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ABSTRACT

Cross-Border and Foreign-Affiliate Sales of Services: Evidence From German Micro-Data*

We merge German balance-of-payments and foreign-affiliate-trade statistics to obtain data about trade in commercial services at the firm level. We use these data to study export market participation and the choice of export mode: cross-border versus foreign-affiliate sales. We find that for firms in our sample productivity is both a statistically significant and economically important determinant of the export participation and export mode choice. We also identify the role of industry- and country-specific determinants.

JEL Classification: F12, F15 and L13
Keywords: commercial presence, firm heterogeneity, foreign direct investment, international trade, multinational enterprises, supply modes and trade in services

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1 Introduction

High-income countries nowadays are primarily service economies. In 2007, services accounted for nearly 75% of GDP of high-income OECD countries, up from 58% in 1977.[1] And while the bulk of international trade is still in merchandise, service trade is catching up. Since the 1990s trade in commercial services has grown at more than 10% a year, much faster than merchandise trade. World exports of commercial services, excluding travel and transport, stood at nearly $2 trillion in 2008 (WTO, 2009). This catching-up process is likely to continue and may even accelerate. For instance, the ongoing digitalization of many service activities has facilitated direct cross-border sales of disembodied services. There are now 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. Rapid progress in communication technology and the deregulation of service markets have made it easier to supply services to foreign customers by establishing a commercial presence abroad. Foreign affiliate sales of services have grown even faster in the last two decades than direct cross-border sales (Francois and Hoekman (2010)).

Despite the growing importance of trade in commercial services, very little is known about the firms that carry it out and about how this trade is being conducted. We have almost no systematic evidence regarding the factors that determine whether a firm will sell a given type of service in a given country and which mode of supply it will use. We have little information about the degree of heterogeneity within and across sectors in firms' mode choices and about whether there is any systematic selection of different firms into different service supply modes. We know next to nothing about whether different modes are substitutes or complements at the firm level. The basic lack of knowledge regarding these micro-level trade patterns is troubling for at least two reasons. First, the modes of supply, as defined in Article I:2 of the General Agreement on Trade in Services (GATS), form the basis of all efforts within the WTO to liberalize service trade. WTO member countries have to specify for each supply mode which trade concessions to grant other member countries. Second, further negotiations to liberalize international service markets explicitly require an assessment of trade in services, as laid out in GATS Article XIX:3.[2] No such assessment has taken place yet due not least to a lack of data.

To be more precise, Article I:2 defines four modes of supply: 1) cross-border trade, whereby the service is produced at home and delivered to foreign customers

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

[2] Article XIX:3 of GATS stipulates that "the Council for Trade in Services shall carry out an assessment of trade in services in overall terms and on a sectoral basis..."

through telecommunications or mail; 2) consumption abroad, which means that foreign customers travel to the home country of the producer to obtain the service; 3) commercial presence, whereby the service is rendered by a foreign affiliate; and 4) temporary movement of natural persons, which typically implies that an employee of the home firm travels abroad to deliver a service to a foreign customer. The bulk of service trade occurs through modes 1 and 3. Trade restrictions vary considerably across modes, with trade via mode 3 typically being the least constrained (WTO, 2010). However, to assess how tough barriers to service trade are overall we have to know how easily firms can switch between modes. This again points to the importance of understanding whether and how firms select into different modes.

Of course, the biggest obstacle in the way of a systematic inquiry into these issues has been a lack of data (see also Lipsey (2006)). The first task of our paper hence is to construct a suitable and comprehensive dataset of firm-level trade in commercial services. For this purpose we merge two databases provided by the Deutsche Bundesbank, namely the Balance-of-Payments (BoP) statistics and the Micro Database Direct Investment (MIDI), to obtain information on nearly the entire population of German service exporters. This unique, merged dataset allows us to examine service exports not only by firm, service category and destination country but also by mode of supply. To be more precise, we can distinguish at the level of the individual firm between two channels of supply: (i) the cross-border sales of services that are recorded in the BoP, and (ii) sales through a foreign affiliate listed in MIDI. The BoP definition of cross-border sales is broader than the GATS definition. Specifically the transactions recorded in the BoP comprise those classified by GATS as mode 1 (cross-border supply), mode 2 (consumption abroad) and mode 4 (temporary movement of natural persons). Subsuming these three GATS modes under our cross-border-sales channel makes sense, according to the WTO (2009b,c), since it is often hard to distinguish empirically between transactions under modes 1 and 2, and there is no possibility yet to obtain separate measures of mode 4 transactions.[3] Our channel (ii), foreign-affiliate sales, matches up with GATS mode 3 (commercial presence). Using foreign affiliate trade statistics to measure service trade under mode 3, as we do, is also suggested by the WTO (2010).

Our second task is to use this micro dataset to examine the export decision, specifically which channel, cross-border or foreign-affiliate sales, firms use to supply services to customers abroad. We apply a discrete-choice model to determine how the choice of export channel is driven by firm characteristics. Additional controls allow us to assess to what extent the choice differs by industry and country

[3]Rough estimates suggest that transactions under mode 4 are quantitatively small. See Magdeleine and Maurer (2008) for further information.

characteristics, such as industry-specific technology, market size, labor costs, and government regulation.

