

International Trade in Services – Evidence from Danish Micro Data

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SUMMARY: International trade in services is a growing phenomenon, but data in this area trail far behind those for international trade in goods. This is partly due to the fact that trade in services is less tangible and more diversified than trade in goods. This article exploits unique Danish micro data from different sources to construct a detailed picture of which services are currently exported from Denmark. Furthermore, we compare those services that are currently exported to those that are potentially tradable. This comparison provides an indication of the unexploited potential for export of services, and hence also indicates where different »barriers« (such as trade costs, trade restrictions and in practice also differences in demand) to international trade in services currently exist.

1. Introduction

International trade in services is becoming increasingly important. According to the IMF Balance of Payments Statistics, global trade in services has grown more rapidly than international trade in manufactured goods in recent decades. However, data on international trade in services are still much scarcer and less detailed than data on international trade in manufactured goods; see, e.g., Lipsey (2006). This has partly to do with the intangible nature of many services, and the different ways in which services can be traded between countries. As opposed to trade in goods, the export of services

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rarely requires physical goods to cross the customs border between countries. Instead, some services can be delivered by e-mail or through telephones while other services require the supplier to produce the service at the location of the customer.

The lack of information on international trade in services is probably the main reason why there has only been very little empirical research on international trade in services; see, *e.g.* Lipsey (2006). With respect to trade in goods, there is a long tradition for empirical research ranging from the extent and implications of trade policy, see, *e.g.* Feenstra (1995), to the productivity of exporting firms relative to non-exporting firms; see, *e.g.*, Bernard and Jensen (1995). The lack of knowledge about international trade in services is an increasing problem for at least two reasons. First, in developed countries an increasing share of production takes place within services, and an increasing share of international trade occurs within services. Second, there are only few restrictions on international trade in goods. If substantial further gains are to be realised from increasing international trade, these gains are therefore most likely to arise from trade in services. To achieve this, a better knowledge of the implications of different types of restrictions on international trade in services is required.

In this paper, we exploit information in Danish registers to construct unique micro data on services exported (and imported) by Danish firms in recent years. We exploit from the VAT register in Statistics Denmark, where we have information on total exports of goods and services at the firm level, and from the External Trade Statistics and the VAT register, we can also construct detailed measures of exports of goods at the firm level. Combining these data sources allows us to derive firms' exports of services as the residual.

To the best of our knowledge only one other study, Breinlich and Criscuolo (2009) is able to apply information on firm-level trade in services. Using data from various sources for a large number of British firms in the period 2000-2005, Breinlich and Criscuolo (2009) focus on how services traders differ from non-traders with respect to outcomes such as size, productivity, capital intensity and wages. As in the literature on firm-level trade in goods, they find significant exporter premiums in these dimensions; see also Bernard and Jensen (1995), Wagner (2007) and Munch and Skaksen (2008).

In the present paper, we use register information to construct firm-level measures of exports for the entire population of Danish firms. This in turns allows us to construct a detailed picture of which services are currently exported from Denmark, and to identify sectors with unexploited export potential.

More precisely, we show in this paper that our firm-level measures of trade in services are consistent with the more aggregate data from the balance-of-payments (BoP) statistics. This is a strong indication that the data provide relatively precise measures of international trade in services at the firm level. We also illustrate how these data al-

low us to calculate exports of services at, *e.g.*, a detailed industry level, whereas existing aggregate statistics only report exports of services on relatively aggregate categories, and not for separate industries. Our calculations reveal, among other things, that while there is a lot of international trade in goods within service industries, there is only very little trade in services within manufacturing industries.

Finally, we apply the data on exports of services to perform a simple analysis to identify service industries in which Danish producers do not (yet) fully exploit the potentials for export, and hence where potential »barriers« to international trade in services still exist. In this context, barriers should be interpreted relatively broadly, and may cover different impediments to international trade such as high trade (transportation) costs, formal or informal trade restrictions (*e.g.* standards), and even differences in demand can be interpreted as a kind of »barrier«, as some services may not be demanded in other countries/cultures.

The character of trade costs associated with services is very different from the character of those associated with manufactured goods, and trade costs also vary considerably across different types of services. Services that can be shipped by e-mail, such as software, are thus associated with very low trade costs, while other services are associated with extremely high trade costs as they require the temporary movement of persons across borders. This in turn makes some services intrinsically more tradable than others, although technological innovations, such as the internet, have lowered the trade costs of some services significantly over time.

International trade in services may also be hampered by trade restrictions which may be very different from trade restrictions on manufactured goods. Thus, international trade in services has been limited mostly by non-tariff barriers such as local standards and restrictions on temporary migration. Moreover, it is very complex to identify these barriers, as they often serve other purposes than just restricting import competition; see, *e.g.*, Copeland and Mattoo (2008).

One way of identifying existing barriers to international trade in services is to compare those services that are currently exported to those that are potentially tradable. In this paper, we identify the potentially tradable service industries using a method developed by Jensen and Kletzer (2006) which compares the geographical concentration of production and demand for an industry within a country. A related method was applied by Malchow-Møller *et al.* (2007) in an analysis of the tradability of construction services within Denmark. Comparing the tradability of different service industries with their actual exports of services derived from our firm-level data, provides us with an indication of the unexploited potential for export of services and hence indicates where barriers to international trade in services currently exist.

Our approach is also related to a couple of recent studies in the literature which use gravity regressions to estimate the potential trade flows for the more aggregate service

categories from the balance-of-payments statistics using aggregate bilateral trade data. By comparing these potential flows with actual trade flows, estimates of (the tariff equivalent of) barriers to trade can be constructed; see Francois and Hoekman (2009) or Brandicourt *et al.* (2008) for more details.¹

Our analysis reveals a robust relationship between the tradability of a service industry and its actual international exports of services. However, within »IT-services (excluding software)« and to a smaller extent within »software« and »advertising« we find signs of an unexploited export potential. For comparison, Francois *et al.* (2008) report – based on the gravity-regression approach – that within the EU, the largest barriers to trade are to be found within communication services.

