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**BUSINESS SERVICES, TRADE AND COSTS**

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**by Molly Leshner and Hildegunn Nordås**

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## ABSTRACT

This technical paper analyses the role of business services in selected OECD and non-OECD economies using recently published input-output tables for 32 countries in or close to the year 2000. Business services have long been recognised as important drivers in the global economy, and this study reinforces that view with a comprehensive, quantitative cross-country analysis of how the manufacturing and business services sectors interact in the production process. Our analysis suggests that access to a wider variety of business services improves productivity in manufacturing. In small OECD and developing countries, the gains from trade in business services come primarily from access to a broader and more specialised business services supplier base than the domestic economy can sustain. In the largest OECD countries, gains from trade in business services stem mainly from lower costs of imported services and, to a lesser extent, an increase in variety.

*Keywords:* Business services, manufacturing, productivity, trade policy, outsourcing, off-shoring, input-output analysis, product variety, backward linkage, forward linkage, concentration index.

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## EXECUTIVE SUMMARY

This technical paper analyses the role of business services in select OECD and non-OECD economies using recently published input-output tables for 32 countries in or close to the year 2000. Business services are essential inputs in other industries, represent one of the most dynamic sectors in many economies and they are increasingly being outsourced and off-shored. While business services have been acknowledged to be important drivers in the global economy, this study presents a comprehensive, quantitative cross-country analysis of how the manufacturing and business services sectors interact in the production process. The most important findings are outlined below.

- In most OECD countries, business services are catching up with manufacturing in terms of their contribution to GDP, demonstrating that business services have emerged as one of the most dynamic sectors in many OECD countries.
- The business services sector in most OECD countries shows significantly stronger forward linkages than the average forward linkage in the manufacturing sector, and the linkages are dispersed among a broad range of downstream industries. In contrast, all of the developing countries studied showed stronger forward linkages in manufacturing as compared to the business services sector, and the linkages were less dispersed among other sectors.
- Our analysis suggests that access to a wider variety of business services improves productivity in manufacturing.
- In small OECD and developing countries, the gains from trade in business services come primarily from access to a broader and more specialised business services supplier base than the domestic economy can sustain. Since an increase in trade results in more variety, and more variety has been shown to increase welfare, countries that do not have a robust business services sector would be well-served to open their economies to trade in these services.
- In the largest OECD countries, gains from trade in business services stem mainly from lower costs of imported services and, to a lesser extent, an increase in variety.

Overall, business services are becoming increasingly important for OECD economies. Firms use business services primarily as intermediate inputs, and other business services firms tend to be each others' largest customers. The business services sector exhibits significant spillover effects as evidenced in the strength and dispersion of the forward linkages calculated in this paper. And while most large OECD economies have a robust domestic supplier base from which to draw inputs, all countries benefit from lowering trade barriers to business services through lower costs, greater variety, or both.

## BUSINESS SERVICES, TRADE AND COSTS

### Introduction

1. Many OECD economies have experienced a rapid increase in the share of business services in GDP, demonstrating that business services now represent one of the most dynamic sectors in many economies. Developments in the value of business services as a share of GDP can be traced for three countries since 1970 – Denmark, Germany and Norway – in the OECD STAN database. In these countries, business services' share of GDP more than doubled in Denmark (from 3.5% in 1970 to 7.3% in 2003) and more than tripled in Germany and Norway (from 3.7% to 11.9% and from 1.9% to 6.7%, respectively)<sup>1</sup>. Data available from 1980 show that the GDP share tripled for Austria and approximately doubled for Finland and France between 1980 and 2002-2003.

2. The business services share of GDP in the most recent year available, 2002 or 2003, varies from about 3% in Greece to 12.7% in France. In the United States, for which data is not reported in the OECD STAN database, the share of business services in GDP was 11.8% as compared to 12% for manufacturing in 2005<sup>2</sup>. The data thus show that business services is one of the most dynamic sectors in most OECD economies, its relative share of GDP in some countries is close to that of total manufacturing, and its share of GDP varies greatly among OECD countries.

3. We define business services to include “computer and related services”, “research and development” and “other business services” (ISIC Rev. 3 categories 72, 73 and 74). The computer and related services category (72) includes services such as hardware and software consulting, data processing and the maintenance and repair of office equipment, among others. The research and development category (73) involves activities related to the natural and social sciences, humanities and engineering. Finally, the other business services category (74) represents services such as advertising, architectural, engineering, legal, accounting and business management services, among others.

4. These services represent essential inputs in other industries. For example, computer and related services facilitate the transmission of new developments in information and computer technology (ICT), both directly and indirectly through technology spillovers. Mun and Nadiri (2002) document the spillover effects for the United States by exploring the externalities from ICT investments during the period 1984-2000. They find that the business services sector is one of the sectors in which investment in ICT has the strongest effect on other sectors' costs. The effect is largest for other services sectors such as finance, real estate, communication and education, but the effect is also significant in manufacturing, particularly in machinery-producing sectors.

5. In addition, research and development services improve products and processes, and other business services – which include legal, advertising and recruitment services – are all fundamental for the operation of a modern business. In the past, many believed that most of these services were of strategic

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1. Data for Germany represents Western Germany from 1970 to 1990.

2. Source: [http://www.bea.gov/bea/pn/GDPbyInd\\_VA\\_NAICS.xls](http://www.bea.gov/bea/pn/GDPbyInd_VA_NAICS.xls). The U.S. Bureau of Economic Analysis defines business services as “professional and business services”, a more inclusive definition than the one used in this paper.

importance or required firm-specific knowledge and, as a result, these services were largely produced in-house.

6. Yet firms can realise gains from outsourcing business services through lower costs as outside suppliers exploit scale economies that only the largest firms can match by in-house production. In addition, outsourcing provides firms with access to a broader range of specialists using state-of-the art technology than they could possibly employ in-house. And access to a diverse base of business services suppliers is particularly important for the competitiveness of small- and medium-sized enterprises.

7. For small countries, the domestic market may not be large enough for a broad and diversified business services sector to gain sufficient scale to be cost effective. For such countries, international trade can contribute to both lower costs and broader variety. First, local firms can obtain sufficient scale through exports. Second, downstream customers can access a wider range of services than what is available locally through imports.

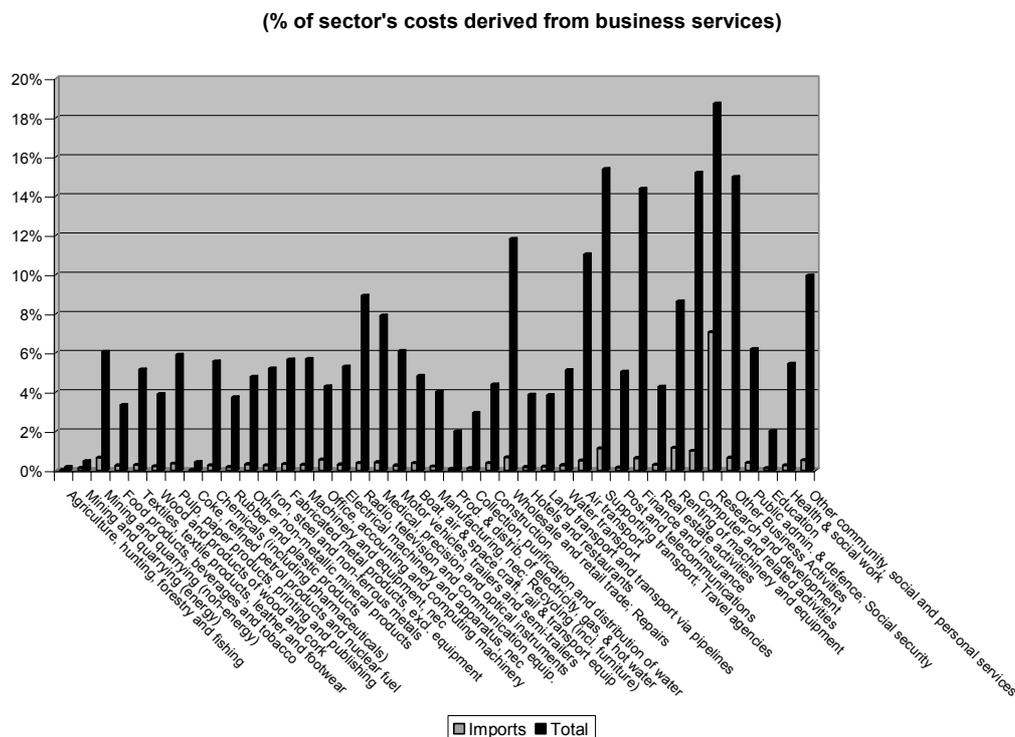
8. This study documents the relative importance of business services in OECD and select non-OECD economies and their contribution to other industries' costs, particularly manufacturing. The recent publication of updated OECD input-output tables allows us to study in detail the role that business services plays in the manufacturing production process. Do business services represent a relatively large cost share of the output produced in other sectors? Are business services more important for some industries than others? How does trade in business services affect the cost structure in other sectors? This paper seeks to answer these questions to better understand the inter-linkages between manufacturing and business services.

### **Business services and production**

9. An analysis of the intermediate supply and demand dynamics among industries represents a first step in assessing the role that business services plays in the manufacturing production process. Input-output tables are a useful tool in analysing the flows in the value of goods and services between any two sectors of the economy because they highlight the role of intermediary products, such as business services. Input-output analysis also helps identify "key" industries on which most industries in the economy rely. Financial, transport and communication services can be characterised as key industries, but as will be shown in this study, business services also fall under this category.

10. It is useful to have a sense of the magnitude of the business services cost shares for the 48 sectors included in the input-output tables in the dataset. We use the latest edition of the OECD input-output tables, which includes data for 26 OECD countries and 6 non-member economies, in and around the year 2000 (see Annex I for more information about the dataset). While space constraints prohibit the inclusion of the business services cost shares for all countries, a representative sample is included in Annex IV. Below we analyse Italy, which is representative of a relatively large OECD economy.

Figure 1. Cost shares of business services in the Italian economy



Note: Cost shares are calculated from the OECD input-output table for Italy (2000) as of 1 June 2006.

