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The Role of Exchange Rate and Non-Exchange Rate Related Factors in Polish Firms' Export Performance

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Abstract

This paper analyzes the export performance of Polish manufacturing firms. It focuses on the extensive and intensive margins of exports, on the decision to enter export markets and the intensity of exports, given participation, examining price and non-price determinants of export performance. The analysis relies on two different but complementary sources of data: a panel survey of Polish firms for 2005–13, and an exporter-level customs data set, for the same period, with detailed information on products and destinations. The findings reveal that firms face high sunk costs for entering export markets, and that once these costs have been paid, they depreciate rapidly over time. Strong positive local spillovers are also identified, which help reduce entry costs. Finally, the paper shows that the impact of real exchange rate fluctuations on firms' export performance is dependent of the degree of integration in international production networks.

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1. Introduction

What determines entry and successful participation in export markets? What role does the real exchange rate play in that process, and what other factors are at play? As the productivity and growth gains from integration into the global marketplace are better understood, policy makers across the world seek to understand what drives firms' entry into export markets, and their subsequent success in them. This paper addresses the above question in the context of Polish manufacturing firms.

Poland has often been cited as an example of a successful transition from middle to high income. That transition happened on the back of a productive transformation led by private sector firms. Over the last fifteen years, firms in Poland have become increasingly internationalized. New firms have entered export markets, and firms already exporting have increased the intensity of their exposure to foreign markets (Albinowski et al. 2015). The decrease in trade costs that resulted from the association with the EU, and the formal accession to the market were important drivers of this process, coupled with the increasingly important fragmentation of the production process across borders – the emergence of international production networks. From a firm-level perspective, what were the underlying factors that facilitated this internationalization? Why did some firms thrive and grow while others struggle to compete?

The paper focuses on real exchange rate and non-real exchange rate related determinants of export performance,[1] such as sunk costs, location and sectoral spillovers, financial constraints, and productivity. This paper contributes to the literature by analyzing the export performance of Polish firms during a crucial period of productive transformation associated with the enlargement of the European Union. The Polish case is useful to understand other transition processes that firms in Central and Eastern Europe and beyond face when operating in a context of substantial pro-market reforms and increased market access. The analysis integrates the major determinants considered in the literature, and explores two different but complementary sources of data. First, a panel survey of Polish firms for the period 2005-2013 that contains detailed information on firms' characteristics and their export performance. Second, an exporter-level customs data set for the same period of analysis. Customs data provide detailed information on

[1] The real exchange rate has been often identified as a key determinant of export performance in Poland and elsewhere. For example, in 2009 the exchange rate of PLN against the EUR depreciated over a 6 month period by 40% that is believed to help Poland maintain its competitiveness and dampen the effect of the financial crisis, see e.g. Toroj (2012).

products exported and their destination and allow a more accurate analysis of the impact of destination-specific exchange rate movements and their volatility.

Along the lines of Melitz (2003) and the related strand of literature, we show that firm-level productivity is important for export participation. Polish exporters are also, on average larger, and more likely to be foreign owned than other firms. Our results show that firms face high sunk costs for entering the export market, which make firms that exported in the previous year 50 percent more likely to export also in the following year. The returns of having paid these sunk costs, however, depreciate rapidly over time meaning that firms rapidly lose the benefits of the initial investments if they exit export markets. We identify strong positive local spillovers indicating that proximity between exporters in the same sector reduces entry costs. Similar to recent findings in the literature (Amiti et al., 2014; Ahmed et al., 2015), we find that impact of real exchange rate fluctuations on firms' export performance is highly dependent on the degree of integration in regional or global value chains. The effect of real exchange rate movements on export decisions is, therefore, heterogeneous across and within sectors, and affects the most firms with low shares of imported intermediate goods. In particular, firms in the motor vehicles sector are more likely to be relatively hedged against an appreciation of the Polish Zloty, as they show the highest intensity of imported intermediates. The opposite is expected for firms in the furniture, wood, printing and media, other non-metallic mineral or food and beverages sectors that rely mostly on domestic inputs. The findings are complemented using customs-level data that allow us to determine the relevant source of exchange rate variability. The additional findings confirm the negative impact of exchange rate appreciation and volatility on export performance for small and medium size firms. Finally, results confirm that also liquidity plays a role in facilitating entry in the export market. When focusing on export intensity rather than entry, the most relevant determinant of export intensity is productivity growth, although the impact is economically small. Real exchange rate movements, instead, have no significant impact on export volumes, but its volatility does negatively affect performance when examined with detailed export-transaction data.

The remainder of this paper is structured as follows. Section 2 discusses the literature on determinants of export participation and intensity. Section 3 presents the methodology, and section 4 describes the data. Section 5 discusses the results on the drivers of export entry, and section 6 discusses the results on export intensity. Section 7 concludes.

2. Literature Review

The determinants of export participation and export intensity have been largely studied in the empirical literature. A survey of the literature can help understand some of the drivers of export dynamics, although most papers tend to focus on only one of the several aspects influencing export decisions. In this paper, we aim at testing the five major channels identified in the literature with Polish data: real exchange rate fluctuations, sunk costs, geographical and sectoral spillovers, financial conditions, and productivity.

First, we look at the role of real exchange rate changes. Large real exchange changes may have long-lasting, firm-level composition effects if they irreversibly impact on entry and exit into and from export markets (Baldwin and Krugman, 1989). Such an impact depends on the characteristics of the economy at large, on the characteristics of the individual firms populating it and on the nature of the interactions between firms.

However, in the world of global value chains, effective changes in the RER (as perceived by firms) may depend on the degree of involvement in both imports and exports, and these relationships are not-trivial, as shown by e.g.: Bems and Johnson (2012) and Patel et al. (2014). Ahmed et al. (2015) show that in firms integrated in international production networks, the import-content of products will be larger, while the effect of the real exchange rate on exports acts through the effect on the domestic value added. In fact this literature identifies a decline in the export responsiveness to real exchange rate changes as international production networks became more prominent.[2] Most interestingly, this empirical result seems to be capturing a change in firms' trading patterns, rather than just an increase in their import-content shares. With international production networks, most trade happens among firms ('business-to-business') rather than from firm to consumer, or final demand. With complex production processes, costs of switching suppliers are likely to make purchase decisions more inelastic to prices, at least within a relatively small range. This may also affect the export response to real exchange rate changes. Those effects may be even more straightforward in Poland, given that most of its imports and exports is with the rest of the EU and is denominated in euro (EUR), Polish zloty (PLN) or to a smaller extent in USD, which makes it highly probable that a firm's imports and exports may be denominated in the same currency.[3]

Second, we consider the role of sunk costs in preventing participation in the export market (Dixit, 1989; Baldwin and Krugman, 1989). In particular, following Bernard and Jensen (2004), we test for the presence of entry costs by looking at the effects of

[2] In line with this argument, Amiti et al. (2014), for example developed a theoretical framework with variable markups and imported inputs predicting that firms with high import shares and high market shares will have low exchange rate pass through. Their prediction was empirically confirmed using Belgian data.

[3] According to the report by the Central Statistical Office, http://goo.gl/OEKqGj.

exporting yesterday on exporting today. The high fixed costs associated with exporting are important barriers, in particular for small and medium enterprises to participate in the global marketplace.

Third, activities of neighboring firms may affect a firm's entry costs into export markets due to spillover effects. For example, a cluster of firms in a given location may increase the supply of necessary skills for a particular activity, improve infrastructure or increase the stock of information about foreign markets that may be available to other firms. On the other hand, a high concentration of firms in a specific location may push input prices upwards through increased demand, which may affect other firms negatively. For these reasons the sign of the effect is a priori ambiguous and warrants an empirical investigation. For example, Koening et al. (2010) examine local export spillovers in France, on the decision to start exporting, and on the export intensity. They find evidence of positive spillovers on the former, but not on the latter, suggesting that spillovers act through fixed rather than variable costs. They also find spillovers to be stronger when specific: by product and destination, and not significant when considered on all products, all destinations. They also find that they decay spatially – they decline with distance. Bernard and Jensen (2004), instead, find no role for export spillovers on the export decision of manufacturing firms in the United States. Closer to home, Cieslik and Hagemejer (2010), who study export spillovers in Poland, find that the probability of exporting by domestic firms is positively related to the geographic concentration of export activities by multinationals.

Fourth, we explore whether a firm's financial conditions affect the decision to enter export markets. A priori, given the high fixed costs associated with exporting, and the fact that production takes time and there is a lag between the moment in which inputs are purchased and the moment in which revenues are cashed, exporting firms have particularly high financial needs (see Greenaway et al., 2007).

Finally, productivity, on the other hand, has been identified as one of the most important factors underlying the fuzzy concept of "competitiveness" (e.g.: Krugman, 1994; Porter, 2011).[4] Firms' productivity levels, being at the heart of the income convergence process of a country, interact in complex ways with their degree of internationalization, including foreign ownership, and participation in export and import markets. More productive firms are better positioned to face the highly demanding international markets, and in turn they become more productive by facing increased competition and by learning from sophisticated competitors and clients. On the theoretical front, self-selection of most productive firms into export markets has been elaborated by Melitz (2003) and several subsequent papers.

[4] Krugman (1994) argues that "competitiveness" would turn out to be a funny way of saying productivity.

Evidence on drivers of the intensive margin – the determinants of export intensity, is scarcer. Campa (2004) a, for example, has found that exchange rate changes, as well as some firm-level characteristics, can impact on both the decision to export and export intensity. Héricourt and Poncet (2015) demonstrate that real exchange rate volatility is an important factor that influences both extensive and intensive margins of exports. Real exchange rate appreciations make the foreign export price of goods and services produced by domestic firms more expensive, but also make the inputs they import cheaper. As argued above, Koening (2010) finds no evidence of spillovers on the intensity of exporting.

