PRODUCER SERVICES AND TRADE IN MANUFACTURED GOODS

Hildegunn Kyvik Nordås
Trade and Agriculture Directorate, OECD[1]

Abstract

This study analyses the interrelationship between goods and producer services in production and trade using the most recent input-output tables for all OECD countries. It first presents descriptive statistics that illustrate the role of services in production and trade in goods. Trade in services could in principle contribute to a broader services supplier base that supports competitiveness in high-technology and high value added manufacturing. However, cross-border trade in producer services is often quite marginal and commercial presence appears to be the favoured mode of servicing foreign markets. We find a positive empirical relationship between openness to foreign investment as measured by the OECD FDI restrictiveness index and exports and productivity in downstream manufacturing industries. I also find that a higher business services content is correlated with a higher value to weight ratio, suggesting that services intensity is related to a higher degree of processing and economising on material inputs through better supply chain management. Simulations using a CGE model show how reduction of services trade costs affect the production structure and trade in goods. Countries with superior organizational technology (using producer services more effectively) will specialize in manufacturing. With low, but still significant trade costs in services, large countries will have a comparative advantage for services-intensive manufactured goods, an advantage that is enhanced if the country also produces intermediate services more effectively or has lower barriers to entry in this sector.

Keywords: Producer **s**ervices, trade, general equilibrium modelling.
JEL: F10, F47.

1. INTRODUCTION

Most services play a role in the production and marketing of goods. For instance business services provide direct inputs into the production of goods; transport, logistics, wholesale and retail trade ease the flow of products between different stages of production and from producers to final customers; R&D helps improve the quality of products and processes; health and education services improve the quality of human capital; while financial services facilitate transactions within and across international borders and channel funds from savings to investment. This study focuses on the importance of services as a direct input into the production and distribution of manufactured goods.

The manufacturing process consists of a large number of tasks, some of which are conducted inside the manufacturing firm, and some are purchased from outside suppliers. In a growing market there tends to be a development towards firms narrowing the range of tasks being conducted in-house and buying more tasks from the market. This helps improve productivity by sharpening core competencies while exploiting

[1] E-mail: Hildegunn.nordas@oecd.org

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economies of scale. The process of vertical disintegration in a growing market is nicely described by Schelling (1978). "Tasks" bought from the market can be bundled and embodied in intermediate inputs or they could be individual tasks delivered by an external services provider, depending on the depth of specialization.

During the past few decades trade costs have declined significantly and the scope of vertical specialisation has taken an international dimension (Yi, 2003). The latest development in this long-term trend towards deepening specialization with an expanding geographical reach is trade in intermediate services and tasks. However, some manufacturing sectors lend themselves more readily to fragmentation than others. Geographical fragmentation requires that the manufacturing process can be sliced up into the production of parts, components, services and tasks that can be separated in time and space. According to this criterion the sectors that lend themselves most easily to fragmentation are electronics and clothing (Farrel, 2004). Managing a network of external suppliers over large geographical distances can, however, be a daunting task even for these sectors. Communication technology, management systems and logistics are crucial, suggesting that trade in services is strongly complementary to trade in goods. The fact that services trade as a share of total trade has remained at about 20% for decades also points in the direction of strong complementarities.[2]

At high trade costs, national markets are largely self-contained with differentiated inputs, and the degree of specialization depends on the extent of the domestic market. Thus, when services trade costs are high, a local services supplier base can be a source of comparative advantage in services-intensive industries in the same way as relative abundance of capital forms the basis for comparative advantage in capital-intensive goods. As we shall see in the next section, services-intensive industries are often high-technology sectors or high-technology segments within a sector. At very low trade costs, in contrast, local manufacturers can draw on a regional or global services supplier base and manufacturing productivity converges across the countries that share a supplier base.

As we shall see in this study, it appears that for a number of intermediate services and tasks trade costs are still too high for manufacturers to draw significantly from an international supplier base unless suppliers establish a commercial presence close to the manufacturing site. It is for instance usually the case that tasks such as R&D, engineering and design are complementary to manufacturing and can only be separated from it, geographically or organisationally, if state-of-the art telecommunications are available. And even when this is the case, these services typically embody tacit knowledge that suppliers have to communicate

[2] The share is calculated from the World Development Indicators for the period 1970-2005.

directly to the consumer. Cross-border trade in such services is therefore typically complemented by commercial presence or frequent visits by services suppliers to the premises of the manufacturer.

The objective of this study is to assess how a reduction in services trade costs affects the production and trade patterns in manufacturing. Reduced trade costs can be induced by lowering or eliminating explicit barriers to trade in services, investment in communication networks or technological progress that reduces communication costs. Comparing input-output relationships in 1995 and 2000 reveals that services play an important role as intermediate inputs into manufacturing. However, for most countries the import share of intermediate services remains small and the share of services in total costs has increased less than one would expect from the current debate. Statistical/econometric analysis of the relation between services inputs and manufacturing performance suggests that a higher services content is related to a higher value to weight ratio and higher labour productivity. Furthermore, restrictions on FDI in backbone services industries are related to weaker export performance and less engagement in intra-industry trade in manufacturing. Finally, I introduce a relatively simple CGE model and simulate the production and trade responses to declining services trade costs. Large countries have a comparative advantage for services-intensive manufactured goods, an advantage that is enhanced if the country also produces intermediate services more effectively or has lower barriers to entry in this sector. As services trade costs come down, this comparative advantage is eroded as smaller countries can draw on the same services supplier base as their larger trading partners. Countries with superior organizational technology (using producer services more effectively) will specialize in somewhat "hollowed out" manufacturing.

The rest of the study is organised as follows: Section 2 provides a brief review of recent literature. Section 3 sets the stage for the empirical analysis by presenting calculations of direct and indirect services content of production and trade in manufactures, using input-output analysis. Section 4 presents the model and simulation results, while section 5 summarizes and concludes.

2. RELATIONS TO PREVIOUS RESEARCH

An early analysis of trade in producer services was Markusen (1989) who demonstrated that while trade in final goods improves the allocation efficiency of the economy, trade in intermediate inputs also reduces production costs by providing new, better or cheaper inputs. Subsequent literature has shown that one of the most important gains from trade among developed countries stems from the expansion of the variety of inputs that manufacturers can choose from. With a broader variety of goods, it is easier to find a good match between inputs used in the production process reducing firms' search costs.

A study of the Czech Republic investigated the interrelationship between liberalisation and reforms in key services sectors on the performance of manufacturing sectors, analysing firm-level data (Arnold *et al*., 2006). They found that there is a positive correlation between performance of manufacturing firms and the overall progress of policy reform (as measured by the European Bank of Reconstruction and Development in its Transition Report), and the presence of foreign providers in services. They did, however, not find a significant correlation between manufacturing performance and measures of competitiveness in the services sectors.

