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Exchange Rate Risk as an Obstacle to Export Activity[1]

Abstract: The focus of the paper is on identifying major factors that can determine the vulnerability of Polish manufacturing companies to exchange rate risk. In order to verify our hypotheses, we have estimated logistic regression models based on a unique database to assess internal and external factors that make companies vulnerable to exchange rate risk. Our observations confirm the importance of exchange rate variability as one of the obstacles to starting and conducting export activity as well as expanding it to new markets. We have found that exchange rate risk is particularly severe for companies that are financially constrained and get financing abroad as well as those whose balance sheets are negatively affected by devaluation. Also vulnerable are innovative firms and those that rely more on input imports.

Exchange rate volatility appears to be less of a concern for foreign-owned companies and enterprises that have higher shares of euro-denominated receivables and invoice exports in the Polish zloty. Companies competing by means of product quality and distribution channels are also among those less vulnerable to exchange rate risk.

Generally, we have confirmed the problem of exchange rate risk as an important cost to export activity. This gives some implications for exchange rate risk management at both the macroeconomic and microeconomic levels as well as for monetary integration.

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Introduction

The exchange rate is one of the most important prices in the economy and the related exchange rate risk can be a significant factor affecting macroeconomic variables and microeconomic incentives in international trade. Contrary to intuitive expectations, the negative effect of exchange rate risk on trade has not been definitively confirmed empirically. Sometimes a positive influence of exchange rate risk on trade flows is documented [Fang *et al.*, 2009]. Nevertheless, advocates of monetary integration argue that currency stability is conducive to international trade because of exchange rate risk elimination. They see the single currency as a more trustworthy solution than any other exchange rate regime since it reduces exchange rate volatility to zero, eliminates the competitive devaluation of the national currency, promotes long-term relationships, directs investment relocation, and encourages various forms of political cooperation [Mongelli, De Grauwe, 2005].

The problem in weighing the costs and benefits of the monetary union is complicated by the fact that a floating exchange rate regime is appreciated as one of the most effective external shock absorbers. However, it is sometimes blamed as a source of instability. Thus, the decision to embark on a road toward the monetary union and the shape of current exchange rate policy have to be carefully thought through.

In this paper, we throw light on the relative importance of the costs of exchange rate risk for foreign market entry and penetration by Polish manufacturing firms. We aim to identify firms' characteristics that make them particularly vulnerable to exchange rate risk. The analysis conducted in this paper will make it possible to identify the channels through which exchange rate risk and the concomitant transaction costs act as a drag on exports by Polish companies.

Throughout the paper, the terms "exchange rate risk" and "volatility" will be used interchangeably. Moreover, exchange rate fluctuations create uncertainty because they are largely unpredictable. The famous Meese and Rogoff puzzle states that a random walk forecasts exchange rates better than economic models. On the basis of a thorough empirical evaluation of the success of the predictors identified in the literature, using the most recent techniques and databases, Rossi [2013] concludes that exchange rate predictability depends on the choice of predictor, forecast horizon, sample period, model, and forecast evaluation method. Thus, volatile exchange rates not only expose firms to currency risk but also create uncertainty.

The plan of the paper is as follows. After the literature review in the next part and presentation of our hypotheses, we turn to data description and methodological issues. In the empirical part, we assess the importance of exchange rate risk against the backdrop of other obstacles to entering or increasing penetration of foreign markets. We also present the results of a regression model analysis of firms' characteristics, which have explanatory power

for the probability of reporting concerns about exchange rate volatility costs. Conclusions are included in the final part.

Related literature and testable hypotheses

Exchange rate changes are seen as an important potential obstacle to trade [Huchet-Bourdon, Korinek, 2011][2]. Their effects operate through two channels: exchange rate volatility and the exchange rate level.

One strand of literature, to which our paper contributes, underlines the importance of exchange rate risk, which is usually associated with its volatility and is believed to have a negative impact on trade. High volatility and unpredictability make companies' financial planning more difficult, affect investment decisions and financial flows, and generate risk or costs related to hedging against it. An increase in exchange rate volatility, which is not fully predictable, forces some agents to decrease their engagement in foreign operations [Dell'Ariccia, 1999].

Another strand of the literature, not directly associated with exchange rate risk, considers the role of the exchange rate level, which, according to the literature: 1) may have negative consequences when it is misaligned (overvalued or undervalued) from the equilibrium level; 2) may affect trade and economic activity in a positive way when the currency is undervalued [Rodrik, 2008]; 3) may affect trade in a negative way even when the currency is undervalued because it can petrify the current economic structure, which is not optimal in the long term.

