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The Role of Services for Competitiveness in Manufacturing

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Abstract

THE ROLE OF SERVICES FOR COMPETITIVENESS IN MANUFACTURING

This study analyses the relationships between competitiveness in manufacturing and the quality of key supporting services. Three indicators of competitiveness are considered: the degree of product differentiation, unit prices obtained in export markets and the duration of trade. The density of telecoms networks and the reliability of electricity supply stand out as the most crucial for competitive manufacturing. In addition the ease at which contracts can be enforced and the time it takes to export and import goods are strongly related to competitiveness. Our methodology allows us to go beyond a one size fits all policy analysis. Interestingly, we find that in low-income countries, the impact of services quality and policy on competitiveness is highest in low-technology industries; in middle-income countries it is highest in medium-technology sectors and in high-income countries the impact is highest in medium-high and high-technology industries. This suggests that better services contribute to moving up the value chain in industries where a country already has technological capacity and comparative advantage, but better services alone may not stimulate product differentiation in sectors where a country is far from the competitive edge – at least not in the short run. Policy reforms needed are to simplify procedures for contract enforcement, liberalisation of FDI, strengthen pro-competitive regulation of network services, and eliminate tariffs. It is concluded that new ways of doing business where manufacturers build relationships with customers and compete on the basis of products they are willing to pay a premium for has the potential to become an important driving force for growth after the great recession, provided that adequate support from competitive services markets is in place.

Keywords: Competitiveness, new industrial revolution, services liberalisation, services regulatory reform, telecommunications, electricity, contract enforcement, transport costs, tariffs.

JEL: F12, F13, F14

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Executive Summary

This study sheds light on the role of services in international merchandise trade taking into account new ways of organising production. It analyses the relationships between the quality of key services and competitiveness in manufacturing. Three indicators of competitiveness are considered: the degree of product differentiation, unit prices obtained in export markets and the duration of trade. The objective of the analysis is to identify which services are critical for competitiveness in which sectors at which level of income; and how services trade policy and services market (de)-regulation may help manufacturers move up the value chain into differentiated products with higher mark-ups over costs in export markets.

The study first takes stock of recent literature and relates headline-grabbing buzzwords – "the new industrial revolution" and "the second unbundling" – to recent analysis of structural changes in the way production is organised. The review highlights the role of services for manufacturers' ability to distinguish themselves from competitors, fetch a premium in local and foreign markets and move away from one-off market transaction towards implicit or explicit contractual relations with customers. We observe that technology and organisational innovations are coming together in ways that raise hopes for a revival of manufacturing in OECD countries. In particular, social media and machine tools capable of producing small quantities of designer products at low costs have brought a fringe of new innovative firms into the market which might have the potential to fill gaps that opened during the great recession and over time become the mainstream.

Against this backdrop the study provides empirical analyses of how services contribute to international competitiveness in manufacturing, starting by computing direct linkages between goods and services from input-output tables. High-technology industries are more business services intensive than other sectors, and higher business services content is associated with higher export prices obtained in major markets. Import penetration of business services is quite low, but has grown rapidly and is increasingly important for high-technology industries. Import penetration in transport, logistics and travel services is, however, highest and fastest growing in low-technology industries. We also find that exporters of technology (measured by the receipts of royalties) tend to experience more resilient manufacturing export relations.

An important source of competitiveness in manufacturing for high-cost countries is to design great products for which consumers are willing to pay a premium. Manufacturers distinguish themselves from competitors through branding and other forms of intellectual property rights protection. At the industry level such product differentiation means specialisation on fewer products produced in higher volumes for the international market. Product differentiation drives intra-industry trade, which is commonly measured by the Grubel-Lloyd index, hereafter the GL-index. The GL-index is calculated for six sectors: pharmaceuticals (HS 30) plastics (HS 39), apparel (HS 61 and 62), electronic machinery (HS 85) and motor vehicles (HS 87), and related to services quality and policy.

The correspondence between intra-industry trade, product differentiation and moving up the value chain is not perfect. Therefore, two additional variables are included in the analyses; prices obtained in export markets and the resilience of trade flows as measured by the duration of bilateral trade relationships. These three variables capture different aspects of competitiveness and together they give a realistic and multifaceted representation of the relationship between services sector performance, services trade policies and manufacturing competitiveness.

The services performance indicators used in the analysis are telecommunications density, interest spread between banks' deposit and lending rates, transport costs, time for exports and imports, reliability of electricity supply and average years of schooling. The services policy indicators included are the OECD foreign direct investment restrictiveness index by sector, the OECD product market regulation index in air transport and telecommunications, tariffs and the number of procedures needed to enforce a contract. It is found that the quality of these services contributes substantially to product differentiation, export prices and duration of trade in some or all of the selected manufacturing sectors. It is worth bearing in mind that statistically significant relationships do not necessarily imply causality.

The relationship between services indices and manufacturing competitiveness is not uniform across sectors and income groups. The two clothing sectors and electronics are the sectors most sensitive to services quality and policies, closely followed by motor vehicles. Interestingly, the impact of services quality on product differentiation is related to technological capacity. In low-income countries, the impact is highest in low-technology industries, in middle-income countries it is highest in medium-technology sectors, and in high-income countries the impact of services quality and policy is highest in medium-high and high-technology industries. This suggests that better services contribute to moving up the value chain in industries where a country already has technological capacity and comparative advantage, but better services alone may not stimulate product differentiation in sectors where a country is far from the competitive edge – at least not in the short run. Our empirical analysis thus allows us to go beyond a one size fits all policy recommendation and make some tentative suggestions on which reforms would be most important in which countries.

More telephone and internet connections are significantly and positively associated with all three measures of competitiveness. Moreover, telecoms are also associated with higher export volumes concentrated on fewer 6-digit Harmonized System product categories. Turning to policy measures, product market regulation in telecoms has a relatively strong impact on export prices. Best practice telecoms regulation evolves with changing market conditions and our findings suggest that regulation that stays abreast with market developments is important for competitiveness in manufacturing, not least for high-income countries.

Reliable electricity supply is strongly associated with competitive manufacturing. This may reflect the importance of a rapidly proliferating industrial internet where sensors monitor and control manufacturing processes and supply chain management systems. Investing in electricity distribution, for instance smart grids would be a substantial contribution to competitiveness, particularly in high-income countries where the production technology and business processes are more sensitive to disruptions in electricity supply.

The number of procedures for contract enforcement has a strong negative impact on product differentiation and export volumes, particularly in sectors of comparative

advantage. These findings suggest that eliminating red-tape and strengthening contract enforcement bolster local firms' incentives to innovate and move up the value chain. In addition easier contract enforcement could institute market confidence such that lead firms in international production networks or global value chains more willingly source specialised differentiated inputs on a longer-term contractual basis from local firms.

FDI restrictions in services sectors are consistently associated with less product differentiation. In the clothing sector, the effect is stronger the lower the level of income, while in the other sectors the impact rises with income level. FDI restrictions in the transport sector, however, have a stronger negative effect on product differentiation in manufacturing the lower the level of income in all sectors. Liberalising the transport sectors, particularly in low and lower middle-income countries could improve their connectivity to the rest of the world and help them move away from reliance of price competition alone. Tariffs have a strong negative impact on both product differentiation and export prices in all sectors, and the impact typically rises with the level of income. Removing tariffs would enhance competitiveness significantly particularly in high-income countries.

In a nutshell, we find that the most important policy measures in low and lower middle income countries are lower tariffs, improvement of the level of education and simplification of contract enforcement. These reforms could help moving into branded clothing products. In addition improving the reliability of electricity supply and reducing time for exports would help entering into global value chains in the electronics sector. Finally, opening up the services sectors, particularly finance and transport, to foreign direct investment would help obtain higher export prices in the sectors of comparative advantage. Tariff reductions, FDI liberalisation and better contract enforcement are the low-hanging fruits for low and lower middle income countries. Such reforms do not require investments or taxing government capacity and scarce resources very much, and would make a relatively large impact as a first step up the value chain. Also for upper middle income and high income countries the low-hanging fruits would be elimination of tariffs and simplification of contract enforcement. However, ensuring that regulation provides the right incentives for investment in telecommunications while keeping the telecoms market competitive and not least investing in smart electricity grids are equally important, but also more costly.

We have demonstrated policy spillovers from services to manufacturing and we have extracted from the literature that goods and services are increasingly bundled both in production and consumption. Against this backdrop it may be worth exploring how trade policy measures could ensure that firms face a similar policy environment whether they engage in services or goods trade – or both. Bundling goods and services often implies a movement away from one-off market transactions towards long-term contractual relationships. These may be based on after-sales services or goods may serve as a platform for services sales on a long-term contractual basis. When such bundling is combined with market segmentation which imposes considerable switching costs for consumers, there may be a case for cross-border cooperation on establishing and enforcing competition rules.

Finally, product differentiation often involves product development and marketing based on real-time observations of consumer behaviour and targeted advertising, which require the accumulation and handling of enormous amounts of information. Another emerging policy area in this regard is cross-border transmission and storage of information. Striking a balance between open markets and protection of privacy and intellectual property rights is therefore gaining prominence in international services trade policy discussions.

To conclude, the proliferation of high-speed internet has opened new opportunities for manufacturers to build relationships with customers and compete on the basis of products they are willing to pay a premium for. New ways of doing business along these lines may have the potential to become an important driving force for growth after the great recession, provided that adequate support from competitive services markets is in place.

Introduction

Economic downturns and structural changes go together in history. During periods of strong growth, established companies using proven technologies do well and the opportunity cost of switching to new technologies may be high. A recession in contrast, is a window of opportunity for new ideas which in turn have the potential to drive the recovery.[1] Thus, some of the world's greatest companies were born during recessions. Examples are Hewlett Packard, General Electric, Microsoft, CNN and McDonalds. The 2008 financial crisis and subsequent recessions are no exception. According to some observers a new industrial revolution, where goods and services are integrated, is gathering pace with the potential to fill the gaps left open by crisis-hit companies and markets.[2]

Ongoing structural changes have been coined the second unbundling.[3] To explain the second unbundling, let us briefly recall the first unbundling. It started during the (first) industrial revolution, was set back during, and between, the two world wars and picked up steam again from the 1960s. During these periods tariffs and transport costs came down substantially. As a result production became more geographically dispersed and a spurt in trade relative to GDP ensued. At first specialisation according to comparative advantage was the major driving force. As trade costs came further down and consumers became richer and more sophisticated, intra-industry trade among countries with similar resource endowments and income levels pushed the ratio of trade to GDP higher still.

Intra-industry trade can be either horizontal or vertical. Horizontal intra-industry trade features the exchange of different brands of the same good, to the benefit of consumers who have more varieties to choose from. Furthermore, consumers are willing to pay more for brands that correspond to their preferences and their desire to distinguish themselves from the crowd. Thus, branding and product differentiation are sources of larger mark-ups for producers and goes together with a rising services content of manufacturing.

1. See Brezis et al. (1993) for a theoretical explanation of this phenomenon.

2. A new book by Peter Marsh (2012) synthesising recent industrial and technological developments has contributed to a vigorous recent debate. Even more recently, Chris Anderson (2012) weighs in predicting a new area of entrepreneurial "makers of things" and a "long tail of things".

3. See Baldwin (2006; 2011); Baldwin and Evenett (2012).

Vertical intra-industry trade represents the slicing up of the value chain with production of parts, components, services and tasks dispersed geographically and shipped to assembly lines either in large factories in low-cost countries or in smaller workshops close to the market. Proponents of the idea of a new industrial revolution argue that the workshops close to the market are gaining prominence (Marsh, 2012; Anderson, 2012), with new business opportunities for firms able to read and shape consumer tastes and create the products that consumers want even before they know it.

While rapidly declining transport and trade costs drove the first unbundling, a sharp reduction in coordination costs made the second unbundling possible. It started in the 1980s following advances in communication technology (ICT) that allowed slicing up production into different stages or functions which became dispersed both geographically and organisationally. Vertical intra-industry trade in goods and services has gained prominence as a result, featuring international sourcing of parts and components, and more recently also services.

Geographical dispersion of production notwithstanding, industrial clusters also gained prominence during the 1980s. Clustering and dispersion of economic activities appear to be contradictory phenomena, but in fact they can be explained by the same theory featuring centrifugal and centripetal forces balancing each other (e.g. Fujita et al., 2001). Relocating or offshoring an activity is mainly driven by cost considerations, while clustering is motivated by the benefits of having access to a pool of skilled workers, readily available local suppliers (Porter, 1990; Delgado et al., 2012), and a dynamic industrial environment – or "something in the air" as Alfred Marshall (1890) put it.

A trade off-between cost savings from locating in low-cost countries, and trade-and coordination costs related to managing suppliers at a distance shapes the way production is organised. In which location each activity along the supply chain ends up depends on relative production, trade and coordination costs, the life cycle of the product, and the importance of flexibility in reacting to or shaping market responses.[4] By implication, when the relative costs of production, trade and coordination change, the balance shifts, triggering structural adjustments and relocation of activities. The second unbundling is an example of such a shift. Since the late 1990s the proliferation of broadband and wireless internet connections has reduced coordination costs as well as bringing a host of business services into international markets. This by itself shifts the balance towards further dispersion of production with lengthening value chains and outsourcing and offshoring of services.

This is not the only driving force at play, however. Production costs have changed too. Flexible machine tools and automation of production processes mean that the cost of switching from one task to another is low and unit costs do not vary much with batch size. Economies of scale have in many instances shifted from fabrication to marketing, including monitoring consumer behaviour. New production and communication technologies enable manufacturers to target niche markets where design and marketing constitute an integrated feed-back loop. These activities, and sometimes also production in small batches, tend to cluster in major markets. Some analysts argue that this is the beginning of a revival of manufacturing in high-income countries (Marsh, 2012;

4. A best-selling book entitled *The World is Flat* argued that recent developments in communication technology combined with open markets would result in a flat world where economic activities would be located where costs are the lowest, and distance would no longer matter. This appears not to have come to bear so far.

Anderson, 2012), although most observers recon that mass production of standardised parts and components as well as standardised and digitised services are likely to locate where production costs are the lowest.

What we are witnessing is both unbundling and re-bundling of activities along the value chain. Examples of new ways of bundling goods and services are manufacturers without factories in industries such as clothing and sportswear (e.g. Nike) and electronics (e.g. Dell Computers and IBM). In heavier industries where fabrication remains a main source of competitiveness, services are added as a customisation tool. Manufacturers of machinery and equipment, for instance, reinvent themselves as system providers offering performance monitoring, maintenance and replacement of the machines that they sell or rent out (e.g. engines for aircraft, copy machines, coffee machines etc.). The services part of the system is typically the strategically most important, distinguishing the firm from its competitors, and the vehicle through which it engages with customers in contractual relationships.

There are also examples of services providers venturing into (or contracting out) manufacturing. Google and Microsoft have both entered the market for tablets; Amazon and Barnes & Noble have contracted out the development and production of their own e-readers and general retailers have developed and contracted out production of their own brands (so-called private labels or store-brands).

These developments have radically changed the way production is organised. Value chains sprawl across international borders as never before, unbundling and re-bundling activities in new ways. A host of services play an increasingly important role both in adding value to manufactured products and in coordinating global value chains. For this reason services trade restrictions as well as behind the border services sector regulation have caught the attention of manufacturers (Rentzog, 2010) and a revival of business interest in services trade negotiations.[5] In addition, the bundling of goods and services changes the relation between suppliers and customers from arms-length market transactions to longer-term contracts, raising new issues concerning the relation between trade and competition policy.

This study contributes to shedding light on the role of services in international merchandise trade taking into account new ways of organising production. It analyses the relationships between the quality of the services which are likely to affect trade performance in sectors in which product differentiation is important. Three indicators of trade performance in manufactured products are considered: the degree of product differentiation as measured by the Grubel-Lloyd index of intra-industry trade; unit prices obtained in export markets and the duration of trade.

The rest of the study is organised as follows. Section two takes stock of recent literature and distils applied policy messages from it. Direct linkages between goods and services sectors are computed from input-output tables and presented in section three. The role of services in product differentiation takes centre stage in section four which presents analysis of the determinants of intra-industry trade. Branded products and specialised intermediate inputs tend to be provided on the basis of long-term contracts, which are likely to be more resilient to changes in market conditions and economic crises than standard plain vanilla products. Section five relates the resilience of bilateral trade flows

5. See for instance BIAC's statement to the 2012 OECD Ministerial. www.biac.org/statements/high_level/BIAC_Statement_to_MCM_2012.pdf

to competitive and open services market. Section six draws the policy implications gleaned from the literature review and from our empirical findings and concludes.

Relations to previous research

Given the size and importance of the services sectors in employment and trade, services trade has received surprisingly little attention in the literature. Furthermore, although goods could not flow across borders without supporting services, their role is largely ignored in merchandise trade analysis. A literature review of the relation between goods and services in international trade can therefore be made quite brief.