3. Methodology

In this section, we present the methodology adopted to estimate the determinants of export participation (extensive margin) and export size (intensive margin).

Export participation

We test several hypotheses about the factors that increase the propensity of firms entering export markets (the extensive margin). Starting with the characteristics of the firm itself, we explore whether size, ownership structure, productivity and R&D expenditure and sunk costs are important for export decisions. Next, we consider four main factors that might matter for entry into foreign markets: sunk costs, spillovers, financial conditions and real exchange rate changes.

Following Bernard and Jensen (2004) we estimate the following reduced form model:

$$d_{ist} = \beta X_{it} + \gamma Z_{st} + v_t + u_i + \varepsilon_{ist}, \tag{1}$$

where d_{ist} is a dummy indicating whether firm i in sector s exported in year t. X_{it} represents firm level characteristics while Z_{st} are sector-level variables. The variables that are meant to capture the four major determinants and are defined below.

We test the role of sunk costs in preventing participation in the export market by looking at the effects of exporting in period t-1 on exporting in period t as in Bernard and Jensen (2004). We explore the role of location and sectorial spillovers on firms' export decisions by looking at the effects of activities of other firms in the same sector or region. We then include a set of financial indicators to capture the financial status of a firm. Finally, we look at the role of real exchange changes by constructing sector-level exchange rates, which takes account of the destination composition of each sector, and estimate the participation response to positive RER changes (i.e.: depreciations of the domestic currency). Following Greenaway et al. (2010) we account for different exposure to changes in the price of imported-inputs at the firm level by considering the ratio between imported and total intermediates used.

To gain a deeper understanding of the impact of exchange rate movements on export performance along the extensive margin, we complement the results using a customs-level data set on export transactions. Although this data set offers little information on firm characteristics, it provides very detailed information on destinations reached by firms. In the model below we analyze the determinants of firm entry in a new market. Our dependent variable is binary and, following Héricourt and Poncet (2015), takes value 1 when a firm starts exporting to country *j* at time *t* but did not at time t-1.[5] The estimating equation is the following:

$$Y_{ijt} = \beta RER_{jt} + \theta W_{jt} + u_{ij} + v_t + \varepsilon_{ijt}, \tag{2}$$

The vector W includes a set of control variables at destination level such as GDP and the real effective exchange rates to account for destination's market size and relative prices. Moreover, to control for country j's demand for goods, we include total imports of country *j*. We also include firm-destination fixed effects, u_{ij}, and time dummies, v_t. The variable RER captures bilateral exchange rate effects. We also explore the impact of RER volatility computed as the standard deviation of monthly log differences in the nominal exchange rate (NER). The switch from real to nominal when looking at exchange rate volatility effects is driven by availability of monthly data only for nominal exchange rates for the set of destinations considered in this analysis. Given that prices are relatively stickier than nominal exchange rates, it is reasonable to expect that most of the variation of RER volatility is actually driven by NER volatility.

Both models are estimated using a linear probability framework (i.e. the error term, ε_{ist}, is assumed to be normally distributed) that allows us to control for time-invariant unobserved heterogeneity by including firm fixed effects, u_i. Despite the binary nature of the dependent variable, a linear probability model is preferred because the inclusion of firm fixed effects does not bias the estimates (Angrist, 2001). Linear probability models provide good estimates of the partial effects for average values of the explanatory variables and the coefficients allow for a straightforward interpretation of the effects (Wooldridge, 2002). We also include time dummies, v_t, to control for common shocks such as changes in the business cycle, trade liberalization across all industries and overall changes in demand that affect all firms. All regressors are logged. Because one of our variables of interest is the lagged dependent variable, we also implement the system GMM estimator (Blundell-Bond, 1998) that deals with endogeneity concerns by instrumenting with lagged first-differences of the explanatory variables. We report robust standard errors clustered at the firm level to deal with general heteroskedasticity and serial correlation.

[5] We slightly depart from Hericourt and Poncet (2015) inasmuch we consider entry after one year or more of non-exporting, while they consider entry if the product has not been exported before during the sample period.

Export intensity

In this section, we provide an empirical framework to estimate the relationship between export intensity and firm and sector level characteristics. While the previous section focused on the main factors affecting the extensive margin of exports, this section focuses on their importance through exports adjustments conditional on market participation (the intensive margin of exports). The estimable equation is as follows:

$$exp_{ist} = \beta X_{it} + \gamma Z_{st} + v_t + u_i + \varepsilon_{ist}, \tag{3}$$

where exp_{ist} is the log value of exports of firm i in sector s in year t. X_{it} are firm level characteristics while Z_{st} are sector-level variables. Because the export intensity is only available for firms that have chosen to export, a potential problem of selection bias arises. Therefore, we implement a two-stage approach where firms first choose whether to export or not (selection equation), and second decide how much to export (export intensity equation). Following Wooldridge (1995), we first estimate the selection equation below for each t using a probit model:

$$d_{ist} = \theta d_{ist-1} + \beta X_{it} + \gamma Z_{st} + v_t + u_i + \varepsilon_{ist}, \qquad \text{for each } t \tag{4}$$

The equation is similar to the one estimated in the previous section where past export status is considered as predictor for whether a firm is currently exporting. For each equation, we compute the inverse Mills ratio (λ_{it}). In the second stage, we estimate the following export intensity equation conditional on selection:

$$exp_{ist} = \beta X_{it} + \gamma Z_{st} + \psi\lambda_{it} + \phi\lambda_{it} v_t + v_t + \varepsilon_{ist}, \tag{5}$$

where we include the Mills ratios and their interactions with time dummies. This equation is estimated using correlated Chamberlain's random effects estimator (CRE) that controls for time averages of all time-varying firm variables in equation to capture unobserved firm effects. We report robust standard errors clustered at the firm level to deal with heteroscedasticity and serial correlation.

We also analyze determinants of export intensity using customs export transactions data. The baseline specification is analogous to equation (2), with the dependent variable being the log of exports of a firm *i* to a country *j*:

$$exp_{ijt} = \beta RER_{jt} + \theta W_{jt} + u_{ij} + v_t + \varepsilon_{ijt}, \tag{6}$$

4. Data and Summary Statistics

We rely on two sources of data: a firm-level panel survey, and a customs-level export transactions data set. The first data set is the F01 database of Polish firms for the period

2005-2013 with 10 or more employees provided by the Central Statistical Office of Poland to the National Bank of Poland. We consider only firms in the manufacturing sector given the lack of disaggregated trade data for the service sector. Moreover, this allows us to benchmark our results with the findings of the academic literature that focuses on manufacturing firms. The sample comprises about 21,000 manufacturing firms. The data have an unbalanced structure, with an average of about 5 observations per firm. Table 1 reports the number of firms by number of years.

Table 1: Manufacturing firms by number of years recorded in the dataset

Number of years	Number of firms
1	3122
2	2260
3	2078
4	1618
5	1736
6	1465
7	1271
8	1172
9	6254
Total	20976

Source: Authors' calculations from F01 dataset

Table 2 reports the share of exporters by sector. About 70% of the firms in the sample have exported at least in one year. The share ranges between 0.45 in the food industry and 0.83 in the motor vehicles and other transport sectors.

Table 2: Share of exporters by sector

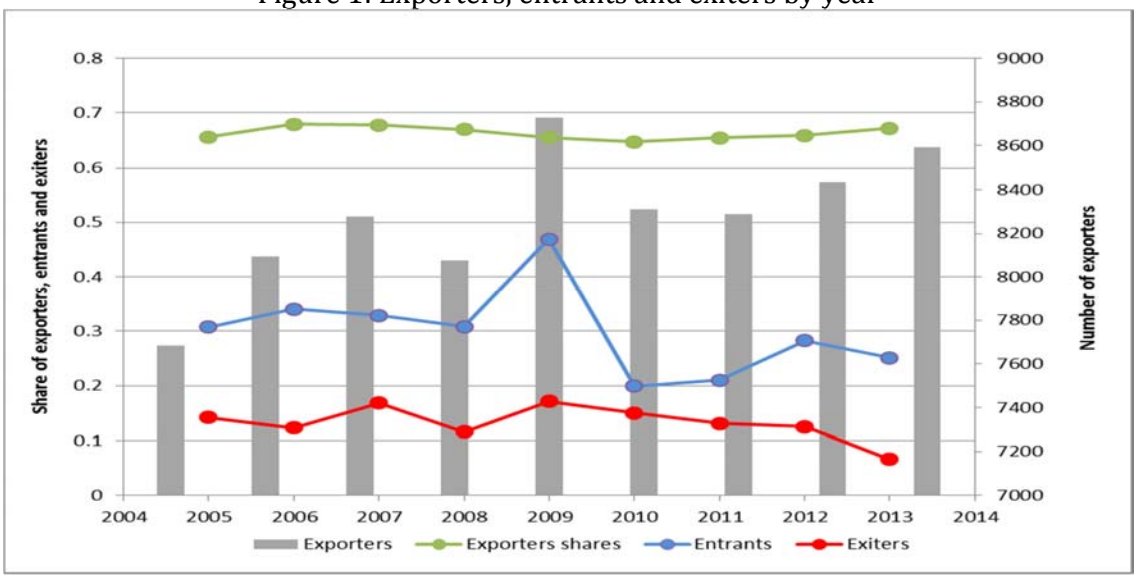
Sector	Share of exporters	Sector	Share of exporters
Food	0.46	Rubber and plastic	0.77
Beverages	0.54	Other non-metallic mineral	0.50
Tobacco	0.82	Basic metals	0.80
Textiles	0.78	Fabricated metal	0.67
Wearing apparel	0.71	Computer, electronic and optical	0.70
Leather	0.75	Electrical equipment	0.72
Wood	0.73	Machinery	0.74
Paper	0.66	Motor vehicles	0.83
Printing and media	0.52	Other transport	0.83
Coke and refined petroleum	0.74	Furniture	0.81
Chemicals	0.76	Other	0.77
Pharmaceutical	0.66		

Source: Authors' calculations from F01 dataset

Figure 1 shows the share and the total number of exporters by year as well as the fraction of exporters that stopped exporting and the share of non-exporters that started exporting. The peak in the number of exporters observed in 2009 is mainly due to a rise in entrants, while the increasing trends in exporters observed since 2011 is due to both an increase in entrants and a decrease in exiters. The share of exiters has been stable over time, averaging around 11% of exporters, and only since 2010 has it started to decrease. On the other hand, the fraction of entrants is more volatile and averages around 30% of

non-exporters. Overall the figure highlights that exporting is not a once-and-forever phenomenon, since year-to-year transition rates are notable.

