Economic integration, industrial structure, and catch-up growth: Firm-level evidence from Poland*

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Abstract

We examine if and how closer economic integration with high-income nations impacts firm performance. We exploit Poland's accession to the European Union in 2004 as a source of variation in the degree of market integration with Germany. Using data on Polish manufacturing firms in the period 1995-2013, we find that EU accession was followed by significant within-firm growth in output and productivity, notably in industries in which Germany was more specialized at the moment of accession. The deepening of trade and foreign investment linkages in these sectors appears to have played a role in shaping these effects. These results accord with models of trade and growth, in which deeper integration stimulates the flow of knowledge to the less advanced nation, and thereby narrows the productivity gap within industries.

Keywords: Economic integration, industrial structure, knowledge transfer, catch-up growth, firm performance.

JEL Classification: F11; F14; F15; F23; F63; L25; O47

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1 Introduction

Suppose that two nations with different levels of income per capita become more closely integrated. What are the implications for industrial performance in the less developed nation? In the standard Ricardian model of comparative advantage, both countries would gain from the reallocation of productive resources towards the industries in which they are relatively more efficient. In contrast, the literature on trade-induced knowledge transfers emphasizes efficiency gains caused by the flow of more advanced technologies, production processes, or organizational methods to the less developed economy, which contribute to narrow the productivity gap within industries (Grossman and Helpman, 1991; Coe and Helpman, 1995; Coe, Helpman and Hoffmaister, 1997; Goldberg et al., 2010; Bloom, Sadun and Van Reenen, 2012; Alfaro, 2016). If the transferable knowledge and technologies are industry-specific, the less developed country may plausibly observe stronger productivity and output growth in sectors in which the richer nation is relatively more advanced (Coe, Helpman and Hoffmaister, 1997; Romer, 2010).

Despite the prominence of trade and growth models, we have surprisingly little evidence to date on the relevance of this hypothesis and the underlying microeconomic mechanisms. This paper sets out to investigate the extent to which this hypothesis played an important role in driving the patterns of catch-up growth observed in Poland following accession to the European Union in 2004—and the consequent deepening of market integration with Germany. Using detailed data on Polish manufacturing firms during 1995-2013 in a difference-in-differences strategy, we examine if and how the evolution of firm performance in Poland following EU accession was mediated by pre-determined measures of industrial specialization in Germany. If the scope for knowledge transfers was higher in sectors in which Germany was relatively more efficient at the moment of accession, we would expect to observe stronger improvements in performance among Polish firms operating in those sectors.

Poland's integration experience offers several interesting features for this analysis. Following the collapse of the Soviet Union in the late 1980s, a comprehensive reform program enabled the country to transform its socialist-style planned economy into a market economy. Like other post-communist nations, Poland experienced slumps in social and economic standards during this transition. But it became the first post-communist coun-

try to reach its pre-1989 income levels, which it achieved by 1995 following a period of strong economic growth. As integration with the EU deepened around 2004, Poland observed a sharp increase in the degree of openness to international trade. A significant share of this rise was accounted for by the growth of trade flows with its higher-income neighbor, Germany—Europe's major center of high-tech industrial production. At the same time, Poland became a more important destination for Germany's FDI, and experienced a period of remarkable catch-up growth: GDP per capita (in current prices) increased from about 18% of Germany's in 2004 to about 29% in 2013.

The difference-in-differences estimates reveal that Polish manufacturing firms operating in sectors in which Germany was more specialized at the moment of accession experienced stronger output and productivity growth in the post-2004 period. These results remain qualitatively similar across different measures of comparative advantage, including output-based indicators of industrial specialization and measures of relative factor intensity in the sector. Reassuringly, placebo tests using similar measures of industrial specialization for Poland, Russia and other less developed neighbor countries—notably Ukraine and Lithuania—fail to identify systematic links with the evolution of firm performance following EU accession.

Having established that within-firm productivity gains following EU integration were stronger in sectors in which Germany was more specialized at the moment of accession, we proceed by examining if trade and investment linkages appear to have played a role in shaping these differential within-firm responses across sectors. Using a similar identification strategy, we find that manufacturing firms operating in these sectors were more likely to become exporters or foreign-owned during the post-accession period. Taken together, our findings suggest that the mechanisms emphasized by models of trade-induced knowledge transfer played an important role in shaping the patterns of catch-up growth observed in Poland in the post-accession period.

In addition to the work cited above, this paper complements and extends several strands of literature. A number of cross-country studies have identified systematic empirical links between increased openness to trade, knowledge transfer and economic growth of less developed economies (Coe, Helpman and Hoffmaister, 1997; Henry, Kneller and Milner, 2009). The current paper contributes to this literature by providing firm-level evidence on these links, exploiting Poland's accession to the EU as a source of variation

in the degree of integration with a high-income country. In doing so, this paper also relates to recent research using firm-level data to document effects of exports and foreign acquisitions on firm performance, including Van Biesebroeck (2005), De Loecker (2007), Verhoogen (2008), Arnold and Javorcik (2009), Guadalupe, Kuzmina and Thomas (2012), Lileeva and Trefler (2010), Bustos (2011), Bloom, Sadun and Van Reenen (2012), Bastos, Monteiro and Straume (2016), Atkin, Khandelwal and Osman (2017), Bastos, Silva and Verhoogen (2017). In contrast to this strand of literature, we emphasize the role of industry heterogeneity in the advanced economy in driving the impacts of deeper integration on firm performance in the less developed country.

The remainder of the paper proceeds as follows. Section 2 describes the institutional and economic background associated with Poland's accession to the European Union in 2004. Section 3 outlines theoretical mechanisms and presents the empirical strategy. Section 4 describes the data and provides summary statistics. Section 5 reports the main econometric results and examines their robustness. Section 6 conducts placebo tests, while section 7 provides evidence on mechanisms driving the main results. Section 8 concludes the paper.

2 Background

During the Revolutions of 1989, that led to the collapse of the Soviet Union, Poland's government transitioned from communism and the nation adopted a new constitution establishing itself as a democracy. In the early 1990s, a comprehensive reform program enabled Poland to transform its socialist-style planned economy into a market economy. Although Poland suffered slumps in social and economic standards during this transition, it became the first post-communist country to reach its pre-1989 GDP levels, which it achieved by 1995 following a period of strong economic growth.

Poland acceded to the European Union in May 2004. The negotiation process underlying accession began in 1989, when the *Poland and Hungary: Assistance for Restructuring their Economies (PHARE)* was launched to promote convergence with the European Union's extensive legislation and promote Economic and Social Cohesion. In 1991 to prepare for EU membership, Poland first signed the Europe (or association) Agreement. The agreement entered into force in February 1994, after the Polish Parliament had given

its opinion and the ratification procedures had been completed. The Europe Agreement consolidated concessions previously granted and made provision for the progressive establishment of a free trade area over 10 years and for the gradual abolition during the same period of customs duties between the EU and Poland.

