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**Active on many foreign markets
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Joachim Wagner

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Joachim Wagner

Leuphana University Lüneburg and CESIS, KTH, Stockholm

wagner@leuphana.de

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Abstract:

This paper uses information on more than 160 million export and import transactions by German firms from 2009 to 2012 to document the decisive role of multi-market traders that are active on many foreign markets, where a market is defined as a combination of a good traded and a country traded with. Using merged information from trade transactions and from surveys conducted by the statistical offices it is shown that, controlling for detailed industry affiliation, the number of foreign markets a firm from manufacturing industries is active on as an exporter or importer is higher in firms that are larger, older and foreign owned and that have higher labor productivity, human capital intensity and R&D intensity. With the exception of labor productivity these results are valid ceteris paribus, too. All these empirical results are in line with hypotheses that are derived from the literature on the links between firm characteristics and the extensive margins of foreign trade.

JEL Classification: F14

Keywords: Exports, Imports, Transaction level data, Germany

* Keynote for AFID-Workshop, Berlin, March 29-30, 2017. All computations were done at the research data centers of the Federal Statistical Office in Wiesbaden and the Statistical Office Berlin-Brandenburg in Berlin. The transaction level data and firm level data used are strictly confidential but not exclusive, see www.forschungsdatenzentrum.de for access. To facilitate replication the Stata do-files used are available from the author on request.

Joachim Wagner
Leuphana University Lüneburg
PO Box 2440
D-21314 Lüneburg

1. Motivation

Germany is number three among the exporters and importers in world merchandise trade (World Trade Organization 2016, p. 94). International trade is important for the dynamics of the German economy as a whole, and in its regions and industries, in the short and in the long run. Reliable information on the causes and consequences of exports and imports, therefore, are important for analyses of the German economy. Over the last 25 years empirical studies on these issues were based more and more on data from the actors on the world market for goods – the internationally trading firms. A typical paper in this literature uses data collected in surveys by official statistics or others in local production units (establishments) or legal units (enterprises). This literature is seriously limited in two ways:

The studies focus on exports (see Wagner (2011a) for a survey). Due to lack of information on imports in the surveys only a few papers deal with imports. Here, only the importer status of a firm is inferred from turnover tax data, and no information on the quantity of imports or any other details can be used (see Vogel and Wagner (2010) and Wagner (2012a, 2013)).

The papers focus on which firms export how much. Due to missing information on other extensive margins of trade these studies do neither deal with the goods traded nor with the countries traded with. An exception is the distinction of exports to the Euro-zone vs. exports outside the Euro-zone in Wagner (2007a) and in Verardi and Wagner (2012).

Recently, new data on international trade in goods by German firms became available that overcome both limitations. These data are based on transaction level data collected by the customs (for trade with partners outside the European Union) or reported by the firms when trading with partners inside the EU (for the statistics on

intra-EU trade). The data cover detailed information on the goods traded, its value, its weight, and the country of destination (for exports) or origin (for imports). In short, the data do not only show “who trades and how much”, but also “who trades how much of which goods of which value and which weight with firms from which countries”. Furthermore, this information is available not only for firms from manufacturing industries, but for firms from all parts of the economy.

Transaction level data that include information on the German firm involved in the transaction have been prepared by the Federal Statistical Office for the reporting years 2009 onwards. These data, however, do not contain any information on characteristics of these firms (e.g., its size, age, productivity, or innovative activities) that can be expected to be related to the margins of exports and imports.

A way out is to use the firm identifier that is included in the transaction level data to link these data with information from other sources, including surveys conducted by official statistics that use the same firm identifier. Merged data of this type have been used in a number of studies that shed light on various aspects of Germany’s trade in goods for the first time.¹

However, hitherto studies only looked at either the number of countries traded with or at the number of goods traded, one at a time. But exporting to, say, five countries the same good or exporting to five countries several different goods obviously makes a difference – in both cases, however, the extensive margin “number of countries exported to” is the same. The same reasoning applies to the extensive margin “number of goods exported” – it makes a difference whether five different goods are exported to one country only or whether some of them are exported to several countries.

¹ See Wagner (2016a) for a survey of the literature (including studies with data for Germany) that uses transaction level data on exports and imports of goods.

This paper contributes to the literature by not looking at the number of countries traded with and the number of goods traded separately but by looking at the number of markets a trading firm is active on, where a market is defined as the combination of one traded good and one country traded with.

The rest of the paper is organized as follows. Section 2 introduces the transaction level data for German exports and imports of goods, reports basic facts on the number of markets the exporting and importing firms are active on, and documents the decisive role of multi-market traders. Section 3 derives six empirical hypotheses on the links between firm characteristics and the number of foreign markets a firm is active on as an exporter or importer and reports results from an econometric investigation of these hypotheses. Section 4 concludes.

2. German multi-market exporters and importers: Basic facts

How important are firms that trade many goods on many foreign markets for German exports and imports as a whole? To the best of my knowledge, an answer to this basic question cannot be found in publications from official statistics (or elsewhere). The data that are needed to reveal it, however, are available, and these data are used here to document basic facts on the role of multi-market traders in Germany's foreign trade.