The paper that comes closest to this study in spirit is Robert-Nicoud (2008) who develops a model in which offshoring of production of intermediate parts and components is distinguished from offshoring of (routine) tasks. Trade in parts and components is subject to (iceberg) transport costs while trade in tasks is subject to (iceberg) communication costs. It is shown that as communication costs come down, international division of labour tends to shift from sectoral to functional specialisation. Offshoring of tasks, it is argued, allows high cost countries to retain and refine high-technology and skills-intensive functions in manufacturing instead of moving the entire manufacturing production chain to low wage countries. As is well known from the new economic geography literature, at a range of intermediate trade costs, advanced manufacturing tends to cluster in the largest market, while standardised low-technology industries tend to locate where labour costs are the lowest. Robert-Nicoud (2008) shows that offshoring of routine tasks expands the range of trade costs that sustains this pattern of specialisation. Conversely, restricting trade in tasks may encourage the relocation of the entire manufacturing supply chain to low-cost countries.

Information and communication technology (ICT) facilitates the separation of tasks and hence a development from sectoral to functional specialisation. This shift is first observed within countries. Duranton and Puga (2005) observe that cities shift from specialising in sectors with headquarters and production plants located in the same city towards having headquarters and business services clustered in large cities and production plants clustered in smaller cities. This type of specialisation appears to take place also at the international level. Headquarter and business services and some skills-intensive production tasks are clustered in high-income countries while fabrication is dispersed in low-income countries.

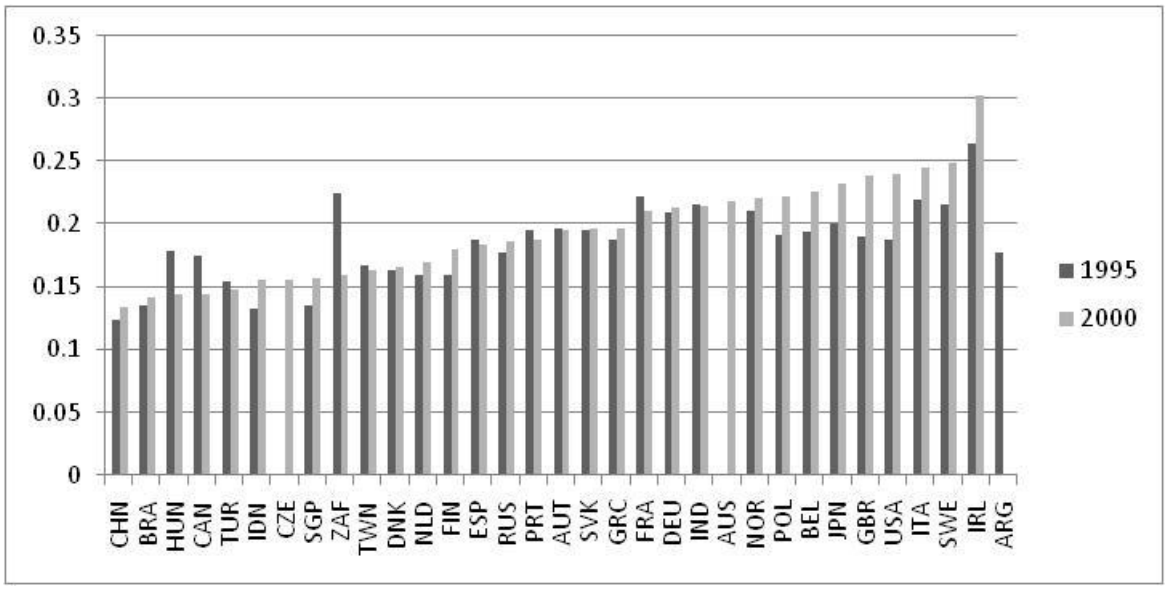
In sum recent research on trade in services, including in tasks suggest new patterns of specialization and underscores complementarities between goods and services both in production and trade (Dicken, 2003). Analysing trade responses to trade liberalisation in services should take into account such

complementarities. This paper provides an attempt to do so. The next section looks at how goods and services production is linked using input-output tables from the OECD input-output database for the years 1995 and 2000 (the latest available). In addition it provides some simple regression analysis of how restrictions on services trade and investment are correlated with trade in goods.

3. DESCRIPTIVE STATISTICS

Intermediate services inputs accounted for between 13 and 30% of total industry output, or total costs, in the manufacturing sector in the year 2000 in the countries included in the OECD input-output database, as depicted in Figure 1. Ireland clearly has the most services-intensive manufacturing sector, followed by Sweden, Italy and the United States. At the other end of the spectrum are China, Brazil and Hungary. The top nine countries have experienced an increase in the cost share of services in the manufacturing sector, while South Africa, Hungary and Canada have experienced a significant decline.

Figure 1. Intermediate services share of industry output, total manufacturing, 1995 and 2000.



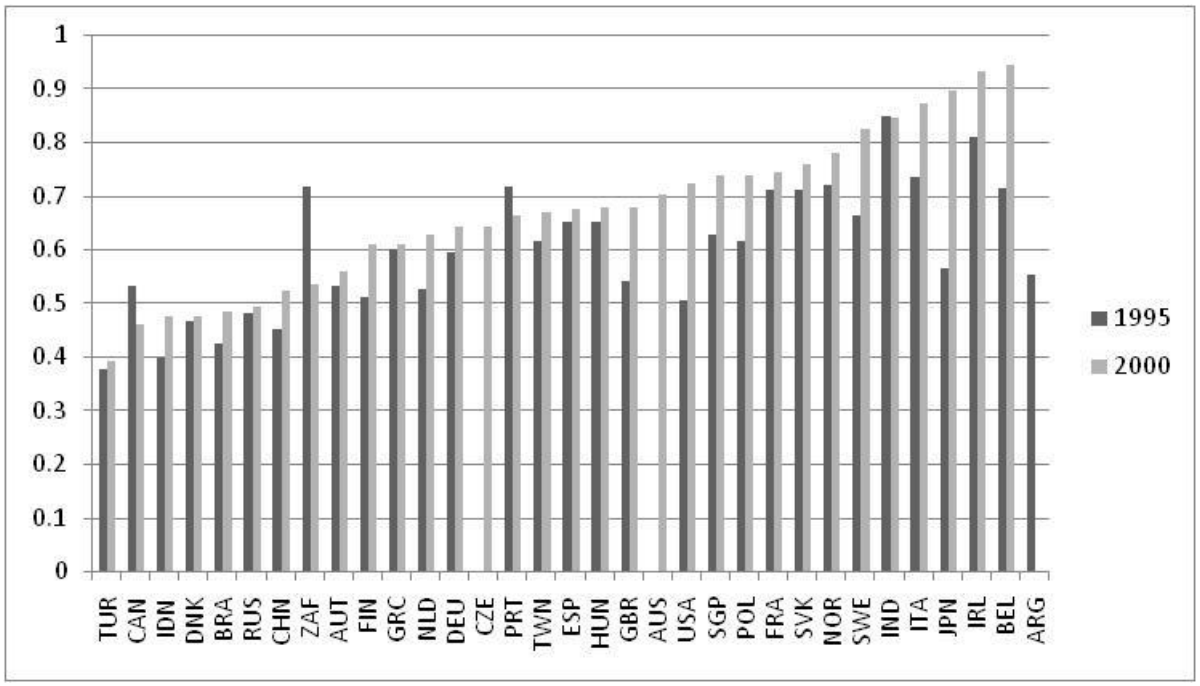
Source: Calculated from the OECD input-output database.