In June 1993 at the European Council meeting the European Community leaders explicitly endorsed the future accession of Poland conditional on the fulfillment of three conditions (known as the Copenhagen criteria, or membership criteria): the achievement of stable institutions that guarantee democracy, legality, human rights and respect of minorities, a working market economy, and the acceptance of all the membership responsibilities, political, economic and monetary.

The EU supported Poland to adopt the Community's rules through a pre-accession strategy that covered all aspects of alignment with the European Union, such as progressive integration with the EU single market, the development of infrastructure in the context of the trans-European networks, the promotion of inter-regional cooperation and cooperation on environmental matters. The European Union also gave Poland financial assistance for developing its institutions, infrastructure and economy.

On 30 March 1998 the accession process was formally launched and the negotiations started. The priorities and the specific support Poland required were defined in the accession partnerships adopted in 1998 and revised in 1999 and 2002. These documents were the basis for sector-by-sector evaluation to establish a roadmap that specified the legislation needed to be adopted or amended. Poland concluded the accession negotiations in December 2002 and the Copenhagen European Council was declared among the 10 candidate countries (others were: Cyprus, Estonia, Hungary, the Czech Republic, Slovenia, Latvia, Lithuania, Malta and Slovakia) that fulfilled the conditions necessary for joining the EU. Poland signed the Accession Treaty on 16 April 2003 in Athens and officially joined the EU on 1 May 2004 after the ratification procedures were completed.

[Insert Figures 1 and 2]

As integration with the EU deepened around 2004, Poland observed a sharp rise in the degree of openness to trade (see Figure 1). A significant proportion of this increase was accounted for by the growth of trade flows with Germany—Poland's high-income neighbor

and main trade partner, and Europe's major center of high-tech industrial production. Following accession, Poland further became a more important destination for German FDI (Figure 2). At the same time, the country experienced a remarkable period of catch-up growth: Poland's income per capita (in current prices) increased from about 18% of that of Germany in 2004 to about 29% in 2013. Similar patterns of catch-up growth were observed relative to the EU-15: GDP per capita in Poland was about 20% of that of the EU-15 in 2004 and it reached about 33% in 2013 (see Figure 3).[1]

[Insert Figure 3]

3 Theoretical motivation and empirical strategy

Models of trade and growth identify several channels by which deeper economic integration between countries with different levels of income per capita may influence productivity growth in the less developed economy (Grossman and Helpman, 1991; Coe, Helpman and Hoffmaister, 1997; Goldberg et al., 2010). First, international trade makes available to firms in the poorer country a larger variety of intermediate inputs and capital equipment. Second, trade and foreign direct investment offer channels of communication that stimulate the flow of better production and organizational methods, product design, and market conditions to the less developed country. Third, a broader set of international contacts make it possible for the less developed country to imitate technologies and adjustment to domestic use. Finally, deeper integration with a more advanced economy can lead to productivity gains in the development of new technologies or in the imitation of foreign technologies, thereby raising total factor productivity.

By integrating with a nation that is closer to the technology frontier, a less developed country stands to gain more—with regard to the products it can import and the direct knowledge it can acquire—than it would by integrating with a less advanced country. If the transferable inputs and knowledge are industry-specific, these gains would be

[1]Prior the 2004 enlargement, the EU was composed of the following 15 member states: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

stronger in sectors in which the stock of transferable knowledge of the advanced economy is relatively larger (Romer, 2010). To examine this hypothesis, we adopt the following econometric specification:

$$\log Y_{ijt} = \alpha Post_t + \beta Post_t * S_j + \gamma_i + \eta_t + \varepsilon_{ijt} \tag{1}$$

where Y_{ijt} is a measure of performance of firm i in sector j in year t; $Post_t$ is a dummy variable that takes value 1 for the post-accession period (i.e. from 2005 to 2014); and the variable S_j is a measure of Germany's specialization in sector j measured in the pre-accession period.

The main coefficient of interest is β which corresponds to the interaction between the post-accession dummy and the pre-determined sector-level measure of Germany's comparative advantage. Equation (1) can be viewed as a difference-in-differences specification, in which all firms are treated after EU accession, but with a different intensity of treatment given by their industry's exposure to Germany's stock of knowledge. The standard errors are clustered at the sector level. For robustness, we will consider several alternative specifications.

4 Data and summary statistics

The empirical analysis uses data from the F01 data set, a census of firms operating in Poland with more than 10 employees for the period 1995-2013. The F01 data set contains information on a set of firm attributes, including employment, wages, capital stock, export and foreign ownership status and industry affiliation. Unique firm identifiers make it possible to follow firms over time. As is customary in the empirical trade literature, the analysis excludes the "coke and refined petroleum" sector because of highly volatile data. The data set has an unbalanced structure and comprises information on 18,465 manufacturing firms with more than 10 employees. Data for the period 2000-2002 are available only for firms with more than 50 employees, and hence are excluded from the main analysis.

In the econometric analysis, we consider three different measures of firm performance: total factor productivity (TFP), revenue and employment. TFP is measured using the Levinsohn and Petrin (2003) methodology, in which total expenditure on material inputs

is used as a proxy to unobservable productivity shocks. In order to allow for differences in technologies across sectors, different production functions were estimated for each 2-digit sector. As emphasized by de Loecker and Goldberg (2014), this is a commonly used measure of revenue-based TFP which also reflects changes in markups, the product mix and product quality.[2]

[Insert Table 1 here]

Table 1 reports summary statistics on each of these variables. The statistics in column (1) reveal that manufacturing firms in the estimation sample employed on average about 169 workers during the period 1995-2013. The statistics in columns (2) and (3) also show that average firm size declined in the post-accession period, from about 219 employees in 1995-2004 to 147 employees in 2005-2013. By contrast, TFP and revenues are higher, on average, in the post-2004 period. Column (1) further reveals that about 67% of firms were exporters during the sample period and 18% were owned by foreign investors. Columns (2) and (3) reveal that these proportions are moderately higher in the post-accession period.

[Insert Table 2 here]

Table 2 reports summary statistics on the same variables for each manufacturing sector over the period 1995-2013. The statistics in this table reveal that the measures of firm performance vary substantially across manufacturing industries. Firm-level TFP tends to be higher, on average, in the sectors "Motor vehicles, other transport", "Electrical, communications, medical", and "Pulp, paper and printing". The former two sectors are also characterized by a relatively high average firm size, both in terms of employment and revenue. They are also sectors with a relatively high share of exporters and, especially, foreign-owned firms.

