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Wagner, Joachim

Published in:
Economics Bulletin

Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

Economics Bulletin

Volume 34, Issue 3

Extensive margins of imports, productivity and profitability: First evidence for manufacturing enterprises in Germany

Joachim Wagner
Leuphana University Lueneburg

Abstract

This paper uses a tailor-made newly available data set for enterprises from manufacturing industries in Germany to investigate for the first time the links between the extensive margins of imports (the number of imported goods and the number of countries imported from) and two dimensions of firm performance, productivity and profitability. While both extensive margins are highly positively linked with firm productivity, profits are not higher in firms that import more goods and from more countries. This demonstrates that productivity advantages of importers are eaten up by extra costs related to buying more goods in more countries.

I thank an anonymous referee for helpful comments on an earlier version of the paper. All computations were done at the Research Data Centre of the Statistical Office of Berlin-Brandenburg in Berlin. The firm-level 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.
Citation: Joachim Wagner, (2014) "Extensive margins of imports, productivity and profitability: First evidence for manufacturing enterprises in Germany", *Economics Bulletin*, Vol. 34 No. 3 pp. 1669-1678.
Contact: Joachim Wagner - wagner@leuphana.de.
Submitted: May 15, 2014. **Published:** July 28, 2014.

1. Motivation

Over the past twenty years a huge literature emerged that uses micro-data at the firm level to investigate econometrically the links between different forms of international firm activities (exports, imports, offshoring, foreign direct investment) and various dimensions of firm performance (including firm size, productivity, wages, innovation and survival).[1] One performance dimension that has been investigated only in a very small number of studies from this literature is profitability. This comes as a surprise because profit maximization can be regarded as a central aim of a firm. The number of studies on trade and profits, however, is still small and the number of countries covered (all of which are member states of the EU) is even smaller. Wagner (2012b) surveys the evidence for five countries from six studies. Remarkably, all of these studies look at the link between exports and profitability only, and none of the studies investigates the role of imports for profitability. Results differ widely across the studies – from positive to no to negative profitability differences between exporters and non-exporters; from evidence for self-selection of more or less profitable firms into exporting to no evidence for self-selection at all; from no positive effects of exports on profits to positive effects.

To the best of my knowledge, the only study that investigates the link between imports and profitability is Wagner (2012b). This study looks at manufacturing firms from Germany. Descriptive statistics and regression analysis point to the absence of any statistically significant and economically large effects of imports on profits. This comes as a surprise because importing firms are known to be much more productive than comparable firms that do not import.[2] It seems that any productivity advantages of trading firms are eaten up by extra costs related to buying on foreign markets.

One shortcoming of the study by Wagner (2012b) is that it looks at the link between the importer status of firm (i.e. being an importer or not) and profitability only, while the extensive margins of import activity - the number of imported goods and the number of countries imported from – are not considered due to missing information. This is a gap in the literature because it is known that these extensive margins of imports are positively related to productivity. Firms that import more goods and that import from more countries of origin are more productive (Wagner 2012c). Are these productivity premia absorbed by higher costs related to sourcing more goods abroad and from more countries? Importing is associated with fixed costs that are sunk costs, because the import agreement is preceded by a search process for potential foreign suppliers, inspection of goods, negotiations, contract formulation etc. Furthermore, there are sunk costs of importing due to learning and acquisition of customs procedures. Many of these costs tend to occur again for each source country and for each imported good. It is argued that these extra costs are a reason for self-selection of more productive firms into imports, because only firms with a productivity that is high enough can be profitable when these extra costs have to be covered. However, it is an open question whether all the productivity advantages of multi-country / multi-goods importers are needed to cover the extra costs caused by the extensive margins of imports, or whether the productivity advantage is mirrored in a profitability advantage.