11. In Italy, as with many of the large developed economies analysed, other services sectors – rather than manufacturing sectors – showed the highest cost shares of business services. In addition, we tend to see more variation between the highs and lows of the business services cost shares among the services sectors in comparison to the manufacturing sectors. It is worth noting, however, that the high-technology manufacturing sectors such as radio, television, communication equipment and medical, precision and optical instruments are the manufacturing industries that use business services most intensively.

12. We also study Italy in conjunction with the other large OECD economies: Canada, France, Germany, Japan, the United Kingdom and the United States. In these countries, the three categories of business services of interest – computer and related services, research and development, and other business services, which include advertising, engineering, legal, accounting and business management services, among others – tend to be each others' largest customers. The graphs in Annex IV indicate that the computer and related activities sector uses business services most intensively, with an average of 19% and a high of 27% for the United Kingdom (see Figure 19). The other business services sector has the second highest average at a little over 15% and the research and development sector is not far behind at around 14%. These results suggest that business services firms tend to assemble a package of specialised services to their customers.

13. The finance and insurance sector represents another sector that intensively uses business services. Across the seven countries analysed, the average cost share of business services in this sector was 13%. This finding is consistent with the literature, and some studies note that economies that are strong in sectors that intensively use business services are likely to develop a strong business services sector because of complementarities that exist between the sectors (see Guerrieri and Meliciani, 2005).



for 7 sectors in the Irish economy. Moreover, the sectors that most intensively use business services as inputs are manufacturing – rather than services – sectors. The pulp, paper products, printing and publishing and radio, television and communication equipment sectors both derive over 20% of their inputs from business services.

18. However, some services sectors also have fairly large cost shares for business services, such as hotels and restaurants as well as the business services sector itself, with cost shares in the range of 15%. The results also fit the pattern observed for the larger developed countries (*i.e.*, that the business services sectors largely feed themselves). Ireland also imports a much greater share of business services inputs than larger, more developed economies, such as Italy. In fact, Ireland imported most of its business services inputs in 1998.

### Trade and costs

19. Figures 1 and 2 demonstrate that imports are a more important source of business services in a small country such as Ireland than a large economy such as Italy. In this section, we assess the possible impact on total costs and productivity from importing business services. As argued above, firms derive gains from outsourcing business services from two sources – lower costs of each input and a broader variety of inputs. This can be represented by the following equations:

$$B = \left[ \sum_{i=1}^N b_i^\rho + \sum_{j=1}^M b_j^{*\rho} \right]^{1/\rho} \quad C_b = \left[ \sum_{i=1}^N p_i^{1-\sigma} + \sum_{j=1}^M p_j^{*1-\sigma} \right]^{1/(1-\sigma)}$$

20. The first equation represents total business services, denoted  $B$ , as an aggregate of a number of differentiated individual services, denoted  $b$ , of which  $N$  are produced locally and  $M$  are imported, and  $\rho$  represents the substitution parameter. The second equation represents the dual cost function where  $p$  represents prices of local business services and  $p^*$  denotes the price of imported business services. In the latter equation,  $\sigma = (1/(1-\rho))$  and is the elasticity of substitution<sup>3</sup> between any two services – that is, the degree to which any two services may be substituted for one another. The elasticity of substitution for services is always larger than one and it is often assumed to be between two and five (see, for instance, Markusen, Rutherford and Tarr (2004) and Decreux and Fontagné (2006)).

21. What is notable with these functions is that the  $B$ -aggregate increases with the number of differentiated business services even when the aggregate value of business services remains constant. This property captures the notion that, for instance, when constructing a yacht it is better to have one man-month input from each of an architect, an engineer and a designer than three man-months of an engineer only. By the same token, the cost index for business services declines with the number of inputs. The larger is  $\sigma$ , the smaller the effect of an increase in the number of inputs. This is reasonable, since  $\sigma$  tells us that many business services are close substitutes. In other words, the more similar the business services the less is the gain from adding a new variety.

22. Feenstra *et al.* (1999) show how the two aggregates above relate to total factor productivity and total costs in a sector in which the final product is produced by assembling inputs only (with no value added). We follow this approach and construct scenarios that yield a rough estimate of the gains from trade in business services. We chose two industries, “machinery and equipment” and “radio, television and communication equipment” in the United States, France, Ireland and Japan as examples.

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3. Technically speaking, the elasticity of substitution is a measure of the change in factor proportions resulting from a change in the marginal rate of technical substitution.

23. To make the analysis tractable, we first discuss the gains from expanding product variety, holding prices of each input constant. Next, we hold the number of varieties constant and analyse the impact of lower prices (*e.g.*, due to a shift in sourcing of imports to developing countries). From Feenstra *et. al.*'s work we know that the productivity gains from imports can be measured as follows<sup>4</sup>:

$$TFP = \frac{1}{\sigma - 1} \ln \left( \frac{n + m}{n} \right)$$

24. In our case, business services are one of many inputs in the cost function, and we must adjust this by the share of business services in total costs. The cost shares are calculated from the dual of a KLEM-type production function. The production function takes the form:  $Y = K^\alpha L^\beta G^\varepsilon S^\varphi B^\gamma$  where  $\alpha + \beta + \varepsilon + \varphi + \gamma = 1$ .  $Y$  represents gross output,  $K$  stands for capital,  $L$  signifies labour,  $G$  denotes material inputs,  $S$  represents services other than business services and  $B$  symbolises business services. The parameters  $\alpha$ ,  $\beta$ ,  $\varepsilon$ ,  $\varphi$  and  $\gamma$  simply show the share of each input in gross output – that is, the cost share coefficients represent the input required per unit of industry output – and they vary between sectors and countries as indicated in Table 1 where locally produced and imported goods and services are distinguished.

**Table 1. Cost structure of selected industries, in millions of USD and cost shares**

Panel A: Costs in millions of USD								
	USA		France		Ireland		Japan	
	Machinery	Radio	Machinery	Radio	Machinery	Radio	Machinery	Radio
<b>Domestic</b>								
Value added	116776	105888	15430	7119	869	2053	105991	90974
Goods	98971	70637	13441	11747	80	177	112842	101113
Other services	43159	43491	4976	3253	203	421	35158	29065
Business services	24539	34472	6641	4791	16	236	17877	29739
<b>Imports</b>								
Goods	19465	40421	4640	5116	927	818	8797	18044
Other services	217	176	32	24	4	17	383	259
Business services	68	137	340	251	66	781	305	364
Panel B: Shares of total costs								
	USA		France		Ireland		Japan	
	Machinery	Radio	Machinery	Radio	Machinery	Radio	Machinery	Radio
<b>Domestic</b>								
Value added	38.5	35.9	33.9	22.0	40.1	45.6	37.7	33.7
Goods	32.6	23.9	29.5	36.4	3.7	3.9	40.1	37.5
Other services	14.2	14.7	10.9	10.1	9.4	9.3	12.5	10.8
Business services	8.1	11.7	14.6	14.8	0.7	5.2	6.4	11.0
<b>Imports</b>								
Goods	6.4	13.7	10.2	15.8	42.8	18.2	3.1	6.7
Other services	0.1	0.1	0.1	0.1	0.2	0.4	0.1	0.1
Business services	0.0	0.0	0.7	0.8	3.0	17.3	0.1	0.1
Memo: import share, business services %	0.3	0.4	5.1	5.2	412.7	330.9	1.7	1.2

Source: OECD input-output tables converted to USD using market exchange rates from the IMF's International Financial Statistics.

4. Here we have made the simplifying assumption that the individual varieties of business services enter the aggregates symmetrically.

25. The difference between Ireland and the other countries in the table is quite striking. A small market that cannot support a well-diversified domestic supplier base appears to have had two effects on the Irish manufacturing sectors included in the table. First, the value added share is significantly higher than in the three larger countries, particularly in the radio, television and communication equipment sector. This suggests that more activities are kept in-house, as one would expect when the domestic supplier base is shallow. Second, we notice that the import share of both goods and services is much higher in Ireland than the three larger countries. In fact, the import share is three to four times higher than the share of domestically provided inputs for business services. The smallest economy among the four has the highest imports in dollar terms, while the largest country, the United States, has the lowest imports in dollar terms reported in the table.

26. France has a relatively low value added share in both sectors, indicating deeper vertical specialisation than the three other countries. France also has a relatively high import share in business services compared to the United States and Japan, again suggesting that imports complement domestic supply and provide greater variety.

27. The data sources do not report the number of varieties, and we therefore need to construct proxies. Previous studies on the gains from expanding variety in goods have used the number of 6-digit sectors in which a country produces (or exports) as a proxy. For services this is not feasible, since both production and export data are given at an aggregate level and business services are much more heterogeneous than goods. An alternative option that gives us a sense of the dispersion of variety between countries is to use an index in which we set the number of varieties in the United States to 100. In other countries, the number of domestic business services will be 100 times the country's production of business services relative to the United States. Normalising the number of business services to 100 in the United States yields an index of 35 in Japan, 1 in Ireland and 13 in France, rounded to the nearest integer.

28. We now conduct a simple analysis of possible gains from trade in business services. First, the impact of expanding variety by one index unit is assessed using two different assumptions of the elasticity of substitution, one at each end of the spectrum of elasticities commonly found in the literature. The results are presented in Table 2.

**Table 2. Productivity gains as a result of a one index unit expansion of product variety**

	Scenario 1, $\sigma = 2$		Scenario 2, $\sigma = 5$	
	Machinery	Radio	Machinery	Radio
US	0.08	0.12	0.02	0.03
France	1.14	1.16	0.28	0.29
Ireland	2.61	15.66	0.65	3.91
Japan	0.18	0.31	0.05	0.08

29. A one unit increase in product variety means extending the local range of services by the equivalent of one percentage point of the U.S. range of varieties. This would obviously amount to a 1% increase in the United States, while it would double the variety in Ireland. Due to diminishing returns to diversity, an extra unit will have very different productivity effects in the four countries. In the United States, the productivity gains for the two downstream industries would be a tenth of a percentage point or less. In contrast, Irish productivity could increase by as much as 16 percentage points when  $\sigma = 2$ .

30. While a doubling of the amount of variety may sound like a tall order, between 1998 and 2005 Irish exports of business services in nominal dollar terms more than quadrupled while imports more than doubled. Based on the results from the scenarios constructed in this section, the increase in Irish imports in the last six years has probably more than doubled the variety. This finding is in line with the literature,

which suggests that trade increases variety, which in turn raises consumer welfare (for example, see Roemer (1994) and Andersson (2005)).