The rest of the paper is structured as follows. In Section 2, we first discuss the distinction between goods and services, and we explain the different ways in which international trade in services can take place. In Section 3, we consider the aggregate development in the Danish international trade in services according to the official balance-of-payments statistics. In Section 4, we derive our firm-level measures of trade in services that allow for a more detailed account of the Danish export of services. In Section 5, we identify the potentially tradable service industries and compare those to the numbers for actual exports from Section 4. Finally, Section 6 concludes.

2. Basic Concepts

In this section, we first discuss how services are defined and distinguished from manufactured goods both at a conceptual level and in practice, *i.e.*, in the statistics. We then present the different modes through which international trade in services may occur according to the General Agreement on Trade in Services (GATS), and we discuss how this corresponds to the way in which international trade in services is currently measured in the statistics.

2.1 Services vs. goods

Services are difficult to define precisely. The »Manual on Statistics of International Trade in Services« (MSITS) – a manual developed and published in 2002 jointly by the United Nations (UN), the European Commission (EC), the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), the United Nations Conference on Trade and Development (UNCTAD), and the World Trade Organization (WTO) – uses the following definition of services:²

1. Another approach used to identify barriers to international trade in services has been to construct different openness indices through collection of information on applied policies; see Francois and Hoekman (2009).

2. This definition is basically taken from the System of National Accounts 1993, which was produced jointly by the OECD, the United Nations Statistical Division, the International Monetary Fund, the World Bank and the Commission of the European Communities, and is a conceptual framework that sets the international statistical standard for the measurement of the market economy; see <http://unstats.un.org/unsd/sna1993>.

»Services are not separate entities over which ownership rights can be established. They cannot be traded separately from their production. Services are heterogeneous outputs produced to order and typically consist of changes in the condition of the consuming units realised by the activities of the producers at the demand of the customers. By the time their production is completed they must have been provided to the consumers.« [MSITS, p. 7].

As opposed to goods, services thus cover a heterogeneous group of products and activities, which are often intangible, invisible and perishable, requiring simultaneous production and consumption, and hence cannot be traded like goods; see also Copeland and Mattoo (2008). Examples include: cleaning, transport, and education.

In practice, there are a number of exceptions from this definition. One example is the production of software which is considered a service activity despite the fact that software may be stored on, *e.g.*, harddisks and CDs and traded like goods. Other examples are movies and music. More generally, the MSITS classifies all output in sections 5-9 of the Central Product Classification (CPC), version 1 as services.³

Instead of distinguishing at the product/activity level, a distinction between goods and services can be made at the firm or industry level. Productive units are thus typically allocated to an industry in the International Standard Industrial Classification of all Economic Activities (ISIC) or the Classification of Economic Activities in the European Community (NACE) according to their main economic activity.⁴ Hence, firms belonging to industries considered as service industries in the ISIC/NACE can then be considered as service producers. However, it is important to bear in mind that many firms in the manufacturing industries produce both goods and services; and similarly for firms in the service industries.

2.2 Trade in Services

International trade in goods requires the shipment of physical goods across borders. International trade in services is different for at least two reasons. First, some services require physical proximity between the supplier and the consumer, as in the case of, *e.g.*, haircuts, cleaning and construction services, and hence cannot be shipped across borders. Second, among the services that can be shipped from the supplier to the customer, many of these are intangible, as in the case of many financial services. Hence, the trade does not involve physical units passing the borders.

3. The CPC can be found on: <http://unstats.un.org/unsd/cr/registry/>. Sections 5-9 are: (5) Intangible assets; land; constructions; construction services; (6) Distributive trade services; lodging; food and beverage serving services; transport services; and utilities distribution services; (7) Financial and related services; real estate services; and rental and leasing services; (8) Business and production services; and (9) Community, social and personal services.

4. The ISIC can be found on: <http://unstats.un.org/unsd/cr/registry/>, and the NACE on <http://ec.europa.eu/eurostat>.

As a consequence, GATS has defined four different *modes* of trade in services – based on the location of both the supplier and the consumer of the traded service:

- Mode-1 trade (*cross-border supply*) takes place when the supplier and the consumer remain in their respective countries of residence, and the service is shipped across national borders. Although, this is the type of trade in services that resembles trade in goods most closely, there is often no package that passes the customs frontier. Instead, the shipment can take place over the internet, via telephones, via fax machines, *etc.* Examples include financial services, computer software, and call-centre services.
- Mode-2 trade (*consumption abroad*) takes place when the consumer moves temporarily to the country of residence of the supplier to consume the service. This is the case of, *e.g.*, tourism and education services, but the repair of ships in foreign ports also constitutes an example of mode-2 trade.
- Mode-3 trade (*commercial presence*) covers trade in services through a commercial presence of the supplier in the country of the customer. It thus covers the cases where it is necessary to establish a commercial presence abroad, *e.g.*, a locally established subsidiary or branch of the company, through which the supplier can deliver her services. Consultancy services sold through a local division of a multinational firm thus fall within this category.
- Mode-4 trade (*presence of natural persons*) takes place when an individual resident in the exporting country moves temporarily to the country of the consumer to provide the service. The service can be provided in two conceptually different ways. First, the individual can deliver a service to a customer through a *service transaction* on behalf of the individual's employer in the exporting country or on behalf of the individual if she is herself. This is the case for many consultancy and construction services. Second, the individual can take up *temporary employment* in a (service) firm in the host country and deliver the service through her employment in that firm. In that case, the payment for the service is the wage received by the individual.

Thus, according to the GATS definition, international trade in services is not so much about units passing the borders, but about service transactions between customers resident in one country and suppliers resident in (or controlled by residents in) another country.

Although the distinction between the four modes may seem conceptually clear, reality is less so. First, many service transactions in practice involve more than one mode. Thus, some business services may mainly be delivered through mode 1, but may

sometimes require the company to temporarily visit the customer's country, in which case mode 4 is also involved. Second, other transactions may involve both goods and services, as when buying a new IT system that also includes on-site installation by the supplier. Third, while services delivered through temporary movement of persons belong to mode 4, it is unclear what it takes before this turns into a commercial presence and instead becomes mode-3 trade. In GATS, a commercial presence can thus also cover entities created for a short period. Finally, mode-4 trade through employment covers only non-permanent employment in the country of the consumer, but again it is not clear where to draw the line between »non-permanent« and »permanent« employment.