Figure 1: Exporters, entrants and exiters by year



Note: Authors' calculations from F01 database. The green line indicates the share of exporters over the total number of firms. The blue (and red) line indicates the share of firms that entered (exit) the export market in a given year.

Firms that export are larger than non-exporters, they are more productive and pay higher wages**.** Table 3 compares the average characteristics of exporters and non-exporters. Results confirm what we typically find in the literature (see for example Bernard and Jensen, 2004 and Greenaway and Kneller, 2004). Furthermore, foreign owned firms are more likely to export, 26% of exporters are foreign owned against 5% of non-exporters. Considering total factor productivity (TFP), exporters are 12% more productive than non-exporters. The ratios for exporters/non-exporters on employees, wages and TFP are roughly in line with what is found in the literature for other European economies (Figure 2, descriptive statistics by sector are reported in the Appendix).

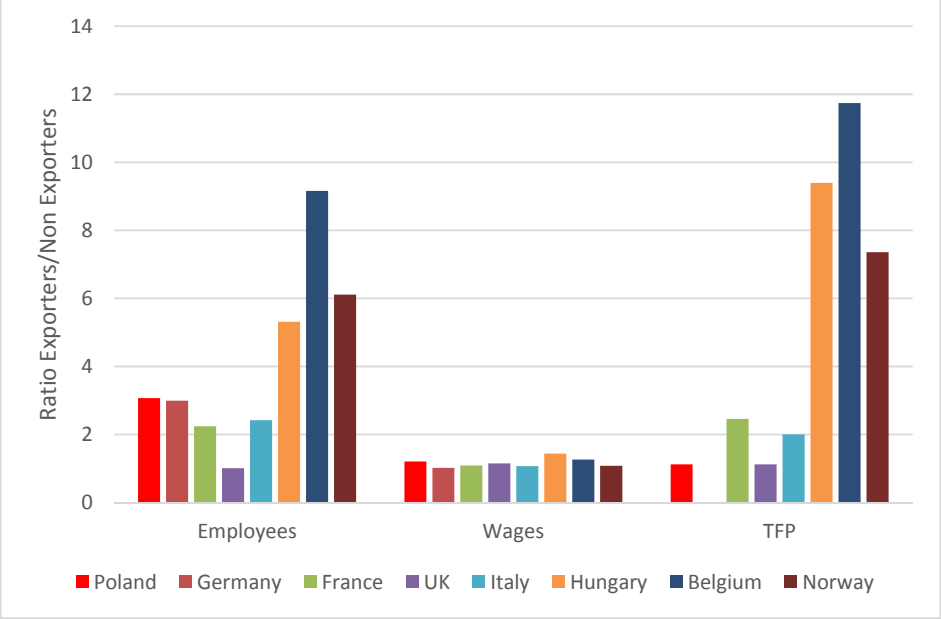
Table 3: Characteristics of exporters and non-exporters

Variable	Exporters	Non-exporters
Employees	177.86	58.02
	(379.10)	(95.37)
Wage	35	29
	(89)	(91)
TFP	4.68	4.17
	(0.88)	(0.87)
Foreign	0.26	0.05
	(0.44)	(0.22)
Observations	74479	37898

Source: Authors' calculations from F01 database. Tables reports sample averages and standard deviations in parentheses. Wages are in thousands PLN.

Figure 2 shows the ratio of wages, employees and productivity of exporters over non-exporters for Poland and a selected number of countries. Polish exporters are about 3 times larger than non-exporters, similar to Germany (2.99) and above France (2.24) and Italy (2.42). The wage premia for exporters (20 percent) is similar to what is observed in the United Kingdom (15 percent) and Belgium (26 percent), and is much larger than in Germany (2 percent), France (9 percent) and Italy (7 percent). While in Poland exporters are 12 percent more productive than non-exporters, as in the United Kingdom (12 percent), firms in Germany and Italy show greater productivity differential, 145 percent and 200 percent more, respectively. The productivity premia is even higher in Hungary, Belgium and Norway where, however, exporters are also substantially larger than non-exporters.

Figure 2: Benchmarking against other European Countries



Source: Authors' elaboration based on Mayer & Ottaviano (2007).
Note: comparisons across countries should be read as rough indicators and interpreted with caution as these ratios are constructed for different periods.

We construct three different measures of geographic and sectoral spillovers following Bernard and Jensen (2004). Region-specific spillovers are captured by export activity in the region but outside the three-digit (NACE Rev2) sector. Sector-specific spillovers refer to activities in the same sector but outside the region where the firm is located. Finally, local spillovers are captured by export activity in the same sector and region as the firm. Spillovers are computed both in terms of number of exporters and value of exports. Table 4 provides a detailed description of our measures of spillovers.

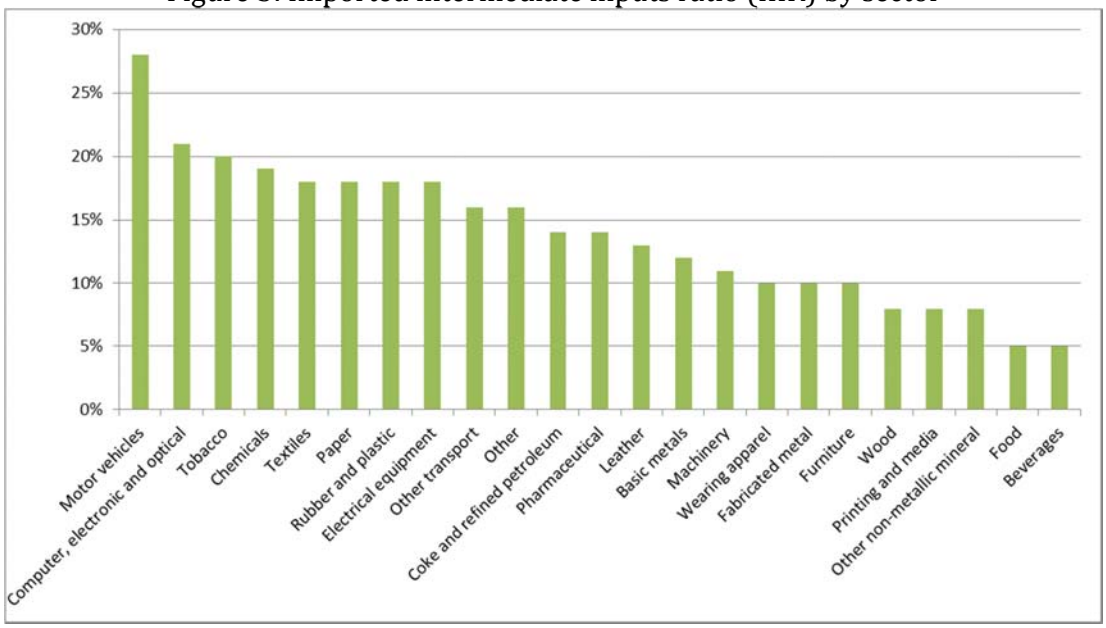
Table 4: Variables used to measure spillovers

Variable	Description
Exporter (region)	(Exporting firms)/(total firms) for firms in the region and outside the Nace 3 digit sector

Exporter (sector)	(Exporting firms)/(total firms) for firms in the Nace 3 digit sector and outside the region
Exporter (region-sector)	(Exporting firms)/(total firms) for firms in the region and in the Nace 3 digit sector (excluding firm in question)
Exports (region)	Exports/(total shipments) from firms in the region and outside the Nace 3 digit sector
Exports (sector)	Exports/(total shipments) from firmsin the Nace 3 digit sector and outside the region
Exports (region-sector)	Exports/(total shipments) from firms in the region and in the Nace 3 digit sector (excluding firm in question)

To analyze the role of real exchange rate fluctuations on the probability of exporting we construct sector level (3 digit NACE rev2) real effective exchange rates (REER). Following Bernard and Jensen (2004) we construct export-weighted averages of real exchange rates, where weights are average export shares of the partner country during the entire period. Data on nominal exchange rates and national deflators were taken from the World Bank's World Development Indicators (WDI). Data on bilateral trade were obtained from UN Comtrade. To assess the potential offsetting effect of imported intermediates we follow Greenaway et al. (2006) and construct the ratio of imported intermediate to total intermediates (IIIR). Figure 3 reports average IIIR by sector while the evolution of the REER over time by sector is reported in the Appendix. The largest fluctuations in the REER are observed in the chemicals, coke and refined petroleum products, fabricated metals, other transport and tobacco sectors.

Figure 3: Imported intermediate inputs ratio (IIIR) by sector



Source: Authors' calculations from F01 database.

Firms in the motor vehicles, computer, electronic and optical sector tend to rely more on imported intermediates. About 28 percent of intermediate costs in the motor vehicles sector are due to imports of materials. The lowest share is found in food and beverages.