Unlike in the case of merchandise trade, it is not obvious that service firms face a choice regarding the export channel.[4] Natural or technical requirements for proximity of customer and supplier might restrict firms to foreign affiliate sales. Legal restrictions to foreign ownership, on the other hand, might force firms to choose cross-border sales to provide services in foreign markets. To analyze a discrete choice of firms between the two channels, it is necessary to focus on services that are generally tradable across borders. We therefore restrict our analysis to the product groups given in Table 2. For this sample, we find that firm characteristics, specifically a proxy for productivity, is an important driver of both the selection into exporting and the choice of export channel. More productive firms are more likely to export and more likely to choose foreign-affiliate sales. Regarding industry and country characteristics we identify roles for wages, distance and market size, among other things. Firms tend to export services to high-wage countries, but high wages in the importing country tend to foster cross-border rather than affiliate sales. Distance to the foreign market discourages overall exports, but is especially detrimental to cross-border sales. A large foreign market raises the likelihood that a firm will export there, but market size has little effect on the choice between cross-border and foreign-affiliate sales once we control for export participation.

The paper is related to three strands of 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 (2011) who use a sample of UK firms, Kelle and Kleinert (2010) who use German BoP data, and Temouri et al. (2010) who examine a sample of German, French and UK firms. These studies all find that export market participation is positively correlated with measures of firm productivity. Second, there are a few studies that examine productivity premia for service FDI. They come up with mixed results. Kox and Rojas-Ramagosa (2010) find a positive productivity premium for FDI in service by Dutch firms. Bhattacharya et al. (2010) show a negative productivity premium for FDI by Indian software firms. Compared to these two sets of papers, our study provides a much more comprehensive view of service trade by simultaneously considering selection into exporting and into export modes. Third, several sector-level studies examine industry- and country-specific determinants of cross-border and foreign-affiliate

[4]In the case of merchandise 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. The typical explanation for this is that exporting and foreign affiliate production involve substantial fixed costs that only the most productive firms in an industry are able to bear. See Melitz (2003) and Helpman et al. (2004) for relevant theoretical models. See also the recent surveys of the empirical and theoretical literature by Greenaway and Kneller (2007) and Wagner (2007).

sales of services, and compare these determinants with those for manufacturing. Among others, Lennon (2008) shows that at the industry-level cross-border supply and sales through service affiliates appear to be complements. Christen and Francois (2010) find, among other things, that countries that are larger and more distant receive a larger share of foreign-affiliate sales. 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 partly explains why foreign-affiliate sales play a much larger role in services. Finally, Nordas and Kox (2009) find strong effects of market regulations especially on foreign affiliate sales of services. Our study of selection effects at the firm level nicely complements these sector-level studies.

The rest of the paper is organized as follows. Section 2 presents a theoretical framework to inform our choice of explanatory variables and the baseline empirical model. Section 3 provides a detailed description of the data. The empirical model is presented in Section 4, and Section 5 contains the empirical results for different variations of the model. Section 6 concludes, and the Appendix provides data sources.

2 Theoretical Framework

In this section we sketch a simple model to motivate the discrete choice of a firm i between supplying producer services to foreign customers through cross-border sales (cb) or foreign affiliate sales (fa). Cross-border sales imply that firm i produces the service using home-country (country h) 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 where we check how this biases our results.

Producer services serve as inputs for downstream firms. The demand for these 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), $S_1, ...S_n$, into a final output, X_m,

according to the CES production function:

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

where Ω 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 of a representative firm in the m industry is to choose S_i, $i \in \Omega$, according to

$$\max_{S_i} p_m \left(\sum\nolimits_{i \in \Omega} S_i^{\rho} \right)^{\frac{1}{\rho}} - \sum\nolimits_{i \in \Omega} q_i S_i. \tag{2}$$

The corresponding first-order condition is

$$\frac{p_m}{\rho} \left(\sum\nolimits_{i \in \Omega} S_i^{\rho} \right)^{\frac{1-\rho}{\rho}} \rho S_i^{\rho-1} = q_i. \tag{3}$$

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

$$q_i = A \rho S_i^{\rho-1}, \tag{4}$$

where firm i takes as fixed

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

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 "distance" cost associated with 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 γ_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 produced at home are more difficult to sell abroad or less useful to foreign customers. The distance cost associated with cross-border sales takes the form of an iceberg cost, $\delta > 1$; that is, δ 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:

$$\max_{S_i} \left(A\rho S_i^{\rho-1} - \frac{w_f}{\gamma_i} \right) S_i - F. \tag{5}$$

The corresponding problem for cross-border sales is:

$$\max_{S_i} \left(A\rho S_i^{\rho-1} - \frac{\delta w_h}{\gamma_i} \right) S_i. \tag{6}$$

The maximized profits in the case of foreign-affiliate sales and cross-border supply, respectively, are:

$$\pi_i^{fa} = B \left(\frac{w_f}{\gamma_i} \right)^{\frac{-\rho}{1-\rho}} - F, \tag{7}$$

$$\pi_i^{cb} = B \left(\frac{\delta w_h}{\gamma_i} \right)^{\frac{-\rho}{1-\rho}}, \tag{8}$$

where

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

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

$$\frac{\pi_i^{fa}}{\pi_i^{cb}} = (\delta w_h)^{\sigma-1}\left[\left(\frac{1}{w_f}\right)^{\sigma-1} - \frac{F}{B}\left(\frac{1}{\gamma_i}\right)^{\sigma-1}\right]. \tag{9}$$

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 (9) the discrete choice between cross-border and foreign-affiliate sales is determined by firm characteristics, namely labor productivity γ_i, as well as parameters that are likely to vary by industry and destination country, including the distance cost of cross-border supply δ, 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 B.

Due to the fixed cost of operating an affiliate, only firms with a sufficiently high productivity γ_i will choose foreign-affiliate sales. Less productive firms will go for cross-border sales.[5] The predicted effects of the industry/country controls are straightforward: a lower foreign relative to home wage, and greater demand for services abroad should encourage foreign-affiliate sales.