Note: Data for Australia is from 1998/99, Greece and Portugal 1995 and 1999, Hungary and Ireland 1998 and 2000, India 1993/94 and 1998/99, Turkey 1996 and 1998 and South Africa for 1993 and 2000.

There are many possible explanations for changes in the cost share of services in the manufacturing sector. One possibility is outsourcing of services to outside suppliers, in which case outside services suppliers replace in-house value added in the manufacturing firm. In order to investigate this explanation, I calculated the services inputs to value added ratio and compared the results for the two years. The result is depicted in Figure 2. Belgium had the highest ratio in 2000, followed by Ireland, Japan and Italy. The

increase in the services share for these economies may thus be partly due to outsourcing. By the same token the decline in the services share of gross output for Canada and South Africa corresponds to a decline in the services ratio to value added, suggesting that in-house services production has become more important in these countries.

Figure 2. Intermediate services to value added ratio, total economy

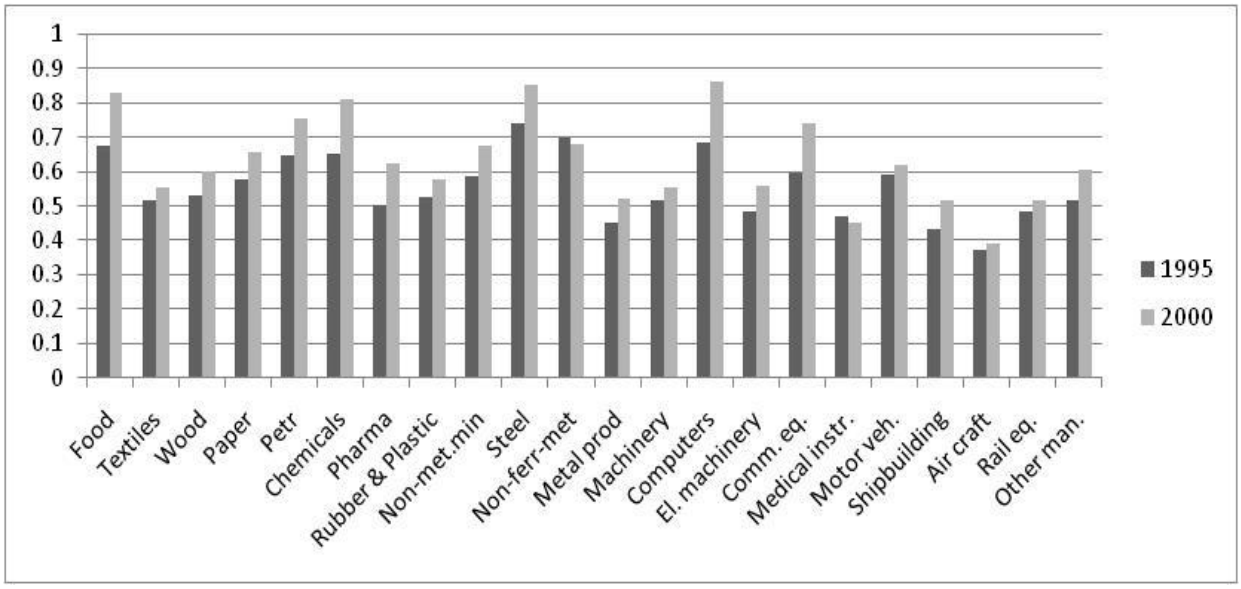


Source: Calculated from the OECD input-output database.

Note: Data for Australia is from 1998/99, Greece and Portugal 1995 and 1999, Hungary and Ireland 1998 and 2000, India 1993/94 and 1998/99, Turkey 1996 and 1998 and South Africa for 1993 and 2000.

A second explanation is a change in industrial structure and thus changes in the relative importance of services-intensive industries. In order to assess developments in the services intensity of individual manufacturing sectors, I calculated the services to value added ratio for all manufacturing industries for the two periods. Figure 3 depicts the median value for all OECD countries by sector for the two years, while Figure 4 depicts the median, together with the minimum and maximum for the year 2000.

Figure 3. Median intermediate services/value added ratio by sector, 1995 and 2000

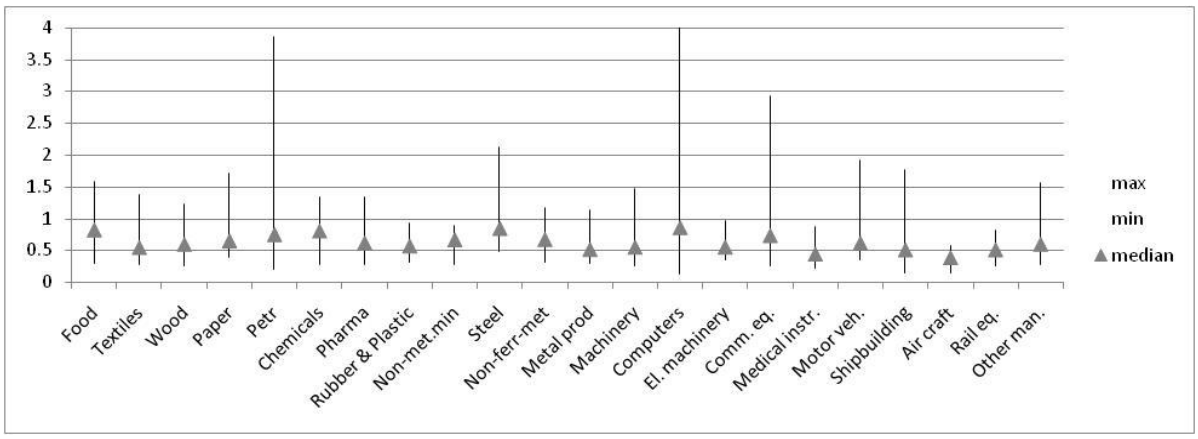


Source: Calculated from the OECD input output database

It is noticed that the median services intensity of all manufacturing sectors, except non-ferrous metals and medical and scientific instruments, has increased during this 5-year period. The most services-intensive manufacturing industry in 2000 was computers and office machinery, perhaps surprisingly closely followed by iron and steel, food and chemicals. The median only tells part of the story, however. Figure 4 shows the variation in services inputs to value added in the year 2000 for each sector. The by far largest variation is found in the computer industry where the services/value added ratio ranks from 0.12 in China to 9.15 in Finland (see note to Figure 4). Other sectors characterized by large differences in services intensity among countries are petroleum refining and communication equipment. Finally it is noted that the distribution is skewed towards a long tail on the high services intensity side. Thus, a higher services content in manufacturing in a country can stem from both a general increase in most manufacturing sectors and a shift to more services-intensive sectors and subsectors.

A third possible source of increasing services intensity in manufacturing is a change in relative prices, e.g. due to trade liberalisation and lower unit prices of material inputs. This is, however more difficult to assess empirically.

Figure 4. Variation in the services/value added ratio by industry, 2000.



Source: Calculated from OECD input-output database.