Considering the financial factors variables (Table 5), liquidity is defined as the firm's current assets net of current liabilities over total assets. Leverage is defined as the firm's ratio of short-term debt to current assets.[6] Current assets are those reasonably expected to be converted into cash within one year (cash, accounts receivable, inventories, marketable securities, etc.). The higher its liquidity ratio and the lower its leverage ratio, the better the firm's financial health. The table shows that exporters are characterized by a higher liquidity ratio (0.18 on average) than non-exporters (0.15 on average), while non-exporters display a higher average leverage ratio (1.41 on average) compared to exporters (0.89 on average). The difference is persistent over time. This descriptive evidence suggests a link between firms' financial health and export status.

Table 5: Financial status of exporters and non-exporters over time

Year	Liquidity		Leverage		R&D	
	Exporters	Other	Exporters	Other	Exporters	Other
2005	0.14	0.11	0.93	1.31	11.43	1.46
	(0.32)	(0.37)	(1.48)	(5.03)	(200.80)	(26.18)
2006	0.16	0.12	0.90	1.38	18.06	1.59
	(0.31)	(0.36)	(1.52)	(7.57)	(409.88)	(63.62)
2007	0.17	0.15	0.85	1.21	53.27	0.55
	(0.31)	(0.36)	(1.92)	(5.10)	(3092.72)	(14.95)
2008	0.17	0.16	0.93	1.28	38.15	1.10
	(0.32)	(0.36)	(4.42)	(9.65)	(1672.41)	(28.45)
2009	0.18	0.15	0.85	1.26	38.42	1.33
	(0.33)	(0.38)	(1.34)	(5.72)	(1658.95)	(28.99)
2010	0.18	0.15	0.87	1.14	93.79	0.80
	(0.32)	(0.36)	(2.48)	(3.54)	(6058.12)	(19.67)
2011	0.19	0.17	0.82	1.26	75.83	3.48
	(0.31)	(0.35)	(1.98)	(9.87)	(3161.43)	(124.26)
2012	0.20	0.17	1.02	2.69	55.46	2.17
	(0.31)	(0.36)	(19.73)	(102.20)	(1691.74)	(74.77)
2013	0.21	0.18	0.83	1.12	76.76	3.10
	(0.31)	(0.36)	(3.95)	(4.00)	(2623.64)	(100.73)

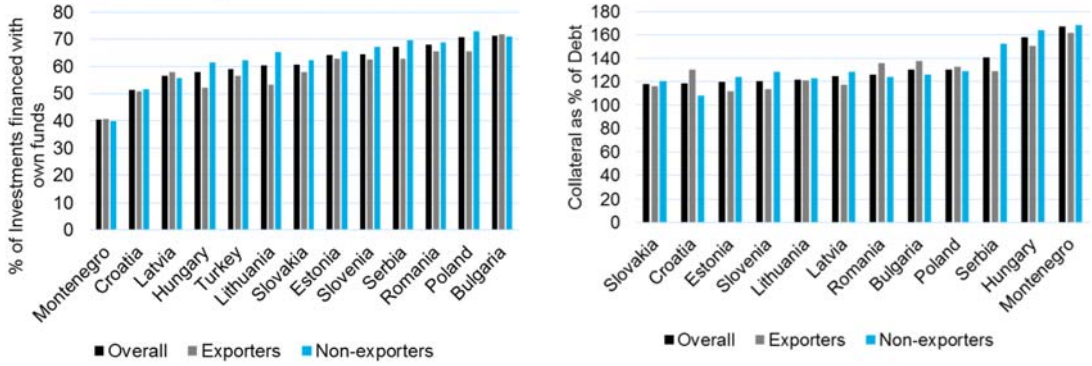
Source: Authors' calculations from F01 database. Tables report sample averages and standard deviations in parentheses.

Access to finance has been identified as a constraint for innovation (among various sectors), and for business operations (for services). Banks do not finance projects on which they do not have priors of returns. Even successful firms may struggle to obtain bank financing for innovative projects due to information asymmetries between lenders and creditors. Field level interviews revealed that banks tend to be willing to fund activities with a well-established track record of success, but are reluctant to finance innovations. An entrepreneur operating in the motor vehicle sector, in particular, indicated that banks had not perceived that developing hybrid technologies was going to

[6] Descriptive statistics of firms' characteristics by sector are reported in Table A1of the Appendix.

be a promising activity. They had less information about the project than the entrepreneur did, and took a more risk averse stance.[7]

Figure 4: Access to Finance in Poland and Benchmarks



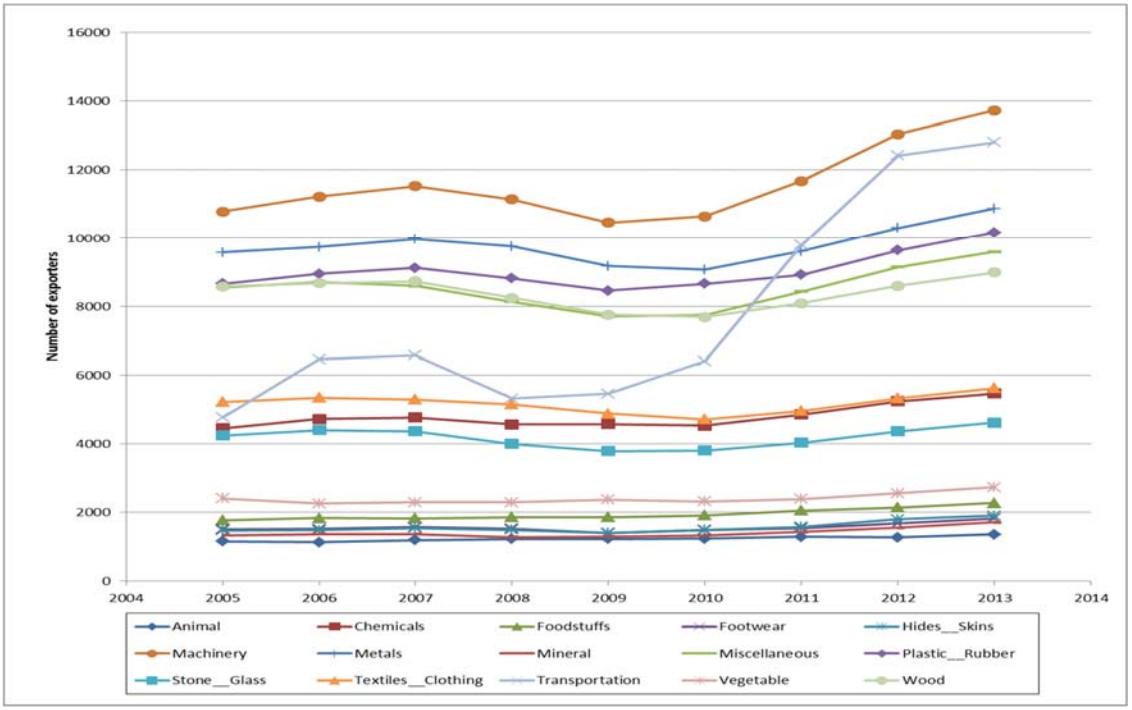
Source: World Bank enterprise surveys.

Figure 4 provides a comparison of firms' ability to access financing in Poland and other countries. Polish firms tend to finance 70 percent of their investments with own funds. Although this should not necessarily be a source of concern, it may be a symptom of firms not being able to access external financing, and may be restricting the type of investments that are actually conducted. This ratio is higher than observed in the Slovak Republic, Lithuania, Estonia, Slovenia or Turkey. In addition, if we look at one indicator of external financing costs, such as the collateral as a portion of the debt, we observe that it is also high in Poland (130 percent) when benchmarked against comparators such as the Slovak Republic (120 percent) and Lithuania (122 percent).

The customs-level export transaction data set also covers the period 2005-2013 and records transactions for more than 40,000 exporters in 2013 (about 32,000 in 2005). Overall, the number has increased by 36 percent since 2005, with smaller firms entering the export market. Indeed, the median exporter size has declined over time. The transport equipment and machinery sectors have led the way in terms of increase in the number of exporting firms, likely associated with a process of integration into international production networks. The number of exporters in the transport sector has increased substantially by more than 100 percent since 2009. A notable increase is also observed in the machinery sector. The sector went from about 5,000 exporters in 2009 to more than 12,000 in 2013 (Figure 5).

Figure 5: Number of exporters per sector

[7] Evidence from the World Bank Enterprise Survey confirms that access to finance is a source of concern in Poland, with more than 30 percent of firms identifying that as an obstacle or a major obstacle for operations, higher than in most countries in the region.



Source: Authors' calculations from customs -level export transactions database.

Additional data such as GDP and the destination-specific real effective exchange rate were obtained from the WDI, while total imports were provided by UN Comtrade. The real effective exchange rate is the ratio of the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) to a price deflator or index of costs. Weights are derived from industrial country trade in manufactured goods.

5. Results: Export Decision

In this section, we describe the results of estimating equation (1) on firm-level data to analyze the determinants of export participation and the results of estimating equation (2) on customs-transactions data to analyze determinants of entry in new markets.

Firm-level data

Our first baseline results are reported in Table 6. It reports the coefficients on firm characteristics on the probability of exporting from the linear probability model. The first column, reporting pooled OLS estimates, confirms our initial findings. Foreign, larger and more productive firms have higher probabilities of exporting. Columns (2) – (5) report results in which firm-level fixed effects are added. Adding firm-level effects is useful to control for unobserved firm characteristics that may be correlated with the regressors and with the dependent variable at the same time, thus reducing the scope of biases in

the estimates. At the same time, by adding firm fixed effects we are less likely to identify the specific effects of firm-level characteristics that show little variation over time.