In Germany information on goods² traded across borders and on the countries traded with is available from the statistic on foreign trade (*Außenhandelsstatistik*). This statistic is based on two sources. One source is the reports by German firms on transactions with firms from countries that are members of the European Union (EU); these reports are used to compile the so-called *Intrahandelsstatistik* on intra-EU

² Note that in Germany information on international trade in services is compiled by the German Central Bank (*Deutsche Bundesbank*) to build the balance of services trade (*Dienstleistungsbilanz*).

trade. The other source is transaction-level data collected by the customs on trade with countries outside the EU (the so-called *Extrahandelsstatistik*).³ The raw data that is used to build the statistic on foreign trade are transaction level data, i.e. they relate to one transaction of a German firm with a firm located outside Germany at a time. Published data from this statistic report exports and imports aggregated at the level of goods traded and by country of origin.

The data used in this section are based on the raw data at the transaction level. The unit of observation in these raw data is a single transaction between economic agents located in two countries, e.g. the import of X kilogram of good A with a value of Y Euro from China to Germany.⁴ For a given year, the sum over all transactions is identical to the figures published by the Federal Statistical Office for total exports or imports of Germany.

The record of the transaction usually includes a firm identifier (tax registration number) of the trading German firm. Using this identifier information at the transaction level was aggregated at the level of the trading firm for the reporting years 2009 – 2012.⁵ These data show which firm trades how much of which good with firms from which country. Products are distinguished according to very detailed

³ Note that firms with a value of trade with EU-countries that did not exceed 400,000 Euro in the previous year or in the current year per direction of trade do not have to report to the statistic on intra-EU trade. For trade with firms from non-member countries all transactions that exceed 1,000 Euro (or have a weight that exceeds 1,000 kilogram) are registered. For details see Statistisches Bundesamt, Qualitätsbericht Außenhandel, Januar 2011.

⁴ Transaction level data of this type have been used in numerous empirical studies on international trade for many countries in recent years; see Wagner (2016a) for a survey.

⁵ Note that the firm identifier is missing for 956,775 out of 117,746,292 export transactions and for 527,176 out of 44,496,776 import transactions for various reasons including traders that do not have a (German) tax identification number; further details were not revealed to me.

classifications. In the data used for this paper, the Harmonized System at 6-digit level (HS6) is used as the product classification system.

In this paper, a *market* is defined as a combination of a HS6-good and a country of destination (for exports) or a country of origin (for imports).

For the reporting years 2009 to 2012 the transaction level data at the firm-product-country level were used to compute for each year the number of exporting or importing firms, the shares of the largest 3, 50 and 100 traders in total trade, the number of markets served by exporters and importers on average and at selected percentiles of the size distribution, and the share of traders with the 3, 50 and 100 largest numbers of markets in total trade.

Results are reported in Table 1 for exports and in Table 2 for imports. To start with exports, we see that exports tend to be highly concentrated in the largest exporting firms. While there are 100,000 and more exporting firms, the largest 3 exporters cover more than ten percent of total exports, the largest 50 exporters contribute more than a third of all exports, and the share of the largest 100 exporters is 40 percent. On average, the exporting firms serve more than 60 different markets. The bulk of firms is active on a much smaller number of export markets – the median value is 6 markets in 2010 to 2012. Some firms, however, export to a much larger number of markets. Firms from the top one percent of the distribution of the number of markets export to more than 1,000 different markets, where exporters with the very largest number of markets served cover many thousand export markets. Multi-market exporters play a decisive role for exports as a whole – the share of exporters with the 100 largest numbers of markets is 30 percent of total exports.

[Table 1 near here]

The big picture for imports documented in Table 2 is similar to the one for exports. Imports tend to be highly concentrated in the largest importing firms. While there are 115,000 to 140,000 importing firms, the largest 3 exporters cover more than six percent of total imports, the largest 50 importers contribute more than a quarter of all imports, and the share of the largest 100 importers is more than a third. On average, the importing firms source from 25 different markets. The bulk of firms is active on a much smaller number of export markets – the median value is 5 or 6 markets in the years covered. Some firms, however, import from a much larger number of markets. Firms from the top one percent of the distribution of the number of markets import from more than 300 different markets, where importers with the very largest number of markets sourced cover 2,500 import markets. Multi-market importers play a decisive role for imports as a whole – the share of importers with the 100 largest numbers of markets is about one fifth of total imports.

[Table 2 near here]

The bottom line, then, is that in Germany the bulk of exporters and importers of goods is active on a small number of markets (defined as a combination of a HS6-good and a country of destination or origin) only, but that multi-market traders are responsible for the lion's share of foreign trade.

3. Characteristics of German multi-market traders

Using information on more than 160 million export and import transactions from 2009 to 2012 by German firms it was documented in section 2 that the lion's share of foreign trade is due to firms that are active on many foreign markets (defined as a

combination of a HS6-good and a foreign country). This section looks at the characteristics of these multi-market exporters and importers.