Thus, determining actual trade flows within each of the four modes – and in total – is difficult, and the data required are therefore not available at the moment. The MSITS provides a detailed discussion of the difficulties involved using currently available data. It also provides a number of recommendations for future data collection.

The Balance of Payments (BoP) is currently the main source of data on international trade in services in most countries. In the BoP, international trade in services is split into 11 different service categories (Transportation, Travel, Communication services, Construction services, Insurance services, Financial services, Computer and information services, Royalties and license fees, Other business services, Personal, cultural and recreational services, and Governmental services) following the recommendations in IMF's Balance of Payments Manual (BPM5).⁵ Together, these 11 categories should cover modes 1, 2 and that part of mode 4 that takes place through service transactions. But a given transaction can still belong to more than one mode, *cf.* the examples above. In the MSITS, an attempt is made to allocate the first 10 categories across the four different modes of trade, with some categories belonging to more than one mode. As an example, »Construction services« are partly mode 3 and partly mode 4, depending on whether an office is established in the customer's country.

Mode-4 trade through temporary employment in firms in the host countries is not accounted for by these 11 categories. However, if individuals work for less than a year in a country in which they are not residents, their income is recorded in the Balance of Payments under »Compensation of employees«. Hence, one can use this as an approximate measure of the part of mode-4 trade that takes place through temporary employment.

Finally, services traded under mode 3, *i.e.*, services sold by a local subsidiary or a branch of the company, are not counted as part of the BoP. Information about this type of trade typically requires rather detailed information about the activities of foreign affiliates – information which is currently not available.

5. See <http://www.imf.org/external/pubs/ft/bopman/bopman.pdf>.

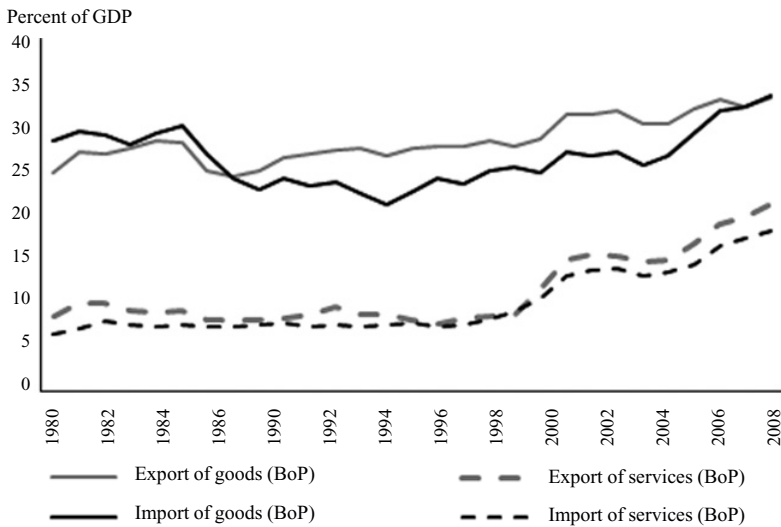


Figure 1. The Danish International Trade in Goods and Services (Balance of Payments Statistics), 1980-2008.

Source: The Balance of Payments Statistics (BET6 and BOP6) and the national accounts (NAT01) from Stat Bank Denmark, Statistics Denmark.

Because of the lack of data on mode-3 trade, we shall focus exclusively on modes 1, 2 and 4 in the rest of the paper. In the next section, we briefly present the aggregate numbers according to the BoP. When we turn to micro-level evidence in section 4, the focus is on mode-1 trade and the part of mode-4 trade that takes place through service transactions, as this is the type of service export that is recorded at the firm level.

3. The Aggregate Development

In this section, we briefly present the aggregate development in trade in services for Denmark using data from the Balance-of-Payments Statistics from Statistics Denmark. Like other countries, Denmark follows the guidelines in the MSITS and uses the Extended Balance of Payments Services Classification (EBOPS), which is an elaboration of the BPM5 classification from above. Within the 11 main categories of BPM5, trade in services is divided into subcategories. As mentioned above, these categories cover Modes 1, 2 and the part of 4 that takes place through service transactions.

The data are collected through reporting from the population of firms. Each month, approximately 350 of the largest service firms report to Statistics Denmark. Together these firms cover around 70% of the international trade in services. This information is supplemented by quarterly information from 1,200 randomly selected small and medium-sized firms, representing the more than 20,000 firms that are responsible for

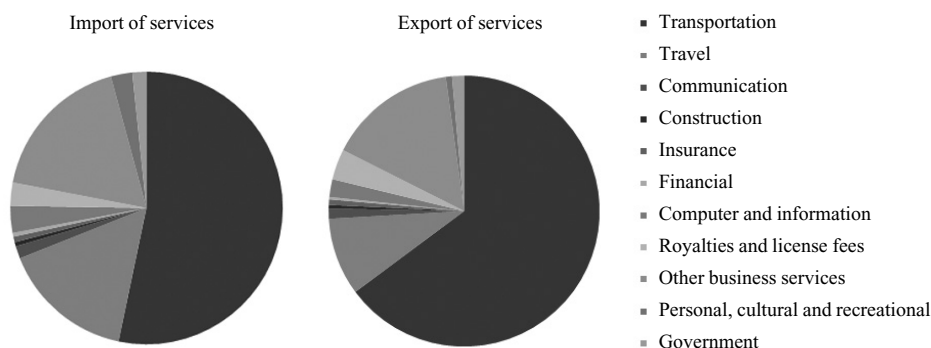


Figure 2. The Composition of Danish Exports and Imports of Services (Balance of Payments Statistics), 2008.

Source: The Balance of Payments Statistics (BOP6) from Stat Bank Denmark, Statistics Denmark.

the final 30% of the trade. With respect to the »Travel« category, the firm information is supplemented by information from, *e.g.*, interviews with foreigners visiting Denmark and Danish households travelling abroad. See Statistics Denmark (2007) for more details.