Indeed, when we control for firm fixed-effects much of the effects of the firm-level characteristics are swept away. Total factor productivity and real wages are no longer significant and the foreign effect is no longer distinguishable from the firm fixed effect. This is reasonable if real wages, productivity and foreign ownership do not vary substantially over time at the level of the firm. An increase in size, however, still shows a moderate effect on the probability of exporting. A 10% increase in employment at the firm level leads to a 0.6 percentage-point increase in the probability of exporting.

Table 6: Determinants of the decision to export - Baseline results

	(1)	(2)	(3)	(4)	(5)
Lag Log of Number of employees	0.121***	0.071***	0.063***	0.063***	0.056***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lag Log of real wages	0.060***	0.004	-0.002	-0.002	-0.001
	(0.000)	(0.508)	(0.734)	(0.728)	(0.817)
Lag Log of TFP	0.033***	0.003	0.003	0.003	0.003
	(0.000)	(0.277)	(0.275)	(0.275)	(0.298)
Lag REER at 3 digit	-0.003	-0.010	-0.007	-0.007	-0.014
	(0.773)	(0.140)	(0.304)	(0.303)	(0.125)
Lag Dummy: Foreign ownership	0.128***	0.004	0.002	0.002	0.003
	(0.000)	(0.698)	(0.795)	(0.796)	(0.741)
Lag Dummy exporter			0.137***	0.139***	0.135***
			(0.000)	(0.000)	(0.000)
Exporter in t-2 but not in t-1				0.005	0.003
				(0.636)	(0.815)
Sector-Year	Yes	Yes	Yes	Yes	Yes
Sector	Yes	No	No	No	No
Region	Yes	No	No	No	No
Observations	82443	82443	82443	82443	76806
Firms		16479	16479	16479	15887

Robust standard errors clustered at the firm level in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. Last column excludes outliers identified has observations with studentized residuals above 3 and below -3.

Sunk costs are important determinants of the decision to export. This is evidenced by the fact that having exported in the previous period significantly affects the decision to export in the current period, increasing the probability of exporting by 14 percentage points. Nevertheless, estimates are smaller than those found in Bernard and Jensen (2004) for the United States and Greenaway et al (2007) for the United Kingdom. It is likely that given the single market conditions in the EU, and the portion of exports that are directed to that market, the sunk costs associated with exporting are relatively lower than those faced by US firms, or even by UK firms that have a more diversified market scope. Moreover, we do not find any positive effects of having last exported two years ago, indicating that sunk costs rapidly depreciate over time.

Table 7: GMM estimates

	(1)	(2)	(3)

Lag of Dummy exporter	0.474***	0.523***	0.382***
	(0.000)	(0.000)	(0.000)
Exporter in t-2 but not in t-1	0.291	0.071	0.123*
	(0.118)	(0.229)	(0.083)
Lag of Log of Number of employees	0.029***	0.025***	0.029***
	(0.006)	(0.008)	(0.004)
Lag of Log of real wages	-0.018	-0.024**	-0.016
	(0.101)	(0.017)	(0.102)
Lag of Log of TFP	0.000	0.001	0.001
	(0.895)	(0.809)	(0.871)
Lag of RER at 3 digit	-0.014	-0.008	-0.014
	(0.326)	(0.561)	(0.284)
Lag of Dummy: Foreign ownership	-0.006	-0.006	-0.003
	(0.658)	(0.695)	(0.854)
Year	Yes	Yes	Yes
Observations	64839	64839	53517
Firms	14106	14106	13011
Hansen Degrees of Freedom	23	34	23.000
Hansen test (p-value)	0.220	0.144	0.182
AR 1 Test	0.019	0.000	0.000
AR 2 Test	0.606	0.147	0.926

Robust standard errors clustered at the firm level in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. The first column uses all lags starting from the third as instruments. Column 2 considers also the second lag. Last column excludes outliers identified with studentized residuals above 3 and below -3.

Table 7 reports the results using the Arellano-Bond estimator that deals with the endogeneity of the lag dependent variable. The lag dependent variable is instrumented with its third and fourth lags. The coefficient of the lag dependent variable becomes larger and confirms the presence of sunk costs in entering the export market. Having exported in the previous year increases the probability of exporting today by 50 percentage points. These costs, however, depreciate rapidly over time as previously found.

We now turn our attention to the role of the spillovers between the activities and locations of other firms and export behavior. Table 8 reports the coefficients of our three measures of spillovers: region-specific spillovers, sector-specific spillovers and local spillovers. As discussed above, we consider two specifications, one based on the number of firms and another based on the value exported at the region, sector, and region-sector levels. Columns 1, 2 and 4 consider the ratio of exporting firms to total firms in the category while columns 3 and 5 consider the ratio of total exports by value to total shipments in the category.

Table 8: The impact of activities spillovers on export decision

	(1)	(2)	(3)	(4)	(5)
Lag Log of Number of employees	0.062***	0.055***	0.070***	0.048***	0.054***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lag Log of real wages	0.004	-0.002	0.005	-0.000	0.001
	(0.545)	(0.743)	(0.463)	(0.939)	(0.926)

Lag Log of TFP	0.002	0.002	0.003	0.002	0.003
	(0.397)	(0.398)	(0.280)	(0.457)	(0.291)
Lag REER at 3 digit	-0.015**	-0.012*	-0.003	-0.005	0.001
	(0.033)	(0.083)	(0.606)	(0.440)	(0.925)
Lag Dummy: Foreign ownership	0.009	0.007	0.007	0.008	0.005
	(0.373)	(0.422)	(0.465)	(0.390)	(0.589)
Exporter (region)	0.162	0.142		0.107	
	(0.234)	(0.273)		(0.438)	
Exporter (sector)	-0.024***	-0.022***		-0.024***	
	(0.001)	(0.001)		(0.000)	
Exporter (region-sector)	1.353***	1.329***		1.390***	
	(0.000)	(0.000)		(0.000)	
Lag Dummy exporter		0.120***		0.117***	0.132***
		(0.000)		(0.000)	(0.000)
Exports (region)			0.117		0.043
			(0.213)		(0.641)
Exports (sector)			0.001		-0.024
			(0.983)		(0.379)
Exports (region - sector)			0.051***		0.046***
			(0.000)		(0.001)
Sector-Year	Yes	Yes	Yes	Yes	Yes
Observations	82443	82443	82443	76806	76133
Firms		16479	16479	15886	15806

Robust standard errors clustered at the firm level in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. Last column excludes outliers identified has observations with studentized residuals above 3 and below -3.

We find strongly significant positive local spillover effects (both when measuring them in terms of firms and value exported). This might indicate that proximity between exporters in the same sector reduces entry costs. There are several mechanisms at work within this channel. First, it could be that the local presence of other exporters in the same sector lowers the cost of production by increasing the availability of specialized capital or/and labor inputs (Bernard and Jensen, 2004). Second, the presence of other exporters in the same sector is likely to increase the stock of knowledge about exporting specific products, and this knowledge may be more readily available for other firms to profit. Interestingly, firms generally do not benefit from the proximity to other exporters if these do not operate in their same sector.[8] Moreover, surprisingly, we find a negative coefficient for the sector-specific spillovers, when considering the ratio of exporting firms to total firms in the sector. This indicates that the presence of other exporters in the same sector reduces the probability of exporting, likely due to competition pressures.

Results concerning financial factors and R&D expenditure are reported in Table 9. We follow Greenaway et al. (2007) in the choice of the two measures of financial constraints: liquidity and leverage. These measures have been widely used in the literature. The higher the liquidity ratio and the lower the leverage ratio, the better the firm financial health. Liquidity has a positive and strongly statistically significant effect on export market participation, although its economic effect is not large. Taking the results from

[8] This, however, might be driven by the fact that because we use a firm-level not a plant-level data set, the majority of firms have headquarters in Warsaw.

column 6 – with the largest estimated coefficient, the results suggest that if the liquidity ratio increases by one standard deviation (0.3), then the probability of exporters is expected to increase by slightly more than a third of a percentage point (more precisely, by 0.0036). On the other hand, the coefficient of leverage is small and not significantly different from zero. Firms in Poland are known to face credit constraints. Many of them are unable to borrow (as argued before, 30 percent of Polish firms in the World Bank Enterprise Survey claimed that access to finance was an obstacle or a major obstacle).

Liquidity matters for export activities. This is confirmed also in our findings since liquidity is an important factor to cover the sunk costs of entering the export market. This suggests that a sizable number of firms that are struggling to access external financing and that may have feasible export projects may be excluded from export markets due to liquidity constraints.

We also find that the export market is not a platform for Polish producers with high R&D intensity. R&D expenditure does not play a significant role in affecting the probability of exporting. The empirical analysis reveals that producers with high R&D content in their cost structures do not seem to be predominantly exporting, in addition only very few firms do conduct R&D in the sample (about 300 per year). This is to some extent confirmed by field interviews. When we asked some apparently sophisticated firms whether they were conducting R&D investments, the managers generally mentioned that they had "competence centers" or "design centers" – which were "one step below" R&D centers. One caveat here is that firms may not have any incentive to declare R&D expenditures. This is because by declaring them they do not receive incentives but their operative costs may increase due to more questionnaires being sent by statistical offices. The extent to which this is a significant cost that may induce firms not to declare expenses is unclear.