3.1 Data

The transaction level data on exports and imports does not include any information on the characteristics of the trading firms. However, the firm identifier that comes with this data can be used to merge the information on foreign trade activities at the firm level with information collected on these firms in other surveys. The empirical investigation here uses a tailor-made data set that combines information on the number of markets a firm exported to or imported from with information from high quality firm-level data from three other official sources.

The first source of firm level information is the regular survey of establishments from manufacturing industries by the Statistical Offices of the German federal states. The survey (known as the *Monatsbericht*, or monthly report) covers all establishments from manufacturing industries that employ at least twenty persons in the local production unit or in the company that owns the unit. Participation of firms in the survey is mandated in official statistics (see Malchin and Voshage (2009) for details). For this study the monthly establishment data were aggregated to annual data and at the enterprise level to match the unit of observation in the other data sources (described below).⁶ The use of the enterprise (the legal unit) instead of the establishment (the local production unit) as the unit of analysis is mandated by the use of the enterprise as the unit of observation in the other data sources used in this

⁶ Note that beginning with reporting year 2007 firms with more than 20 but less than 50 persons no longer have to report to the *Monatsbericht*. However, these firms have to report information on total sales, exports, number of employees and the sum of wages and salaries paid in the so-called *Jahresbericht* (the annual report), and this information is added to the data set used here.

study. It seems appropriate here because decisions about export activities are taken at the enterprise level, taking the characteristics of all establishments in a multi-establishment enterprise into account.

The second source of data is the cost structure survey for enterprises in the manufacturing sector. This survey is carried out annually as a representative random sample survey in about 15,000 firms. The sample is stratified according to the number of employees and the industries; all firms with 500 and more employees are covered by the cost structure survey (see Fritsch et al. 2004).⁷

The third source of data is the enterprise register system (*Unternehmensregister-System*) that is used to link information from the transaction level data on foreign trade with firm level data collected in the surveys by the statistical offices. With these linked data sets it is possible to investigate the role of firm characteristics for the number of foreign markets a firm is active on for firms from manufacturing industries (that are covered in the surveys).

3.2 Empirical hypotheses

Building on the literature on the links between firm characteristics and the extensive margins of foreign trade the empirical investigation tests for the correlation between the numbers of foreign markets that firms are active on in exporting or importing and the following firm characteristics.

Firm size: A positive link between firm size and margins of foreign trade qualifies as a stylized fact. This positive link is due to fixed costs of exporting and importing. Larger firms have efficiency advantages due to scale economies, advantages of specialization in management and better conditions on the markets for

⁷ Data from the *monthly report*, the *annual report* and the *cost structure survey* are part of a combined data set known as the *AFiD Panel*; see Malchin and Voshage (2009) for details.

inputs. Large firms can be expected to have cost advantages on credit markets while small firms often face higher restrictions on the capital market leading to a higher risk of insolvency and illiquidity. Furthermore, there might be disadvantages of small firms in the competition for highly qualified employees. There are limits to the advantage of size, because coordination costs mount as the scale of operations increases, and at some point any further expansion might cease to be profitable. Therefore, a positive relationship between firm size and foreign trade, at least up to a point, is expected. For Germany empirical evidence in line with this is reported in a number of studies (see Wagner (2011a) for a survey). Firm size is measured here by the number of employees in a firm (also included in squares to take care of non-linearity). The source of information on the number of employees is the cost structure survey.

Labor productivity: The positive link between exports and productivity qualifies as a stylized fact that has been documented in hundreds of studies for countries from all over the world (see Wagner (2007b) for a survey). According to findings from this literature an important reason for the positive productivity differential between exporters and non-exporters is self-selection of more productive plants on export markets. Furthermore, there is evidence for a market driven selection process in which exporters that have low productivity fail as a successful exporter, while only those that are more productive continue to export. The reason for this is that there exist additional costs of selling goods in foreign countries. The range of extra costs include transportation costs, distribution or marketing costs, or production costs in modifying current domestic products for foreign consumption. This implies that firms that export to a larger number of foreign markets and a larger number of different goods have to be more productive, because at least some of the extra costs mentioned (e.g., preparing a user's manual in another language, or checking the relevant national laws) recur for each foreign market served and for each good

exported. Vogel and Wagner (2010) show that similar arguments can be made with regard to imports and productivity. Empirical evidence for Germany reported in Wagner (2012b) is fully in line with this.

Labor productivity is measured here by value added per employee; the information on sales and costs used in the computation of this productivity variable are taken from the cost structure survey.⁸

Human capital intensity: Given that Germany is relatively rich in human capital, firms that use human capital intensively can be expected to have a comparative advantage on international markets. Empirical studies find that the qualification of the workforce is an important factor for the international competitiveness of German firms (Wagner 2011b). Human capital intensity is measured here by the average wage per employee. Direct information on the qualification of the employees in a firm is not available in the data used in this study, but Wagner (2012c) demonstrates that the average wage is indeed a good proxy variable for the qualification of the workforce in German manufacturing firms. The source for information on the amount of wages paid and the number of employees is the cost structure survey.