The aggregate development in Denmark's international trade in goods and services is illustrated in Figure 1. The figure shows that over the last 10-15 years, exports and imports of services have doubled their share in GDP. However, Lipsey (2006) argues that part of the observed increases in the importance of trade in services for many countries may reflect better data collection rather than new activities.⁶

Data on the distribution of Danish exports and imports by the 11 main categories from BPM5 are only available from 2005 onwards. Figure 2 shows the distribution in 2008. It is seen that the distribution is more or less the same for exports and imports of services. »Transportation« constitutes the largest shares in both cases. In fact, 65 percent of the total export of services is due to transportation services, while 53 percent of the total import of services is due to transport. »Travel« and »other business services« (including, *e.g.*, consulting services) are responsible for 9 percent and 15 percent, respectively, of exports of services, while they each account for 16-18 percent of the imports. »Financial services« and »construction services« are responsible for the smallest shares of both exports and imports of services as they each account for less than 0.5 percent of total exports and imports of services.

6. Note that in 2006, there are sizeable increases in both exports and imports of services. These are partly due to the acquisition of the British-Dutch company P.O. Nedlloyd by A.P. Møller – Mærsk. This increases exports, as the services of P.O. Nedlloyd are now credited Denmark. It also increases imports, however, as many of the ships are registered abroad, and hence the charter rent (the payment for the ships) is registered as an import of services; see DØRS (2006).

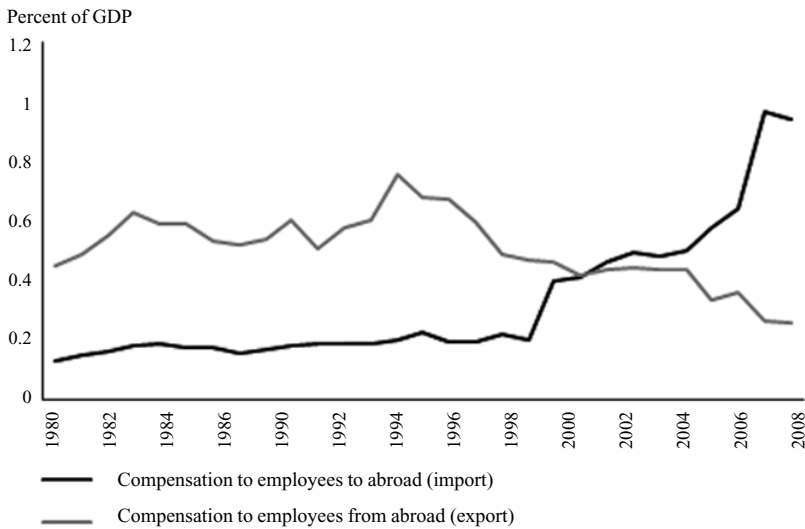


Figure 3. Compensation to employees (Balance of Payments Statistics), 1980-2008.

Source: The Balance of Payments Statistics (BET6 and BOP6) and the national accounts (NAT01) from Stat Bank Denmark, Statistics Denmark.

Figure 3 shows the development in the compensation to employees according to the BoP statistics. This measure is a proxy for the part of mode-4 trade that takes place through temporary employment in foreign firms. While compensation to abroad (import) is more or less constant from 1988 to 1998, it increases rapidly after 1998, rising to close to 1 percent of GDP in 2007-8. The compensation to employees from abroad, on the other hand, has exhibited a declining trend since the mid 1990s. Quantitatively, this type of trade in services, is thus less important than the trade depicted in Figure 2, *i.e.*, the trade through mode 1, mode 2 and the transactions part of mode 4.

4. Micro Evidence

In this section, we derive firm-level measures of exports (and imports) of services from micro data. The firm-level measures in turn allow us to calculate exports of services at, *e.g.*, a detailed industry level, whereas the aggregate statistics only report exports of services for relatively aggregate types of services and not by industries.

Our firm-level measure of exports of services will be derived as the difference between the firm's total exports (including both goods and services) and the firm's exports of goods only. The total exports are recorded at the firm-level for taxation purposes in the VAT register in Statistics Denmark. The data for trade in goods are based on information from the Danish External Trade Statistics at Statistics Denmark and the VAT register. In the same way, it is possible to derive imports of services at the firm level, by subtracting imports of goods from total imports.

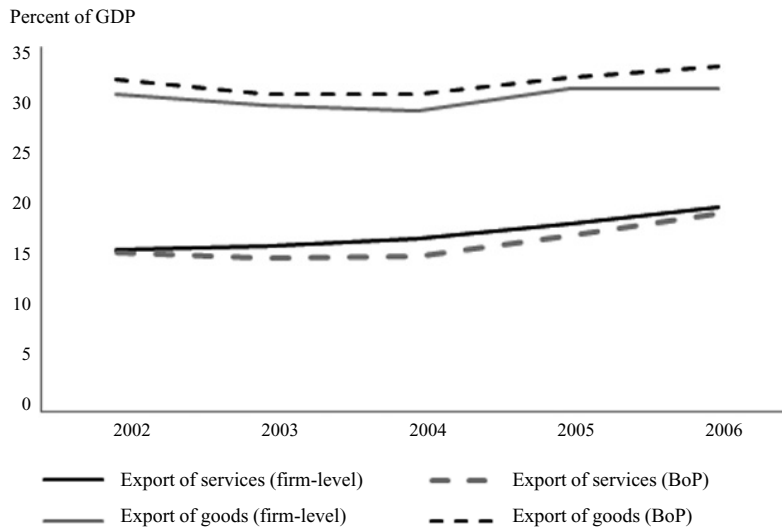


Figure 4a. The Danish International Export of Goods and Services (firm-level data and BoP data), 2002-2006.

Source: Own calculations on the External Trade Statistics and the VAT register from Statistics Denmark.

A couple of additional remarks about the construction of the service trade measure are in order. The External Trade Statistics are compiled in two systems: Intrastat (trade with EU countries) and Extrastat (trade with non-EU countries). The level of detail in this register is very high as trade flows are recorded by destination/origin country and an eight-digit product code. Trade flows in Extrastat are recorded by customs authorities, and the coverage rate is therefore close to complete. In contrast, the coverage rate in Intrastat is lower (around 90%), because some predominantly small firms appear not to report data to the system. Also, data on intra-EU trade is censored in such a way that only firms exporting goods with a total annual value exceeding a certain threshold are recorded in the files. Fortunately, the VAT register also records the total export of goods to EU countries and the total import of goods from EU countries from 2002 onwards, and the coverage rate here is higher. Hence, we should be able to calculate trade in services at the firm level fairly accurately for the years 2002 through 2006.

