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Wagner, Joachim

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Quality of firms' imports and distance to countries of origin: First evidence from Germany

Joachim Wagner
Leuphana University Lueneburg

Abstract

This paper documents a new fact: The quality of goods imported by German firms increases with distance to the countries of origin. This holds after controlling for fixed effects for goods, for firms, and for firm-product combinations. The empirical investigation uses a tailor-made new data set of 3,204,851 observations for import quality (measured by the unit value of imports) at the firm-product-origin level for the reporting year 2011. Data are from 138,688 firms that imported 4,986 products (recorded at the HS6-level) in 1,938,602 firm-product combinations from 175 countries. Trade costs – which are related to distance – lead to within-firm selection of product quality across countries of origin. Firms that import multiple vertically-differentiated varieties of a product source higher quality varieties on more distant markets.

Many thanks to two anonymous reviewers for helpful comments on an earlier version. All computations were done at the Research Data Centre of the Federal Statistical Office in Wiesbaden. I thank Melanie Scheller for preparing the transaction level data for imports and for checking the output of my do-files for the violation of privacy. The micro data used are strictly confidential but not exclusive; see http://www.forschungsdatenzentrum.de/datenzugang.asp for information on how to access the data. To facilitate replications the Stata do-file used is available from the author on request.
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Contact: Joachim Wagner - wagner@leuphana.de.
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1. Motivation

The quality of internationally traded goods can be considered as a key characteristic of exports and imports. Empirical evidence on this dimension of trade, however, tends to be scarce. The quality of traded goods and its drivers are a relatively unexplored dimension of firms' cross-border activities. While we have some evidence that export unit values (used as the proxy-variable for export quality) increase systematically with distance to destination countries from studies using data for Portugal (Bastos and Silva 2010) and Germany (Wagner 2016b), to the best of my knowledge comparable evidence for imports has not been reported in the literature.

This can be considered as an important gap in knowledge. For exports, the positive effect of distance on export quality reported for Portugal and Germany is not only due to sorting of firms across markets, but also a consequence of the within-firm-product variation of export unit-values across countries of destination. Trade costs – which are related to distance – lead to within-firm selection of product quality across countries of destination. Firms that export multiple vertically-differentiated varieties of a product sell higher quality varieties on more distant markets. Does the same hold for imports? Do firms that import multiple vertically-differentiated varieties of a product buy varieties of a higher quality on more distant markets? Empirical evidence on this might contribute to our understanding of the structure of trade in goods and of the geographical structure of this trade. The case of Germany is especially interesting here because Germany is one of the most important actors on the world market for goods.[1] Empirical evidence on the relation between import quality and distance to countries of origin for this large "global player", therefore, is interesting in itself. Furthermore, facts that are revealed on this topic might be useful as a benchmark for the formulation of the assumptions used in theoretical models of models for firms trade variants of goods as importers and exporters on different markets.

This paper contributes to the literature by documenting a new fact: The quality of goods imported by German firms increases with distance to the countries of origin. This holds after controlling for fixed effects for goods and for firm-product combinations. Trade costs – which are related to distance – lead to within-firm selection of product quality across countries of origin. Firms that import multiple vertically-differentiated varieties of a product buy higher quality varieties on more distant markets.

The rest of the paper is organized as follows. Section 2 discusses the data used. Section 3 presents the results of the empirical investigation. Section 4 concludes.

2. Data and measurement issues

The lack of empirical studies for Germany on the link between the distance to countries of origin and the quality of imported goods is due to the fact that until most recently suitable data on imports at the firm-product-origin level that could be used in an econometric investigation were not available. The empirical investigation here uses a tailor-made data set that combines for the first time high quality import data from official statistics with data on the distance between Germany and countries of origin of imports, plus other information for characteristics of the countries of origin.

[1] According to the World Trade Organization's World Trade Report 2014 Germany hold rank 3 among the importers of goods in 2013 with a share of 6.3 percent; see World Trade Organization (2014,p. 34).

In Germany information on the goods imported and on the countries from which these goods are imported[2] 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 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 are 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 imports aggregated at the level of goods traded and by country of origin.

The data used in this paper are based on the raw data at the transaction level. The unit of observation in these 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 import transactions is identical to the figures published by the Federal Statistical Office for total imports of Germany.