There are two ways through which better services may improve the competitiveness of manufacturing in international trade. The first is through reduced costs, the second through making great products for which customers are willing to pay a premium. Efficient, reliable and reasonable transport, distribution, finance, utilities, telecommunications and business services are essential for cost effective production and marketing of goods. The competitiveness of transport and distribution also strongly affects to what extent reduced import prices following trade liberalisation in goods sectors pass through to the consumer. Indeed trade liberalisation may fatten the margins for transporters and distributors rather than resulting in lower consumer prices in the absence of sufficient competition in the transport and distribution sectors (Hummels et al., 2009; Francois and Wooton, 2010). In addition high transport costs inhibit entry into new markets and contribute to a higher rate of exit from new markets (Besedeš and Prusa, 2006a).

Supply chain management typically involves developing a set of pricing, delivery and payment processes – often contained in electronic supply chain management platforms. Such platforms reduce transaction costs and often also entry barriers for suppliers. Firms may for instance provide a single input to the value chain without the need to rely on a local resource base (Baldwin, 2011). Joining a value chain may be easier than building one, but a chain is only as strong as its weakest link and the firms joining must often satisfy stringent quality and reliability standards. Therefore, a host of business services have entered global value chains, among other things to help suppliers comply with such standards. In addition services help absorb shocks to the supply chain, for instance through tracking and shifting flows of inputs in the event of natural disasters, strikes or other disruptions. Finally services inputs contribute to higher market prices of the end product due to better design and better matching of supply and demand.

Another ICT-based source of improving cost effectiveness is the remote monitoring of industrial facilities, utilities and capital equipment. The cost of sensors and digital instruments has plummeted and they are increasingly installed in machinery and equipment allowing better capacity utilization and improved energy efficiency. According to a recent study by Evans and Annunziata (2012) of General Electric, linking sensors and instruments through what they call an industrial internet could reduce costs substantially in sectors currently producing about half of global GDP.

As noted in the introduction, goods and services tend to be bundled in new ways where services often provide strategic inputs that enable the producers to target premium or niche markets. Such inputs are provided at each end of the value chain - pre-production design and product development; and post-production marketing and after sales services. The observation that services create value at both ends of the value chain was coined the "smile curve" by Stan Shih, the founder of Acer computers. He argued that R&D, design

and marketing are the core activities that create value for the company, while fabrication is a low-margin activity that could be outsourced to specialised "fabs".

The business literature provides many examples of the linkages between goods and services. A recent contribution is Marsh (2012) who compares modern manufacturers of differentiated products to consultants who spend a lot of time discussing with customers before creating, having made and delivered the products that the customer needs. In many instances discussions with consumers are conducted through social network internet sites. In addition to conveying real time information on consumer perceptions of products, popular concerns about environmental and ethical standards related to their production are voiced through social networks and taken seriously by industry. Consumer loyalty programs are another important source of information on consumer preferences, and in some cases specialised computer services firms providing data mining services handle this information.

Studies from Sweden provide further evidence of the growing importance of services for manufacturing firms. Not only do services contribute to a higher share of intermediate inputs in manufacturing, they also account for a rising share of manufacturing firms' revenue and are positively associated with exports (Lodefalk, 2012a and b). For instance a Swedish machine tool manufacturer uses 40 different services in order to uphold its delivery chain and it sells 15 different types of services to its customers (Rentzhog, 2010). Firm level analysis from the United Kingdom and Germany also find that services account for a significant share of manufacturers' revenue, including export revenue (Breinlich and Criscuolo, 2011; Kelle and Kleinert, 2010).

The literature on global value chains was preceded by the new trade and economic geography literature, featuring intra-industry trade among trading partners at similar levels of income and clustering of economic activities (Krugman, 1979). Intra-industry trade takes place when countries specialise in different brands or varieties of a particular good while importing brands and varieties from other countries. A country would for instance both export and import cars because consumers want to have a choice between several models and makes, while a country would usually either export or import sugar – not both, since consumers cannot tell the difference between sugar from different sources.[6]

Early literature focussed on horizontal intra-industry trade, but with the proliferation of international production networks, vertical intra-industry trade has also expanded among countries at different levels of income, which trade parts and components rather than different varieties of final goods or services. Whether intra-industry trade is horizontal or vertical, a range of business services is needed to make such trade economical. For instance combining international supply chains with just-in-time organisation of production obviously requires effective and reliable transport and logistics services, but also technical testing, legal advice, ICT support and many other business services (Nordås et al., 2006).

Entering a differentiated product market and obtaining prices that comfortably cover cost, is, however, not the end of the story. In fact, most firms that enter new product lines

6. Recently commodities such as sugar have been branded not for the intrinsic quality or other features of the product, but for the way it is produced, e.g. in an environmentally friendly way, a socially responsible way or being fairly traded (www.fairtrade.net/sugar.html) or all of these www.wholesomesweeteners.com/brands/Wholesome_Sweeteners/Fair_Trade_Certified_Organic_Sugar.html.

or markets fail after the first three to five years.[7] On the other hand, trade relationships that survive the first critical period tend to be more resilient and the probability of market exit decreases with the number of years of uninterrupted trade (Nitsch, 2009).

Various explanations have been put forward for the high hazard rate in international trade. Some are related to the nature of the products being traded, others to the size of and the cost of entering and operating in foreign markets. It is found that trade relationships in differentiated products tend to last longer (Besedeš and Prusa, 2006a; 2006b). Interestingly, initial purchases of such goods tend to be lower than for homogenous goods, suggesting that importers search for suitable suppliers, try them out and then invest in the relationship. Trade in parts and components have many of these characteristics and tend to be more resilient than trade in final goods (Arndt 2004; Obashi, 2010).[8]

Firms entering foreign markets typically incur entry costs that are duplicated in each market. Examples of such costs are compliance with country-specific standards and regulations; developing or joining distribution channels; and searching and processing information about new markets. The higher the entry barriers, the fewer exporters enter, as one would expect. But it also appears that the harder a market is to get into, the longer the trade relationship lasts after having survived the first hurdles of market entry. By the same token, lower entry barriers are associated with more entry and exit and shorter duration of trade (Eaton, Eslava et al. 2008). Exports to large markets tend to last longer, probably because fixed entry costs can be spread on larger sales volumes. Variable trade costs, notably transport costs, tend to increase the hazard rate (Besedeš and Prusa 2006a; 2006b).[9] An important insight from the analysis of hazard rates is the role that search costs play in establishing lasting trade relationships. One would expect that the proliferation of the internet reduces search costs and contributes to longer trade relationships, a hypothesis that is explored in this study.

Having established that services are important for manufacturing export performance, what are the features of the services markets that would contribute to more competitive manufacturing exports of e.g. branded products? There is scant analysis of this in the literature, but there is some evidence that countries that have open services markets tend to be more competitive in manufacturing (Francois and Wörz, 2008; Nordås, 2010); and services sector reform is associated with productivity gains in downstream manufacturing firms (Arnold et al. 2011).

Important policy messages emerging from recent literature are that goods and services complement each other and services often enhances the value of manufactured products. Services are provided as links in global value chains and trade barriers as well as behind the border regulatory burdens may spill over to other activities affecting the competitiveness of the entire supply chain. Therefore, impact assessment of new regulations, trade agreements or regulatory reform need to take into account regulatory

7. See Esteve-Pérez *et al*. (2007) and Fugazza and Molina (2009).

8. Obashi (2010) studied bilateral machinery trade at 6-digit HS level among nine East Asian countries during the period 1993-2006.

9. Besedeš and Prusa (2006a; 2006b) found that differentiated and high-valued products have a longer median duration, based on a search cost model applied to US imports. Besedeš (2008) showed the persistency of short and small valued relationships by applying Rauch and Watson (2003) search model.

spillovers along the value chain. Indeed, Egger et al. (2012) find that trade liberalisation in goods and services reinforce each other. Their estimations suggest that in the European Union simultaneous and coordinated internal liberalisation of goods and services markets raised welfare by 11% more than the sum of welfare effects from independent inception of goods and services internal market opening. Finally, the prominent role of telecommunications is highlighted. The bundling of goods and services involves an enormous amount of information processing – increasingly in real time – which requires access to reliable, fast, secure and cost-effective telecommunications networks. This is a sector subject to rapid technical change. It is also a sector subject to ex ante regulation. Such regulation needs to evolve with changing technology and market conditions to ensure competitive markets supporting effective and efficient value chains.

Services and technology go together in manufacturing

As noted in the introduction, many observers argue that manufacturing has become more services-intensive and that services play a strategic role for manufacturers in their effort to distinguish themselves from competitors. High-technology manufacturing tends to have complex production processes where R&D, engineering and a host of other business services play an important role. It is therefore interesting to explore to what extent services intensity varies systematically with the technology level in manufacturing. Figure 1 depicts the services intensity of manufacturing calculated from the OECD input-output database, broken down to four technology categories using the OECD/Eurostat classification which in turn is based on R&D expenditure (Annex A). Admittedly, this categorisation is somewhat dated, and it should be borne in mind that most manufacturing sectors have both high- and low-technology segments.

Figure 1 shows the average services share of gross output and the average intermediate services to value added ratio for the 53 countries covered by the OECD input output database, distinguishing between locally sourced and imported services.[10] [11] [12] The chart confirms that services intensity in manufacturing has increased during the decade from the mid-1990s to the mid-2000s. It should be noted up-front that cost shares are imperfect measures of the importance of the services input. Some services, such as telecommunications, may not account for a large share of total costs, but it would be impossible to do business without such services. It should also be noted that it can be difficult to distinguish clearly between pure intermediate services that enter the

10. These are the 34 OECD countries plus Argentina, Brazil, Bulgaria, China, Chinese Taipei, Cyprus, India, Latvia, Lithuania, Malta, Romania, The Russian Federation, South Africa, Thailand and Vietnam. However, some of these as well as some of the OECD Members are not covered for the entire period. Only direct intermediate services inputs are considered.

11. Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue."

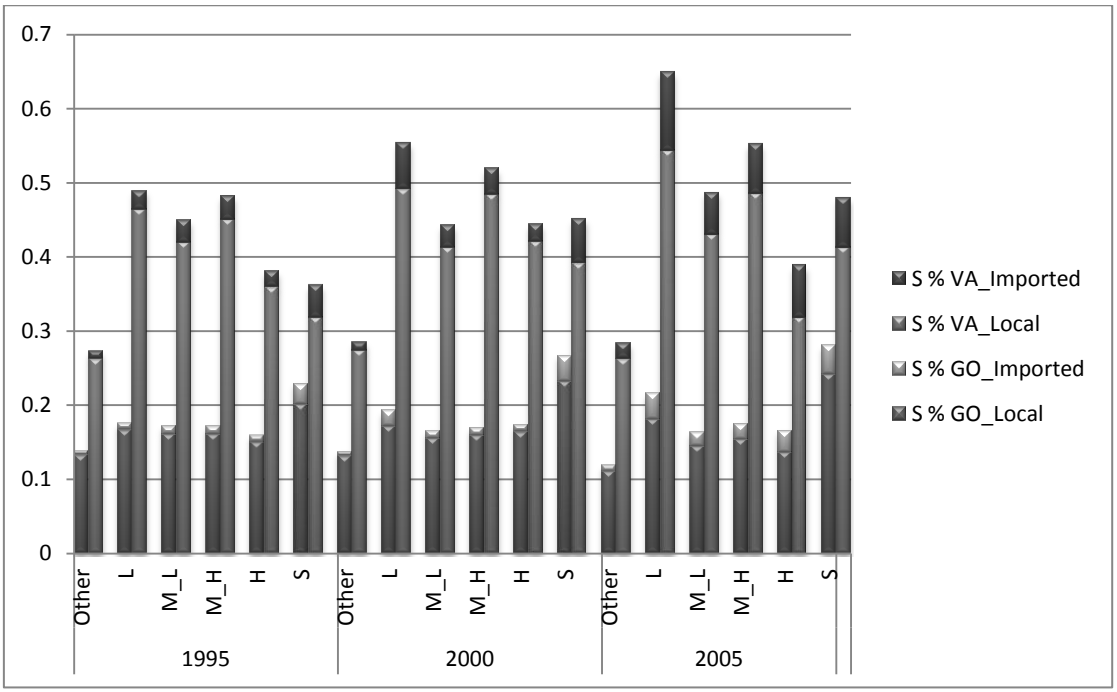
12. Footnote by all the European Union Member States of the OECD and the European Union

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

manufacturing process narrowly defined and services that support manufacturing and marketing. The input-output tables record as intermediate inputs whatever is purchased by the manufacturer (except capital goods), so if for instance distribution and marketing is paid for by the manufacturer these services are recorded as intermediate inputs. The top five services inputs to the Japanese electrical machinery illustrate the point. These are R&D (8.9% of gross output), wholesale and retail trade (5.5%), other business activities (1.9%), renting machinery (1.7%) and land transport (1.2%).[13]

Figure 1. Intermediate services relative to gross output and value-added by technology category and year

Averages across countries and sectors



Source: Direct intermediate use of services is calculated from the OECD input-output database. Other includes the primary sectors, electricity gas, water and construction; L represents low technology industries; M_L medium to low-technology; M_H medium to high-technology; H high technology industries and S represents services. The first bar in each cluster shows the share of services in gross output and the second the ratio of services to value added. Each bar is split into locally sourced and imported intermediate services.

Bearing in mind the caveats, Figure 1 reveals some interesting patterns. First, the relative importance of intermediate services has increased over time both compared to gross output and value added in all categories except high-technology industries. High-technology industries consist of pharmaceuticals, computers and office machinery, electronics and communication equipment, and scientific instruments. These sectors have been subject to very rapid technological changes over the time period considered and the input-output structure is quite volatile both across countries and over time. Some small countries report negative value added in some of these sectors, while others report a very low value added share in 1995.[14]

13. The shares of gross output are calculated from the 2005 Japanese input-output table.

14. The input-output database is not sufficiently detailed to separate pharmaceuticals from chemicals and aerospace from other transport equipment. These two high-technology sectors

Services sectors are by far the most intensive users of intermediate services when compared to gross output, while the difference is smaller when measured relative to value added. This simply reflects that services sectors have a higher value added to gross output ratio, and thus generate a higher share of output value in-house; or conversely rely less on inputs purchased from other sectors. Figure 1 does not reveal a clear and systematic relationship between services intensity and technology level.

The graph also breaks down intermediate services into local and imported inputs. The import share is perhaps surprisingly small, but has risen sharply over the ten year period considered. It is worth noticing that low-technology manufacturing is the most intensive user of imported intermediate services and the share of imported services has grown faster in low-technology industries than any other group, more than quadrupling from 1995 to 2005. A likely explanation is the fragmentation and geographical dispersion of production in low-technology industries, which requires extensive transport, logistics and other supply chain management services.

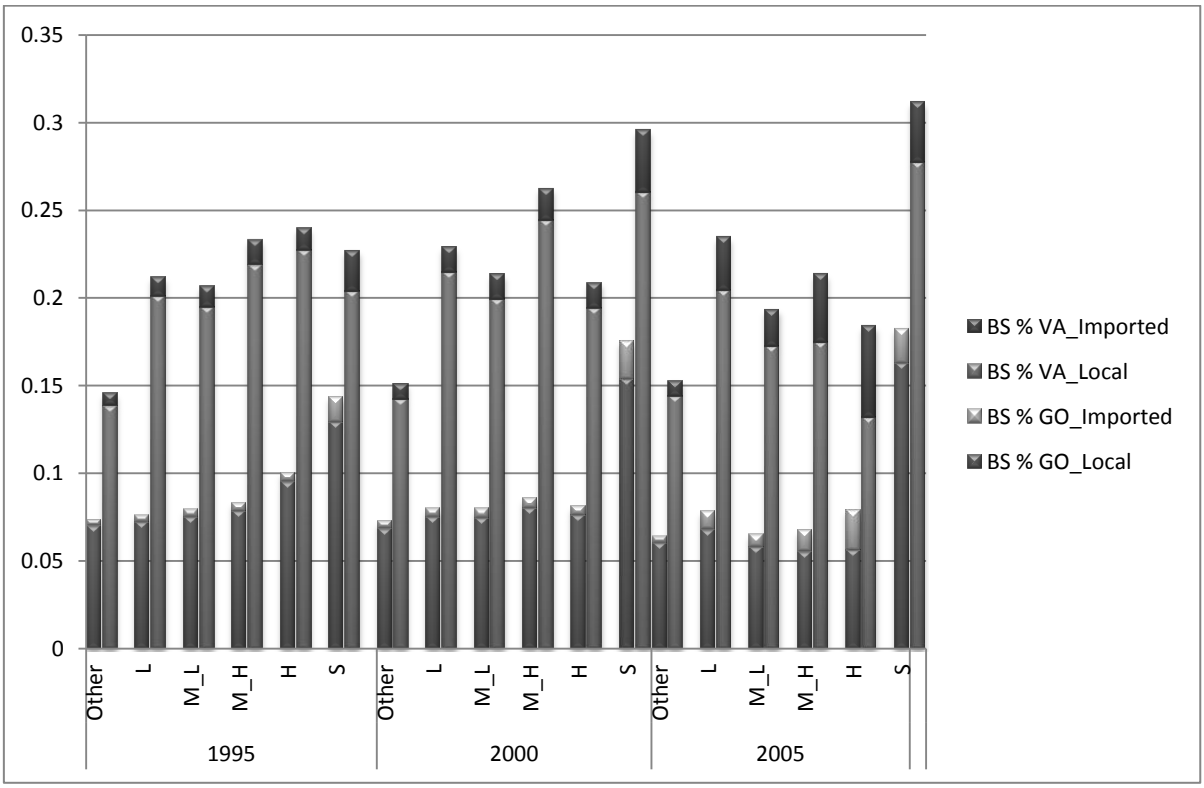
Intermediate services such as transport, utilities and telecommunications are sourced externally by most manufacturers.[15] The quality and cost of these backbone services therefore affect the competitiveness of manufacturing, and could moreover be an important factor when firms decide where to locate manufacturing activities. Business services, in contrast, may either be sourced from the market or produced in-house. Strategic services are likely to be produced in-house, while non-core services and highly specialised services, even if they are of strategic importance, tend to be sourced from the market. Access to specialised state of the art business services is therefore also important for firms operating in markets where competitiveness is driven by quality and product differentiation. Figure 2 presents developments of external sourcing of business services across technology categories and over time.

are therefore aggregated with transport equipment and chemicals respectively and assigned to the medium-high technology category. The value of intermediate services was more than eight times higher than value added in high-tech industries in Canada in 1995, which contributes substantially to the high share in 1995.