To implement equation (1), we consider different measures of Germany's comparative advantage. In the main analysis, we consider two different output-based measures of

[2] Applications of this method in an international trade context include Pavcnik (2002), Amiti and Konings (2007), Fernandes (2007) and Topalova and Khandelwal (2011).

industrial specialization: (i) the share of each industry in total exports; and (ii) the share of each industry in total manufacturing output. In the context of the neoclassical trade model, these measures have the advantage of allowing for both differing technologies and differing factor supplies as drivers of international specialization (Harrigan, 1997; Redding, 2002). For robustness, we further consider input-based measures of relative factor intensity in each sector, notably average wages, capital stock, and capital stock per worker. Since Germany has relatively large supplies of skilled labor and capital, it would be expected to have a comparative advantage in the sectors that use these factors more intensively (Levchenko, 2007; Debaere, 2014). Industries that are intensive in skilled labor and capital would also be expected to have larger stocks of knowledge, which might be potentially shared with Polish firms through trade and investment linkages. To mitigate concerns about endogeneity, all these measures are constructed using data for Poland's pre-accession period. For example, data on Germany's pre-accession exports and output by sector refer to the averages over the period 1994-2004. To conduct placebo tests, we further collected data on output-based measures for Poland itself, Russia and other neighbor countries, notably Ukraine and Lithuania. Data on the various measures of comparative advantage are obtained from Eurostat, OECD and UNIDO. The Appendix reports summary statistics on the main measures.

5 Main Results

Table 3 reports the point estimates yielded by equation (1), using Germany's initial export and output shares in the sector during 1994-2004 as measures of comparative advantage. The specifications in columns (1) and (2) consider differential effects of accession on TFP. Those reported in columns (3) and (4) consider effects on revenue. Finally, the estimates in columns (5) and (6) estimate effects on employment. The point estimates reveal that Polish manufacturing firms operating in sectors where Germany was more specialized at the moment of accession experienced significantly higher TFP and revenue growth in the post-2004 period. The point estimates on employment are also positive, but imprecisely estimated when using the export share as a measure of initial industrial specialization in Germany.

[Insert Table 3 here]

We proceed by assessing the robustness of the main results to alternative sub-samples and econometric specifications. In Table 4, we use the industry's export share to measure Germany's industrial specialization at the moment of accession. Since EU accession was pre-announced, some of its impacts might be expected to start materializing before 2004. To account for this possibility, in column (1) we exclude from the sample the years 2000-2004, thereby examining the differential evolution of firm performance across sectors between 1995-1999 and 2004-2013. Reassuringly, the point estimates for TFP and revenue remain very similar to those reported in Table 3 (slightly larger).

As noted above, for the years 2000 to 2002 the F01 data set include only firms with more than 50 employees. For this reason, data for these years were excluded from the main estimation sample. For robustness, the estimation sample used in column (2) of Table 4 includes these three years, but considers only firms with more than 50 employees. Reassuringly, the estimates remain qualitatively and quantitatively very similar to those in Table 3. Using this restricted sample, Figure 4 provides further evidence on how the evolution of firm TFP was mediated by Germany's industrial specialization pattern at the moment of accession. The diagram in Panel A plots the coefficient of the interaction term between Germany's export share and a full set of year fixed effects. In turn, the diagram in Panel B plots the coefficient of the interaction term between Germany's output share and these year effects. The visual evidence points to a clear positive relationship between each measure of industrial specialization in Germany and the evolution of firm TFP in Poland in each year of the the post-accession period. Furthermore, the figure suggests that the estimates in Table 3 are not driven by pre-trends: the surge in TFP in these sectors coincided with EU accession and persisted throughout the post-accession period.[3]

[Insert Figure 4 here]

The baseline estimates are based on an unbalanced panel including all firms above 10 employees, irrespective of the year in which they were first observed in the data set. The baseline results might therefore partially reflect differential patterns of entry and exit

[3] As noted above, the sample used in these regressions includes only firms with more than 50 employees, thereby allowing us to cover all years in the sample period.

of firms across sectors, as opposed to within-firm improvements in size and efficiency of firms that were already operating prior to EU accession. To account for this possibility, the estimates in column (3) excludes from the estimation sample firms that are only observed in the post-2004 period, while those in column (4) exclude firms that switched sector over the sample period. Once again, the point estimates remain very similar when imposing these restrictions.

[Insert Table 4 here]

In the baseline analysis, Germany's pre-determined export shares were measured in the period 1994-2004. If Germany's specialization patterns changed considerably over this period, one may worry about the extent to which they are an appropriate measure of industrial specialization at the moment of accession. To account for this concern, the estimates in column (5) use Germany's export shares measured in the period 2000-2004. Reassuringly, the baseline estimates remain robust when considering this alternative specification.

During the period of analysis, the Polish food and chemicals industries were subject to significant changes in the regulatory environment, which might have direct effects on firm performance. In column (6), we examine the extent to which the baseline results are sensitive to the exclusion of firms operating in these sectors. In column (7) we account for tariff changes, which might also be expected to have direct effects on firm performance. Finally, in column (8) we exclude firms from the food and chemicals sector and control for tariffs. Once again the results show that the baseline estimates are robust across these various sub-samples and econometric specifications.

In Table 5 we conduct similar robustness checks, but now using output shares instead of export shares to measure the extent of industrial specialization in Germany in the pre-accession period. Reassuringly, the baseline estimates for TFP and revenue remain robust across these various specifications. The effects on employment, which were positive and statistically significant in column (6) of Table 3, remain positive but are not statistically significantly different from zero.

[Insert Table 5 here]

As a further robustness check, in Table 6 we consider pre-determined input-based measures of comparative advantage in Germany. In particular, we consider measures of relative factor intensity in each sector, notably average wages, capital stock, and capital stock per worker. Since Germany has relatively large supplies of skilled labor and capital, it would be expected to have a comparative advantage in the sectors that use these factors more intensively (Levchenko, 2007; Debaere, 2014). The results in Table 6 reveal that our main findings are generally robust across these various alternative measures. In particular, they provide evidence that TFP and revenue growth among Polish firms following EU accession was significantly stronger in German sectors characterized by higher average wages and capital stock at the moment of accession. We also find positive and significant effects on employment when using these alternative measures.

[Insert Table 6 here]

6 Placebo tests

In the analysis so far, we have examined the extent to which the evolution of firm performance in Poland following EU accession was mediated by pre-determined measures of comparative advantage in Germany. If these time-invariant measures are systematically correlated with other drivers of firms performance in Poland, our interpretation of the econometric results might be challenged. In particular, we worry that the differential evolution of firm performance across sectors following EU accession reflects, at least in part, Poland's comparative advantage (as opposed to Germany's). To explore this possibility, in columns (1) and (2) of Table 7, we examine the extent to which the evolution of firm performance in the post-2004 period was mediated by Poland's initial export shares across sectors. Reassuringly, the results in column (1) do not show a significant relationship between Poland's export shares and firm performance in the post-accession period. In column (2), we include simultaneously the pre-determined export shares for Poland and Germany. The results reveal that Germany's initial export share in the sector is a significant predictor or the evolution of firm TFP and revenue in the post-2004 period, while that of Poland is not.