31. Moreover, France stands to gain significantly from further expansion of the variety of business services available. We also notice that the gains differ substantially depending on the assumptions made about the elasticity of substitution between any two varieties of business services<sup>5</sup>. Finally, we emphasise that this is not a forecast, but rather a stylised and realistic example of the gains to be made from expanding product variety through trade.

32. The second experiment that we make simulates the cost effect of lower prices of business services through the sourcing of such services from lower-cost countries. An OECD study (2004) finds that about 20% of most services produced in OECD countries could be outsourced. So let us assume that 20% of the business services currently sourced locally in the four countries were imported instead. In 2000, OECD countries accounted for a large portion of the imports of business services in France (82%), Ireland (78%), Japan (72%) and the United States (80%)<sup>6</sup>. In our scenario, we reduce this share to 70% for all four countries. Finally, research by McKinsey Global Institute (2003) suggests that business services from developing countries cost about 40% less than in OECD countries; this is the final assumption that we use in the construction of the scenario. Table 3 reports the cost reductions that would result from this experiment.

**Table 3. Cost savings from shifting sourcing of business services**

	USA		France		Ireland		Japan	
	Machinery	Radio	Machinery	Radio	Machinery	Radio	Machinery	Radio
Cost savings (% of total cost)	0.2	0.3	0.4	0.4	0.1	0.7	0.2	0.3

33. The cost reductions are not large – less than 1% in all four countries in both sectors. The largest cost savings are in the radio, television and communication equipment sector in Ireland. The costs savings would of course be larger if we assumed that developing countries took a larger market share, but since business services are a relatively skills- and IT-intensive sector, this may not be realistic. The largest gains from trade in business services are therefore likely to come from expanding product variety or, in other words, access to more specialised business services.

34. So far we have analysed the direct links between business services and the manufacturing sector. The next section extends the analysis to include both direct and indirect links.

### **Business services and their links with other sectors in the economy**

35. Linkage theory has its roots in the work of Rasmussen (1956) and Hirschman (1958). It is useful to compare the linkages of the manufacturing and business services sectors to understand the dynamics of

5. Different assumptions about the elasticity of substitution between goods and services from different sources is one important reason why model estimates of the gains from trade differ from one study to the next even when they analyse the same policy measures for the same countries during the same period.

6. Source: OECD database on bilateral trade in services.

the structure of production across countries<sup>7</sup>. Soofi (1992) notes several reasons why linkages among sectors are important:

1. Sectors that are linked to relatively more sectors tend to produce more and have a higher labour share in final demand;
2. Linkages generate multiplier effects in the economy; and
3. Industry interconnectedness facilitates technology transfer.

36. We calculate four different types of linkages: backward linkages, forward linkages, backward concentration indexes and forward concentration indexes. We then analyse these linkages to further study the relationship between business services and manufacturing.

### ***Backward and forward linkages***

37. Backward linkages assess how a one unit rise in final demand affects a sector's suppliers; thus, backward linkages measure the degree to which sectors depend upon other sectors for their inputs. Forward linkages quantify the effect on the producer industry due to an increase of one unit of final demand; that is, forward linkages show the extent to which sectors supply inputs to other sectors down the value chain. Sectors which have a backward or forward linkage greater than 1 are considered "key" sectors.

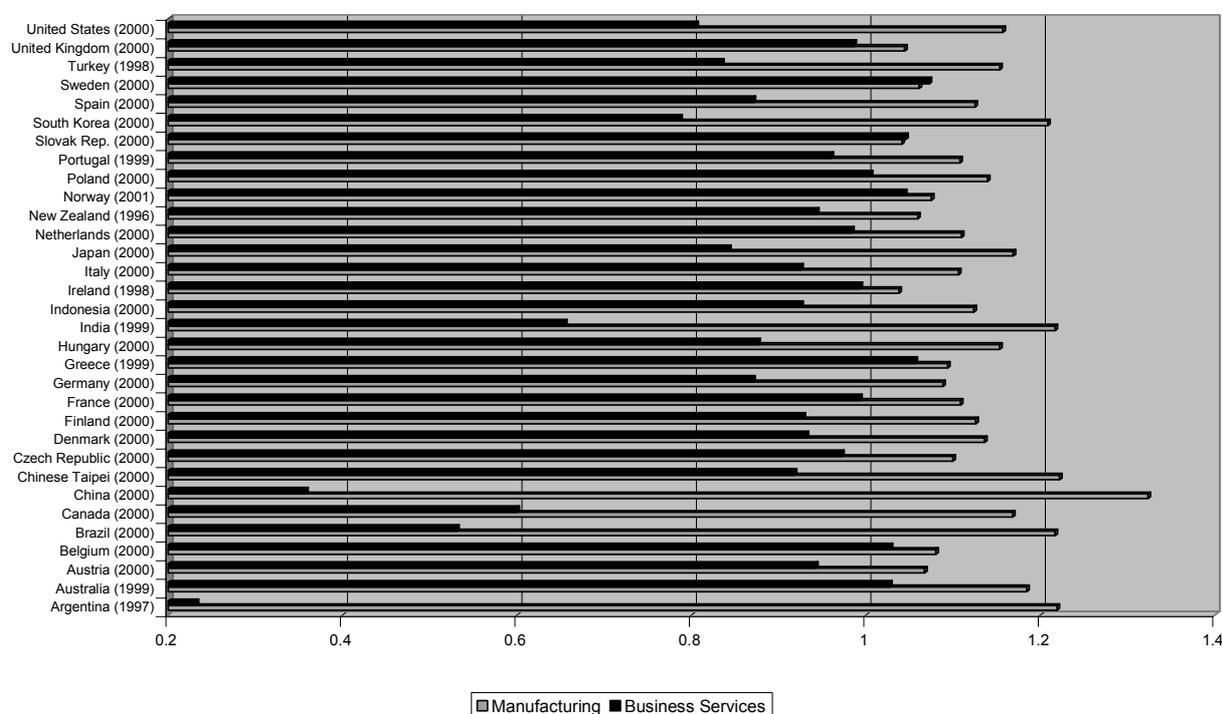
38. The linkages are unweighted averages for manufacturing and business services and are derived from the total requirement matrix<sup>8</sup>. Annex II includes the formulas used for calculating the linkages.

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7. The manufacturing sector represents an average of the 22 manufacturing sectors present in the OECD input-output tables while the business services sector is an average of the computer and related services, research and development, and other business services categories in the OECD input-output tables.

8. The total requirement matrix is calculated as  $[I-A]^{-1}$  (*i.e.*, the inverse of the input-output matrix).

Figure 3. Backward linkages for total inputs



Note: Backward linkages are calculated from recent editions of the OECD input-output tables (see Annexes I and III for details about the dataset).

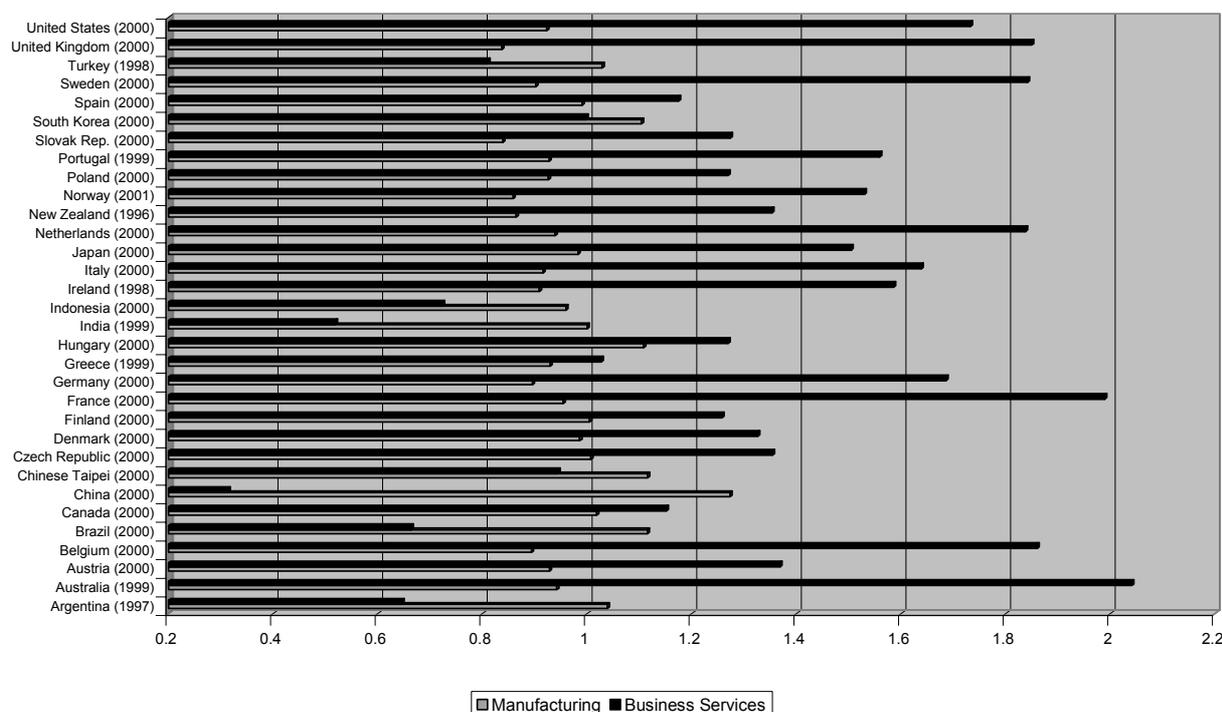
39. The results show that across countries, backward linkages are generally stronger for the manufacturing sector than the business services sector. On average, this means that a rise in final demand for manufacturing goods significantly affects the industries that supply the manufacturing sector (that is, one would expect an increase in demand in the supplying sectors). On the other hand, the business services sector shows an average backward linkage that is less than 1 for most countries in our sample, thus indicating that changes in the final demand for business services do not impact other industries considerably. This makes sense insofar as business services are primarily used as inputs in other sectors.

40. In general, the variation in backward linkages for developed countries is less pronounced than it is for the developing countries in the dataset. The difference between the manufacturing and business services averages across the OECD countries is 0.18, in contrast to 0.62 for the non-OECD members in the dataset. This result simply shows that the OECD countries have more developed services sectors than the non-member economies.