Innovation is measured by a firm's activities in research and development (*R&D*) that are closely related to product and process innovations. These activities are known to be positively linked to firms' participation in exports and to export intensity in German firms (see Wagner (2011a, 2011b)). That said, innovative firms cannot only be expected to outperform non-innovative firms with respect to export participation and the share of exports in total sales. More innovative firms can be expected to serve more foreign markets because their advantage compared to local

⁸ Note that the data used has no information on the capital stock of the firms, so more elaborate measures of productivity like total factor productivity cannot be computed.

producers of competing similar goods can be expected to be not limited to only one foreign market (or a small number of markets). Furthermore, they can be expected to export more different goods because innovation activities are often not concentrated on the development of one single good only, but spread over several lines of production. In line with this Wagner (2016b) finds that more innovative firms outperform less innovative firms at both extensive margins of exports – they export more goods and they export to a larger number of countries.

R&D activity is measured here as the share of employees in R&D in all employees. Information on R&D activity is taken from the cost structure survey.

Firm age: Although some newly founded firms are „born globals“ that export or import from the start, typically it takes years before firms eventually become active on one foreign market, and then enter further markets progressively. Firms gain expertise in entering new foreign markets from experience, and this lowers the fixed costs of entry to any further new market. A similar argument can be made with regard to the number of products traded. At any point in time, therefore, firm age and the margins of foreign can be expected to be closely linked. Germany is a case in point. Wagner (2015b, 2015c) shows that in Germany older firms are more often exporters and importers, and they export and import more different goods to and from more different countries compared to younger firms from the same industry.

Information on firm age is not available from the data used in this study. However, we know whether a firm was already active in 1995 (the first year data from the monthly report are available for) or not. Firms that reported to the monthly report in 1995, and that were founded before 1996 accordingly, are classified as old firms. Firms that started to report in the years between 1996 and 2002 are classified as medium-aged firms, and firms that started to report from 2003 onwards are classified as young firms.

Foreign owned firm: Firms that are subsidiaries of a multinational enterprise with headquarter in a foreign country are termed foreign owned firms. Foreign ownership is known to have a positive impact on the margins of exports, because these firms can use the international networks and trade contacts of their parent companies and are involved in international supply chains (see Raff and Wagner (2014) for a discussion of the literature, a theoretical model, and empirical evidence for Germany). The same arguments hold for imports. A firm is considered to be foreign owned if more than 50 percent of the voting rights of the owners or more than 50 percent of the shares are controlled (directly or indirectly) by a firm or a person/institution located outside Germany. Information on foreign ownership status of an enterprise is taken from the enterprise register system.

Industry: Dummy variables for 4-digit industries are included in all empirical models to control for industry specific effects like competitive pressure, policy measures, demand shocks etc. Information on industry affiliation is taken from the cost structure survey.

This discussion of the links between firm characteristics and the activity of firms in exports and imports lead to the following six empirical hypotheses:

H1: The number of markets exported to and imported from increases with firm size.

H2: The number of markets exported to and imported from increases with labor productivity.

H3: The number of markets exported to and imported from increases with human capital intensity.

H4: The number of markets exported to and imported from increases with Research and Development intensity.

H5: The number of markets exported to and imported from increases with firm age.

H6: The number of markets exported to and imported is larger in foreign owned firms compared to domestically owned firms.

Note that all these hypotheses are expected to hold after controlling for detailed industry affiliation at the 4-digit level.

3.3 Econometric investigation

In the empirical investigation data for the years 2009 to 2012 for samples of enterprises from manufacturing industries are used. Firm characteristics are either constant (firm age) or they do not vary much over the four year period. Furthermore, in 2012 a new sample has been drawn for the cost structure survey that is the source of most of the variables. Therefore, the data are not used as a panel data set here.⁹ Instead, all empirical models are estimated with cross-section data for each year separately.

Descriptive statistics for the samples of exporting and importing firms in 2012 are listed in the upper and lower panel of Table 3, respectively.¹⁰ On average, the firms in the sample have about 150 employees, which is quite large compared to all manufacturing firms in Germany. However, by construction the data set used is limited to firms that are active in foreign trade, and these firms tend to be considerably larger on average than non-trading firms. About seven percent of all firms in the sample trade on a single foreign market only, while most trading firms are active on several foreign markets.

⁹ See Wagner (2011b, section 5) for a discussion of this issue.

¹⁰ Results for the samples used for 2009 – 2011 are very similar and not reported here to economize on space.

[Table 3 near here]

The number of foreign markets served in exports or sourced in imports varies widely across the trading firms. To test the six hypotheses H1 to H6 (detailed in section 3.2) on the links between the number of foreign markets and firm characteristics empirical models are estimated with the number of markets (measured in logs) as the dependent variable and the firm characteristics listed above (i.e., firm size; labor productivity; human capital intensity; R&D intensity; firm age; and foreign ownership status) – either one at a time or taken together – plus detailed 4-digit industry controls as independent variables. The models are estimated by OLS for data for each year from 2009 to 2012 and for exports and imports separately.¹¹ These models cannot reveal any causal relationships, because the data at hand are not rich enough to estimate structural empirical models. Results, therefore, do only indicate correlations between the number of foreign markets a firm is active on and firm characteristics while controlling for industry affiliation.