[Insert Table 7 here]

In columns (3)-(8), we further assess the validity of our interpretation of the econometric results by conducting a set of placebo tests for Russia and two other neighboring countries: Lithuania and Ukraine. Since EU accession did not entail deeper integration with Russia and Ukraine, we would not expect to observe systematic positive effects on firm performance. Lithuania also joined the EU in 2004, but unlike Germany did not have significantly higher levels of income per capita. The econometric results suggest that the export shares for these countries do not have a systematic positive effect on the dynamics of firm performance in Poland after accession to the EU. In Table 8 we conduct a similar set of placebo tests using initial output shares, instead of export shares. The results are qualitatively similar. We interpret this evidence as providing further support to the hypothesis that deeper integration with Germany following EU accession was an important driver of firm performance in the post-accession period. Taken together, these results reported above are consistent with theories of trade-induced knowledge transfer.

[Insert Table 8 here]

7 Mechanisms

As discussed above, models of trade and growth suggest that foreign trade and investment provide important channels of communication by which inputs and knowledge can be transferred between nations. If the transferable inputs and knowledge are industry-specific, these gains would be stronger in sectors in which the stock of transferable knowledge of the advanced economy is relatively larger. Although the data available to us do not make it possible to examine empirically the full set of mechanisms emphasized by these models, they allow us to examine if EU integration had differential effects on the export and foreign-ownership status of Polish firms across sectors.

[Insert Tables 9 and 10 here]

In Tables 9 and 10 we examine if the various pre-determined measures of Germany's comparative advantage are associated with increased export participation and foreign ownership among Polish manufacturing firms in the post-accession period. The points estimates are positive across all measures, and statistically significant in 7 out of 10 specifications considered. The results in these tables therefore provide evidence that manufacturing firms operating in sectors in which Germany had a stronger comparative advantage at the moment of accession were more likely to become exporters or foreign owned in the post-accession period. When seen in conjunction with the estimates reported in the previous sections, these findings suggest that the deepening of trade and investment linkages in these sectors appear to have played a role in explaining the differential evolution of firm performance in Poland following EU accession.[4]

8 Concluding remarks

The belief that closer integration with high-income markets can help firms in less developed countries to reduce efficiency gaps is a key argument for pursuing deeper international economic integration. Prominent models of trade and growth emphasize efficiency gains caused by the flow of more advanced technologies, production processes, or organizational methods to the less developed economy, which contribute to narrow the productivity gap within industries. If the transferable knowledge and technologies are industry-specific, the less developed country may plausibly observe stronger productivity and output growth in sectors in which the richer nation is relatively more advanced.

Despite the prominence of trade and growth models, there is still surprisingly little evidence on the relevance of this hypothesis and the underlying microeconomic mechanisms. In this paper we have exploited Poland's accession to the European Union in

[4]This hypothesis is further supported by anecdotal evidence that we gathered through interviews to foreign and domestic firms from the automotive sector in the region of Gliwice. The region is currently cluster for the automotive sector, in which GM Opel operates and where domestic suppliers are located. In the auto sector–in which Germany's firms are world leaders–increased trade and investment linkages with Poland were reported to have facilitated knowledge transfers and to improve the performance of domestic firms. When GM Opel first start operating in Gliwice's special economic zone it created a reaction through the whole supply chain. The zone has now about 80 plants, many of which are supplying to GM Opel, but also to other carmakers in Poland and abroad. By becoming accredited suppliers of GM Opel domestic firms helped domestic firms in two ways. First, they received training and supervision by GM Opel. Second, they acquired the reputation of supplying high-quality products which improved their prospects with other clients as well.

2004 as a source of variation in the degree of market integration with Germany–Poland's high-income neighbor and Europe's major center of high-tech industrial production. We have used firm-level panel data in a difference-in-differences strategy to examine whether and how the evolution firm performance in Poland following EU accession was mediated by measures of industrial specialization in Germany in the pre-accession period.

The econometric results provide evidence that EU accession was followed by significant within-firm growth in scale and efficiency, especially in industries in which Germany was more specialized at the moment of accession. The deepening of trade and foreign investment linkages appears to have played a role in shaping these effects. These findings accord well with theories of trade-induced knowledge transfer.

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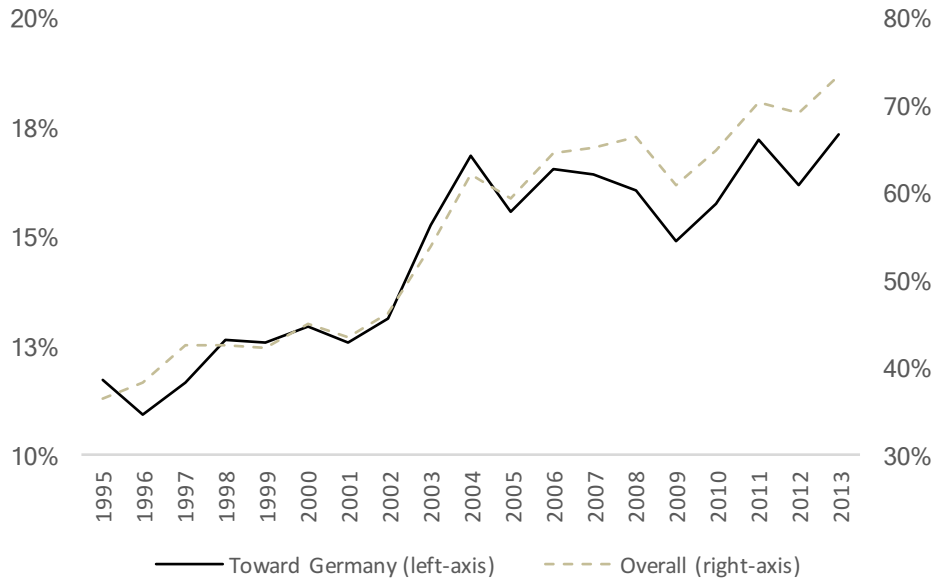
Appendix

A. Export and output shares, 1994-2004

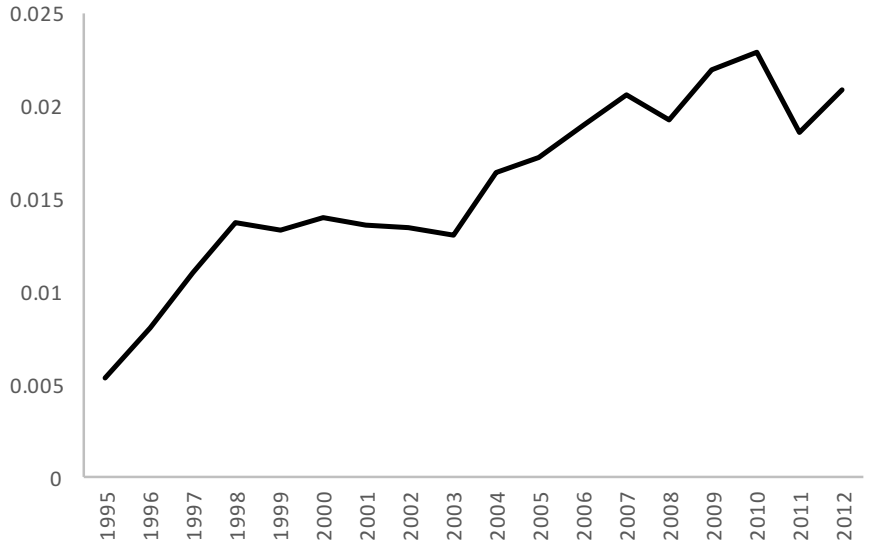
[Insert Tables A1 and A2 here]