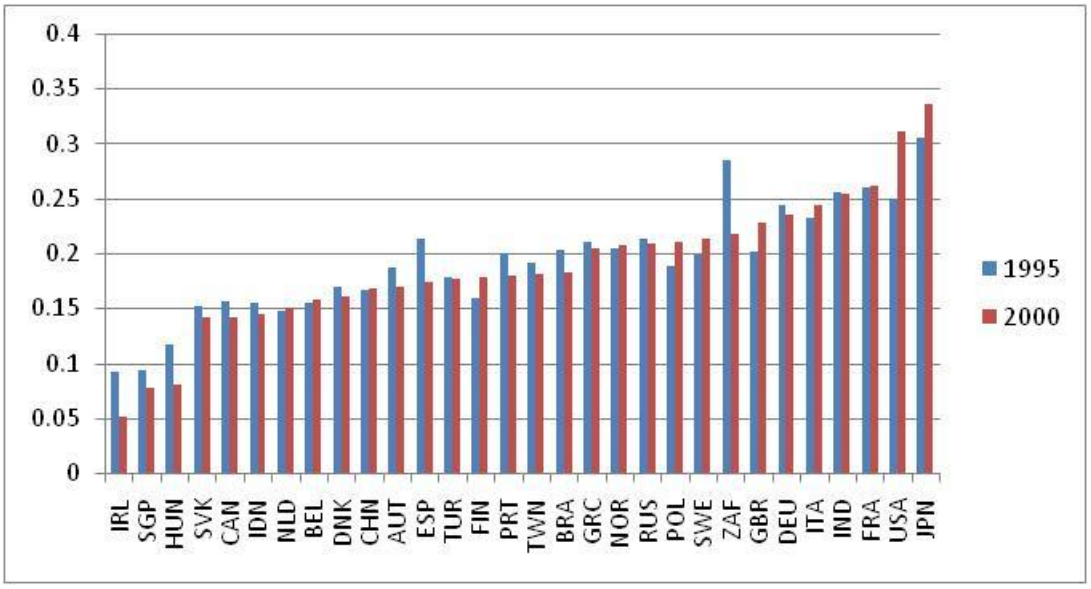
Note: The vertical axis is cut off at 4 in order to visualise the variation in other sectors than computers, which exhibit a maximum of more than 9.

Another measure of the interaction between manufacturing and services in international trade is the services content of manufactured exports. I calculated domestic services value added embodied in manufacturing exports as a share of export value for all countries for which data are available in the OECD input-output database. The result is depicted in Figure 5.[3]

[3] The domestic services value added share of manufacturing exports is calculated as follows: $\mu_s [I - A]^{-1} X_m / \sum x_m$

where μ is a row vector where the elements are the value added share of gross output if the sector is a services sector and zero otherwise. The term in square bracket is the inverted input-output matrix and X_m is a column vector where the elements are total exports if the sector is a manufacturing sector, zero otherwise, and finally I divide with total manufacturing exports.

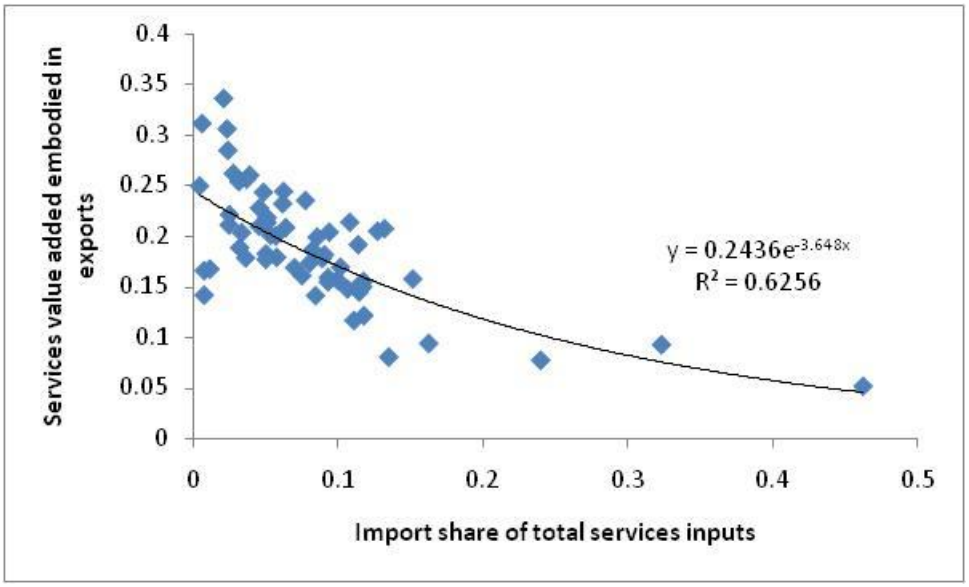
Figure 5. Domestic services value added embodied in manufacturing exports, 1995 and 2000



Source: Calculated by author from OECD input-output database.

Japan and USA clearly had the largest domestic services value added embodied in their manufacturing exports, and for these countries the share increased substantially from 1995 to 2000. However, in a number of countries the domestic services value added embodied in manufacturing exports has actually declined over the 5-year period analysed. This may seem surprising, and a possible explanation is that some domestic services value added has been replaced by imports. Figure 7 plots the domestic services value added embodied in manufacturing against the import share of total services inputs in manufacturing. There is a strong negative correlation between the two variables (shown by the trend line), supporting this hypothesis, and suggesting that local services can be complemented by foreign services. This is particularly noticeable in small, dynamic economies such as Ireland and Singapore where domestic services value added embodied in manufacturing exports constitute a small share of export value, and the share has, moreover dropped significantly from 1995 to 2000. However, for most other countries imported services account for less than 15% of total intermediate services inputs and for more than half of the countries the share is less than 10%.

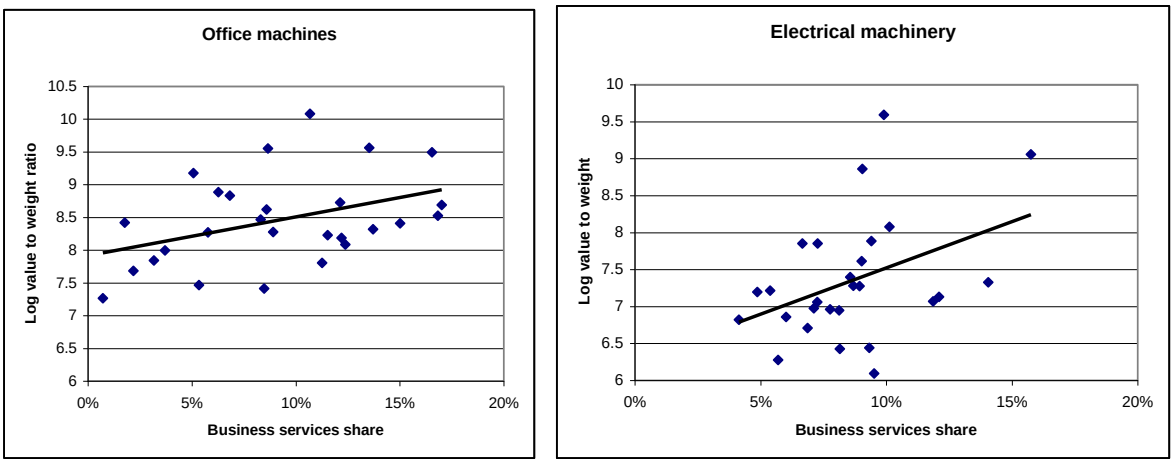
Figure 6. Domestic services value added embodied in manufacturing exports versus import share of services inputs in manufacturing



Note: The chart plots the domestic services value added embodied in manufacturing exports as depicted in Figure 5 against the import share of intermediate services in manufacturing for 1995 and 2000. The inserted trend-line is exponential, which is the functional form that gave the best fit.