¹¹ Although the dependent variable in the empirical models is a count variable that can only take positive integer values equal to or larger than one (because by construction only firms that trade on at least one foreign market are included in the samples) all models are estimated by OLS. Both the number of export markets and the number of import markets are distributed over a broad range (see Table 3). This justifies the use of OLS in estimating the empirical models. As a robustness check all empirical models were estimated using a zero-truncated negative binomial model that is designed for instances like these, where observations are counts and where an outcome of zero exists (i.e., there are firms with no export or import markets at all) in the population but have been excluded from the sample (see Long and Freese 2014, p. 518ff.). The big picture from the signs and significance levels of the estimated coefficients is identical with the one from the OLS estimates reported here. Details are available on request.

Results for 2012 are reported in Tables 4 for exports and in Table 5 for imports.¹² To start with results for the number of export markets, columns 1 to 6 of Table 4 report results for empirical tests of H1 and H6 (detailed above), one at a time. Results are fully in line with the theoretical hypotheses; all estimated regression coefficients are statistically highly significant and have the expected sign.¹³ From column 7 we see that this is the case, too, when all variables are included in the empirical model, but with the exception of H2 (labor productivity). In model 7 the estimated regression coefficient of labor productivity is no longer statistically significant. This is due to the fact that labor productivity is highly positively correlated with human capital intensity (see Appendix Table 7).¹⁴

[Table 4 near here]

To put the estimation results for model 7 into perspective we compute the size of the estimated effects of a change in the firm characteristics on the number of export markets. Remember that when the dependent variable is measured in logs (as is the case here) the estimated regression coefficient β is the change in $\log(\text{number of markets})$ when the respective independent variable is changed by one unit, and $\beta \cdot 100$ is the approximate percentage change in the number of markets. This is why

¹² The big picture for the other years is very similar; detailed results are documented in Table A.1 to Table A.6 in the appendix.

¹³ The estimated regression coefficients for the number of employees and the squared number of employees indicate a hump-shaped relation between firm size and the number of markets. The estimated maximum of this hump-shaped relation, however, is very large (2,735) compared to the distribution of the number of employees in the sample (see Table 3), and the estimated average marginal effect is positive (0.0043). Therefore, the estimation results point to an increase of the number of markets with an increase in firm size at a decreasing rate.

¹⁴ See Wagner (2011b, section 6) for a discussion of the role of human capital intensity as a determinant of labor productivity in the context of empirical models for export activities of firms.

$\beta \cdot 100$ is often labelled the semi-elasticity of the number of markets with respect to the respective independent variable. For dummy variables the percentage change due to a change of the value of the independent variable from zero to one is given by $(e^{\beta}-1) \cdot 100$.¹⁵

That said, estimation results for model 7 indicate that an increase in the number of employees by one standard deviation goes hand in hand with an increase in the number of export markets served by a firm of 81 percent.¹⁶ For human capital intensity and R&D intensity the respective figures are 29 percent and 12 percent. Compared to old firms the number of markets served in exports is 7 percent smaller in medium aged firms and 15 percent smaller in young firms, while foreign owned firms export to 56 percent more markets than domestically owned firms. All these estimated effects can be considered to be of a relevant order of magnitude from an economic point of view.

Turning to the number of import markets, columns 1 to 6 of Table 5 report results for empirical tests of H1 and H6. The big picture is rather similar to the results for the number of export markets. Again, all estimated regression coefficients have the expected sign.¹⁷ From column 7 we see that this is the case, too, when all variables are included in the empirical model, but again with the exception of H2 (labor productivity). In model 7 the estimated regression coefficient of labor productivity is no longer statistically significant at a conventional level. This is again

¹⁵ For a discussion of the interpretation of estimated regression coefficients from models using a logarithmic functional form see e.g. Wooldridge (2006, p. 197ff.)

¹⁶ The estimated marginal effect for the number of employees in model 7 is 0.0036 (see footnote 13); standard deviations of variables are reported in Table 3.

¹⁷ Here the estimated average marginal effect for the number of employees is 0.0046.

due to the fact that labor productivity is highly positively correlated with human capital intensity (see Appendix Table 7).¹⁸

[Table 5 near here]

An application of the same approach to interpret the estimation results for model 7 that was used in the case of export markets above indicates that an increase in the number of employees by one standard deviation goes hand in hand with an increase in the number of import markets sourced by a firm of 81 percent.¹⁹ For human capital intensity and R&D intensity the respective figures are 48 percent and 12 percent. Compared to old firms the number of markets sourced in imports is 21 percent smaller in medium aged firms and 30 percent smaller in young firms, while foreign owned firms import from 15 percent more markets than domestically owned firms. Like in the case of export markets all these estimated effects can be considered to be of a relevant order of magnitude from an economic point of view.