15. In poor countries where public utilities can be unreliable, it is not uncommon for manufacturers to produce their own electricity and other utilities.

Figure 2. Intermediate business services relative to gross output and value-added by technology category and year

Averages across countries and sectors



Source: Direct intermediate use of services is calculated from the OECD input-output database. Other includes the primary sectors, electricity gas, water and construction; L represents low technology industries; M_L medium to low-technology; M_H medium to high-technology; H high technology industries and S represents services. The first bar in each cluster shows the share of services in gross output and the second the ratio of services to value added. Each bar is split into locally sourced and imported intermediate services.

Services industries are the most intensive users of business services, but the gap to manufacturing has narrowed substantially over time. In manufacturing, business services intensity by and large increases with the technology level, although low-technology industries are more business-services intensive than expected from this trend. Furthermore the trend has strengthened over time, with an increase of close to 90% for high-technology industries, 35% for medium to low technology industries and 67% for low-technology industries from the mid-1990s to the mid-2000s. Interestingly, both high and low-technology industries have seen the value added share of gross output rise over this decade, while the opposite is true for the other categories. Thus, it appears that high and low-technology industries have increased both their external sourcing of business services and their in-house services activities.[16] Import penetration in business services is very limited, but high-technology industries have the highest propensity to import and the fastest growth rate of imported business services.[17] Thus, high-technology industries

16. Other explanations are possible, but other studies have found that both external sourcing of services and employment in services-related occupations in manufacturing have increased over time. See for instance Lodefalk (2012a) or McKinsey Global Institute (2012).

17. The import share of business services quadrupled in high-technology industries from 1995 to 2005.

conduct more tasks in-house (since the value added to gross output ratio has increased) and at the same time rely more on imported business services.

Given the importance of business services for technology and branding, one would expect that business services content is positively associated with the price that a manufacturer obtains in the market (Francois and Reinert, 2007). We find that this is indeed the case. Using information on export values and volumes for exports to the European Union for all countries included in the OECD input-output database, it is estimated that a one percentage point increase in the business services share of gross output is associated with between 6 and 7.5% higher export prices (see Annex C for further details).

To summarise, this section has shown that manufacturing has become more services-intensive over time, business services intensity tends to increase with the level of technology in manufacturing, and business services intensity is associated with higher export prices obtained in high-income markets. Low-technology manufacturing industries in contrast have become more transaction-intensive with a sharp rise in the share of services other than business services (mainly transport and communications) in total gross output value. Although rapidly rising, import penetration in services is low. Business services are typically provided through interactions between suppliers and customers and the dominant mode of supply may therefore be commercial presence, which is not recorded as imports. To explore to what extent policy barriers facing services producers spill over to manufacturing, we include restrictions on services FDI and behind the border regulation in the next section.

Services and product differentiation in manufacturing

Services and intra-industry trade in manufacturing

This section analyses the linkages between export competitiveness of manufacturing on the one hand, and services quality and services policy on the other. Ability to differentiate products from foreign competitors and unit prices obtained in the export markets are used as measures of competitiveness in manufacturing. The objective of the analysis is to identify which services are critical to product differentiation in which sectors, at what income level; and how services trade policy and services market (de)regulation can help manufacturers move up the value chain into more differentiated products and products that fetch higher prices in the market.

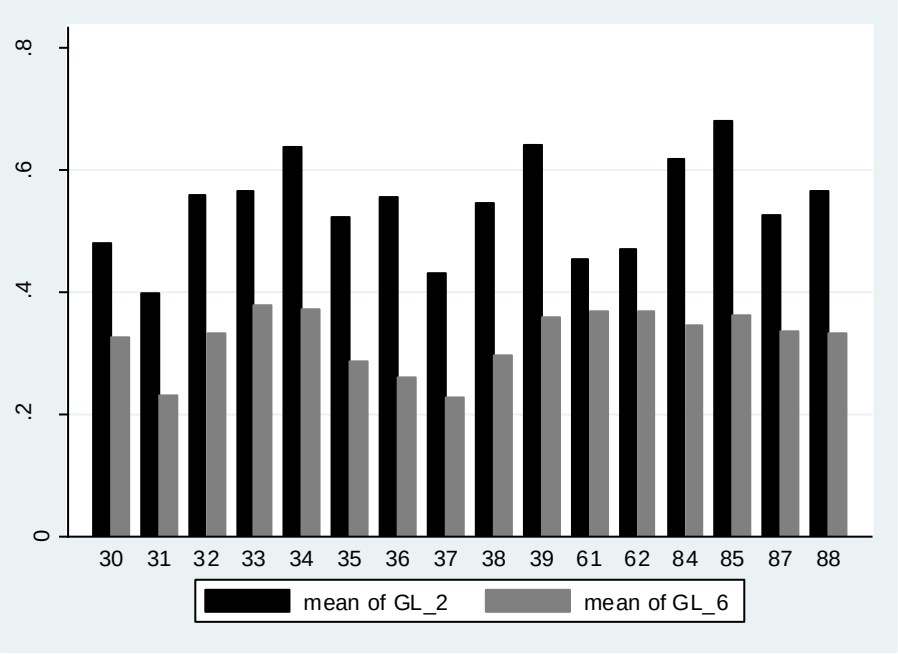
Intra-industry trade is an indicator of product differentiation in international trade and is measured by the Grubel-Lloyd index (hereafter the GL-index). The index takes values between zero and unity where zero represents the case where trade is one-way and the country in question is either an importer or an exporter, not both, of the good in question. A value of unity signifies balanced trade in the sector. One may ask why not focus on exports rather than intra-industry trade? The reason is that exports by itself do not necessarily reflect competitiveness. What is important is that trade supports income growth, which implies exporting higher margin, branded products. These features of trade are captured reasonably well by the GL-index of intra-industry trade. A couple of examples illustrate the point. India is a substantial net exporter of clothing, but does not engage much in branding and product differentiation —which is reflected in a GL-index of only 0.07 on average for the sector. France in contrast is a net importer of clothing, but exports mainly up-market branded products. Its GL-index in the sector is about 0.60. By the same token, the United States and France are net importers of motor vehicles, while

Romania and India are net exporters. Nevertheless, the United States and France host the headquarters of major car manufacturers designing and developing their branded models. This is reflected in the GL-index which is on average 0.62 for France, 0.59 for the United States, 0.38 for India and 0.37 for Romania.

As noted in Section 2, intra-industry trade involves the exchange of different varieties of the same product. But in the absence of information on trade in individual products, how should varieties of the *same* product be defined? We propose to use the six-digit Harmonised System level of aggregation, hereafter HS6. This is the most detailed level at which all countries classify goods in the same way. The GL-index strongly depends on the level of aggregation on which it is calculated as illustrated by Figure 3 which contrasts the GL-index at a HS 2-digit and HS 6-digit level. Interestingly, the difference between the two levels of aggregation is smallest for clothing which boasts one of the highest average rates of intra-industry trade at a 6-digit level.

Figure 3. Index of intra-industry trade by HS sector, 2008

2-digit and 6-digit GL-index, mean of 60 countries



Source of data: Comtrade. HS 30-38 are chemicals, 39 plastics 61-62 clothing, 84-85 machinery and 87-88 transport equipment.

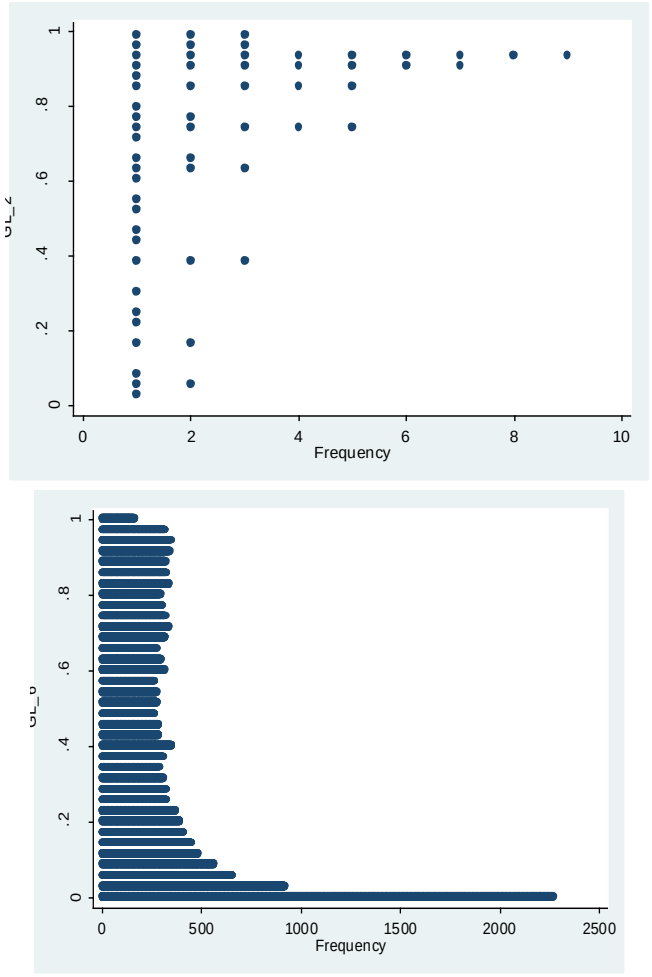
The average conceals large variation across countries. Figure 4 plots the observations for each country at the 2-digit and 6-digit HS level respectively for electrical machinery (HS 85), which is a sector characterised by a high degree of vertical as well as horizontal intra-industry trade. At the 2-digit level most observations are in the upper half of the chart, with relatively high degrees of intra-industry trade. At the 6-digit level in contrast the majority of observations represent one-way trade, while fully balanced trade is rare.[18] Thus, most countries both export and import electrical machinery, but few countries both export and import for instance **"**Reception apparatus for Television, Colour"

18. There are 293 HS 6-digit categories within HS 85, which represents *Electrical machinery & equip. & parts, telecommunications equip., sound recorders, television recorders.*

(HS 852812). The average GL-index (at a 2-digit level) increases with the level of income, but at a declining rate, and it varies more across income groups than across the sectors included in our analysis.[19] The average index value for high-income countries is between 0.4 and 0.5, between 0.3 and 0.4 for upper middle income countries, around 0.25 for lower middle income countries, and finally between 0.09 and 0.33 for low-income countries with the lowest score in the clothing sector.

Figure 4. Distribution of the intra-industry index at different levels of aggregation

HS 85 Electrical machinery, 2008



Source: Calculated from Comtrade trade data.

Six HS 2-digit manufacturing sectors were selected for the empirical analyses in this section and section five:

- Pharmaceutical products (HS 30)
- Plastics (HS 39)

19. A simple regression including GDP per capita and its square only, yielded a positive coefficient on the linear term and a negative coefficient on the square term, both significant at a 1% level.

- Articles of apparel and clothing accessories, knitted or crocheted (HS 61)
- Articles of apparel and clothing accessories, not knitted or crocheted (HS 62)
- Electronic machinery (HS 85)
- Motor vehicles (HS 87)

These represent sectors characterised by product differentiation both horizontally and vertically; and by global value chains. Furthermore, the selection represents both labour-intensive low-technology industries for which developing countries have comparative advantage (HS 61 and HS 62) and R&D-intensive high-technology industries (HS 30) for which high-income countries have comparative advantage.

Pharmaceuticals are a high-technology industry dominated by multinational enterprises with a global scope and to which R&D is a strategic input, but with a competitive fringe of generic suppliers, often located in developing countries, notably India. High-income countries tend to be net exporters in this sector. Low-income countries in turn tend to import pharmaceuticals, but enter the export markets in less technology-intensive products such as animal substances (HS 300190), antibiotics (HS 300320), bandages (HS 300590) and first aid kits (HS 300650).[20] Thus, for low-income countries an increase in the GL-index typically implies entering export markets starting with these types of products, while for high-income countries it means specializing in high-end patented products while importing generic versions of the same products. Plastics are also a highly differentiated sector, producing mainly material inputs to downstream manufacturers. The product range varies from commodities such as boxes and tableware to sophisticated materials for motor vehicles, aircraft, electronics and many more.

The textiles and clothing sector is the most business-services intensive low-technology industry and also a sector characterised by a high degree of product differentiation. Global value chains have been a feature of this sector for decades, and low-income countries typically have comparative advantage in the sector, which is reflected in substantial net exports. The sector nevertheless contains high-technology segments. For instance temperature sensitive textiles that keep the wearer dry, warm or cool are gaining prominence for sportswear, while conductive e-textiles with the ability to measure the wearer's heartbeat, or connect the wearer to communication networks have started to appear in the market. Army uniforms are early applications of e-textiles and an additional example of goods and services being bundled in new ways.

Production of computers and other electronic machinery is typically fragmented with R&D, design and production of high-technology components located in high and upper middle income countries such as the United States, Japan, Korea and Chinese Taipei, and assembly largely concentrated in the People's Republic of China. The sector also contains less sophisticated items such as batteries and household appliances. Finally, the motor vehicle industry has featured regional rather than global value chains for decades and the sector has been studied extensively in the literature. The supply chains have for instance been compared and contrasted to those of the clothing sector. One important difference is that the lead firms in textiles and clothing supply chains are retailers – and thus services sector firms, while the lead firms in the motor vehicle supply chains are the

[20]. These 6-digit HS lines were the only products under the pharmaceuticals category for which net exports is negatively correlated with GDP per capita.

manufacturers.[21] Also in this sector, there are opportunities for firms in low-income countries to enter global value chains for instance through processing trade.

The services quality and policy indices included in the empirical analysis are presented in Table 1, which lists the variables, the source of information, the sample mean, standard deviation, minimum and maximum values. They relate to the quality or performance of key services sectors such as transport, finance, telecommunications, electricity and education, which as noted in section 3 are recorded as intermediate inputs. It would be desirable to include business services in the analysis as well, but unfortunately quality indicators are not readily available for this sector. Since product differentiation depends on services inputs, we expect services quality to be positively associated with the GL-index and the mark-up over costs that firms obtain in the export markets. Our sample contains 60 countries (see list in Annex B).

Table 1. Explanatory variables

Summary statistics

Variable	Mean	Std. Dev.	Min	Max	Source
Interest rate spread	5.4	5.7	-1.4	45.1	WDI
Mobile telephone lines per 100 inhabitants	80.4	29.0	3.2	188.3	WDI
Fixed telephone lines per 100 inhabitants	34.3	18.0	2.6	71.8	WDI
Broadband lines per 100 inhabitants	9.9	8.6	0	36.5	WDI
1- Electricity loss, share of transmitted	0.90	0.05	0.73	0.98	WDI
Time for exports (days)	15.1	7.7	5	49	WDI
Time for imports (days)	16.8	10.0	4	71	WDI
Cost to export (USD per container)	895.5	321.4	362.5	2 590	WDI
Cost to import (USD per container)	992.1	363.1	317.0	2 868	WDI
Number of legal procedures, contract enforcement	33	5.6	21	46	WDI
Average years of schooling	9.5	2.1	4.4	12.9	Barro and Lee
Tariffs	6.36	8.35	0	125	Comtrade; WTO
FDI restrictiveness index, total all sectors	0.1	0.1	0	0.4	OECD
Total services	0.1	0.1	0	0.5	OECD
Financial services	0.1	0.1	0	0.6	OECD
Telecommunications	0.1	0.2	0	0.8	OECD
Transport	0.3	0.2	0.04	0.7	OECD
Product market regulation index					OECD
Telecommunications	1.6	0.8	0.2	4.3	OECD
Air transport	1.8	1.4	0	4.8	OECD

Note: The statistics represent average values for the period 2003-2008 for 60 countries or the countries covered by the index. WDI represents World Development Indicators from the World Bank. Tariffs are simple average applied MFN rate for the 6-digit HS category.

Using econometric techniques, we analysed the relationship between services quality and services policy on the one hand and the GL-index of intra-industry trade on the other. We perform the analysis for each 2-digit HS category separately, using observations at the HS6 level. Although a statistically significant result with the expected sign supports our hypothesis, it is worth bearing in mind up-front that a statistically significant result does not necessarily imply causality.

21. Lead firms tend to be located at the position in the supply chain where market concentration is the highest and strategic inputs are being provided.