This paper intends to fill this gap. It uses a tailor-made newly available data set (described in detail in section 2) to investigate for the first time the links between the extensive margins of imports (the number of imported goods and the number of countries imported from) and two dimensions of firm performance, productivity and profitability in Germany, one of the leading actors on the world market for goods. To anticipate the most

[1] For a recent survey of this literature see Wagner (2012a).
[2] See Vogel and Wagner (2010) for a survey of the literature and for evidence for Germany.

important result, we report that both extensive margins are highly positively linked with firm productivity, but that profits are not higher in firms that import more goods and from more countries. This demonstrates that productivity advantages of importers are indeed eaten up by extra costs related to import more goods and from more countries.

2. Data and measurement issues

The lack of empirical studies on the link between profitability and the extensive margins of imports is due to the fact that until most recently suitable data at the level of the firm 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 firm-level data from three official sources.

The first source is the regular survey of establishments from manufacturing industries by the Statistical Offices of the German federal states. The survey 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 establishment data were aggregated to the enterprise level to match the unit of observation in the other data sources (described below). From this survey information is used on total sales, the number of employees in the firm and detailed industry affiliation.

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. 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). This survey is the source for information on the profitability of a firm.

Information on the goods traded internationally 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] Data in the statistic of 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.

For the reporting years 2009 and 2010 these transaction-level data have been aggregated at the level of the importing firm for the first time. Using the firms' registration number for turnover tax statistics these data were matched with the enterprise register system (*Unternehmensregister-System*) and with the enterprise level data from the two other sources discussed above. For each importing firm that reported either to the statistic on intra-EU trade, or to the statistic on trade with countries outside the EU, we know from the data the number of goods imported and the number of countries imported from. This information is the source for information on the extensive margins of imports by a firm.

The *rate of profit of a firm* is computed as a rate of return, defined as gross firm surplus (computed in line with the definition of the European Commission (1998) as gross

[3] Note that firms with a value of imports from EU-countries that does not exceed 400,000 Euro in 2009 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 are registered. For details see Statistisches Bundesamt, Qualitätsbericht Außenhandel, Januar 2011.

value added at factor costs minus gross wages and salaries minus costs for social insurance paid by the firm) divided by total sales (net of VAT) minus net change of inventories:[4]

$$(1) \qquad rate\,of\,profit = \frac{gross\,value\,added - gross\,wages - costs\,for\,social\,insurance}{total\,sales - net\,change\,of\,inventories}$$

This profit measure is a measure for the price-cost margin which, under competitive conditions, should on average equal the required rental on assets employed per money unit of sales (see Schmalensee 1989, p. 960f.). Differences in profitability between firms, therefore, can follow from productivity differences, but also from different mark-ups of prices over costs and from differences in the capital intensity.[5]

Productivity is measured as labor productivity (defined as total turnover per employee) because information on the capital stock of a firm is not available, so more elaborate measures of total factor productivity cannot be used in this study. Bartelsman and Doms (2000, p. 575) point to the fact that heterogeneity in labor productivity has been found to be accompanied by similar heterogeneity in total factor productivity in the reviewed research where both concepts are measured. In a recent comprehensive survey Syverson (2011) argues that high-productivity producers will tend to look efficient regardless of the specific way that their productivity is measured. Furthermore, Foster, Haltiwanger and Syverson (2008) show that productivity measures that use sales (i.e. quantities multiplied by prices) and measures that use quantities only are highly positively correlated. Therefore, we argue that labor productivity is a suitable measure for productivity at the firm level.

Furthermore, the empirical models includes the *number of employees* (also included in squares to take care of non-linearity) to control for any relationship between firm size and firm productivity or profitability, and a complete set of 4-digit level *industry dummy variables* to control for the role of industry-specific factors.

Given that the East German economy still differs in many respects from the West German economy, especially with regard to foreign trade (see Wagner (2008)), this study looks at manufacturing enterprises from West Germany and East Germany separately.

With these data it is possible to investigate the relationship between the extensive margins of imports – the number of countries imported from and the number of different goods imported – on the one hand and the productivity or the profitability of the firm on the other hand.