4. Concluding remarks

This paper uses information on more than 160 million export and import transactions by German firms from 2009 to 2012 to document the decisive role of multi-market traders that are active on many foreign markets, where a market is defined as a combination of a good traded and a country traded with. It is shown that the bulk of exporters and importers of goods is active on a small number of markets only, but that multi-market traders are responsible for the lion's share of foreign trade.

¹⁸ See footnote 14.

¹⁹ The estimated marginal effect for the number of employees in model 7 is 0.0036 (see footnote 13); standard deviations of variables are reported in Table 3.

Using merged information from trade transactions and from surveys conducted by the statistical offices it is shown that, controlling for detailed industry affiliation, the number of foreign markets a firm from manufacturing industries is active on as an exporter or importer is higher in firms that are larger, older and foreign owned and that have higher labor productivity, human capital intensity and R&D intensity. With the exception of labor productivity these results are valid *ceteris paribus*, too. All these empirical results are in line with hypotheses that are derived from the literature on the links between firm characteristics and the extensive margins of foreign trade.

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Table 1: Exporters in Germany, 2009 – 2012

	2009	2010	2011	2012
Number of exporters	97,270	110,111	120,559	121,972
<u>Share of largest exporters in total exports</u>				
Largest 3 exporters (percent)	11.08	11.78	12.31	12.52
Largest 50 exporters (percent)	34.09	34.02	33.97	34.46
Largest 100 exporters (percent)	40.56	40.03	39.96	40.65
<u>Number of markets served by exporters</u>				
Mean	65.37	66.09	64.32	66.94
p1	1	1	1	1
p50	7	6	6	6
p99	1,036	1,074	1,054	1,096
Exporters with 3 largest no. of markets	30,502	31,453	32,544	23,802
Exporters with 50 largest no. of markets	7,857	8,574	8,292	8,749
Exporters with 100 largest no. of markets	5,840	5,925	6,269	6,444
<u>Share of exporters with largest number of markets in total exports</u>				
Exporters with 3 largest no. of markets	8.32	8.58	8.67	8.90
Exporters with 50 largest no. of markets	21.15	22.65	23.11	23.46
Exporters with 100 largest no. of markets	29.93	28.47	29.47	29.18

Note: Exporters refer to exporters of goods. p1, p50 and p99 are the 1st, 50th and 99th percentile of the distribution of the number of markets, where a market is the combination of a HS6-good and a country of destination of exports. The minimum and maximum share / number of markets is confidential because these figures (may) refer to a single firm.

Table 2: Importers in Germany, 2009 – 2012

	2009	2010	2011	2012
Number of Importers	115,383	126,457	141,134	140,082
<u>Share of largest importers in total imports</u>				
Largest 3 Importers (percent)	6.84	6.82	6.40	6.74
Largest 50 Importers (percent)	28.06	29.16	30.09	31.00
Largest 100 Importers (percent)	35.13	36.29	37.29	38.22
<u>Number of markets served by importers</u>				
Mean	25.84	25.54	24.72	25.68
p1	1	1	1	1
p50	6	6	5	5
p99	301	307	299	310
Importers with 3 largest no. of markets	2,497	2,513	2,596	2,736
Importers with 50 largest no. of markets	1,933	1,835	1,814	1,832
Importers with 100 largest no. of markets	1,322	1,257	1,380	1,396
<u>Share of importers with largest number of markets in total imports</u>				
Importers with 3 largest no. of markets	0.10	0.13	0.10	0.13
Importers with 50 largest no. of markets	16.51	15.66	15.58	14.36
Importers with 100 largest no. of markets	19.85	18.04	18.14	17.52

Note: Importers refer to importers of goods. p1, p50 and p99 are the 1st, 50th and 99th percentile of the distribution of the number of markets, where a market is the combination of a HS6-good and a country of origin of imports. The minimum and maximum share / number of markets is confidential because these figures (may) refer to a single firm.

Table 3: Descriptive statistics for samples of firms

Exports, 2012	Mean	Std.dev.	p1	p50	p99
Number of markets	41.3	70.6	1	19	343
Number of employees	154.5	226.2	21	85	1,063
Labor productivity	64,641	75,784	8,998	55,801	198,055
Human capital intensity	36,257	11,544	13,566	35,447	67,093
R&D intensity	2.72	6.13	0.0	0.0	29.69
Medium aged firm (Dummy)	0.1790				
Young firm (Dummy)	0.2811				
Foreign owned firm (Dummy)	0.1422				

No. of observations	6,447				
No. of single-market exporters	463 (7.18%)				

Imports, 2012	Mean	Std.dev.	p1	p50	p99
Number of markets	139.4	409.4	1	30	1,889
Number of employees	151.75	224.5	21	83	1,054
Labor productivity	64,337	74,951	9,878	55,642	196,477
Human capital intensity	36,238	11,512	13,198	35,403	67,093
R&D intensity	2.71	6.09	0.0	0.0	29.69
Medium aged firm (Dummy)	0.1784				
Young firm (Dummy)	0.2752				
Foreign owned firm (Dummy)	0.1387				

No. of observations	6,490				
No. of single market importers	417 (6.43)				

Note: For a definition of variables see text. The minimum and maximum values of variables are confidential because they (may) refer to a single firm.