3 Data

3.1 Construction of the sample

We merge two confidential micro-level datasets from the *Deutsche Bundesbank* that cover—up to a reporting limit—the universe of German service exporters. The first dataset records service transactions between residents and non-residents collected to compile the Balance-of-Payments (BoP) Statistics. Firms have to report to the Deutsche Bundesbank the product identification or "Kennziffer" ("KNZ" for short) of any transaction they conduct with non-residents, the value of the transaction, and the destination country, provided the value of the transaction exceeds 12,500 euros.[6] Each reporting firm in the BoP Statistics has a unique identifier at-

[5] 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.

tributed by the Bundesbank (Deutsche Bundesbank, 2009). The Bundesbank also provides information on each firm's sector classification at the two-digit (NACE rev-1) level.[7] The BoP data do not allow us to distinguish between transactions carried out under GATS modes 1 (cross-border trade), 2 (consumption abroad), and 4 (movement of natural persons). We therefore subsume all three of these modes under the category cross-border sales.

The Bundesbank uses the same identifier for firms that appear in the Micro Database Direct Investment (MIDI). The MIDI provides comprehensive firm-level information on affiliate activities in more than 180 countries. It also provides information on the sector classification of both the parent and the affiliate at the two- or three-digit (NACE rev-1) level.[8] The MIDI allows us to identify transactions that are carried out under GATS mode 3 (commercial presence). These transactions are used to identify foreign affiliate sales, our second category of service trade.[9]

Obviously crucial to our work is the ability to match both datasets at the firm, country and product levels for each year. Given the existence of common identifiers at the firm and country levels, the only difficulty is to construct the product dimension. For this purpose we combine the KNZ of the BoP Statistics with the NACE rev-1 sector classification of the MIDI. From the MIDI we define nine service product groups that represent mostly producer services. The first six correspond to NACE two-digit-level sectors and include construction, transport, auxiliary transport, post & telecommunication, data processing, as well as R&D. The last three are all classified as business services at the NACE two-digit level, but we are able to split them into management services, advertising, and personnel services using the NACE three-digit-level classification. From the BoP Statistics, we aggregate the KNZs, which are defined at a much finer level, to match the nine service product groups. Table 1 gives the correspondence between the two nomenclatures.

Our empirical analysis makes use of a cross-section of data for 2005. The sample comprises 9,848 observations, where each observation is a combination of firm, service product group, destination country, and export channel (cross-

[6]For further details on the residency definition see also IMF (2007).

[7]For some sub-sectors data are broken down at the three-digit level.

[8]A foreign affiliate of a German firm is defined in MIDI by 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 information on foreign affiliates is subject to a rather low reporting limit (Lipponer (2009)).

[9]We attribute total sales of an affiliate to the sector in which it is classified. This implies that we might overestimate service sales of an affiliate in a specific service sector, if the affiliate also sells other services. However, we might also underestimate sales because we do also not account for sales of a particular service by affiliates which are classified in a different sector. Despite this underlying problem, the OECD (2008) concludes that affiliate sales are preferable to FDI stock or flow data when estimating service trade conducted by foreign affiliates.

border or foreign-affiliate sales). These observations represent service sales to 48 countries and are the basis for the descriptive statistics in Table 2 and 3. By far the largest number of observations (9,529) comes from firms choosing cross-border sales to supply a given foreign market. 319 observations come from firms that have foreign-affiliate sales in a country.

It is important to note that there are 201 cases in which a firm chooses both supply modes for the same service group in the same country. In the regression analysis we subsume these observations under foreign-affiliate sales; a robustness check, reported below, confirms that this does not bias our results. This reduces our regression sample to 9,647 observations of which 9,328 show cross-border sales and 319 foreign affiliate sales of services.[10]

3.2 Product Group Heterogeneity

In Table 2 we report the number of firms selling services from a given product group by export channel and the associated sales volume in 2005.[11] We want to highlight three points from Table 2. First, the number of firms engaged in cross-border sales is much larger than the number of firms selling through foreign affiliates. The total MNE ratio, i.e., the number of firms with foreign-affiliate sales over the total number of exporters, is 0.04. Second, average foreign-affiliate sales are much larger than average cross-border sales; in fact, they are more than 32 times as big. The total affiliate sales ratio, i.e., aggregate foreign-affiliate sales over total exports, is 0.56. Third, we find considerable heterogeneity across product groups in the use of the two export channels. Cross-border sales are the main export channel in R&D, Advertising and Management Services. Firms in Auxiliary Transport, Construction or Data Processing rely heavily on foreign-affiliate sales, as evidenced by affiliate sales ratios of 0.78, 0.75 and 0.68, respectivley.[12]

Insert Table 2 about here.

[10] In our regression analysis we also worked with a slightly larger sample of 10,997 observations from 76 countries. We obtain this larger sample when we replace our proxy for the foreign wage with *GDP per capita*, which is available for more countries. Below we only report regression results for this larger sample for our baseline specification. Results for other specifications are suppressed, since they hardly differ from those for the smaller sample.

[11] Notice that we ignore the country dimension. The number of firms is computed by adding up the firms that recorded sales in a given product group using a given export channel. Organizing the data in this manner implies some double counting, if a firm (i) sells a given service via both affiliate and cross-border sales (not necessarily to the same country), and (ii) has exports in more than one product group.

[12] Notice that in Table 2 we have dropped Personnel services. These services are exported exclusively through cross-border sales. We also exclude them from the regressions, since we use product group fixed effects (there is no variance within this product group).