Figure 1: Poland's trade openness, 1995-2013



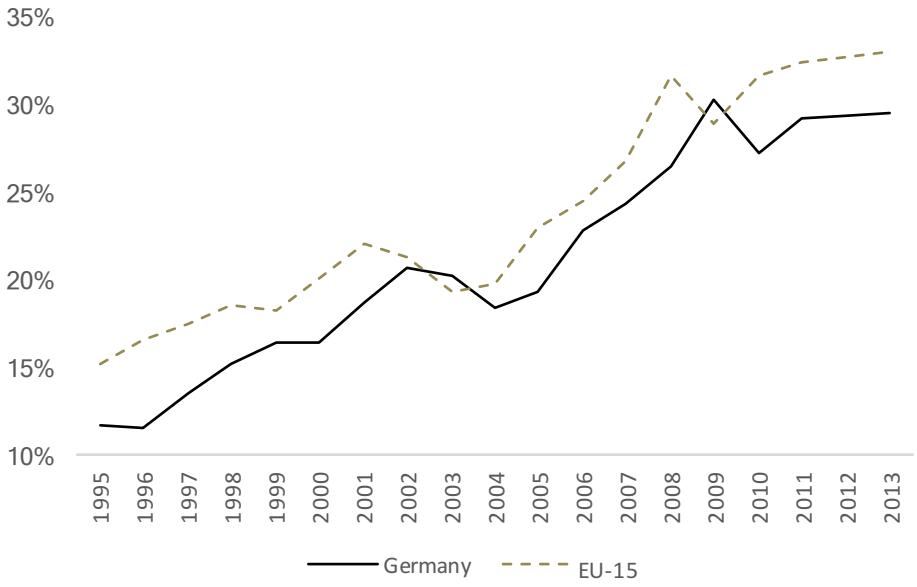
Notes: The figure depicts the evolution of Poland's degree of trade openness relative to the world (defined as the sum of multilateral exports and imports over GDP) and relative to Germany (defined as the sum of bilateral exports and imports with Germany over GDP). The sources of the data are UN COMTRADE and the World Development Indicators of the World Bank.

Figure 2: Germany's outward FDI position toward Poland, 1995-2012



Notes: The figure depicts the share of Poland in Germany's total outward foreign direct investment in the years 1995 to 2012. The source of the data is the OECD.

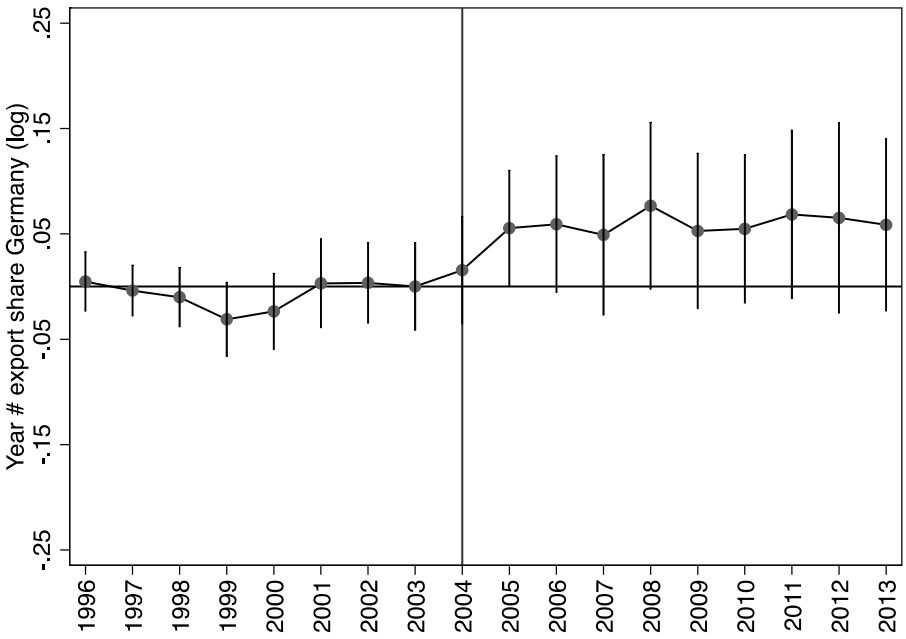
Figure 3: Poland's GDP per capita relative to Germany and the EU-15



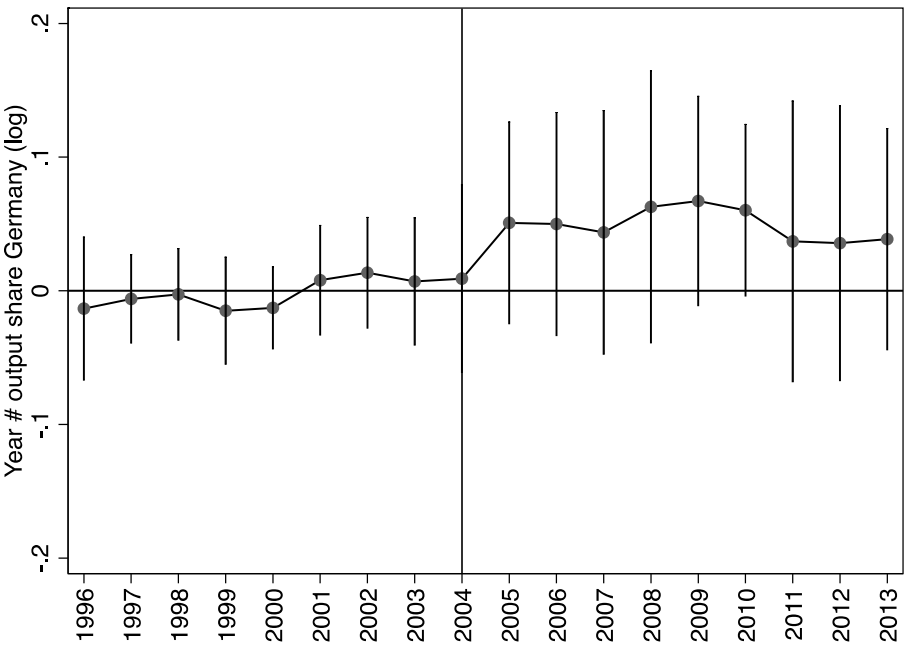
Notes: The figure depicts the evolution of Poland's GDP per capita (in current prices) as a share of that of Germany and the EU-15. The source of the data is the EU AMECO database.