Table 4: Firm characteristics and number of markets in exports, Germany, 2012

Model		1	2	3	4	5	6	7
No. of employees	β	0.005						0.004
	p	0.000						0.000
No. of employees (squared)	β	-9.14e-7						-7.58e-7
	p	0.000						0.000
Labor productivity	β		2.21e-6					1.35e-7
	p		0.008					0.603
Human capital intensity	β			0.000047				0.000025
	p			0.000				0.000
R&D intensity	β				0.042			0.020
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.243		-0.075
	p					0.000		0.050
Firm age: young firm (Dummy)	β					-0.427		-0.160
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.815	0.447
	p						0.000	0.000
Constant	β	2.166	2.665	1.103	2.693	2.971	2.692	1.365
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.407	0.184	0.280	0.198	0.187	0.208	0.464
No. of observations		6,447	6,447	6,447	6,447	6,447	6,447	6,447

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table 5: Firm characteristics and number of markets in imports, Germany, 2012

Model		1	2	3	4	5	6	7
No. of employees	β	0.005						0.004
	p	0.000						0.000
No. of employees (squared)	β	-1.00e-6						-7.82e-7
	p	0.000						0.000
Labor productivity	β		2.48e-6					-3.96e-7
	p		0.076					0.475
Human capital intensity	β			0.000062				0.000042
	p			0.000				0.000
R&D intensity	β				0.048			0.020
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.466		-0.233
	p					0.000		0.000
Firm age: young firm (Dummy)	β					-0.682		-0.362
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.618	0.141
	p						0.000	0.008
Constant	β	2.713	3.218	1.133	3.248	3.648	3.292	1.430
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.366	0.211	0.324	0.223	0.228	0.215	0.436
No. of observations		6,490	6,490	6,490	6,490	6,490	6,490	6,490

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.1: Firm characteristics and number of markets in exports, Germany, 2009

Model		1	2	3	4	5	6	7
No. of employees	β	0.004						0.004
	p	0.000						0.000
No. of employees (squared)	β	-5.95e-7						-5.15e-7
	p	0.000						0.000
Labor productivity	β		1.66e-6					8.69e-8
	p		0.001					0.634
Human capital intensity	β			0.000045				0.000025
	p			0.000				0.000
R&D intensity	β				0.031			0.018
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.219		-0.097
	p					0.000		0.011
Firm age: young firm (Dummy)	β					-0.287		-0.149
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.839	0.497
	p						0.000	0.000
Constant	β	2.155	2.641	1.252	2.650	2.832	2.629	1.332
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.382	0.165	0.248	0.172	0.165	0.194	0.439
No. of observations		6,120	6,120	6,120	6,120	6,120	6,120	6,120

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.2: Firm characteristics and number of markets in exports, Germany, 2010

Model		1	2	3	4	5	6	7
No. of employees	β	0.005						0.004
	p	0.000						0.000
No. of employees (squared)	β	-9.82e-7						-8.35e-7
	p	0.000						0.000
Labor productivity	β		2.25e-6					1.66e-7
	p		0.002					0.493
Human capital intensity	β			0.000048				0.000025
	p			0.000				0.000
R&D intensity	β				0.039			0.020
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.254		-0.090
	p					0.000		0.018
Firm age: young firm (Dummy)	β					-0.273		-0.115
	p					0.000		0.003
Foreign owned firm (Dummy)	β						0.859	0.489
	p						0.000	0.000
Constant	β	2.128	2.635	1.137	2.668	2.879	2.663	1.271
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.397	0.174	0.265	0.183	0.169	0.200	0.454
No. of observations		6,225	6,225	6,225	6,225	6,225	6,225	6,225

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.3: Firm characteristics and number of markets in exports, Germany, 2011

Model		1	2	3	4	5	6	7
No. of employees	β	0.005						0.004
	p	0.000						0.000
No. of employees (squared)	β	-9.42e-7						-8.08e-7
	p	0.000						0.000
Labor productivity	β		2.20e-6					1.94e-7
	p		0.005					0.524
Human capital intensity	β			0.000046				0.000023
	p			0.000				0.000
R&D intensity	β				0.044			0.022
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.220		-0.080
	p					0.000		0.030
Firm age: young firm (Dummy)	β					-0.307		-0.151
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.854	0.527
	p						0.000	0.000
Constant	β	2.183	2.692	1.197	2.714	2.939	2.722	1.365
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.409	0.177	0.263	0.193	0.173	0.204	0.466
No. of observations		6,330	6,330	6,330	6,330	6,330	6,330	6,330

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.4: Firm characteristics and number of markets in imports, Germany, 2009