The numbers for trade in services derived in this way will in principle cover all mode-1 exports as well as the part of mode-4 exports that takes place via firms, *i.e.*, through service transactions. The import numbers will, of course, only cover that part of mode-1 and mode-4 imports that takes place via the firms.

Figures 4a and 4b show the aggregate development in exports and imports, respectively, of goods and services when calculated from firm-level information. For compa-

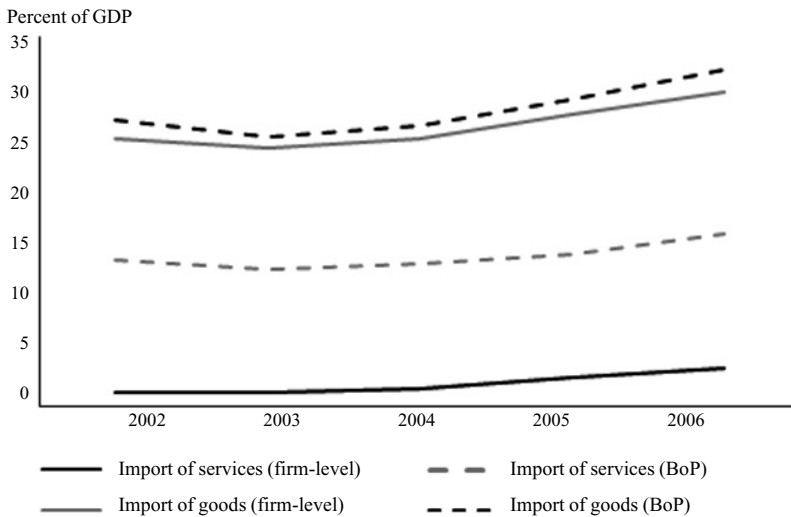


Figure 4b. The Danish International Import of Goods and Services (firm-level data and BoP data), 2002-2006.

Source: Own calculations on the External Trade Statistics and the VAT register from Statistics Denmark.

risson, we have also included the official aggregate numbers from the extended balance of payments statistics from Figure 1.

Consider first the exports in Figure 4a. It appears that the total level of exports of goods is slightly lower (1-2% of GDP) when using our firm-level information instead of the official aggregate numbers from the extended balance of payments statistics in Figure 2. This is probably due to the incomplete coverage rate in the firm-level statistics on goods trade as discussed above, and other technical corrections made in the aggregate numbers; see Statistics Denmark (2007).

When comparing the two series for exports of services, we should bear in mind that trade with mode-2 services is not included in the firm-level numbers. Since exports of travel services (mode 2) amount to approximately 1.5% of GDP in the aggregate numbers, we should expect (all else equal) the firm-level export numbers to undershoot the BoP numbers by this amount.

However, as the two series are in fact close to identical, another bias (of a similar size) must work in the opposite direction (provided that the BoP numbers measure the aggregate export of services correctly). This bias is likely to come from the fact that total exports at the firm-level also include some domestic sales that are not subject to VAT, e.g., newspapers and transport of persons. As exports of services at the firm level are calculated as a residual by subtracting exports of goods from total exports, these domestic sales will be included there.

Turning to the import numbers in Figure 4b, the differences are larger. The total level of imports of goods is thus lower by 1.2-2.2% of GDP when using firm-level information instead of the official aggregate numbers from the extended balance of payments statistics in Figure 2. While this may again be due to incomplete coverage in the firm-level statistics, it may also be partly explained by the fact that imports of goods directly by consumers are not included in the firm-level numbers.

When it comes to the numbers for imports of services, the divergence between the two sources is substantial. There are several potential explanations for this. First, imports of mode-2 services (which are more important than exports) are not included in the firm numbers. Second, import directly by consumers is not included in the firm numbers either. Third, some mode-4 imports of services may not be registered as imports in the firms if the foreign supplier is required to pay Danish VAT. Fourth, imported transportation services may be registered as imports of goods at the firm level. The reason for this is that imports of goods are recorded as CIF (including Cost, Insurance, and Freight) in the trade statistics, thereby including the value of, *e.g.*, insurance and transportation services in the total imports of goods. In the BoP statistics the value of these services is estimated and subtracted from the total imports of goods, and added to the total imports of services, Statistics Denmark (2007). Exports of goods, on the other hand, are recorded as FOB (Free On Board), and insurance and transportation services will thus appear as export of services in this case – both at the firm level and in the BoP statistics.

In summary, we conclude that while there is a rather large divergence between the firm-level numbers and the BoP numbers on imports of services, the biases affecting the service export numbers appear to be relatively small (although not negligible). Due to this, we shall focus on the export part of the international trade in services in most of the subsequent analyses. We will be using data from 2005 as it turns out that the match between the VAT register, the External Trade Statistics and the General Firm Statistics – a match which is required in the following analyses – is much better in 2005 than in 2006.

Table 1 illustrates how much of the international trade in goods and services takes place within firms belonging to the manufacturing and service industries. Manufacturing industries are defined here as industries with NACE codes in the interval (150000, 400000), whereas service industries belong to the interval (400000, 750000). As can be seen from the table, international trade in goods is not limited to manufacturing firms. In fact, over 40 percent of total exports of goods and close to 75 percent of total imports of goods in these sectors are traded through firms in the service industry. We suspect that wholesale firms are responsible for a large part of that trade; but this is an issue that deserves closer analysis in future work. In the case of trade in services,

Table 1. Exports and imports of goods and services by manufacturing and service firms, 2005 (mil. DKK).

	Industries	
	Manufacturing	Service
Export of services	24,465	234,352
Export of goods	264,596	178,650
Import of services	6,296	25,521
Import of goods	101,448	295,264

Source: Own calculations on the General Firm Statistics, the External Trade Statistics and the VAT register from Statistics Denmark.

however, 80 percent of imports and over 90 percent of exports take place through firms in the service industries; making it reasonable to focus on these industries when considering the international trade in services.