3.3 Firm Heterogeneity

To examine how much heterogeneity there is in the service export activities of firms we aggregate the cross-border and foreign affiliates sales of each firm and examine the distribution of total exports across 10 deciles. The results are reported in Table 3.

Insert Table 3 about here.

We find that exports are concentrated on a few big traders. The 10% largest exporters account for 94.2% of total service exports. Large exporters on average sell to more countries and sell services in a larger number of product groups.[13] These large exporters are also the ones that engage in foreign-affiliate sales. The number of countries served through foreign affiliates is zero in the five lowest deciles (column 5). It is positive and increasing in the top deciles. In the 10^{th} decile, 59% of total exports come from foreign-affiliate sales. Hence the use of foreign-affiliate sales is positively correlated with total exports.

Table 3 also suggests that firms that are able to export services from more product groups or to serve more countries are more likely to establish a foreign affiliate. If firms face a choice between cross-border and foreign affiliate sales, this choice appears to depend systematically on firm characteristics.

4 The Empirical Model

Equation (9) guides the specifications of our baseline empirical model. While we cannot observe the ratio of profits from foreign affiliate sales to profits from cross-border sales, we can infer from the mode of delivery chosen by the firm whether this ratio is larger or smaller than one. We therefore estimate a discrete choice model where we replace the profit ratio by a binary indicator variable, $Mode_{ijf}$. This variable represents the decision of firm i to export a service j to country f. It takes the value of zero whenever the firm chooses cross-border sales, and a value of 1 whenever it chooses foreign affiliate sales.

The baseline empirical model is given by:

$$\begin{aligned} Mode_{ijf} &= \beta_0 + \beta_1 \ln(Productivity_i) + \beta_2 \ln(Wage_f) + \beta_3 \ln(Distance\ costs_f) \\ &+ \beta_4 \ln(Foreign\ operation\ costs_{jf}) + \beta_5 \ln(Market\ size_f) + u_{ijf} \end{aligned}$$

[13] Kelle and Kleinert (2010) show that the most important margin to explain differences in total exports at the firm level is the intensive margin. Furthermore, they find that the margins are positively correlated.

where $Productivity_i$ is firm i's labor productivity, $Wage_f$ stands for the wage in the foreign country, $Foreign\ operation\ costs_{jf}$ for the fixed costs of operating a foreign affiliate in sector j of country f, $Market\ size_f$ for the foreign market size, and $Distance\ costs_f$ for the distance costs between the home country and the destination country f; u_{ijf} denotes the error term. The residuals of our regressions are likely to be correlated within firms. The correlation does not bias the estimated coefficients but leads to an underestimation of the true standard errors. In all specifications, we therefore use clustered standard errors at the firm level (Wooldridge, 2003; Arellano, 1987).

We use a number of proxies for these explanatory variables; see the Appendix for a detailed description. The MIDI and BoP database do not provide information to calculate firm-level labor or total factor productivity. We therefore proxy $Productivity_i$ by an extensive margin of the firm, namely the number of countries to which the firm exports (*Internationalization*). In our data the largest service exporters are active in many countries. Breinlich and Criscuolo (2010) show that the firm's extensive margin is mainly determined by its labor productivity. This suggests that the firm's level of *Internationalization* is indeed a good proxy for productivity. We expect it to have a positive sign.

The costs associated with cross-border sales, $Distance\ costs_f$, are unobservable and hard to proxy especially for services. We use the geographical distance between the largest cities in Germany and the foreign country (*Distance*) and a border dummy variable (*Border*). Other potential proxies, such as the differential in time zone and the use of a common language, fail to be significant when we also account for *Distance* and *Border*.[14] We further control for the tradability of services by including a set of dummy variables that correspond to the 8 different product groups listed in Table 2. Moreover, we include sector dummies to control for differences in the average propensity of firms in different sectors to use a particular export channel.[15]

We introduce two proxies for fixed set-up costs, $Foreign\ operation\ costs_{jf}$. The first is the value of the OECD's service FDI restrictiveness index (*Service FDI restrictions*), which varies across countries and product groups. It reflects various restrictions and requirements to operate an affiliate in the foreign country. A larger value of this index is associated with greater barriers to FDI in services. This variable is expected to have a negative effect on the probability to sell through

[14]Time zone differences are highly positively correlated with geographical distance in our data (the correlation coefficient is about 0.8) and have only a significant impact when we drop *Distance*. There are only three countries, in which more than nine percent of the population speaks German. These all share a border with Germany.

[15]The sector classification refers to the firm that conducts the service trade and not to the service product traded. If a construction firm transports the material needed for a construction site in a foreign country, the firm is classified in the construction sector while the product is a transport service.

a foreign affiliate. The second proxy is measured at the firm level and corresponds to the fixed *organization costs* incurred by the parent firm when it sells through foreign affiliates. It is given by the average number of transactions in a service product group per year. Since larger firms naturally have more transactions, we scale this number by sales. It measures whether trading in a given service group requires frequent transactions or is conducted only occasionally. We expect organization costs to positively affect the probability to sell through a foreign affiliate, because transaction costs can be reduced by an affiliate abroad that is closer to customers.

To capture the wage effect, $Wage_f$, we use the wage of a high-skilled department manager taken from the survey of prices and earnings conducted by the Union Bank of Switzerland ($Wage$). In a robustness check we use the destination country's GDP per capita ($GDP\ per\ capita$), which also has the advantage of enlarging the sample to more countries. The variables *Wage* and *GDP per capita* are highly correlated; the correlation coefficient is 0.85. We expect a negative sign for the wage proxies, because a higher wage abroad increases the cost of employing foreign labor in an affiliate relative to the cost of domestic labor associated with cross-border sales. However, note that these variables might capture more than just relative wage effects. For instance, high-income countries are likely to have a more advanced technological infrastructure, which should facilitate the cross-border supply of services.