Figure 4: Differential evolution of firm TFP across sectors

Panel A: Germany's initial export share



Panel B: Germany's initial output share



Notes: The figure depicts the differential evolution of Total Factor Productivity among Polish firms across sectors, depending on Germany's initial export share (Panel A) and output share (Panel B). Estimates are based on sample of firms with more than 50 employees.

Table 1: Summary statistics, estimation sample, 1995-2013

	1995-2013	1995-2004	2005-2013
TFP (log)	4.485	4.311	4.563
	(1.017)	(1.000)	(1.015)
Employment	169.316	219.109	147.251
	(381.35)	(468.777)	(333.031)
Revenues (in 000)	55.673	44.245	60.736
	(280.926)	(198.18)	(310.489)
Export participation	0.673	0.655	0.681
	(0.469)	(0.475)	(0.466)
Share of foreign owned	0.182	0.161	0.191
	(0.386)	(0.368)	(0.393)
N (obs.)	140,302	43,070	97,221
N (firms)	18,465	13,776	15,684

Notes: The table reports the mean and standard deviation (in parentheses) for variables in the sample of manufacturing firms with more than 10 employees over the period 1995-2013 (except 2000-2002). A firm is foreign owned if foreign investors hold at least 50% of capital. Monetary variables are in 2010 prices.

Table 2: Summary statistics, estimation sample by sector, 1995-2013

Sector	TFP	Employment	Revenues	Exporters share	Foreign Share	N (obs.)	N (firms)
Food and beverages	3.865	151.866	64.439	0.466	0.105	25,841	3,592
	(0.847)	(287.204)	(205.281)	(0.499)	(0.307)		
Tobacco	2.743	829.116	1174.163	0.833	0.5	138	14
	(0.958)	(871.017)	(1391.239)	(0.374)	(0.502)		
Textile, wearing apparel and leather	3.974	157.637	16.212	0.764	0.188	13,782	1,867
	(0.922)	(235.768)	(42.777)	(0.424)	(0.391)		
Wood	3.626	127.085	29.272	0.785	0.152	7,150	1,034
	(0.691)	(195.2)	(110.173)	(0.411)	(0.359)		
Pulp, paper and printing	5.313	116.178	42.833	0.613	0.171	6,686	916
	(0.884)	(206.713)	(147.089)	(0.487)	(0.376)		
Chemicals	4.684	258.429	119.735	0.776	0.244	5,472	687
	(0.886)	(559.629)	(316.885)	(0.417)	(0.43)		
Rubber and plastic	4.066	122.512	38.165	0.778	0.231	11,774	1,622
	(0.708)	(266.831)	(130.317)	(0.416)	(0.421)		
Non-metallic mineral products	4.456	172.164	48.617	0.549	0.197	8,300	1,114
	(0.856)	(298.299)	(108.157)	(0.498)	(0.398)		
Basics and fabricated metals	4.64	141.681	43.103	0.717	0.187	21,419	3,000
	(0.78)	(374.529)	(264.849)	(0.45)	(0.39)		
Machinery and equipment	5.009	152.354	43.198	0.668	0.143	12,704	1,707
	(0.791)	(326.021)	(256.078)	(0.471)	(0.35)		
Electrical, communication and medical equipment	5.227	202.276	71.201	0.709	0.231	9,619	1,262
	(0.949)	(424.024)	(379.659)	(0.454)	(0.421)		
Motor vehicles and other transport equipmment	5.419	354	152.26	0.783	0.288	8,348	1,056
	(0.989)	(806.788)	(728.611)	(0.412)	(0.453)		
Other	4.612	202.387	39.12	0.83	0.196	8,004	1,150
	(0.874)	(442.729)	(153.547)	(0.376)	(0.397)		

Notes: The table reports the mean and standard deviation (in parentheses) for variables in the sample of manufacturing firms with more than 10 employees over the period 1995-2013 (except 2000-2002) by sector. A firm is foreign-owned if foreign investors hold at least 50% of capital. Monetary variables are in 2010 prices.

Table 3: Baseline estimates

Dep. variable:	log TFP		log revenue		log employment	
	(1)	(2)	(3)	(4)	(5)	(6)
Post*Germany's initial export share (log)	0.053***		0.084**		0.030	
	(0.017)		(0.031)		(0.023)	
Post*Germany's initial output share (log)		0.046**		0.095**		0.062**
		(0.020)		(0.040)		(0.026)
N (obs.)	140,302	140,302	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465	18,465	18,465	18,465
R-squared	0.058	0.057	0.11	0.111	0.076	0.079

Notes: All regressions include firm and year fixed effects. Germany's exports and output shares are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 4: Robustness across sub-samples and set of controls, export share

	excluding 2000-2004	only firms with empl. above 50	only firms born before 2004	germany export share for 2000-2004	excl. firms that switch sector	excl. food and chemicals	control for tariffs	excl. food and chemicals and control for tariffs
A. Dep. variable: log TFP	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post*Germany's initial export share (log)	0.065**	0.050*	0.054***	0.054***	0.055***	0.070***	0.052***	0.069***
	(0.024)	(0.024)	(0.017)	(0.018)	(0.019)	(0.009)	(0.017)	(0.009)
Tariffs							0.003	0.032
							(0.007)	(0.024)
N (obs.)	116,185	105,498	116,476	140,302	132,444	109,184	137,536	107,044
N (firms)	16,696	11,718	13,794	18,465	17,734	14,308	18,461	14,304
R-squared	0.093	0.103	0.063	0.058	0.058	0.068	0.050	0.060
B. Dep. variable: log revenue								
Post*Germany's initial export share (log)	0.094*	0.086**	0.084**	0.088**	0.085**	0.101***	0.084**	0.100***
	(0.051)	(0.037)	(0.031)	(0.032)	(0.033)	(0.032)	(0.031)	(0.030)
Tariffs							0.015	0.127***
							(0.013)	(0.038)
N (obs.)	116,185	105,498	116,476	140,302	132,444	109,184	137,536	107,044
N (firms)	16,696	11,718	13,794	18,465	17,734	14,308	18,461	14,304
R-squared	0.204	0.210	0.113	0.111	0.106	0.120	0.107	0.117
C. Dep. variable: log employment								
Post*Germany's initial export share (log)	0.019	0.020	0.030	0.033	0.034	0.030	0.032	0.033
	(0.039)	(0.028)	(0.023)	(0.024)	(0.024)	(0.024)	(0.022)	(0.023)
Tariffs							-0.021*	0.067
							(0.011)	(0.040)
N (obs.)	116,185	105,498	116,476	140,302	132,444	109,184	137,536	107,044
N (firms)	16,696	11,718	13,794	18,465	17,734	14,308	18,461	14,304
R-squared	0.104	0.214	0.113	0.111	0.106	0.120	0.107	0.117