Table 9: The impact of liquidity and R&D on export decision

	(1)	(2)	(3)	(4)	(5)	(6)
Lag Log of Number of employees	0.071***	0.063***	0.071***	0.063***	0.063***	0.059***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Lag Log of real wages	0.005	-0.002	0.004	-0.002	-0.002	-0.002
	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Lag Log of TFP	0.003	0.003	0.003	0.003	0.003	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Lag REER at 3 digit	-0.010	-0.007	-0.010	-0.007	-0.007	-0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Lag Dummy: Foreign ownership	0.004	0.002	0.004	0.002	0.002	0.005
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)
Lag Liquidity	0.005***	0.004***			0.004***	0.012**
	(0.001)	(0.001)			(0.001)	(0.006)
Lag Dummy exporter		0.137***		0.137***	0.137***	0.136***
		(0.008)		(0.008)	(0.008)	(0.008)
Lag Leverage			0.000	0.000		
			(0.000)	(0.000)		
Lag Log of R&D					0.000	-0.000

					(0.000)	(0.000)
Sector-Year	Yes	Yes	Yes	Yes	Yes	No
Observations	82443	82443	82442	82442	82443	79897
Firms	16479	16479	16479	16479	16479	16108

Robust standard errors clustered at the firm level in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. Include controls for spillovers.

The results reported in Table 10 focus on the role of the exchange rate on export decisions. The real effective exchange rate (REER) is defined in terms of units of foreign currency for a unit of Polish zloty. Therefore, an increase indicates an appreciation of the Polish zloty. Results reported in column 1 reveal no overall average impact of exchange rate variations on export decisions. Real exchange rate depreciations increase the zloty-denominated revenues associated with export flows, but also make the inputs they import more expensive.

Table 10: The impact of the exchange rate on export decision

	(1)	(2)	(3)	(4)
Lag Log of Number of employees	0.071***	0.073***	0.064***	0.063***
	(0.000)	(0.000)	(0.000)	(0.000)
Lag Log of real wages	0.004	0.003	-0.003	-0.001
	(0.508)	(0.591)	(0.660)	(0.885)
Lag Log of TFP	0.003	0.003	0.003	0.003
	(0.277)	(0.295)	(0.302)	(0.407)
Lag REER at 3 digit	-0.010	-0.022***	-0.019**	-0.019**
	(0.140)	(0.007)	(0.017)	(0.047)
(Lag REER) X (Lag IIIR)		0.057**	0.057**	0.064**
		(0.022)	(0.028)	(0.035)
Lag IIIR		0.001	-0.002	-0.006
		(0.890)	(0.818)	(0.522)
Lag Dummy exporter			0.137***	0.105***
			(0.000)	(0.000)
Year	Yes	Yes	Yes	Yes
Observations	82443	82443	82443	69592
Firms	16479	16479	16479	15331

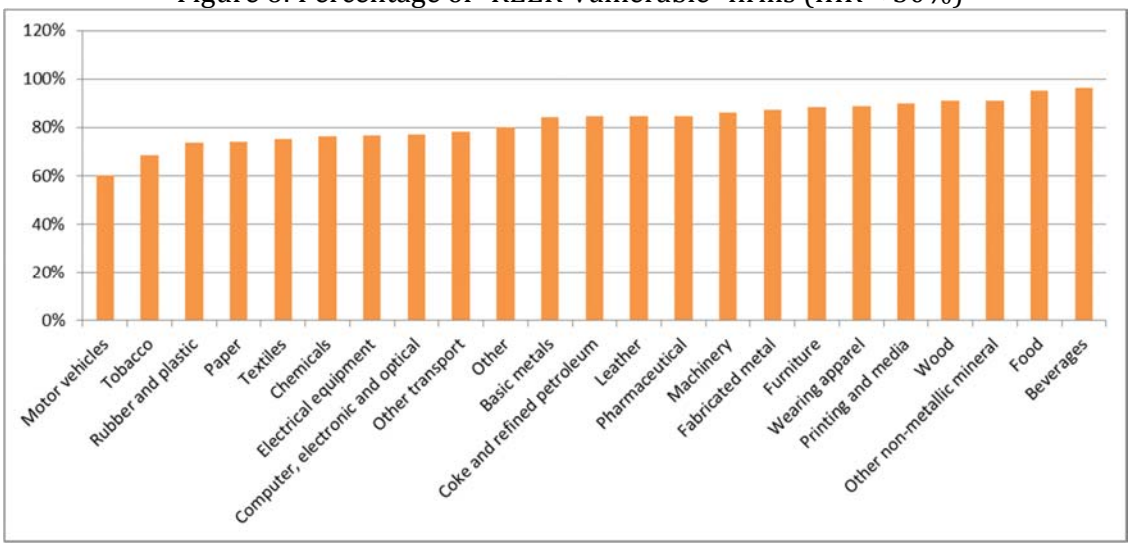
Robust standard errors clustered at the firm level in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. Last column excludes outliers identified has observations with studentized residuals above 3 and below -3.

However, when we condition the effect of the REER on the ratio of imported intermediate inputs on overall input costs (IIIR) (reported in columns 2-4), we find the expected results. In particular, we find evidence of a two-sided effect of the real exchange rate on firms' export decision. On one hand, a depreciation of the Polish zloty increases the zloty-denominated revenues from export orders, thus encouraging market participation. On the other, it increases the costs of imported intermediates as well as the costs of servicing debt denominated in foreign currency. The REER effect on export participation therefore depends on the imported intermediates input ratio (IIR) – the greater this is, the lower the overall effect of a real depreciation on the probability of exporting. Notice that the ratio of imported intermediates on total input costs captures the broader concept of

participation in international production networks, which also mediates the effect between RER and exports.

Considering the results reported in column 3, on average, firms that import less than 30 percent of their inputs are more likely to suffer from an appreciation of the zloty, while those with imported inputs above that threshold are likely to be relatively hedged. This latter group of firms are more likely to be found in the motor vehicles sector where the average IIIR ratio is close to the threshold at 28%. Firms most likely to suffer from appreciations of the zloty are found in the furniture, wood, printing and media, other non-metallic minerals, food and beverages sectors that rely mostly on domestic inputs.

Figure 6: Percentage of "REER-vulnerable" firms (IIIR < 30%)



Source: Authors' calculations from F01 database.

More than 80 percent of firms can be considered to show some responsiveness to exchange rate changes as their share of imports in the total import bill is relatively low. Figure 6 shows the portion of firms that import less than 30 percent of their imports for each sector considered. In the motor vehicles sector about 60 percent of the firms import less than 30 percent of their inputs as opposed to more than 95 percent in the food and beverage sectors.

Export transaction data

In this section, we employ customs-level export transaction data. The advantage of using this data set is that we have information on the destination of a firm's exports and, therefore, can determine the relevant source of exchange rate variability. Using firm-level data we were constrained to use sector-level measures of real exchange rate based on sectorial export shares to different destinations. Table 11 reports the results of estimating the equation (2) when the dependent variable is the decision to start exporting to a destination. The first two columns show that an appreciation of the PLN has a negative impact on the decision to export.

Table 11 – Exchange rate movement and export decision

Dep. var: export decision	(1)	(2)	(3)
Log Real exchange rate (RER)	-0.006	-0.010*	-0.264***
	(0.006)	(0.006)	(0.053)
GDP (log)	0.194***	0.124**	0.125**
	(0.051)	(0.053)	(0.053)
Real effective exchange rate	0.001***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Total imports (log)		-0.025***	-0.026***
		(0.009)	(0.009)
(RER) X (medium-small)			0.171***
			(0.056)
(RER) X (medium-large)			0.241***
			(0.053)
(RER) X (large)			0.276***
			(0.053)
Firm -destination fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	360105	352740	352740
Firm-destination pairs	168728	165994	165994

Standard errors clustered at firm-destination level in parenthesis. * $p < 0.1$, $^{**}p < 0.05$, *** $p < 0.01$. In column 3 the omitted interaction term is with small firms. We obtain similar results using a logit model

The last column shows that the impact is negative only for small and medium firms while exchange rate movements do not affect the decision to export of large firms.[9] Considering the last column, for small firms a 1% appreciation of the Polish zloty decreases the probability of exporting by 0.3 percentage points.

Table 12 – Exchange rate volatility and export decision

	(1)	(2)	(3)	(4)
Dep. var: export decision	FE	FE	Logit-FE	FE
ER volatility (ERV)	-0.194*	-0.149	-0.464	-0.815***
	(0.106)	(0.123)	(0.351)	(0.293)
GDP (log)	0.216***	0.111**	0.240	0.111**
	(0.051)	(0.053)	(0.162)	(0.053)
Real effective exchange rate	0.001***	0.000	0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.000)
Total imports (log)		0.001	-0.005	0.001
		(0.009)	(0.027)	(0.009)
(ERV) X (medium-small)				0.498
				(0.352)
(ERV) X (medium-large)				0.731**
				(0.315)
(ERV) X (large)				0.797***
				(0.299)
Firm -destination fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	359556	352221	323269	352221

[9] As small we denote exporters with mean value of exports lower than the 25th percentile of the population. Analogously, medium-small are located between the 25th percentile and median, medium-large between median and the 75th percentile, while large exporters are above the 75th percentile.

Firm-destination pairs	168481	165761	136813	165761

Standard errors clustered at firm-destination level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. In column 4 the omitted interaction term is with small firms.

Finally, Table 12 considers the impact of exchange rate volatility on export decision. The volatility of the exchange rate also negatively impacts export decisions (column 1). The effect, however, becomes less precisely estimated when controlling for total imports of destination country. The last column explores heterogeneous effects across firm size and shows that, again, small firms are more negatively affected by exchange rate volatility. Large firms are also negatively affected but the impact is notably smaller and very close to zero. This is likely associated with larger firms being able to hedge both through relying on a larger share of imported inputs and of credit in foreign currency, and through other financial instruments.

6. Results: Export Intensity

In this section, we present the findings on the determinants of export intensity and discuss the results from firm-level data and customs–level data.

Firm-level data

Once firms have decided to enter export markets, what drives the intensity with which they participate in them? This section focuses on factors affecting export intensity – the intensive margin - at the firm level. Conceptually, factors that affect both the fixed and variable costs of exporting are likely to affect both exports at the extensive and at the intensive margin, while those that predominantly act on one or the other type of costs, will have different effects on the extensive and the intensive margins. In this way, examining the results of this section in light of the findings of the previous section is informative to better understand the channels through which different potential determinants affect export performance.