To draw policy implications from our analysis, it is useful to have a sense of in which areas reforms would contribute the most to product differentiation. A useful tool for comparing the relative impact of each measure is the elasticity of the GL-index with respect to the measure. Box 1 explains the concept of elasticity.

Box 1. Elasticity

Elasticities provide a common yardstick for assessing the impact of each explanatory variable on the dependent variable. For instance, the elasticity of export prices with respect to telecoms density is defined as the percentage change in the export price associated with a 1% change in telecoms density. If a 1% increase in telecoms density is associated with a 1.7% increase in the export price, the elasticity is 1.7. Conversely, if a 1% increase in time for exports and imports is related to a 2% reduction in the export price, the elasticity is -2, and time for exports has a stronger marginal impact on export prices than telecoms density.

Trade is driven by product differentiation as well as comparative advantage. Comparative advantage in turn is determined by resource/asset endowments, technology and size and composition of domestic demand. The impact of improved services quality and services policy reforms on the GL-index may therefore depend on which driving force is the most important in the country and sector in question. To explore this possibility we investigate to what extent the elasticity of the services indicator in question vary with the level of development as measured by GDP per capita. Among the six sectors included in the analysis, net exports tend to rise with GDP per capita in pharmaceuticals and plastics, decline with GDP per capita in the two clothing sectors and net exports are unrelated to GDP per capita in the electronics and motor vehicle sectors, which encompass low-technology, labour-intensive segments as well as high-technology, skills-intensive segments.[22] A rise in the intra-industry index for pharmaceuticals in rich countries and clothing in poor countries therefore implies faster growth in imports than in exports. The dynamics behind this is that specialising in a narrower range of branded goods for the global market leaves space for imports in the market segments vacated by local firms. Furthermore OECD work on global value chains shows that competitiveness at one link in the value chain often rests on the ability to add value to imported parts and components, not least through high-quality services inputs that eventually become embodied in exports.[23] We supplement the GL regressions with analysis of the relationship between the services indicators and exports to shed light on whether comparative advantage or product differentiation is the main driving force.[24]

Some of the services quality measures are correlated with GDP per capita, which could make it difficult to distinguish the effects of higher income from those of better services. Furthermore, some of the policy and quality indicators are correlated with each other. For instance countries with high tariffs also tend to restrict foreign direct investment, and, as one would expect, policy variables are correlated with performance in the sector to which they apply (a correlation matrix is provided in Annex Table C.2). The

22. A pair-wise correlation between net exports and GDP per capita produced statistically significant coefficients at 1% level for clothing, pharmaceuticals and plastics, but statistically insignificant coefficients for electronics and motor vehicles.

23. See for instance www.oecd.org/sti/ind/tiva-policy-implications.pdf

24. In the interest of space these regressions are not reported. They are available from the authors upon request.

methodology for dealing with this problem and the regression results are presented in Annex C. Here we provide a non-technical summary.

Our first exercise is to include all services quality variables listed in Table 1 in one regression and explore which variables give the most precise estimates and have the strongest explanatory power (Annex Table C.3). This "race" among the services indicators is won by *time for exports and imports* and *reliable electricity supply* which are strongly associated with product differentiation in all sectors. Equally robust are *telephone and internet density* and the *number of legal procedures required to enforce a contract* in all sectors except pharmaceuticals.[25] Three of the "winners" are related to coordination and transaction costs which strongly support the hypothesis that such costs play an important role for product differentiation as discussed in Section 2.

Having established which services appear to be most robustly related to product differentiation when controlling for GDP, GDP per capita and a time trend, we explore in more detail the relationship between services performance, product differentiation and to what extent the role of services differs across sectors and income levels. Due to the correlation problem, we introduce the services indicators of interest one by one. The estimated elasticities then suggest which services and services policies are the most important for product differentiation in which sectors and at what income levels. One should, however, not add the parameters of the different services performance indicators to obtain a total or combined effect of reforms and quality improvements. One interesting observation up-front is that the GL-index appears to have declined over time in all sectors, suggesting that intra-industry trade at the HS6 level has become slightly less important over time.[26] A possible explanation for this is more vertical specialisation along global value chains, where different stages in the production of parts, components and tasks fall under different HS6 categories. Another general observation is that the estimated elasticities are highest in low-income countries in low-technology sectors, middle-income countries in medium technology sectors and in high-income countries in medium-high and high-technology sectors. This finding suggests that improved services quality is particularly important for moving up the value chain in sectors for which the country already has established industrial capacity and possibly comparative advantage. We now turn to a discussion of the main findings related to each services indicator.

We start with *transport costs* which entail the costs of bringing the goods from the manufacturer to the ship, but not the cost of international transport. Broadly, the higher are transport costs, the lower is the intra-industry trade index. In all sectors except clothing the elasticity of the GL-index with respect to transport costs is highest for lower middle income countries. As we shall see, this is a general pattern, suggesting that the quality of services is crucial for product differentiation in middle income countries. The elasticities of product differentiation with respect to transport costs are moderate, ranging from -0.05 to -0.40, which in the latter case means that a 10% reduction in transport costs is associated with a 4% increase in the GL-index. In the clothing sector, transport costs are positively associated with the GL-index at low income levels. Here, closer scrutiny reveals that transport costs slow down exports more than imports. Or put differently, reducing transport costs in low-income countries would allow them to better exploit their

25. Product differentiation in pharmaceuticals, and to some extent plastics, appears to be less sensitive to services performance than the other four sectors.

26. The time dummies take a statistically significant and negative sign in most regressions (see Annex Table C.4).

comparative advantage for basic clothing, but lower transport costs alone may not help them expanding in the fashion market segment. Nevertheless, FDI restrictions in the transport sector are always negatively associated with the GL-index, suggesting that the policy environment facing the sector has effects beyond transport costs, for instance affecting the timeliness and reliability of transport services.

Another variable closely related to transport cost is *time to export and import*. This variable has a negative effect on product differentiation in all sectors, with relatively high elasticities, particularly in lower middle and low-income countries. Product differentiation in the clothing sector is very sensitive to time at all income levels. Low-income countries typically export through mass market retailers selling their own brands. The retailers' branding strategies rely on so-called fast fashion where global sourcing of inputs to contractual manufacturers is common. The marginal impact on product differentiation of time to export and import is as high as -5 in low-income countries, sharply declining to -0.10 in high-income countries. The low elasticitiy in high-income countries may reflect that they tend to specialise in less time-sensitive up-market products such as men's suits and sportswear, they locate production close to the market and the time to export and import is already so short that further improvements only have a small effect. In the sectors where vertical intra-industry trade is more common, particularly electronics and plastics, processing trade combined with just-in-time production is a likely explanation for the relatively high elasticities of time for exports and imports, particularly for middle-income countries that are also typically found mid-stream in the value chain. Interestingly, burdensome product market regulation in air transport services as captured by the OECD PMR index is always negatively associated with the GL-index and follows a very similar pattern of elasticities across sectors and income levels as the time for exports and imports, albeit with lower elasticities.

Telecommunications density is positively related to product differentiation in all sectors and the marginal impact tends to increase with income level in all sectors except clothing. At an income level of USD 1 000 per capita a 1% increase in telecoms density is associated with an increase of about 2-2.5% in the GL-index for the clothing sectors. In both middle and high-income countries electronics is the sector where product differentiation is the most sensitive to telecoms density with an elasticity of about 0.9 in upper middle-income countries declining to about 0.7 for high-income countries. FDI restrictions in telecoms are negatively related to product the GL-index, particularly in the clothing sectors, but with much lower elasticitities than the telecoms density indicator. Lack of adequate pro-competitive regulation as captured by the product market regulation index for telecommunications have a similar effect, with elasticities higher than for the FDI restrictiveness and lower than for telecoms density.

The competitiveness of the *banking sector* is measured by the interest spread between deposits and loans. Form this measure it appears, surprisingly, that finance is not a binding constraint for product differentiation in any of the sectors included in the analysis. However, we notice that the elasticity of the GL-index with respect to *FDI restrictions in financial services* is much higher than the elasticity on interest rate spreads, suggesting that the policy environment surrounding the financial sector is important.

Electricity is an essential intermediate input in all manufacturing sectors. As discussed in Section 2, digitisation and electronic monitoring of production processes and supply chains are becoming more and more important and the functioning of electronic devises is highly sensitive to reliable electricity supply. Electricity pass through (i.e. one minus transmission and distribution losses) is used as an indicator of the quality of

electricity supply. The indicator performs surprisingly strongly in the regressions. In upper middle and high income countries reliable electricity supply has the highest elasticity of all services quality indicators in the electronics and motor vehicle industries, reaching as much as 7 for high-income countries in motor vehicles. This finding has important policy implications as electricity supply reliability has become an issue in both emerging and high-income countries where blackouts and brownouts not only cost the economy billions of dollars, but also provide a disincentive to invest in for instance the industrial internet as highlighted in Section 3.[27]

Level of education as measured by the average years of schooling is mainly a public service indicator likely to affect both comparative advantage and competitiveness in manufacturing. It is, however, one of the explanatory variables most strongly correlated with GDP per capita and it is therefore more difficult to distinguish clearly between the impact of schooling and level of income.[28] With this caveat in mind, it appears that education is one of the most important factors for product differentiation in the clothing sectors for low-income countries, where a 1% increase in the level of education is associated with more than 8% increase in the GL-index. Education is also important for product differentiation in pharmaceuticals and electronics in high-income countries.

Turning to policy measures, the focus of this study is on services policy, but one should not overlook the most obvious trade policy measure affecting intra-industry trade in goods – *tariffs*. Tariffs accumulate over sequential production stages in the event of vertical intra-industry trade and even moderate to low tariffs may have a significant impact on trade performance. Tariffs indeed have a negative effect on the GL-index. Interestingly, the marginal impact is largest for high-income countries in all sectors except clothing. The impact is by far the largest in the electronics sector where the elasticity is about -4 for high-income countries. For low-income countries, tariffs are a significant and formidable constraint on product differentiation only in the clothing sectors, where the elasticity is above -10 (in absolute terms).

As emphasised in section 2, trade in differentiated products are typically based on long-term contracts. A policy related measure that captures the ease of contract enforcement is *the number of procedures needed to enforce a contract*. The higher the number of procedures the more cumbersome and costly is contract enforcement. Recall that contract enforcement came out as one of the most robust determinants of product differentiation in the regressions including all services indicators reported in Annex Table C.3. For low-income countries the elasticity is highest in the clothing sectors, reaching about -7; in middle-income countries the elasticity is highest in plastics, electronics and motor vehicles, and for high-income countries it is highest in pharmaceuticals. These findings suggest that eliminating red-tape and strengthening contract enforcement bolster local firms' incentives to innovate and move up the value chain. In addition it could institute market confidence such that lead firms in international production networks more willingly source specialised differentiated inputs on a long-term contractual basis from local firms.

The other policy variables included in the analysis are the OECD FDI restrictiveness indices which cover 48 countries. Here we examine the impact of the overall index while

27. See for instance http://energy.gov/articles/america-s-competitiveness-depends-21st-century-grid

28. Omitting GDP per capita in the regressions always yields a strong positive relation between the GL-index and years of schooling in all sectors, with the highest elasticities in the clothing sectors.

sector-specific indices were discussed above (see Annex Table C.5 for details). The overall measure of restrictions on foreign direct investment has a negative impact on product differentiation in all sectors included in the analysis, and the marginal effect is highest in the two clothing sectors, where the elasticity is higher the lower the level of income. In the other sectors, however, the marginal impact of this restriction *increases* with the level of income, a feature that we also found for tariffs. We note that *FDI restrictions in services* spill over to manufacturing sector trade performance, and have a similar effect as overall FDI restrictions, although the marginal impact is somewhat smaller.

To summarise this section, the services indicators most strongly associated with product differentiation are time for exports and imports, reliable electricity supply, telecommunications infrastructure and the number of procedures related to contract enforcement. We recall that access to real time information is important for keeping abreast with market development in differentiated products. The strong performance of telecommunications intensity and reliable electricity supply in the regressions supports this anecdotal evidence. We also noted in section 2 that product differentiation is more often associated with contractual relations between manufacturers, suppliers and distributors. The strong performance of the indicator associated with the ease of enforcing contracts underscores this feature of product differentiation.

The sectors most sensitive to services quality and policy are clothing followed by electronics and motor vehicles. Interestingly, the impact of improvement in services performance seems to be strongest in countries that have a comparative advantage in the sector in question, and appears to be particularly important for middle-income countries. These are countries that have typically exhausted their comparative advantage in basic labour-intensive goods and tasks and seek to diversify and upgrade their manufacturing to branded goods or to move up the value chain in other ways. Good quality services inputs and open, competitive services markets are crucial for making that move.

Finally policy distortions in the form of tariffs, restrictions on FDI and regulatory burdens behind the border impede product differentiation the most in high-income countries, again with the exception of the clothing sector. To our knowledge this result has not been reported in the trade and investment literature before, but it is in line with recent theory developments which find that trade barriers and other distortions have a larger impact the deeper the division of labour in a country (Jones, 2011). The intuition behind this is that distortions affect transaction costs, and more sophisticated economies have more transactions.

A tentative conclusion is that services sector performance is crucial for moving up-market into differentiated products in sectors where countries already have industrial capacity, but better services alone are unlikely to trigger market entry in differentiated products in sectors for which the country in question does not have the basic skills, infrastructure or technology, at least not in the short run.

Services and prices obtained in export markets

We stated in section 2 that services may enhance the competitiveness of manufacturers through lower costs or better products, or both. Further, we found in section three that a larger services content of manufacturing is associated with higher unit prices of exports to the European Union, supporting the better products hypothesis. Given these findings, one would expect that better services and more open services markets are associated with higher mark-ups over marginal costs in export markets. Higher mark-ups

are often associated with higher prices relative to competitors, but there is also the possibility that cost reductions could be sufficient to allow for both more competitive prices and higher margins.

This section explores the relation between services quality and policy and export prices. We use information on export values and export volumes from the Comtrade database to calculate unit prices at HS6 level. The range of products within each HS6 category is limited, but still sufficient that there is a danger of comparing apples with oranges. To reduce this problem, the estimated unit prices for each HS6 category are normalised (Annex C) and regressed on the explanatory variables included in Table 1 above. By and large we find that the variables that had a negative effect on product differentiation also have a negative impact on export prices. The variation in impact across sectors and income levels are also similar (see Annex Tables C.6 and C.7 for details). In the following, we highlight the main findings.

Starting with *transport costs*, one would expect a positive relationship between export prices and transport costs since export values are measured free on board (f.o.b.) and the trade costs measures extracted from the World Bank Doing Business Indicators entail the costs of bringing the goods from the manufacturer to the ship.[29] If exporters were able to pass on the full cost of transport and related handling fees to the foreign customer, the elasticity of export price to transport costs would be unity. If the elasticity is smaller than unity, the transport costs are partly borne by the exporter. Hence, the smaller the elasticity, the higher the incidence of transport costs on the exporter. We indeed find that the elasticity of export prices to transport costs is positive in most cases, but less than unity, implying that lower transport costs would raise the factory gate price.

To shed more light on the driving forces behind the results, we explored to what extent transport costs have a bearing on the volume and diversity of exports (i.e. the extensive and intensive margin of trade). The incidence of transport costs fall mainly on exporters in the plastics sector where exporters recover only a fifth of increases in transport costs on average. Behind this average impact is a reduction in the number of HS6 categories, probably towards less transport-intensive goods, and lower export volumes, probably through the exit of the least cost effective firms. The dynamics is similar in the clothing and electronics sectors. But in clothing the incidence of transport costs on the exporter is smaller the higher the income level, while the opposite is true in the electronics sector.[30] In conclusion, lower transport costs raise the factory gate price for exporters, trigger entry of more products into export markets and increase export volumes in clothing, electronics and plastics, raise factory gate prices in pharmaceuticals, but appear to have little impact on export prices in the motor vehicles sector. The inconclusive results for the latter sector probably stems from the transport costs data being less relevant there, since motor vehicles are rarely transported in containers.

29. The transport cost measure includes costs for documents, administrative fees, customs clearance, technical control, customs broker fees, terminal handling fees and inland transport for a standard container filled with non-hazardous goods.

30. In the interest of space we do not report the regression results for the probability to export and the relationship between exports and transport costs. The parameters on the log of transport costs in the probit regressions were -0.34, -0.78, -0.85 and -0.29 respectively for HS2 categories 39, 61, 62 and 85 respectively, while the elasticity of exports with respect to transport costs were -1.20 (HS39), -2.05 (HS61), -1.59(HS62), -1.53(HS85) respectively, all statistically significant at a 1% level.

Export prices are not very sensitive to *time for exports and imports*, although there is a significant impact in the electronics sector. The dynamics are very similar to that for transport costs; with longer time lags reducing the probability to export substantially, particularly in clothing and to a lesser extent the electronics sectors, and likewise export volumes are reduced by between 1.5 and 2% if time for trade increases by 1% in the clothing and electronics sector. The somewhat surprising positive relationship between time for trade and export prices in low and middle income countries for plastics and electronics thus probably stems from a strong negative impact on export volumes, where the least competitive firms and HS6 categories exit the market.