In Table 2, the five service industries (defined at the 2-digit NACE level) with the highest service-export intensities (calculated as exports of services relative to total sales) are listed. The picture that emerges is consistent with the previous findings. The three industries with the highest service-export intensities are all related to the transport sector – with water transport as a clear outlier.⁷ Remember that transportation was responsible for around 65 percent of the total export of services according to the aggregate numbers in Figure 2. However, the »Research and development« industry also exhibits considerable service export.

Using a more detailed industry classification, *e.g.*, at the 4-digit NACE level, yields a very similar picture with the ten most service-export intensive industries found to be within the five 2-digit industries from Table 6 plus »Renting of machinery and equipment without operator and of personal and household goods« (NACE code 71) and »Wholesale trade and commission trade« (NACE code 51).

5. Tradable Services vs. Exported Services

As mentioned in the introduction, the trade costs associated with services are very different from those associated with manufactured goods, and they vary considerably across different types of services. Services traded through mode 1, which can be shipped by e-mail or via downloads from the internet, such as software, are typically easier to trade than most manufactured goods which require a physical package to be shipped. On the other hand, mode-4 trade in services is typically associated with higher

7. Remember, however, that the export intensities in the transportation sector may be biased upwards because domestic sales that are not subject to VAT (this includes transportation of passengers) are included in the measure of total exports at the firm level.

Table 2. Top-5 Service-export industries (2-digit NACE level), 2005.

NACE code	Industry	Service export intensity	Total sales (mil. DKK)
61	Water transport	0.86	125,013
62	Air transport	0.40	18,023
63	Supporting and auxiliary transport activities; activities of travel agencies	0.36	81,502
73	Research and development	0.33	5,342
72	Computer and related activities	0.14	54,914

Note: Financial and insurance industries are omitted due to missing information on total sales.

Source: Own calculations on the General Firm Statistics, the External Trade Statistics and the VAT register from Statistics Denmark.

costs than trade in manufactured goods as it involves the movement of persons across borders. Hence, we can think of some services as being intrinsically more tradable than others, although technological innovations, such as the internet, have lowered the trade costs of some services significantly over time.

However, international trade in services may also be hampered by trade restrictions which may be very different from trade restrictions on manufactured goods. Furthermore, these may not be as easy to spot as barriers to trade in manufactured goods. International trade in services has thus been limited mostly by non-tariff barriers such as local standards and restrictions on temporary migration. Yet in practice another »barrier« to international trade may be differences in demand across countries, implying that some services are not demanded (or less demanded) in other countries for, *e.g.*, cultural or geographic reasons.

One way of identifying existing barriers to international trade in services is to compare those services that are currently exported to those that are potentially tradable. The potentially tradable services can be identified using a method developed by Jensen and Kletzer (2006). A related method was applied by Malchow-Møller *et al.* (2007) in an analysis of the tradability of construction services in Denmark.

Jensen and Kletzer (2006) use the geographical concentration of industries within the US to find the potential tradability of services produced in different industries. The idea is to compare the demand for services and goods in a given industry (by other industries and consumers) in a given area of the country with the production or employment of the same industry in the same area. Goods and services produced by industries that are geographically more concentrated than their demand must be tradable within the country. Without any restrictions or impediments to international trade, we must expect the same goods and services to be tradable internationally.

Formally, the share of total domestic demand for industry i in area p is calculated as:

$$IDS_{i,p} = \sum_{j=1}^J \left(\frac{Y_{i,j}}{Y_i} \cdot \frac{EMPL_{j,p}}{EMPL_j} \right)$$

where Y_i is the total output of industry i used domestically, and $Y_{i,j}$ is the output of industry i used in industry j . Hence, $Y_{i,j}/Y_i$ is the share of industry i 's production used by industry j . Similarly, $EMPL_{j,p}$ is the employment in industry j in area p , and $EMPL_j$ is the total employment in industry j . Thus, $EMPL_{j,p}/EMPL_j$ is a measure of the share of industry j located in region p . Multiplying the two shares therefore gives us a measure of the share of industry i 's total output used by industry j in area p . And summing over industries in area p then gives us the share of industry i 's total output demanded by area p .

Note that investment and consumption by the government and private households is included as an extra »industry« among the J industries in the summation above, where the »local employment share«, $EMPL_{j,p}/EMPL_j$, of this »industry« is given by the share of residents in area p . Hence, $IDS_{i,p}$ measures the share of total output (excluding exports) from industry i used by other industries, consumers or the government in area p .

We then define $\sigma EMPL_{i,p}$ as the cumulative share of industry i employment in regions $1, \dots, p$, and $\sigma IDS_{i,p}$ as the cumulative share of demand for industry i in regions $1, \dots, p$, when regions are sorted in ascending order by their employment shares in industry i . Plotting these cumulative shares against each other gives us industry i 's »Lorentz curve«. If production shares match the demand shares perfectly, the Lorentz curve is a straight 45-degree line with an area of 0.5 below the curve. In all other cases, the Lorentz curve will be convex with an area less than 0.5 below it. The smaller the area, the worse is the match between the geographical distribution of demand and the geographical distribution of production (employment).

