

# **Trade and FDI in Services: Firm Level Evidence for Germany**

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# Preface

The dissertation at hand is the result of three years research, from May 2008 till May 2011, within a research project funded by the “Deutsche Forschungsgemeinschaft” (DFG) and the French counterpart “Agence Nationale de la Recherche” (ANR). The title of the project was “Foreign Direct Investment in Services”. The members of our project team were Horst Raff from the University of Kiel, Jörn Kleinert from the University of Graz and Farid Toubal from the University of Angers in Paris. Before I present the analysis and its results, I would like to give the reader some information about how this collaboration affected my dissertation.

The dissertation is an empirical work, which builds up on two merged datasets from the *Deutsche Bundesbank*, which comprise comprehensive information about service trade activities of German firms. The data are very innovative, because firm level evidence about services trade is quite limited, and raise the opportunity to deal with various topics related to the internationalization of services. The preparation of the data was very time-consuming, because of the large complexity of the firm level dataset and very little data documentation. With one of the datasets, a dataset collected to compile the BoP-Statistics, no researcher was ever working before. Jörn Kleinert had the idea to use these datasets and proposed first issues we could examine with the data. Jörn Kleinert and I managed the



preparation and the merge of the two datasets in several visits at the Deutsche Bundesbank in Frankfurt (Main). The high confidentiality level for firm level data did not allow us to handle the data outside the Bundesbank. The different chapters of the dissertation built up on already published or preliminary papers of me and my respective co-authors.

Chapter 3 is closely related to a joint paper with Jörn Kleinert (Kelle and Kleinert, 2010) that is published in the *Applied Economics Quarterly* from the “Deutsches Institut für Wirtschaftsforschung” (DIW). For this paper, I developed the general idea to collect innovative stylized firm level facts for both service exports and imports. Furthermore, I suggested how we could relate these issues to the existing literature and managed the data collection. We refined and finally formulated the results in close cooperation.

The fourth chapter is based on a joint paper with Jörn Kleinert, Horst Raff and Farid Toubal, which will soon be published as a working paper with the title “Cross-Border and Foreign-Affiliate Sales of Services: Evidence From German Micro-Data”. This paper is more complex than the first one. The theoretical part, which models the service supply of producer service firms in foreign markets, was mainly constructed by Horst Raff and Jörn Kleinert. Together with Jörn Kleinert and Farid Toubal, I discussed the empirical methods to test our theoretical considerations with our datasets. Mainly Jörn Kleinert and me were responsible for the data collection, the preparation of the results and their description.

Chapter 5 presents my own research ideas that emerged during the work with the data. It collects descriptive evidence about the service export activities of manufacturing firms. I intent to publish it as a working paper this year.

Markus Kelle

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# List of Abbreviations

BoP	Balance of Payments
FDI	Foreign Direct Investment
GATS	General Agreement on Trade in Services
IMF	International Monetary Fund
knz	Code Digit (in German: Kennziffer)
MiDI	Micro Database Direct Investment
MNE	Multinational Enterprise
NACE	Statistical Classification of Economic Activities in the European Community (in French: Nomenclature générale des activités économiques dans les Communautés européennes)
OECD	Organisation for Economic Co-operation and Development
UNCTAD	United Nations Conference on Trade and Development
WTO	World Trade Organization

# Chapter 1

## Introduction

### 1.1 Background

The literature on trade in services is quite sparse. Most empirical and theoretical research in the international trade literature is related to trade in goods. Blinder (2006) states that the focus on goods trade can be explained by the long existing perception of services as non-tradables, while goods are commonly regarded as tradables. This classification is mainly based on the specific characteristics of services compared to goods. Services often require a close interaction of the provider and the consumer of a service, which often need to be at the same place at the same time. Only a small fraction of services, for instance software, can be transported similarly to commodities. This creates a proximity burden that hampers the international supply of services (Francois and Hoekman, 2010).

Despite the limited literature associated with services trade it has become an important topic in international economic policy and public debates for at least two reasons. First, services play a continuously growing role in modern economies.

Today, high-income countries are primarily service economies. In 2007, services accounted for nearly 75% of GDP of high-income OECD countries, up from 58% in 1977.<sup>1</sup> With proceeding economic development, a further increase of this share is rather likely. Second, services are increasingly traded across borders. In 2007, world service exports stood at \$3,260 billion (WTO, 2008),<sup>2</sup> accounting for a 24% share of world trade. Since the 1990s trade in commercial services has grown at more than 10% a year, much faster than merchandise trade. In particular, business services have contributed to this development.

This catching-up process of services trade is likely to continue and may even accelerate due to the technological change. Technological progress and, particularly, the rapid development of the global telecommunication infrastructure increase the tradability of services, as they help to overcome the geographical distance between suppliers and consumers. For example, Freund and Weinhold (2002) conclude that the growing availability of Internet accounts abroad promoted cross-border services imports of the US in the 90s. Today, there are certainly many more services that can be supplied through cross-border trade than one or two decades ago, and there will be many more in the future.

These facts underline the increasing economic importance of services trade, on the one side, but also the need for a deeper understanding of services trade in order to encourage service trade liberalization to obtain welfare gains and foster economic growth, on the other side.<sup>3</sup> One of the most important programs for global service trade liberalization is the “General Agreement on Trade in Services”

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<sup>1</sup>Even for the world as a whole, services made up 70% of GDP in 2007, compared to 55% in 1977 (Francois and Hoekman, 2010).

<sup>2</sup>The numbers refer to trade statistics from the Balance of Payments (BoP) Statistics and do not include sales through foreign affiliates.

<sup>3</sup>We use the term “trade liberalization” for all policy activities that facilitate services trade.

(GATS), which is promoted by the “World Trade Organization” (WTO).<sup>4</sup> The GATS offers a useful framework to analyze services trade by defining four different modes of how services trade can be carried out: cross-border supply (mode 1), trade via consumption abroad (mode 2), a commercial presence abroad through an affiliate (mode 3), and via temporary presence of service suppliers abroad (mode 4). All four modes describe ways to overcome the geographical distance between the supplier and customer. It is worthwhile to note that the definition of “services trade” in the GATS deviates from the concepts related to goods trade, which define goods trade as cross-border trade in general. Services trade, however, is also related to services foreign direct investment (FDI) and not restricted to cross-border activities.<sup>5</sup>

Empirical evidence shows that it might be useful to take foreign affiliate sales also into account when analyzing services trade. Foreign affiliate sales of services have been growing even stronger in the recent past than cross-border trade. Christen and Francois (2010) find that the private service affiliate sales of US multinational enterprises (MNEs) increased by roughly 70% between 1999 and 2005. In the same time, private service cross-border exports increased by 50%. The total level of affiliate sales was almost 50% larger in 2005 than cross-border sales. Francois and Hoekman (2010) argue that the high level of foreign affiliate service sales might reflect the extensive privatization of service sectors in many countries, particularly in the 1980s and 1990s. Kox et al. (2009) state that the important role of foreign

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<sup>4</sup>However, Hoekman (2008) states that service trade liberalization more often relies on local agreements instead of striving global solutions in the GATS framework. For instance, the European Union (EU) also aims at creating an open domestic market for services with the EU-Service directive (EU 2006).

<sup>5</sup>Li et al. (2010) discuss some problems for the comparison of goods and services trade, because of the different measurements. We distinguish in the dissertation between cross-border sales, which comprise mode 1, 2 and 4, and foreign affiliate sales (mode 3). See for more details the data description in chapter 2.



affiliates to provide services might reflect that large barriers for cross-border sales still exist. They point out that only one tenth of global services output is related to international trade but fifty percent of the production of goods. Many services, construction services for example, might still rely strongly on personal contact of provider and customer for at least some part of the service delivery. This makes services providers more dependent on regulations and restrictions than manufacturing firms, which might make a permanent commercial presence abroad the only profitable mode to choose for many firms.

The different characteristics of services, in particular the above-mentioned proximity burden, imply that service trade barriers differ from barriers to commodity trade. Markusen and Strand (2009) divide service trade barriers into “natural” and “policy-imposed” barriers. Natural barriers can be communication and travel costs, different languages and time-zones or local consumer preferences and customs. Policy-imposed costs are price restrictions or restrictive licensing, requirements for residence or particular diploma, input requirements and bureaucratic procedures for visa and labor market regulations or restrictions for the temporary stay of workers, for instance.<sup>6</sup> Head et al. (2009) find evidence that the natural barriers are indeed important for services trade. They estimate gravity-type equations of services trade for different types of services and many countries and find that a large geographical distance between countries strongly reduces services trade volumes, similarly to goods trade. Bhattatarchya et al. (2010) find opposing effects. On the one side, they argue that the use of the telecommunication infrastructure could drive distance costs in terms of transportation or travel costs close to zero. On the other side, they find that geographical distance between provider and consumers might make the quality of services less evaluable for consumers and

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<sup>6</sup>See also Banga (2005) for a review of services trade barriers.

thus could reduce demand.

The “Organization for Economic Cooperation and Development” (OECD) (2009) states that the policy imposed measures are even more important than natural barriers. Furthermore, these barriers are directly under policy control and thus a natural instrument for economic policy. However, these service trade barriers are hard to identify and to measure.<sup>7</sup> First evidence shows that it might be difficult to find out with which costs service providers are confronted, because service transactions are often complex. For instance, Chanda (2006) presents several case studies which show a large variety of international activities of firms associated with services trade. She finds that these are often related to different modes of services trade which may be substitutes or complements. This often depends on the individual characteristics of services which can differ a lot, because services are very heterogenous. Furthermore, she shows that there often exist also interrelationships between services traded and the manufacturing sector.

Hoekman (2008) summarizes that important reasons for the slow progress of trade liberalization are the unknown costs and benefits of policy reforms and a lack of clear guidance how to design them to achieve the largest welfare gains. We are convinced that more empirical research is necessary to understand how services trade works, how it can be promoted by reducing trade barriers and how it can be implemented to increase global welfare.

Despite the growing importance of trade in commercial services, the large liberalization potential and first efforts to support international trade, very little is known about the firms that engage in trade and about the way trade is being conducted. However, the literature on goods trade shows that firm level heterogeneity

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<sup>7</sup>See OECD (2009) for an overview of the development process of a services trade restrictiveness index.

is very pronounced and determines the pattern of international trade to a large extent (Eaton et al., 2004). It is often found that only few firms are operating in foreign markets and that these are mostly more productive than the large bulk of firms that sell only domestically.<sup>8</sup> The most productive firms are even able to set up foreign affiliates and produce abroad (e.g., Head and Ries, 2003, 2004). The typical explanation for this is that exporting and foreign affiliate production involve substantial fixed costs and only the most productive firms in an industry are able to bear these costs.<sup>9</sup> The theoretical literature states that this firm heterogeneity leads to positive welfare effects of trade liberalization (e.g., Melitz and Ottaviano, 2008). Liberalization can increase the variety of services supplied, but is also associated with productivity gains in the related industries, because only the most productive firms enter foreign markets and increase competition. The tougher competition forces the least productive firms to exit the market and thus the average productivity of industries increases.

These stylized facts are very common for the international production and distribution of goods, but it is hardly examined if they apply also to services trade. Thus having more knowledge about whether and to which extent firm heterogeneity affects the pattern of services trade will be important to evaluate the welfare impacts of service trade liberalization. We would like to contribute to the understanding of service trade by presenting a service trade pattern at the firm level and want to encourage further research in this field. We believe that this is helpful to give profound guidance for future policy arrangements.

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<sup>8</sup>See, for example, the recent surveys of the empirical and theoretical literature by Greenaway and Kneller (2007) and Wagner (2007a).

<sup>9</sup>Melitz and Ottaviano (2008) and Helpman et al. (2004) develop relevant theoretical frameworks to explain the empirical evidence. These, in turn, built up on Melitz (2003).

## 1.2 Research Focus and Results

Of course, the biggest obstacle in the way of a systematic inquiry into these issues has been a lack of data.<sup>10</sup> Many earlier studies of service trade rely on aggregated trade data. Differences at the firm level, however, are aggregated away in studies at a higher level of aggregation.<sup>11</sup> Hence, one important task of the dissertation was to construct a suitable and comprehensive dataset of firm level service trade. We merge the balance of payments statistics (BoP) and the foreign direct investment micro database (MIDI), both provided by the Deutsche Bundesbank, to obtain information on nearly the entire population of German service traders. This unique dataset allows us to distinguish between (i) the cross-border sales of services, which includes GATS modes one, two and four, and (ii) sales through a foreign affiliate (mode three), at the level of the individual firm. In sum, we can rely on comprehensive information about German service trade on firm level.<sup>12</sup>

We begin the analysis in chapter 3 by collecting stylized firm level evidence about services trade and compare them with results from goods trade. We find that some important features of the trade of manufacturing goods that have been found in other studies (e.g., Bernard et al., 2007) apply also to the service trade. Particularly, we find a strong dominance of large service traders for both exports and imports of services. We distinguish three margins of trade at the firm level: the number of countries a firm is trading with, the number of types of services it trades (the two extensive margins) and the average volume of sales at the firm-country-

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<sup>10</sup>See Lipsey (2006) or Feenstra et al. (2010) for an in-depths discussion.

<sup>11</sup>For instance, Christen and Francois (2010) and Lennon (2008) present sector level evidence.

<sup>12</sup>The data contain mainly producer services in eleven service categories: construction, transport, auxiliary transport, post and telecommunication, insurance, data processing, R&D, management, engineering and architectural (E&A), advertising and personnel services. The construction of the dataset is discussed in detail in chapter 2.

service level (the intensive margin). Our results show that the strong concentration of service trade sales can be explained by all of the three margins and that these are positively correlated.<sup>13</sup> This suggests that heterogeneous firm models might be suited to explain services trade as well. Surprisingly, we find a very similar pattern for both exports and imports.

Chapter 4 addresses the question of how and to which extent firm heterogeneity determines the decision whether to supply services in foreign markets through cross-border or foreign affiliate sales. As already stated above, in the case of goods trade there is overwhelming evidence that firm heterogeneity within industries plays a key role in determining exports and foreign affiliate sales. Only productive firms select into export markets, and only the most productive ones are able to establish foreign affiliates. For services, this must not be necessarily the case, *ex ante*. Services might often not be tradable across borders and need to be provided as foreign affiliate sales. On the other hand, service FDI restrictions may force firms to choose cross-border sales, irrespectively of the productivity of the firm. If the service trade mode is predetermined by service and country characteristics, we do not observe self selection of firms into the different modes of supply depending on their productivity.

We find that most producer services in the sample are generally traded using both channels when they are regarded at the service sector level. We apply a discrete-choice model to determine how the firm's choice of how to supply a given service in a foreign country is driven by firm, service sector and country characteristics. We find in a sample with German producer service firms that proxies of firm productivity play indeed an important role for the decision of firms to sell services either through cross-border or foreign affiliate sales. More productive firms

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<sup>13</sup>The results refer in general to cross-border trade, but we control for effects of foreign affiliate sales on the stylized facts for export sales.

rather choose foreign affiliate sales. This result suggests that at least some parts of international trade with services can be explained by heterogeneous firm models as well. However, this is not the case for the entire sample of firms and services. Some firms exhibit only foreign affiliate sales, which suggests that they sell indeed services which are not tradable across borders. One important group of firms that also shows different drivers for the service export decision compared to the producer service firms are the manufacturers. These show hardly any foreign service affiliate activities and rely mainly on cross-border sales.

Totally, manufacturers account for roughly 30% of cross-border service exports of German firms. This evidence is striking, because the supply of services, by definition, is not the main business line of manufacturers. Obviously, services trade is not only associated with the services sector. This is supported, e.g., by Daniels (2000), who emphasizes that there are very dynamic linkages and synergies between service and manufacturing activities in an economy. Milgrom and Roberts (1990) claim that there is a complementary relationship between service and manufacturing activities even for single firms. Manufacturing activities of a firm become more valuable when they are complemented or supported by service activities and vice versa. Consequently, Preissl (2007) concludes that the service and manufacturing sectors should not be analyzed independently. However, the interdependencies between them are hardly analyzed and understood in the context of international trade (Daniels, 2000).

Chapter 5 is relating directly to this point and analyzes the cross-border service export activities of manufacturers more deeply. Particularly, we analyze the links between goods exports and foreign affiliates of manufacturing firms with their service export activities. We find that service exports serve only to a small extent to support the production and distribution affiliates of firms. Firms tend to sell

services abroad much more often to complement the supply of goods in foreign markets. This suggests that trade of goods and services is closely related even at the firm level.<sup>14</sup> We find that this might be particularly important for goods exporters and MNEs in high-tech manufacturing industries.

Altogether, the dissertation presents innovative stylized facts about service trade pattern at the firm level and contributes to the recent empirical literature on trade and FDI in services. In many parts of the thesis, the evidence has rather a descriptive character to get first insights of the pattern of service trade activities of firms. Beyond this first evidence, we find interesting and relevant questions for future research.

The rest of the dissertation proceeds as follows: In chapter 2, we present a detailed description of the two datasets from the Deutsche Bundesbank, which contain the information about services trade activities of firms, and how they are merged. In chapter 3, we start the analysis by collecting stylized facts on firm level. Particularly, we examine the heterogeneity of firms associated with the three margins of trade. Chapter 4 analyzes how firm productivity as well as country and sector level determinants affect the choice of firms whether to choose cross-border or foreign affiliate sales and presents under which conditions this choice exists for firms. Chapter 5 deals with the service export activities of manufacturers. With descriptive methods, we examine whether service exports of manufacturers are related to goods exports of firms or to support foreign affiliates. Chapter 6 concludes and gives an outlook to future research issues.

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<sup>14</sup>However, we interpret our results with caution, because we cannot observe goods exports at the firm level.

## Chapter 2

# Construction of the Dataset

The following chapter describes the contents and the preparation of the data that we use for the entire analysis. We merge two confidential micro-level datasets from the Deutsche Bundesbank, which contain nearly the whole population of German producer services exporters and importers.

The first dataset records service transactions between residents and non-residents, collected to compile the BoP-Statistics. For every service transaction with a value above 12,500 Euro, resident firms have to report the type of transaction they conducted with non-residents (“Kennziffer” or “knz” for short), the direction of the transactions (export or import), the value of the transaction, the partner country, and the firm’s sector classification (Deutsche Bundesbank, 2009).<sup>1</sup> The annual data are available for the period 2001 to 2010.

The BoP data contain transactions carried out under GATS mode 1, 2, and 4. The different modes characterize different ways of overcoming the distance

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<sup>1</sup>For further details on the residency definition see also International Monetary Fund (IMF) (2007). Firms state their main business line when they convey data about their activities to the Deutsche Bundesbank. The sector classification of firms follows the classification in NACE rev-1.



between supplier and consumer of a service, because production and consumption often occur simultaneously (Francois and Hoekman, 2010). In mode 1 (cross-border trade), both the supplier and the consumer of the service stay in their home country and interact, for instance, through the internet or post and telecommunication infrastructure. Mode 2 (consumption abroad) describes service trade transactions when consumers move abroad and consume a service in the foreign country. Mode 4 transactions (movement of natural persons) are cases in which a service supplier moves temporarily abroad and provides a service locally to a foreigner. Mode 3 finally, which is denoted as “commercial presence”, subsumes the activities of service providers via local foreign affiliates.<sup>2</sup> We cannot distinguish between mode 1, 2, and 4 in the BoP data and subsume all three of these modes under the category “cross-border sales”.

Every reporting firm in the BoP-Statistics has been given a firm identifier by the Bundesbank. The Bundesbank uses the same identifier for firms that appear in the second dataset we use, the MIDI (MIcrodatabase Direct Investment). The MIDI provides a detailed breakdown of the foreign assets and liabilities of all foreign affiliates of German investors and all German affiliates of foreign investors, if they exceed the rather low reporting limits (Lipponer, 2009).<sup>3</sup> In addition to the balance-sheet data, this comprehensive database includes information on affiliate sales and employment in more than 180 countries. It also provides information on the sector of activity of both the parent firm and the affiliate at the NACE rev-1 two-digit level (occasionally at the three-digit level). The data covers foreign affiliates’ activities

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<sup>2</sup>See for more details about the different modes and their implementation in the GATS WTO (2011).

<sup>3</sup>German foreign direct investment is defined in MIDI as the direct or indirect ownership or control by a single German entity of at least ten percent of the voting securities of an incorporated foreign firm or the equivalent interest in an unincorporated foreign firm. The same criteria define a German affiliate of a foreign investor.

between 1989 and 2009.

The affiliates' sales data from MIDI are used to identify foreign service affiliate sales of firms, our second category of service trade. These are transactions according to GATS mode 3, since the provider has established a permanent commercial presence in the country where the customer resides. One problem with this kind of data, which is known as "Foreign Affiliate Trade Statistics" (FATS) in the literature, is that we know only the sector classification of an affiliate and its total sales. There is no differentiation between different services or goods that are sold by the affiliate. Therefore, on the one hand, we overestimate the service sales of an affiliate in a specific product group, because it is very unlikely that an affiliate sells only services according to the group in which it is classified. Yet, on the other hand, we underestimate trade because we also do not account for sales of a particular service by affiliates that are classified in a different sector. In sum, an upward bias of foreign affiliate service sales is likely. Despite these underlying problems, the OECD (2008) concludes that FATS data is the best we have and is preferable to estimating service trade through commercial presence by using FDI stock or flow data.

Nevertheless, it is controversial whether foreign affiliate sales should be labelled as "exports of services" at all, because this is contrary to the goods trade literature, which distinguishes between exports and FDI. Li et al. (2010) state that this inconsistent treatment of foreign sales hampers comparisons between commodity and services trade with aggregated data. For instance, statements about imbalances of trade flows between countries can change tremendously when affiliate sales are included or neglected. This, in turn, can lead to very different policy implications. However, we find that including foreign affiliates in firm level analyses is useful, because cross-border and affiliate sales can substitute and complement each other

at the firm level. Mostly, we distinguish between foreign affiliate and cross-border sales to clarify the results.

We split our service trade data into eleven service sectors, which represent mainly producer services. The first seven sectors are at the two-digit level: construction, transport, auxiliary transport, post & telecommunication, insurance, data processing, and research & development (R&D) services. The last four are business services that we split into management services, advertising, engineering and architectural (E&A) and personnel services using the three-digit level classification. Thus, we cannot interpret our sectoral data as observing service products, because the data are much too aggregated for such an interpretation. We denote the different services as different types or groups of services, which in turn include different service products.<sup>4</sup>

We aggregate the values of each firm's cross-border trade transactions for all combinations of firm, year, kind of service trade (export or import), and partner country from the BoP trade database to match the structure of the observations from the MIDI database. The aggregation is necessary, because the sector classification of the foreign affiliates in the MIDI is more aggregated than for the services traded in the BoP-Statistics. Furthermore, there is no distinction between different transactions with customers of an affiliate. Table A.1 in the Appendix A gives an overview of the kind of services included in both datasets and the matching of the data. The matching targets on obtaining the highest level of disaggregation of the data that possible with our two datasets.