Export prices are positively associated with *telecommunications density* in all sectors except motor vehicles, and the elasticity is higher the richer the country in pharmaceuticals, plastics and electronics, while the impact is larger in low-income countries in the clothing sectors. Telecoms is also positively associated with export volume, but with a lower probability to export. A likely interpretation is that telecommunications facilitate specialisation on fewer HS6 product lines that are differentiated and sold at higher prices in export markets.

Export prices are not very sensitive to *interest rate spread* in the banking sector, which captures how much competition there is in financial markets, to the benefit of corporate customers. With the possible exception of electronics in high-income countries the elasticities are small, although highly statistically significant.

More reliable *electricity supply* is associated with higher export prices in the plastics, electronics and motor vehicle industries, where it is also associated with both higher probability to export and higher export volumes. In clothing, however, higher volumes and a wider range of HS6 categories exported go together with lower prices, and the cost reduction effect appears to dominate.

The level of education, as captured in *years of schooling* is associated with higher export prices in all middle and high-income countries in all sectors except pharmaceuticals where we did not find a statistically significant effect. Higher export prices go together with higher export volumes and a broader range of HS6 categories exported in the electronics sector, a higher export volume in motor vehicles and lower export volume spread on a larger number of HS6 categories in clothing.

The number of *legal procedures* is associated with lower export prices in pharmaceuticals and plastics and higher export prices in clothing and electronics. In all sectors more cumbersome contract enforcement is associated with lower export volumes spread on a larger number of HS categories. When this is combined with lower prices a likely explanation is a shift towards products sold on spot markets rather than premium products subject to contractual relationships. When combined with higher export prices a possible explanation is that only the most productive firms engage in "shipping the good apples out."

Export prices are very sensitive to *tariffs*, with a strong negative effect on export prices in pharmaceuticals, electronics and motor vehicles. This probably reflects that vertical fragmentation within global value chains is important in these industries and tariffs accumulate over production stages, reducing the ability to compete in higher margin products. In clothing in contrast, export prices are positively associated with tariffs (in the exporting country). However, tariffs on imports negatively affect the export volume also in clothing, with a higher elasticity the higher the income level of the country in question.

Services and the dynamics of manufacturing trade

Firms enter and exit new markets at a rapid rate, and this section explores to what extent survival of trade flows is related to the quality and regulation of services. Ideally the analysis should be conducted at a firm level, but we do observe a surprisingly high rate of entry and exit also at the 6-digit HS level. Services are likely to affect the survival rate of exports since staying in a market requires the establishment of a distribution networks, after sales services and not least market monitoring. The time period analysed is from 1998 to 2010 for the 34 OECD countries and Brazil, China, India, Indonesia, the Russian Federation and South Africa.[31]

A methodological issue when analysing the determinants of the duration of trade is how to deal with the end points of the period analysed. The data set does not contain information about for how long the trade flows observed in the first year have lasted. By the same token we cannot know how long the trade flows observed in the last year will last. A common way of dealing with this censoring problem is to disregard the first and the last year for observations that are terminated the first year or commence the last year (see Annex C). Only one-spell trade flows will be considered. Thus, if a country pair HS 6-digit trade flow is discontinued and next re-established, these will be considered two single spells.

Two estimators are employed to investigate the dynamics of trade relationships: the Kaplan-Meier (K-M) estimator, which is a measure of the length of time that a trade relation lasts, and Cox regression, which simply put explains the risk that a trade flow is terminated. Table 2 presents the summary statistics: number of observations of each sectors, mean, standard deviation and min-max values. There are three sets of variables: country-specific characteristics such as GDP per capita, aggregate trade value, and services indicators; bilateral time-invariant gravity variables such as contiguity, language and distance, and finally time-variant bilateral trade values. The explanatory variables included in the analysis are as far as possible the same as in the previous section. However, the services policy indices are not available for the entire period of the survival analysis and could therefore not be included. The dependent variable, duration of trade, is one spell of the trade relationship from the start to the end.

31. Bilateral trade flows at 6-digit level for a 13-year period add up to a huge amount of observations and for practical computer capacity reasons the sample is limited to 40 countries in this section.

Table 2. Summary statistics

Variables	Definitions	Sector	Obs.	Mean	Std. Dev.	Min	Max
Duration	One spell from beginning to the end of the trade relationship (years)	HS 30	195 853	9.554	4.118	1	13
		HS 39	1 057 930	9.897	3.994	1	13
		HS 61	844 408	9.070	4.278	1	13
		HS 62	1 031 671	9.472	4.169	1	13
		HS 85	2 697 200	9.677	3.998	1	13
		HS 87	568 475	9.610	4.092	1	13
Ln trade vale	Log value of Trade value (USD)	HS 30	195 853	12.055	3.391	-1.781	23.609
		HS 39	1 057 930	11.331	3.085	-3.738	21.814
		HS 60	844 408	9.606	2.963	-2.469	21.976
		HS 61	1 031 671	9.805	2.938	-4.351	21.583
		HS 85	2 697 200	10.864	3.195	-4.377	24.153
		HS 87	568 475	11.823	3.351	-3.219	24.173
Ln GDP	Log value of GDP			26.710	1.488	22.445	30.298
Royalty 1	Royalty and license fees, payments (BoP, USD)			20.877	1.837	13.192	24.356
Royalty 2	Royalty and license fees, receipts (BoP, USD)			19.917	2.457	9.496	25.387
Electric	Electric power transmission and distribution (% loss, inverse)			92.111	4.324	75	98.85
interest_rate	Interest rate spread (lending rate minus deposit rate, %)			4.933	6.599	-6.910	58.400
Telephone	Telephone lines (per 100 people)			43.528	16.545	2.120	74.700

Source: UN Comtrade for trade of goods, CEPII gravity database for gravity variables and the World Development Indicator for service indicators.

The survival rate differs systematically across income groups as depicted in Table 3, which shows hazard rate, number of events and the 25th, 50th, and 75th percentiles of survival time. The upper part of the table shows the general summary statistics. The percentiles of survival time are derived from a Kaplan-Meier survival function. The function estimates about a 25% chance of failure within six years after market entry, and 50% within 12 years. This means that the probability that a trade relationship will continue at any point in time increases with the duration of the relationship up to that point in time. The lower part of the table breaks down the information by income groups. For instance, about 50% of low-income countries' trade survives for ten years while it takes 12 years for half the trade flows to be extinguished in high-income countries.

Table 3. Summary of the K-M survival time

Sectors	Categorical variables	Dummy	Total observations	Hazard rate	Number of events	Survival time (25%, 50%, 75%)		
HS30	General survival rate		1 871 231	10.5%	195 853	6	12	13
HS39			10 470 264	10.1%	1 057 930	7	13	13
HS61			7 658 442	11.0%	844 408	5	11	13
HS62			9 771 555	10.6%	1 031 671	6	12	13
HS85			26100357	10.3%	2 697 200	7	12	13
HS87			5463227	10.4%	568 475	6	12	13
HS 30	Income group (1-4)	1	44 340	11.6%	5 122	4	10	13
		2	124 219	11.0%	13 628	5	11	13
		3	401 709	10.4%	41 821	6	11	13
		4	1 300 963	10.4%	135 282	6	12	13
HS 39		1	299 598	10.1%	30 319	7	13	13
		2	838 451	10.3%	86 495	7	11	13
		3	2 199 675	10.4%	228 468	6	12	13
		4	7 132 540	10.0%	712 648	7	13	13
HS 61		1	42 030	14.9%	6 247	3	6	11
		2	309 502	13.5%	41 934	3	7	11
		3	1 258 067	12.3%	154 185	4	8	13
		4	6 048 843	10.6%	642 042	6	12	13
HS 62		1	61 911	14.2%	8 766	3	7	11
		2	419 909	12.8%	53 680	4	8	12
		3	1 624 930	11.8%	191 362	5	9	13
		4	7 664 805	10.1%	777 863	6	13	13
HS 85		1	717 727	10.4%	74 417	6	12	13
		2	1 954 252	10.6%	207 939	6	11	13
		3	5 468 242	10.7%	583 931	6	11	13
		4	17 960 136	10.2%	1 830 913	7	13	13
HS 87		1	82 352	11.9%	9 760	4	9	13
		2	309 743	11.3%	35 143	5	10	13
		3	1 103 958	10.8%	118 822	6	11	13
		4	3 967 174	10.2%	404 750	7	13	13

Note: See Annex Table B.2 for the definition of income groups.

The two clothing sectors (HS 61 and HS 62) have a relatively high hazard rate. This may be because the trade policy regime for this sector changed drastically following the abolishment of quotas in the early 2000s. Compared to other studies, the survival rate at 50% and 75% is relatively high. This is probably because we controlled for censoring bias and considered one-spell trade relationships only. In addition while our sample contains bilateral trade among 34 OECD countries plus the BRIICS most other studies analyse imports to one country from all other countries. Our sample may have more stable trade relationships. Differences across income groups and sectors are illustrated by Figures 4 and 5, which depict Kaplan-Meier estimators of the survival functions.

Figure 5. K-M survival estimates for HS62 by income group

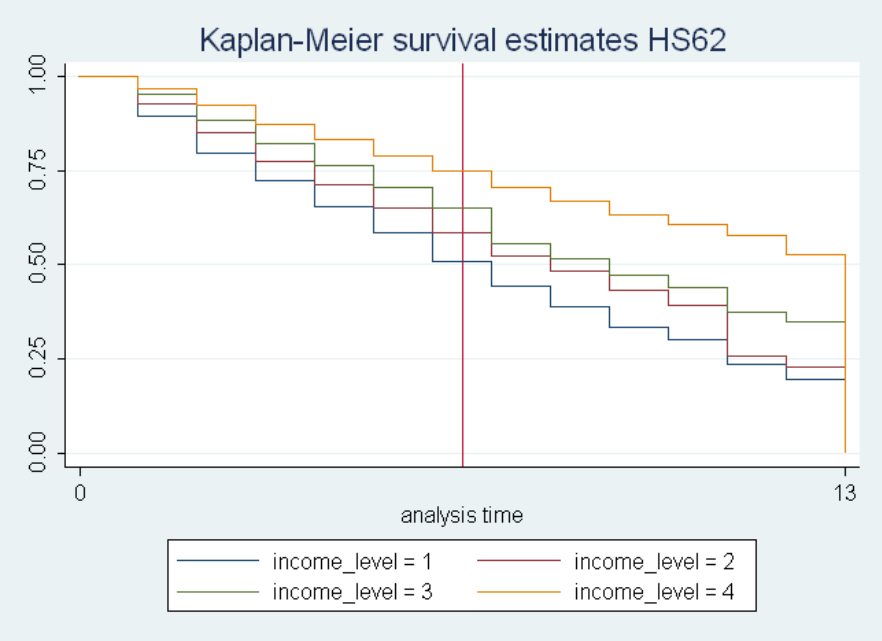
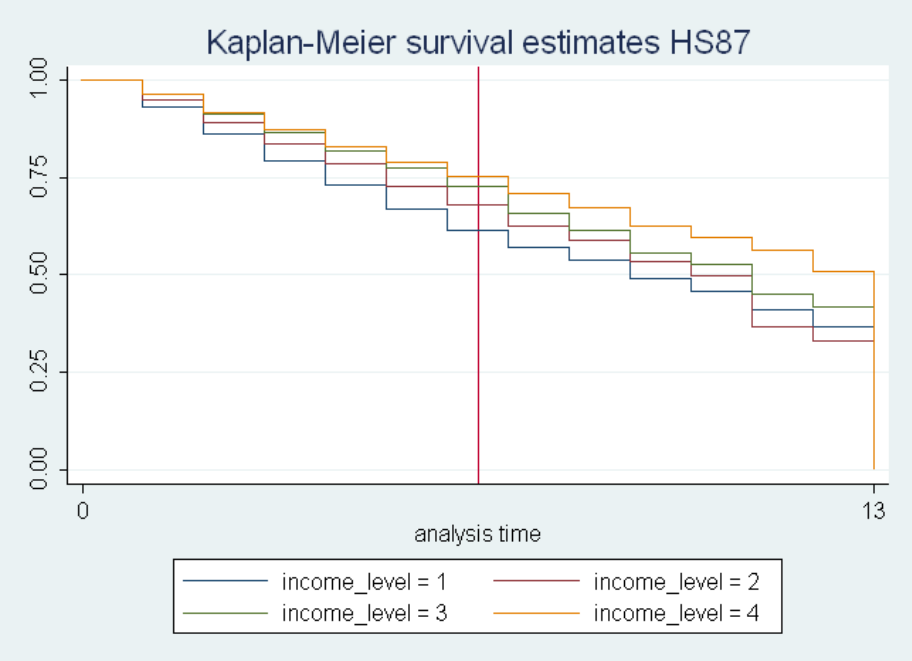


Figure 6. K-M survival estimates for HS87 with income level



Interestingly, apparel (HS 62) which is a highly differentiated consumer good, has a larger spread across income groups than any other sector. Even though the general hazard rate of HS 62 is high (10.6%), the trade of high income countries (income level 4) has similar survival rate as other sectors. But the trade relationships of low income countries in this sector have a much higher failure rate than the other sectors. For instance, 25% of HS 62 trade fails after three years, while in the motor vehicle sector it takes four years for 25% to fail. The sector with the highest survival time for low income countries is plastics (HS 39).

The contribution of this study to the literature is to relate the duration of trade in goods to performance indices of services sectors that are assumed to reduce entry barriers, trade costs and enhance competitiveness in manufacturing. To find the specific contribution of each of these indicators we ran the Cox proportional hazard estimates for bilateral trade relationships at the product level, controlling for the usual gravity variables (country pair log difference of GDP, distance [in log], common border, common language and total trade value [in log]). The results are presented in Table 4.

Table 4. The Cox hazards estimates for bilateral trade relationship

		HS30	HS39	HS61	HS62	HS85	HS87
y=Duration	**Hypothesis**	**Haz. Ratio p>|z|**	**Haz. Ratio p>|z|**	**Haz. Ratio p>|z|**	**Haz. Ratio p>|z|**	**Haz. Ratio p>|z|**	**Haz. Ratio p>|z|**
Royalty 1	(-)	1.062***	1.071***	1.073***	1.065***	1.075***	1.098***
(payment)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Royalty 2	(+)	0.999	0.979***	0.986***	0.981***	0.979***	0.972***
(recipient)		(0.920)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Electric	(+)	0.995***	0.994***	0.989***	0.991***	0.998***	0.996***
(electricity)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interest rate	(+)	0.999***	0.995***	0.999***	0.998***	0.995***	0.998***
(Banking)		(0.000)	(0.000)	(0.007)	(0.000)	(0.000)	(0.000)
Telephone	(+)	0.993***	0.995***	0.992***	0.992***	0.995***	0.993***
(Telecom)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln trade value	(+)	0.857***	0.852***	0.830***	0.825***	0.862***	0.876***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contiguous	(+)	0.961***	1.009**	0.967***	0.985***	0.967***	0.906***
		(0.000)	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)
Common language	(+)	0.978***	0.994	0.884***	0.872***	0.973***	0.967***
		(0.007)	(0.102)	(0.000)	(0.000)	(0.000)	(0.000)
Ln distance	(-)	1.009***	1.011***	1.031***	1.034***	1.002***	0.976***
		(0.001)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
Market size	(+)	0.999***	0.999***	0.999***	0.999***	1.000***	0.999***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N		106 452	572 741	447 813	555 132	555 132	310 815

Interpretation: The hazard rate for each observation equals the baseline hazard when the value of all covariates is set to zero. Hazard ratio is greater than one if the corresponding covariate negatively (-) affects the duration of trade relationships, and vice versa. A ratio equal to one implies no impact on the duration of trade relationships.

The duration of trade relationships is indeed strongly and significantly associated with the standard gravity variables. Large transaction values increase the probability of survival and the country pair-specific features that increase bilateral trade in gravity models are also beneficial for the duration of trade. Furthermore, distance is negatively associated with the duration of trade, suggesting that transport and other transaction costs that are associated with distance restrain both the volume of trade and the duration of bilateral trade flows. The two clothing sectors' hazard rates are the most sensitive to the standard gravity variables.

Table 5. Summary results

Performance of services and competitiveness of manufacturing

Services variable	Product differentiation	Export prices	Duration of trade
Interest spread	Negligible impact	Higher interest rate spread is associated with lower export prices in the electronics sector for upper middle and high-income countries.	Positive
Telephone density	Relatively large to moderate positive elasticities. Most important for low-income countries in clothing and for middle and high-income countries in electronics.	Positive, highest elasticity in pharmaceuticals in high-income countries.	Positive
Time for exports and imports	Relatively large and negative elasticities. Most important for low and lower middle income countries.	Varies with sector and income group without any clear patterns.	n.a.
Transport costs	Moderate to low elasticitities. Mostly negative and most important for middle and high income countries.	The incidence of transport costs tends to fall on the exporter.	Distance has a negative effect
Years of schooling	Large and positive elasticity in low and lower middle income countries in clothing. Important for high-income countries in electronics and pharmaceuticals.	Large and positive elasticities in middle and high income countries, particularly in electronics and motor vehicles.	n.a.
Electricity distribution reliability	Large positive elasticitities. Highest in sectors of assumed comparative advantage	Large positive elasticities in electronics and motor vehicles, negative elasticities in clothing.	Positive
Number of contract enforcement procedures	Strong negative effect. Most important for low-income countries in the clothing sector and for middle and high-income countries in the electronics sector	Relatively large and positive elasticities in clothing and electronics, no impact in motor vehicle industry.	n.a.
FDI restrictions	Negative, moderately large elasticities Elasticity largest for low-income countries in clothing, in other sectors the marginal impact is larger the richer the country. FDI restrictions in the transport sector, however has a larger elasticity in low-income countries.	Mainly negative, small to moderate elasticities. Most important in low-income countries.	n.a.
Product market regulation (PMR), telecoms and air transport	Moderate to high negative elasticities, with the largest marginal effects in low-income countries.	Moderate to high negative elasticities. In telecoms the elasticities do not vary much with income, and is highest in the motor vehicle industry.	n.a.
Tariffs	Large and mainly negative elasticities. The elasticity rises with income level except in the clothing industry.	Large mainly negative elasticities that rises with income.	