The Gini-coefficient, which lies between 0 and 1, is calculated as 1 minus two times the area under the Lorentz curve. It is therefore equal to zero for industries with a perfect geographical match between demand and production. On the other hand, an industry with production concentrated in one area and demand spread across areas will have a high Gini-coefficient, and is therefore considered tradable (within the country). Technically, the Gini is approximated using the following formula:

$$G_i = 1 - \sum_p (\sigma EMPL_{i,p} + \sigma EMPL_{i,p-1}) \cdot (\sigma IDS_{i,p} - \sigma IDS_{i,p-1})$$

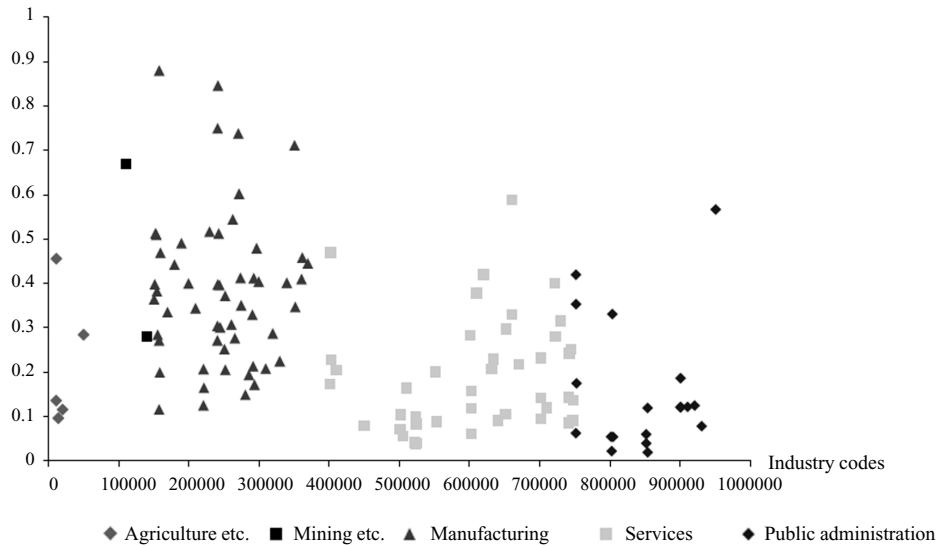


Figure 5. Gini coefficients for 124 different industries, 2005.

Source: Own calculations on input-output tables and matched employer-employee data from Statistics Denmark.

To calculate the demand shares we use information from input-output tables and matched employer-employee data (IDA) from Statistics Denmark. We use 124 different industries in the analysis as the input-output tables »only« distinguish between 130 different industries and since some of these have to be aggregated as they »share« one or more NACE codes. Alternatively, we could use a more detailed industry classification, *e.g.*, at the 4-digit NACE level as in Jensen and Kletzer (2006), but would then have to assume identical demand shares, $IDS_{i,p}$, for industries in the 4-digit classification that belong to the same industry in the 130-classification.

Furthermore, we use 9 different geographical areas which are somewhat smaller than the geographical areas used by Jensen and Kletzer (2006) for the US.⁸

Figure 5 illustrates the distribution of the calculated Gini-coefficients for the 124 industries for 2005. Not surprisingly, the manufacturing industries are on average more tradable than other industries. However, a number of service industries also appear relatively tradable with Ginis exceeding 0.3 – at least more tradable than many manufacturing industries. Four of the seven service industries with Ginis above 0.3 correspond closely to four of the industries from Table 2 (excluding »supporting and auxiliary transport activities«). The last three industries with Ginis exceeding 0.3 are two insurance industries plus a »gas supply« industry.

8. The nine areas are: Copenhagen, Bornholm, Zealand, Lolland-Falster, Funen, Southern Jutland, Eastern Jutland, Western Jutland and Northern Jutland.

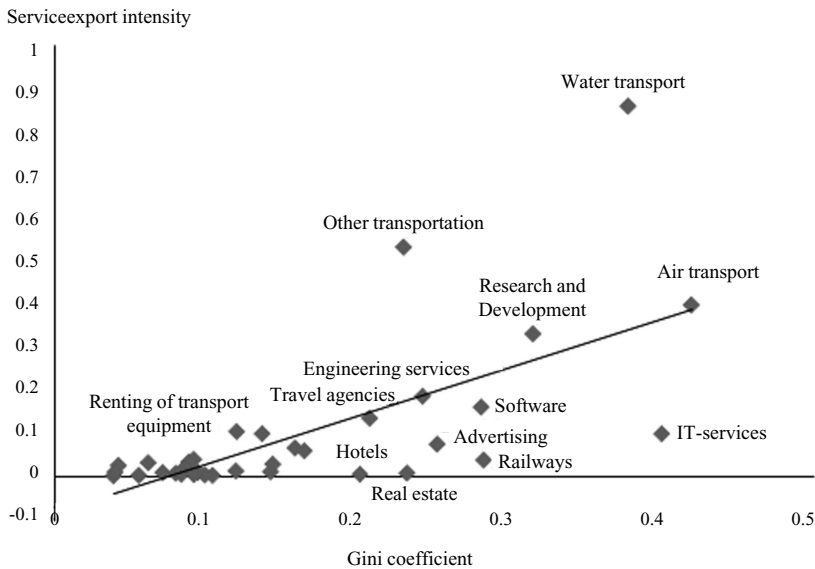


Figure 6. Tradability and service-export intensity, services industries, 2005.

Source: Own calculations on input-output tables, matched employer-employee data, the General Firm Statistics, the External Trade Statistics and the VAT register from Statistics Denmark.

Jensen and Kletzer (2006) use a Gini-value of 0.1 as the cut-off between tradable and non-tradable industries. Because of the smaller geographical areas used in the present study, a similar value cannot be applied here. The use of smaller geographical areas will automatically increase the Gini-coefficients – making industries look more tradable than in Jensen and Kletzer (2006).

Another problem with the Ginis as indicators of tradability is that industries that are tradable may still sometimes be geographically dispersed, *e.g.*, if there are no economies of scale or if some factors of production cannot be concentrated as in, *e.g.*, agriculture. The low Ginis for agriculture in Figure 5 are likely to be caused by the distribution of arable land which automatically leads to a geographically dispersed production, despite very tradable output. Similarly, a geographical concentration of industries need not imply international tradability but may be due to domestic specialization in more concentrated markets, *e.g.*, theatres and hotels in larger cities.

Despite these limitations of the concentration indices, it still seems reasonable to assume that industries that are concentrated in one part of Denmark are (all else equal) more tradeable than industries spread equally across the country. Hence, the Gini-coefficient seems to be a good indicator of the trade potential for an industry. Partly to check this, we analyse the relationship between tradable services and actually traded services.