The results of estimating the export intensity equation (4) are reported in Table 13. [10] The first column reports the results of a linear model with firm fixed effects while the remaining columns deal with sample selection by including the inverse Mills ratios from a set of probit estimations. We find that firms that have experienced an increase in TFP are more likely to export greater volumes. The result is consistent across all specifications. The number of employees is also positively correlated with export intensity. The overall impact of the exchange rate is again insignificant. In column 4, we include the imported intermediates input ratio (IIIR) and its interaction with the exchange rate. We find that firms that increase their share of imported intermediates are more likely to experience an increase in exports. Appreciations of the exchange rate do not have a negative effect on export intensity even when firms import zero inputs.

[10] The results for the first-stage regression of export participation (equation 3) are reported in Table A3 of the Appendix.

Therefore, we do not find evidence of a negative exchange rate effect. Finally, we do not find any significant effect of liquidity and investment in R&D on exports value.

Table 13: Determinants of export intensity

	(1) FE	(2) CRE	(3) CRE	(4) CRE	(5) CRE
Lag Log of Number of employees	0.808***	0.753***	0.753***	0.737***	0.736***
	(0.030)	(0.036)	(0.036)	(0.036)	(0.036)
Lag Log of real wages	0.119***	0.018	0.029	0.015	0.015
	(0.032)	(0.042)	(0.042)	(0.042)	(0.042)
Lag Log of TFP	0.082***	0.074***	0.073***	0.079***	0.079***
	(0.015)	(0.019)	(0.018)	(0.019)	(0.019)
Lag RER at 3 digit	-0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Lag Dummy: Foreign ownership	0.111**	0.053	0.061	0.058	0.058
	(0.050)	(0.054)	(0.054)	(0.054)	(0.054)
Lag IIIR			0.102**	0.102**	0.102**
			(0.052)	(0.051)	(0.051)
(Lag REER) X (Lag IIIR)			-0.001	-0.001	-0.001
			(0.002)	(0.002)	(0.002)
Lag Liquidity				0.011	0.011
				(0.044)	(0.044)
Lag Log of R&D					0.000
					(0.002)
Sector	No	Yes	Yes	Yes	Yes
Region	No	Yes	Yes	Yes	Yes
Time-averages of time variant variables	No	Yes	Yes	Yes	Yes
Mills ratios	No	Yes	Yes	Yes	Yes
Observations	57159	49991	49991	49877	49877

Standard errors clustered at the firm level in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. Control variables include Mills ratios generated from estimating equation 3.

Export transaction data

Table 14 reports the results when the dependent variable is the log of total exports to a given destination based on the custom-level export transaction data. The first two columns consider the impact of exchange rate movements and find no significant impact on sales both when considering the contemporaneous (column 1) and lagged effect (column 2). Given the lack of firm-level information we cannot explore whether this is the result of a two-sided effect as we have done using the F01 data set. The remaining columns consider the impact of exchange rate volatility and find a significant and negative impact on the intensive margin. The impact, however, is very small and non-statistically different from zero when controlling for total imports of destination country. The lagged effect is instead stronger and persists when including the additional control (column 6).

Table 14 – Exchange rate movements and volatility on exports value

Dep. var: export value (log)	(1)	(2)	(3)	(4)	(5)	(6)
Log of Real exchange rate (RER)	0.003					

	(0.007)					
Log of RER – lagged		0.009				
		(0.007)				
ER volatility (ERV)			-0.384***	-0.096		
			(0.138)	(0.149)		
ER volatility (ERV) lagged					-1.029***	-0.480***
					(0.162)	(0.171)
GDP (log)	0.748***		0.736***	0.517***		
	(0.069)		(0.069)	(0.074)		
Real effective exchange rate	0.002***		0.002***	0.002***		
	(0.000)		(0.000)	(0.000)		
Total imports (log)				0.117***		
				(0.015)		
GDP (log) lagged		0.800***			0.865***	0.771***
		(0.089)			(0.084)	(0.089)
REER lagged		-0.001***			-0.002***	-0.002***
		(0.001)			(0.001)	(0.001)
Total imports (log) lagged		0.058***				0.056***
		(0.016)				(0.017)
Firm -destination fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	940589	560814	938418	905655	578969	559714
Firm-destination pairs	302561	161513	301816	292177	165434	161291

Standard errors clustered at firm-destination level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7. Conclusions

In this paper, we have analyzed the main drivers associated with firms' participation in export markets and with the intensity with which they trade. In particular, we explored the importance of four main factors: the real exchange rate, sunk costs, local and sectoral spillovers, and financial conditions.

We found that Polish exporters are exceptional performers, as it is the case elsewhere. They are on average 3 times larger, 12 percent more productive and are 5 times more likely to be foreign owned than non-exporters. Firms face high fixed (sunk) costs for entering export markets. This makes firms that exported in the previous year up to 50 percent more likely to export also in the following year because they have acquired an intangible asset associated with information and know-how. This also partially explains our second finding that liquidity plays an important role by facilitating entry to the export market. However, we also find that proximity between exporters in the same sector reduces such entry costs. This is likely due to lower cost of production given by an increased availability of specialized capital or/and labor inputs, or due to the increased availability of market information.

Finally, we find that real exchange rate movements affect firms' decisions to enter export markets. But the effect depends on the intensity with which firms use imported intermediates and participate in international production networks. In particular, we find that 80 percent of exporters are not fully 'hedged' against exchange rate changes. Interestingly, the effect of RER changes is also conditional on firms' size. Larger firms tend to be more immune to RER changes, likely related to their ability to hedge against RER shocks in multiple manners.

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Appendix

Descriptive Statistics by sector

Table A1 reports means and standard deviations of the established relevant firms' characteristics employed in the analysis.

Table A1: Descriptive statistics of firms' characteristics by sector

Sector	Employment		Average wage		TFP		Foreign firms	
Food	129.52	(266.09)	25.93	(34.20)	4.15	(0.82)	0.10	(0.29)
Beverages	172.99	(391.53)	38.72	(35.91)	4.42	(1.16)	0.21	(0.41)
Tobacco	543.83	(464.26)	53.33	(37.04)	5.09	(1.35)	0.64	(0.48)
Textiles	118.42	(199.72)	26.84	(23.14)	4.13	(0.77)	0.25	(0.43)
Wearing apparel	107.48	(156.11)	23.63	(221.55)	3.85	(0.68)	0.16	(0.37)
Leather	103.57	(136.91)	27.29	(112.40)	3.98	(0.76)	0.14	(0.35)
Wood	100.41	(167.70)	24.86	(61.07)	4.04	(0.73)	0.14	(0.35)
Paper	114.44	(173.28)	32.91	(45.99)	4.41	(0.81)	0.22	(0.41)
Printing and media	82.31	(185.11)	36.38	(38.46)	4.39	(0.71)	0.11	(0.31)
Coke and refined petroleum	368.79	(832.43)	58.28	(29.96)	5.38	(1.08)	0.13	(0.33)
Chemicals	157.23	(349.45)	42.05	(27.92)	5.28	(0.99)	0.25	(0.43)
Pharmaceutical	233.49	(323.28)	56.61	(82.60)	5.61	(0.96)	0.21	(0.41)
Rubber and plastic	109.58	(230.20)	31.14	(20.40)	4.49	(0.75)	0.24	(0.43)
Other non-metallic mineral	130.96	(229.94)	37.16	(109.23)	4.57	(0.86)	0.18	(0.39)
Basic metals	247.82	(820.56)	37.80	(64.97)	4.65	(0.84)	0.19	(0.40)
Fabricated metal	92.86	(136.61)	35.47	(55.77)	4.53	(0.72)	0.19	(0.39)
Computer, electronic and optical	174.18	(395.62)	41.59	(75.15)	5.11	(0.85)	0.26	(0.44)
Electrical equipment	200.23	(473.16)	37.22	(45.39)	5.18	(0.87)	0.27	(0.44)
Machinery	125.42	(234.08)	38.51	(28.93)	5.13	(0.77)	0.20	(0.40)
Motor vehicles	348.07	(719.54)	37.04	(137.88)	5.33	(0.95)	0.44	(0.50)
Other transport	315.40	(661.78)	47.56	(112.80)	5.07	(0.91)	0.28	(0.45)
Furniture	185.99	(435.18)	29.86	(219.30)	4.22	(0.74)	0.17	(0.38)
Other	94.84	(162.42)	34.37	(132.73)	4.43	(0.93)	0.22	(0.41)

Source: Authors' calculations from F01 database. Tables reports sample averages and standard deviations in parentheses. Wages are in thousands PLN.

The average number of employees (a proxy for average firm size) ranges between 82 in the Printing and media sector and 368 in the Coke and refined petroleum sector. The average wage is computed as the ratio between the firm's total wage bill and its number of employees. The lowest wages are found in the Wearing apparel sector (26,000 PLN) while the highest are again in the Coke and refined petroleum sector (about 58,000 PLN). Foreign is a dummy equal to 1 if a firm shows some form of foreign ownership, and 0 otherwise. The largest share of foreign owned firms is found in the Tobacco sector (64%) followed by the Motor vehicle sector (44%). Regarding our measure of productivity, which was calculated using the Levinsohn and Petrin (2003) method, the Pharmaceutical sector tops the list while the Wearing apparel sector shows the lowest level of total factor productivity.