Notes: All regressions include firm and year fixed effects. Germany's export shares are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 5: Robustness across sub-samples and set of controls, output share

A. Dep. variable: log TFP	excluding 2000-2004 (1)	only firms with empl. above 50 (2)	only firms born before 2004 (3)	Germany export share for 2000-2004 (4)	excl. firms that switch sector (5)	excl. food and chemicals (6)	control for tariffs (7)	excl. food and chemicals and control for tariffs (8)
Post*Germany's initial output share (log)	0.056**	0.030	0.046**	0.046**	0.048**	0.076***	0.048**	0.075***
	(0.024)	(0.031)	(0.020)	(0.018)	(0.020)	(0.009)	(0.019)	(0.009)
Tariffs							0.012	0.020
							(0.009)	(0.023)
N (obs.)	116,185	105,498	116,476	140,302	132,444	109,184	137,536	107,044
N (firms)	16,696	11,718	13,794	18,465	17,734	14,308	18,461	14,304
R-squared	0.092	0.102	0.062	0.058	0.057	0.068	0.050	0.060
B. Dep. variable: log revenue								
Post*Germany's initial output share (log)	0.128**	0.098**	0.096**	0.094**	0.096**	0.144***	0.102***	0.141***
	(0.054)	(0.045)	(0.040)	(0.037)	(0.040)	(0.033)	(0.036)	(0.030)
Tariffs							0.034***	0.101***
							(0.012)	(0.031)
N (obs.)	116,185	105,498	116,476	140,302	132,444	109,184	137,536	107,044
N (firms)	16,696	11,718	13,794	18,465	17,734	14,308	18,461	14,304
R-squared	0.206	0.213	0.114	0.112	0.107	0.124	0.109	0.122
C. Dep. variable: log employment								
Post*Germany's initial output share (log)	0.019	0.020	0.030	0.033	0.034	0.030	0.032	0.033
	(0.039)	(0.028)	(0.023)	(0.024)	(0.024)	(0.024)	(0.022)	(0.023)
Tariffs							-0.021*	0.067
							(0.011)	(0.040)
N (obs.)	116,185	105,498	116,476	140,302	132,444	109,184	137,536	107,044
N (firms)	16,696	11,718	13,794	18,465	17,734	14,308	18,461	14,304
R-squared	0.108	0.215	0.114	0.112	0.107	0.124	0.109	0.122

Notes: All regressions include firm and year fixed effects. Germany's output shares are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 6: Robustness, input-based measures

A. Dep. variable: log TFP	(1)	(2)	(3)
Post*Germany's initial average wages (log)	0.058***		
	(0.013)		
Post*Germany's initial capital per worker (log)		0.025	
		(0.045)	
Post*Germany's initial capital stock (log)			0.037**
			(0.014)
N (obs.)	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465
R-squared	0.058	0.056	0.057
B. Dep. variable: log revenue			
Post*Germany's initial average wages (log)	0.118***		
	(0.027)		
Post*Germany's initial capital per worker (log)		0.149*	
		(0.081)	
Post*Germany's initial capital stock (log)			0.093***
			(0.025)
N (obs.)	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465
R-squared	0.115	0.109	0.114
C. Dep. variable: log employment			
Post*Germany's initial average wages (log)	0.065**		
	(0.028)		
Post*Germany's initial capital per worker (log)		0.123**	
		(0.048)	
Post*Germany's initial capital stock (log)			0.062***
			(0.017)
N (obs.)	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465
R-squared	0.079	0.079	0.081

Notes: All regressions include firm and year fixed effects. Germany's output shares are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 7: Placebo test: initial export share for Poland, Russia, Ukraine and Lithuania

	Poland		Russia		Ukraine		Lithuania	
A. Dep. variable: log TFP	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post*country's initial export share (log)	0.021	-0.023	0.016	-0.022	-0.004	-0.039***	-0.022	-0.039***
	(0.030)	(0.022)	(0.026)	(0.025)	(0.015)	(0.011)	(0.017)	(0.014)
Post*Germany's initial export share (log)		0.061***		0.065***		0.079***		0.062***
		(0.020)		(0.015)		(0.013)		(0.014)
N (obs.)	140,302	140,302	140,302	140,302	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465	18,465	18,465	18,465	18,465	18,465
R-squared	0.057	0.059	0.057	0.057	0.057	0.059	0.057	0.059
B. Dep. Variable: log revenue								
Post*country's initial export share (log)	0.020	-0.053	0.050	0.001	-0.004	-0.059***	-0.061	-0.089***
	(0.047)	(0.044)	(0.047)	(0.040)	(0.021)	(0.019)	(0.037)	(0.031)
Post*Germany's initial export share (log)		0.102**		0.083***		0.122***		0.105***
		(0.038)		(0.022)		(0.033)		(0.030)
N (obs.)	140,302	140,302	140,302	140,302	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465	18,465	18,465	18,465	18,465	18,465
R-squared	0.106	0.111	0.107	0.110	0.106	0.113	0.108	0.115
C. Dep. variable: log employment								
Post*country's initial export share (log)	0.022	0.001	0.032	0.021	-0.002	-0.022	-0.028	-0.039
	(0.022)	(0.034)	(0.033)	(0.035)	(0.015)	(0.022)	(0.028)	(0.030)
Post*Germany's initial export share (log)		0.030		0.019		0.045		0.039
		(0.031)		(0.022)		(0.029)		(0.027)
N (obs.)	140,302	140,302	140,302	140,302	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465	18,465	18,465	18,465	18,465	18,465
R-squared	0.076	0.076	0.076	0.077	0.076	0.077	0.076	0.078

Notes: All regressions include firm and year fixed effects. Revealed comparative advantage indicators are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 8: Placebo test: initial output share for Russia, Ukraine, Lithuania and Poland

	Poland		Russia		Ukraine		Lithuania	
A. Dep. variable: log TFP	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post*country's initial output share (log)	0.000	-0.094***	0.006	-0.063***	0.003	-0.055***	-0.031*	-0.041***
	(0.019)	(0.016)	(0.018)	(0.017)	(0.015)	(0.014)	(0.016)	(0.011)
Post*Germany's initial output share (log)		0.112***		0.105***		0.101***		0.057***
		(0.017)		(0.020)		(0.020)		(0.012)
N (obs.)	140,302	140,302	138,768	138,768	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,269	18,269	18,465	18,465	18,465	18,465
R-squared	0.057	0.060	0.057	0.060	0.057	0.059	0.058	0.059
B. Dep. variable: log revenue								
Post*country's initial output share (log)	0.023	-0.140***	0.024	-0.100***	0.017	-0.090***	-0.048**	-0.068***
	(0.050)	(0.024)	(0.039)	(0.033)	(0.032)	(0.025)	(0.021)	(0.017)
Post*Germany's initial output share (log)		0.194***		0.187***		0.184***		0.113***
		(0.042)		(0.046)		(0.044)		(0.028)
N (obs.)	140,302	140,302	138,768	138,768	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,269	18,269	18,465	18,465	18,465	18,465
R-squared	0.106	0.116	0.107	0.116	0.106	0.115	0.108	0.116
C. Dep. variable: log employment								
Post*country's initial output share (log)	0.045	-0.018	0.025	-0.038*	0.019	-0.040**	-0.006	-0.018
	(0.028)	(0.025)	(0.021)	(0.018)	(0.018)	(0.018)	(0.015)	(0.012)
Post*Germany's initial output share (log)		0.074*		0.096**		0.101**		0.067**
		(0.040)		(0.037)		(0.036)		(0.027)
N (obs.)	140,302	140,302	138,768	138,768	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,269	18,269	18,465	18,465	18,465	18,465
R-squared	0.077	0.079	0.075	0.078	0.076	0.080	0.076	0.080