Turning to the relation between services inputs and the variation in value added within manufacturing sectors, a measure, although not perfect, of the value added in a sector is the value-to-weight ratio of a product. Raw materials tend to have a low value-to-weight ratio, while high-technology products such as semiconductors and pharmaceuticals have a high value-to-weight ratio. We estimated this ratio using Eurostat data on import value and import quantities in kilograms. The result for office machinery (SITC sector 75) and electrical machinery (SITC sector 77) are depicted in Figure 7, where the vertical axis represents the log of export value per 100 kg exported to the EU and the horizontal axis depicts the share of business services in total costs in the sector in question. A trend-line shows a statistically significant upward sloping relation between the two variables.

Figure 7. Value to weight ratio of exports and business services share in total costs



Source: Estimated by author based on the OECD input-output database and Eurostat.

We observe a clear positive correlation between value to weight obtained in export markets and the business services content of the product for both office machines and electrical machinery, suggesting that larger business services content is associated with a higher rung on the quality ladder. It is also obvious that electrical machinery is heavier than office machinery and that the trend-lines therefore intercept the vertical axis at different points in the two sectors. In order to further explore the relation between business services content and export value, I regressed the value-to-weight ratio obtained in the EU market on services share of total input using the following regression equation. The estimates take into account that sectors are inherently different concerning value to weight and thus focus on the differences between countries *within* sectors:[4]

$$\ln(value_i / weight_i) = a_i + a_1 \ln(1 + BS_i / GO_i) + \mu_i$$

4.7***(st.error 1.5), N = 305, Adjusted R^2 = 0.77

BS represents business services and GO gross output while subscript *i* indicates sector. Notice that the constant is allowed to vary by sector, thus repressenting sector fixed effects. The results suggested that the share of total services in total costs is unrelated to the value to weight ratio in export markets (using the

[4] The regression is run using sector fixed effects, which implies that the intercept is allowed to differ among sectors.

European Union as the representative OECD market), while the share of business services was strongly and positively related to the value to weight ratio (reported below the equation). A one percentage point increase in the business services share of total costs is associated with an increase in the value to weigh ratio of about 5%.

Correlation does not imply causality and it is not argued that an increased services share *causes* an increase in the value to weight ratio. The results rather suggest that a high value to weight ratio goes together with a high business services share. A reasonable interpretation is that business services are needed to raise value added within a manufacturing sector. By the same token, a shallow business services sector appears to be a constraint on moving up the value chain in manufacturing, but it does not follow that having sophisticated and diversified business services will automatically raise value added in manufacturing. Conversely, demand for business services from the manufacturing sector creates business opportunities for business services firms. The presence of a market for specialised business services firms in turn improves productivity in downstream manufacturing firms and further raises demand for business services and so on in a virtuous cycle (Guerrieri and Meiciani, 2006).

I next explored whether export orientation in manufacturing is related to restrictions on trade in services. I first correlate the export share of total output in manufacturing to measures of trade restrictions in services, weighted by the share of the service in question in total cost. The measures of trade restrictiveness included in the regressions are the OECD Product Market Regulation index (PMR) for 1998 and the FDI restrictiveness index developed by Golub (2003).[5] The results show that only the latter index was statistically significantly correlated with trade performance, which is consistent with Arnold et al.'s (2006) results for the Czech Republic. It is found that an increase in the FDI restrictiveness index by one standard deviation from the mean for business services is related to a 5% lower export share of gross output in manufacturing on average. Raising the FDI restrictiveness by one standard deviation in financial services and water transport from the mean is correlated with a 3% reduction in the export share of gross output in manufacturing in both cases. Liberalising foreign market access in these backbone services thus appears to enhance exports in manufacturing. The results appear in columns 1-3 in Table 1, using the following regression equation:

$$\ln(X_i / GO_i) = b_i + b_2 \ln gdpcap + b_3(S_j / GO_i)SR_j + \mu_i$$

[5] See Conway et a. (2005) for a description of the PMR indicators.

Where X_i indicates exports, S_j indicates services sector j (j= business services, financial services, maritime services) and SR_j the FDI restrictiveness indicator in the sector.

Intra-industry trade, both horizontal and vertical, indicates to what extent an industry participates in international production sharing. I calculated the intra-industry index for each manufacturing industry included in our sample and correlated it with the same measures as reported above. Also for this measure it was only the FDI restrictiveness indicator for business services and water transport that proved to be statistically significantly correlated with the intra-industry index. As expected, it appears that services play a more important role for intra-industry trade than for exports in general. A one standard deviation increase in the FDI restrictiveness index in business services is associated with a 13% lower intra-industry trade index, while the corresponding relationship between water transport FDI restrictiveness and intra-industry trade is a 6% lower index.

Other services that were investigated for a possible correlation with the trade performance indicators for goods were telecommunications, construction, air transport road transport and electricity. None of these were statistically significantly correlated with trade performance in the selected manufacturing sectors. The results are presented in columns 4 and 5 in Table 1 and the regression equation is the following:

$$\ln((X_i + M_i) - |X_i - M_i|_i / (X_i + M_i)) = b_i + b_2 \ln gdpcap + b_3 (S_j / GO_i) * SR_j + \mu_i$$

where M_i indicates imports and the right-hand side the intra-industry index.

Table 1. Regression results, services and services investment restrictions

Left hand side variable	Export share			Intra-industry trade	
	Business services	Finance	Maritime services	Business Services	Maritime services
Ln GDP per capita	0.16*** (0.04)	0.16*** (0.04)	0.12*** (0.05)	0.16*** (0.09)	0.11 (0.09)
Ln(1+share business services)				2.6** (1.2)	
Services trade restrictions	-10.3** (4.8)	-10.5* (6.2)	-30.0* (16.4)	-27.7*** (9.0)	-68.5** (31.5)
Sector dummies:	Yes	Yes	Yes	Yes	Yes
N	237	245	237	237	237
Adjusted R^2	0.34	0.33	0.33	0.21	0.19

Note: Standard errors in parenthesis, ***, ** signify statistical significance at a 1 and 5 level respectively. The first column presents results on the correlation between value to weight and the (log of) the cost share of business services, columns 1-3 depict the correlation between the export share of gross output by sector and the FDI restrictiveness index, weighted by the share of the service in question in total cost, while the last two columns correlates intra-industry trade with the weighted FDI restrictiveness index.

I next explored whether services offshoring improves productivity and hence competitiveness in manufacturing industries, regressing output per worker on imported services inputs as share of total output value. The results suggest that there is a statistically and economically significant relationship between unit labour demand, which is a measure of labour productivity, and offshoring of services, using a broad measure where all services purchased from abroad are included.[6] As demonstrated in the previous section, there is a large variation among sectors as far as services offshoring is concerned. I therefore controlled for sector fixed effects and also a time trend in order to focus on how differences in offshoring patterns among countries affect labour productivity. Office, accounting and computing machinery is one of the sectors in which offshoring has played a major role in many countries, for instance Ireland. The mean share of imported services in total cost in this sector is 3%, but ranges from 0 to 38%. Our regression results show for instance that in this sector an increase of one percentage point from the mean would increase labour productivity by about 3%. The results are presented in Table 2.