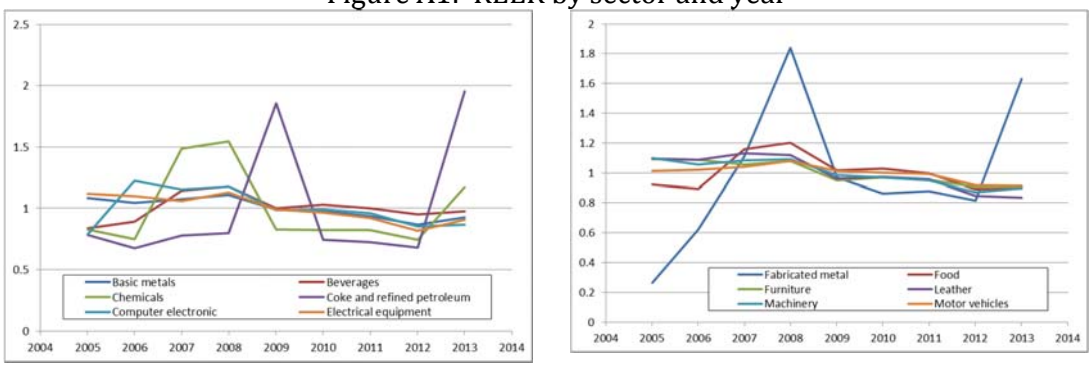
Table A2: REER and Imported intermediate inputs ratio (IIIR) by sector

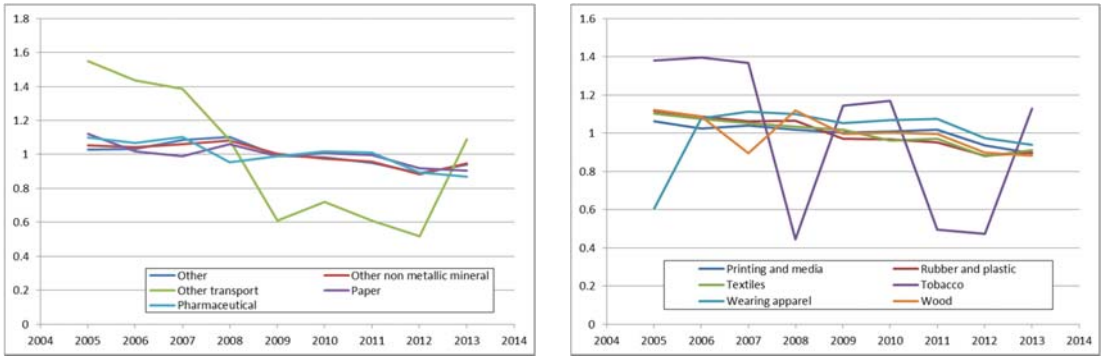
Sector	REER		IIIR	
	Mean	Sd	Mean	Sd
Food	32.88	(20.58)	0.05	(0.13)
Beverages	12.75	(1.44)	0.05	(0.10)
Tobacco	38.09	(15.37)	0.20	(0.22)
Textiles	15.31	(6.67)	0.18	(0.23)
Wearing apparel	6.44	(0.50)	0.10	(0.35)
Leather	18.15	(15.26)	0.13	(0.21)
Wood	9.25	(2.78)	0.08	(0.16)
Paper	15.78	(1.01)	0.18	(0.24)
Printing and media	22.10	(0.75)	0.08	(0.19)
Coke and refined petroleum	8.53	(4.70)	0.14	(0.22)
Chemicals	28.15	(14.30)	0.19	(0.23)
Pharmaceutical	46.81	(16.30)	0.14	(0.25)
Rubber and plastic	16.50	(0.98)	0.18	(0.24)
Other non-metallic mineral	20.96	(8.26)	0.08	(0.15)
Basic metals	17.18	(5.55)	0.12	(0.26)
Fabricated metal	15.83	(47.86)	0.10	(0.20)
Computer, electronic and optical	27.07	(24.57)	0.21	(0.81)
Electrical equipment	21.89	(7.43)	0.18	(0.25)
Machinery	49.12	(21.13)	0.11	(0.22)
Motor vehicles	9.92	(0.69)	0.28	(0.32)
Other transport	12.96	(6.82)	0.16	(0.24)
Furniture	4.24	(0.29)	0.10	(0.17)
Other	19.16	(5.26)	0.16	(0.26)

Source: Authors' calculations from F01 database. Tables report sample averages and standard deviations in parentheses.

Table A2 reports average REER and IIIR by sector while Figure A1 plots the sector-level exchange rate over time. The series have been normalized to have mean 1 over the period 2005-2013. The largest fluctuations are observed in the following sectors: chemicals, coke and refined petroleum products, fabricated metals, other transport and tobacco.

Figure A1: REER by sector and year





Source: Authors' calculations from WDI (exchange rate) and Comtrade (bilateral trade flows by sector). The exchange rate series have been normalized to have mean one.

Export participation (selection) estimations

The results for the first-stage regression of export participation (equation 3) are reported presented in table A3 for each year. We only report the most comprehensive specification. Consistent with the literature and with our previous findings we find that firms that export are more likely to be bigger, more productive, and foreign owned (see for example, Greenaway and Kneller, 2007). These variables are significantly correlated with the probability of entering the export market in all years. Liquidity is also positively correlated with export participation in 5 out of 8 specifications. Similar to our previous findings, exchange rate fluctuations do not have an overall effect on entry as the negative effect through higher export prices is compensated by a positive effect through lower input costs. The interaction effect, however, is only visible in one specification as this specification lacks the time dimension that allows a better identification of such effect. Finally, there is also some limited evidence that firms with higher R&D expenditure are more likely to participate in the export market. These regressions are used to generate the inverse Mills ratios for each period that will be included in the estimation of the export intensity equation to control for selection into the export market.

Table A3: Annual probit models for export participation (selection equation)

	(1) 2006	(2) 2007	(3) 2008	(4) 2009	(5) 2010	(6) 2011	(7) 2012	(8) 2013
Dep. variable: Dummy Exporter, Yes = 1								
Lag Dummy exporter	2.315***	2.380***	2.338***	2.270***	2.174***	2.306***	2.394***	2.511***
	(0.043)	(0.042)	(0.042)	(0.041)	(0.039)	(0.041)	(0.042)	(0.043)
Lag Log employees	0.254***	0.260***	0.313***	0.327***	0.301***	0.260***	0.358***	0.248***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.023)	(0.023)	(0.025)	(0.026)
Lag Log of real wages	0.093*	-0.033	0.027	-0.019	0.068	0.072	-0.004	0.066
	(0.053)	(0.052)	(0.050)	(0.052)	(0.049)	(0.052)	(0.055)	(0.055)
Lag Log of TFP	0.075**	0.045	0.048	0.035	0.117***	0.049	0.095***	0.095***
	(0.036)	(0.036)	(0.036)	(0.034)	(0.032)	(0.033)	(0.035)	(0.035)
Lag REER at 3 digit	0.068	0.050	0.053	0.006	-0.001	0.005	0.005	0.002
	(0.464)	(0.042)	(0.043)	(0.007)	(0.003)	(0.004)	(0.007)	(0.006)
Lag IIIR	1.106***	0.869***	0.616***	1.066***	0.818***	0.327	0.616***	0.763***
	(0.268)	(0.235)	(0.180)	(0.190)	(0.222)	(0.209)	(0.210)	(0.189)
(Lag REER) X (Lag IIIR)	-0.009	0.004	0.007	0.003	0.007	0.020**	0.007	-0.002
	(0.010)	(0.009)	(0.005)	(0.005)	(0.009)	(0.010)	(0.009)	(0.006)

Lag Foreign ownership	0.392***	0.321***	0.424***	0.280***	0.247***	0.116*	0.336***	0.276***
	(0.078)	(0.071)	(0.070)	(0.067)	(0.061)	(0.061)	(0.068)	(0.071)
Lag Liquidity	0.045	0.189***	0.040	0.256***	0.124**	0.033	0.074	0.054
	(0.067)	(0.068)	(0.067)	(0.064)	(0.059)	(0.063)	(0.068)	(0.068)
Lag Log of R&D	0.008	0.015	0.016	0.005	0.018**	0.017	0.008	0.003
	(0.010)	(0.011)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9806	10073	9968	10124	10694	10279	10430	10534

Standard errors in parentheses. *** indicates significant at 1%, ** at 5% and * at 10%. The table reports coefficients from separate probit models (not marginal effects) for each year.

Qualitative evidence

Qualitative based evidence tends to support our findings. Field interviews with selected firms were conducted to help in understanding two important issues, namely: (1) how firms react to exchange rate shocks and how they envision the possibility of euro adoption, (2) how the characteristics of the firm affect this reaction. The main lessons learned from the interviews are the following:

- Firms systematically expressed views that their business was not on exchange rate speculation, and that likely, euro adoption will be a positive development conditional on the zloty/euro parity at which it happens (most mentioned 4 zloty/euro). Exporting firms' reactions to exchange rate changes are heterogeneous and depend on:
    - *The type of product exported*. For example, for firms from a service sector with highly customer-tailored products (IT systems, for example), re-orientation is not viable option and thus exchange rate changes are perceived as a noise that affects their business decisions. This tends to be the case in B2B type of businesses. For firms exporting mass products directly to the consumer, re-orientation after exchange rate changes is less costly, and may benefit firms' margins – in line with literature on irreversible investment and RER uncertainty.
    - *The currency mismatches of firms' balance sheets.* Given that most exporting firms have a large portion of their revenues coming from euro denominated exports and a large portion of their costs (import) denominated in euro the effects of changes in the price of the zloty/euro are mitigated (in line with the literature on trade effects of exchange rates and global value chain participation).

The size of the firm, and in particular, their ability to hedge using available financial instruments. Only large firms hedge (the rest use "natural hedging" implying matching the currency in which they source inputs with the currency in which they get revenues). This is despite the fact that, according to anecdotal evidence, the market for hedging instruments is deep.