All computations are performed for two years, 2009 and 2010. In 2009, the value of German imports of goods declined by 17.5 percent compared to 2008. This was followed by an increase in imports by 19.9 percent in 2010 (Statistisches Bundesamt 2012, p. 414). Therefore, a look at these two very different years can be considered as a robustness check to make sure that the results reported are not specific for a crises or recovery period.

3. Empirical findings

Among importing firms both the number of goods imported and the number of countries imported from differ widely. For the sample of firms used in this study the shares of firms

[4] Note that the data set does not have any information on the capital stock, or the sum of assets or equity, of the firm, so that it is not possible to construct profit indicators based thereon like return on assets or return on equity.

[5] Given that the data set does not have information on the capital stock employed by the firms in the econometric investigations in the following sections differences in the capital intensity are controlled for by including detailed industry dummy variables at the 4-digit level.

from six groups for both extensive margins of imports in the two years 2009 and 2010 and in both parts of Germany are reported in Table I.[6] While some firms import only one good or a small number of goods and from one country or a small number of countries only, others import many goods and from many countries. Firms from East Germany tend to have smaller values for both extensive margins of imports.

How are productivity and profitability of an importing firm linked to the extensive margins of imports? To investigate this question empirical models are estimated with the productivity or the rate of profit of a firm as the dependent variable and either the number of goods imported or the number of countries imported from as the independent variable, controlling for firm size and a full set of detailed industry dummy variables measured at the 4-digit industry level. In the empirical model the number of products and the number of countries is included either as the number itself or in form of 5 dummy variables for groups of firms with different numbers of products and countries (using the firms that import only one good or that import from one country only as the reference group).[7] These regression equations are not meant to be empirical models to explain productivity or profitability differences at the firm level; the data at hand are not rich enough for such an exercise. The regression equations are just a vehicle to test for, and estimate the size of, the difference in productivity and profitability in firms with different values of the extensive margins of imports while controlling for firm size and industry affiliation. This is a standard approach used in a huge number of empirical papers from the emerging literature on the links between international activities of heterogeneous firms and firm performance.[8]

Results for the estimated productivity premia are reported in Table II. The big picture is identical to the one reported in earlier investigations based on different samples of manufacturing firms from Germany. All estimated regression coefficients are positive and highly significant statistically (with larger coefficients for East Germany than for West Germany). Productivity increases with both margins of imports, and the estimated premia are large from an economic point of view. In West Germany in 2009 the (unconditional) average amount of sales per employee in all firms in our sample was 227,726 €. Compared to firms from the reference group that imported only one product, labor productivity was 14,668 Euro higher on average (controlling for firm size and industry) in firms that imported 2 – 5 products, and 47,398 €uro higher in firms that imported 50 or more products. These premia are large with regard to the overall average productivity. The same holds for the estimated productivity premia with regard to the number of countries imported from. The big picture for West Germany in 2010 is the same, and this holds for East Germany in both years and with regard to both extensive margins of imports, too.

In West Germany in 2009 the (unconditional) average rate of profit in all firms in our sample was 4.9 percent, with a value of -30.7 percent in first percentile and 29.0 percent in

[6] For information on the share of countries of origin and the type of products imported in total imports see Statistisches Bundesamt (2012), p. 411ff. Note that in 2010 68 percent of imports originated in Europe (56 percent in the EU), 9 percent in America and 20.5 percent in Asia. The 10 most important countries of origin were China, The Netherlands, France, United States, Italy, United Kingdom, Austria, Belgium, Switzerland and Russia. As regards types of imported goods, the shares in 2010 were 31 percent for intermediate goods, 29.5 percent for capital goods, 15.7 percent for consumer non-durables, 11.5 percent for energy, and 3.7 percent for consumer durables.

[7] Note that by construction only importing firms are included in the data set.