We use the GDP of the foreign country (GDP) as a proxy for market size, $Market\ size_f$. Market size may also depend on the sales of German affiliates in the foreign country, especially if these affiliates find it easier to rely on German service suppliers instead of building up new business relationships with foreign suppliers (see Raff and von der Ruhr (2007)). We measure the demand of these potential German customers for services by total German affiliate sales relative to the country's GDP ($Aff\ sales$). Both proxies for market size should positively influence the choice of affiliate sales.

Finally, we also include a control variable that we did not explicitly model but that may nevertheless be important. The sector-specific variable *Heterogeneity* controls for differences in the size distribution of firms within an industry. It is calculated as the variance of sales of German service firms in each sector scaled by average sales of this sector. Helpman, Melitz and Yeaple (2004) find that in the case of manufacturing 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 can bear the fixed cost of maintaining an affiliate abroad. Following this line of reasoning, we expect a positive sign. Table 4 presents summary statistics for all explanatory variables.

5 Estimation Results

5.1 Baseline Model

The marginal effects of two baseline probit estimations are reported in Table 5. We evaluate the marginal effects at the means of the independent variables. Both specifications (P1) and (P2) differ slightly in sample size. In column (P2), the use of wage data reduces the sample size to 9,647 observations and 48 countries.[16] In both columns (P1) and (P2) about 4 percent of the total number of observations concerns foreign affiliates.

Insert Table 5 about here.

The empirical results for both specifications are generally consistent with our theoretical predictions. *Internationalization*, our proxy for firm productivity, positively affects the choice of foreign affiliate sales and is significant at 1%. In both specification, the estimated marginal effect is 0.0004. Each additional country to which the firm exports is associated with approximately a 0.04 percentage point increase in the probability of exporting through foreign affiliates.

With very few exceptions, the country- and industry-specific variables also have the expected signs, although some do not achieve significance at the 5%-level. More precisely, the likelihood of choosing the affiliate sales channel is negatively affected by foreign labor costs. A lower *Wage* abroad or lower *GDP per capita* increase the probability of supply through a foreign affiliate, although the latter is not statistically significant.[17] In column (P2), the marginal effect associated with the wage is -0.0028 meaning that a one-percent increase of skilled workers' wages reduces the probability of foreign affiliates sales by 0.28 percentage points.

The *GDP* of the partner country has a positive and highly significant effect on the probability to serve foreign consumers through an affiliate. The estimated marginal effect is around 0.004. Thus, the probability that firms choose foreign affiliate sales increases by 0.4 percentage points when a country's GDP is one-percent larger. Our second proxy of foreign market size, the relative sales of German affiliates abroad (*Aff sales*), has an additional significant positive impact. The presence of German manufacturing and service MNEs abroad increases the probabililty that service firms choose to set up a foreign affiliate in this country. Altogether, market size positively affects the probability to serve foreign customers through affiliate sales.

[16] Notice that by dropping 28 countries, we reduce the estimation sample by only 10%.

[17] We find very similar results in a regression with low-skill wages. In the remainder of the paper, we restrict the analysis, however, to high-skill wages.

Turning to the effect of set-up costs, we do not find a significant impact of *FDI restrictions* in services. The marginal effect of *Organizational costs*, however, is positive and estimated with a high degree of precision. A one-unit increase in *Organizational costs* raises the probability of foreign affiliate sales by about 1.7 percentage points.

We do not find a statistically significant effect of the *Distance* and *Border* variables. These findings are driven by a selection bias in the data. As we shall see in the next section, *Distance* and *Border* turn out to be significant once we adjust for selection into exporting.

In the remaining subsections we verify that the main results continue to hold when we correct for selection into export markets and relax some other assumptions underlying our theoretical and empirical models.

5.2 Export Market Participation

In the theory section we model the choice between cross-border and affiliate sales, and do not condition this choice on export participation. Consistent with this, the baseline empirical model implicitly treats firm-service-country combinations for which no trade is recorded as random. This is obviously a strong assumption, since a firm's decision whether to enter a foreign market depends on its own characteristics and those of the market.

If we assume that entry into a foreign market is costly, then a firm only supplies the foreign market if at least one of the export channels yields a positive profit net of the entry cost. Observing a zero firm-service-country combination is therefore informative, as it implies that neither cross-border nor foreign-affiliate sales are profitable. In the following specifications, the dependent variable has three possible outcomes: it is "0" if a firm does not engage in export activities in a particular service product group-country combination, "1" if it uses cross-border sales, and "2" if it supplies the service through a foreign affiliate. We inflate the dataset used for regression (P2) above to include the zeros that correspond to no entry. This raises the number of observations to 131,140.[18] We hence observe zero exports in about 92% of all possible firm-service-country combinations. About 8% of observations correspond to cross-border sales while about 0.3% correspond to foreign-affiliate sales.