Table 2. Regression results, services trade and productivity (conditional labour demand)

	(1)	(2)
Wages	-0.77***	-0.40***
	(0.04)	(0.14)
Price of materials	0.50*	0.43***
	(0.29)	(0.16)
Capital stock	0.14***	0.14*
	(0.03)	(0.08)
R&D	0.64*	0.99**
	(0.39)	(.42)
Output	0.82*	0.18**
		(0.08)
Services Offshoring	-3.31**	-3.72***
	(1.61)	(1.27)
Sector fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
N	401	194
Adjusted R^2	0.97	0.42

Note: Standard errors in parenthesis, ***, **, * signify statistical significance at a 1, 5 and 10 level respectively. Column 1 presents results using ordinary least squares while the second column presents the results of using first differences.

To summarise this section, there is empirical evidence that services content is correlated with a range of performance indicators in manufacturing accounting for differences both between and within sectors. However, there is not sufficient reliable data available to establish the direction of causality with certainty. I therefore continue with analysing the question by modelling the relations between goods and services in a CGE framework.

[6] The lower the demand for labour per unit of output the higher is labour productivity.

4. THE MODEL

The model features two countries, one factor of production and three final goods manufacturing sectors in addition to a range of intermediate services providers. Manufacturing is defined as the conduct of a number of tasks that can be performed inside the firm or purchased from outside firms. Firms choose to perform or buy tasks depending on the relative cost of each alternative. There are *N* business services suppliers in the home country and *n* suppliers in the foreign country. They contribute to the production of manufactures, and the more diversified and specialised the more they contribute to the productivity in the downstream manufacturing sector. While spreading a given amount of expenditure on services inputs on a greater variety of services contributes to higher productivity, the model also has the property that the marginal increase in productivity in downstream firms from adding another variety declines with the number of varieties already employed. For instance the 11th variety adds more to productivity than the 101st. Each services provider will have to incur some up-front costs in order to set up its business and develop its unique service. This cost will have to be recovered in the market, and the size of the market will therefore determine how many business services firms can be accommodated. Both business services and final goods can be traded, but at a cost.

Consumers are assumed to distribute their expenditure on manufacturing such that the expenditure share on each category is constant, but preferences may differ between countries.

Each sector produces a consumption good (Y_j) using labour (L_{Yj}) and a composite (S_j) of business services as inputs. Sectors are indexed *j*, countries are indexed *i* and varieties of the intermediate services/tasks are indexed *v*. Goods or services consumed in a different country than they are produced are denoted in lower case letters:

$$(1) \qquad Y_{ij} = \left[\beta_{ij} L_{Yij}^{\rho_{ij}} + (1-\beta_{ij}) S_{ij}^{\rho_{ij}}\right]^{1/\rho_{ij}},$$

where β is an allocation parameter which indicates how intensively manufacturing sector *j* uses direct labour and business services respectively. The parameter ρ defines the elasticity of substitution between business services and labour ($1/(1-\rho) > 1$). L and S can be interpreted as tasks being performed inside and outside the firm respectively and the elasticity of substitution can be interpreted as a measure of how easily tasks are outsourced in the sector. Profit maximisation yields the ratio of tasks produced within the firm and outside the firm as follows:

(2) $$\frac{L_{ij}}{S_{ij}} = \left[\frac{W_i}{P_{iSj}} \frac{1-\beta_{ij}}{\beta_{ij}} \right]^{1/(\rho_{ij}-1)}$$

And the unit cost function of the representative firm:

(3) $$C_{iYj} = \left[\beta_{ij}^{1/(1-\rho_{ij})} W_i^{\rho_{ij}/(\rho_{ij}-1)} + (1-\beta_{ij}) P_{iSj}^{\rho_{ij}/(\rho_{ij}-1)} \right]^{\rho_{ij}-1)/\rho_{ij}}$$

The composite of business services is defined as:

(4) $$S_{ij} = \left[\left(\sum_{v=1}^{N} \left(H_i I_{ijv} \right)^{(\varepsilon-1)/\varepsilon} + \sum_{v=N+1}^{N+n} \left(Hi_{ijv} \right)^{(\varepsilon-1)/\varepsilon} \right) \right]^{\varepsilon/(\varepsilon-1)}$$

in which N and n are the number of business services, or tasks, in the home and foreign country respectively, I_{ij} is the amount of business services of variety i used in sector j, H captures how efficiency business services are used, and $\varepsilon > 1$ is the elasticity of substitution between any pair of business services or tasks. This way of modelling diversified business services captures the well-documented fact that the joint inputs of a team of experts in different, but relevant areas of specialisation are more productive than one generalist providing the same number of man-months as the expert team. Thus, the larger the number of local and foreign differentiated business services, or tasks, the more a given quantity of S contributes to the production of Y.

The corresponding price index for the S-aggregate equals:

(5) $$P_{iSj} = \frac{1}{H_i} \left[\sum_{v=1}^{N} P_{iIv}^{1-\varepsilon} + \sum_{v=N+1}^{N+n} \left(P_{iIv} \tau \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}$$

Communication costs are assumed to be of the iceberg type so $\tau \geq 1$. The productivity parameters H capture differences in economic fundamentals of technological capability with which intermediates (either produced at home or abroad) are transformed into final consumption goods. Cost minimization yields the following spending rule on local and imported tasks (country 1 is the home country):

(6) $$\frac{I_{1jv}}{i_{2jv}} = \left[\frac{\tau P_{2Iv}}{P_{1Iv}} \right]^{\varepsilon}$$

Each business service or task is produced subject to economies of scale stemming from a fixed cost of developing the task in question. Employment in each service activity is given by

(7) $$L_{iIv} = L_{if} + \gamma I_{iv},$$

where L_f is the fixed cost of inventing the service in question, while γ is the unit labour cost of producing the service variety I_i. With free entry in the services sector, the price of the business service will be a mark-up over marginal cost defined by the elasticity of substitution between any two business services or tasks:

(9) $$P_{ilv} = \frac{\varepsilon}{\varepsilon - 1}\gamma_i W_i$$

Where W is the wage rate. Using (5), (7) and the free entry condition that ensures that profits are zero, output of the representative business service firm can be calculated to;

(8) $$I_{iv} = \frac{(\varepsilon - 1)L_{if}}{\gamma_i}$$

It follows from (6), (7) and (8) that employment in each services firm is εL_f. Consumers in both countries are assumed to have Cobb-Douglas preferences

(10) $$U_i = \prod_{j=1} C_{ij}^{\sigma_{ij}}$$

Where C_j represents consumption of products from sector j, and implies that consumers spend a fixed share of their income, σ_j, on final output j. It is assumed that final goods are traded subject to a small transport cost and that goods are differentiated according to country of origin (the Armington assumption). This allows trade and location patterns to be determined in a model with one factor and many sectors.