[8] For recent surveys of this literature see Bernard et al. (2012), Melitz and Redding (2014) and Wagner (2012a).

the 99th percentile. Results for 2010 and for East Germany are similar.[9] How are the large differences in productivity between importers with lower and higher values of the extensive margins of imports documented in Table II related to these differences in firm profitability? Results from profitability premia regressions that are specified identically compared to the empirical models used to estimate the productivity premia are reported in Table III. The estimated regression coefficients are never statistically different from zero at an error level of five percent,[10] and the point estimates do not indicate a consistent pattern over both years and both parts of Germany. Firm profitability is not related to the extensive margins of imports.

4. Discussion

This paper uses a tailor-made newly available data set for enterprises from manufacturing industries in Germany to investigate for the first time the links between the extensive margins of imports (the number of imported goods and the number of countries imported from) and two dimensions of firm performance, productivity and profitability. In line with results from earlier studies it is found that productivity increases with both margins of imports, and that the estimated premia are large from an economic point of view in West Germany and in East Germany, and in the import crisis year 2009 and the import boom year 2010. These large productivity premia of firms that import more goods and from more countries does not lead to a positive link between the extensive margins of imports and profitability. The evidence suggests that productivity advantages of firms with larger extensive margins of imports are eaten up by extra costs related to buying more goods in more countries.

An open question that has not been dealt with in this paper is the potential role played by unobserved firm characteristics like management quality for the links between productivity or profitability of firms on the one hand and the extensive margins of import on the other hand. If these unobserved firm characteristics are correlated with the extensive margins the estimated regression coefficients are biased and any conclusions based on the estimates have to take this potentially large bias into account. A standard solution to take at least those unobserved factors into account that do not change over the period under investigation is the addition of fixed firm effect to an empirical model that is estimated for panel data that cover all years from these period. This, however, is not a feasible strategy here. As of today, the data for the extensive margins of imports are available for the years 2009 and 2010 only. Furthermore, these extensive margins tend to be highly persistent at the level of the enterprise. Estimates from fixed effects panel data models that are based on the variation of variables over time inside a firm only, therefore, are no panacea here.

That said, the reported statistically significant and economically non-negligible correlation between the productivity of a firm and the extensive margins of imports that goes hand in hand with no correlation at all between the profitability of a firm and these extensive margins should be regarded as an interesting new finding. This finding might motivate further investigations of the causes and consequences of differences in the diversification of imports over space and products in manufacturing firms.

[9] Details are available on request. Note that minimum and maximum values are confidential because they refer to a single (but unknown) firm.

[10] Note that the (negative!) coefficient from model 1 for East Germany in 2010 for the number of products has a prob-value that comes close to the significance level of five percent. However, this seemingly negative link of the number of imported products and the rate of profit does not show up in the estimated coefficients of the group dummy variables that are not statistically different from zero at any conventional level.

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Table I: Extensive margins of imports in German manufacturing firms

		Share of firms (percent)			
		West Germany		East Germany	
		2009	2010	2009	2010
Group	Number of goods				
1	1	5.25	5.38	8.72	7.95
2	2 – 5	16.09	14.44	17.53	18.28
3	6 – 10	13.54	13.37	18.97	17.90
4	11 – 25	24.07	23.33	29.60	26.70
5	26 – 49	20.12	20.20	14.56	16.67
6	50+	20.94	23.28	10.63	12.50
No. of firms		6,004	6,060	1,044	1,056
Group	Number of countries				
1	1	8.49	9.09	12.45	12.78
2	2 – 5	22.58	22.00	26.05	26.14
3	6 – 10	23.92	22.01	29.69	25.76
4	11 – 25	33.78	35.00	27.78	30.11
5	26 – 49	10.14	11.02	3.64	4.55
6	50+	1.08	0.87	0.38	0.66
No. of firms		6,004	6,060	1,044	1,056