41. Sweden and the Slovak Republic are exceptions to this general pattern as their business services backward linkage is both above 1 and slightly higher than the linkage calculated for the manufacturing sector. These results could be influenced by the rapid growth of the business services sector in Sweden in the 1990s, and in particular very high demand for specialised services. Moreover, in the Slovak Republic, the share of services in GDP has increased consistently since the 1990s, and reached 61% in 2000, while at the same time manufacturing's share of GDP decreased by 50% between 1990 and 2000 (EIU, 2004). Perhaps the large increases in services in these two economies can at least partly explain why backward linkages in business services are so strong relative to the other countries.

42. A comparison of the forward linkages in the manufacturing and business services sectors is another important component of linkage analysis. Figure 4 presents the forward linkages calculated for the countries in the dataset.

**Figure 4. Forward linkages for total inputs**



Note: Forward linkages are calculated from recent editions of the OECD input-output tables (see Annexes I and III for details about the dataset).

43. The pattern of forward linkages suggests that on average, a one unit increase in final demand implies that producers of business services must increase supply more than the average industry to meet the rise in demand. Again, forward linkages above 1 suggest that the sector is a “key” sector; in this case, as a supplier of inputs to other sectors further along the value chain. Several of the countries analysed, including the United States, the United Kingdom, the Netherlands, Germany, Australia and France, among others, show high forward linkages (*e.g.*, above 1.5).

44. However, for developing countries a different pattern emerges. The graph shows that all of the non-OECD member countries analysed – Argentina, China, Chinese Taipei, India, Brazil and Indonesia – have greater forward linkages in manufacturing than in business services. This could in part reflect that developing countries generally have less mature services sectors, and that manufacturers largely produce business services in-house in these economies. As shown in Figure 8 in Annex III, Ireland has an extremely large forward linkage for imports of business services; it is the highest by far of any of the countries surveyed. As discussed in the previous section, Ireland’s spectacular growth – particularly in business services intensive industries – would probably not have been possible without access to a diversified base of imported business services.

45. For OECD countries, one can also see a greater difference in the variation of forward linkages between the manufacturing and business services sectors (0.53) than the backward linkages (0.18). In addition, the forward linkages are on average of a greater magnitude than the backward linkages, with the

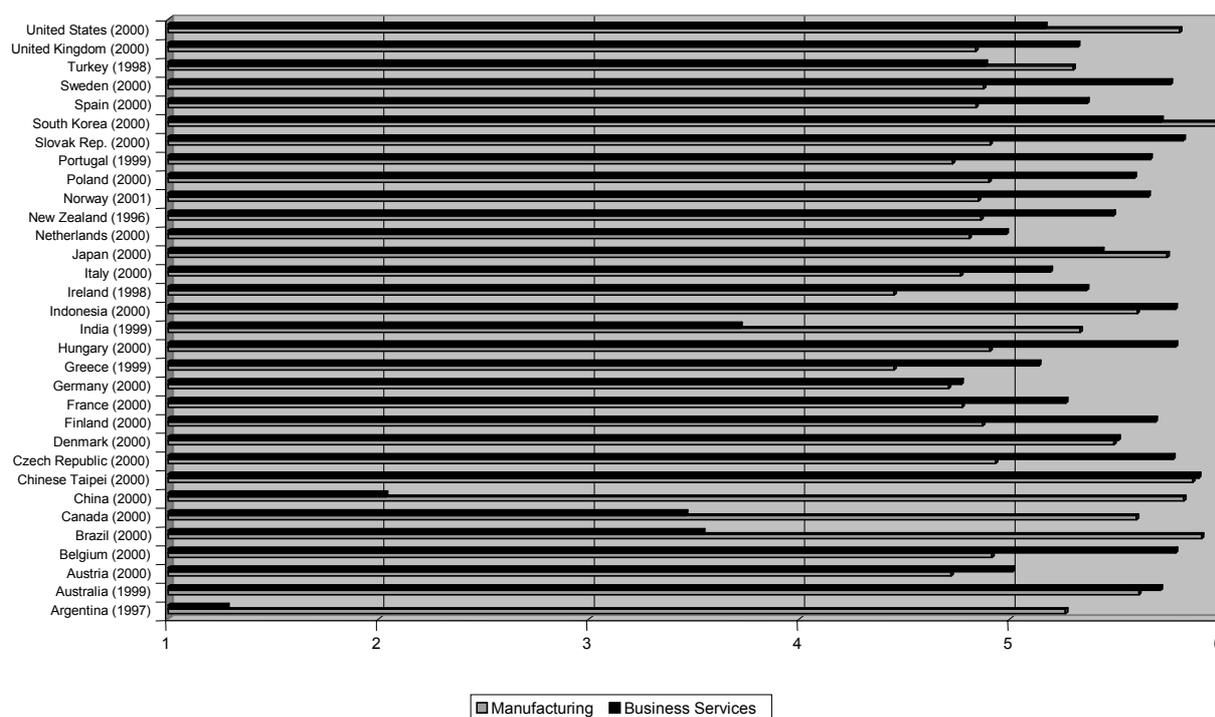
forward linkage for business services exceeding 2 for Australia. This result further underscores that the business services sector is a key sector in OECD economies.

**Concentration indexes**

46. While backward and forward linkages are useful in understanding the magnitude of inter-industry transactions, they are nevertheless subject to extreme values. Another method of studying the transactions among industries in an economy is the use of measures that show whether industries trade a lot with a few sectors or with a wide variety of sectors. Sectors with relatively more linkages across sectors can be considered key sectors from a policy perspective because they have more of a “ripple effect” through the economy.

47. The specifications of industry concentration borrow from the approach used by Claus (2003). The indexes are constructed such that a higher concentration index indicates that a sector trades with a relatively larger number of other sectors. The indexes are calculated using the same total requirement matrix used to construct the backward and forward linkages, and they are specified mathematically in Annex II.

**Figure 5. Backward concentration indexes for total inputs**



Note: Backward concentration indexes are calculated from recent editions of the OECD input-output tables (see Annexes I and III for details about the dataset).

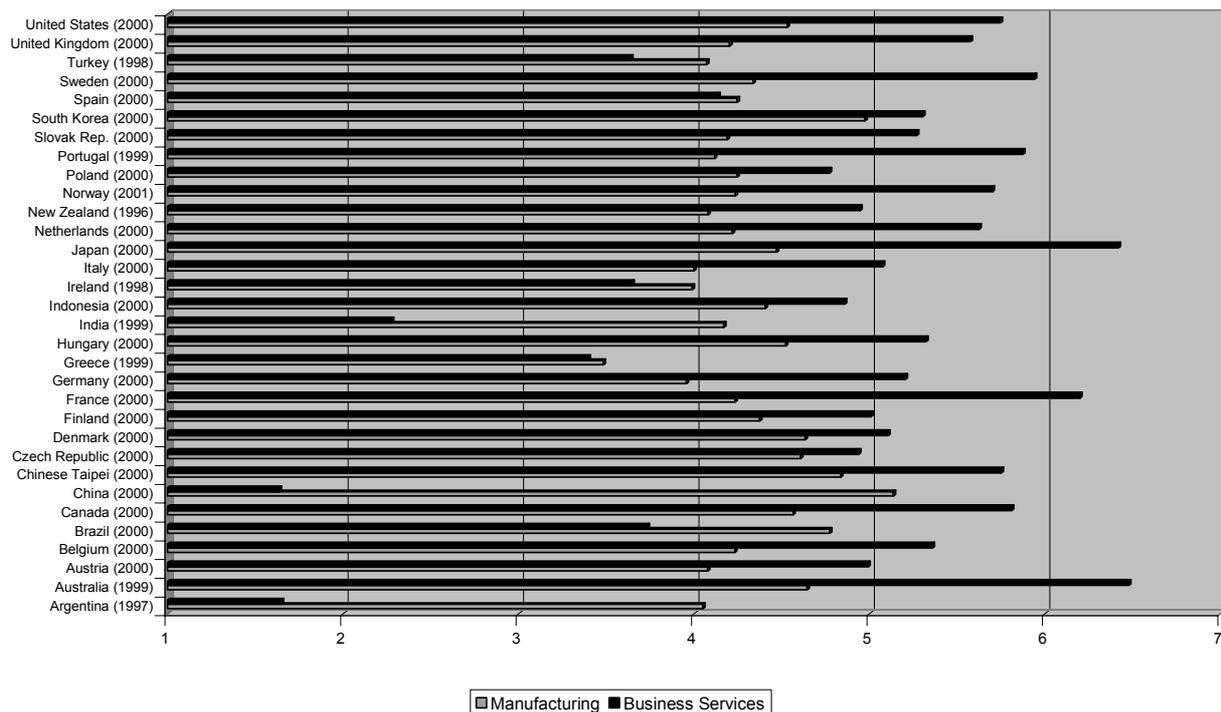
48. The OECD countries in our sample show higher backward concentration indexes for business services than they do for the manufacturing sector with the exceptions of the United States, Turkey, South Korea, Japan and Canada. These results suggest that in OECD countries, an increase in final demand implies that the business services sector draws on inputs from relatively more sectors than is the case for the manufacturing sector (*i.e.*, the ripple effect is relatively larger for suppliers of business services).

49. The non-member economies have higher backward concentration indexes for manufacturing than they do for business services except for India and Chinese Taipei. Thus, we can say that in non-member

economies, the ripple effect of an increase in final demand is on average greater for suppliers of the manufacturing sector.

50. The forward concentration indexes generally show more variation than the corresponding backward concentration indexes. Figure 6 graphically represents the forward concentration indexes across the countries in the dataset.

**Figure 6. Forward concentration indexes for total inputs**



Note: Forward concentration indexes are calculated from recent editions of the OECD input-output tables (see Annexes I and III for details about the dataset).

51. The results suggest that all countries except Argentina, Brazil, India, China, Turkey, Spain, Ireland and Greece have higher forward concentration indexes for business services than they do for the manufacturing sector. The forward concentration indexes measure how spread out the effect of a one unit increase in final demand is on the sales from one sector to other sectors in the economy. Since it appears that the business services sector in most of the economies studied has a higher forward concentration index, we can conclude that higher final demand implies that the business services sector will sell its output to relatively more sectors than will the manufacturing sector.