The record of the transaction usually includes a firm identifier (tax registration number) of the importing firm.[5] Using this identifier information at the transaction level can be aggregated at the level of the trading firm to generate year-firm-product-value-weight-origin data. These data show who trades how much of which good with suppliers from which country in a given year. Products are distinguished according to very detailed classifications. In the data used for this paper, the Harmonized System at 6-digit level (HS6) is used as the product classification system.

For the reporting year 2011 the transaction level data at the firm-product-origin level were used to compute the *quality of imported goods* that is defined as the unit value of imports and that is computed as value of imports (measured in Euro) over quantity of imports (measured in kilogram). This measure of quality is widely used in the empirical literature. While it is far from perfect, it can be considered as a suitable proxy-variable, because the "unit values of internationally traded goods are heavily influenced by quality" (Feenstra and Romalis (2014, p. 477)).

Note that the import values are the so-called "statistical values" which is the value of an imported good at the German border without any tariffs, taxes and other duties. Transport costs like shipping charges, therefore, are included. This could be a problem here, but according to managers active in international trade direct transport costs tend to be minimal due to the low per-item transport costs, especially when imports are shipped in containers. The most important dimension of transport costs for import tends to be the time that it takes to

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[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*).

[3] Note that firms with a value of imports to and imports from EU-countries that did not exceed 400,000 Euro in the previous year or in the current year 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 this identifier is missing for several transactions for various reasons including traders that do not have a (German) tax identification number; further details were not revealed to me.

transport goods from a country of origin to Germany. This kind of transport cost is not included in import values.

Data on *distance to countries of origin* between Germany and the countries of origin of imports are taken from the CEPII's *GeoDist* database (Mayer and Zignago 2011). The "distw" – measure is used that calculates the distance between two countries based on bilateral distances between the biggest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country's population (see Mayer and Zignago (2011, p. 11) for details).

The empirical models that link the quality of firms' imports to the distance to countries of origin are estimated with a number of standard gravity variables as control variables (see Bustos and Silva 2010):

Market size is proxied by the Gross Domestic Product (GDP) of the country of origin, measured in Millions of US-Dollar in current prices. Information is taken from the World Bank World Development Indicators database (see http://data.worldbank.org/indicator/NY.GDP.MKTP.CD).

GDP per capita is measured in current prices and U. S. dollars. Data are from the International Monetary Fund's World Economic Outlook Data Base, April 2012 edition (see https://www.imf.org/external/pubs/ft/weo/2012/01/weodata/index.aspx).

Landlocked is a dummy-variables that takes the value 1 if a country has no direct access to the sea. Information is taken from the CEPII's *GeoDist* database (Mayer and Zignago 2011).

Furthermore, two groups of trade partner countries are distinguished, namely countries that are *members of the European Union* (EU) and Non-EU countries. This dummy variable takes on the value of 1 for EU-member countries, and it controls for the cutoff-point used when imports to EU-members are recorded.

3. Results

The empirical investigation uses 3,204,815 observations for import quality (measured by the unit value of imports) at the firm-product-origin level for the reporting year 2011. Data are from 138,688 firms that imported 4,986 products (recorded at the HS6-level) in 1,938,602 firm-product combinations from 175 countries. The total import value covered by the transaction included in the estimation sample amounts to 416,265 Million Euro, 86.4 percent of the total German imports of goods recorded in the official statistics.[6]

Descriptive statistics for the variables are reported in Table I. The distance varies between 378 kilometers (which refers to imports from Luxembourg) and 18,220 kilometers (which refers to imports from New Zealand).[7] The index of import quality varies widely between less than one Euro per kilogram and more than 1,865 Euro per kilogram. Note, however, that these are unconditional descriptive statistics that do not control for the goods

[6] Transactions without a firm identifier (see footnote 5) and with a weight below 0.5 kilogram (that is reported as zero in the original data, and for which a unit value could not be calculated) are excluded. Furthermore, information on some of the country characteristics is missing for some countries of origin.

[7] Descriptive statistics are reported in logs (except for the dummy variables) because the variables enter the empirical models in logs, following the usual specification of gravity-models. Note that the minimum and maximum values of the variables cannot be reported because they (may) refer to a single firm and, therefore, this information is confidential. For the distance to countries of origin, however, these values are known.

imported. Therefore, the large range between the top and the bottom of the value-to-weight ratio are no surprise – think, for example, of mobile phones and cement.