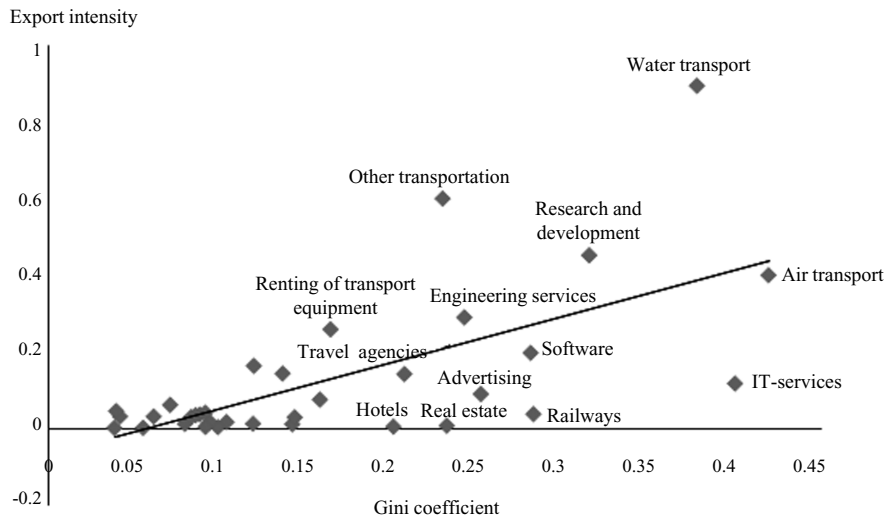


Figure 7. Tradability and total-export intensity, service industries, 2005.

Source: Own calculations on input-output tables, matched employer-employee data, the General Firm Statistics, the External Trade Statistics and the VAT register from Statistics Denmark.

Figure 6 plots the relationship between the calculated Gini-coefficient for a service industry – which indicates the potential for international trade – and the actual service-export intensity in the industry. Similarly, Figure 7 plots the relationship between the Gini-coefficient for a service industry and the total (services and goods) export intensity in the industry. There are 43 service industries in the 124-classification used. However, information about actual export intensity is missing for 9 of these industries (the finance/insurance industries and the industries responsible for water, gas and electricity supply).

As expected there is a clear and significantly positive relationship between the Gini-coefficient and the actual export intensity of an industry – both when using the service-export intensity and when using the total-export intensity. In both cases, the t -statistics exceed 4. This should not be taken to reflect any causal relationship, but it supports the idea that the Gini is a useful indicator of the international trade potential.⁹

The figures also show that most of the transport industries are characterised by both high tradability of their services and high actual export intensities. However, the figures also reveal some interesting outliers that exhibit high tradability but little actual export activity (observations below the regression line), and hence an apparent un-

9. Although both the Gini and the export intensity range between 0 and 1, there is not a one-to-one relationship between the two measures, and hence we should not expect a 45-degree line to emerge.

exploited potential for international trade. This is the case for, *e.g.*, »IT-services (excluding software)«, »advertising«, »railways«, »real estate« and »hotels«. These industries all have Gini-coefficients above 0.2 (which is relatively high, *cf.* Figure 8), while their service-export intensities are all lower than 0.1 (which is low compared to other service industries). There might be an obvious explanation for this in the case of the »hotel« industry: Hotels are typically concentrated in larger cities, and are therefore found to deliver potentially tradable services, when using the approach from Jensen and Kletzer (2006). However, their international export of services takes place through mode-2 and is therefore not recorded in the firm statistics. Hence, the difference between tradability and actual trade in this case is likely to be an artifact of the data. A similar explanation may apply (at least partly) to »railways« and »real estate«.

When it comes to »IT-services« and »advertising«, other explanations of the observed difference between tradability and actual trade could be at work. While services from these industries are traded within the country (as reflected in the Ginis), differences in languages, cultural patterns and market structures may work as impediments to international trade in these industries. The fact that the »software« industry enjoys higher export intensity than the »IT-services« industry perhaps reflects that software can more easily be shipped across borders than other IT-services.¹⁰

As a robustness check, we also estimated the relationships in Figures 6 and 7, excluding the four industries with service-export intensities exceeding 0.3. There is still a significantly positive relationship between an industry's Gini-coefficient and its actual service-export (or total-export) intensity. Furthermore, »IT-services (excluding software)« and to some extent also the »advertising« and »software« industries are still found below the regression line, *i.e.*, they are characterised by relatively high Ginis compared to their actual export intensities.

In summary, apart from »IT-services« and to a smaller extent »software« and »advertising«, the analysis reveals a rather robust relationship between a service industry's tradability and its actual international export of services.

6. Conclusion

In this paper, we have exploited information from the Danish statistical registers to construct a unique micro data set which contains firm-level measures of services exported (and imported) by Danish firms in recent years. These data allow for a much more detailed picture of service-export activities than existing studies which rely on aggregate BoP data.

10. The two outliers above the line »other transportation« and »water transport« may be due do some domestic sales being recorded as exports (as some of the services in these industries are not subject to VAT).

We showed that these firm-level measures are consistent with the more aggregate BoP data, which strongly indicates that the data provide relatively precise measures of exports of services at the firm level. We also illustrated how the data allow us to calculate exports or services at, *e.g.*, a detailed industry level. We found that while service industries are responsible for a large part of the trade in manufactured goods, most of the trade in services does in fact take place within the service industries. Among the services industries, high service-export intensities are found within some transport industries – in particular »water transport« – but also within R&D and computer services.

We also compared the actual export intensity of a service industry with its potential tradability using a method developed by Jensen and Kletzer (2006). The analysis revealed a robust relationship between a service industry's tradability and its actual international export of services. Only within »IT-services (excluding software)« and to a smaller extent within »software« and »advertising« do we find signs of an unexploited export potential, and hence potential barriers to international trade.

The data set constructed and used in the present paper also provides interesting possibilities for future research. A substantial literature has documented that exporters of manufactured goods tend to be more productive and pay higher wages than non-exporting firms; see, *e.g.*, Wagner (2007) for a recent survey. This evidence has highlighted a new potential source of gains from trade, as trade liberalization will reallocate resources from the least productive to the most productive firms. A similar analysis of the heterogeneity among service exporters can now be performed by exploiting the panel dimension of the current data. This is an obvious priority for future research.

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