52. One also observes greater variation in the magnitudes of the differences between the forward concentration indexes for manufacturing and business services and the backward concentration indexes. This suggests that an increase in final demand affects a sector's sales to other sectors more unevenly than it does that sector's suppliers.

## Conclusion

53. The propensity of manufacturers to fragment the production process into increasingly smaller components has meant that services have begun to play an even more important role in the manufacturing value chain. Business services in particular are important inputs in the production of goods as well as services; thus, it is critical for policymakers to understand the role that business services plays in the manufacturing production process.

54. The input-output analysis presented in this paper sheds light on how the manufacturing and business services sectors interact in the production process. The most important findings are outlined below.

- In most OECD countries, business services are catching up with manufacturing in terms of their contribution to GDP, demonstrating that business services have emerged as one of the most dynamic sectors in many OECD countries.
- The business services sector in most OECD countries shows significantly stronger forward linkages than the average forward linkage in the manufacturing sector, and the linkages are dispersed among a broad range of downstream industries. In contrast, all of the developing countries studied showed stronger forward linkages in manufacturing as compared to the business services sector, and the linkages were less dispersed among other sectors.
- Our analysis suggests that access to a wider variety of business services improves productivity in manufacturing.
- In small OECD and developing countries, the gains from trade in business services come primarily from access to a broader and more specialised business services supplier base than the domestic economy can sustain. Since an increase in trade results in more variety, and more variety has been shown to increase welfare, countries that do not have a robust business services sector would be well-served to open their economies to trade in these services.
- In the largest OECD countries, gains from trade in business services stem mainly from lower costs of imported services and, to a lesser extent, an increase in variety.

55. Overall, business services are becoming increasingly important for OECD economies. Firms use business services primarily as intermediate inputs, and other business services firms tend to be each others' largest customers. The business services sector exhibits significant spillover effects as evidenced in the strength and dispersion of the forward linkages calculated in this paper. And while most large OECD economies have a robust domestic supplier base from which to draw inputs, all countries benefit from lowering trade barriers to business services through lower costs, greater variety, or both.

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## ANNEX I

Table 4. Input-output tables in the dataset

<b>OECD Members</b>	
Australia	1998/1999
Austria	2000
Belgium	2000
Canada	2000
Czech Republic	2000
Denmark	2000
Finland	2000
France	2000
Germany	2000
Greece	1999
Hungary	2000
Ireland	1998
Italy	2000
Japan	2000
Korea	2000
Netherlands	2000
New Zealand	1996
Norway	2001
Poland	2000
Portugal	1999
Slovak Republic	2000
Spain	2000
Sweden	2000
Turkey	1998
United Kingdom	2000
United States	2000
<b>Non-OECD Members</b>	
Argentina	1997
Brazil	2000
China	2000
Chinese Taipei	2001
India	1998/1999
Indonesia	2000

Notes : Data come from the OECD as of 1 June 2006 except Belgium, Brazil, France, Greece, the United States and Korea, which are as of 1 July 2006. The tables include 48 sectors, although not every country reports in each sector.

## ANNEX II

To compute the backward and forward linkages as well as the backward and forward concentration indexes, it is necessary to invert the input-output tables. The resulting (unweighted) coefficients are then used to construct the linkage and concentration measures. A full description of the mechanics behind matrix inversion can be found in Claus (2003).

**Backward and forward linkages**

The backward linkages can be represented mathematically as an index:

$$U_{.j} = \frac{(1/N)b_{.j}}{(1/N^2)\sum_{j=1}^N b_{.j}} = \frac{b_{.j}}{(1/N)\sum_{j=1}^N b_{.j}}$$

where  $b_{.j}$  equals the sum of the coefficients in a given column  $j$  in the inverted matrix, or:

$$b_{.j} = \sum_{i=1}^N b_{ij}$$

Simply stated, this index is calculated by dividing the effect of a one unit rise in final demand for sector  $j$ 's output on other industries by the effect of a one unit increase in final demand for the output of all sectors in the entire economy.

The forward linkages can also be represented mathematically as an index:

$$U_{.i} = \frac{(1/N)b_{.i}}{(1/N^2)\sum_{i=1}^N b_{.i}} = \frac{b_{.i}}{(1/N)\sum_{i=1}^N b_{.i}}$$

where  $b_{.i}$  equals the sum of the coefficients in a given row  $i$  in the inverted matrix, or:

$$b_{.i} = \sum_{j=1}^N b_{ij}$$

Simply stated, this index is calculated by dividing the effect resulting from a one unit rise in final demand on sector  $i$ 's output by the effect of a one unit increase in final demand for the output of all sectors in the entire economy.

**Concentration indexes**

The backward concentration indexes can be represented mathematically as follows:

$$G_{\cdot j}(b_{ij}) = \left[ N \left( 1 - \sum_{i=1}^N (c_{j,ij})^2 \right) \right]^{1/2}$$

where for all  $i$  and  $j$ :

$$c_{j,ij} = \frac{b_{ij}}{\sum_{i=1}^N b_{ij}} = \frac{b_{ij}}{b_{\cdot j}}$$

The forward concentration indexes can be represented mathematically as follows:

$$G_{\cdot i}(b_{ij}) = \left[ N \left( 1 - \sum_{j=1}^N (c_{i,ij})^2 \right) \right]^{1/2}$$

where for all  $i$  and  $j$ :

$$c_{i,ij} = \frac{b_{ij}}{\sum_{j=1}^N b_{ij}} = \frac{b_{ij}}{b_i}$$

Since these indexes assume that the number of sectoral links are determined by sector output (*i.e.*,  $G = (n-1)^{1/2}$ ), the indexes result in a measure of sector “interconnectedness” in which a higher value indicates that a sector is spreading out more into other sectors of the economy relative to other sectors.

ANNEX III

All graphs in this annex are derived from recent editions of the OECD input-output tables (see Annex I for details about the countries and years). Due to issues of data aggregation, Argentina's business services average also includes the renting of machinery and equipment category. For China, the business services average includes the renting of machinery and equipment as well as the other community, social and personal services categories. And for India, the business services average includes the education sector.