To investigate the link between import quality and the distance to countries of origin a regression model is estimated based on 3,204,805 observations of import quality at the firm-product-origin level with the log of import quality as the endogenous variable and the log of distance to the country of origin as exogenous variable. Following Bastos and Silva (2010), the model includes a set of control variables for further characteristics of the country of origin (described in detail above), namely the log of GDP, the log of GDP per capita, a dummy variable indicating whether the country is a member of the EU, and a dummy variable indicating whether the country is landlocked. Two variants of the empirical model are estimated: Model 1 includes fixed effects for 4,986 goods (measured at the HS6-level), and model 2 includes 1,938,602 fixed effects at the firm-good level. Results are reported in Table II.

The regression coefficient of log(distance) is an estimate of the elasticity of the quality of firms' imports with respect to distance to countries of origin. According to the results for Model 1, therefore, an increase in distance by one percent leads to an increase of import quality by 0.1 percent. This means that doubling the distance is related to an increase in quality by 10 percent. The regression coefficient of the distance variable here is solely identified from the within-goods variation of import quality between importing firms. This points to sorting of heterogeneous firms across markets of origin – firms that import higher quality variants of the same good tend to buy from more distant markets.

It is known that many German firms import more than one good and from more than one country of origin (see Wagner 2012). Therefore, unit values are often not directly comparable within a firm across origins. To control for this, Model 2 includes 1,938,602 firm-product fixed effects. Here, identification of the regression coefficient of the distance variable comes from the within-firm-product variation of unit values across countries of origin. The results for Model 2 show that the effect of distance on import quality is positive, although the estimated elasticity is considerably smaller than in Model 1.

4. Concluding remarks

The bottom line, then, is that the link between the quality of imports and the distance to countries of origin is positive - within goods across firms and within firm-product import flows. In line with results reported for exports for Portugal by Bastos and Silva (2010) and for Germany by Wagner (2016b), this positive effect of distance on import quality is not only due to sorting of firms across markets, but also a consequence of the within-firm-product variation of import unit-values across countries of origin. This might indicate that trade costs – which are related to distance – lead to within-firm selection of product quality across countries of origin. Firms that import multiple vertically-differentiated varieties of a product source higher quality varieties on more distant markets.

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Table I: Descriptive statistics

	Mean	Standard deviation	p1	p50	p99
log (import quality)	-10.829	1.856	-14.914	-10.874	-6.284
log (distance to origin)	7.671	1.252	5.938	7.394	9.308
log (GDP county of origin)	14.224	1.509	10.599	14.143	16.558
log (GDP per capita country of origin)	10.073	1.100	7.225	10.561	11.304
Origin EU member (1=yes)	0.406	0.491	0.000	0.000	1.000
Origin landlocked (1 = yes)	0.174	0.379	0.000	0.000	1.000
Number of observations	3,204,815				

Note: For a detailed definition of the variables see text. p1, p50 and p99 refer to the 1st, 50th and 99th percentile of the distribution of the variable (minima and maxima cannot be reported due to violation of privacy).

Table II: Quality of firms' imports and distance to countries of origin: Regression results

Characteristics of country of origin		Dependent variable: log (quality of imports) Model 1	Model 2
log (distance)	ß	0.104	0.038
	p	0.000	0.000
log (GDP)	ß	0.005	0.001
	p	0.021	0.493
log (GDP per capita)	ß	0.277	0.126
	p	0.000	0.000
EU-member (Dummy variable)	ß	0.040	0.052
	p	0.000	0.000
Landlocked (Dummy variable)	ß	0.095	0.048
	p	0.000	0.000
Constant	ß	-14.516	-12.439
	p	0.000	0.000
Fixed effects: Goods (N = 4,986)		yes	no
Fixed effects: Firms*Goods (N = 1,938,602)		no	yes
R-squared		0.559	0.890
Number of observations		3,204,815	3,204,815

Note: OLS regressions. ß is the estimated regression coefficient, p is the prob-value (based on heteroscedasticity-consistent standard errors clustered at the level of the importing firm). For a detailed definition of the variables see text.