Table II: Extensive margins of imports and productivity in German manufacturing firms

			West Germany		East Germany	
Model		year	2009	2010	2009	2010
1	Number of products	ß	0.194	0.237	0.495	0.460
		p	0.000	0.000	0.000	0.000
2	2 – 5 products	ß	14.668	6.618	13.725	5.304
	(Dummy; 1 = yes)	p	0.000	0.041	0.034	0.419
	6 – 10 products	ß	22.389	15.750	33.452	27.664
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	11 – 25 products	ß	31.596	26.495	40.218	38.071
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	26 – 49 products	ß	36.321	36.234	48.086	49.892
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	50 + products	ß	47.398	48.267	72.688	74.922
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
1	Number of countries	ß	1.557	1.898	3.181	3.298
		p	0.000	0.000	0.000	0.000
2	2 – 5 countries	ß	17.001	11.166	31.639	23.166
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	6 – 10 countries	ß	29.928	28.350	35.700	41.131
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	11 – 25 countries	ß	43.402	43.100	67.080	59.597
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	26 – 49 countries	ß	55.449	58.934	84.562	100.83
	(Dummy; 1 = yes)	p	0.000	0.000	0.000	0.000
	50 + countries	ß	84.068	103.50	223.88	171.50
	(Dummy; 1 = yes)	p	0.000	0.000	0.003	0.000

Note: Dependent variable is labor productivity. ß is the estimated regression coefficient, p is the prob-value (based on heteroscedasticity consistent standard error estimates). All empirical models include the number of employees (also included in squares), a complete set of 4-digit industry control variables, and a constant. Reference group in model 2 is made of firms that import one good and from one country, respectively.

Table III: Extensive margins of imports and profitability in German manufacturing firms

			West Germany		East Germany	
Model		year	2009	2010	2009	2010
1	Number of products	ß	0.194	0.022	2.523	-1.069
		p	0.180	0.798	0.192	0.055
2	2 – 5 products	ß	-30.035	49.325	-67.776	111.96
	(Dummy; 1 = yes)	p	0.520	0.084	0.487	0.198
	6 – 10 products	ß	1.038	11.428	3.689	62.922
	(Dummy; 1 = yes)	p	0.977	0.709	0.959	0.461
	11 – 25 products	ß	7.411	21.207	-81.104	72.101
	(Dummy; 1 = yes)	p	0.836	0.505	0.322	0.393
	26 – 49 products	ß	22.865	21.512	-35.225	41.596
	(Dummy; 1 = yes)	p	0.500	0.465	0.725	0.595
	50 + products	ß	10.853	28.055	-53.323	29.302
	(Dummy; 1 = yes)	p	0.757	0.346	0.735	0.757
1	Number of countries	ß	1.156	0.110	8.909	-1.286
		p	0.328	0.806	0.218	0.497
2	2 – 5 countries	ß	36.631	-12.052	-87.706	33.649
	(Dummy; 1 = yes)	p	0.589	0.332	0.244	0.608
	6 – 10 countries	ß	37.389	-16.784	-82.381	21.740
	(Dummy; 1 = yes)	p	0.553	0.327	0.313	0.670
	11 – 25 countries	ß	53.197	-12.181	18.060	41.994
	(Dummy; 1 = yes)	p	0.446	0.283	0.841	0.456
	26 – 49 countries	ß	74.966	-2.800	349.49	-31.079
	(Dummy; 1 = yes)	p	0.357	0.852	0.225	0.726
	50 + countries	ß	47.905	7.467	117.75	21.358
	(Dummy; 1 = yes)	p	0.622	0.845	0.706	0.824

Note: Dependent variable is profitability. ß is the estimated regression coefficient, p is the prob-value (based on heteroscedasticity consistent standard error estimates). All empirical models include the number of employees (also included in squares), a complete set of 4-digit industry control variables, and a constant. Reference group in model 2 is made of firms that import one good and from one country, respectively.