Figure 7. Backward linkages for imported inputs

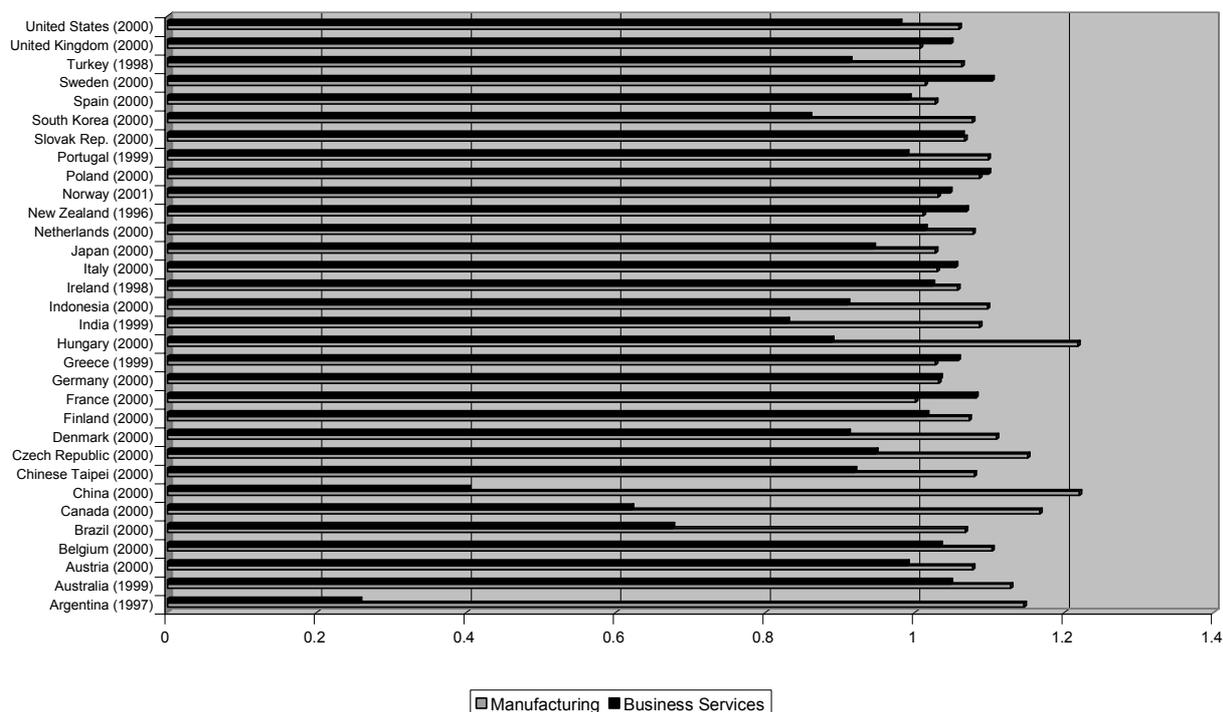


Figure 8. Forward linkages for imported inputs

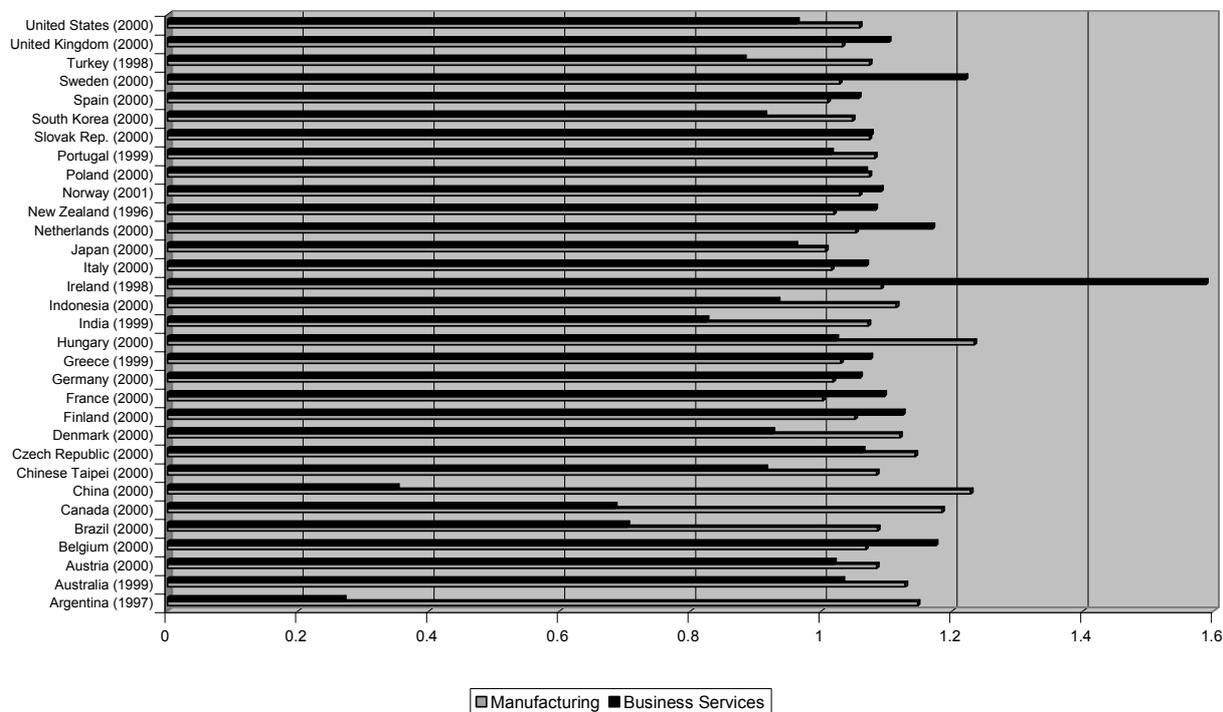


Figure 9. Backward concentration indexes for imported inputs

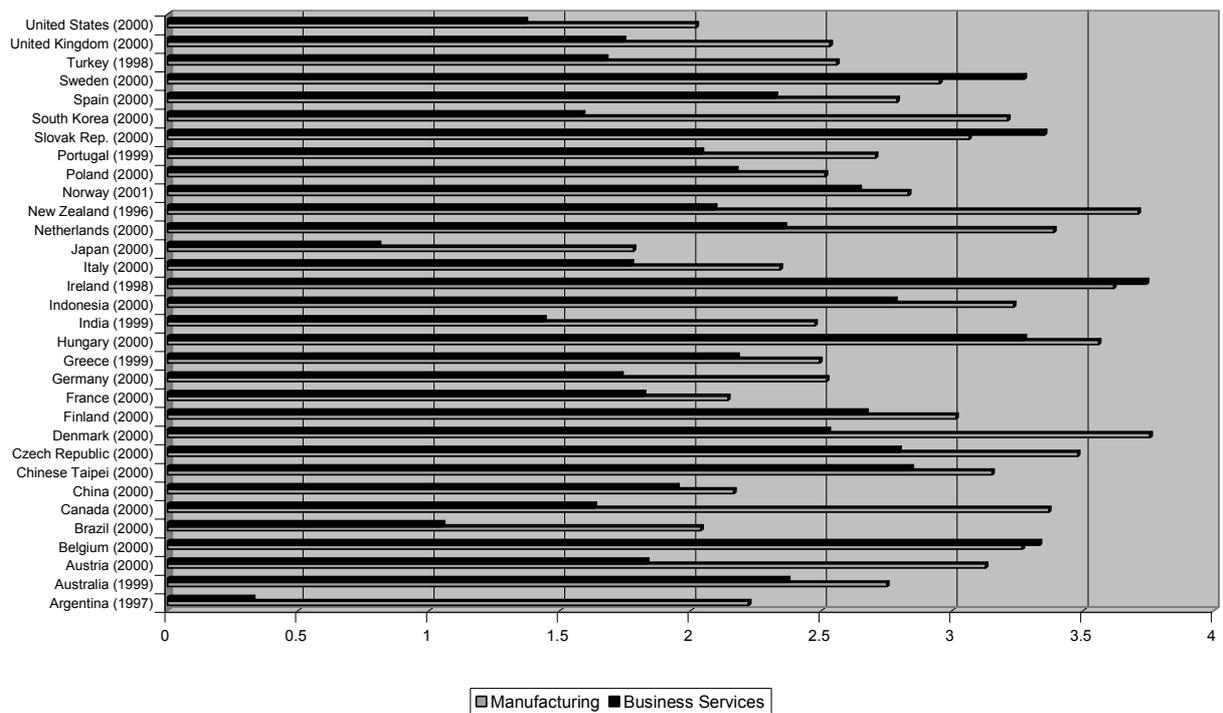


Figure 10. Forward concentration indexes for imported inputs

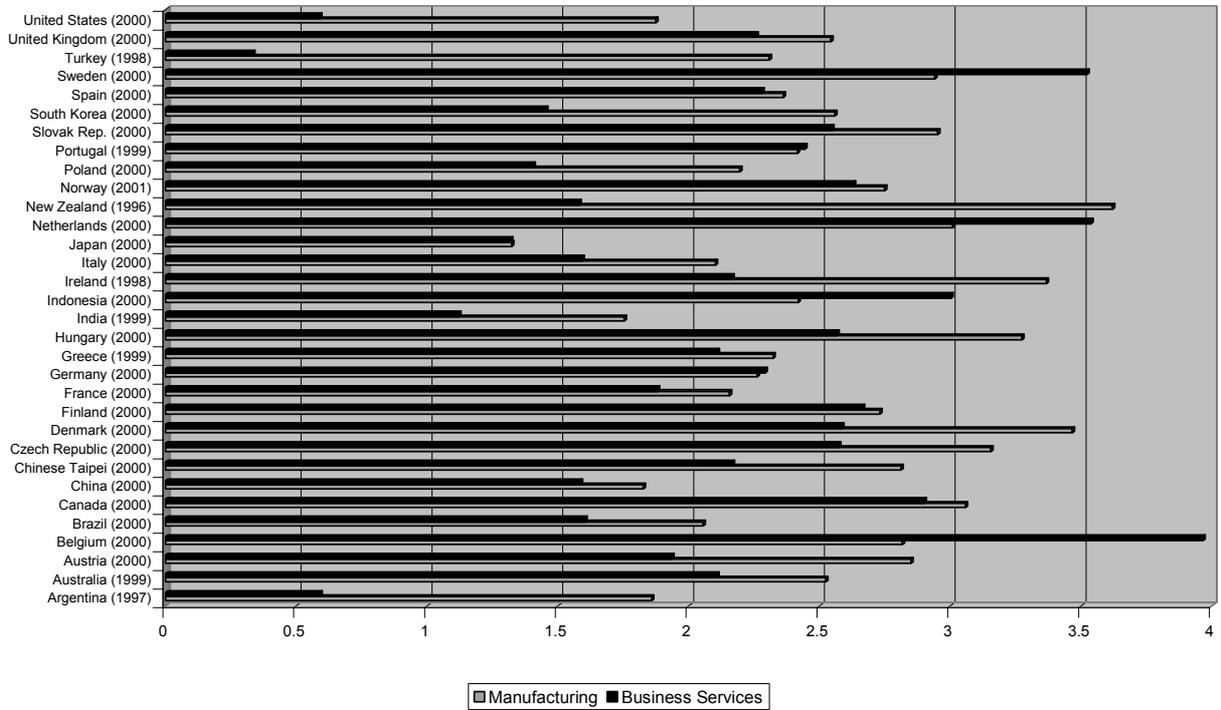


Figure 11. Backward linkages for domestic inputs

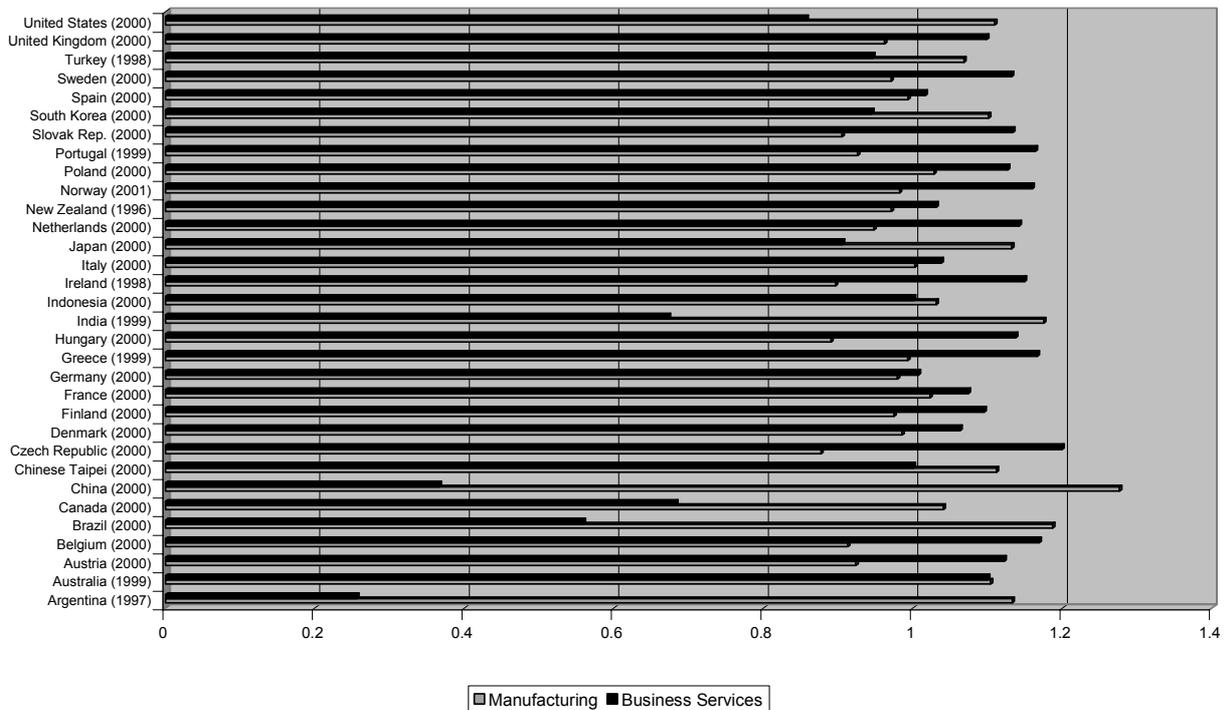