We use data for 2005 in the entire dissertation to describe the basic pattern of service trade involving German firms at the micro level. The sample of firms

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<sup>4</sup>Note that the types of services that we use differs slightly in the further chapters of the dissertation. In chapter 3 and 4 we do not use E&A services. In chapter 4 insurance services are dropped as well, because we find that these do not apply to our discrete choice approach.

and services regarded differs slightly in the three following chapters. We explain the construction of the sample size and relevant descriptive facts in the respective sections. Altogether, the datasets comprise more than 22,500 service importers and 5,000 exporters. These account for around 43,000 observations for exports and 150,000 for imports.<sup>5</sup>

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<sup>5</sup>These values account for both cross-border and foreign affiliate sellers.

# Chapter 3

## German Firms in Services Trade

### 3.1 Introduction

We mainly refer in this chapter to Kelle and Kleinert (2010) and collect some new facts on the pattern of services trade in Germany at the micro level. As already discussed in the introduction, firm heterogeneity has been found in the international trade literature to be very important to explain the pattern of goods trade (e.g., Eaton et al., 2004). We examine firm heterogeneity for services trade, because firm level evidence is quite scarce for services trading firms. In particular, we analyze the different margins of trade of firms: the two extensive margins, the number of countries traded with and the number of products, and the intensive margin, the volume of sales given a firm sells a product to a given country. Furthermore, we compare the export side of the economy with service imports.

Some important features that have been found to apply in the trade of manufacturing goods in other studies (e.g., Bernard et al., 2007) apply also to the service trade: (i) Only a small number of German service firms participates in the services

trade. (ii) Trading firms vary a lot concerning their trade values, with (iii) large firms strongly dominating trade. (iv) Most large firms do both import and export services. (v) The dominance of large firms can be explained by all the margins of trade. (vi) Finally, the patterns of the imports are amazingly similar to those of the exports.

The dominance of a few large firms in trade has been found in goods trade before. Mayer and Ottaviano (2008) and Manova and Zhang (2009) present such evidence for manufacturing firms in several European countries and in China, respectively. Manova and Zhang (2009) and Bernard et al. (2007) report also that trade is dominated by firms that handle both import and export goods and that all margins of trade contribute to the differences in firms' trade. Thus, the service trade pattern that we report is very similar to the pattern in goods trade. This is also found by Breinlich and Criscuolo (2010) for service trade in the United Kingdom (UK).

The similarity to trade in goods holds also true for the positive relationship of the different margins of trade. The extensive margin with respect to the number of products requires activities of multi-product firms as modeled by Mayer et al. (2011) and Bernard et al. (2009). They develop models with multi-product firms that face a firm-specific productivity and product-specific capabilities or expertise. These firm and product characteristics lead to a positive relationship between the number of products traded and the volume of sales, because more productive firms can sell more products and larger volumes of a given product. Arkolakis and Muendler (2010) use a similar model, with fixed costs for entering a foreign market and variable costs for placing a product, to study the export of Brazilian manufacturers. They find a positive relationship between product range and sales per product for a given destination. We investigate the relationship between the

margins of service trade and find a similar relationship in our data, although the interrelation of all three margins is a bit more complex.

Additionally, we find a strong within-firm concentration of trade on a few markets and services. Such a concentration has already been found by Breinlich and Criscuolo (2010) for firms from the UK. Even firms that trade with many countries and trade many different services tend to concentrate their activities in only a few markets and services. Heterogenous firm models based on monopolistic competition are very helpful in organizing ideas about the relationship of the different margins, but they can explain the strong concentration of exporters in one or very few foreign markets only with relatively strong assumptions. The enormous concentration on the import side challenges the assumption of monopolistic competition even more.

The remainder of the chapter is organized as follows: in Section 2, we give a brief description of the dataset we are using in the present chapter. In Section 3, we analyze the differences in service trade flows across service product groups and across the sectors of the trading firms. Section 4 examines firm-level differences concerning the volume of sales, the number of services supplied abroad, and the number of countries served. In Section 5, we document the great dominance of the most important market even for large "global and diversified" firms. In the last section, we conclude and discuss some issues for further research.

## **3.2 Sample Characteristics**

In this chapter of the dissertation, we split our service trade data into ten service sectors, which are listed in Table 4.1. The first seven sectors are at the two-digit level. The last three are business services that we split into management services,

advertising, personnel services using the three-digit level classification.

We make use of more than 160,000 observations concerning service trade, which can differ along five dimensions: the firm, the type of service group traded, the trade mode (cross-border or commercial presence), the kind of transaction (export or import), and the partner country. The 125,000 observations for imports clearly dominate the roughly 35,000 observations for service exports. Many firms are involved in foreign activities using more than one channel. For the analysis at the sector and at the firm level, we use a sample with 18,004 cross-border importers, 5,058 cross-border exporters, and 542 German parent firms. Table 4.1 shows trade values and the number of firms engaged in trade aggregated for the different trade modes.

In 2005, the 542 German parents exporting services through their foreign affiliates had aggregated affiliate service sales of 216 billion Euros (column 7). Affiliates' service sales were more than twice as large as the cross-border supply, which amounted to 86.5 billion Euro (column 3). Affiliates sales abroad were also higher than were foreign firms' German affiliates' sales (90.0 billion Euros, column 8), roughly equaling the 88.3 billion Euro aggregate cross-border service imports (column 5).

Unfortunately, we cannot conduct an analysis of total service imports at a disaggregated level, because we do not have information about the buyers of the services supplied by the German affiliates of foreign multinationals. We therefore drop imports through commercial presence from our further analysis and use only cross-border trade data for comparing imports and exports. On the export side, we can analyze both cross-border exports and those using a commercial presence in the foreign country. We highlight the important differences in the results for total and cross-border exports along the study.



Table 3.1: Sector Variation in Producer Services Trade 2005 (billions of Euros)

Sector	Cross-border		Cross-border		Comm. presence		
	Exporter	Exports	Importer	Imports	Exporter	Exports	Imports
Construction	845	8.2	2,043	5.1	78	14.9	6.7
Transport	654	14.8	3,806	8.3	111	24.3	12.9
Auxiliary Transp. Post & Tele-	372	5.8	2,152	8.5	116	40.7	5.2
communications	172	2.7	1,053	4.0	43	46.3	23.3
Insurance	462	28.9	1,969	32.4	93	67.6	18.7
Data Processing	925	6.7	3,812	6.8	90	15.2	16.0
R & D	968	9.1	3,145	10.3	35	2.0	1.1
Management Serv.	1,422	5.4	6,297	7.7	28	1.4	3.3
Advertising	643	2.8	4,236	3.7	25	0.7	1.2
Personnel Serv.	471	0.9	2,266	1.5	-	2.7	1.6
Total	-	86.5	-	88.3	-	215.8	90.0

Note: Firms that trade services from different sectors are counted more than once.

The total of the number of firms is meaningless.

Sources: MIDI (2007), BoP (2009), authors' computation.

Table 3.2: German Service Trade by Country 2005 (billions of Euros)

Cross-border Exports				Cross-border Imports			
Rank	Country	Share	Sales	Country	Share	Sales	
1	USA	16.1%	13.9	USA	17.2%	15.2	
2	UK	10.7%	9.3	UK	13.4%	11.8	
3	Netherlands	8.5%	7.4	Switzerland	9.8%	8.6	
4	Switzerland	8.0%	6.9	Netherlands	9.2%	8.1	
5	France	4.9%	4.2	France	5.7%	5.1	
Total		100.0%	86.5	Total		100.0%	88.3

  

Outward Affiliate Sales				Inward Affiliate Sales			
Rank	Country	Share	Sales	Country	Share	Sales	
1	USA	26.5%	57.1	Netherlands	28.4%	25.6	
2	UK	13.4%	29.0	Luxembourg	16.6%	15.0	
3	Netherlands	7.5%	16.2	UK	10.7%	9.7	
4	Austria	4.8%	9.8	USA	9.9%	8.9	
5	France	3.5%	7.5	France	5.9%	5.4	
Total		100.0%	215.8	Total		100.0%	90.0

Sources: MIDI (2007), BoP (2009), authors' computation.

German firms trade services with more than 180 countries and regions. The five most important trading partners are ranked in Table 3.2 according to their share in cross-border and foreign affiliate services sales for both exports and imports. Except for the inward foreign affiliate sales, the USA and the United Kingdom (UK) are the most important service trading partners of Germany.

### 3.3 Sector Analysis

In this section, we examine whether there are any regularities in service trade at the sector level. We distinguish two ways to aggregate service trade to the sector level: (i) according to the characteristics of the service traded and (ii) according to the classification of the trading firms. In the first step, we investigate export

participation and intensities in ten different service product groups. In the second step, we analyze trade concerning the role of firms from different industries.

Information about the export participation of German firms and the importance of foreign markets is presented in Table 4.1. Export values refer to cross-border exports. We report the number of firms classified in the different sectors in Germany in column 6 and their production values in column 7 from the *Statistical Yearbook 2008*.<sup>1</sup> Based on these values, we calculate the participation ratio in column 4 as the share of exporters of a particular type of service (column 2) in all firms in the sector (column 6). Export intensities in column 5 are derived by dividing cross-border exports (column 3) by the production in Germany (column 7).

Note a conceptual issue concerning Table 3.3. The number of exporters and the exports are lower than in Table 4.1. The reason is that we include only firms with the same sector classification with respect to the traded service type and the classification of the trading firm. For instance, R&D exports of R&D firms are included, but transport service exports of these firms are not. In some sectors, that causes a serious bias. R&D exporters, for example, come from all industries, particularly from manufacturing. Nevertheless, we include only firms exporting in the same sector to achieve comparability to the numbers from the statistical yearbook, which is organized according to the classification of the firm and not according to the product.<sup>2</sup>

We want to highlight three results from Table 3.3. First, the average export participation ratio (0.14%) is fairly low in services trade (column 4). These values

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<sup>1</sup>Production value includes a firm's turnover in Germany and cross-border exports, but does not account for affiliate sales. Thus, it serves as a rough proxy for service sales in the different German service sectors.

<sup>2</sup>The import side is neglected because we do not know to whom the German affiliates of foreign multinational firms sell.

Table 3.3: Cross-border Exports and Participation in German Services Sectors 2005  
(billions of Euros, number)

Sector	Cross-border		Exporter Ratio	Export	Firms in Germany	Prod. in
	Exporter	Exports				
Construction	197	1.05	0.05	0.60	361,070	175.1
Transport	53	1.96	0.09	2.08	60,753	94.2
Auxiliary Transp. Post & Tele- communications	65	1.83	0.28	1.93	23,379	94.6
Insurance	47	1.74	0.54	1.65	8,636	105.4
Data Processing	190	17.6	11.6	-	1,633	<i>a</i>
R & D	305	4.82	0.65	7.82	47,104	61.6
Management Serv.	93	0.63	2.12	7.97	4,391	7.9
Advertising	5	0.02	0.00	0.03	129,073	54.7
Personnel Serv.	d	d	d	d	25,516	17.6
Total	d	d	d	d	4,268	11.4
Total	960	29.7	0.14	4.76	665,823	622.5

*a* No comparable number for sales in Germany. The trade figures include only the service component of the insurance contract. d: deleted because of confidentiality  
Sources: MIDI (2007), BoP (2009), *Statist. Yearbook 2008*, authors' computation.

are downward biased, on the one side, by the notification threshold of 12,500 Euros per transaction in the BoP-Statistics and, on the other side, because we account only for firms that export the services according to their sector classification. When we calculate a broader measure that divides the number of producer service firms that exports any of the ten producer services by the total number of producer service firms in Germany from the Statistical Yearbook (2008), we obtain a slightly larger value of 0.34%.<sup>3</sup>

This low trade participation matches results from earlier studies in manufacturing. For instance, Bernard et al. (2007) find that 3.1% of U.S. manufacturers

<sup>3</sup>We define producer service firms as firm with a Nace rev-1 code between 600 ("land transport") and 748 ("miscellaneous business activities") and the construction firms.

exported and 2.2% imported goods in 2000. Vogel and Wagner (2010) find an export participation of 16% for German business services, but they neglect firms with total sales below 250,000 Euros, which leads to an upward bias in their results.

Second, export intensities in the analyzed sectors are much higher than the participation rates. The average export intensity over all sectors (excluding Insurance for data reasons) is 4.8% (column 5). This implies that average exports per service exporter are relatively large compared to average domestic sales per firm. Third, export participation and intensity differ a lot among services. Participation rates range from nearly 0.0% for Management Services to 11.6% for Insurance. Export intensity is nearly 0.03% for Management Services and 8.0% in the R&D sector. These sector differences might arise from different reasons such as differences in comparative advantages, tradability of the services, or the mismatch in the classification of products and firms discussed above.

Next we present the sector aggregation with respect to the firm that trades the service. Information about service trade in ten German sector groups is collected in Table 3.4 and 3.5. The analysis is mostly restricted to cross-border trade to facilitate comparability between exports and imports. In Table 3.5, we also include foreign affiliates sales of firms. The second column in Table 3.4 shows the value of the cross-border exports of a particular sector group. The third column presents the fraction of service exports conducted by this group in total cross-border exports. The fourth column gives the share of cross-border exports conducted by firms that do both export and import of services (E+I firms) in percent. The fifth, sixth, and seventh columns present the same information as the second, third, and fourth columns do for imports, respectively.

Firms from all sectors export and import services. In sector-specific analyses of service trade it seems, therefore, more important than for trade in goods to

Table 3.4: Cross-border Service Exports and Imports 2005 by Industry of the Firm (billions of Euros, %)

Industry	Exports (bn. Euro)	Share (%)	E+I Share	Imports (bn. Euro)	Share (%)	E+I Share
Primary	0.3	0.3	96.0	0.27	0.3	85.2
Motor Vehicles Manufacturing	5.6	5.7	100.0	4.0	4.5	81.5
low-tech Manufacturing	4.0	4.6	97.7	9.1	10.3	76.8
high-tech	12.4	14.3	98.4	10.8	12.3	91.5
Wholesale & Retail	2.5	2.9	82.8	3.3	3.7	35.5
Construction & Utilities	1.1	1.3	97.3	0.7	0.8	55.4
Transports	18.0	20.8	96.1	11.4	12.9	67.8
Finance, Insurance & Communication	21.1	24.4	99.1	25.9	29.4	95.0
Business, R&D & Computer	10.0	11.5	94.5	7.9	9.0	79.4
Holdings & Oth. Serv.	12.3	14.1	98.4	14.7	16.7	88.7
Total	86.4	100.0	97.2	88.1	100.0	83.5

Note: E+I firms: firms that export and import services.

Sources: MIDI (2007), BoP (2009), authors' calculations.

account for the sector of the trading firm. Nevertheless, service firms account for the majority of service exports and imports. The three sector groups Transport; Finance, Insurance & Communication; and Business, R&D & Computer account together for more than 56% of cross-border exports (column 3) and 50% of cross-border imports (column 5). When holdings and other service firms are also taken into account, this share increases to roughly 70% and 75%, respectively.

The share of manufacturing firms is also very sizeable, with nearly 25% in total service exports and roughly 27% for imports. While we expected a share like this

Table 3.5: Total Exports and Number of Cross-border Exporting and Importing Firms 2005 by Industry of the Firm (billions of Euros, %)

Industry	Total Exports	Share (%)	Cr.-border Exporter	E+I Share	Cr.-border Importer	E+I Share
Primary	0.3	0.1	37	70.3	120	21.7
Motor Vehicles Manufacturing	5.6	1.8	69	84.1	216	26.9
low-tech Manufacturing	7.7	2.5	577	77.6	3,106	14.4
high-tech Manufacturing	14.3	4.7	797	73.5	2,313	25.3
Wholesale & Retail	5.5	1.8	487	63.7	3,069	10.1
Construction & Utilities	13.8	4.5	227	52.4	663	17.9
Transports	43.3	14.3	871	81.6	2,391	29.7
Finance, Insurance & Communication	114.8	37.8	520	83.1	1,245	34.7
Business, R&D & Computer	27.1	8.9	1,064	52.8	3,123	18.0
Holdings & Oth. Serv.	71.0	23.4	271	66.3	1,758	15.4
Total	302.1	100.0	5,058	69.7	18,004	19.6

Note: E+I firms: firms that export and import services.

Sources: MIDI (2007), BoP (2009), authors' calculations.

for the import side, the 25% for cross-border service exports is higher than we expected. Breinlich and Criscuolo (2010) find a share of 12% for manufacturing firms in both exports and imports for the United Kingdom, using a slightly different composition of services in their analysis. The higher share of manufacturing in Germany might be due to the larger importance of the manufacturing industry for the German economy. Table 3.5 shows that the share of the manufacturers for exports would be smaller than 10% if we also accounted for exports through foreign affiliates (column 3). Service firms export more often through foreign affiliates and

have, on average, larger sales abroad if compared to manufacturers.

Firms that both export and import services account for a surprisingly high share of total cross-border exports and imports. The share stands at 97.2% for exports and 83.5% for imports (Table 3.4). Breinlich and Criscuolo (2010) obtain a similar value for imports (86.4%), but a slightly lower one (79.8%) for exports. Table 3.5 shows that the share of E+I firms decreases to 69.7% for exports (column 5) and 19.6% for imports (column 7) when the number of firms instead of the sales is considered.

### **3.4 Firm-level Differences**

In the last section, we collected new facts about service export participation and trade values at the sector level. However, Eaton et al. (2004) report that export participation and export values in goods trade are more strongly affected by firm than by sector characteristics. They find strong firm heterogeneity within industries concerning the export activities of firms. In this section, we therefore look at differences at the firm-level. Although we have information only on firms that participate in trade, this group by itself is not composed of symmetric firms. In the first subsection, we study the heterogeneity in the values of exports and imports, in their intensive margin, and in their two extensive margins. In the second subsection, we analyze the relationship between the margins more deeply using multivariate regressions.



Table 3.6: Deciles of Cross-border Exporters 2005 (thousands of Euros, number)

Decile	Exports (bill. Euro)	Share (%)	Average Sales	Average Number of	
				Countries Served	Services Offered
1	0.001	0.00	18.0	1.12	1.02
2	0.03	0.03	44.1	1.41	1.09
3	0.06	0.07	81.7	1.85	1.16
4	0.12	0.14	151.9	2.32	1.21
5	0.24	0.28	240.9	3.49	1.32
6	0.48	0.56	415.7	4.45	1.35
7	0.9	1.04	775.5	5.72	1.42
8	1.8	2.07	1,441.7	6.68	1.53
9	4.2	4.87	2,507.1	9.02	1.64
10	78.5	91.0	7,934.1	21.43	1.96
Total	86.3	100.0	1,359.6	5.75	1.37

Sources: MIDI (2007), BoP (2009), authors' computation.

### 3.4.1 Concentration of Trade

To analyze trade at the firm level, we aggregate the exports and imports of each firm over all sectors and partner countries, and rank firms according to their sales in deciles. We find striking differences among the trading firms with respect to trade values. These differences can result from (i) differences in the value of trade of a particular service with a particular country (intensive margin), (ii) the number of countries traded with (the extensive margin with respect to countries), and (iii) the number of services traded (extensive margin with respect to products).

Table 3.6 lists the sum of cross-border exports (unweighted), average firm exports per sector-country combination, average number of countries served, and average number of service groups traded by a particular firm for each decile. These figures show a strong increase of total sales per firms in the higher deciles. Certainly, the increase is by construction, because we grouped the firms with the lowest

Table 3.7: Deciles of Cross-border Importers 2005 (thousands of Euros, number)

Decile	Imports (bill. Euro)	Share (%)	Average Sales	Average Number of Source Countries	Average Number of Services Imported
1	0.02	0.02	11.1	1.13	1.06
2	0.05	0.05	22.6	1.20	1.1
3	0.08	0.09	35.9	1.48	1.23
4	0.14	0.16	55.4	1.67	1.3
5	0.23	0.26	77.7	2.22	1.49
6	0.38	0.43	115.9	2.64	1.6
7	0.67	0.76	174.4	3.31	1.75
8	1.32	1.50	261.4	4.6	2.0
9	3.39	3.85	495.1	7.0	2.35
10	81.9	93.0	2,375.1	16.4	3.29
Total	88.1	100.0	362.1	4.16	1.71

Sources: MIDI (2007), BoP (2009), authors' computation.

exports in decile 1. Yet, the increase is impressive: the firms in the 10th decile account for nearly 91% of cross-border exports (column 3). The ten largest exporters, roughly 0.2% of firms, account for around 40% of cross-border exports.<sup>4</sup>

Similar results can be found for service imports in Table 3.7: 10% of cross-border importers, which are the largest firms, account for 93% (column 3) of total cross-border imports. The top 100 or 0.5% of the importers, account for roughly 60% of imports. Thus, large firms strongly dominate trade in services in Germany, for imports and for exports.

Comparing cross-border exports and imports, we find that, on average, importers trade more different types of services: 1.7 compared to 1.4 for exports. In contrast, the average number of partner countries is larger for exports (5.8) than for imports (4.2). The intensive margin of trade (column 4) is more than three times

<sup>4</sup>We even find a slightly stronger concentration of sales when we include also foreign affiliate sales. The firms in the tenth decile account then for more than 95% of total foreign sales.

Table 3.8: Cross-border Export 2005, Extensive Margins (billions of Euros, %)

Number of Countries	Exports (bn. Euros)	Share (%)	Number of Exporters	Share (%)
1	3.1	3.6	2,082	41.2
2	1.8	2.1	760	15.0
3-5	3.8	4.4	828	16.4
6-10	5.1	5.9	595	11.8
11-50	30.8	35.7	744	14.7
> 50	41.8	48.4	49	1.0

  

Number of Sectors	Exports (bn. Euros)	Share (%)	Number of Exporters	Share (%)
1	38.1	44.1	4,030	79.7
2-3	28.0	32.4	795	15.7
4-5	10.3	11.9	195	3.9
> 5	10.0	11.6	38	0.8

Sources: MIDI (2007), BoP (2009), authors' calculation.

larger on the export side. Columns 4-6 in Tables 3.4 and 3.5 show that the strong increase of trade volumes in the upper deciles can be explained by an increase of all three margins for both imports and exports: firms with larger imports or exports have larger average trade volumes in a given country and sector, trade with more countries, and trade services from more groups.

The intensive margin shows impressive differences for exports and for imports. For instance, average imports per country and product group by a firm in the fifth decile (77,700 Euro), for instance, are 7 times larger than the sales of a firm in the first decile (11,100 Euro), but only 5% of the sales of a firm in the tenth decile (2,375,100 Euro).<sup>5</sup>

<sup>5</sup>Cross-border exports in the tenth decile are 400 times larger than in the first, where cross-border imports are 210 times larger. When we consider total exports (cross-border and commercial presence), sales in the tenth decile are more than 3,500 times larger than in the first decile.

Table 3.9: Cross-border Import 2005, Extensive Margins (billions of Euros, %)

Number of Countries	Imports (bn. Euros)	Share (%)	Number of Importers	Share (%)
1	3.0	3.4	8,410	46.7
2	1.8	2.0	2,943	16.4
3-5	4.3	4.9	3,287	18.3
6-10	8.1	9.2	1,810	10.1
11-50	28.9	32.8	1,473	8.2
> 50	42.1	47.7	81	0.5

  

Number of Sectors	Imports (bn. Euros)	Share (%)	Number of Importers	Number of (%)
1	17.7	20.1	11,666	64.8
2-3	13.5	15.3	4,711	26.2
4-5	16.3	18.5	1,144	6.4
> 5	40.6	46.1	483	2.7

Sources: MIDI (2007), BoP (2009), authors' calculation.