(11) $$C_{ij} = \left[Y_{1j}^a + y_{2j}^a\right]^{1/a}$$

where a represents the Armington elasticity. With consumer goods differentiated according to source, producers are able to obtain a mark-up over marginal costs (as given by (3)) as follows: $P_{iyj} = C_{iyj}/(1-a)$

Consumers in the home country maximize utility subject to their budget constraint:

(12) $$Max \prod \left[Y_{1j}^a + y_{2j}^a\right]^{\sigma_{1j}/a} s.t. \sum_j P_{1yj}Y_{1j} + \sum_j tP_{2yj}y_{2j} \le wL + \frac{1}{1-a}\sum_j Y_{1j}$$

where $t \ge 1$ is the iceberg transport cost. The last term is profits from the final goods sector that are received by consumers. This yields a similar spending rule as for intermediate services inputs as follows:

(13) $$\frac{Y_{1j}}{y_{2j}} = \left[\frac{tP_{2yj}}{P_{1yj}}\right]^a$$

Market clearing conditions in the labour market, the market for business services, the market for final goods and the balance of payments determine the equilibrium of the model and are given as follows:

(14) $$\sum_j \left(I_{ijv} + \pi_{ijv}\right) = \frac{\varepsilon - 1}{\gamma_i}L_{if}$$

(15) $$L_i = \sum_j L_{iyj} + N_i \varepsilon L_{if}$$

(16) $$P_{1yj} Y_{1j} + t P_{2yj} y_{2j} = \sigma_{1j} (w_1 L_1 + \sum_j Y_{1j} /(1-a))$$

and similar for the foreign country. The balance of payment condition closes the model

(17) $$\sum_j t P_{1yj} y_{ij} + N \tau P_{1I} i_1 = \sum_j t P_{2yj} y_{2j} + n \tau P_{rI} i_2$$

An analytical solution cannot be found unless stronger restrictions are imposed on the model, but it is possible to solve it numerically. I am interested in analysing how falling costs of trade in services affect production structures, trade in goods and services, and real income for different constellations of the exogenous parameters. For that purpose the model is written in GAMS having three final goods sectors that differ in services intensity and elasticity of substitution between services and value added in equation (1). As a benchmark I solve the model for symmetrical countries both in terms of labour endowments, consumer preferences and technology. I next explore the following scenarios: i) the home country has a 20% larger labour force than its trading partner; ii) the home country is 20% more efficient in its use of intermediate services or tasks (H is 20% higher); iii) The home country is more efficient in producing intermediate services or tasks (γ is 20% lower); iv) The home country has lower entry barriers in the services sector (L_f) is 20% lower.

An interesting question is the relation between the services intensity in the final goods producing sectors and the elasticity of substitution between outsourced services/tasks and value added produced within the representative firm. Whether there is a relation between the two parameters and if so, what such a relation should be is not clear a priori. I therefore explore two cases. First, I set parameter values such that both β and ρ declines in j. Second I let β decline in j while ρ increases in j. It turns out that this constellation matters for the results. In all scenarios and cases I run 30 steps where τ increases by 0.1 for each step, holding everything else constant. The base line scenario has the following parameter values: $\gamma = L_f = H = 1$ for both countries, $\varepsilon = 5$, $a = 8$, $t = 1.01$ and $L = 100$ for both countries. The value of the sector-specific parameters is presented in Table 3.

Table 3. Parameter values for simulation

		Case 1		Case 2	
Sector	σ	β	ρ	β	ρ
1	0.33	0.6	0.8	0.6	0.4
2	0.33	0.4	0.6	0.4	0.6
3	0.33	0.25	0.4	0.25	0.8

The resulting changes in key variables from the highest services trade cost included (τ =3.9) to the lowest τ = 1 are presented in Table 4.

Table 4. Simulation results

Percent change in key variables following a reduction in τ from 3.9 to 1.

Panel A: Case 1

	Home country					Foreign country			
	Symm.	L_1=120	H_2=0.8	γ_2=1.2	Lf_2=1.2	L_1=120	H_2=0.8	γ_2=1.2	Lf_2=1.2
PY3/PY1	-8.0	-7.0	-7.6	-6.6	-7.6				
GDP per capita	13.4	10.7	18.0	8.3	14.6	17.6	15.8	23.0	14.6
Employment share in services	0.7	2.2	-14.2	3.8	1.8	-0.1	-0.1	-2.0	-0.4
Export value									
Y1	1.5	-0.4	96.9	-4.8	-1.6	4.7	-37.9	5.6	3.9
Y2	1.5	-6.8	46.4	-15.8	-3.2	12.9	-33.8	27.1	6.2
Y3	1.5	-8.6	33.1	-19.4	-4.1	15.9	-26.3	42.9	7.4
Services*	116.2	121.7	141.5	142.3	116.6	112.4	100.8	99.8	114.9
Import penetration									
Y1	0.0	4.4	-41.7	6.8	3.0	-4.1	70.4	-10.2	-3.3
Y2	0.0	12.7	-37.8	28.6	5.3	-10.2	26.5	-20.6	-4.9
Y3	0.0	15.6	-30.7	44.6	6.5	-12.0	15.0	-24.0	-5.8

Panel B: Case 2

	Home country					Foreign country			
	Symm.	L_1=120	H_2=0.8	γ_2=1.2	Lf_2=1.2	L_1=120	H_2=0.8	γ_2=1.2	Lf_2=1.2
PY3/PY1	-4.8	-4.2	-3.2	-3.7	-4.5				
GDP per capita	13.3	13.1	13.5	7.4	14.2	17.4	10.2	17.6	14.2
Employment share in services	4.8	7.3	-37.1	5.7	5.0	6.1	6.1	2.6	4.7
Export value									
Y1	1.3	1.0	128.6	-6.0	-0.2	3.2	-47.7	4.9	2.5
Y2	1.3	-3.1	44.2	-18.2	-3.7	8.5	-37.9	26.9	6.4
Y3	1.3	-3.6	38.0	-19.4	-4.1	9.2	-34.2	31.2	7.0
Services*	120.1	121.7	103.5	120.7	120.9	124.8	116.4	116.8	120.1
Import penetration									
Y1	0.0	2.3	-50.6	6.0	1.7	-2.0	77.7	-8.4	-1.8
Y2	0.0	7.6	-41.4	28.2	5.6	-6.0	23.2	-20.3	-5.2
Y3	0.0	8.2	-37.9	32.6	6.2	-6.5	15.9	-21.4	-5.6

Note: Change in services trade is given by a times increase. E.g. 116.2 means that services exports increased 116.2-fold.