Figure 12. Forward linkages for domestic inputs

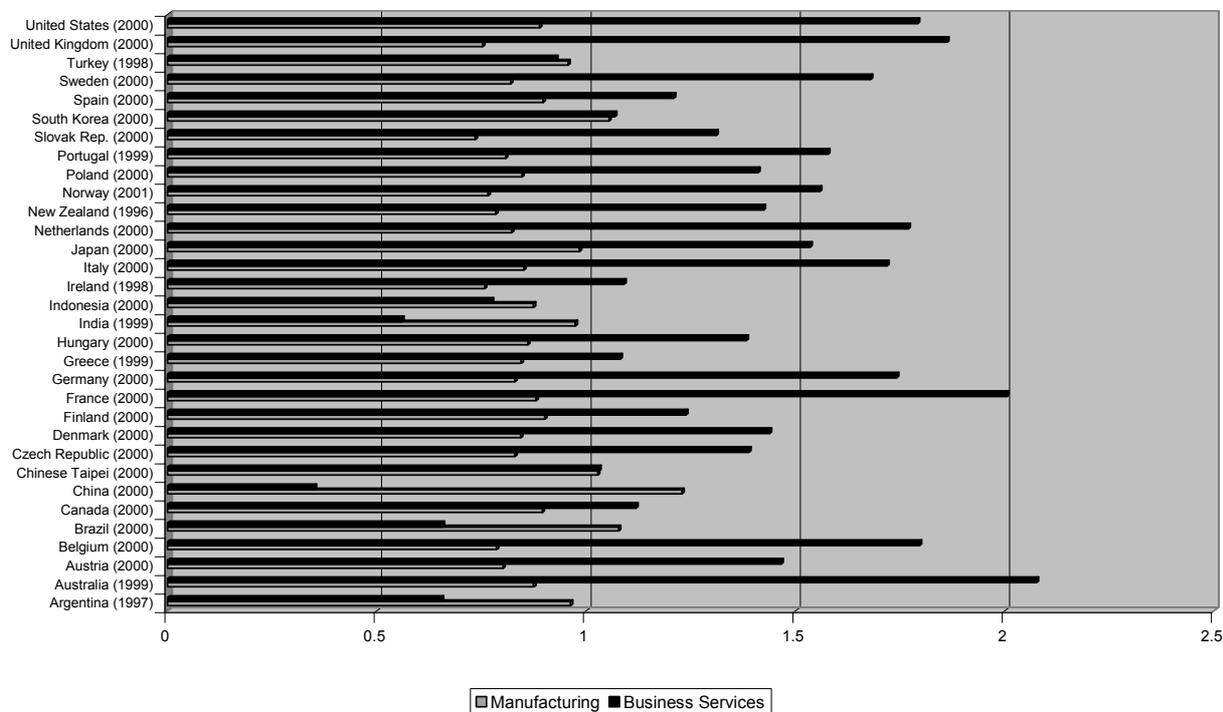


Figure 13. Backward concentration indexes for domestic inputs

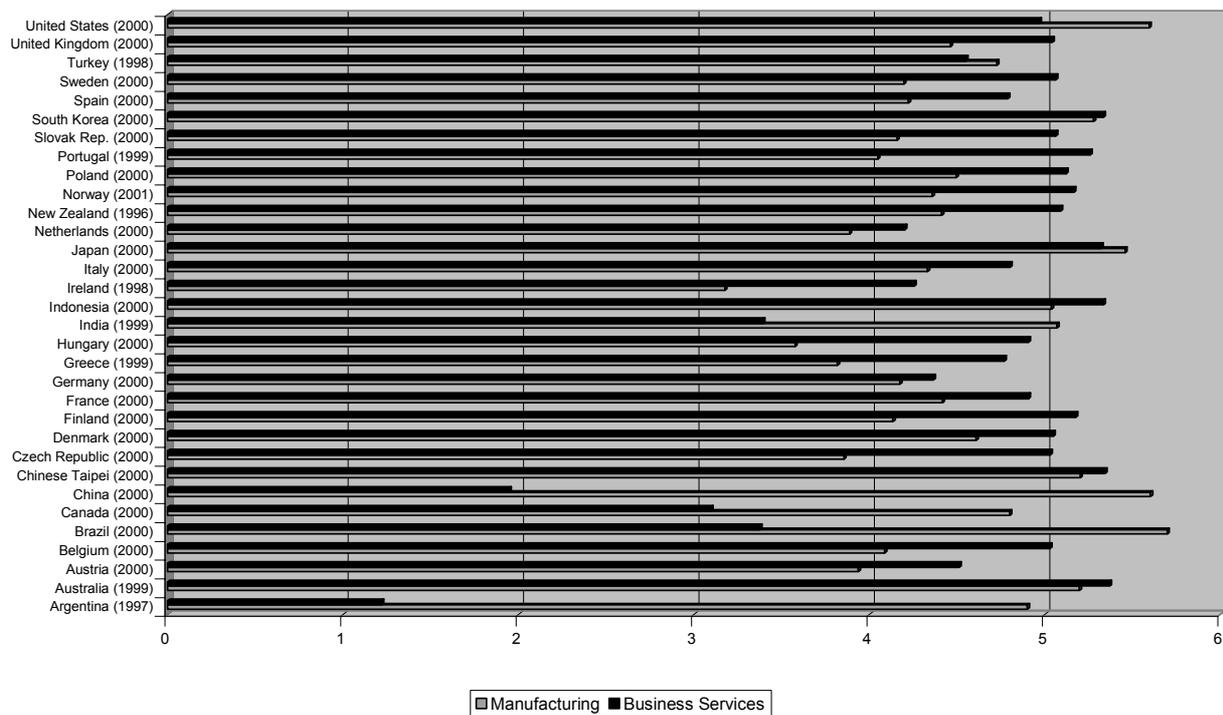
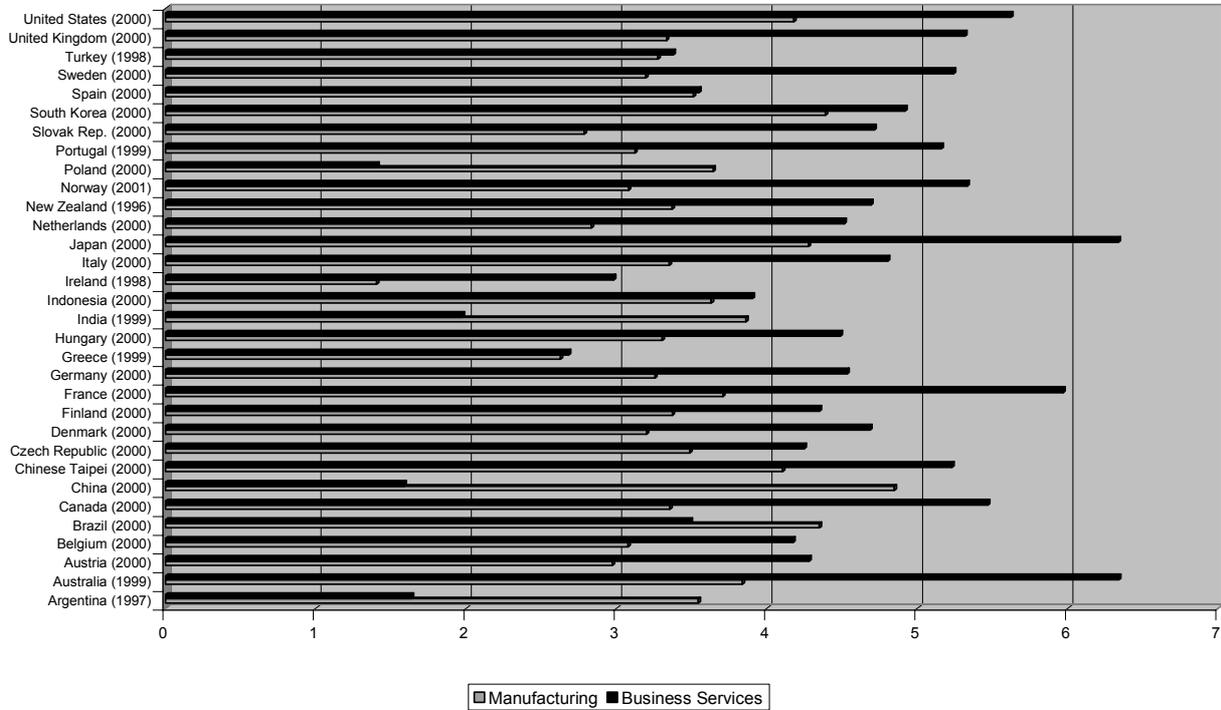


Figure 14. Forward concentration indexes for domestic inputs



ANNEX IV

These graphs show cost shares for business services or, in other words, the percentage of each sector's costs derived from business services, in a sample of the OECD input-output tables in the dataset.