Table 3.8 shows the extensive margins for cross-border exports. Apparent is a strong concentration of exports on the few firms in the highest category. The 49 firms that export to more than 50 countries account for almost half of the exports, although they are only about 1% of all exporters. On the other end of the distribution, we have many exporters that export to just one country. These firms account for only a small share of German service exports. The dominance of the highest category with respect to the number of services supplied is less pronounced. The 38 firms exporting more than 5 product groups account for more than 10% of the exports.<sup>6</sup>

Table 3.9 displays similar results for cross-border imports. The 81 importers that import from more than 50 countries, roughly 0.5% of the firms, account for

<sup>6</sup>Considering total exports further strengthens the dominance of large firms.

nearly 50% of German service imports. Similarly, the 483 firms importing from more than five product groups account for almost half of the imports. Thus, services trade in Germany is dominated by globally engaged, multi-product firms.

To assess the role of the different margins in explaining the differences in firm sales, we simply regress the three margins on total firm sales in three different OLS regressions in log-log form. The intensive margin on the firm level is calculated as in Tables 3.6 and 3.7: the average trade volume per sector-country combination on the firm level. The results for cross-border exports and imports in the six different regressions are presented in Table 3.10. All coefficients are significant at the 1%-level. The coefficient is highest for the intensive margin (column 2) followed by the number of partner countries (column 3) and the number of service types traded (column 4). Breinlich and Criscuolo (2010) find similar results for firms in the UK. The coefficient of the intensive margin is slightly higher for cross-border exports than for cross-border imports.

The small coefficient of the number of services traded is probably due to the high aggregation level of the service groups in our data, which leads to low variation of this variable (particularly for exports) as shown in Tables 3.6 and 3.7. Bernard et al. (2009) use goods trade data at the 10-digit level and find a stronger positive effect from the number of products exported on the intensive margin of exports than we find here. In addition to the level of aggregation, another explanation for the differences in the results may be differences in fixed costs. Providing an additional service in a foreign market might be more expensive than exporting an additional good. This idea is proposed by the OECD (2009).

Table 3.10: Log-log Regression of Service Sales on Different Margins of Trade of Firms

Explaining Variables	Avg. Sales per Countr.-Sector	Number of Countries	Number of Services
<i>Cross-border Exports</i>	0.68** (131.7)	0.30** (60.2)	0.05** (22.2)
$R^2$	0.77	0.42	0.09
<i>Cross-border Imports</i>	0.63** (247.3)	0.33** (134.0)	0.13** (76.7)
$R^2$	0.77	0.50	0.25

\*\* significantly different from 0 at 1% level. Std. errors in parantheses.  
Sources: MIDI (2007), BoP (2009), authors' computation.

### 3.4.2 Margins of Service Trade

After having studied the three margins explaining the differences in firms' trade values, we now analyze their correlation. According to the theory sketched in the introduction, the relationship should be positive. The correlation between the two extensive margins is positive and significant at the 1% level. The correlation coefficient for cross-border imports (0.48) is larger than for cross-border exports (0.28) and total exports (0.3).

To analyze the relationship between the intensive margin and the extensive margins, we run log-log regressions for the value of trade in every given firm-sector-country combination on the two extensive margins. This has the advantage that we can control for country and sector biases by including country and sector dummies. Additionally, we include a dummy variable for the sector of the trading firms.

Running separate regressions for the extensive margins, we obtain, in line with theory, positive coefficients that are significant at the 1% level for both margins and

for imports and exports. The explanatory power of *Internationality*, the number of partner countries, is larger compared to *Diversity*, the number of service products traded.<sup>7</sup> The results become more complex when we include both margins in one regression, as can be seen in Table 3.11. We find that Internationality still has a positive impact on the trade values of a firm for both cross-border imports and exports as well as for total foreign sales. The coefficients of *Internationality* are significantly larger than zero at the 1% level in all columns in Table 3.11.

For *Diversity*, we obtain significantly negative coefficients. As a robustness check we split the sample in manufacturing and service firms and run separated regressions for total exports. The results are presented in columns 5 and 6. The coefficient of Diversity is significantly negative for manufacturers (column 5). For service firms, however, it is positive, although insignificant (column 6).<sup>8</sup> Arkolakis and Muendler (2010) find as well, both theoretically and empirically, that there is not necessarily a positive relationship between a firm's Diversity and its intensive margin.<sup>9</sup>

The Affiliate-Dummy in columns 4-6, which is set to one if the export is conducted by a foreign affiliate, is highly significant in the regressions for total exports and has a large positive coefficient. Obviously, trade volumes are much larger when firms choose commercial presence as their export mode. Moreover, columns 2 and 3 report that firms which both import and export have larger intensive margins: the exporter dummy in column 3 and importer dummy in column 2 are positive

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<sup>7</sup>This result concerns both the size of the coefficients and the adjusted residual square sum.

<sup>8</sup>This suggests that firm productivity could be more important for service firms than for manufacturers to explain the relationship between the different margins of trade.

<sup>9</sup>They find that the number of products per destination country is much more related to the intensive margin of sales in the specific foreign market. We find as well that the positive relation between *Diversity* and the intensive margin is clearly stronger when it is calculated on firm-country level.

Table 3.11: Regression of the Intensive Margin on the Extensive Margins of Trade

	Cross-border		Total	Total Exports	
	Exports	Imports	Exports	Manufact.	Serv. Firms
<i>Internationality</i>	0.30** (24.7)	0.23** (29.4)	0.35** (32.0)	0.42** (20.8)	0.36** (25.0)
<i>Diversity</i>	-0.21** (9.5)	-0.26** (20.6)	-0.08** (3.5)	-0.15** (4.7)	0.04 (1.2)
<i>Exp.-Dummy</i>	-	0.29** (19.6)	-	-	-
<i>Imp.-Dummy</i>	0.27** (7.1)	-	-	-	-
<i>Out.-MNE Dummy</i>	0.81** (20.9)	0.87** (34.9)	-	-	-
<i>Inw.-MNE Dummy</i>	0.26** (5.6)	0.31** (10.6)	-	-	-
<i>Affiliate-Dummy</i>	-	-	5.00** (92.7)	5.08** (31.0)	4.89** (81.5)
<i>Adj.R<sup>2</sup></i>	0.15	0.12	0.32	0.19	0.39
<i>Observations</i>	33,737	95,105	34,999	12,572	19,376

All regressions included sector, country, and firm sector classification dummy variables. Standard errors in parantheses: \*, \*\* significantly different from 0 at 5% level, at 1% level.

and significant at the 1% level. This supports the evidence from Table 4 that E+I firms dominate trade. One reason for this dominance is a larger intensive margin. Additionally, we include a dummy that indicates whether a firm is a German multinational (Outward MNE) or if it belongs to a foreign multinational (Inward MNE). Both type of firms have larger cross-border trade, with German MNEs having particularly high trade levels.

This section highlighted the high concentration of sales in a few (large) firms and the role of the different margins to explain the heterogeneity among firms that trade services. We found that all three margins of adjustment contribute to this



heterogeneity. The analysis has mainly focused on the averages of the margins across firms. Yet, so far we have said nothing about the distribution of sales across different trading partner countries and traded services within a single trading firm. The following section therefore analyzes the within-firm concentration of trade activities in particular markets.

### **3.5 Composition of Trade Within Firms**

In this section, we illustrate to what extent firms' trade activities are concentrated on the most important partner countries or service products. We find that there is not only a large concentration of trade activities in a few firms, but also a pronounced concentration of trade within these firms.

To show this, we calculate the market share of cross-border export and import values in the first, second, and third important partner country of a particular firm. We average this firm-specific market share for all firms and present the result in column 2 of Table 3.12. Columns 3, 4, and 5 give the average market share for all firms that have exactly 5, 15, and 40 partner countries, respectively. This gives us the average relative importance of a single country and service for the total trade value of a firm.

The shares of the most important market are very high for both exports and imports. For a firm with 15 partner countries, the most important market accounts for an impressive 44% of the exports and 43% of the imports (column 4). For comparison, note that the average market share is 6.7%. Even an exporter with 40 partner countries (average market share 2.5%) exports 41% of all services to its most important partner country (column 5). The three most important destinations account for 68% of all exports. An importer with 40 partner countries buys 27% of

Table 3.12: Concentration of Sales on Destination Countries for Cross-border Exports and Imports, (%)

Markets ranked	All firms	Firms with export relationships with exactly		
		5 countries	15 countries	40 countries
Most important	0.75	0.57	0.44	0.41
Second	-	0.22	0.19	0.16
Third	-	0.11	0.11	0.11
Observations	5,058	186	59	7

  

Markets ranked	All firms	Firms with import relationships with exactly		
		5 countries	15 countries	40 countries
Most important	0.80	0.57	0.43	0.27
Second	-	0.22	0.18	0.20
Third	-	0.11	0.11	0.12
Observations	18,004	704	128	7

Sources: MIDI (2007) BoP (2009), authors' calculations.

all services from its most important and 59% from its three most important source countries.

We find that concentration is even more pronounced with respect to the number of service groups in which a firm trades. We show this in Table 3.13, which is organized as Table 3.12 above, but which contains information about the concentration of firms' trade in the three most important product groups. The concentration in the most important product group is high. Breinlich and Criscuolo (2010) find similar results for the trade of firms in the UK. While concentration with respect to both products and partner countries is, on the export side, in line with models where a single or multi-service producer sells services to different markets that differ in market size and trade barriers, the high concentration on the import side is more puzzling. These results do hold only for service firms, but also for manufacturers.

Table 3.13: Concentration of Sales on Types of Services for Cross-border Exports and Imports, (%)

Service group Ranked	All firms	Firms with exports in exactly		
		2 groups	3 groups	5 groups
Most important	0.96	0.83	0.75	0.66
Second	-	0.17	0.19	0.22
Third	-	-	0.06	0.08
Observations	5,058	576	219	63

  

Service group Ranked	All firms	Firms with imports in exactly		
		2 groups	3 groups	5 groups
Most important	0.91	0.80	0.73	0.67
Second	-	0.20	0.20	0.20
Third	-	-	0.07	0.09
Observations	18,004	3,260	1,404	403

Sources: MIDI (2007) BoP (2009), authors' calculations.

### 3.6 Conclusion

We presented in this chapter an empirical overview on service trade at the micro level. Many stylized facts are comparable to evidence for goods trade. We find that rather few firms trade services. The differences between the service sectors analyzed are sizable, but much less pronounced than within sector differences between firms. The bulk of exports and imports are concentrated in few global and diversified firms. All three margins of trade contribute to this concentration, while the intensive margin is the most important one. But even within these firms, activities are very much concentrated on one partner country and service group.

Furthermore, we find some evidence that the intensive and extensive margins of trade are positively linked at the firm level, but we identify some differences between manufacturers and service firms. Additionally, the number of service products exported seems to have a weaker correlation to the intensive margin, as it does in

goods trade.

We see three main issues for future research arising from the analysis. First, the high share of non-service firms and particular manufacturing firms in services trade deserves a more detailed analysis. Moreover, the analysis of the different margins of trade reveals that the determinants of service trade may be different for firms from manufacturing. We will take up this point in chapter 5 and analyze service exports of manufacturers more in detail.

Second, the high concentration of trade in firms that are both importing and exporting deserves further research. Taking the first steps in this direction, Breinlich and Criscuolo (2010) find that employment, capital-intensity, or productivity are larger for firms that both import and export. Bernard et al. (2007) and Kasahara and Lapham (2008), for instance, propose increasing international fragmentation of production as a possible reason for the dominance of firms with export and import activities. They argue that there is a positive effect on the export activities of firms from reducing their costs by offshoring. Amiti and Wei (2009) find that in the last decade, offshoring of business activities has not only been sizable, but has also contributed significantly to the increase in productivity in developed countries.

Third, the large concentration at the firm-level is particularly surprising for imports, for which empirical evidence and theoretical considerations are still scarce. It seems as if service imports are channeled through a few large firms. But if both the export side and the import side is so strongly concentrated, models of perfect and also of monopolistic competition probably do not describe trade appropriately. Strategic interaction and monopolistic behavior might play a much larger role than the models suggest. The concentration on the import side is particularly hard to explain in the frameworks that model consumers on the buyers side. The data, in contrast, point to a "business-to-business" relationship in service trade.

This is not just an academic point. Market structure heavily influences the welfare effects of trade liberalization. Raff and Schmitt (2009) make this point in a model showing the buyer power of importers. Welfare gains from lower trade costs are thereby strongly reduced by the buyer's power. Thus, it is important to understand the import behavior of firms more deeply in order to give profound guidance for further liberalization of trade in producer services.

Altogether, the evidence presented in this chapter shows that the pronounced firm level heterogeneity found for goods trade applies in general also to services trade. Breinlich and Criscuolo (2010) show in a similar analysis for services trade in the UK that the concentration of service trade on few large firms is driven by firm's labor productivity. This suggests that related firm heterogeneity models might be suited to describe also services trade. However, these stylized facts are only a first glance of the data. Deeper analysis needs to follow. The next chapter takes a first step in this direction and deals with the issue whether and how much firm heterogeneity affects the decision of firms whether to serve foreign markets through foreign affiliate or through cross-border sales.

## Chapter 4

# Cross-border and Foreign Affiliate Service Sales of Producer Service Firms

### 4.1 Introduction

The last chapter shows that firm level heterogeneity is not only important for goods trade but for services trade as well. Large firms that trade several types of services with many countries dominate the overall picture. In the present chapter, we proceed with the analysis of firm heterogeneity. We examine whether firm productivity affects the decision of producer service firms whether to serve foreign markets through cross-border or foreign affiliate sales. As already discussed in the introduction, the literature for manufacturers shows that only the most productive firms set up foreign affiliates, likely because these are the only one which can bear the additional fix costs related to foreign affiliates. Whether this can be found for

services trade too, is an open question. Many services might be restricted to one of the two channels, because of non-tradability of the service product or policy restrictions (e.g., Francois and Hoekman, 2010, Kox et al., 2009).

Our main result is that firm characteristics together with country-level factors are the main drivers of the export mode choice. This result is quite novel. We find specifically that variables that are known to be positively related with firm size and productivity foster service supply through foreign affiliates. That is in line with the evidence from goods trade and suggests that the firm heterogeneity models apply also to services trade. However, this result is not valid for the entire sample of producer service sellers. We restrict the analysis to producer service firms and do not examine manufacturers, for instance. Manufacturers likely show different determinants for the export mode decision and deserve a deeper individual analysis that will be done in chapter 5.<sup>1</sup> Furthermore, we do not account for firms that show no cross-border sales at all, because these obviously do not face a choice between cross-border and foreign affiliate sales.<sup>2</sup> Altogether, our results apply to a sample with producer service firms which account for roughly 30% of producer service export sales of German firms.<sup>3</sup>

The analysis is related to two strands of the literature. First, there are a number of papers that examine the selection of service firms into cross-border exports and imports. These include Breinlich and Criscuolo (2010) who use a sample of UK firms, and Kelle and Kleinert (2010) who use the German BoP data

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<sup>1</sup>For instance, we find that these hardly choose foreign affiliate sales and rely strongly on cross-border sales.

<sup>2</sup>Because these account for more than 60% of foreign affiliate sales of producer service firms, we check how they would influence the results in a robustness check.

<sup>3</sup>This relative measurement depends on the underlying sample of services categories and firms included. In the sample of producer service firms that is analyzed in this chapter, our results apply to 50% of service sales.

to demonstrate that only the more productive or larger firms engage in inward and outward service trade. Vogel (2009) and Temouri et al. (2010) find for business service firms in France, Germany and the United Kingdom that exporting firms are on average more productive than non-exporters. Furthermore, there are studies which analyze also MNEs. Kox and Rojas-Romagosa (2010) find that service firms with service affiliates are more productive than firms with only cross-border export sales. Furthermore, they find that the productivity premium of Service MNEs even exceeds the one for manufacturing MNEs. These results generally support our findings. However, the papers did not examine the decision of firms in different foreign markets.

In contrast to our results, Bhattacharya et al. (2010) find in a small sample of Indian software service firms that not the most productive firms set up foreign affiliates. They show in a theoretical framework that this might be related to the specific characteristics of services. Some services, like software services, show hardly any transportation costs because of the intensive use of the telecommunication infrastructure. Furthermore, the authors presume that the large uncertainty of consumers about the quality of services due to the geographical distance to the provider can increase the relative costs of cross-border supply so strongly that only the most productive firms can choose cross-border sales. These findings underline that the large heterogeneity of services will make a more precise analysis of specific service sectors in the future quite useful.<sup>4</sup>

Second, several studies examine industry level determinants of cross-border and foreign-affiliate sales of services, and compare these determinants with those for manufacturing. Head et al. (2009) find large distance costs of cross-border sales

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<sup>4</sup>Nevertheless, we find in a robustness check that the positive impact of productivity on the decision to choose foreign affiliate sales remains in a subsample with only data processing services. The estimation results are available upon request.



for several services, which hamper services trade across borders. Christen and Francois (2010) show, among other things, that countries that are larger and more distant receive a larger share of foreign-affiliate sales. Furthermore, these studies often find a complementary relationship of cross-border and foreign affiliate service sales (e.g., Christen and Francois, 2010, Fillat-Castejón et al., 2009, Lennon, 2008), because attractive markets usually attract services through both channels. Kox et al. (2009) state that this result is founded by the high aggregation of the data. They emphasize that analyzing whether service or goods cross-border and foreign affiliate sales are substitutes or complements requires product level data. This kind of data is hardly available for services. We find evidence that firms seem to face in general a discrete choice between these two supply channels even for the same type of service in the same country. However, we find that some firms sell services also through both channels to a foreign country. One explanation for that is likely that our services data are still too aggregated to distinguish services on the product level.

In a study using US data at the sector level, Oldenski (2009) finds that whether a service or manufacturing industry relies on foreign-affiliate rather than cross-border sales depends on the task composition of the industry. Specifically, industries where direct communication with the customer and nonroutine activities are important are more likely to rely on foreign-affiliates to supply overseas customers. These features are obviously much more important for services than for manufacturing, which explains why foreign-affiliate sales play a much larger role in services. This sector level analysis nicely complements our findings of selection effects within service industries.

The rest of the chapter is organized as follows. Section 2 presents a theoretical framework to inform our choice of explanatory variables and the baseline empirical

model, which is introduced in Section 3. Section 4 provides a description of the data, and Section 5 contains the empirical results for our baseline model and various robustness checks. Section 6 concludes, and the Appendix provides data sources.

## 4.2 Theoretical Framework

In this section we sketch a simple model to motivate the discrete choice of a firm  $i$  between supplying services to foreign customers through cross-border sales (*cb*) or foreign affiliate sales (*fa*). Cross-border sales imply that firm  $i$  produces the service in its home country (country  $h$ ) using local labor, and sells it to the foreign country (country  $f$ ) using GATS modes 1, 2 or 4. Foreign affiliate sales (GATS mode 3) imply that the firm establishes a permanent affiliate in the foreign country that uses foreign labor to produce the service. We focus exclusively on this choice, assuming implicitly that firm  $i$  has already decided to export services; we revisit this assumption in the empirical section when we check for robustness.

Most of the service trade recorded in our data is trade in producer services. That is, the service firms we are dealing with sell intermediate inputs to downstream firms. The demand for services is hence a derived demand stemming from the profit-maximization decisions of these downstream firms. We follow Markusen (1989) in postulating a downstream industry in the foreign country, industry  $m$ , that costlessly assembles services (and possibly other intermediates),  $S_1, \dots, S_n$ , into a final output,  $X_m$ , according to the CES production function:<sup>5</sup>

$$X_m = \left( \sum_{i \in \Omega} S_i^\rho \right)^{\frac{1}{\rho}}, \quad 0 < \rho < 1, \quad (4.1)$$

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<sup>5</sup>Markusen's model of trade in producer services, in turn, builds on Ethier (1982).

where  $\Omega$  is the set of available services, and the elasticity of substitution between services is given by  $\sigma = 1/(1 - \rho)$ .

Let the market price of good  $m$  be denoted by  $p_m$  and the price of service input  $i$  be given by  $q_i$ . Then the profit maximization problem in the  $m$  industry is to choose  $S_i$ ,  $i \in \Omega$ , according to

$$\max_{S_i} p_m \left( \sum_{i \in \Omega} S_i^\rho \right)^{\frac{1}{\rho}} - \sum_{i \in \Omega} q_i S_i. \quad (4.2)$$

The corresponding first-order condition is

$$\frac{p_m}{\rho} \left( \sum_{i \in \Omega} S_i^\rho \right)^{\frac{1-\rho}{\rho}} \rho S_i^{\rho-1} = q_i. \quad (4.3)$$

Assuming that there are sufficiently many service producers so that each producer views  $p_m$  and  $X_m$  as exogenous, we may write the inverse demand function for service  $i$  as

$$q_i = A \rho S_i^{\rho-1}, \quad (4.4)$$

where firm  $i$  takes as fixed

$$A \equiv \frac{p_m}{\rho} \left( \sum_{i \in \Omega} S_i^\rho \right)^{\frac{1-\rho}{\rho}}.$$

Labor is the only factor used to produce and deliver services. We may hence express all costs as the product of the wage rate ( $w_h$  at home, and  $w_f$  in foreign) and the respective labor requirement. Labor requirements are determined by a firm's mobile and immobile assets or capabilities (Nocke and Yeaple, 2007). By mobile capabilities we mean that a firm has some know-how in producing services that can be used both at home or transferred to the foreign country to produce services

there. Local capabilities, i.e., local knowledge and contacts with customers, cannot be so easily transferred abroad because service trade is facilitated by close contact with customers and the ability to tailor services to their specific needs, much more so than, for example, trade in goods. The cross-border supply of services suffers especially from this lack of proximity to customers. Cross-border supply hence may either mean that customers abroad do not receive the full benefit of the service, or that service personnel travels temporarily to the customer to deliver the service, or that the foreign customer travels to the home country to acquire the service.

These potential disadvantages of cross-border supply can be overcome if the firm acquires local capabilities in the foreign country, i.e., if it sets up a foreign affiliate to create more direct contact with foreign customers. However, operating a foreign affiliate is itself costly. It seems reasonable to assume that this cost has more the character of a fixed cost, whereas the travel cost or disutility of cross-border trade is proportional to output and hence a variable cost.

We formalize the concept of mobile and immobile capabilities and the trade-off between cross-border supply and foreign-affiliate sales by parameterizing service technology in the following way. The technology used to produce services exhibits a firm-specific unit labor requirement of  $1/\gamma_i$ ; hence  $\gamma_i$  is firm  $i$ 's labor productivity. This productivity represents the firm's mobile capabilities in that this productivity is the same whether the service is produced at home or by a foreign affiliate. In the case of cross-border sales, the lack of local capabilities in the foreign market implies that services are more difficult to sell abroad or less useful to foreign customers. The variable cost associated with cross-border sales takes the form of an iceberg cost,  $\delta > 1$ ; that is,  $\delta$  units of the service have to be "shipped" from the supplier in country  $h$  in order for one unit to arrive at the customer in country  $f$ . The fixed cost of operating a foreign affiliate is denoted by  $F$ .