It is straightforward to adjust our theoretical model by introducing fixed costs of cross-border sales while keeping the assumption that foreign-affiliate sales are

[18]Since we work with firm-level data with low reporting limits, we treat all country-firm relationships for which no trade is reported as zeros. More precisely, we construct a sample where each exporting firm has an observation for *each product group* in which it supplies services (to *any* country) and *every* foreign country. Hence, we inflate the country dimension but not the product group dimension.

associated with a (sufficiently larger) fixed cost compared to cross-border sales so that only the most productive firms generate enough sales to allow them to operate a foreign affiliate. Less productive firms then choose cross-border sales, while the least productive firms generate zero exports. Given this pecking order, the appropriate empirical model to use is a generalized ordered logit model where the ordering depends only on the productivity proxy, while all other coefficients are estimated freely.[19] To see why this is appropriate notice that higher levels of productivity are indeed related to a higher index number of the endogenous variable. However, ordering the outcome with respect to *Distance*, for example, would imply that the latent variable (relative profits) and therefore the index number always increases or decreases with *Distance*, which is obviously not true from a theoretical point of view. A higher distance *decreases* the probability of cross order supply relative to inactivity ("0" vs "1") but *increases* the probability to engage in foreign affiliate production relative to cross-border supply ("1" vs "2") according to the theoretical model.[20]

Table 6 reports the coefficients of the generalized ordered logit regressions, where we use the same exogenous variables as in the baseline model (P2). In the first column, they 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 difference between the two export channels "1" and "2".

Insert Table 6 about here.

Consider the first column that explains participation in the export market. The coefficients are mostly significant and have the expected signs. *Internationalization*, our proxy for firm productivity, has a positive and significant effect on export market participation. The coefficient on *Wage* is also positive and significantly different from zero, suggesting that German firms' service export activities are concentrated in countries with high skilled-worker wages. The coefficient on

[19] The generalized ordered logit model relaxes the proportional odds assumption of the ordered logit model. The effects of the independent variables change with the point at which the categories of the dependent variable are dichotomized.

[20] Alternatively we could have run a Heckman selection model that does not a priori impose an ordering of outcomes by productivity. We prefer the generalized ordered logit (GOL) approach to a Heckman selection bias correction, because (i) our estimation equation is non-linear; and (ii) the GOL allows implementing the restriction on the productivity coefficient that come from the theory; specifically, this coefficient should be the same for export participation and for the likelihood to choose foreign-affiliate sales, since in both cases the productivity term has the same exponent. Introducing the zeros in the sample solves the selection bias, if one accepts that the low reporting limit is not binding for service producers.

Distance is negative and significant. This suggests a strong concentration of service exports in neighboring countries. This is indeed confirmed by the positive and significant impact of *Border* on export participation. Our proxies for foreign demand (*GDP* and *Aff sales*) both have a strong positive and significant effect on the decision to export. Hence the zeros in the data are not random but systematically affected by the explanatory variables of our model.

The second column considers the choice between cross-border and foreign-affiliate sales. The *Internationalization* variable remains strongly significant. More productive firms are therefore more likely to engage in affiliate sales than in exports via cross-border sales. Controlling for export participation, we find that a lower skilled-worker *Wage*, and higher *Organization costs* increase the probability that a firm opts for foreign-affiliate rather than cross-border sales. These sign patterns match those of the earlier probit model, suggesting that the earlier results of Table 5 are not affected by the selection bias that arise from the omission of the export participation equation.[21]

There are, however, two important differences between the findings of Table 5 and of Table 6. First, conditional on export market participation, the *Distance* variable is now significant and positive. Larger *Distance* increases the probability of foreign-affiliate sales, which is in line with the theoretical prediction. Second, foreign market size, when measured through *GDP*, is not significant anymore. The *Aff sales* keeps its positive effect, but is estimated with less precision. This suggests that firms are more likely to export to large foreign markets, but the size of the foreign market does not matter so much when it comes to the choice of export channel. This, too, would be in line with the theoretical model, if large markets were more open to cross-border sales.

5.3 Robustness Check: Exporters Using Both Channels

In the analysis so far we subsumed observations in which a firm uses both export channels to supply a given market under foreign-affiliate sales. In this section we check whether this affects our results by explicitly distinguishing the choice of supplying a foreign market through foreign-affiliate sales only from the choice of supplying this market using both export channels.

The fact that we observe some firms using both channels to reach customers in a given country is not very surprising. Our service product categories are fairly aggregated and comprise very different service activities. Firms may therefore choose different channels for different services within the same product group. We

[21]The size of the coefficients of the generalized ordered *logit* model cannot be compared with those from the *probit* model for two reasons. First, the size of the coefficients always differs between logit and probit models. Second, we have presented marginal effects for the probit regression above.

do not expect the results to differ much between firms that only rely on foreign-affiliate sales and those using both channels, not least because they both have to overcome the same barriers to affiliate sales. This is confirmed in Table 7, which reports the marginal effects of a multinomial probit model with 3 alternatives. The dependent variable takes the value of "0" if the firm chooses cross-border sales; this is our benchmark category. It takes a value of "1" if it sells through affiliates only, and a value of "2" whenever the firm uses both channels.

Insert Table 7 about here.

The signs of the marginal effects remain qualitatively the same as in Table 5, but the standard errors increase and hence some coefficients lose their significance. *Internationalization* is still positive and significant at 1% in both alternatives. That is, productivity has a positive and significant effect on the decision to set up a foreign affiliate whether or not the firm also uses cross-border sales. The marginal effect of the *Internationalization* variable is three times larger in the second alternative than in the first one.