Figure 15. Canada

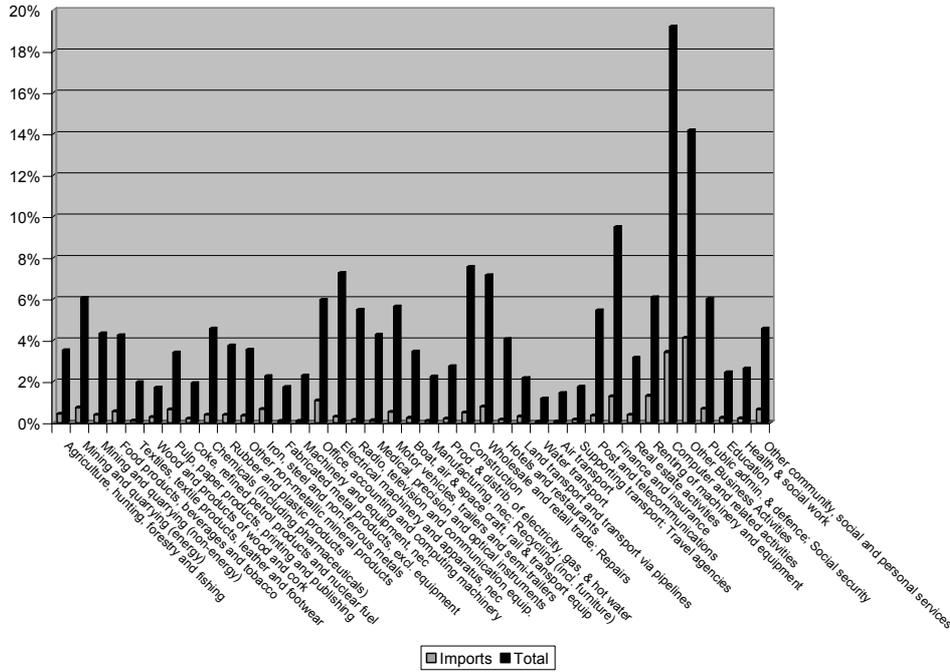


Figure 16. France

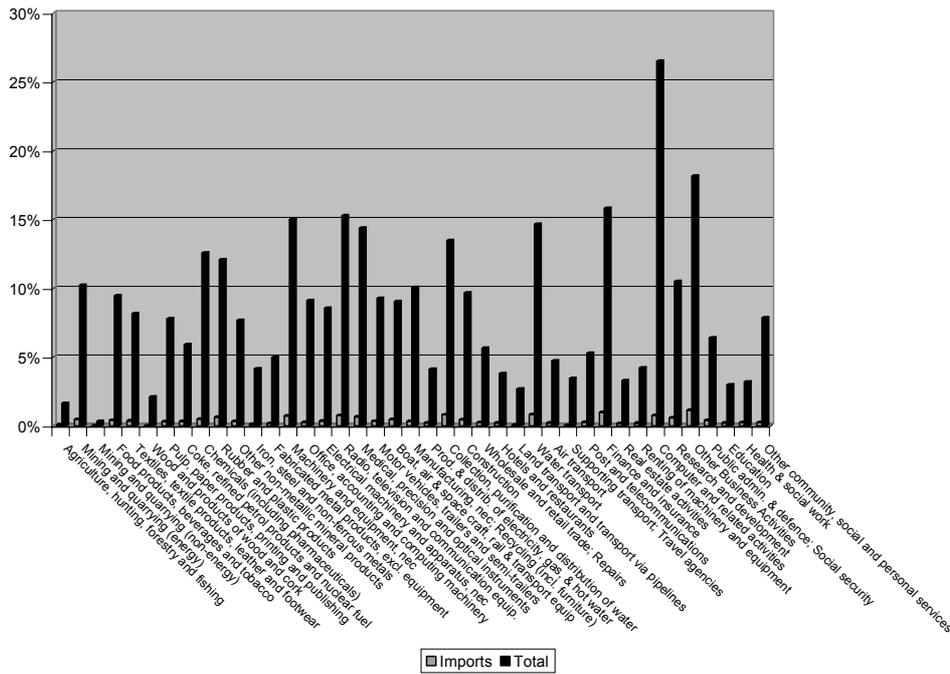


Figure 17. Germany

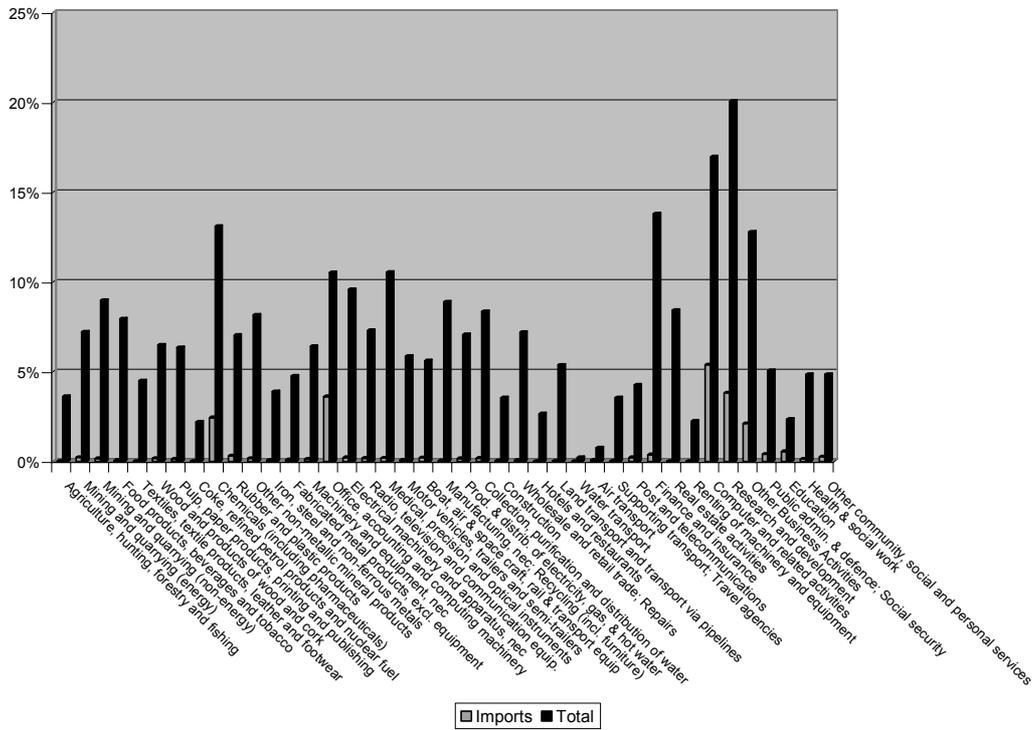


Figure 18. Japan

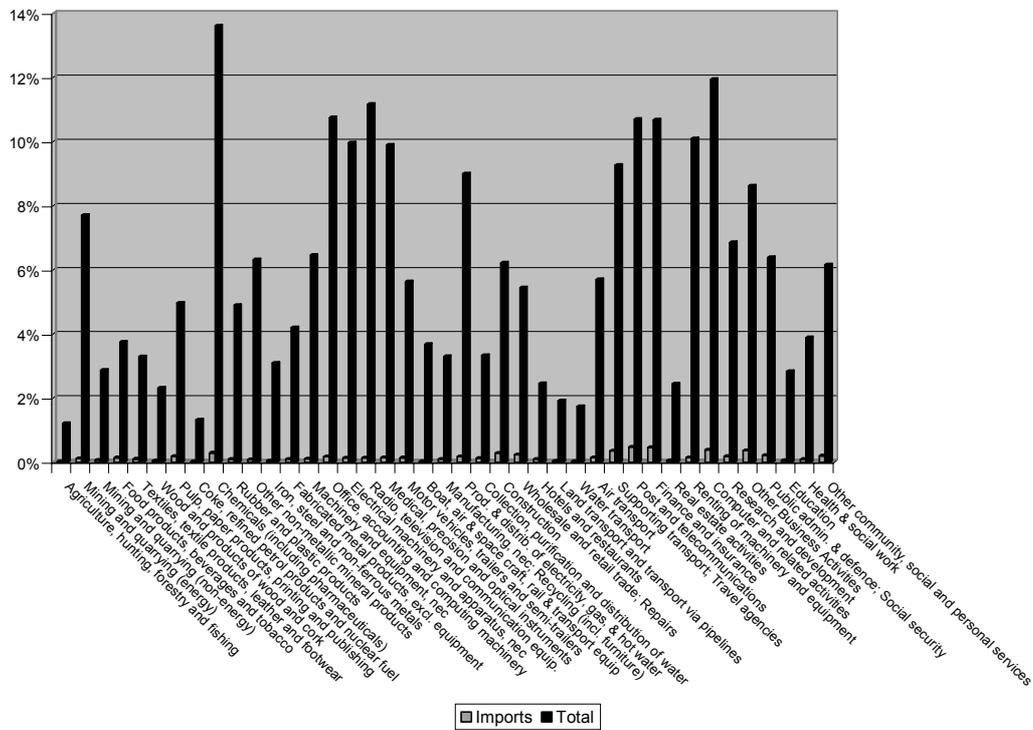


Figure 19. The United Kingdom

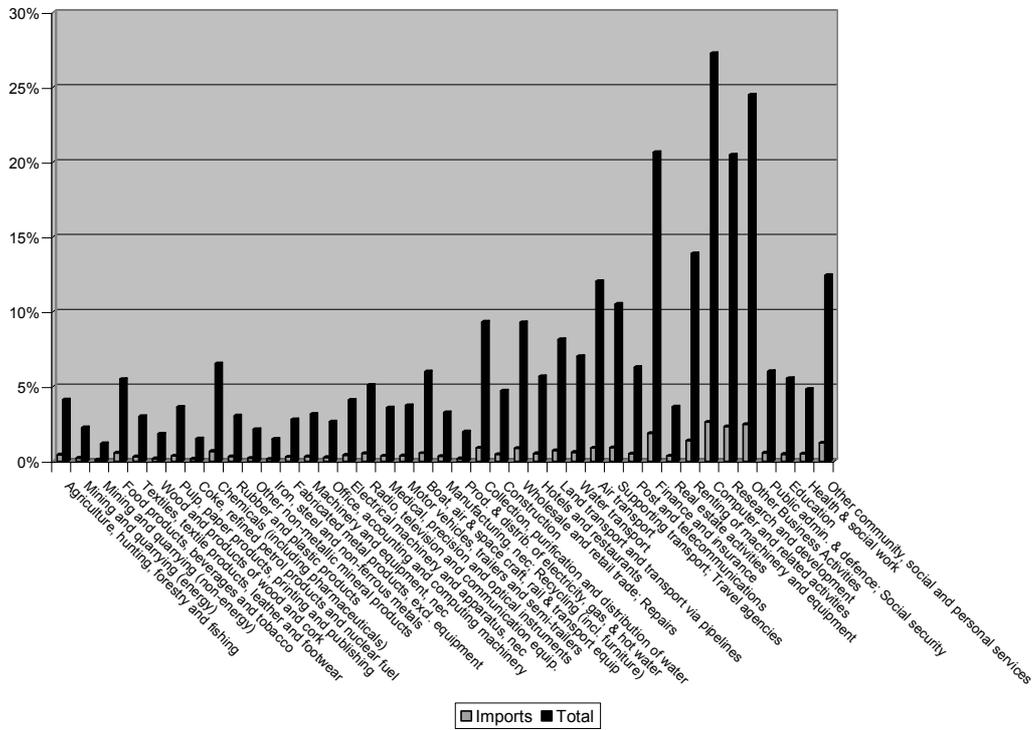


Figure 20. The United States