Given these costs, the profit maximization problem of service firm  $i$  when it chooses foreign-affiliate sales can be written as:

$$\max_{S_i} \left( A\rho S_i^{\rho-1} - \frac{w_f}{\gamma_i} \right) S_i - F. \quad (4.5)$$

The corresponding problem for cross-border sales is:

$$\max_{S_i} \left( A\rho S_i^{\rho-1} - \frac{\delta w_h}{\gamma_i} \right) S_i. \quad (4.6)$$

We show in the Appendix that the maximized profits in the case of foreign-affiliate sales and cross-border supply, respectively, are:

$$\pi_i^{fa} = B \left( \frac{w_f}{\gamma_i} \right)^{\frac{-\rho}{1-\rho}} - F, \quad (4.7)$$

$$\pi_i^{cb} = B \left( \frac{\delta w_h}{\gamma_i} \right)^{\frac{-\rho}{1-\rho}}, \quad (4.8)$$

where

$$B \equiv \left( \frac{1-\rho}{\rho} \right) (\rho^2 A)^{\frac{1}{1-\rho}}.$$

is a measure of the size of service demand in country  $f$ .

Using  $\sigma = 1/(1-\rho)$ , the profits from affiliate sales relative to those from cross-border sales can be rewritten as

$$\frac{\pi_i^{fa}}{\pi_i^{cb}} = (\delta w_h)^{\sigma-1} \left[ \left( \frac{1}{w_f} \right)^{\sigma-1} - \frac{F}{B} \left( \frac{1}{\gamma_i} \right)^{\sigma-1} \right]. \quad (4.9)$$

If this ratio is larger than one, firm  $i$  chooses to supply the service via a foreign affiliate; if it is smaller than one, the firm chooses cross-border supply. According to (4.9) the discrete choice between cross-border and foreign affiliate sales is

determined by firm characteristics, namely labor productivity  $\gamma_i$ , as well as parameters that are likely to vary by country and industry, including the variable cost of cross-border supply  $\delta$ , the fixed cost of operating an affiliate  $F$ , the foreign wage  $w_f$  relative to the home wage  $w_h$ , and the size of the foreign demand for services  $A$ .

Due to the fixed cost of operating an affiliate, only firms with a sufficiently high productivity  $\gamma_i$  will choose foreign affiliate sales. Less productive firms will go for cross-border sales. If we assumed that cross-border sales also involved a fixed cost, plausibly smaller than that associated with affiliate sales, then the least efficient firms would not export at all. We do not model such fixed costs here, because their effect is obvious, but consider them in our empirical investigation.<sup>6</sup>

To filter out the effects of firm-specific determinants it is especially important to control for the costs of cross-border supply and of operating a foreign affiliate, as we would expect them to vary widely across both service industries and countries due to the very heterogeneous nature of services and a host of country-specific barriers to service imports. The predicted effects of the other industry/country controls are also straightforward: a lower foreign relative to home wage, and greater demand for services abroad should encourage foreign affiliate sales.

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<sup>6</sup>As already discussed in the introduction of this chapter, Bhattacharya et al. (2010) model cross-border supply slightly different than we do. They assume zero distance costs when the internet is used to provide services. Furthermore, they model the increasing uncertainty of consumers when there is no direct contact with the service provider as a demand reducing effect. This creates a scenario in which only the most productive firms choose cross-border sales and the less productive firms foreign affiliate sales.

### 4.3 The Empirical Model

We estimate the discrete choice model to explain the decision whether to sell services in a foreign market through a foreign affiliate or through cross-border trade given by equation (4.9). The decision by firm  $i$  to sell service  $j$  in country  $f$  through cross-border trade is indicated by a zero. Each firm-service-country combination characterized by sales through a foreign affiliate is indicated by a one. We use the indicator variable  $Mode_{ijf}$  as the endogenous variable in our regression analysis.<sup>7</sup>

In the appendix we show that the mode choice based on relative profits (4.9) leads to the regression equation:

$$\begin{aligned} D_{mode} &= \beta_0 + \beta_1 \ln(Productivity_i) + \beta_2 \ln(Foreign Wage_f) + \beta_3 \ln(Distance costs_f) \\ &+ \beta_4 \ln(Foreign operation costs_f) + \beta_5 \ln(Market Size_f) + u \end{aligned}$$

where  $Productivity_i$  is firm  $i$ 's labor productivity,  $Wage_f$  stands for the wage in the foreign country,  $Foreign operation costs_f$  for the fixed costs for operating a foreign affiliate in country  $f$ ,  $Market Size_f$  for the foreign market size and  $Distance costs_f$  for the distance costs between the home country (Germany) and the partner country  $f$ .  $u$  denotes the error term.

Our dataset does not allow us to calculate labor or total factor productivity of the German firms. We therefore proxy productivity by an extensive margin of the firm, namely the number of countries to which the firm exports. Breinlich and Criscuolo (2010) show that firms with higher labor productivity export services to

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<sup>7</sup>We treat in our baseline regressions observations on firm-service-country level which show both foreign affiliate and cross-border sales as observing only foreign affiliate sales. We analyze in a robustness check how this affects our results.

more countries. For our data we know that the largest service exporters are active in many countries. This suggests that a firm's *Internationalization* is indeed a good proxy for productivity. We expect it to have a positive sign.

The costs of cross-border supply,  $\delta$ , i.e. *Distance costs*, are unobservable and not easy to proxy. We use the geographical distance between Germany and the foreign country (*Distance*) and a border dummy (*Border*). We know that these variables reflect the effect of the costs of cross-border supply only incompletely. Yet, additional variables, such as time zone, language or cultural differences turned out to be insignificant, but positively correlated with geographical distance. Additionally, we use sector dummies  $d_j$  to control for the effects of the tradability of the services. Sector dummies give an average propensity to use a particular mode for the firms in a sector. The descriptive statistics in Table 4.1 emphasize the differences between the service sectors concerning the importance of the different trade modes.

The costs of operating an affiliate,  $F$ , have a political and an organizational dimension. The political dimension, FDI restrictions, is proxied by the value of the FDI restrictiveness index from the OECD (*FDI Restrictions*). It reflects, for instance, local-ownership or input requirements and screening of a firm's business. The index varies across countries and service sectors. We expect a negative sign for this variable. The organizational component of fixed costs is proxied by sector averages of the number of transaction per year scaled by sales (*Organizational costs*). It measures whether the service trade requires frequent transactions or is conducted only occasionally. We expect *Organizational costs* to have a positive sign, because transaction costs can be reduced by an affiliate abroad with larger proximity to the customer.

To catch the wage effect,  $w_f$ , we use the wage of a high-skilled department manager  $\ln(\textit{High-skilled wage})$  and as a robustness check low-skilled sales person



$\ln(\text{Low-skilled wage})$  both taken from the wages and prices survey of the Union Bank of Switzerland (UBS, 2006). In a further robustness check we use GDP per capita of the foreign country to enlarge the sample to more countries  $\ln(\text{GDP per capita})$ . Wages and *GDP per capita* are highly positively correlated.<sup>8</sup> We expect a negative sign for all three wage proxies, because a higher wage abroad increases the relative costs of employing foreign workers in an affiliate.

As a proxy for market size  $A_f$  we use the GDP of the partner country  $\ln(\text{GDP})$ . The size of the market of a particular partner country perceived by a German service exporter might also depend on the aggregated sales of German affiliates in this foreign country. Raff and von der Ruhr (2001), for instance, argue that it might be easier for foreign affiliates of German firms to rely on German service suppliers in a foreign country instead of building up new business relationships with foreign firms. We distinguish between two groups of potential German customers abroad, German service affiliates and German manufacturing affiliates abroad, and measure their demand for services by total affiliate sales of these groups relative to the country's GDP,  $\ln(\text{Serv aff sales})$  and  $\ln(\text{Manu aff sales})$ , respectively. All three proxies for market size should have a positive sign.

We also include a number of controls that we did not explicitly model but may nevertheless be important. The sector-level variable *Heterogeneity* controls for differences in industry market structure. It is calculated as the variance of sales of German service firms scaled by average sales. Helpman et al. (2004) find that the heterogeneity of firm sales has a positive effect on a measure of affiliate sales relative to cross-border sales. Heterogeneous sectors have very large firms, and these firms tend to rely on affiliate sales, because they are presumably very productive and

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<sup>8</sup>The correlation coefficient is 0.85 for high-skill and 0.93 for low-skill wages. The correlation of the two wage measures is 0.90.

can bear the fixed cost of maintaining an affiliate abroad. Following this line of reasoning, we expect a positive sign. Finally, we include in most regressions dummy variables for the sector classification of the firms and the service group we observe. Appendix B provides more details about the exogenous variables and the data sources.

## 4.4 Description of the Data

### 4.4.1 Sample Characteristics

In this chapter, we focus on German exports in 9 producer service sectors that are listed in Table 4.1.<sup>9</sup> We restrict the sample to firms which are classified as producer service firms. Hence, we keep firms from the construction sector and firms with a NACE rev-1 code between 600 (“transport”) and 748 (“miscellaneous business activities”).<sup>10</sup> This yields 15,500 observations, which can differ along four dimensions: the firm, the service sector, the trade mode (cross-border or foreign affiliate sales) and the partner country. The sample contains 2,754 firms. These split up into 2,524 cross-border exporters and 318 German parent firms with service affiliates abroad. 88 firms show both activities.

The 230 firms that only hold foreign affiliates but do not engage in cross-border sales to any country do not fit in the theoretical framework, because they might not have a choice in their mode of supply. Our theoretical model works with country-

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<sup>9</sup>On the export side we know the business group structure of German firms, including the ultimate owner, parent and all affiliates as well as the cross-border exports of the firms. We do not have these informations for foreign parents and their service exports to Germany and hence do not study service imports into Germany.

<sup>10</sup>Firms state their main business line when they convey data about their activities to the Deutsche Bundesbank. The sector classification of firms follows as well the classification in NACE rev-1.

specific decisions about the mode. Seeing a firm with a service affiliate in a foreign country implies that the firm's productivity exceeds the minimum productivity needed to produce with an affiliate there. It is very unlikely that the productivity of such a firm does not allow for profitable cross-border exports to another country. It is more likely that the non-tradability of the product forces firms to use foreign affiliate supply. If that is a technical requirement, firms do not face the choice. Studying a discrete choice approach is then not really convincing. We therefore drop these firms.<sup>11</sup> They make up for 639 observations combing 82.8 billion euro or 65% of total foreign affiliate sales. Roughly 40 billion euro of these affiliate sales can be assigned to post & telecommunication services, 16 billion euro to auxiliary transport service, 9.4 billion to construction and 8.6 billion to transport services.

Dropping these firms leaves us with a sample of 2,524 firms and 14,861 observations. 14,469 of the observations are cross-border and 392, roughly 2.7%, are foreign affiliate sales.<sup>12</sup> Most of the firms in the sample are classified in one of the nine service sectors we use to group the service trade transactions. Additionally, our sample contains mainly financial, insurance and other business services firms.

To complete the description of the data it is useful to examine how much variation there is across the different service sectors in their reliance on cross-border sales compared to foreign affiliate sales. We also study how much heterogeneity there is at the firm level in the choice of cross-border and affiliate sales.

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<sup>11</sup>We check the impact of these firms in a robustness check in section 5.4 and present some ideas about the determinants of their behavior. Further different explanations why these firms appear are discussed in the conclusion to give some ideas for future research.

<sup>12</sup>The number of observations in the regressions is smaller, because the country variables are not available for all countries.

## 4.4.2 Heterogeneity of Services

Table 4.1 displays the number of firms exporting the different services included in our analysis and the volume of exports. We distinguish between foreign affiliate sales (columns 1 and 2) and cross-border sales (columns 3 and 4). It is important to note that we classified the firms according to the type of service they sell and not with respect to the sector of the German exporter. Organizing the data like this has two implications that should be kept in mind: first, construction service exporters, for instance, can come from all industries and second, firms that appear in the table as transport exporters, for instance, can also appear as R&D exporters.

Table 4.1 shows that German parents exporting services through their foreign affiliates generated aggregated sales of 39.6 billion Euro in 2005 (column 2). Affiliate sales were thus nearly as large as cross-border sales which amounted to 36.3 billion Euro (column 4).<sup>13</sup>

We want to highlight three points from Table 4.1. First, the number of firms engaged in cross-border sales is large compared to the number of firms selling through foreign affiliates. The ratio of German firms that have affiliates abroad (column 1) over cross-border exporters (column 3) is 0.03 (column 5). Second, average sales through a foreign affiliate of a German multinational are much larger than average cross-border exports of a firm. This is revealed by the affiliate sales ratio in column 6 which is roughly 35 times larger than the MNE-ratio (column 5).<sup>14</sup> Third, we find large heterogeneity across sectors in their use of the two

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<sup>13</sup>As already mentioned, these values are related to our so defined producer service firms, which do not show only foreign affiliate sales. In the sample with all firms, we would find foreign affiliate sales of 151 billion euro and 62.1 billion euro cross-border sales. Thus, our analysis covers around 35% of German services export sales.

<sup>14</sup>As discussed in the data description, the affiliate sales data are likely upward biased. Nevertheless, the affiliate sales ratio would still be much larger even if we overestimated affiliate sales even by 50%.

Table 4.1: Cross-border and Foreign Affiliate Service Sales of Producer Service Firms 2005, (number, billions of euros)

Sector	Foreign Affiliate		Cross-border		MNE- Ratio	Aff. Sales Ratio
	Exporters	Exports	Exporters	Exports		
Construction	20	4.2	277	1.9	0.07	2.21
Transport	18	7.1	675	18.2	0.03	0.39
Auxiliary Transp. Post & Tele- communications	21	11.7	255	4.1	0.08	2.85
Data Processing	9	5.3	112	2.7	0.08	1.96
R & D	17	10.6	510	5.2	0.03	2.04
Management Serv.	d	d	181	1.0	d	d
Advertising	6	0.4	516	1.8	0.01	0.22
Personnel Serv.	d	d	234	1.1	d	d
Total	0	0.0	141	0.3	0.00	0.00
Total	91	39.6	2,901	36.3	0.03	1.09

d: not displayed for confidentiality reasons.

Source: MIDI (2007), BoP (2009), authors' computation.

sales channels. Apparently, cross-border sales are much more important in R&D, management, advertising and personnel services, as evidenced by the rather low affiliate sales ratios than in the other services. For personnel services we find no foreign affiliate sales in the data.

### 4.4.3 Firm Heterogeneity

To check how much heterogeneity there is in export performance across firms, we compute for each firm the foreign service sales to all countries through both cross-border and foreign affiliate sales. We then rank firms in deciles depending on their total sales. The results are reported in Table 4.2. This table yields three additional insights. First, we find that exports are concentrated on few large traders. 10%

Table 4.2: Deciles of Service Exports of Producer Service Firms 2005, (number)

Decile	Foreign Sales (mill. euro)	Share (%)	Average Sales (th. euro)	Average Number of		
				Countries Served by cross-border	comm. pres.	Services Offered
1	5.31	0.0	19.5	1.13	0.0	1.02
2	14.9	0.0	49.6	1.32	0.0	1.04
3	36.0	0.0	103.7	1.70	0.0	1.08
4	73.6	0.0	197.6	2.17	0.0	1.10
5	155.0	0.2	345.6	2.98	0.0	1.11
6	311.1	0.4	700.7	3.58	0.04	1.18
7	570.0	0.8	1,232.1	4.44	0.04	1.17
8	1,104.4	1.5	2,288.9	5.23	0.01	1.15
9	2,484.7	3.3	3,599.2	8.61	0.06	1.26
10	71,100.0	93.8	12,101.9	22.3	1.44	1.48
Total	75,800.0	100.0	2,061.6	5.34	0.15	1.16

Source: MIDI (2007), BoP (2009), authors' computation.

of the firm account for nearly 94% of total foreign sales (column 2).<sup>15</sup> These large exporters own most of the foreign affiliates. The number of countries served through the foreign affiliates of a firm is zero in the five lowest deciles (column 5). The number rises as we move up the deciles.

Second, we find again that all margins of trade contribute to the differences in firm exports. This can be seen in columns 3 to 6. Large exporters sell more per service-country combination (intensive margin), export to more countries and sell a larger number of different types of services (extensive margins). Third, we find that at the firm level, cross-border exports are used to serve much more countries and to sell a larger number of different service types on average than foreign affiliate sales. Affiliate sales are, however, much more important for the average intensive

<sup>15</sup>This concentration measure would be 88% for cross-border exports and 84% for affiliate sales, if we considered these modes separately.

margin of firms. This confirms the idea that choosing foreign affiliates is related to large market entry costs due to fix costs and thus can be observed only scarcely, but with large volumes of sales.

Table 4.2 shows pronounced firm heterogeneity, with firms serving more service-country combinations being more likely to establish a foreign affiliate. If firms face a choice between cross-border supply and foreign affiliate sales, this choice appears to depend systematically on firm characteristics, such as productivity, that usually are highly correlated with the extensive margins. In particular, we would expect more productive firms to choose foreign affiliate sales with a higher probability. We investigate in the next section whether this is actually the case.

## 4.5 Estimation Results

### 4.5.1 Baseline Model

Table 4.3 summarizes the results of our baseline probit model (4.10). We present two specifications that differ slightly in sample size, which stems from the fact that information on wages is not available for all countries. In probit regression (P1) we use a sample for service exports to 76 countries, the largest number for which we have data on FDI restrictions. We rely on *GDP per capita* to proxy the wage costs, because we do not have wage data for all 76 countries. Wage data is used in our regression (P2). This reduces the number of countries to 48 and the number of observations from 10,997 to 9,647. Thus, while we loose 37% of our countries, we loose only 10% of the observations. In regression (P1) and (P2) we still observe for roughly 3 percent of the observations foreign affiliate sales. Table 4.3 shows the marginal effects of the variables on the probability that a firm chooses foreign

affiliate sales.

The empirical results are generally consistent with the predictions in both specifications. With very few exceptions, the variables have the expected signs. However, some important variables do not achieve significance at the 5%-level. More precisely, we find that the choice of foreign affiliate sales is significantly positive affected by *Internationalization*, our proxy for firm productivity. More productive firms are, *ceteris paribus*, more likely to set up a foreign affiliate.

In addition, the choice between production abroad and cross-border supply is negatively affected by relative foreign labor costs. A lower *High-skilled wage* abroad or lower *GDP per capita* increase the probability of supply through a foreign affiliate.<sup>16</sup> Partner country *GDP* has a positive and highly significant effect on the probability to serve foreign consumers through an affiliate. Sales of German manufacturing affiliates abroad (*Manu aff sales*) show a positive impact as well. Service affiliates (*Serv aff sales*), in contrast, have an insignificant coefficient. Altogether, market size positively affects the probability to serve foreign customers through affiliate sales. Foreign affiliates of German multinational firms, particular manufacturing affiliates, seem to account for an important share of foreign service demand.

The results obtained for the costs of cross-border and foreign affiliate sales only are mixed. But, as already mentioned above, these costs are hard to measure and our proxies are probably not very precise. This is why we are not too concerned about the findings. *Distance* affects the choice of foreign affiliate sales positively, but its impact is only very weak and insignificant. The *Border* variable is positive, but insignificant as well. Thus, geographical distance to the customer obviously

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<sup>16</sup>We find very similar results in a regression with low-skill wages. We restrict the following analysis on high-skill wages.



Table 4.3: Probit Regression Results: Choice of Mode of German Producer Service Firms 2005

	P1 ( <i>GDP per capita</i> )	P2 ( <i>High-Skill Wages</i> )
<i>Internationalization</i>	0.0004** (6.23)	0.0004** (6.38)
$\ln(\text{High-skilled wage})$		-0.0036* (2.82)
$\ln(\text{GDP per capita})$	-0.002* (1.96)	
$\ln(\text{Distance})$	0.0005 (0.43)	0.001 (0.82)
<i>Border</i>	0.001 (0.68)	0.003 (1.46)
$\ln(\text{GDP})$	0.004** (4.82)	0.004** (4.20)
$\ln(\text{Manu aff sales})$	0.003* (2.36)	0.003* (1.99)
$\ln(\text{Serv aff sales})$	0.0024 (1.80)	0.002 (1.30)
<i>Organizational costs</i>	0.013** (3.06)	0.017** (4.34)
<i>Heterogeneity</i>	0.001* (2.13)	0.001* (2.09)
<i>FDI restrictions</i>	0.007 (1.29)	0.0006 (0.10)
Observations	10,997	9,647
Countries	76	48
Pseudo $R^2$	0.226	0.231

The table reports marginal effects. All regressions include industry and service sector dummy variables. Cluster robust z-values in Brackets. \*, \*\* Significantly different from 0 at 5% level, at 1% level, respectively.

does not play a large role to explain the choice of a firm through which channel the customer is served.<sup>17</sup>

Higher *Organizational costs*, i.e., a higher frequency of service transactions, foster foreign affiliate sales, which is consistent with our model. By contrast, the proxy for the fixed costs of affiliate sales related to policy restrictions does not meet our expectations. Barriers to FDI in services (*FDI restrictions*) are not significant and even have the wrong sign. *Heterogeneity* in the sector of the exporting firm affects the decision to sell through a foreign affiliate positively in both regressions.<sup>18</sup>

The results generally support the predictions derived from the theoretical model presented in Section 2 even when we use different proxies for wage costs, though not all variables obtain significant coefficients. We are especially encouraged by the fact that our proxy for firm productivity yields economically and statistically significant results. A 10% increase of our proxy for a firm's *Productivity* increases the probability to supply foreign customers through a foreign affiliate by 2.4% for a firm with the mean value of *Internationalization* and all other variables at their mean levels as well.<sup>19</sup>

In the remaining subsections we verify that this result continues to hold when we relax some of the implicit assumptions underlying both our theoretical and our empirical model. Other results slightly change.

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<sup>17</sup>We find that alternative measurements of distance costs like time zones or cultural distance have an insignificant impact, but are positively correlated with *Distance*.

<sup>18</sup>This variable becomes insignificant as well when we drop the dummies for the sector classification of the firm.

<sup>19</sup>The marginal effects reported for the probit regressions are absolute values. We calculate marginal elasticities of internationalization for different values of a firm's *Productivity*. That shows that the marginal impact of a firm's productivity increases with firm productivity. Furthermore, we find that the Pseudo  $R^2$  remains at the high level of 0.216 when all variables except *Productivity* and the service sector and firm sector classification dummies are dropped. A regression with only the dummies yields a  $R^2$  of 0.06. That underlines the strong impact of *Productivity* on the mode decision of firms.

### 4.5.2 Robustness Check I: Export Market Entry

In our theoretical model, we concentrate on the choice between cross-border and affiliate sales, implicitly assuming that the firm has chosen to export its services to a particular country. Consistent with this, the baseline empirical model implicitly treats firm-service-country combinations for which no trade is observed as being random. This is obviously a strong assumption, especially given the large number of zero firm-service-country observations. Hence we need to make sure that our results still hold when we relax it. In addition, we want to check what information, if any, these zero observations provide regarding firms' decisions to enter export markets.

If we assume that cross-border supply involves fixed costs, too, a firm only supplies the foreign market, if the variable profit generated from service exports exceeds the fixed costs of cross-border supply. Firm-service-country combinations that show no service sales are then not random but hold information: neither cross-border supply nor supply through a foreign affiliate is profitable. We investigate this issue using a generalized ordered logit model that assumes a pecking order of export modes in the sense that foreign affiliate sales are associated with a sufficiently greater fixed cost than cross-border sales so that only the most productive firms generate enough sales to allow them to operate a foreign affiliate. The less productive firms choose cross-border sales and the least productive ones do not export at all.