6 Conclusions

We merge the German balance-of-payments and foreign-affiliate-trade statistics to obtain firm-level data on exports of commercial services. We use these data to study the export market participation decision of firms and to examine which channel, cross-border or foreign affiliate sales, exporters use to reach foreign customers. Whether firms can actually choose between different export channels is itself an important question in the case of service trade, since technical and government-imposed barriers to trade are likely to prevent the export of certain services via certain channels. However, we find that in our sample the assumption of a discrete choice between export channels appears appropriate, and for these observations the empirical models we estimate yield sensible results. We find in particular that more productive firms are more likely to export and are more likely to choose foreign affiliate sales. Firms are more likely to export services to high-wage countries, but high wages in turn favor cross-border rather than affiliate sales. Distance to the foreign market reduces the likelihood that the market will be served, but raises the likelihood that, if served, firms will rely on foreign affiliate sales. Foreign market size raises the likelihood that a firm will export there but has little effect on the choice of export channel. Another variable exerting a robust effect is the proxy for organizational costs, which calls for supply through a foreign affiliate.

An obvious caveat in any analysis of service trade, not just ours, stems from the difficulty of measuring barriers to trade by product group and export channel. A case in point is our FDI restrictions variable which does not show a systematic

pattern and is never significant. We blame this failure on the poor quality of the proxy. Barriers to cross-border and affiliate sales are obviously important as indicated in our sample not only by the huge number of zeros but also by the fact that many firms in our sample use only one channel no matter which country they export to. We will come back to this in future research once better measures of service trade barriers become available.

Still we reach a couple of tentative conclusions regarding the policy issues raised in the introduction. First, in many cases firms appear to be tied to a particular channel when they want to export their services. This suggests that they cannot easily move between cross-border and foreign-affiliate sales. Second, even where such a choice appears possible so that firms may circumvent barriers, say, on cross-border sales by switching to foreign-affiliate sales, such a substitution seems possible only for relatively productive or large firms. In fact, we record foreign affiliate sales of services for only a very small number of German firms. Hence barriers to trade imposed even on a subset of supply modes may have very strong effects on overall trade flows. Third, while there are a few firms in the sample that use both cross-border and foreign-affiliate sales to supply a given country, these firms are empirically indistinguishable from those that rely only on foreign-affiliate sales. Hence there is little evidence of complementarities at the firm-level between the two export channels.

Fourth, the fact that we observe some productivity driven selection of firms into cross-border sales and foreign-affiliate sales suggests that 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 not least because nowadays aggregate productivity growth in advanced economies is mainly driven by productivity gains in services rather than manufacturing (Francois and Hoekman, 2010).

7 Appendix: Data Sources and Description

- **Wages** are taken from the UBS Prices and Earnings Survey 2006. UBS collects representative prices and wages from the location of their affiliates in US Dollar. We choose wages for two service occupations as "representative" for our service firms: the wage of a high-skilled department manager and the wage of a low-skilled sales person. The correlation of the two wages is 0.90 so that we used only the manager wage. The results do not change if we use the sales person's wage instead. In one regression we replaced the wage by GDP per capita to broaden the sample.

- **GDP and Population** are available for a wide range of countries from the World Bank's World Development Indicators (WDI) database.
- The **FDI restrictiveness index** is taken from the OECD (*Service FDI restrictions*). It reflects various restrictions and requirements, among them local-ownership or input requirements. The index varies across countries and industries. It is a composite index which takes the highest value of one for the highest level of restrictions.
- **Geographical distance and border** are taken from the CEPII distances database (CEPII, 2005). The geodesic distances in kilometers are calculated according to the great circle formula, which uses latitudes and longitudes of the most important cities or population agglomerations. Border is a dummy variable that takes the value of 1 if the importing country has a border with Germany.
- The firm level regressors are computed from the Bundesbank database.
  - For each firm we count the number of countries it exports to and use this as our **Internationalization** variable.
  - When aggregating cross-border exports to annual values to make them comparable to the information on affiliate sales, we keep the number of transactions 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, several or many transactions.
  - Finally, we used the DAFNE database to construct a measure for the **Heterogeneity** within German service sectors. DAFNE includes about 50,000 German firms, many of them in services. We use the two digit sector classification that matches the MIDI and the BoP data. We measure heterogeneity as the variance of sales in this sector scaled by average sales.

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Table 1: Product Group Classification in the MIDI and the BoP Data

Product Group	MIDI (Nace rev. 1)	BoP (KNZ)
Construction	4500: Construction	Construction, Installation: 570, 580
Transport	6000: Land Transport, Pipelines 6100: Water Transport 6200: Air Transport	Rail & Road: 013, 215, 226, 233, 234, 240; Maritime and Inland: 081, 210, 216, 220; Air: 014, 020, 225, 244, 270; All Transp.: 015, 016, 080, 260, 271
Auxiliary Transport	6300: Supporting and Auxiliary Transport Activities, Travel Agencies	Logistics & Other Support: 300, 310, 320, 340, 360 Repairing Transport Means: 560
Post & Telecommunications	6400: Post & Telecommunications	518: Communication Services (Satellite, Telephone, Wire) 591: Post & Courier Services
Data Processing	7200: Computer & rel. Activ.	513: Electronic Data Processing
R&D	7300: Research & Development	501: Artistic Copyrights 502: Patents, Licenses, Inventions 511: R&D for products, procedures
Management Services	7411: Legal Advice 7412: Accounting, Bookkeeping 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
Advertising Personnel	7440: Advertising 7450: Labour Recruitment and Provision of Personnel	540: Advertising and Fair Costs 517: Personal Leasing 521: Non-self-employed Work

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

Table 2: German Service Exports by Export Channel in 2005, (number, billion Euro)

	Foreign-Aff. Sales		Cross-Border Sales		MNE-	Aff. Sales
Product Group	Number	Turnover	Number	Turnover	Ratio	Ratio
Construction	15	3.90	226	1.29	0.06	0.75
Transport	17	6.32	564	14.30	0.03	0.31
Auxiliary Transport	18	11.20	227	3.23	0.07	0.78
Post & Telecommunications	8	3.90	89	2.14	0.08	0.65
Data Processing	17	9.72	431	4.68	0.04	0.68
R&D	x	x	163	0.87	x	x
Management Services	5	0.38	323	0.96	0.02	0.28
Advertising	x	x	189	0.83	x	x
Total	85	35.50	2212	28.30	0.04	0.56

MNE-Ratio = Number of firms with a foreign affiliate over total number of exporters.
Aff. Sales Ratio = Aggregate foreign-affiliate sales over total exports.
x: values deleted for reasons of confidentiality.
Source: MIDI (2007), BoP (2009), authors' computation.