Model		1	2	3	4	5	6	7
No. of employees	β	0.004						0.004
	p	0.000						0.000
No. of employees (squared)	β	-6.09e-7						-5.15e-7
	p	0.000						0.000
Labor productivity	β		1.40e-6					-8.57e-7
	p		0.158					0.079
Human capital intensity	β			0.000054				0.000039
	p			0.000				0.000
R&D intensity	β				0.034			0.018
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.412		-0.268
	p					0.000		0.000
Firm age: young firm (Dummy)	β					-0.523		-0.360
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.490	0.077
	p						0.000	0.172
Constant	β	2.702	3.213	1.497	3.198	3.465	3.231	1.618
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.346	0.194	0.278	0.202	0.207	0.199	0.401
No. of observations		6,196	6,196	6,196	6,196	6,196	6,196	6,196

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.5: Firm characteristics and number of markets in imports, Germany, 2010

Model		1	2	3	4	5	6	7
No. of employees	β	0.005						0.004
	p	0.000						0.000
No. of employees (squared)	β	-1.06e-6						-8.70e-7
	p	0.000						0.000
Labor productivity	β		1.86e-6					-8.65e-7
	p		0.093					0.064
Human capital intensity	β			0.000061				0.000043
	p			0.000				0.000
R&D intensity	β				0.042			0.018
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.448		-0.249
	p					0.000		0.000
Firm age: young firm (Dummy)	β					-0.496		-0.293
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.527	0.072
	p						0.000	0.189
Constant	β	2.699	3.251	1.291	3.252	3.548	3.299	1.453
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.374	0.213	0.317	0.224	0.223	0.217	0.436
No. of observations		6,265	6,265	6,265	6,265	6,265	6,265	6,265

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.6: Firm characteristics and number of markets in imports, Germany, 2011

Model		1	2	3	4	5	6	7
No. of employees	β	0.005						0.004
	p	0.000						0.000
No. of employees (squared)	β	-1.02e-6						-8.50e-7
	p	0.000						0.000
Labor productivity	β		4.52e-6					5.54e-7
	p		0.000					0.094
Human capital intensity	β			0.000060				0.000039
	p			0.000				0.000
R&D intensity	β				0.044			0.018
	p				0.000			0.000
Firm age: medium aged firm (Dummy)	β					-0.435		-0.248
	p					0.000		0.000
Firm age: young firm (Dummy)	β					-0.470		-0.271
	p					0.000		0.000
Foreign owned firm (Dummy)	β						0.520	0.093
	p						0.000	0.079
Constant	β	2.772	3.147	1.298	3.315	3.612	3.371	1.501
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4-digit industry controls		[included in all models]						
R ²		0.391	0.244	0.332	0.244	0.240	0.235	0.451
No. of observations		6,303	6,303	6,303	6,303	6,303	6,303	6,303

Note: All models were estimated by OLS with the log of the number of markets as the dependent variable, where a market is defined as a combination of a HS6-good and a country. For a definition of the independent variables see text. β is the estimated regression coefficient and p is the prob-value (based on heteroscedasticity-consistent standard errors).

Table A.7: Correlation matrix for variables included in the empirical models

Part 1: Models for (log) number of export markets, 2012

	Markets	Productiv.	Medium	Young	Foreign	Human cap.	R&D	Employees
Markets	1.0000							
Productivity	0.1119	1.0000						
Medium age	-0.0074	-0.0159	1.0000					
Young	-0.1046	-0.0142	-0.3019	1.0000				
Foreign	0.2221	0.0757	0.0404	0.0259	1.0000			
Human capital	0.3320	0.3266	-0.0398	-0.0769	0.2277	1.0000		
R&D	0.2379	0.0629	0.0213	0.0491	0.0631	0.2486	1.0000	
Employees	0.4347	0.0957	-0.0239	-0.1061	0.0998	0.2417	0.1070	1.0000

Part 2: Models for (log) number of import markets, 2012

	Markets	Productiv.	Medium	Young	Foreign	Human cap.	R&D	Employees
Markets	1.0000							
Productivity	0.1071	1.0000						
Medium age	-0.0464	-0.0159	1.0000					
Young	-0.1344	-0.0142	-0.3019	1.0000				
Foreign	0.1347	0.0742	0.0389	0.0273	1.0000			
Human capital	0.3842	0.3266	-0.0398	-0.0769	0.2245	1.0000		
R&D	0.2204	0.0629	0.0213	0.0491	0.0676	0.2486	1.0000	
Employees	0.3550	0.0957	-0.0239	-0.1061	0.1045	0.2417	0.1070	1.0000

Definition of variables (for detailed definition, see text)

Markets	log(number of markets) in exports or imports, respectively
Productivity	Labour productivity
Medium age	Medium aged firm
Young	Young firm
Foreign	Foreign owned firm
Human capital	Human capital intensity
R&D	R&D intensity
Employees	Number of employees (firm size)

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Institut für Volkswirtschaftslehre
Postfach 2440
D-21314 Lüneburg
Tel.: ++49 4131 677 2321
email: brodt@leuphana.de

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