There are three possible outcomes of a firm's decision concerning entry in a particular market  $f$ . The dependent variable hence has also three possible outcomes: it is zero if a firm does not engage in export activities in a particular sector-country combination, one if it uses cross-border sales, and two if it supplies

the service through a foreign affiliate. To study this decision we inflate our dataset to include the zero observation: no exports to a particular country. We constructed a balanced sample where each exporting firm occurred with each service sector it supplies (to *any* country) in combination with *every* foreign country. Hence, we inflated the country dimension. The availability of the wage data restricts our sample to 48 countries.

Since we work with firm-level data with low reporting limits, we treat all non-reported country-firm relationships as zeros. The number of newly created zeros exceeds that of one's and two's by far, pointing to the fact that service exports are rare. In 91.9% of all possible firm-service-country combinations, there is no export; in 7.9% of all cases there is cross-border supply; and in only 0.23% of all combinations do we observe service trade through a foreign affiliate.

Yet, the theoretical model does not only suggest three outcomes, it also proposes an order of the outcome with respect to *Productivity*. Thus, the appropriate model is an ordered probit or logit model where higher levels of productivity are related to a higher value of the endogenous variable. However, the endogenous variable is ordered only with respect to *Productivity* and not to any other variable. Ordering the outcome with respect to *Distance*, for instance, would imply that the relative profits and therefore our left-hand side variable increases or decreases with *Distance*, which is obviously not true for our theoretical model. A higher distance *decreases* the probability of cross-border supply relative to not exporting (0 vs. 1) but *increases* the probability to engage in foreign affiliate production relative to cross-border supply (1 vs 2). Hence, we must make sure that our ordering depends only on *Productivity*. The more flexible generalized ordered logit model has been developed for such tasks.<sup>20</sup> It allows to estimate an ordered logit where the order-

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<sup>20</sup>See for more details about the generalized ordered logit estimation approach Williams (2006).

ing depends only on the productivity variable. All other coefficients are estimated freely. We use the same exogenous variables as in the baseline model (P2).

Table 4.4 reports the results of the generalized ordered logit regressions. The coefficients in the first column give the effect of the explanatory variables on the entry decision in the particular market. Thus, the underlying model tests how outcome “0” (“no exports”) compares to “1” and “2”, i.e., exports through either cross-border or affiliate sales. The coefficients in the second column express the impact on the decision between the two export channels “1” and “2”.<sup>21</sup>

The coefficients in the export market entry estimation (column one) are mostly significant and have the expected signs. Our proxies for foreign demand *GDP* and *Serv aff sales* have a strongly positive and significant effect on the decision to export.<sup>22</sup> The coefficient on *Distance* is negative: countries further away from Germany are more likely not to be served at all. The coefficient of the wage for skilled labor is positive, suggesting that German firms’ export activities are concentrated in high wage countries. Altogether, we find that firms rather serve countries with high wages and a large market and that are nearby the home country. The results show that the zero observations in the data for foreign service sales of firms are by no means random but systematically affected by the explanatory variables of our model.

The second column considers the choice between cross-border and foreign affili-

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<sup>21</sup>The coefficients for the mode choice in column two are obtained by subtracting the coefficients in column one from the coefficients of an estimation for the observations of “0” and “1” compared to observations of “2”, which are not presented.

<sup>22</sup>Note that the variables *Serv aff sales* and *Manu aff sales* have a correlation coefficient of 0.6. Maybe, the sign of *Manu aff sales* is negative because of multicollinearity between the two variables. However, the sum of the coefficients is strongly positive. The stronger effect of *Serv aff sales* suggests that the variable could capture more than the size of foreign demand through German MNEs. Maybe, it accounts also for the general importance of services in the foreign economy, which could influence the market entry decision of service suppliers.

Table 4.4: Generalized Ordered Logit Regression Results: Market Entry Decision and Mode Choice

	Market Entry Decision: "0" vs. "1" and "2"	Mode Choice: "1" vs. "2"
<i>Internationalization</i>	0.063** (8.01)	0.063** (8.01)
$\ln(\text{High-skilled wage})$	0.291** (12.38)	-0.375** (4.07)
$\ln(\text{Distance})$	-0.393** (18.58)	0.342** (3.44)
<i>Border</i>	0.269** (6.99)	0.287 (1.78)
$\ln(\text{GDP})$	0.529** (36.43)	-0.043 (0.57)
$\ln(\text{Manu aff sales})$	-0.074** (3.87)	0.170 (1.90)
$\ln(\text{Serv aff sales})$	0.402** (18.03)	-0.029 (0.25)
<i>Organizational costs</i>	0.060 (1.13)	-0.169 (0.86)
<i>FDI restrictions</i>	-0.032 (0.33)	-0.251 (0.64)
<i>Heterogeneity</i>	0.004 (1.41)	-0.062* (1.97)
Observations	131,170	131,170
Pseudo $R^2$	0.29	0.29

All regressions include service sector dummy variables.  
Cluster robust z-values in brackets.  
\*, \*\* significantly different from 0 at 5% level, at 1% level.

ate sales. The size of the coefficients of the generalized ordered *logit* model cannot be compared with those from the *probit* model for two reasons: (i) the size of the coefficients always differs between logit and probit model, and (ii) we gave marginal effects for the probit regression above. However, the sign patterns match. We find two important changes compared to our baseline estimation (P2). First, we find that *Distance* has a significant impact on the channel choice of a firm. Larger *Distance* increases the probability of serving the foreign market through an affiliate when we correct for the negative impact of distance to be operating in a country at all. Second, from our three market size proxies we find only the sales of the manufacturing affiliates to keep its positive effect and that only at the 10% level of significance. Firms are rather serving large foreign markets, but we find only a weak influence of market size on the choice whether to choose cross-border or foreign affiliate sales beyond the impact on export market entry. In contrast to these changes in results, lower wages abroad still foster supply through a foreign affiliate. Firms choose rather foreign affiliate sales compared to cross-border sales when wages are relatively low and countries are far away so that distance increases the costs of service cross-border sales. This suggests that despite technological advances the distance between provider and customer of a service still hampers cross-border sales of services due to travel costs or the lack of local capabilities, for instance.

### **4.5.3 Robustness Check II: Exporters Using Both Channels**

Next, we check whether we have correctly classified firms that use both cross-border and foreign-affiliate sales for supplying a given service product group to a given

foreign market. We find 201 observations for which this applies. While this number is small relative to the number of cross-border sales, their share in the group of foreign affiliate sales is 63% (201 of 319 observations) and hence economically very important. This raises the question whether firms face a discrete choice between the two channels of foreign market supply at all. We are optimistic that this does not counter our discrete choice approach for three reasons:

First, the frequent observation of both channels reflects at least in parts service trade activities of firms which require intermediate services as inputs for a foreign service affiliate. If these are classified in the same product groups, it shows up as if the firm uses two channels to serve the customer. Second, two modes for one product group in the same country might simply present different products sold to different customers. Our service categories are still highly aggregated and comprise very different service activities. Some of these maybe more easily provided through an affiliate than others. Third, the customers could have different characteristics as well or be resident in distant regions in the same country, which could support the choice of different channels for the same type of service in one country.

In the analysis above, we classified these observations as serving the foreign country through an affiliate on the basis that the productivity of the observed firm is high enough to support a foreign affiliate. We deviate from this treatment of the observations and run three tests to check whether these different approaches change our results:<sup>23</sup> (i) We drop the observations when firms are doing both in the same market, which leads to weaker effects of the explanatory variables on the decision of a firm. Generally, the signs of the coefficients remain the same, but the standard errors increase. The impact of *Internationalization* is still positive and

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<sup>23</sup>We report only the result from the multinomial probit. The other two are available upon request.



significant at the 5%-level. (ii) We reclassify these observations as cross-border observations, which results in about the same coefficients as under (i), though the effects become even slightly weaker; and (iii) we estimate a multinomial probit with three outcomes: cross-border sales (“0”), foreign affiliate sales (“1”), and both (“2”). In the multinomial probit regressions, two binary probit regressions, one for affiliate sales and one for observations with both channels, are estimated against the same benchmark, which are here cross-border sales. The results are presented in Table 4.5.

The coefficients of the two regressions are similar, but show some notable differences as well.<sup>24</sup> In both subsamples productivity affects the decision to set up a foreign affiliate significantly positive. *Internationalization* has a slightly larger and highly significant coefficient for “both channels” compared to the coefficient for “affiliate sales only”. For “affiliate sales only” (column one) the same pattern emerges as in the simple probit model presented in Table 4.3. Thus the decision between cross-border and foreign affiliate sales is found very sharply in Table 4.5, although uncorrected for the biases we have discussed in the subsections 2 and 3. We find a highly significant impact of the foreign high-skill wages and German service affiliate sales. For “both channels”, these variables have insignificant coefficients. *Organizational Costs* has different and significant signs in both regressions. The positive sign for “affiliate sales only” is in line with our baseline results.

Not surprisingly, we find that the effects of the variables except *Productivity* are in general slightly stronger for “affiliate sales only”. To observe “both channels” service and country characteristics are required that promote the two channels

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<sup>24</sup>Note that the number of observations is larger compared to our baseline regressions, because we did not include service and firm sector dummies in the multinomial probit. When dummies are included some observations are dropped because the dependent variable shows no variation when the dummy variable is equal to one.

Table 4.5: Multinomial Probit Regression Results: Choice of Exporting Mode

	Affiliate sales only: “0” vs. “1”	Both channels: “0” vs. “2”
<i>Internationalization</i>	0.011* (2.52)	0.019** (6.66)
$\ln(\text{High-skilled wage})$	-0.208** (2.68)	-0.099 (1.37)
$\ln(\text{Distance})$	0.117 (1.45)	0.058 (0.93)
<i>Border</i>	0.093 (0.73)	0.272* (2.15)
$\ln(\text{GDP})$	0.113* (3.08)	0.128* (2.20)
$\ln(\text{Manu aff sales})$	0.088 (1.23)	0.122 (1.70)
$\ln(\text{Serv aff sales})$	0.196** (2.93)	0.050 (0.61)
<i>Organizational costs</i>	0.208* (2.44)	-0.202* (2.11)
<i>FDI restrictions</i>	-0.082 (0.23)	0.050 (0.24)
<i>Heterogeneity</i>	-0.019 (1.85)	-0.026* (2.41)
Observations	10,572	10,572
Pseudo $R^2$	0.15	0.15

Table shows marginal effects. Cluster robust z-values in brackets.  
\*, \*\* significantly different from 0 at 5% level, at 1% level.

instead of only one. For instance, a larger distance would promote foreign affiliate sales compared to cross-border sales but when both channels are observed the effect becomes less clear. Nevertheless, the question remains how to interpret the observation of “both channels” economically within our service export framework. We find in the data that the choice of both channels is particularly important for data processing, management and post& telecommunication services. For these service groups, we find in more than 80% of the observations of foreign affiliate sales also cross-border sales of these services by the same firm to the foreign country.<sup>25</sup> Hence, more detailed analysis of service sectors could be helpful to get a deeper understanding of complementary and substituting relationships between different service products and different modes of supply.

Altogether, we find significant differences between both groups, “affiliate sales only” and “both channels”, and the firms choosing cross-border sales. Firms using both export modes behave similarly to firms engaging only in foreign-affiliate sales. Firm productivity seems to be even more important for them. This suggests that our classification of these firms as foreign affiliate sellers in our baseline regression is indeed appropriate.

#### **4.5.4 Robustness Check III: Firms with only Affiliate Sales**

Finally, we demonstrate that our assumption to drop firms which show only foreign affiliate sales and no cross-border activities is important for our findings. Table 4.6 shows our baseline regression (P2) extended by the 230 firms with only foreign affiliate sales.<sup>26</sup> We find two main results: first, the coefficient of *Internationaliza-*

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<sup>25</sup>Note that the results for the regression with “both channels” are as well strongly shaped by data processing services. These account for fifty percent of all observations of both channels.

<sup>26</sup>This increases the number of “ones” on the left-hand side of the regression equation from roughly three to nearly eight percent of total observations.

*tion* turns insignificant. Second, the country variables are now all highly significant with the expected signs.

The first result suggests that firm productivity does not significantly affect the mode decision of firms. However, we find that *Internationalization* is very small for the firms which sell only through affiliates, on average even smaller than for cross-border sellers. These firms have affiliates in only few countries. This suggests that *Internationalization* is a biased proxy for the productivity of these firms or that their choice of foreign affiliate sales cannot be explained by their productivity. Maybe, they are restricted to foreign affiliate sales because they sell service products that are not tradable across borders. However, we cannot identify these products with our services data. Furthermore, we find that 40% of these firms are holding companies belonging to a group of service firms. These holdings might be existing only to coordinate foreign affiliates and thus the non-existing discrete choice would be determined by firm characteristics in these cases.

The second result shows that the country variables chosen to test our theoretical model are well suited to capture effects that favor the choice of setting up a foreign affiliate abroad. Obviously, firms with only affiliate sales have affiliates in rather distant countries, with relatively low wages, large market size and low FDI restrictions. Altogether, the two discussed effects bias our results so that country variables seem to be more important than firm productivity. We find instead that firm characteristics play indeed a key role when we drop firms that seem to have no choice between foreign affiliate and cross-border sales. However, these firms are economically meaningful and deserve a deeper analysis.

Table 4.6: Probit Regression Results: Choice of Mode in Sample including Firms that have only Affiliate Sales

	Including Firms with only Affil. Sales
<i>Internationalization</i>	0.00027 (0.93)
$\ln(\text{High-skill wage})$	-0.021** (6.64)
$\ln(\text{Distance})$	0.008** (2.95)
<i>Border</i>	0.017** (3.03)
$\ln(\text{GDP})$	0.012** (5.52)
$\ln(\text{Manu aff sales})$	0.010** (3.09)
$\ln(\text{Serv aff sales})$	0.011** (3.18)
<i>Organizational costs</i>	0.048** (4.77)
<i>Heterogeneity</i>	0.002 (1.30)
<i>FDI restrictions</i>	-0.013 (1.29)
Observations	10,985
Countries	48
Pseudo $R^2$	0.151

All regressions include industry and service sector dummy variables. Table reports marginal effects. Cluster robust z-values in brackets. \*, \*\* significantly different from 0 at 5% level, at 1% level.

## 4.6 Conclusion

This chapter has studied if producer service firms use cross-border or foreign affiliate sales to export services. We find that the relative foreign affiliate and cross-border sales are varying significantly across service sectors. This suggests that the tradability of services plays indeed an important role and trading costs differ across services. Despite these sector differences, we find that heterogeneity with respect to firm-specific characteristics play an even more important role in determining the choice of firms between cross-border and foreign affiliate sales. Specifically, the more productive a firm, the more likely it is to rely on foreign-affiliate sales. This result is robust to different treatments of biases in our empirical model.

Furthermore, we find in all specifications that a higher wage in the foreign country favors cross-border over foreign affiliate sales. All the other variables are not robust to at least one change in the regression set-up we introduce. Distance, proxying the costs of lacking proximity of the provider and the consumer of a service, shows only a significant effect in the generalized ordered logit model. This approach takes the export market entry decision of firms into account. We find that firms rather export to high-income countries that are close to the home country and have a large market size. Correcting for this effect, we find that firms choose more likely foreign affiliate sales in more distant countries which suggests that cross-border trade costs increase indeed with geographical distance. This suggests that travel costs or the need for knowledge about local preferences and customs of consumers constitute an important natural barrier for cross-border sales of services. Market size is also affected by the selection bias but in the opposite way: it shows a very strong positive impact on the export market entry decision of firms. When we correct for this we do not find a significant impact on the mode choice decision

any more.

The fixed costs variables do not show a systematic pattern. This is particularly surprising for the OECD FDI restrictiveness index, which we expected to be important. Since we think that fix costs are essential for service FDI, we presume that the measurements we use to proxy these fix costs are not appropriated. Altogether, we find that the usual tradeoff between fix and variable costs that determines the choice between foreign affiliate and cross-border sales can be generally found for services trade as well. Nevertheless, the pattern for services trade is much more complex and results are less generalizable. We did not examine the entire sample of firms and restrict the main part of the chapter to producer service firms for which we find cross-border sales of services. However, there are some firms which exhibit only foreign affiliate sales. These are economically quite meaningful, because they account for more than 60% of foreign affiliate sales of producer service firms. Altogether, our results apply to around 30% of foreign producer service sales of German firms.

From a policy perspective the observed selection of firms into cross-border and foreign-affiliate sales suggests that ongoing efforts to liberalize service trade are worthwhile not only because they might lead to cheaper service imports and greater service variety, but also because they might lead to productivity gains within service sectors as output is reallocated from less to more productive firms. This is important because aggregate productivity growth in advanced economies like the United States is today mainly driven by productivity gains in services rather than manufacturing industries (Francois and Hoekman, 2010).

As already mentioned, we find that manufacturers show a different trade pattern than service firms, but are economically meaningful. We analyze in the next chapter the determinants of their service export activities and how these are related to the

main business activities of firms, which is the production and distribution of goods.



# Chapter 5

## German Manufacturers as Services Exporters

### 5.1 Introduction

The discussion in the introduction and the stylized facts presented in chapter 3 show that services trade not only relates to the services sector but to the economic development of the manufacturing sector as well. We find that manufacturing firms account for around 30% of German cross-border producer service trade sales.<sup>1</sup> This is particularly striking for exports, because the supply of services, by definition, is not the main business line of manufacturers. The share of manufacturing firms in total cross-border exports, amounting to nearly 100 billion euro in 2005, is especially high for R&D services (80.8%), E&A (75.2%) and construction services (71.3%). Furthermore, we find that manufacturers mainly rely on cross-border sales, which is in contrast to service firms which show large foreign affiliate sales.

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<sup>1</sup>This value is larger than in chapter 3, because we include here also engineering services, which are often provided by manufacturers.

In the present chapter, we analyze the determinants of service exports of manufacturers. We focus mainly on the impact of goods exports and foreign affiliates of firms on the pattern of service exports.

As already mentioned in the introduction, Daniels (2000) concludes that the linkages between the manufacturing and services sector are hardly understood in the context of international trade. The scarce literature related to this issue states that the access to high-quality producer services inputs can be an important determinant for the competitiveness of firms in international goods markets (e.g., Daniels, 2000, Kasahara and Lapham, 2008). Furthermore, Debaere et al. (2010) find that the availability of locally provided services is important for firms to get access to the international material input markets.

Moreover, services are not only inputs in the value added chain of products. Increasingly, they are also an output in the manufacturing sector. Preissl (2007) states that it has become common in the German machinery sector that firms selling the machines or equipment also install it as well as maintain and supervise electronic systems that are necessary to run them. Gage and Leshner (2005) mention that providing financial services might be particularly important for automobile firms. They summarize that it becomes more and more difficult to categorize firms either as manufacturers or service firms, because complementary service activities become more and more important for manufactured goods. This is known in the literature as the bundling of goods and services (e.g., Horn and Shy, 1996). Firms may be able to enhance the perceived value of the product they are selling or they can differentiate their products from competitors by supplying complementary services.

In the context of international trade, this implies that selling goods abroad - either through goods exports or goods produced abroad in foreign affiliates - might

be also associated with selling services abroad. The empirical evidence on whether and to which amount these service exports are relevant for export activities of manufacturers is very scarce. Lennon (2009) shows with sector level trade data that there is a positive relationship between goods and service trade between countries. A complementary relationship of goods and services on product-level could be a partial micro level explanation of this phenomenon. We investigate in the present chapter, if this relationship can be found with firm level service trade data as well.

Exporting services as complements to goods is not the only considerable motive for service exports. A second motive for manufacturers might be the support of foreign affiliates. Those services are often denoted as headquarter services in the literature. They play an important role in the well-known knowledge-capital model, for instance in Markusen (2002). In this model, multinational enterprises (MNEs) decide where to locate headquarter and production units. Knowledge-capital serves as a public good internal to the firm and is transferred to foreign affiliates. Examples for this knowledge-capital are patents or trademarks sustained by R&D. Furthermore, firms may transfer organizational capabilities to their affiliates to coordinate and plan activities in different markets or support production and distribution. These activities may show up as trade in management or advertising services (e.g., Davies, 2005 and Godart et al., 2009).

The two different motives for exporting services described above can be distinguished by the driving force of the export decision. In the first case of complementary services, services are closely linked to foreign sales of goods.<sup>2</sup> In the second case of headquarter services, service exports are related to a firm's foreign affiliate. Here, services serve as an input in the production and distribution process. In

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<sup>2</sup>We use the more general formulation "foreign sales of goods" when both cross-border and foreign affiliate sales are to be described.

both scenarios, existing service trade barriers hamper the international activities of manufacturers, which may result in welfare losses. In the present chapter, we mainly focus on the question whether and how much service export activities of manufacturers are driven by these two different motives. We use in particular information about the number of manufacturing and distribution affiliates of firms in the different countries and focus in general on cross-border sales of firms. These are denoted as “services exports”.<sup>3</sup>

One challenge for the analysis originates from the complexity of possible scenarios which might explain the service export observations in the data. Providing complementary services can be driven by goods exports as well as by foreign affiliate sales of firms. Furthermore, services might be exported completely independently of goods sold or foreign affiliates. Alternatively they might support the distribution of goods even when the firm has no distribution affiliate in the foreign market. We aim to account for these different aspects, but try to keep the analysis simple.

We begin the analysis by describing the types of services exported and how these vary between the different manufacturing industries the firms are classified in. The most important services are R&D, construction, and E&A services. These service exports are conducted by few high-tech industries. The kind of services exported varies strongly across the different industries. For instance, construction services exports are mainly conducted by the machinery sector. This suggests a close relationship between service exports and the goods produced and sold by an industry. This is supported by the result that a large majority of service export

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<sup>3</sup>Manufacturers use mainly cross-border exports and thus it seems to be more useful to focus the analysis on explaining these activities. Furthermore, the motives to set up foreign service affiliates for manufacturers might be different compared to cross-border sales and deviate from the concept of complementary or headquarter services. One reason to observe foreign service affiliates could be for instance that the firms offshore services.

activities can be found for countries in which the respective firm has no foreign affiliate. Generally, headquarter services seem to play a rather minor role in explaining service export activities. Many manufacturing MNEs do not export any producer services at all.

Finally, we use estimation methods to identify some determinants of the service export activities of firms. We estimate the service export participation decision of firms on firm-country level and the intensive margin of service sales on firm-service-country level. We find evidence for a positive link between services exports and goods exports of firms, which is particularly pronounced for construction services. These likely represent complementary services. Data processing service exports are found to be strongly affected by foreign affiliates of firms. These are obviously often provided as headquarter services of the parent to the affiliate. All in all, we find that particularly large multinational high-tech firms export services.

The rest of the chapter is organized as follows: Section 2 provides descriptive statistics about the types of services exported and different manufacturing industries involved. In section 3, we examine how foreign affiliates of firms influence their service export activities. Section 4 tests some of the hypotheses about determinants of the intensive and extensive margins of service exports of manufacturers with regression methods. Section 5 concludes.