Royalty payments and receipts are included to explore to what extent licensing of technology affects the duration of trade. Unfortunately data is available only at a country level, so we do not know in which sectors they accrue or are paid. The data therefore indicates to what extent the country in question is an exporter or importer of proprietary – or both. Interestingly, licensing technology from abroad (payment) reduces the duration of trade significantly in all sectors, while exporters of technology tend to have longer trade spells. Royalty payments have the highest impact on duration of trade in the motor vehicle sector. Unsurprisingly, telecommunications density is positively related to the duration of trade in all sectors, as it is likely to reduce search costs as well as transaction costs. The impact is similar across sectors. The interest rate spread has a significant positive impact on the duration of bilateral trade.

This section has shown the dynamics of international trade at the product level. A short spell of exports may occur because of chance or failure to reach a critical export volume in a new market. However, services may affect the hazard rate through lowering entry barriers, which could raise the hazard rate; and reducing search costs, which would lower the hazard rate. Table 5 summarises the results of the econometric analysis in this and the previous section.

Policy implications

This study has explored the linkages between goods and services in international trade along several dimensions. We have focussed on manufacturing sectors which are characterised by product differentiation and horizontal or vertical intra-industry trade. The main findings are that i) high-technology industries are more business services intensive than other sectors, and variation in business services content across countries is highly correlated with variation in export prices obtained in major markets; ii) countries in which manufacturers have access to high quality transport, telecommunications, electricity and financial services tend to do better in terms of product differentiation and export prices and their exports tend to be more resilient over time; iii) the marginal effect of the services indicators vary substantially across sectors and level of development; iv) policy distortions in services markets spill over to manufacturing export markets and have a larger negative marginal impact on manufacturing export performance the higher the level of development; v) better services *alone* does not have a discernible impact on product differentiation in sectors where a country is far from the technical frontier or does not have a comparative advantage. But better services are important for moving up the value chain in sectors for which countries already have an advantage.

Our empirical analysis allows us to go beyond a one size fits all policy recommendation and make some tentative suggestions on which reforms would be most important in which countries. Starting with low-income countries and assuming that their industrial capacity rests in low-technology industries, the most important policy measures would be to reduce tariffs, improve the level of education, improve contract enforcement and reduce time for exports and imports. These reforms could help them moving into branded clothing. In addition improving the reliability of electricity supply would help entering into global value chains in the electronics sector. Finally, opening up the services sectors, particularly finance, to foreign direct investment would help obtain higher export prices in the sectors of comparative advantage. Tariff reductions, FDI liberalisation, better contract enforcement and reduced time for exports and imports are the low-hanging fruits for low and lower-middle income countries. Such reforms do not require

investments or taxing government capacity and scarce resources very much, and would make a relatively large impact as a first step up the value chain.

Tariffs have among the largest marginal impacts on both product differentiation and export prices in middle and high-income countries. Most OECD countries have relatively low tariffs on manufactured products but nevertheless we find that tariffs penalise exporters particularly hard in high-income countries. This is mainly because rich countries tend to be part of complex value chains, but our finding could also reflect that tariffs are sometimes accompanied with administrative burdens that may be more costly than the tariff itself. Therefore, removing tariffs altogether would contribute to product differentiation and higher export prices for rich countries' exports.

Even if telecoms density does not produce the highest marginal effects in any sector or at any income level, it is the measure that is most unambiguously associated with moving up the value chain of the services indicators included in this study. More telephone lines and internet connections are associated with more extensive product differentiation, higher export prices, more resilient exports and also higher export volumes concentrated on fewer HS6 product lines. Furthermore, product market regulation in telecoms, which reflect the extent to which competitive markets prevail, has a relatively strong impact on export prices. Telecoms are a sector subject to rapid technological changes and changing market structure. Best practice telecoms regulation evolves with changing market conditions and our findings suggest regulation that stays abreast with market developments is of utmost importance not least for high-income countries.

The strong impact of reliable electricity on competitiveness in manufacturing is somewhat surprising. However, in the light of recent analysis of the role of reliable electricity in the emerging industrial internet where sensors monitor and control manufacturing processes and supply chain management systems, the results are plausible. Investing in electricity distribution, for instance smart grids, would be a substantial contribution to manufacturing competitiveness, not least in high-income countries. Even if electricity supply is already more reliable in rich countries, manufacturing may incur higher costs following blackouts or brownouts when they happen.[32] Another somewhat surprising result is the small effect of the measures included related to financial services. These are the policy implications drawn directly from our empirical analysis. We now turn to policy implications that can be drawn from the literature reviewed in this study.

Both goods and services are delivered cross-border, through commercial presence and movement of natural persons. Furthermore, new ways of bundling goods and services and new technology sometimes make it difficult to distinguish between goods and services, particularly when products can be delivered both electronically and as a physical good or when a physical product mainly serves as a platform for delivering services. An example of the latter is manufacturers of durable goods who see themselves as system providers adding life-cycle services to the package offered to the customer. A more cohesive international trade regime for goods and services when it comes to commercial presence and movement of people would better cater to the business realities that emerge with the second unbundling.

We have seen that discouraging the establishment of services activities through restrictions on services FDI as well as burdensome behind the border regulation of

32. See for instance http://energy.gov/articles/america-s-competitiveness-depends-21st-century-grid.

services industries negatively affects competitiveness in manufacturing. It is therefore useful to assess the impact of services trade policy and regulation not only on the sector directly targeted, but also on manufacturing. Where possible regulatory spillovers along the value chain, both the activities located at home and abroad, should be taken into account to get a sense of the direct impact as well as possible unintended indirect effects of regulation and trade restrictions.

Behind the border regulation such as technical standards, trade-related intellectual property rights and other non-tariff measures facing goods and services exporters are conceptually similar. Furthermore, international agreements tend to focus on disciplines rather than the specifics of regulation. It thus appears that there are possibilities for harmonising rules such that companies face a similar policy environment whether they trade goods, services or both.

Continuous market monitoring has become an increasingly important strategic function for suppliers of consumer goods and services. The information that comes out of this activity is used for creating consumer profiles for personalised, targeted marketing and for use in product design. Monitoring activities can be costly and producers may wish to segment markets in order to extract as much consumer surplus as they can from each market to recoupe their monitoring costs. There are several ways of segmenting markets. Routing consumers to a specific national market on a company's e-commerce website is a common example. Bundling goods and services and selling the good at a discount conditioned on a long-term contract for the services part is also common in some markets. Finally loyalty programs may contribute to market segmentation. Moving away from one-off market based transactions may raise the switching costs for consumers and thereby raise barriers to entry for new goods and services suppliers. For these reasons there may be a need for a closer assessment of competition policy implication of new ways of bundling goods and services, some of which could take international dimensions.

Market monitoring takes place electronically and an enormous amount of information is collected and processed. Specialised computer services firms offer such data mining services which can easily be traded across borders. Restrictions on transfer and storage of consumer information may impede trade in computer services as well as cross-border personalised marketing and feed-back loops of market monitoring and design, an important feature of what some observers coin the new industrial revolution. There is therefore a need for striking a balance between legitimate concerns about privacy and the proprietary information on the one hand and open markets on the other.

To conclude, new technology is about to change the way production is being organised. Machine tools are becoming less scale intensive and a host of activities are being performed over the internet, unbundling and re-bundling tasks in new ways. One feature of this process is the prominent role of services both as direct inputs into manufacturing and as part of a goods and services bundle provided on a contractual basis. Access to sophisticated services, particularly in network industries such as telecoms and electricity, could be a source of comparative advantage and a competitive edge in markets and technologies with a potential to revitalise the economy.

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Annex A.

The list below presents classification of sectors according to technology categories (NACE 1.1 3-digit level sector code in parenthesis) according to OECD and Eurostat classification.

High-technology

- Aerospace (35.3);
- Pharmaceuticals (24.4);
- Computers, office machinery (30);
- Electronics-communications (32);
- Scientific instruments (33)

Medium-high-technology

- Electrical machinery (31);
- Motor vehicles (34);
- Chemicals, excluding pharmaceuticals (24, excluding 24.4);
- Other transport equipment (35.2, 35.4 and 35.5);
- Non-electrical machinery (29)

Medium-low-technology

- Coke, refined petroleum products and nuclear fuel (23);
- Rubber and plastic products (25);
- Non metallic mineral products (26);
- Shipbuilding (35.1);
- Basic metals (27);
- fabricated metal products (28)

Low-technology

- Other manufacturing and recycling (36 and 37);
- Wood, pulp, paper products, printing and publishing (20, 21 and 22);
- Food, beverages and tobacco (15 and 16);
- Textile and clothing (17, 18 and 19).

Annex B.

Table B.1. Countries included in the econometric analysis

Argentina	Costa Rica	Hungary	Lithuania	Philippines	Spain
Australia	Czech Republic	Iceland	Luxembourg	Poland	Sweden
Austria	Denmark	India	Malaysia	Portugal	Switzerland
Belgium	Egypt	Indonesia	Mexico	Romania	Thailand
Brazil	Estonia	Ireland	Morocco	Russia	Turkey
Bulgaria	Finland	Israel[1]	Netherlands	Saudi Arabia	Ukraine
Canada	France	Italy	New Zealand	Singapore	United Kingdom
Chile	Germany	Japan	Norway	Slovakia	United States
China	Greece	Korea	Pakistan	Slovenia	Venezuela
Chinese Taipei	Hong Kong	Latvia	Peru	South Africa	Viet Nam

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

Table B.2 reports the classification of countries into income groups outlined in the World Bank Atlas method.

Table B.2. Income groups

Income group	GDP per capita (USD) upper limit
Low	1 025
Lower Middle	4 035
Upper Middle	12 475
High	

Annex C.

Technical Notes and Regression Results

Table C.1 reports the results of a regression where the left hand side variable is the log of export prices obtained in EU and Germany respectively. The explanatory variables are business services share of gross output and export share of gross output. The shares are calculated from the OECD input-output database and the export prices are calculated from Comtrade information on f.o.b. export values and volumes of trade. Within the same sector there are typically several units (kg, items, litres etc.). We used the category that accounted for the largest export value or a value-weighted average in cases where units were comparable and values were similar (e.g. kg and litres). We note that export intensity is not statistically significant, and that business services share of gross output is highly significant in all regressions, the coefficient somewhat smaller in the robust regressions, and that the effect is smaller in Germany than in the European Union on average.

Table C.1. Prices obtained in export markets, manufacturing

Average prices in EU and Germany

	OLS		Robust regressions	
	Price in EU	**Price in Germany**	**Price in EU**	**Price in Germany**
Business services % output	7.406***	3.642***	5.973***	3.332***
	(1.228)	(0.775)	(1.112)	(0.622)
Exports % output	0.103	0.000	-0.032	0.008
	(0.148)	(0.001)	(0.134)	(0.006)
N	496	1 206	496	1 206
R square	0.917	0.9023		

Note: All regressions are run using sector fixed effects. The OLS regressions use the no constant option and all sector dummies, the robust regressions omit one sector. T-statistics are reported in parentheses; *** indicates statistical significance at 1% level.

Services and product differentiation

The most commonly used measure of intra-industry trade is the Grubel-Lloyd index which is calculated as follows:

$$GL_{ist} = 1 - \frac{|x_{ist} - m_{ist}|}{x_{ist} + m_{ist}}$$

where m_{ist} and x_{ist} represent imports and exports to country *i* of good *s* at time *t* respectively. In the case of one-way trade in good *s* the GL-index is zero, while if trade in good *s* is balanced the GL-index is unity. The GL-index is calculated at a Harmonized

System (HS) 6-digit level. The relation between intra-industry trade in manufacturing and the quality of key services is explored using the following regression equation:

$$GL_{ist} = \alpha_o + \alpha_1 lngdp_{it} + \alpha_2 lngdpcap_{it} + \alpha_3 S_{it} + \alpha_4 lngdpcap_{it} * S_{it} + \varepsilon_{ist}$$

The left-hand side variable is an indicator that can take values between 0 and 1 and the appropriate regression to make sure that predicted values also fall within this range is the generalised linear model (glm) using the probit link and binomial distribution. The control variables are the log of GDP and the log of GDP per capita, and the explanatory variable of interest is the services indicator and the interaction term between services and GDP per capita. The regressions are run using robust standard errors.

Intra-industry trade involves both exports and imports, so the variable included in the regression is the log of the sum of exports and imports costs. Interest spread is given in percentage points and is not logged. The data covers the period 1998-2011. The GL-index is somewhat volatile over short intervals. We therefore use the average values of all variables over three periods (1998-2003, 2003-08 and 2008-11). Dummy variables (denoted p2 and p3) indicate period fixed effects. The regression results for all sectors for transport and legal rights are presented below.

Table C.2. Correlation matrix, explanatory variables

	GDP per cap	Transp. cost	Time	Contract enf.	Tele-dens	Interest spread	Electricity loss (inv)	Years schooling	Tariffs
Transp. Cost	0.09	1							
Time	-0.71	0.07	1						
Contract enf.	-0.47	-0.07	0.40	1					
Tele-dens	0.78	0.00	-0.74	-0.48	1				
Interest spr.	-0.29	0.06	0.25	0.51	-0.37	1			
El. Loss (inv)	0.40	-0.18	-0.28	-0.55	0.58	-0.58	1		
School	0.48	0.00	-0.58	-0.55	0.77	-0.45	0.49	1	
Tariffs	-0.38	0.08	0.30	0.27	-0.50	0.38	-0.38	-0.40	1
FDI ri (total)	-0.22	-0.17	0.08	0.18	-0.48	-0.06	-0.09	-0.33	0.32
FDI ri services	-0.32	-0.17	0.19	0.26	-0.56	-0.02	-0.20	-0.41	0.34
FDI ri transp.	-0.10	-0.21	-0.12	0.22	-0.25	-0.10	-0.04	-0.08	0.20
FDI ri finance	-0.13	-0.03	0.05	0.15	-0.42	-0.05	-0.12	-0.29	0.32
FDI ri Tele	-0.09	-0.08	-0.15	0.05	-0.16	-0.14	0.18	0.04	0.25
PMR tele	-0.18	0.06	0.38	-0.02	-0.40	-0.06	-0.06	-0.27	0.20
PMR air	-0.62	0.00	0.63	0.21	-0.65	0.09	-0.43	-0.38	0.36

	FDI ri (total)	FDI ri services	FDI ri transp.	FDI ri finance	FDI ri tele	PMR tele	PMRair
FDI ri services	0.94	1					
FDI ri transp.	0.74	0.66	1				
FDI ri finance	0.90	0.91	0.60	1			
FDI ri Tele	0.82	0.69	0.79	0.74	1		
PMR tele	0.41	0.42	0.13	0.52	0.24	1	
PMR air	0.34	0.36	0.16	0.29	0.15	0.277	1

Note: FDI ri refers to the OECD FDI restrictiveness index El. refers to the electricity sector, Fin financial services, Man manufacturing.

Table C.3. Regression results (glm), GL-index, all services indicators

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.082***	0.163***	-0.111***	-0.111***	0.248***	0.109***
	(0.027)	(0.017)	(0.011)	(0.010)	(0.010)	(0.020)
Ln GDP per capita	0.095*	-0.153***	-0.567***	-0.481***	-0.408***	-0.292***
	(0.058)	(0.032)	(0.036)	(0.033)	(0.024)	(0.046)
Ln tariffs	1.207	2.841***	-2.350***	-3.161***	-2.124***	-0.375
	(0.933)	(0.495)	(0.363)	(0.323)	(0.355)	(0.369)
Ln tele	0.177	0.722***	1.268***	0.925***	0.780***	0.315***
	(0.117)	(0.081)	(0.090)	(0.085)	(0.050)	(0.091)
Ln time	-0.493***	-0.464***	-0.973***	-0.652***	-0.646***	-0.537***
	(0.086)	(0.044)	(0.047)	(0.041)	(0.026)	(0.058)
Ln transp, cost	0.164	-0.150***	0.724***	0.433***	0.079**	0.282***
	(0.123)	(0.047)	(0.056)	(0.046)	(0.032)	(0.062)
Ln legal procedures.	-0.377	-1.130***	-0.686***	-0.884***	-1.548***	-1.710***
	(0.231)	(0.119)	(0.101)	(0.085)	(0.079)	(0.157)
Ln years school	-0.550**	-0.191	0.288**	0.484***	-0.182**	-0.292*
	(0.226)	(0.121)	(0.125)	(0.126)	(0.077)	(0.157)
Interest spread	-0.632	1.251***	4.164***	3.861***	0.072	0.443
	(0.582)	(0.296)	(0.306)	(0.328)	(0.209)	(0.399)
El loss (inv)	1.700**	1.375***	0.660*	2.287***	3.074***	2.319***
	(0.773)	(0.467)	(0.369)	(0.372)	(0.281)	(0.523)
p2	0.222***	0.275***	0.602***	0.397***	0.311***	0.167***
	(0.057)	(0.027)	(0.037)	(0.032)	(0.021)	(0.039)
N	2 092	9 456	8 121	9 101	19 519	5 701

T-statistics are reported in parentheses; ***, ** and * indicate statistical significance at 1, 5 and 10% levels respectively.