Symmetry

In this scenario two identical countries engage in trade in final goods and intermediate services and I study the effect of reducing cross-country communication costs. As communication costs decline from $\tau = 3.9$ to $\tau = 1$, real GDP per capita increases by about 13%. The gain stems almost entirely from deepening specialization as producers of final goods get access to the combined variety of services/tasks available in the two countries. Two-way trade in intermediate services/tasks expands more than 100-fold, but from a very low level at the highest trade cost. With free trade in intermediate services, each producer can develop his niche product and obtain sufficient scale through sales in both markets. This reduces the price index of intermediate services as given in equation (5), which in turn reduces the relative price of the most services-intensive final good, which is good 3. With lower prices of intermediate services, demand for such services increase and there is a small shift in employment towards the intermediate services sector (row three in the tables). This shift is larger in Case 2. Because of higher elasticity of substitution between internal and external production of services in the most services-intensive industry, the demand response to a change in the price index is larger. The second row in the tables presents the price of good 3 relative to good 1 and it declines by 8% in the first case where the most services-intensive good is subject to the lowest elasticity of substitution between internal and externally produced tasks. The change in relative prices of final goods is somewhat less in Case 2 where ρ is higher in sector 3. Trade in final goods expands at the same pace as output value and import penetration does not change. In conclusion the model exhibits the well-known property that even identical countries can gain substantially from trade in intermediate services/tasks due to deepening specialization.

Home country is 20% larger

A larger market allows for deeper specialization and with high trade cost, the price index of intermediate services/tasks is lower at home than in the foreign country. The home country therefore has a comparative advantage in sector 3 at high trade costs. However, as trade costs come down, the price index for intermediate services between the two countries converges and the home country looses its comparative advantage in the most services-intensive final goods industry. Hence, exports of final goods increase in the smaller foreign country and decline in the home country. In both countries exports and imports increase substantially in the services sector, but the increase in exports is largest in the home country. We also observe that the gains from trade in terms of an increase in GDP per capita are higher in the small country. The reason is that the price index of intermediate inputs declines more in this country since the relative number of varieties that carries iceberg trade costs is higher. In both Case 1 and Case 2 resources are shifted from direct inputs into the production of final goods to indirect inputs through intermediate services. This shift is stronger in Case 2 where also the small country experiences an increase in the

employment share in intermediate services. The impact on trade in goods takes the same direction, but is smaller in this case.[7] In conclusion, services trade liberalization erodes comparative advantage in services intensive industries and shifts exports away from services-intensive final goods to intermediate services. Thus, intermediate services are increasingly traded directly rather than embodied in services-intensive goods. The large country becomes more dependent on imports for its final consumption, while the smaller country becomes more self-sufficient in final goods as it imports more intermediate services instead of importing the services-intensive goods.

The home country uses intermediate services more effectively

In this scenario the two countries are similar in all respects except that the home country has a better technology for utilizing intermediate services or tasks. This could for instance be due to superior organizational technology including better supply chain management. The two countries are equally efficient in producing intermediate services/tasks, however. In this setting, services trade liberalisation induces a large shift in production and trade patterns. Since the home country is significantly better at utilising intermediate services, but no better at producing them, its resources are shifted towards the final goods sectors, while the foreign country specialises in intermediate services production. Thus, in this case services trade liberalisation results in a large increase in trade in both goods and services. The effects are similar in Case 2, but gains from trade are somewhat smaller and employment shifts larger.

The home country is more efficient in producing intermediate services

In this scenario the two countries have the same organization technology, but the home country has better production technology in the intermediate services sector, modelled by a 20% lower unit labour requirement. The impact of trade liberalization in this setting is very similar to the one where the home country is larger. In both cases the home country has a lower price index for intermediate services and a comparative advantage for the services-intensive good 3. With convergence of the price index (equation (5)), this comparative advantage is eroded and the home country turns to exporting services directly rather than embodied in final goods. The foreign country in contrast shifts resources away from its relatively inefficient intermediate goods production towards final goods production and exports. There is a substantial gain in GDP per capita in the foreign country since the cost of intermediate inputs declines both due to lower trade costs and due to lower producer prices of imported services.

The home country has lower entry costs in the intermediate services sector

[7] Although exports in sector 1 actually increases slightly in Case 2 in the home country.

Lower entry costs in the intermediate services sector can stem from lower cost of innovation e.g. due to better education, R&D support schemes or it can be due to lower regulatory barriers to entry. Again the home country will have a comparative advantage in services-intensive goods when trade in intermediate services are restricted through high communication costs. However, since the source of comparative advantage is lower costs of previously largely non-traded inputs, as trade opens up, the home country is able to exploit its superior technology in producing inputs directly through international trade in inputs.

5. SUMMARY AND CONCLUSIONS

This paper has analysed the interrelationship between trade in goods and intermediate services. It is first shown that there is a large variation among manufacturing sectors within countries and within manufacturing sectors between countries in terms of how intensively they employ intermediate services. It is also documented that the extent of trade in intermediate services is quite limited. Nevertheless, small open economies such as Ireland and Singapore has a relatively large and growing import share of intermediate services. Their experience demonstrates that the potential for trade in intermediate services can be significant. However, the potential for cross-border trade in intermediate services could be less than what a first glance at these two countries' trade figures suggest since a significant share of trade in services is accounted for by license fees. These are payments e.g. from foreign affiliates to their parent companies for use of trade marks or proprietary technology. A large contribution of licence fees to total trade in services thus suggest that services are largely provided through commercial presence of foreign affiliates.[8]

The paper next construct a model that is suitable for analysing the interrelationship between trade in goods and services. It is argued that with relatively high trade costs for services, a local intermediate service supplier base that offers a broad variety of services at relatively low cost is a source of comparative advantage in services-intensive goods. Although the services-intensity of manufacturing sectors varies between countries, it is generally the case that high-technology industries such as computers and office equipment are services-intensive. It also appears to be the case that a higher quality of goods within a manufacturing sector is associated with higher services intensity.

Having a relatively broad base of services suppliers at relatively low cost is associated with having a large domestic market for such services, superior technology in the production of such services or low barriers to enter the intermediate services sector. In a world of high trade costs in services, countries with relatively low costs of intermediate services will specialize in services-intensive goods and be net exporters of such final goods. High trade costs in intermediate services may stem from explicit or implicit barriers to trade

[8] See Grimes (2006) for a case study of Ireland.

in services. Examples are strict visa requirements and procedures for foreign business travellers, discriminatory qualification requirements for foreign services suppliers and cumbersome regulation. However, it is likely that trade costs stemming from the fact that services are not standardized resulting in incomplete contracts that are more costly to enter and monitor across than within jurisdictions are significant. In addition some services transactions require face-to-face interactions between services supplier and customer. Significant services trade costs are therefore likely to remain in the foreseeable future. Free trade in services is nevertheless a useful benchmark towards which real world scenarios can be compared to.

The model simulations demonstrate that a country with a relatively broad and cost effective intermediate services supply sector resulting in comparative advantage for services-intensive final goods sector will see this comparative advantage being eroded with declining services trade costs. Its exports of final goods will decline, particularly in the most services-intensive industries. However, instead of exporting services embodied in goods, the home country will to a larger extent export the services directly, while increasingly importing final goods. Hence instead of embodying intermediate services in exports of final goods, the home country's intermediate services will to a larger extent be embodied in its imports of final goods.

An interesting scenario is when the home country has superior technology for *using*, but not *producing* intermediate services. This could be empirically relevant particularly for services that can be standardised and traded over electronic networks, and for countries that have firms with highly sophisticated ways of organizing production. In this scenario falling services trade costs will result in specialisation in final goods production in the home country, while it will increasingly import intermediate services. A country with superior organisational technology will thus experience offshoring of intermediate services and a revival of manufacturing, albeit somewhat hollowed out, following falling trade costs in intermediate services.

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