## **5.2 Descriptive Statistics**

The following section provides deeper insights into the service export activities of manufacturers by collecting stylized facts. First, we briefly explain the sample construction. Second, we show the types of services exported and their relative importance for the manufacturing sector. Third, we examine the industry affiliation

of exporters and how export participation and sales differ between industries. The fourth subsection combines these two perspectives and analyzes the importance of different services for different industries.

### **5.2.1 Sample Characteristics**

In the entire chapter, we use data for only 2005 and focus exclusively on service exports of manufacturing firms.<sup>4</sup> There are 1,652 service exporting manufacturers in the sample.<sup>5</sup> These split up into 1,639 cross-border exporters and 42 firms with service affiliates abroad. Overall, cross-border exports of manufacturers amount to 28.1 billion euro and foreign affiliate sales of services to 5.2 billion euro. We can use 15,373 observations at the firm-service-country level for cross-border producer service exports of German manufacturers and 91 for foreign service affiliate sales. The chapter deals in general only with cross-border exports.

Furthermore, we use the data about manufacturing and distribution affiliates of firms from the MIDI dataset. The manufacturing affiliates are classified the same way as the German manufacturing parents as presented in Table 5.2. We classify all affiliates with the Nace-code 500 (“sales, repair of motor vehicles”), 510 (“wholesale trade”) or 520 (“retail trade”) as distribution affiliates.

### **5.2.2 Types of Services exported**

To get a better understanding of service trade activities of manufacturers it is useful to look at the different types of services that firms are exporting. As already

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<sup>4</sup>See Table 5.2 for all manufacturing industries included.

<sup>5</sup>We drop 31 firms which are classified as holding companies, but could be assigned to a group of manufacturing firms. These firms hold 71 foreign service affiliates with sales of 2.8 billion euro, but show no cross-border exports of services.

Table 5.1: Service Sector Variation in Services Exports of German Manufacturers 2005 (billions of euros, number)

Service Type	Cr.-border Obs.	Share (%)	Cross-border Exports	Share (%)	Affiliate Sales	Share (%)
Construction	4,162	27.1	5.87	20.9	0.15	2.9
Transport	32	0.2	0.00	0.0	0.18	3.4
Auxiliary Transp.	725	4.7	2.44	8.7	1.25	24.0
Post & Telecom	49	0.3	0.01	0.0	0.1	1.8
Insurance	304	2.0	0.11	0.4	0.17	3.3
Data Processing	1,133	7.4	1.05	3.7	1.43	27.4
R & D	2,228	14.5	8.16	29.0	0.99	19.0
Management Serv.	1,952	12.7	2.64	9.4	0.00	0.0
Engineering & Architectural Act.	2,856	18.6	6.76	24.1	0.93	17.9
Advertising	1,116	7.3	0.57	2.0	0.02	0.4
Personnel Serv.	816	5.3	0.45	1.6	0.00	0.0
Total	15,373	100.0	28.05	100.0	5.22	100.0

Sources: MIDI (2007), BoP (2009), authors' computation.

mentioned in the data description, the sample contains eleven types of producer services. Table 5.1 shows the relative importance of these different services for foreign service sales of manufacturers. The first column presents the number of cross-border export observations for the different types of services. The second column shows the share of the observations in the total number of observations. Columns three to six display the sales of the different services and the respective share on total sales for both foreign affiliate and cross-border sales.

We find that construction services are exported most frequently with a share of 27% on total observations (column two). In second place are E&A services (18.6%), followed by R&D (14.6%) and management services (12.5%). Considering export sales instead of the number of observations, we find R&D exports dominating. 29.0% of cross-border export sales are associated with R&D services (column four).

The second most important services type is E&A services, and the third most important category construction services. These three types of services account for nearly three fourth of cross-border exports.<sup>6</sup>

In addition, we find that transport, post & telecom and insurance services are hardly exported by manufacturers. This is a little bit surprising, because activities like transporting goods and export insurance are directly related to goods exports of manufacturers. However, these services are obviously rather sourced from third party suppliers than produced and provided by the manufacturers themselves.

Affiliate sales play only a minor role for manufacturing service sales (column five and six): they account for 15% of total foreign service sales of manufacturers and are relatively important for data processing (27.4%), auxiliary transport (24.0%) and R&D services (19.0%). Manufacturers have only 126 producer service affiliates in the sample. Altogether affiliate sales account for only 91 of 15,464 or 0.6% of observations.<sup>7</sup> However, the data may underestimate foreign affiliate sales of services as well, because there is no detailed information about activities of foreign affiliates beyond the sales and the main business line of the affiliate. But as well as the parent firms, even foreign affiliates that are classified as manufacturing affiliates might sell services abroad, for instance as complements to sold products.<sup>8</sup> To focus the analysis more strongly, we restrict on cross-border export activities of firms in the following.

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<sup>6</sup>Obviously, some services are provided rather more frequently with smaller values per order than others. Particular construction, management, advertising and personnel services show small sales per observations while these are relatively large for auxiliary transport and R&D services.

<sup>7</sup>The two values differ because some firms have more than one service affiliate in one country.

<sup>8</sup>The MIDI dataset shows that financial service affiliates are very important for the automobile industry. Automobile firms sell 26 billion euro through financial service affiliates, but there are no comparable cross-border sales in the data. These services likely present complementary services to sold automobiles. This shows that affiliate sales can be important for manufacturers, but are less relevant for the services regarded here.



### 5.2.3 Industries exporting

After presenting the volume and frequency of different producer services exported by manufacturers, the present subsection changes the perspective and investigates the industry affiliation of service exporters and their contribution to service exports. To assign firms to the different industries, we use the sector classification of the firms in the dataset on the Nace-rev 1 two-digit level.

Table 5.2 shows the number of German firms in the different industries (column one) with more than 20 employees in 2005. The data are from the *Statistical Yearbook 2007*. Column two presents the number of firms exporting at least one of the eleven services in the sample. Columns three and four contain each industry's share of the total number of service exporters and the volume of cross-border service exports. The ratio of service exporters to the total number of firms in the industry (service export participation ratio) is displayed in column five.

The most service exporters come from the machinery and equipment producer sector with a share of 35% (column three), followed by the chemical industry with more than 10% of firms and the instruments producers (8.9%). With respect to the volume of cross-border exports (column four), the electrical machinery producers dominate with a share of 19.6%, followed by the automobile industry (18.9%), the machinery and equipment (15.2%), the chemicals industry (14.1%) and the other transport equipment industry (12.7%). These five industries account for around 80% of services exports.

The Statistical Yearbook (2007) shows that these industries dominate also goods exports of the German manufacturing sector. They account for more than 68% of the foreign sales of goods produced in Germany by the manufacturing sector.<sup>9</sup> This

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<sup>9</sup>These goods are sold directly to a foreign country or to intermediate firms that sell them abroad (Statistical Yearbook, 2007).

Table 5.2: Number of German Manufacturers and Service Exporters and Sales by Industry in 2005 (number, %)

Industry	Firms in Germany	Services Exporter	Share in Exporters (%)	Share in Exports (%)	Exp. Particip. Share Ind. (%)
Food	5,245	39	2.4	0.6	0.7
Tobacco	23	d	d	d	d
Textiles, Apparel & Leather	1,454	20	1.2	0.1	1.4
Wood	1,316	20	1.0	0.1	1.3
Paper	827	d	d	d	d
Publishing & Printing	2,515	91	5.6	1.7	3.6
Coke, Petroleum	52	7	0.4	0.7	13.5
Chemicals	1,397	165	10.1	14.1	11.8
Rubber & Plastic	2,687	62	3.8	1.4	2.3
Mineral Products	1,778	39	2.4	0.3	2.0
Basic Metals	904	39	2.4	0.2	4.3
Metal Products	6,258	105	6.4	1.1	1.7
Machinery & Equip.	6,014	579	35.3	15.2	9.6
Computers	164	d	d	d	d
Elect. Machinery	1,954	106	6.5	19.6	5.4
TV & Comm. Equ.	559	56	3.4	4.6	10.0
Medical. Instr. etc.	2,112	146	8.9	4.2	6.9
Motor Vehicles	1,007	75	4.6	18.9	7.4
Oth. Transp. Equ.	313	54	3.3	12.7	17.3
Furniture	1,555	25	1.5	0.3	1.6
Total	38,134	1,639	100.0	100.0	4.3

d: values not displayed for confidentiality reasons.

Sources: MIDI (2007), BoP (2009), Stat. Yearbook (2007), authors' calculations.

points to a positive relationship between the international goods and service export activities of industries. Furthermore, these five industries can be classified as high-tech industries (e.g., Hatzichronoglou, 1997), which implies that service exports might be more important for knowledge intensive industries. This presumption is supported by two facts: first, the share of services exports on goods exports, calculated from the data of the Statistical Yearbook (2007), is 5.5% in these high-tech industries, but only 2.7% on average for the remaining industries. Second, the service export participation ratio (column five) is 9.2% for the five industries, but only 2.4% for the rest.<sup>10</sup>

Generally, we find large variance between the different industries with respect to the export participation ratio (column five). For instance, only 0.7% of the firms in the food and 1.3% in the wood industries export services, but 17.3% of other transport equipment and 13.5% of the coke and petroleum producers. Altogether, only few German manufacturers sell services abroad. The average service exporter participation ratio is 4.3%.<sup>11</sup>

So far, we highlighted the dominance of R&D, E&A and construction services in cross-border exports. Furthermore, we found that few high-tech industries account for the majority of service export activities of manufacturers. The following subsection analyzes whether there is heterogeneity between different industries concerning the kind of services exported.

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<sup>10</sup>These facts suggest that manufacturers still focus very much on producing and selling goods and weakens presumptions that many manufacturers are today rather services than manufacturing firms (e.g., Gage and Lesher, 2005).

<sup>11</sup>This value is upward biased, because the Statistical Yearbook (2007) accounts only for firms with more than 20 employees. A less restrictive measurement in the Statistical Yearbook (2008) counts 296,811 firms in the manufacturing sector in 2005. Using this value reduces the service export participation ratio to 0.5%. This value is even slightly larger than for producer service firms in chapter 3.

Table 5.3: Most important Cross-border Service Exports in different Industries in 2005, (billions of euros, %)

Industry	Most imp.	Share (%)	Second imp.	Share (%)	Third imp.	Share (%)	Total Exp. of Industry
Manufacturing	R&D	29.0	E&A	24.0	Constr.	20.9	28.1
Chemicals	E&A	46.9	R&D	35.3	Manag.	12.4	3.97
Machinery & Equipment	Constr.	62.1	E&A	23.3	R&D	6.6	4.26
Electr. Mach.	Constr.	50.0	E&A	20.2	Data	10.7	5.50
Motor Vehicles	R&D	79.8	Manag.	7.0	E&A	6.8	5.31
Other Transp.	Aux. Trans.	63.5	E&A	26.3	R&D	5.0	3.56

Sources: MIDI (2007), BoP (2009), authors' calculations.

## 5.2.4 Types of Services exported by Industry

Table 5.3 shows the three most important services exported by a given manufacturing industry. We display results for the total sample of manufacturers and for the five most important individual industries described above. The first column shows the type of service with the largest share on total cross-border exports of the firms in the respective industries. The third column shows its share in exports of this industry. Columns four to seven give the same information for the second and third most important service.

For the entire sample of firms, the share of the most important type of service on total service exports stands at 29% (column two). The two most important services account for about 50% of sales. Investigating individual industries, we find a stronger concentration of industries on few services exported. In all industries presented, the share of the most important type of service achieves at least 47%. In the automobile industry it is even almost 80%. The share of the two most important services varies between 70% in the electric machinery and nearly 90%

in the other transport equipment industry. The types of services exported are obviously strongly shaped by the individual activities of the respective industries. This suggests a close relationship between the goods produced and sold in the different industries and their service exports.

In the machinery and equipment industry we see mainly construction service exports, with a share of 62% of total cross-border exports. This confirms Preissl (2007) who states that installation and maintenance services are important services provided by the producers to foreign buyers of machines. Together with E&A services these account for roughly 85% of service exports. The motor vehicles service export activities are dominated by R&D services with a share of around 80%. The transfer of technological knowledge concerning production procedures or the design of motor vehicles seem to be very important for the international activities of this industry.

In the electric machinery sector we see relatively large data processing exports, though the share of 10% in cross-border exports is still small, but much larger than for the entire sample of firms (3.7%).<sup>12</sup> This could reflect the provision of software needed to use the machines. The “other transport equipment” industry provides mostly auxiliary transport services. It seems that firms in this industry provide services for repairing transport equipment and may be using their own products as inputs to provide these services.<sup>13</sup>

In all industries E&A services seem to play an important role, particularly in the chemical industry. Obviously, transferring technological knowledge and know-how

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<sup>12</sup>Including also foreign affiliate sales would increase the share of data processing service sales to more than 20%.

<sup>13</sup>Splitting up the cross-border exports of auxiliary transport service activities shows that the transactions for repairing transport means, which have the “knz” 560 in the BoP dataset, are strongly dominating.

to foreign customers by providing engineering and technical consultancy services is a widely spread activity of German manufacturers.

## **5.3 What drives services exports of firms?**

After describing the sectoral pattern of services trade, we now take next steps and try to identify the drivers of service exports of manufacturers. We use information about foreign affiliates of firms and analyze how these influence the export behavior of firms.

### **5.3.1 Manufacturing and Distribution Affiliates of Firms**

In this section, we use the information concerning countries in which a firm has an affiliate to analyze how this affects the types of services that are exported to a country. This may help to distinguish between headquarter and complementary services exports. We use information about manufacturing and distribution affiliates, because both are economically meaningful.

Table 5.4 presents again the three most important services exported per industry, but this time, the observations are distinguished by whether or not a firm has an affiliate in the country it exports to. It is constructed in a similar manner as table 5.3, but it includes the share on the number of observations. This allows us to check whether having an affiliate abroad induces specific types of service exports. We distinguish three scenarios: (i) whether the firm has a manufacturing affiliate in the destination country or not, (ii) whether it has a distribution affiliate or not, and (iii) whether it has a distribution and manufacturing affiliate or no affiliate in the destination country. We present results for the entire sample of manufacturers

Table 5.4: Most important Services exported when Firm has Affiliate in Country or not in 2005 (numbers, %)

Industry	Manuf. Aff. in Coun.	Most imp.	Share (%)	Second imp.	Share (%)	Third imp.	Share (%)	No. of Obs.
All	yes	R&D	21.9	Manag.	15.1	Data	14.9	1,813
Manuf.	no	Constr.	29.4	E&A	19.4	R&D	13.5	13,560
Chemicals	yes	R&D	32.1	Data	16.5	Manag.	13.5	436
	no	R&D	34.8	Manag.	27.6	Pers.	9.5	1,320
Machinery & Equipment	yes	Constr.	34.6	E&A	15.3	R&D	14.7	327
	no	Constr.	58.6	E&A	19.7	R&D	5.3	5,454
Electr.	yes	Data	15.3	E&A	14.0	R&D	13.3	413
Machinery	no	Constr.	31.5	E&A	22.3	Manag.	11.1	1,189
Motor	yes	R&D	34.0	E&A	13.4	Data	13.4	253
Vehicles	no	R&D	24.8	E&A	22.9	Manag.	15.3	809

  

	Distrib. Aff. in Coun.	Most imp.	Share (%)	Second imp.	Share (%)	Third imp.	Share (%)	No. of Obs.
All	yes	R&D	17.4	Data	14.5	Manag.	14.2	1,341
Manuf.	no	Constr.	28.4	E&A	19.3	R&D	14.2	14,032

  

	Both Aff. in Coun. or no	Most imp.	Share (%)	Second imp.	Share (%)	Third imp.	Share (%)	No. of Obs.
All	yes	R&D	17.2	Data	16.9	Manag.	14.4	604
Manuf.	no	Constr.	30.1	E&A	19.9	R&D	13.3	12,823

Sources: MIDI (2007), BoP (2009), authors' calculations.

and in the first scenario results for the four industries with the most observations.<sup>14</sup>

In general, the number of observations in which a firm exports a service to a country with a manufacturing affiliate is rather small compared to the cases in which the firm has no affiliate there. Table 5.4 shows in row one and two that only 12% of the observations (1,813 of 15,373) can be found in countries where the firm

<sup>14</sup>We drop the other transport equipment industry, because it has only a very small number of observations with a foreign affiliate in the destination country.

has a manufacturing affiliate. Obviously, having a foreign affiliate abroad is often not the driver for service exports of a firm. This is supported by the small number of distribution affiliates of firms which appear in only 9% (1,341 of 15,373) of the observations. Having both kinds of affiliates can be found for only 604 observations (4%).

Nevertheless, looking at the different types of services exported for the entire sample of manufacturers indicates that the pattern of services is quite different when a firm has an affiliate in the country. R&D, management and data processing services, which are often mentioned as possible headquarter services in the literature, can be observed most often when firms have an affiliate in the country (row one). The pattern for observations without an affiliate are very different and show construction, E&A and R&D services as most important (row two). However, the differentiation of industries in row three till ten shows that the pattern of services exported is relatively similar between observations with and without an affiliate. We find only for the electric machinery industry that the most frequently exported type of service is changing when a manufacturing affiliate exists in the country: data processing services are most frequently exported when there is an affiliate. For the second most important service, we find that in the chemical industry data processing replace management services for observations with an affiliate. This points to only small effects of an affiliate on the types of services exported. Nevertheless, we conclude that data processing services seem to be often exported as headquarter services. For all industries except the machinery & equipment industry we find that data processing services are one of the most frequently exported services when there is an affiliate in the destination country. However, it does not appear when there is no affiliate. Apparently, firms often support foreign affiliates with software programs related to production, distribution or administrative



processes.

In addition, the results provide weak evidence that R&D and management services could be exported as headquarter services. However, these services are often also exported when there is no affiliate abroad. This might reflect activities to support the distribution of products. Unfortunately, the broad definition of the services categories does not allow us to analyze more deeply whether the respective service products are different, if an affiliate can be observed in the destination country or not.<sup>15</sup> Finally, we find that roughly 25% of cross-border exports can be assigned to the 12% of the observations in which the firm has a manufacturing affiliate in the country. The average sales per observation are around 2.5 times larger when an affiliate is in the country.<sup>16</sup>

Overall, the pattern of service exports seems to be influenced only slightly by supporting affiliates. Nevertheless, the transfer of technical knowledge through data processing services and to a smaller extent R&D services seem to be relevant to run a multinational network of production units. The following final descriptive section collects evidence how firm characteristics influence the service export activities of firms.

### 5.3.2 Firm Characteristics

So far, we have shown that industry characteristics strongly influence the pattern of service exports by manufacturers. However, the international trade literature indi-

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<sup>15</sup>For R&D services we find relatively more often exports in the knz category 502 compared to 511. Nevertheless, an economic interpretation remains difficult.

<sup>16</sup>This effect is particular pronounced for construction services. Here the average sales are 14 times larger when a firm has a manufacturing affiliate in the country. This may show that some complementary services are exported related to goods manufactured abroad. Furthermore, construction service might be provided to affiliates to support necessary restructurings of production lines.

cates that beyond industrial characteristics, firm or within-industry heterogeneity is very important to explain the trade pattern (e.g., Eaton et al., 2004) The present subsection shows some stylized facts on how firm characteristics might affect the service export behavior of firms.

### **Goods Exporters**

Table 5.2 showed that the service export participation ratio is 4.3% for manufacturers with more than 20 employees. Wagner (2007) states for a comparable sample of German manufacturers that roughly 60% of the firms exported goods in 2004. Not surprisingly, this ratio is much larger than the service export participation. There are only few goods exporters that also export producer services. Probably, other firm or industry characteristics determine whether a goods exporter is also exporting producer services. Unfortunately, we cannot examine these, because we have no information about goods exports on firm level.

### **Manufacturing MNEs and Non-MNEs**

As already stated above, there are 1,639 manufacturers exporting producer services. We find that rather few of them are manufacturing MNEs. Only 22% or 369 of 1,639 firms that export producer services have at least one manufacturing affiliate abroad and thus could be classified as manufacturing MNE. Nevertheless, MNEs have larger margins of service exports than non-MNEs. Table 5.5 shows that, on average, the 369 MNEs export more different types of services (column one) and sell services to nearly twice as many countries compared to firms without a foreign affiliate abroad (column two). Furthermore, the average cross-border exports are almost 45% larger for MNEs. Altogether, the group of MNEs, which represents

Table 5.5: Service Export and Manufacturing Affiliate Activities of different Types of Firms, 2005 (thousands of euros, number)

Services Exporters	No. of Serv. Exported	No. of Dest. Countries	Avg. Sales per Obs.	No. of Firms
MNE	2.44	10.80	2,228.7	369
Non-MNE	1.73	5.53	1,547.4	1,283

  

Manufact. MNEs	No. of Affil. per firm	No. of Affil. per Country	Avg. Sales per Affiliate	No. of Firms
Service Exporter	5.40	1.42	104,931.2	369
Non-Exporter	1.87	1.10	31,438.5	834

Sources: MIDI (2007), BoP (2009), authors' calculations.

only 20% of firms, accounts for about 50% of cross-border service exports. This concentration is explained by all three margins of exports.<sup>17</sup>

### Service Exporting and non-exporting MNEs

Furthermore, we find that being a manufacturing MNE does not necessarily mean that a firm exports services. The MIDI dataset contains 1,203 manufacturers that had at least one foreign manufacturing affiliate in 2005.<sup>18</sup> But only 30% of them, 369 out of 1,203, are exporters of producer services as well. Obviously, parent firms do not necessarily provide headquarter or similar types of services to their affiliates.<sup>19</sup>

<sup>17</sup>Note that we find for the whole sample of manufacturers that the 10% largest service exporters account for roughly 80% of exports. This suggests that not only the MNEs contribute to the concentration of sales. Again, all margins of trade contribute to this concentration. In addition, we find that the extensive margins of manufacturers are on average even larger than for the producer service firms analyzed in chapter 4.

<sup>18</sup>That means that roughly 3% of German manufacturers are manufacturing multinationals. This ratio varies considerably across industries.

<sup>19</sup>Note that there are 756 holding firms which control foreign manufacturing affiliates abroad, but have no cross-border service exports. Accounting for them would increase the share of MNEs that does not export services.

This fact appears to contradict the theory of multinational firms, which states that international knowledge and capability transfer between the headquarter and the production units of a firm are an essential part of the international business of MNEs. However, this result should be interpreted with caution, because headquarter services might not appear in the data for at least three reasons: First, it could be the case that transactions do not exceed the threshold value of 12,500 euro for single transactions. Second, a further reason could be that affiliates simply do not pay the headquarter for providing headquarter services and, instead, the headquarter bears the costs. Third, the data might not capture links between groups or sub-groups of firms that might show headquarter services transactions which are not assigned directly to the owner firm.

Furthermore, we find that the size of a manufacturing MNE, which in turn might reflect firm productivity, might determine whether it is a service exporter or not. Table 5.5 shows the number of manufacturing affiliates and the volume of sales for firms that export services and for firms that do not. On average, in the group of German manufacturing MNEs, the service exporters have much more affiliates (column one), more affiliates on per country in which a firm has an affiliate (column two), and more than three times larger manufacturing affiliate sales per affiliate (column three). This indicates that it is the large and productive MNEs that export services.