Table 3: Decile of Service Exporters' Aggregate Foreign Sales 2005 (Billion Euro, number)

Decile	Aggregate Export	Share of Foreign Affiliates Sales	Average Number of Countries	Countries served by MNE	Product Groups
1	0.00	0.00	1.09	0.00	1.01
2	0.01	0.00	1.35	0.00	1.02
3	0.03	0.00	1.67	0.00	1.06
4	0.06	0.00	2.19	0.00	1.08
5	0.12	0.00	2.84	0.00	1.06
6	0.24	0.00	3.53	1.00	1.17
7	0.44	0.00	4.22	0.00	1.05
8	0.86	0.01	4.66	1.00	1.10
9	1.99	0.05	7.36	1.25	1.18
10	60.1	0.59	15.96	6.96	1.35
total	63.8	0.56	4.48	5.45	1.11

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

Table 4: Descriptive statistics (Number of Observation : 9647)

Variable	Mean	Std. Dev.
Internationalization	23.67	27.32
ln(Wage)	10.58	0.75
ln(GDP per capita)	9.99	0.99
ln(Distance)	7.22	1.17
Border	0.35	0.48
ln(GDP)	20.17	1.43
Aff. sales	0.05	0.05
Organizational costs	5.21	1.28
FDI restrictions	0.20	0.16
Heterogeneity	21.19	14.06
Source: MIDI (2007), BoP (2009), authors' computation.		

Table 5: Cross-Border Sales versus Foreign Affiliates Sales: Results from Probit Regression, 2005 (Marginal effects).

	P1	P2
	(*GDP per capita*)	(*Wages*)
Internationalization	0.0004**	0.0004**
	(6.18)	(6.31)
ln(*Wage*)		-0.0028*
		(-2.25)
ln(*GDP per capita*)	-0.001	
	(-1.12)	
ln(*Distance*)	0.0004	0.0003
	(0.06)	(0.31)
Border	0.003	0.003
	(0.98)	(1.46)
ln(*GDP*)	0.005**	0.004**
	(5.31)	(4.51)
Aff sales	0.080**	0.064**
	(4.83)	(3.66)
Organizational costs	0.013**	0.017**
	(3.06)	(4.31)
FDI restrictions	0.007	0.001
	(1.20)	(0.23)
Heterogeneity	0.001*	0.001*
	(2.13)	(2.09)
Observations	10,997	9,647
Countries	76	48
Pseudo R2	0.22	0.23

Constant not shown. The table reports marginal effects. All regressions include product group and sector dummy variables. z-values in brackets. These are based on robust standard errors that are adjusted for clustering by firm. *,** Significantly different from 0 at 5% level, at 1% level, respectively.

Table 6: Generalized Ordered Logit Regression, Zero Inflated Model

	Export participation	Cross-border vs. affiliate sales
Internationalization	0.063**	0.063**
	(8.45)	(8.45)
ln(*Wage*)	0.385**	-0.333**
	(15.08)	(4.08)
ln(*Distance*)	-0.544**	0.306**
	(25.99)	(3.65)
Border	0.132**	0.168
	(3.57)	(1.00)
ln(*GDP*)	0.538**	-0.009
	(37.15)	(0.13)
Aff sales	2.88**	2.350
	(10.00)	(1.84)
Organizational costs	0.244*	1.22**
	(2.20)	(4.77)
FDI restrictions	0.002	0.109
	(0.02)	(0.27)
Heterogeneity	-0.013	0.189
	(0.39)	(1.20)
Observations	131,140	131,140
Pseudo R2	0.29	0.29

Constant not shown. The table reports estimated coefficients. All regressions include product group and sector dummy variables. z-values in brackets. These are based on robust standard errors that are adjusted for clustering by firm. *,** Significantly different from 0 at 5% level, at 1% level, respectively.

Table 7: Multinomial probit regression: choice of export channels 2005 (Marginal Effects)

	Affiliate sales only ("1")	Both channels ("2")
Internationalization	0.0001**	0.0003**
	(2.96)	(4.02)
ln(*Wage*)	-0.013	-0.0014
	(1.52)	(1.32)
ln(*Distance*)	0.0008	0.0003
	(0.86)	(0.37)
Border	0.0002	0.004
	(0.12)	(1.83)
ln(*GDP*)	0.0016**	0.0025*
	(3.02)	(2.40)
Aff sales	0.037**	0.031*
	(3.22)	(2.05)
Organizational costs	0.0055**	0.0017
	(2.66)	(1.06)
FDI restrictions	-0.0051	0.0021
	(0.93)	(0.60)
Heterogeneity	0.00003	0.0009**
	(0.06)	(2.79)
Observations	9,647	9,647

Constant not shown. The table reports marginal effects. All regressions include product group and sector dummy variables. z-values in brackets. The number of observations in the group of firms that uses both channel is 201 while it is 118 for the group that export only via affiliates. These are based on robust standard errors that are adjusted for clustering by firm. *,** Significantly different from 0 at 5% level, at 1% level, respectively.