We note that because of correlation between the explanatory variables and GDP per capita, GDP per capita is either not significant or takes a negative sign in these regressions. When included on its own, however, GDP per capita is always significantly and positively associated with the GL-index. The indicators most robustly associated with product differentiation are time for exports and imports, electricity loss (the inverse presentation implies that a positive sign should be expected). The pharmaceutical sector does not fit the regressions as well as the other sectors. Outside this sector, telecommunications density and the number of legal procedures to enforce a contract come through as the most robust. This does not necessarily mean that these measures are the most important, only that their relation to the GL-index can be measured more precisely in the presence of other variables to which they are correlated. In the following we include the explanatory variables, one by one, in the regression and interact them with GDP per capita to explore to explore at what levels of income the service in question is of particular importance – and lack of it a constraint on product differentiation. For this purpose the elasticity of the GL-index with respect to the services indicator at different income levels are presented.

Table C.4. GL regression results services quality

Panel A. Transport costs

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.150***	0.178***	-0.116***	-0.102***	0.190***	0.119***
	(0.024)	(0.013)	(0.010)	(0.009)	(0.008)	(0.016)
Ln gdp per capita	0.292***	0.221***	5.122***	3.489***	1.307***	0.208***
	(0.028)	(0.012)	(0.250)	(0.236)	(0.152)	(0.016)
Ln transport costs	-0.212***	-0.471***	6.061***	3.806***	0.844***	-0.195***
	(0.082)	(0.038)	(0.330)	(0.315)	(0.202)	(0.047)
Transp.c.*income			-0.645***	-0.426***	-0.137***	
			(0.033)	(0.032)	(0.020)	
p3	-0.096***	-0.054***	0.001	0.028*	-0.039***	-0.027
	(0.034)	(0.013)	(0.014)	(0.015)	(0.012)	(0.021)
N	3 141	14 047	12 530	13 406	30 594	8 542
Elasticity at income level						
USD 1 000 per cap	-0.12***	-0.28***	3.4***	2.00***	-0.09**	-0.09***
USD 4 000 per cap	-0.19***	-0.40***	0.74***	0.35***	-0.25***	-0.012***
USD 12 000 per cap	-0.16***	-0.29***	0.12***	-0.05***	-0.27***	-0.09***
USD 30 000 per cap	-0.13***	-0.23***	-0.20***	-0.22***	-0.27***	-0.08***

Panel B. Time for exports and imports

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.149***	0.183***	-0.085***	-0.075***	0.185***	0.120***
	(0.024)	(0.013)	(0.010)	(0.008)	(0.008)	(0.016)
Ln gdp per capita	0.123***	-0.602***	-2.290***	-2.175***	0.045***	0.048**
	(0.024)	(0.092)	(0.103)	(0.100)	(0.011)	(0.021)
Ln time	-0.498***	-2.363***	-7.579***	-7.244***	-0.700***	-0.479***
	(0.057)	(0.268)	(0.311)	(0.298)	(0.019)	(0.044)
Time.*income		0.185***	0.710***	0.683***		
		(0.027)	(0.031)	(0.030)		
p3	-0.127***	-0.125***	-0.115***	-0.088***	-0.097***	-0.053**
	(0.031)	(0.013)	(0.015)	(0.015)	(0.012)	(0.023)
N	3 141	14 047	12 530	13 406	30 594	8 542
Elasticity at income level						
USD 1 000 per cap	-0.30***	-0.75***	-4.70***	-5.00***	-0.50***	-0.34***
USD 4 000 per cap	-0.52***	-0.76***	-1.30***	-1.31***	-0.67***	-0.44***
USD 12 000 per cap	-0.37***	-0.41***	-0.50***	-0.53***	-0.48***	-0.31***
USD 30 000 per cap	-0.32***	-0.25***	-0.12***	-0.10***	-0.36***	-0.28***

Panel C. Telecoms

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.173***	0.201***	-0.081***	-0.050***	0.233***	0.154***
	(0.022)	(0.012)	(0.009)	(0.008)	(0.007)	(0.015)
Ln gdp per capita	-0.876***	-0.801***	0.585***	0.359***	-1.731***	-0.804***
	(0.200)	(0.083)	(0.089)	(0.123)	(0.054)	(0.121)
Ln tele	-1.339***	-0.873***	1.778***	1.546***	-1.674***	-0.891***
	(0.218)	(0.088)	(0.133)	(0.177)	(0.059)	(0.134)
Tele*income	0.201***	0.162***	-0.122***	-0.082***	0.317***	0.160***
	(0.035)	(0.014)	(0.016)	(0.022)	(0.009)	(0.021)
P2	-0.351***	-0.397***	-0.411***	-0.423***	-0.654***	-0.355***
	(0.075)	(0.027)	(0.024)	(0.022)	(0.019)	(0.038)
p3	-0.561***	-0.620***	-0.594***	-0.616***	-0.996***	-0.516***
	(0.108)	(0.038)	(0.031)	(0.034)	(0.028)	(0.059)
N	4 703	20 811	18 898	20 105	46 554	12 685
Elasticity at income level						
USD 1 000 per cap	0.03	0.19***	2.10***	2.44***	0.38***	0.16***
USD 4 000 per cap	0.33***	0.44***	0.67***	0.77***	0.88***	0.40***
USD 12 000 per cap	0.40***	0.41***	0.36***	0.47***	0.79***	0.37***
USD 30 000 per cap	0.42***	0.39***	0.24***	0.33***	0.70***	0.41***

Panel D. Interest rate spread

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.119***	0.130***	-0.219***	-0.170***	0.153***	0.089***
	(0.020)	(0.013)	(0.011)	(0.010)	(0.007)	(0.016)
Ln gdp per capita	0.184***	0.161***	0.335***	0.340***	0.218***	0.100***
	(0.043)	(0.017)	(0.014)	(0.014)	(0.010)	(0.020)
Interest rate spread	-13.159***	-14.922***	-10.378***	-6.438***	-1.988***	-9.037***
	(5.060)	(2.019)	(1.928)	(1.650)	(0.164)	(2.735)
Int. rate spr.* income	1.366**	1.667***	1.451***	0.883***		0.986***
	(0.607)	(0.237)	(0.231)	(0.195)		(0.325)
P2	-0.178***	-0.168***	-0.100***	-0.099***	-0.159***	-0.144***
	(0.041)	(0.015)	(0.017)	(0.015)	(0.011)	(0.022)
p3	-0.354***	-0.275***	-0.231***	-0.201***	-0.243***	-0.209***
	(0.049)	(0.021)	(0.022)	(0.021)	(0.018)	(0.035)
N	3 625	16 072	14 762	15 623	36 275	9 772
Elasticity at income level						
USD 1 000 per cap	-0.17***	-0.15***	..	..	-0.06***	-0.09***
USD 4 000 per cap	-0.07***	-0.04***	0.06***	0.03***	-0.08***	-0.03***
USD 12 000 per cap	..	0.02***	0.10***	0.06***	-0.09***	..
USD 30 000 per cap	..	0.06***	0.11***	0.07***	-0.09***	0.04*

Panel E. Electricity

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.154***	0.178***	-0.114***	-0.089***	0.186***	0.142***
	(0.019)	(0.012)	(0.009)	(0.008)	(0.007)	(0.014)
Ln gdp per capita	-1.472***	-0.408***	3.153***	3.181***	-0.910***	0.123***
	(0.400)	(0.136)	(0.200)	(0.264)	(0.097)	(0.017)
Electricity loss (inverse)	-15.039***	-3.755***	28.319***	30.491***	-7.192***	1.770***
	(4.072)	(1.249)	(1.965)	(2.595)	(0.968)	(0.365)
Electricity*income	1.860***	0.624***	-3.136***	-3.198***	1.179***	
	(0.452)	(0.149)	(0.216)	(0.284)	(0.107)	
P2	-0.152***	-0.127***	-0.066***	-0.019	-0.130***	-0.110***
	(0.031)	(0.014)	(0.015)	(0.013)	(0.011)	(0.019)
p3	-0.238***	-0.215***	-0.098***	-0.030*	-0.191***	-0.150***
	(0.044)	(0.020)	(0.019)	(0.017)	(0.016)	(0.027)
N	4 678	20 739	18 870	20 079	46 407	12 608
Elasticity at income level						
USD 1 000 per cap	-1.50***	0.35*	4.42***	5.57***	0.59***	1.10***
USD 4 000 per cap	..	0.83***	1.34***	2.34***	1.51***	1.04***
USD 12 000 per cap	1.41***	1.15***	-0.60***	0.23*	2.12***	0.99***
USD 30 000 per cap	2.20***	1.38***	-1.82***	-1.17***	2.54***	0.94***

Panel F. Years of schooling

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.083***	0.032***	-0.004	-0.010**	0.047***	0.065***
	(0.018)	(0.005)	(0.004)	(0.004)	(0.004)	(0.009)
Ln gdp per capita	-0.650***	-0.059	3.578***	3.621***	-0.285***	0.1
	(0.201)	(0.081)	(0.231)	(0.260)	(0.048)	(0.106)
Ln years of schooling	-3.728***	-1.642***	14.651***	14.495***	-1.710***	-0.308
	(0.789)	(0.336)	(0.971)	(1.077)	(0.195)	(0.451)
School*income	0.425***	0.158***	-1.546***	-1.548***	0.240***	0.04
	(0.094)	(0.038)	(0.103)	(0.115)	(0.022)	(0.050)
P2	-0.156***	-0.097***	0.011	0.039***	-0.093***	-0.078***
	(0.031)	(0.014)	(0.015)	(0.015)	(0.010)	(0.020)
p3	-0.270***	-0.183***	-0.003	0.055***	-0.173***	-0.131***
	(0.040)	(0.018)	(0.019)	(0.019)	(0.016)	(0.027)
N	4 644	20 694	18 704	19 954	46 277	12 536
Elasticity at income level						
USD 1 000 per cap	-0.39***	-0.31***	8.40***	8.78***	..	..
USD 4 000 per cap	..	-0.28***	1.59***	1.46***	0.25***	..
USD 12 000 per cap	..	-0.12***	..	..	0.39***	..
USD 30 000 per cap	0.39***	..	-0.63***	-0.71***	0.43***	..

Panel G. Contract enforcement, legal procedures

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.160***	0.191***	-0.112***	-0.097***	0.234***	0.154***
	(0.024)	(0.013)	(0.010)	(0.009)	(0.008)	(0.017)
Ln gdp per capita	1.909***	0.131***	-3.552***	-3.413***	-0.222	0.094***
	(0.534)	(0.013)	(0.298)	(0.294)	(0.147)	(0.019)
Ln number of procedures	3.989***	-0.827***	-10.858***	-10.580***	-2.700***	-1.216***
	(1.491)	(0.100)	(0.849)	(0.837)	(0.412)	(0.113)
Procedures*income	-0.472***		1.084***	1.041***	0.096**	
	(0.149)		(0.086)	(0.084)	(0.041)	
P2	-0.114***	-0.086***	-0.02	0.001	-0.079***	-0.039*
	(0.032)	(0.013)	(0.014)	(0.015)	(0.012)	(0.023)
N	3 143	14 055	12 532	13 407	30 605	8 550
Elasticity at income level						
USD 1000 per cap	..	-0.56***	-6.60***	-7.22***	-1.38***	-0.81***
USD 4000 per cap	..	-0.76***	-1.56***	-1.65***	-1.79***	-1.08***
USD 12 000 per cap	-0.40**	-0.56***	-0.38***	-0.50***	-1.27***	-0.80***
USD 30 000 per cap	-0.55***	-0.45***	-0.16***	-0.08**	-0.91***	-0.74***

Panel H. Tariffs

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln GDP	0.113***	0.069***	-0.029***	-0.033***	0.083***	0.085***
	(0.020)	(0.007)	(0.005)	(0.005)	(0.006)	(0.010)
Ln gdp per capita	0.305***	0.344***	0.093***	0.102***	0.294***	0.199***
	(0.030)	(0.016)	(0.018)	(0.016)	(0.010)	(0.022)
Ln tariffs	14.298***	15.985***	-10.071***	-7.324***	20.192***	4.909***
	(4.037)	(1.374)	(1.163)	(1.155)	(0.920)	(1.244)
Tariffs *income	-1.674***	-1.850***	0.780***	0.367***	-2.764***	-0.652***
	(0.521)	(0.180)	(0.130)	(0.133)	(0.121)	(0.158)
P2	-0.123***	-0.127***	-0.098***	-0.076***	-0.143***	-0.100***
	(0.034)	(0.015)	(0.016)	(0.014)	(0.011)	(0.020)
p3	-0.213***	-0.189***	-0.189***	-0.136***	-0.186***	-0.141***
	(0.039)	(0.020)	(0.019)	(0.019)	(0.018)	(0.029)
N	4 447	19 701	17 174	18 963	42 229	11 967
Elasticity at income level						
USD 1 000 per cap	1.45***	1.91***	-9.80***	-11.11***	0.72***	..
USD 4 000 per cap	..	0.56*	-3.04***	-3.65***	-2.54***	-0.44*
USD 12 000 per cap	..	-0.97***	-1.55***	-2.37***	-4.06***	-0.80***
USD 30 000 per cap	-1.87***	-1.70***	-1.02***	-1.71***	-4.39***	-1.10***

Note: T-statistics for clustered standard errors are reported in parentheses; ***, ** and * indicate statistical significance at 1, 5 and 10% levels respectively. Interaction terms with GDP per capita are included for the sectors and services indicators where the interaction terms are statistically significant. Where interaction terms were not statistically significant, the regressions without such interaction terms are reported. The last four rows report the elasticity of the GL-index with respect to the services variable in question, calculated at the mean GL-index value at each income level.

Turning to the policy variables, Table C.5 presents the elasticities of the GL-index with respect to the FDI restrictiveness indices and the Product market regulation (PMR) indices, where statistically significant. The regression was first run with the aggregate FDI restrictiveness index, and next broken down on manufacturing and services, and finally broken down on services sectors. It turned out that for FDI restrictions in manufacturing, the coefficients were highly significant from a statistical point of view, but hardly from an economic point of view, with the highest elasticity being -0.13 at a GDP per capita level of USD 30 000 in the clothing sector (HS 62). A likely reason is that FDI restrictions in manufacturing is relatively muted and does not vary much in the sample. In the interest of space, we do not report these regressions. We finally break down the FDI restrictiveness on individual services sectors.

Table C.5. Elasticities of the GL-index with respect to policy variables

Panel A. FDI restrictions

Income level (GDP per capita, USD)	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
FDI restrictiveness index, total economy						
1 000	..	..	-0.64***	-0.53***	..	..
4 000	..	-0.09***	-0.58***	-0.51***	..	-0.07***
12 000	-0.14***	-0.17***	-0.53***	-0.49***	-0.12***	-0.21***
30 000	-0.22***	0.23***	-0.48***	-0.47***	-0.23***	-0.33***
FDI restrictiveness index, services						
1 000	..	..	-0.57***	-0.56***	..	..
4 000	..	..	-0.42***	-0.43***	..	..
12 000	..	-0.09***	-0.28***	-0.31***	..	-0.11***
30 000	-0.12*	-0.14***	-0.17***	-0.20***	-0.06***	-0.20***
FDI restrictiveness index, telecoms						
1 000	..	..	-0.42***	-0.36***	..	..
4 000	..	-0.02***	-0.31***	-0.28***	..	-0.02***
12 000	-0.04***	-0.04***	-0.23***	-0.22***	-0.02***	-0.07***
30 000	-0.06***	-0.06***	-0.16***	-0.18***	-0.06***	-0.10***
FDI restrictiveness index, transport						
1 000	-0.21***	-0.30***	-1.26***	-0.86***	..	-0.24***
4 000	-0.19***	-0.22***	-0.88***	-0.67***	..	-0.23***
12 000	-0.18***	-0.17***	-0.58***	-0.51***	-0.06***	-0.23***
30 000	-0.17***	-0.13***	-0.34***	-0.38***	-0.11***	-0.22***
FDI restrictiveness index, finance						
1 000	..	..	-0.47***	-0.36***	..	..
4 000	-0.03**	-0.05***	-0.36***	-0.29***	..	-0.03***
12 000	-0.07***	-0.11***	-0.28***	-0.24***	-0.07***	-0.10***
30 000	-0.11***	-0.15***	-0.21***	-0.19***	-0.15***	-0.16***

Panel B. PMR indicators

Income level (GDP per capita, USD)	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
PMR telecoms						
1 000	-0.09*	-0.38***	-1.60***	-1.67***	-0.41***	-0.13***
4 000	-0.14*	-0.32***	-0.52***	-0.46***	-0.38***	-0.16***
12 000	-0.10**	-0.15***	-0.29***	-0.24***	-0.15***	-0.11***
30 000	-0.08**	-0.07***	-0.20***	-0.12***	-0.05***	-0.10***
PMR air transport						
1 000	-0.24***	-0.31***	-1.60***	-2.00***	-0.13***	-0.03***
4 000	-0.29***	-0.28***	-0.37***	-0.46***	-0.13***	-0.04***
12 000	-0.13***	-0.12***	-0.12***	-0.16***	-0.06***	-0.03***
30 000	-0.03***	-0.07***	-0.02***	-0.04***	-0.07***	-0.03***

T-statistics are reported in parentheses; ***, ** and * indicate statistical significance at 1, 5 and 10% levels respectively. The PMR index is available for the OECD countries and for Brazil, China, India, Indonesia, The Russian Federation and South Africa in the latest vintage for 2008.