The evidence in this section shows that service exports between a headquarter and production units of a firm tend to explain only a small part of the service export activities of German manufacturers. Only 30% of German manufacturing MNEs export services. Furthermore, more than 75% of service exporters have no manufacturing affiliate abroad at all. Nevertheless, MNEs that export services export a larger variety of services to more countries and with a larger volume of

sales.

## **5.4 Regression Analysis**

The descriptive statistics gave some ideas about the determinants of the service export behavior of manufacturers. Many cross-border exports seem to be linked to the supply of goods abroad and only to a rather small extent to support affiliates. In this final empirical section, we want to check the impact of goods exports and affiliate activities of firms on their service exports with a regression analysis.

### **5.4.1 Estimation Approach**

We examine the service export behavior of firms with two different estimation approaches. First, we estimate the service export market entry decision of firms. We include all firms in our sample and assume that every firm could potentially export to any country and try to find out what determines if a firm exports services to the country or not. We estimate this discrete choice with a probit regression. Second, we go one step further and estimate the determinants of the intensive margin of service sales. We presume that this approach can obtain more precise information about the determinants of service exports of firms, because it describes firm behavior in a particular country. Variables that show significant effects also for the intensive margin should be particularly important. Altogether, we expect in general that variables affect the participation and sales decision in the same direction, but the latter gives more information about the strength of the impact.

The evidence shown so far suggests that only a small part of service exports may be provided as headquarter services to foreign affiliates. That leaves different

possible explanations: First, the services could be provided completely independent of manufacturing activities of firms. Then the determinants of their export behavior should be very similar to the one of service firms, which we analyzed in chapter 4. Second, services could be exported as complements to goods, which is the most intuitive interpretation in our opinion. This is supported by the strong concentration on specific services on industry level. Third, services could be exported to organize the distribution of exported goods. This might apply in particular to R&D, advertising and management services.

We would like to examine whether we find indeed a positive relationship of service exports with goods exports. Unfortunately, we cannot combine the data with information about goods trade activities of German manufacturers at the firm level. Instead, we use the volume of goods exports of a particular industry to a particular country as a proxy at the industry-country level (*Goods Exports*). We use 8-digit goods trade data from the Federal Statistical Office (2005) and aggregate it to match the 2-digit Nace-rev. 1 categories of German manufacturing industries. Then we assign this data to the respective industries. Thus we assume that, for instance, automobiles or automobile parts are only exported by the motor vehicles industry. We presume that this proxy is significantly positively correlated with the exports of the individual firm, because only few firms are exporting services per industry. Hence, we expect a positive sign of this variable in the regressions and would interpret it as evidence for complementary service exports of a firm.

We do not account only for goods exports but also for the affiliate activities of firms. The stylized facts presented that foreign affiliates affect the pattern of service exports of industries and may lead to larger sales of services of single firms. The positive impact of foreign affiliates can again be interpreted twofold: First, this can indicate the support of an affiliate by the parent firm with headquarter

services. Second, these services can be also complementary services that are provided additionally to goods produced and sold abroad. We cannot distinguish these motives but presume that complementary services are more likely provided by the foreign affiliates abroad themselves and mostly not provided by the parent firm. This suggests an interpretation as headquarter services when service exports are driven by foreign affiliates.

We account for these effects by including different measurements of affiliate activities of firms in the service export destination countries. We test the dummy variables whether a firm has a manufacturing or distribution affiliate in the country, the number of the respective affiliates and the volume of affiliate sales. We expect all variables to have a positive impact on service exports of firms. The measures are highly positively correlated and we choose in general the log of the affiliate sales in a country (*Manuf. Affil. Sales* and *Distrib. Affil. Sales*), because they show the strongest impact.<sup>20</sup>

A further result in chapter 5.3 was that MNEs show larger service activities than non-MNEs and that large MNEs seem to export more likely compared to smaller MNEs. We include a manufacturing MNE dummy to control for the MNE-status (*Manufacturing MNE*) of a firm and the number of manufacturing affiliates (*Numb. of Manuf. Affil.*) to account for size or productivity effects on firm level. We expect both to have positive signs. Beyond this, we include further control variables. Lennon (2009) finds for some services exported a positive relationship to imported goods. We apply the same method as for goods exports also to goods imports to control for the effect of *Goods Imports* at the industry-country level. Kelle and Kleinert (2010) find a positive relationship between service exports and

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<sup>20</sup>We choose a dummy variable for distribution affiliate activities (*Distrib. Affil.*) in the participation regression to account for this marginal impact of having an affiliate in the country or not.

imports of a firm. The ratio of manufacturing firms that export and also import services amounts roughly 75% in 2005. Thus, we include a dummy of whether a firm is also a *Service Importer* and expect a positive sign. Furthermore, we add a dummy to indicate if the service exporting firm is an affiliate of a foreign parent firm (*Inward Affiliate*).

Additionally, we include the usual gravity controls like GDP, GDP per capita and geographical distance to control for country determinants of the firms' behavior.<sup>21</sup> We expect a positive sign for both *GDP* and *GDP per cap* and a negative one for *Distance*. Furthermore, we add a *Border* dummy and the sales of German service affiliates relative to the GDP of the destination country (*Rel. Serv. Aff. Sales*), which we found to be important in chapter 4 for services exports of service firms. Finally, we control for the industry of a firm with an industry dummy at the 2-digit level, because the stylized facts show that export participation varies strongly across industries. In the intensive margin regression we include also dummies for the type of service exported.

In the next two subsections, we present the results for both the service export entry and sales decisions of firms. We present also results for estimations with different samples of observations. First, we examine the determinants of firm behavior for observations in which a firm has a foreign affiliate in the destination country. We expect that variables that show a significant impact in this smaller subsample have a relatively stronger link to service exports of the firm. Second, we show results of individual regressions for construction and data processing services. Construction services likely present complementary and data processing services headquarter services. We would like to find out whether we can identify different

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<sup>21</sup>GDP and population data come from the World Development Indicators of the World Bank. The distance between countries is available in the distance database of the CEPII (2005).



determinants for exporting these two types of services.

Finally, note that the chosen estimation approach implicitly assumes that firms first decide to export goods and then whether they provide also complementary services. However, this does not have to be the way firms make their decisions. When the supply of a good is depending on the provision of services it could also be that firms make a simultaneous decision. For instance, it could be that foreign customers are not able to use a machine, if it is not installed and implemented by the producer. Then firms would export both the product and complementary services if this is profitable and not export, if it is not, because of large costs to provide the service, for instance. It would be desirable to analyze a simultaneous estimation system or to account for a possible endogeneity between goods and services exports, but this is not possible without goods trade firm level data. Thus, our estimation results should be interpreted as correlation between different variables. Clearer statements about causality relationships require more information about firm's activities.

#### **5.4.2 Export Market Entry**

The export market entry decision is estimated by a probit regression approach. The sample contains all 1,639 firms that export services and all countries they could potentially trade with. This results in a sample with 286,210 observations. The discrete choice variable on the left-hand side of the estimation equation is equal to zero, if a firm does not export services to the country and is one, if it does so. Because the country variables are only available for 106 countries, the sample reduces to 171,970 observations. 10,227 observations, or nearly 6% of total observations, show service exports; for these cases the discrete choice variable is

equal to one. The standard errors are clustered at the firm level.

Table 5.6 shows the output of the regression for the whole sample in column one. Most of the explanatory variables in column one have the expected and highly significant signs. The latter is likely driven by the large number of observations. Not surprisingly, we find that the country variables *GDP*, *GDP per Cap*, *Distance* and *Border* are very important to explain the firm behavior.<sup>22</sup> Firms export significantly more often to countries which are nearby, have a high-income level and a large market size. Furthermore, the presence of German service MNEs affects the decision also positive. These results are qualitatively the same as for the foreign market entry decision of producer service firms in chapter 4.5. This suggests that the motives of firms to export services might be similar as well. However, we find also that our proxy for goods exports and the variables measuring affiliate activities have significantly positive signs. *Goods exports* and *Goods Imports* have both significantly positive signs. The sign of goods exports is 8 times larger than for imports. Hence, goods exports seem to be much more important. The coefficient of *Manuf. Affil. Sales* is highly significantly positive. The same holds for the dummy whether a firm has distribution affiliate in the destination country or not (*Distrib. Affil.*). Thus, we find the expected impact of foreign affiliate activities of firms beyond the strong effect of country level determinants. Furthermore, we find that *Manufacturing MNEs* export to significantly more countries than non-MNEs. The coefficient of *Numb. of Manuf. Affil.* is significantly positive as well. Firm size affects the service export participation positively. The *Service Importer* dummy has a significant and positive coefficient. Firms that import services export services significantly more often to foreign countries.

The importance of foreign affiliates and goods exports is also demonstrated

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<sup>22</sup>The Pseudo  $R^2$  of 0.3 drops by more than 0.15 when the country variables are dropped.

Table 5.6: Probit Regression Result: Service Export Market Entry Decision of Manufacturers in Foreign Countries

Explanatory Variables	All Observ.	Manuf. Affil. in Country	Constr. Services	Data Proc. Services
<i>Manufact.</i>	0.010** (4.14)	-	0.0024** (3.50)	0.0016 (1.28)
<i>MNE</i>				
<i>Numb. of</i>	0.0006** (4.56)	0.034* (2.53)	0.0001** (4.53)	0.00002** (7.41)
<i>Manuf. Affil.</i>				
<i>ln(Manuf. Affil. Sales)</i>	0.0025** (9.26)	0.055** (3.48)	-0.0001 (1.01)	0.00006** (6.55)
<i>Distrib. Affil.</i>	0.040** (5.19)	-0.036 (0.70)	0.0016 (1.43)	0.0009** (3.13)
<i>ln(Goods Exports)</i>	0.0066** (15.45)	0.052** (2.70)	0.015** (13.51)	0.0002** (6.92)
<i>ln(Goods Imports)</i>	0.0008** (4.49)	0.006 (0.56)	-0.000 (0.12)	-0.000 (0.21)
<i>ln(Service Importer)</i>	0.0164** (12.16)	-0.108 (1.64)	0.003** (9.04)	0.0005** (6.85)
<i>Inw. Affil.</i>	0.0017 (0.99)	-0.050 (0.71)	-0.001* (2.04)	0.0001 (1.25)
<i>ln(Distance)</i>	-0.0017** (5.30)	-0.013 (0.47)	-0.0003** (3.47)	0.00003 (1.63)
<i>ln(GDP per Cap)</i>	0.0010** (4.05)	-0.013 (0.79)	0.0001 (1.87)	0.0001** (3.36)
<i>ln(GDP)</i>	0.005** (17.15)	0.026 (1.47)	0.0004** (5.20)	0.0001** (3.82)
<i>Border</i>	0.006** (7.76)	0.028 (0.54)	0.001** (5.18)	0.0002** (4.01)
<i>ln(Rel. Serv. Aff. Sales)</i>	0.0024** (9.32)	0.019 (0.96)	0.0001* (2.29)	0.0001* (5.02)
Observations	171,907	1,266	155,499	168,015
Pseudo- $R^2$	0.30	0.11	0.30	0.36

Table reports marginal effects. All regressions include dummies for industry of the firm. Z-values in brackets are cluster robust.

\*\*, \* significantly different from 0 at 1% level and 5%, respectively.

by the results in column two. We find that the coefficient of *Goods Exports* and *Manuf. Affil. Sales* is now nearly the same, but for both highly significantly positive. When a manufacturing affiliate exists, the impact of affiliate sales is relatively stronger. The results in column three and four generally support the idea that the determinants of complementary and headquarter services are different. In the regression with construction service exports only (column three), the variable *Manuf. Affil. Sales* of a firm do not significantly affect the export participation and even has a negative sign. Furthermore, having a distribution affiliate in the country does not significantly lead to more frequent construction service exports. *Goods Exports* instead have a large and highly significant coefficient. For data processing services (column four), however, we find for both affiliate variables large and highly significant coefficients.

### 5.4.3 Intensive Margin of Exports

After investigating the extensive margin of export destinations, we now analyze the determinants of the intensive margin of service exports. We use the aggregated sales at the firm-service-country level and regress them on the explanatory variables using OLS. We use roughly the same variables as in the participation estimation to explain the volume of exports. Instead of a dummy indicating whether the firm has a distribution affiliate in a country we use the distribution affiliate sales of firms (*Distrib. Affil. Sales*). Furthermore, we add also dummies for the types of services exported. The sample contains 14,188 observations of cross-border sales of firms.

Table 5.7 presents the estimation results. For the entire sample in column one, we find that the country variables have a much weaker explanatory power compared to the participation regression. Only *GDP* and *Border* have positive and significant

Table 5.7: OLS Regression Results: Determinants of Int. Margin of Service Exports

Explanatory Variables	All Firms	Manuf. Affil. in Country	Constr. Services	Data Proc. Services
<i>Numb. of</i>	0.015**	0.007	0.029**	0.020**
<i>Manuf. Affil.</i>	(5.03)	(1.92)	(7.91)	(3.51)
$\ln(\text{Manuf. Affil. Sales})$	0.043**	0.255**	0.060*	0.046*
	(4.11)	(6.02)	(2.07)	(2.12)
$\ln(\text{Distrib. Affil. Sales})$	0.027**	0.033**	0.031	0.059**
	(2.93)	(2.71)	(0.91)	(3.97)
$\ln(\text{Goods Exports})$	0.136**	0.179	0.398**	0.180
	(3.86)	(1.89)	(4.82)	(1.41)
$\ln(\text{Goods Imports})$	-0.002	0.059	-0.071**	0.027
	(0.12)	(1.17)	(2.65)	(0.58)
$\ln(\text{Service Importer})$	0.499**	0.117	0.858**	0.266
	(6.01)	(0.39)	(6.39)	(0.77)
<i>Inw. Affil.</i>	0.276	-0.003	0.045	0.260
	(2.96)	(0.01)	(0.25)	(1.10)
$\ln(\text{Distance})$	0.045	0.074	0.046	0.096
	(1.91)	(1.24)	(1.01)	(1.37)
$\ln(\text{GDP per Cap})$	0.004	0.008	-0.014	-0.072
	(0.19)	(0.79)	(0.38)	(0.86)
$\ln(\text{GDP})$	0.052*	-0.187**	-0.104	0.106
	(2.23)	(2.64)	(1.79)	(1.47)
<i>Border</i>	0.143**	-0.107	0.142	0.295
	(2.79)	(0.80)	(1.59)	(1.95)
$\ln(\text{Rel. Serv. Aff. Sales})$	-0.038	-0.187**	-0.103*	0.008
	(1.78)	(3.01)	(2.56)	(0.11)
Observations	14,188	1,741	3,785	1,061
Pseudo- $R^2$	0.153	0.293	0.195	0.279

Table reports marginal effects. All regressions include dummies for industry of the firm and the service sector. Z-values in brackets are cluster robust.

\*\* , \* significantly different from 0 at 1% level and 5%, respectively.

signs. Obviously, the intensive margin is more affected by variables which describe the activities in the main business line of the firm, manufacturing and selling of goods.<sup>23</sup>

*Goods exports* have again a positive and significant impact. When the industry exports 10% more goods to a country the firm's export sales of services are by 1.4% larger on average. *Goods imports* do not affect the intensive margin of service sales. Furthermore, we find that both manufacturing and distribution foreign affiliate sales positively affect the service sales in a foreign country, while the marginal effect of manufacturing sales is slightly larger. When manufacturing affiliate sales increase by 10% the service sales of a firm are 0.4% larger. That indicates that goods exports are indeed the most important driver of service exports of firms.

We find that more variables have the expected impact on the export behavior of firms in the regression for the whole sample. The variable *Numb. of Manuf. Affil.* has a positive coefficient that is significant at the 1%-level.<sup>24</sup> Obviously, firm size or productivity of a firm positively affects even the intensive margin of service export sales. In addition, the *Service Importer* variable has a positive and significant coefficient. Firms that import services export larger volumes of services.

The coefficient of *Goods Exports* is only significant at the 10%-level in the regression for observations with a manufacturing affiliate of a firm (column two). Not surprisingly, the sales of manufacturing affiliates of the firm have the strongest impact on services sales. A 10% increase in affiliate sales increases cross-border service sales by 2.5%. Distribution affiliate sales also exhibit a positive and significant sign. The variable *Rel. Ser. Aff. Sales* in a country have a significant negative

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<sup>23</sup>However, these activities of manufacturers are highly correlated with the country variables themselves.

<sup>24</sup>The dummy for manufacturing MNEs is dropped, because it turns insignificant for the intensive margin.

sign. This suggests that the services supply in the foreign country through third party suppliers might be a substitute for cross-border sales of manufacturers when they operate through an affiliate in the foreign market.

The results for construction and data processing services in column three and four show that they may indeed represent different groups of services. Construction services are obviously strongly driven by *Goods Exports*, which have a highly significant coefficient, that is more than two times larger than for the whole sample of services. That suggests a complementary character of this type of services. Data processing services are much more affected by foreign affiliate activities of firms. The variable *Distrib. Affil. Sales* has an even larger coefficient than *Manuf. Affil. Sales* which suggests that providing for instance software solutions to an affiliate is slightly more important for distribution than for manufacturing affiliates.

For the other types of services it is more difficult to assign them to the two groups of complementary and headquarter services.<sup>25</sup> For auxiliary transport services we find that both manufacturing affiliate activities of a firm and goods exports of the respective industry have no significant impact on service export sales of the exporting firm. Obviously, the repair activities are relatively independent of the production and sales of goods and might represent a type of service which is rather provided independent of the manufacturing activities of firms.

Altogether, the results underline the presumption that service exports are indeed driven by the main business activities of manufacturers, this is production and sales of goods. As already discussed, the evidence has a rather descriptive character. To draw stronger conclusions firm level goods trade data would be necessary.

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<sup>25</sup>We do not show the results here, but they are available on request.

## 5.5 Conclusion

The present chapter analyzed service export activities of German manufacturers. These account for around 30% of cross-border producer service exports of German firms. Important services exported are construction, R&D, E&A and management services. Service exports are dominated by the machinery, automobile and chemical industries. The types of services exported vary strongly across industries. Generally, only few manufacturers export services.

Altogether, we find evidence that service exports of firms are often related to products sold abroad, in particular to exported products. Those complementary services are particularly represented by construction services, which are very important for the machinery sector. The installation and implementation of exported machineries and equipment seem to be an important complementing service that German manufacturers provide to their foreign customers. The support of foreign affiliates with headquarter services seems to explain only a small part of the cross-border export services of manufacturers. Many manufacturing MNEs do not export any services at all. However, the data likely underestimate the role of headquarter services for activities of MNEs, because we observe only services for which the affiliate was paying. Nevertheless, we find that data processing services exports are strongly positively affected by foreign affiliates of firms. Obviously, some parent firms provide software systems to their affiliates to organize the production and distribution of goods abroad. Beside these results, we find that manufacturers export services more often to countries close-by, with a high-income level and large market size. This supports results in chapter 4 which were showing that these country characteristics are also important for service exports of service firms. Furthermore, we show that large and likely more productive multinational firms sell



larger volumes of services.

Our results suggest that cross-border service exports of manufacturers are closely related to commodity exports even on firm level. This underlines that services trade barriers are an important deterrent for international activities of manufacturers. Horn and Shy (1996) claim that service trade barriers might be entry barriers for the export of goods in foreign markets when goods are bundled with services. This can lead to goods market segmentation. Those service barriers could be travel restrictions for engineers, bureaucracy costs for business trips or restricted working permissions, for instance. We find that these seem to be particularly important for few high-tech industries, which show large goods exports. Hence, service import restrictions of countries can hamper the import of knowledge-intensive goods and services and the activities of productive goods exporters and MNEs, which might impact welfare negatively.

Generally, the results should be interpreted with caution, because we cannot observe intra-firm trade directly and goods trade data are not available at the firm level. The descriptive nature of the analysis does not allow strong causality statements. The large variety of possible scenarios how service trade can be conducted makes clear conclusions about linkages between different variables difficult.

Future research should focus even more on specific industries like the chemicals, machinery or automobile industry to obtain even more precise statements about the role of services in the business of manufacturers and relevant service trade barriers. An analysis that is guided by a more advanced theoretical model may facilitate the interpretation of the results. Also the link between service imports and exports deserves particular attention. We find that services importers export services to more countries and with larger volumes. Kasahara and Lapham (2008) find for commodity trade that importing from a country reduces fix costs of exporting to

it. It is not clear if this can be found for services trade as well.

# Chapter 6

## Conclusion

### 6.1 Summary of Results

The main goal of the dissertation at hand was to collect firm level evidence about services trade. The empirical literature about goods trade emphasizes that there is large heterogeneity of firms within industries, which is mainly driven by productivity differences of firms. Only few productive firms operate in foreign markets. Theoretical considerations state that this pronounced firm heterogeneity has important implications for trade liberalization. For services trade, in contrast, there is hardly any evidence about the role of firm heterogeneity for the pattern of services trade. This missing evidence can be mainly explained by the lack of appropriate data. Furthermore, services trade did not receive a lot of attention for a long time in the international economics literature, because services were regarded as being non-tradables. However, this treatment is misleading. In modern economies, services play an important role and global services trade is strongly increasing.

We would like to contribute to the economic literature related to empirical evi-

dence of services trade on firm level with the present dissertation. We constructed a firm level dataset by merging two datasets from the Deutsche Bundesbank. This dataset gives us comprehensive information about cross-border and foreign affiliate sales of several producer services by German firms. We find in general that there is very pronounced firm heterogeneity for services trade as well. Chapter 3 shows that only few firms trade services, but these firms trade with many countries, they trade several types of services and exhibit large volumes of sales. Surprisingly, we find that this pronounced concentration of activities on few firms can be found not only for service exports but also for imports. Furthermore, we show that analyzing services trade is not only related to service firms, but also in particular to manufacturing firms.

Chapter 4 supports that firm heterogeneity that is explained by firm productivity influences the pattern of services trade. We analyzed the choice of producer service firms to provide services to foreign customers either through cross-border or foreign affiliate sales. Our most important result is that, *ceteris paribus*, more productive firms are more likely to choose foreign affiliate compared to cross-border sales. This confirms common evidence for goods trade, that only the most productive firms are able to sell through foreign affiliates, because this is associated with larger fixed costs. Furthermore, we find the geographical distance between customers and providers make cross-border sales of services costly. This suggests that natural barriers to trade are still relevant for services despite technological progress and the increasing use of the post & telecommunication infrastructure. However, we find that many producer services are indeed tradable across borders, although this does not apply to the whole sample of firms and services. We find that some firms show only affiliate sales. These firms likely do not face a choice between the two modes. However, they account for more than 60% of foreign affiliate sales of

producer service firms and thus are economically meaningful.

The fifth chapter analyzed the service exports of manufacturers. We find that these account for roughly 30% of cross-border exports of German firms, which we did not expect. The descriptive evidence suggests that producer service exports of manufacturers often serve as complementary services in particular to high-tech goods that are sold in foreign markets. The export of headquarter services, instead, explains only a small fraction of export sales. However, we find that manufacturing MNEs show large service export activities. Hence, presuming that goods exporters and MNEs are relatively productive firms we can conclude that relatively productive manufacturers are exporting services. Altogether, the results show that particular large and globally operating high-tech firms are likely affected by service trade barriers.

