade in Professional Services; the APEC Directory of Professional Services; WTO Trade Policy Reviews, Tradeport; and APEC Individual Action Plans.

19. **APC distribution, legal, maritime transport, and engineering indexes:** The *distrib*, *legal*, *waterAuss*, and *enginindex* restrictiveness indexes were also developed by the APC. Data to construct these indexes primarily comes from staff papers written for the Australian Productivity Commission.

Insignificant results using GATS and Australian Productivity Commission Indexes

As indicated in Section 4, Annex Table 2 shows the insignificant regression results from the global dataset.

Annex Table 2. Liberalisation of services and manufacturing FDI: The global evidence

Dependent variable: Inmfgfdi	Base	GATS Services Incidental to Mfg	GATS Water Transport Index	Distribution Index (APC)	Legal Index (APC)	Maritime Index (APC)	Engineer Index (APC)
Ingdp	0.816** (8.81)	0.833** (7.70)	1.043** (6.71)	0.980** (4.60)	0.941** (2.94)	0.992** (4.71)	0.934** (4.23)
Inicrg	4.317* (1.92)	3.894 (1.53)	2.667 (0.73)	3.602 (0.65)	12.100 (1.23)	-0.953 (0.20)	6.037 (0.80)
Inedu	0.884 (1.02)	1.265 (0.96)	1.751 (1.12)	1.911 (0.79)	2.422 (0.93)	2.966 (1.20)	1.364 (0.62)
Inmobile	-0.177 (0.94)	-0.224 (0.88)	-0.272 (0.96)	-0.299 (1.08)	-0.739 (1.46)	-0.397 (1.13)	-0.294 (0.76)
Intradeopen							
gatsmfg		0.356 (0.68)					
gatswater95			-0.026 (0.45)				
distrib				-0.785 (0.23)			
legal					-2.973 (0.90)		
waterAuss						-4.512 (1.23)	
enginindex							-3.521 (1.04)
R ²	0.723	0.721	0.634	0.529	0.539	0.525	0.52
Observations	51	46	34	29	23	28	26

Source: Notes: Data for each category was not available for every country. All regressions were run with robust standard errors. Absolute values of t-statistics are in parentheses. Values marked (**) and (*) are significant at the 5% and 10% levels, respectively. APC stands for the Australian Productivity Commission.

Additional regression results: OECD-only dataset

20. This regression analysis includes data for the following 23 OECD countries: Australia, Austria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Italy, Japan, Republic of Korea, Mexico, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States.

21. The remaining seven OECD countries were not included in the dataset due to data limitations. There is no manufacturing FDI data for Ireland, Greece, and New Zealand, and only very limited data for Canada. The OECD data on FDI in manufacturing was combined for Belgium-Luxembourg, and it was impossible to disaggregate. Since the OECD restrictiveness indexes do not include Luxembourg, both countries had to be excluded. There is also no FDI restrictiveness index data for the Slovak Republic, so it too had to be excluded from the dataset. Data comes from the OECD International Investment Statistics Yearbook (2005).

22. The sources of data used to construct the OECD indexes include data from the U.S., Japanese, and European authorities, the OECD Codes of Liberalisation and related documents, data from PriceWaterhouseCoopers regarding the investment climate and investment restrictions in OECD countries, and the last draft of the negotiating text of the Multilateral Agreement on Investment (MAI), dated 24 April 1998. While the MAI never came into force, Graham (2001) notes that the provisions in the MAI tended to codify existing FDI rules in individual OECD countries.

23. As indicated in Section 4, Annex Table 3 shows the insignificant regression results from the OECD-only dataset.

Annex Table 3. Services liberalisation and manufacturing FDI: Evidence from the OECD

Dependent variable: lnmfgfdi	Base	Legal Index	Road Transport Index	Water Transport Index	Finance Index
lngdp	0.806** (8.21)	0.754** (6.51)	0.664** (4.58)	0.812** (7.45)	0.766** (6.74)
lnicrg	-0.067 (0.02)	0.203 (0.06)	-1.403 (0.37)	-0.667 (0.18)	-1.455 (0.38)
lnedu2000	2.906 (1.73)	2.633 (1.55)	3.069 (1.81)	3.191 (1.70)	3.291 (1.83)
lnmobile	-0.519 (1.17)	-0.759 (1.26)	-0.446 (0.70)	-0.540 (1.15)	-0.482 (0.94)
oecdlegal		-2.274 (0.92)			
oecdroad			-3.284 (1.48)		
oecdwater				-0.687 (0.47)	
oecdfinance					-2.234 (1.14)
R ²	0.738	0.756	0.773	0.741	0.755
Observations	22	22	22	22	22

Source: Notes: Data for each category was not available for every country. All regressions were run with robust standard errors. Absolute values of t-statistics are in parentheses. Values marked (**) and (*) are significant at the 5% and 10% levels, respectively.