Services and export prices

Export prices are calculated using information on export volumes and export values from Comtrade. Within the same 6-digit sector there are typically several units (kg, items, litres etc.) We used the item that accounted for the largest export value, or a value-weighted average in cases where units are comparable and values similar (e.g. kg and litres). The variation across countries is quite large even within 6-digit HS categories. To minimise the risk of comparing apples to oranges, we normalise the estimated unit prices using two methodologies for robustness checks. The first is to divide the estimated prices with the mean for the HS6 category and time period in question, which ensures that all prices have the same mean (one). The second is to use the min-max normalisation for each HS6 category and time period, which produces price indices that take values between 0 and 1. These prices are regressed on the same explanatory variables as the GL-index, controlling for GDP per capita and including an interaction term to GDP per capita. The results are reported in Tables C.6 and C.7 below.

Table C.6. Regression results, export prices

Panel A. Transport costs

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	0.492***	0.198***	-1.204***	-0.963***	1.049***	-0.607***
	(0.032)	(0.011)	(0.130)	(0.128)	(0.205)	(0.202)
Ln transport costs	0.432***	0.212***	-1.605***	-1.274***	1.584***	-1.059***
	(0.084)	(0.024)	(0.163)	(0.162)	(0.274)	(0.257)
Transp.c.*income			0.218***	0.179***	-0.110***	0.119***
			(0.017)	(0.017)	(0.028)	(0.028)
p3	0.203	0.041	2.013***	1.336***	1.036***	1.761***
	(0.151)	(0.117)	(0.138)	(0.078)	(0.093)	(0.218)
N	3 071	14 021	12 230	13 190	27 671	8 312
R square	0.138	0.037	0.365	0.325	0.089	0.21
Elasticity at income level						
USD 1 000 per cap	0.43***	0.21***	-0.10**	-0.04	0.83***	-0.24***
USD 4 000 per cap	0.43***	0.21***	0.21***	0.21***	0.67***	-0.07*
USD 12 000 per cap	0.43***	0.21***	0.44***	0.41***	0.55***	0.05*
USD 30 000 per cap	0.43***	0.21***	0.64***	0.57***	0.45***	0.16***

Panel B. Time for exports and imports

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	0.541***	0.780***	0.531***	0.481***	1.782***	0.766***
	(0.041)	(0.063)	(0.056)	(0.047)	(0.090)	(0.095)
Ln time	0.093*	1.646***	0.251*	0.258**	4.395***	1.377***
	(0.052)	(0.174)	(0.138)	(0.122)	(0.259)	(0.271)
Time.*income		-0.163***	-0.033**	-0.032***	-0.428***	-0.159***
		(0.018)	(0.014)	(0.012)	(0.025)	(0.027)
p3	0.246	0.077	2.061***	1.379***	1.133***	1.782***
	(0.149)	(0.117)	(0.138)	(0.078)	(0.093)	(0.218)
N	3 141	14 047	12 530	13 406	30 594	8 542
R square	0.13	0.037	0.356	0.313	0.09	0.212
Elasticity at income level						
USD 1 000 per cap	-0.09*	0.52***	..	..	1.44***	028***
USD 4 000 per cap	-0.09*	0.29***	..	..	0.84***	..
USD 12 000 per cap	-0.09*	0.11***	-0.06***	-0.04**	0.37***	-0.12**
USD 30 000 per cap	-0.09*	..	-0.09***	-0.07***	..	-026***

Panel C. Telecoms

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	-0.693***	-0.402***	0.774***	0.547***	-0.145*	-0.529***
	(0.157)	(0.041)	(0.074)	(0.059)	(0.079)	(0.127)
Ln tele	-1.004***	-0.605***	0.738***	0.502***	-0.376***	-1.801***
	(0.155)	(0.046)	(0.089)	(0.072)	(0.103)	(0.174)
Tele*income	0.190***	0.102***	-0.057***	-0.028***	0.074***	0.182***
	(0.025)	(0.007)	(0.012)	(0.010)	(0.014)	(0.022)
P2	-0.021	-0.175	0.188**	0.736***	0.910***	2.932***
	(0.272)	(0.113)	(0.093)	(0.060)	(0.086)	(0.271)
p3	0.085	-0.182	2.150***	2.020***	1.915***	4.748***
	(0.293)	(0.113)	(0.126)	(0.091)	(0.132)	(0.386)
N	4 573	20 707	18 433	19 834	42 959	12 315
	0.142	0.035	0.353	0.389	0.141	0.303
Elasticity at income level						
USD 1 000 per cap	0.30***	0.09***	0.34***	0.31***	0.13***	-0.55***
USD 4 000 per cap	0.57***	0.24***	0.27***	0.27***	0.24***	-0.29***
USD 12 000 per cap	0.78***	0.35***	0.20**	0.24***	0.32***	..
USD 30 000 per cap	0.95***	0.45***	0.15***	0.22***	0.39***	..

Panel D. Interest rate spread

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	0.470***	0.208***	0.675***	0.635***	0.463***	0.112***
	(0.034)	(0.014)	(0.023)	(0.017)	(0.025)	(0.037)
Interest rate spread	0.818**	6.173***	5.609***	11.397***	28.832***	-10.128***
	(0.362)	(1.355)	(1.554)	(1.297)	(2.564)	(3.240)
Int. rate spr.* income		-0.646***	-0.685***	-1.354***	-3.362***	1.053***
		(0.158)	(0.188)	(0.155)	(0.303)	(0.385)
P2	0.305	-0.021	0.180*	0.886***	1.113***	2.821***
	(0.271)	(0.117)	(0.096)	(0.059)	(0.083)	(0.251)
p3	0.453	0.015	2.431***	2.331***	2.276***	4.658***
	(0.303)	(0.119)	(0.126)	(0.091)	(0.124)	(0.369)
N	3 499	15 984	14 411	15 435	33 846	9 506
R square	0.105	0.023	0.318	0.361	0.133	0.28
Elasticity at income level						
USD 1 000 per cap	0.05***	0.10***	0.05***	0.12***	0.34***	-0.17***
USD 4 000 per cap	0.07***	0.07***	..	..	0.08***	-0.12***
USD 12 000 per cap	0.06***	..	-0.06***	-0.09***	-0.19***	
USD 30 000 per cap	0.03***	..	-0.06***	-0.10***	-0.23***	

Panel E. Electricity

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	0.473***	-0.339***	-0.024	0.580***	-1.231***	-1.204***
	(0.040)	(0.092)	(0.085)	(0.014)	(0.139)	(0.185)
Electricity loss (inverse)	0.038	-4.961***	-8.287***	-1.689***	-13.031***	-7.114***
	(0.546)	(0.870)	(0.706)	(0.195)	(1.265)	(1.577)
Electricity*income		0.588***	0.763***		1.676***	1.421***
		(0.102)	(0.089)		(0.153)	(0.197)
P2	0.293	-0.041	0.308***	0.864***	1.042***	2.826***
	(0.281)	(0.116)	(0.091)	(0.058)	(0.082)	(0.253)
p3	0.584*	0.031	2.314***	2.202***	2.123***	4.633***
	(0.303)	(0.116)	(0.122)	(0.086)	(0.126)	(0.362)
N	4 549	20 635	18 412	19 811	42 873	12 256
R square	0.136	0.032	0.351	0.387	0.143	0.301
Elasticity at income level						
USD 1 000 per cap	..	-0.75***	-2.51***	-1.40***	-1.22***	2.23***
USD 4 000 per cap	..	..	-1.72***	-1.49***	0.77***	4.12***
USD 12 000 per cap	..	0.50***	-0.99***	-1.50***	2.42***	5.55***
USD 30 000 per cap	..	1.01***	..	-1.57***	3.93***	6.99***

Panel F. Years of schooling

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	0.467***	-0.123**	-0.385***	-1.248***	-2.090***	-3.376***
	(0.038)	(0.056)	(0.069)	(0.058)	(0.118)	(0.283)
Ln years of schooling	0.212	-0.842***	-3.737***	-5.426***	-6.775***	-11.438***
	(0.176)	(0.242)	(0.227)	(0.192)	(0.406)	(0.906)
School*income		0.129***	0.455***	0.756***	0.998***	1.529***
		(0.028)	(0.031)	(0.025)	(0.051)	(0.118)
P2	0.374	-0.036	0.308***	0.851***	0.994***	2.711***
	(0.288)	(0.115)	(0.091)	(0.057)	(0.080)	(0.244)
p3	0.615*	0.029	2.316***	2.171***	2.039***	4.478***
	(0.313)	(0.115)	(0.122)	(0.087)	(0.122)	(0.352)
N	4 531	20 595	18 262	19 697	42 776	12 194
R square	0.145	0.031	0.347	0.396	0.16	0.315
Elasticity at income level						
USD 1 000 per cap	..	..	-0.60***	-0.20***	..	-0.89***
USD 4 000 per cap	..	0.23***	..	0.85***	1.51***	1.25***
USD 12 000 per cap	..	0.38***	0.54***	1.68***	2.61***	2.94***
USD 30 000 per cap	..	0.49***	0.95***	2.36***	3.51***	4.31***

Panel G. Contract enforcement, legal procedures

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	-1.085**	0.763***	-0.013	-0.128	-0.038	0.284***
	(0.423)	(0.147)	(0.108)	(0.118)	(0.180)	(0.020)
Ln number of procedures	-4.619***	1.201***	-0.387	-0.922***	-0.274	0.056
	(1.145)	(0.410)	(0.301)	(0.340)	(0.500)	(0.084)
Procedures*income	0.441***	-0.164***	0.151***	0.159***	0.096*	
	(0.120)	(0.041)	(0.032)	(0.033)	(0.050)	
P2	0.253	0.062	2.051***	1.373***	1.077***	1.772***
	(0.150)	(0.117)	(0.138)	(0.078)	(0.093)	(0.218)
N	3 072	14 027	12 231	13 190	27 679	8 319
R square	0.133	0.036	0.362	0.317	0.083	0.21
Elasticity at income level						
USD 1 000 per cap	-1.58***	..	0.65***	..	0.39**	..
USD 4 000 per cap	-0.96***	-0.16*	0.87***	0.40***	0.52***	..
USD 12 000 per cap	-0.47**	-0.34***	1.03***	0.57***	0.63***	..
USD 30 000 per cap	..	-0.49***	1.17***	0.71***	0.71***	..

Panel H. Tariffs

	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
Ln gdp per capita	0.541***	0.181***	0.553***	0.445***	0.317***	0.258***
	(0.038)	(0.019)	(0.019)	(0.014)	(0.020)	(0.034)
Ln tariffs	10.350**	0.992	-14.593***	-16.321***	5.616***	13.719***
	(3.828)	(1.376)	(1.056)	(0.854)	(1.661)	(1.998)
Tariffs *income	-0.982**	-0.274*	2.113***	2.341***	-0.931***	-1.778***
	(0.457)	(0.159)	(0.145)	(0.124)	(0.223)	(0.298)
P2	0.309	-0.053	0.348***	0.892***	1.007***	2.793***
	(0.280)	(0.115)	(0.091)	(0.059)	(0.082)	(0.250)
p3	0.587*	0.015	2.316***	2.213***	2.124***	4.606***
	(0.308)	(0.115)	(0.123)	(0.089)	(0.129)	(0.356)
N	4 328	19 609	16 775	18 729	39 386	11 654
R square	0.137	0.035	0.35	0.399	0.142	0.295
Elasticity at income level						
USD 1 000 per cap	3.58***	..	..	..	..	1.45***
USD 4 000 per cap	2.20***	-1.28**	2.94***	3.11***	-2.11***	..
USD 12 000 per cap	..	-1.58**	5.26***	5.69***	-3.13***	-3.00***
USD 30 000 per cap	..	-1.83**	7.17***	7.79***	-3.97***	-4.60***

Table C.7. Regression results, export prices, policy variables

Income level (GDP per capita, USD)	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
FDI restrictiveness index, total economy						
1 000	-0.59***	-0.14***	-1.40***	-1.37***	-1.16***	-0.37**
4 000	-0.37***	-0.09***	-0.50***	-0.21***	-0.14**	..
12 000	-0.18***	-0.04***	-0.10***	0.15***	0.16***	0.13***
30 000	-0.13***	-0.03***	..	0.25***	0.24***	0.16***
FDI restrictiveness index, services						
1 000	-0.71***	..	-1.15***	-1.13***	-0.86***	..
4 000	-0.34***	-0.09***	-0.23***	..	..	..
12 000	-0.13***	-0.06***	..	0.16***	0.13***	0.04***
30 000	-0.17***	-0.10***	0.11***	0.37***	0.31***	0.09***
FDI restrictiveness index, telecoms						
1 000	-0.41***	-0.27***	-0.99***	-0.99***	-0.95***	-0.43***
4 000	-0.19***	-0.13***	-0.23***	-0.16***	-0.18***	..
12 000	-0.08***	-0.05***	-0.02***	0.03***	..	0.04***
30 000	-0.10***	-0.07***	0.06***	0.14***	0.10***	0.11***
FDI restrictiveness index, transport						
1 000	-0.15**	-0.12***	-0.85***	-0.71***	-1.06***	-0.61***
4 000	-0.18**	-0.14***	-0.51***	-0.30***	-0.56***	-0.26***
12 000	-0.15**	-0.12***	-0.13***	0.09***	-0.05**	0.07**
30 000	-0.12**	-0.09***	0.09***	0.29***	0.24***	0.23***
FDI restrictiveness index, finance						
1 000	..	..	-1.16***	-1.27***	-0.68***	-0.35***
4 000	-0.14**	..	-0.18***	-0.09***	..	..
12 000	-0.15***	..	0.10***	0.22***	0.22***	0.08***
30 000	-0.09***	..	0.11***	0.18***	0.16***	0.06***
Income level (GDP per capita, USD)	HS 30	HS 39	HS 61	HS 62	HS 85	HS 87
PMR telecoms						
1 000	-0.12*	-0.57***	-0.64***	-0.73***	-0.94***	-1.43***
4 000	-0.12*	-0.30***	-0.64***	-0.73***	-0.94***	-1.43***
12 000	-0.12*	-0.10***	-0.64***	-0.73***	-0.94***	-1.43***
30 000	-0.12*	0.06*	-0.64***	-0.73***	-0.94***	-1.43***
PMR air transport						
1 000	..	0.26***	-0.53***	-1.06***	-0.42***	-0.89***
4 000	..	0.15***	-0.32***	-0.61***	-0.23***	-0.51***
12 000	..	0.07***	-0.14***	-0.26***	-0.07***	-0.20***
30 000	..	..	..	0.03***	.06***	0.04***

Services and the duration of trade

The event here is the failure of a trading relationship which means exit from a bilateral trade relationship. We estimated the Cox proportional hazards model to control for country-specific and pair-specific characteristics that may influence the duration of trade. The survival period *T* is regarded as a random variable with a probability distribution *F(t)* and its probability density function *f(t)*. With an interest in the probability of surviving to time t or beyond, the function of survival or survive curve *s(t)* is given by:

$$S(t) = P(T \geq t) = 1 - F(t).$$

Let us consider the following question: If the spell has lasted until time t, then what is the probability that trade breaks down in the next time interval (Δt)? This is defined as the hazard rate:

$$h(t) = \frac{f(t)}{S(t)}$$

The instantaneous probability of failure at time *t* divided by the probability of surviving up to time *t* so that:

$$S(t) = \exp(-H(t)),$$

where *H(t)* is the integrated hazard function, also known as the cumulative hazard function (See Greene W., 2007, 6th edition, p 931-942).

Two estimators are used to investigate the dynamic of trade relationship: the Kaplan-Meier (K-M) estimator and Cox regression. Through the comparison of the survival in different subgroups by plotting the K-M estimators of the group-specific survival functions, we investigated the failure times, or times at which the event occur between 1998 and 2010. When some of these are continuous, it is very useful to use a Cox regression. For the individual *i*, the hazard function is given by

$$h_i(t) = h_0(t)\exp(x_i\ \beta'),$$

where $h_0(t)$ is the baseline hazard function, β are coefficients of regressions and x_i covariates. With some assumption about models and proportional hazards, we can maximize the log likelihood with the regression parameters (See Allison, 1984; Clayton and Hills, 1993; Collett, 2003; Klein and Moeschberger, 2003; Cleves et al., 2004).