Altogether, our analysis finds the very innovative evidence that firm heterogeneity plays an important role to explain the services trade pattern. More productive firms sell larger volumes of producer services. The most productive firms sell through foreign affiliates. This applies to a large share of producer service firms. These results suggest that reducing the costs to sell services to foreign customers by reducing service trade barriers related to restrictions and regulations, for instance, will lead to productivity gains for the economies as the heterogenous firm models suggest (Melitz and Ottaviano, 2008). This is a quite encouraging result, because the services sector is very important in modern economies. In addition, the development of services industries affects the manufacturing sector as well. Increasing tradability of services will likely foster also the economic development of the manufacturing sector (e.g., Francois and Hoekman, 2010, Daniels, 2000). Beyond these results, we find many different important issues for future research.

## 6.2 Future Research

One important issue for future research will be collecting more precise evidence than we could, due to the restrictions of our datasets. We find five important points at which our analysis should be extended by further empirical research:

First, an analysis with better measures for firm productivity could yield more information about the driving forces for firm heterogeneity and if the expected welfare gains can be really achieved. We only used proxies for firm productivity and are not able to calculate labor or total factor productivity directly. Second, an analysis of the service trade activities of manufacturers with firm level goods trade data could help to get a deeper understanding of the links of services trade to the activities of manufacturers. This would be useful, because the closer the links are, the larger the effects of trade liberalization of services will likely be. Third, more disaggregated service product data could help to uncover the complementary and substitutive relationships of different modes of foreign services supply, which is an important issue for the design of trade liberalization and often discussed in the service trade literature. (e.g., Christen and Francois, 2010, Fillat-Castejón et al., 2009) Fourth, being able to observe intra-firm trade directly would be helpful to attain more knowledge about the role of services trade for the international production and distribution networks of multinational firms. Finally, we did not analyze the entire sample of firms from different sectors and not all commercial services traded. Chapter 3 has shown that in addition to producer service and manufacturing firms also wholesale firms and retailers, utility and holding firms trade producer services. Furthermore, we did not account for insurance services in chapter 4, which show very large service sales, and we did not analyze financial services so far, though these are likely very important for modern economies.

Beyond these issues, we are able to uncover further important topics for future research. For instance, we find in chapter 3 that the service import pattern is different than often characterized in the literature. We find large concentration of imports on few firms. This challenges monopolistic competition trade models that assume a large amount of similar consumers on the demand side of economies. Imports of producer services are obviously rather driven by business-to-business relationships. Raff and Schmitt (2009) show that market power of importers can reduce the welfare gains of services trade liberalization. Thus, the import behavior of firms should be analyzed more deeply. For instance, the dataset of the Deutsche Bundesbank may be used to find evidence of whether and to what extent service imports are related to offshoring activities of firms by using information of foreign service affiliates of firms.

Directly related to this issue, a deeper investigation of the link between exports of services and imports on firm level would be interesting. We find that most of the exporters of services import services as well and that these firms strongly dominate export sales. The number of service importers that also exports services is smaller, but these are dominating service import sales as well. This can be found for both service and manufacturing firms. Kasahara and Lapham (2008) find that importing products from a country reduces fix costs of exporting products to it. One explanation for this result could be that market entry, either through imports or exports, is related to high information costs for firms. These costs may decrease for firms that are already operating abroad. Whether those links can also be found for services trade is an open question.

One further important issue yet not tackled is that of the determinants of the decisions of firms which show only foreign affiliates sales and sell no services across the border. As already stated in chapter 4, the foreign affiliate sales of these firms

are quite large. We discussed the non-tradability across borders of some service products, which we cannot identify with our data, as one possible explanation for these results. The “United Nations Conference on Trade and Development” (UNCTAD) (2004) states that there was a strong increase of FDI in the telecommunication and transport sector particularly in the 1990s, which was mainly driven by the privatization of service sectors in many countries. This privatization process stimulated large volume of mergers and acquisitions (M&A) in the services sector. This fits to our findings in chapter four that post & telecommunication and transport services dominate the foreign affiliate sales of firms which exhibit no cross-border sales. Whether the privatization of locally provided services is really an appropriate explanation for the results needs to be investigated more deeply.

Altogether, the identification of relevant service trade barriers and how they could be reduced, remains an important issue for future research. The OECD (2009) presents first ideas to develop a “Services Trade Restrictiveness Index”, which could be tested empirically for its relevance on the one side, and serve as a guiding measurement to control the liberalization process and the efforts of single countries, on the other side. It states that it is necessary to analyze single service sectors in detail to understand economic activities in these sectors and design trade liberalization appropriately. Our analysis supports the view that the analysis of individual sectors will be helpful, because the different services are found to be very heterogenous and related to very different economic activities. Collecting more evidence on firm level with disaggregated service data in combination with case studies might be a promising road for future research.



# Appendix A

## Appendix to Chapter 2

Table A.1: Match of MIDI and BoP Data

Sector	MIDI (Nace rev-1)	BoP-Statistics (knz's)
Construction	4500: Construction	570, 580: Construction, Installation, Reparation
Transport	6000: Land Transport, Pipelines 6100: Water Transport 6200: Air Transport	20: Air Transport 210, 220: Water Transport, Goods Trade 230, 240: Land Transport, Rail & Road
Auxiliary Transport	6300: Supporting and Auxiliary Transport Activities, Travel Agencies	300: Seaports 310, 320: Airports, Inland Harbour, Ocean Traffic and Road Transport 330: Carrier 560: Reparation Means of Transport
Post & Tele- communications	6400: Post & Telecommuni- cations	518: Communication Services (Satellite, Telephone, Wire) 591: Post & Courier Services
Insurance	6600: Insurance and Pension Funding, except Social Security	400-461: Life, Pension and Reinsurance
Data Processing	7200: Computer and related Activities	513: Electronic Data Processing
R&D	7300: Research & Development	511: R&D Products, Scient. Consultancy 501: Artistic Copyrights 504, 505, 506: Patents, Inventions, Licenses
Management Services	7411: Legal Advice 7412: Accounting, Book- keeping and Auditing Activities, Tax Consultancy 7413: Market Research, Public Opinion Polling 7414: Business and Management Consultancy	516: Entrepreneurship, Management, Organisation, Administration, Market Research 519: Other Entrepreneurial Activities
Engineering & Architect. Activities	7420: Architectural and Engineering Activities and related technical Consultancy	512: Engineering, Inspection, Technical Consultancy, Architect Royalties
Advertising	7440: Advertising	540: Advertising and Fair Costs
Personnel Services	7450: Labour Recruitment and Provision of Personnel	517: Personal Leasing 521: Non-self-employed Work

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Source: Lipponer (2009), Deutsche Bundesbank (2009)

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# Appendix B

## Appendix to Chapter 4

### B.1 Derivations for Theoretical Model

*Derivation of the maximized profits*

Substituting the inverse demand function in equation (4) for the price of the service  $q_i$  in the profit function for supplying through foreign affiliate sales (5) yields

$$\begin{aligned}\pi_i^{fa} &= \left( q_i^{fa} - \frac{w_f}{\gamma_i} \right) S_i^{fa} - F \\ &= \left( A\rho \left( S_i^{fa} \right)^{\rho-1} - \frac{w_f}{\gamma_i} \right) S_i^{fa} - F.\end{aligned}$$

Maximizing profits by choosing the optimal quantity  $S_i$ , we obtain

$$\frac{\partial \pi_i^{fa}}{\partial S_i^{fa}} = \rho^2 A \left( S_i^{fa} \right)^{\rho-1} - \frac{w_f}{\gamma_i} = 0.$$

Rearranging terms yields and solving for the price  $q_i$  yields

$$\begin{aligned} \left(S_i^{fa}\right)^{\rho-1} &= \frac{w_f}{\gamma_i} \frac{1}{A\rho^2} \\ q_i^{fa} &= A\rho \left(S_i^{fa}\right)^{\rho-1} = \frac{w_f}{\gamma_i\rho}. \end{aligned}$$

Substituting  $q_i^{fa}$  and  $S_i^{fa}$  in the profit function yields (4.7). The same procedure applies to the profit function for cross-border sales (8).

#### *Derivation of the discrete choice model*

We start by rewriting equation (4.9) by combining it with equation (7) as

$$\left(\frac{\delta w_h}{w_f}\right)^{\sigma-1} \left[1 - \frac{F}{\pi_i^{fa, gross}}\right] \begin{matrix} \leq \\ > \end{matrix} 1,$$

where  $\pi_i^{fa, gross}$  denotes the profits of producing abroad without subtracting the fixed costs ( $\pi_i^{fa} + F$ ). Taking logs on both sides of the equation and rearranging yields

$$\begin{aligned} \text{If } \ln(1 - F/\pi_i^{fa, gross}) + (\sigma - 1) \ln(w_h) - (\sigma - 1) \ln(w_f) + (\sigma - 1)\delta \geq 1 &\rightarrow I = 1 \\ \ln(1 - F/\pi_i^{fa, gross}) + (\sigma - 1) \ln(w_h) - (\sigma - 1) \ln(w_f) + (\sigma - 1)\delta < 1 &I = 0 \end{aligned}$$

We cannot solve the term in the squared brackets further but we know that it is a positive function of the productivity  $\gamma_i$  and the market size in the foreign country  $A$  and a negative function of the fixed costs  $F$  and the foreign wages  $w_f$ . The foreign wage exerts in both terms a negative effect on the decision, thus the predicted sign is not ambiguous.

## B.2 Data Sources

We use wage data in the dissertation that we take from the United Bank of Switzerland's (UBS) Prices and Earnings Survey 2006 (UBS 2006). The high-skill wage is the average wage of a department manager in the respective countries. We proxy low-skill wages by using the average wage of saleswomen. We calculate GDP per capita as a robustness check. GDP and Population are available for a wide range of countries from the World Development Indicators database (WDI) from the World Bank. Geographical distance is taken from the distances database (CEPII 2005). The geodesic distances in kilometer are calculated following the great circle formula, which uses latitudes and longitudes of the most important cities or agglomerations (in terms of population). The OECD FDI restrictiveness index is calculated by the OECD for 48 countries and differentiates several services sectors. It contains information about equity constraints, screening liabilities, input and movement restrictions, for instance. More details can be found in Koyama and Golub (2006).

The firm level regressors are computed from the merged database. For each firm we count the number of countries it exports to and uses this as *Internationality* variable. The volume of German service and manufacturing affiliate sales is calculated with the affiliate sales data in the MIDI dataset. When aggregating cross-border exports to annual values in the BoP dataset to make them comparable to the information on foreign affiliate sales we have, we keep the number of transactions which is behind this annual value and use it as a proxy for organization costs. The idea is that it makes a difference whether a firm generates a particular value with one, with several or with many transactions. Finally, we used the DAFNE database to construct a measure for the heterogeneity within German service sec-

tors. DAFNE includes about 50,000 German firms, many of them in services. We use the two digit sector classification which matches the MIDI and the BoP data. We measure heterogeneity as the variance of the sales in this sector, which include also domestic sales, scaled by average sales.

# List of References

Amiti, M., Wei, S.-J. (2009). “Service Offshoring and Productivity: Evidence from the US”. *The World Economy* Vol. 32, No. 2, 203-220.

Arkolakis, C., Muendler, M.-A. (2010). “The Extensive Margin of Exporting Goods: A firm-level Analysis”. NBER Working Paper Series 16641.

Banga, R. (2005). “Trade in Services: A review”. *Global Economy Journal*, Vol. 5, Issue 2.

Bhattacharya, R., Patnaik, I., Shah, A. (2010). “Export versus FDI in services”. IMF working paper, 10/290.

Bernard, A., Jensen, J.B., Redding, S., Schott, P. (2007). “Firms in International Trade”. *Journal of Economic Perspectives*, Vol. 21, No.3, 105-130.

Bernard, A., Redding, S., Schott, P. (2009). “Multi-Product Firms and Trade Liberalization”. Working Papers 09-21, Center for Economic Studies, U.S. Census Bureau.

Blinder, A. (2006). “Offshoring: The next Industrial Revolution”. *Foreign Affairs*, Vol. 85, No. 2, 114–128

- Breinlich, H., Criscuolo, C. (2010). “International Trade in Services: A Portrait of Importers and Exporters”. CEPR Discussion Papers 7837.
- Centre d’Etudes Prospectives et d’Informations Internationales (CEPII) (2005). “The CEPII’s Databases”. <http://www.cepii.fr>.
- Chanda, R. (2006). “Inter-modal Linkages in Services Trade”. OECD Trade Policy Working Papers, No. 30, OECD Publishing.
- Christen, E., Francois, J. (2010). “Modes of Delivery in Services”. Economics working papers 2010-08, Department of Economics, Johannes Kepler University Linz, Austria.
- Daniels, P.W. (2000). “Export of Services or Servicing Exports?”. *Geografiska Annaler*, Vol. 82, No. 1, 1-15.
- Davies, R. (2005). “Fragmentation of headquarter services and FDI”. *North American Journal of Economics and Finance*, Vol. 16, No. 1, 61–79
- Debaere, P., Görg, H., Raff, H. (2010), “Greasing the Wheels of International Commerce: How Services Facilitate Firms International Sourcing”, Kiel Working Papers No. 1591.
- Deutsche Bundesbank (2009). “Erläuterungen zum Leistungsverzeichnis für die Zahlungsbilanz. Sonderveröffentlichung 7”. <http://www.bundesbank.de>.
- Eaton, J., Kortum, S., Kramaz, F. (2004). “Dissecting Trade: Firms, Industries, and Export Destinations”. *American Economic Review*, 94(2), 150-154.
- Ethier, W. (1982). “National and International Returns to Scale in the Modern Theory of International Trade”. *American Economic Review* 72, 389-405.



- European Union (EU) (2006). "Richtlinie des Europäischen Parlaments über Dienstleistungen im Binnenmarkt". <http://eur-lex.europa.eu>.
- Federal Statistical Office (2005). GENESIS online database. <https://www-genesis.destatis.de/genesis/online>
- Feenstra, R., Lipsey, R., Branstetter, L., Foley, F., Harrigan, J., Jensen, B., Kletzer, L., Mann, C., Schott, P., Wright, G. (2010). "Report on the State of available Data for the Study of International Trade and Foreign Direct Investment". NBER Working Paper No. 16254.
- Fillat-Castejón, C., Francois, J., Wörz, J. (2009). "Cross-Border Trade and FDI in Services". WIIW working papers No. 50.
- Francois, J., Hoekman, B. (2010). "Service Trade and Policy". *Journal of Economic Literature*. Vol. 48, No. 3, 642-692.
- Freund, C., Weinhold, D. (2002). "The Internet and International Trade in Services". *American Economic Review*, Vol. 92, No. 2, 236-240.
- Gage, J., Leshner, M. (2005). "Intertwined: FDI in Manufacturing and Trade in Services". *OECD Trade Policy Working Papers*, No. 25, OECD Publishing.
- Godart, O., Goerg, H., Greenaway, D. (2009). "Headquarter services, skill intensity and labour demand elasticities in multinational firms". Kiel Working Papers No. 1575.
- Greenaway, D., Kneller, R. (2007). "Firm heterogeneity, exporting and foreign direct investment". *Economic Journal* Vol. 117, 134-161.

- Head, K., Ries, J. (2003). “Heterogeneity and the FDI versus export decision of Japanese manufacturers”. *Journal of the Japanese and International Economies*, Vol. 17, No. 4, 448–467.
- Head, K., Ries, J. (2004). “Exporting and FDI as alternative Strategies”. *Oxford Review of Economic Policy*, Vol. 20, No. 3, 409–423
- Head, K., Mayer, T., Ries, J. (2009). “How remote is the Offshoring Threat?”. *European Economic Review*, Vol. 53, No. 4, 429-444.
- Helpman, E., Melitz, M., Yeaple, S. (2004). “Export versus FDI with heterogeneous firms”. *American Economic Review*, Vol. 94, No.1, 300–316.
- Hoekman, B. (2008). “The General Agreement on Trade in Services: Doomed to Fail? Does it Matter?”. *Journal of Industry, Competition and Trade*, Vol. 8, No. 3-4, 295-318.
- Horn, H. and O. Shy (1996). “Bundling and Market Segmentation”. *International Economic Review*, Vol. 37, No. 1., 51–69
- International Monetary Fund (2007). “Balance of Payments and International Position Manual”. 6th Edition. Washington, DC: IMF.
- Kasahara, H., Lapham, B. (2008). “Productivity and the Decision to Import and Export: Theory and Evidence”. CESIFO Working Paper No. 2240.
- Kelle, M., Kleinert, J. (2010). “German Firms in Service Trade”. *Applied Economics Quarterly*, Vol. 56, No. 1, 51-72.

- Kox, H., Lejour, A., Verweij, G. (2009). "Regulatory barriers in business and transport services trade". presented at the ETSG 2009 in Rome.  
[www.etsg.org/ETSG2009/papers/lejour.pdf](http://www.etsg.org/ETSG2009/papers/lejour.pdf)
- Kox, H., Rojas-Romagosa, H. (2010). "Exports and productivity selection effects for Dutch firms". CPB discussion paper No. 143.
- Koyama, T., Golub, S. (2006). "OECD's FDI Regulatory Restrictiveness Index". OECD Working Papers on International Investment, 2006/04, OECD Publishing.
- Lennon, C. (2008). "Trade in Service: Cross-Border Trade vs. Commercial Presence. Evidence of Complementarity". Paris School of Economics, Working Paper 2008-53.
- Lennon, C. (2009). "Trade in Services and Trade in Goods: Differences and Complementarities". WIIW working papers, No. 53.
- Li, C., Whalley, J., Chen, Y. (2010). "Foreign Affiliate Sales and Trade in both Goods and Services". *NBER Working Paper* No. 16273.
- Lipponer, A. (2009). "Microdatabase Direct Investment - MiDi: A Brief Guide".  
<http://www.bundesbank.de/download/vfz/fdi>.
- Manova, K., Zhang, Z. (2009). "China's Exporters and Importers: Firms, Products, and Trade Partners". NBER working paper 15249.
- Markusen, J. (2002). "Multinational Firms and the Theory of International Trade". MIT press paperback.

- Markusen, J., Strand, B. (2009). “Adapting the Knowledge-capital Model of the Multinational Enterprise to Trade and Investment in Business Services”. *The World Economy*, Vol. 32, No. 1, 6-29.
- Mayer, T., Ottaviano, G. (2008). “The Happy Few: The Internationalisation of European Firms”. *Intereconomics* Vol. 43, No. 3, 135-148.
- Mayer, T., Melitz, M., Ottaviano, G. (2011). “Market Size, Competition and the Product Mix of Exporters”. NBER Working Paper, No. 16959.
- Melitz, M. (2003). “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity”. *Econometrica*, Vol. 71, No. 6, 1695-1725.
- Milgrom, P., Roberts, J. (1990). “The Economics of Modern Manufacturing: Technology, Strategy, and Organization”. *American Economic Review*, Vol. 80, No. 3., 511–528
- Nocke, V., Yeaple, S. (2007). “Cross-Border Mergers and Acquisitions versus Greenfield Foreign Direct Investment: The Role of Firm Heterogeneity”. *Journal of International Economics*, Vol. 72, No. 2, 335-365.
- Organisation for Economic Co-operation and Development (OECD) (2008), “Measuring Bilateral Trade in Services: A note on the data collected and estimated for the services trade restrictiveness index”, <http://www.oecd.org>
- Organisation for Economic Co-operation and Development (OECD) (2009). “OECD Services Experts Meetings Towards a Services Trade Restrictiveness Index - Report”. <http://www.oecd.org>.
- Oldenski, L. (2010). “Export Versus FDI: A Task-Based Approach”. Georgetown University.

- Preissl, B. (2007). "The German Service Gap Or: Re-Organising the Manufacturing-Services Puzzle". *Metroeconomica*, No. 58 (3), 457-478.
- Raff, H., Schmitt, N. (2009). "Buyer Power in International Markets". *Journal of International Economics*, Vol. 79, No. 2, 222-229.
- Statistical Yearbook (2007). Federal Statistical Office. <http://www.destatis.de>
- Statistical Yearbook (2008). Federal Statistical Office. <http://www.destatis.de>
- Temouri, Y., Vogel, A., Wagner, J. (2010). "Self-Selection into Export Markets by Business Services Firms: Evidence from France, Germany and the United Kingdom". IZA discussion paper No. 5147.
- Union Bank of Switzerland (UBS) (2006). "Prices and Earnings: A comparison of purchasing power around the globe". <http://www.ubs.com>.
- United Nations Conference on Trade and Development (UNCTAD) (2004). "World Investment Report 2004 - The Shift towards Services". United Nations. <http://www.unctad.org>
- Vogel, A. (2009). "Exporter Performance in the German Business Services Sector: First Evidence from the Services Statistics Panel". Working Paper Series in Economics 111, University of Lüneburg.
- Vogel, A. and Wagner, J. (2010). "Exports and Profitability - First Evidence for German Business Services Enterprises". *Applied Economics Quarterly*, Vol. 56, No. 1, 7-30.
- Wagner, J. (2007a). "Exports and productivity: A survey of the evidence from firm-level data". *The World Economy*, Vol. 30, No. 1, 60-82.

Wagner, J. (2007b). “Exports and Productivity in Germany”. University of Lueneburg Working Paper Series, No. 41.

Williams, R. (2006). “Generalized ordered logit/partial proportional odds models for ordinal dependent variables”. *The Stata Journal*, Vol. 6, No. 1, 58-82.

Worldbank (2009). “World Development Indicators 2009”.

<http://www.worldbank.org>.

World Trade Organization (WTO) (2008). “Statistics Database, International Trade and Tariffs data”. <http://www.wto.org>.

World Trade Organization (WTO) (2011). “The General Agreement on Trade in Services (GATS): objectives, coverage and disciplines”.

<http://www.wto.org>

## Eidesstattliche Erklärung

Ich erkläre hiermit an Eides Statt, dass ich meine Doktorarbeit mit dem Titel “Trade and FDI in Services: Firm Level Evidence for Germany” selbstständig und ohne fremde Hilfe angefertigt habe und dass ich alle von anderen Autoren wörtlich übernommenen Stellen, wie auch die sich an die Gedanken anderer Autoren eng anlehenden Ausführungen meiner Arbeit, besonders gekennzeichnet und die Quellen nach den mir angegebenen Richtlinien zitiert habe.

Ich versichere an Eides statt, dass ich mich an keiner anderen Fakultät einer Doktorprüfung unterzogen habe. Meine Prüfung zum Diplom-Volkswirt habe ich an der Christian-Albrechts-Universität zu Kiel abgeschlossen.

Kiel, 28.05.2011

Markus Kelle

## Hilfsmittel

Die Aufbereitung der Daten für diese Dissertation bei der Deutschen Bundesbank in Frankfurt am Main erfolgte mit "STATA 10" und "STATA 11". Die Datenerhebung sowohl für deskriptive Statistiken als die Regressionsanalyse wurde ebenfalls mit diesen Programmen durchgeführt. Einige Ergebnisse wurden für die deskriptiven Statistiken mit "Microsoft Excel" weiterverarbeitet. Das vorliegende Dokument, einschließlich aller Tabellen und Verzeichnisse, wurde schließlich mit "MikTex 2.8" erstellt.

Kiel, 28.05.2011

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