Notes: All regressions include firm and year fixed-effects. Revealed comparative advantage indicators are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 9: Effects on export participation

Dep. variable: Export participation					
	(1)	(2)	(3)	(4)	(5)
Post*Germany's initial export share (log)	0.011				
	(0.010)				
Post*Germany's initial output share (log)		0.033**			
		(0.014)			
Post*Germany's initial average wages (log)			0.024*		
			(0.012)		
Post*Germany's initial capital per worker (log)				0.045**	
				(0.020)	
Post*Germany's initial capital stock (log)					0.027***
					(0.009)
N (obs.)	140,302	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465	18,465	18,465
R-squared	0.005	0.007	0.006	0.006	0.007

Notes: All regressions include firm and year fixed effects. Germany's revealed comparative advantage indicators are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table 10: Effects on foreign-ownership status

Dep. variable: foreign ownership					
	(1)	(2)	(3)	(4)	(5)
Post*Germany's initial export share (log)	0.008				
	(0.005)				
Post*Germany's initial output share (log)		0.010*			
		(0.005)			
Post*Germany's initial average wages (log)			0.009		
			(0.006)		
Post*Germany's initial capital per worker (log)				0.026**	
				(0.009)	
Post*Germany's initial capital stock (log)					0.009*
					(0.005)
N (obs.)	140,302	140,302	140,302	140,302	140,302
N (firms)	18,465	18,465	18,465	18,465	18,465
R-squared	0.007	0.007	0.007	0.008	0.008

Notes: All regressions include firm and year fixed effects. Germany's revealed comparative advantage indicators are measured in the period 1994-2004. Standard errors in parentheses clustered at industry level. *10% level, **5% level, and ***1% level.

Table A1: Export shares by country, 1994-2004

Sector code	Description	Germany	Russia	Ukraine	Lithuania	Poland
15	Food products, Beverages	3.97	2.58	10.25	11.84	8.28
16	Tobacco	0.30	0.09	0.32	0.55	0.17
17	Textile	2.42	0.77	0.85	7.18	2.96
18	Leather	1.26	0.52	2.82	9.73	6.24
19	Footwear	0.50	0.24	1.04	0.99	1.34
20	Wood and Products of Wood and Cork	0.62	2.68	1.07	4.92	3.58
21	Paper	2.32	2.94	1.30	1.15	2.88
22	Printing and publishing	1.05	0.95	0.20	0.43	0.69
23	Coke, Refined Petroleum Products and Nuclear Fuel	1.26	22.15	5.81	18.33	2.31
24	Chemicals and Chemical Products	13.43	11.74	11.56	9.41	6.91
25	Rubber and Plastics Products	3.52	0.84	1.55	2.40	3.90
26	Other Non-Metallic Mineral Products	1.49	0.76	1.39	1.50	2.76
27	Basic Metals	4.88	33.52	41.64	1.57	8.07
28	Fabricated Metal Products	3.37	2.05	2.51	1.95	6.04
29	Machinery and Equipment, not elsewhere classified	16.36	4.11	6.59	4.30	7.22
30	Office, Accounting and Computing Machinery	2.82	0.16	0.23	0.60	0.28
31	Electrical Machinery and Apparatus, not elsewhere classified	5.42	1.44	2.69	2.78	5.85
32	Radio, Television and Communication Equipment	4.92	0.68	0.67	4.50	3.80
33	Medical, Precision and Optical Instruments	4.12	1.55	1.22	1.15	0.79
34	Motor Vehicles, Trailers and Semi-Trailers	20.14	2.35	1.37	5.93	12.23
35	Other Transport Equipment	3.94	5.10	4.42	4.78	5.72
36/37	Manufacturing not elsewhere classified; Recycling	1.89	2.77	0.51	4.03	7.98

Notes: Table reports export shares by sector over the period 1994-2004 for sectors are classified according to NACE Rev. 1 (2-digit) classification.

Table A2: Output shares by country, 1994-2004

Sector code	Description	Germany	Russia	Ukraine	Lithuania	Poland
15	Food products, Beverages	10.46	20.30	22.63	25.01	22.01
16	Tobacco	1.23	1.05	1.23	1.31	2.18
17	Textile	1.20	1.53	1.04	5.59	2.34
18	Leather	0.92	1.20	1.10	5.39	2.12
19	Footwear	0.32	0.45	0.66	0.88	0.87
20	Wood and Products of Wood and Cork	1.54	1.81	0.90	5.12	3.31
21	Paper	2.35	2.39	1.18	1.32	2.36
22	Printing and publishing	3.68	1.03	1.29	2.90	3.36
23	Coke, Refined Petroleum Products and Nuclear Fuel	5.50	9.17	7.61	20.78	6.86
24	Chemicals and Chemical Products	9.81	9.51	6.94	5.96	7.29
25	Rubber and Plastics Products	4.09	2.20	1.97	3.17	4.42
26	Other Non-Metallic Mineral Products	3.09	5.44	4.58	3.37	4.76
27	Basic Metals	4.61	18.18	25.08	0.37	5.83
28	Fabricated Metal Products	6.55	2.41	3.53	2.39	5.58
29	Machinery and Equipment, not elsewhere classified	12.29	7.80	6.13	2.97	5.88
30	Office, Accounting and Computing Machinery	1.16	0.31	0.33	0.12	0.29
31	Electrical Machinery and Apparatus, not elsewhere classified	6.14	2.25	2.36	2.21	3.36
32	Radio, Television and Communication Equipment	2.26	n.a.	0.81	3.56	2.26
33	Medical, Precision and Optical Instruments	2.59	0.96	0.67	1.04	1.10
34	Motor Vehicles, Trailers and Semi-Trailers	15.68	7.65	2.91	0.25	7.00
35	Other Transport Equipment	1.95	1.31	4.29	2.11	2.45
36	Manufacturing not elsewhere classified	2.41	2.13	0.92	3.64	3.99
37	Recycling	0.18	0.92	1.87	0.56	0.38

Notes: Table reports output shares by sector over the period 1994-2004 for sectors are classified according to NACE Rev. 1 (2-digit) classification.