While the exchange rate level is not always a result of its volatility but of many different factors such as structural (level of development) or institutional (exchange rate regime) features, it can still pose problems for exporting activity. As we are prone to admit that it is probably better for exporters to operate in an environment with an undervalued rather than overvalued currency, the critical question is the scale of misalignment[3]. A deeper and longer disconnection from the equilibrium level may imply higher volatility in the future and force companies to undergo costly adjustment processes, so the exchange rate level can also be a source of risk for entrepreneurs[4].

Nevertheless, empirical research does not fully confirm the negative influence of exchange rate volatility and risk on trade[5]. As indicated by Taglioni

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[2] Exchange rate risk, unlike uncertainty, which is more difficult to describe and assess, can be measured and hedged [Knight, 1921; Guerron-Quintana, 2012].

[3] Examining an asymmetric reaction of exporters to exchange rate appreciation and depreciation, Fang *et al.* [2009] indicate a "fear of appreciation" and "love of depreciation" in the case of Asian countries because of their economies' exporting models.

[4] The greater the misalignment, the higher the risk of volatility as a result of the forces which drive the exchange rate closer to the equilibrium level.

[5] Usually, it is assumed that exchange rate volatility has a negative impact on trade, but the key issue is the assumption related to the companies' risk aversion attitude. Firms that are not afraid

[2002], who reviews research between 1970 and the end of 1990, the negative influence of exchange rate changes on trade, if any, is not large or difficult to estimate. New meta-analyses indicate that, depending on assumptions, exchange rate volatility can both foster and impede international trade [Auboin, Ruta, 2013]. A slight negative effect of exchange rate volatility on trade may be confirmed, yet it depends on various factors: companies' risk appetite, the availability of hedging instruments, the import content of exports, the price elasticity of demand, and invoicing trade in the domestic currency.

In the literature concerning exchange rate fluctuations and their influence on exports, factors related to financial development are often indicated. For example, developing countries with less developed financial markets are more susceptible to real exchange rate volatility [Grier, Smallwood, 2007]. Hall *et al.* [2010] indicate that it is important to distinguish between emerging market economies and other developing economies. They confirm that, in the case of emerging markets with more open capital markets, the vulnerability of exports to exchange rate fluctuations was lower. The main reason might be that developed financial markets should give access to different and sophisticated hedging instruments.

Below we recall the most often cited reasons for a weak relation between exchange rates and trade, as well as difficulties in identifying and measuring the diversified impact of exchange rate changes.

Aggregation bias

One of the reasons for the inconclusiveness between economic intuition and empirics might be that most research was based on aggregated trade data. A comprehensive approach to the role of the exchange rate in trade points to the need to assess the impact of volatility in individual economic sectors using and testing various real exchange rate measures [Stavarek, Simakova, 2014]. An aggregate measure of the real exchange rate level based on average labor costs (or other deflators) across all sectors may be misleading because of aggregation bias [Altomone *et al.*, 2012].

Non-linear relationship between exchange rate volatility and trade

Several empirical studies have explored the nonlinearity of the exchange rate volatility effect on trade. A semiparametric regression is one of the approaches to address nonlinearity in economic variables. Mukherjee and Pozo

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of higher volatility can increase trade due to higher exchange rate variability. Moreover, even if firms are high risk-averse, the result of variability may depend on their reaction to it. As indicated in a model presented by De Grauwe [1988], companies may increase trade due to increasing volatility to overcome problems with exchange rate risk. It is, of course, conditioned by a flexible reaction of companies in terms of production.

[2011] applied this method to a pooled sample of more than 200 countries observed in the 1957–2000 period. They augmented the gravity model of bilateral trade flows with a proxy for volatility in the exchange rate calculated as the standard deviation of monthly exchange rate returns. The authors find that exchange rate volatility depresses trade and that its negative impact strengthens as the level of volatility increases. However, at very high levels of exchange rate volatility, this effect abates and disappears. One of the likely explanations is that high exchange rate volatility propels firms to find ways to cope with its costs, using informal dollarization, for instance.

Using similar methodology and data confined to trade among G-7 countries, Herwartz [2003] compared the scope of linear and nonlinear models in forecasting trade growth conditional on exchange rate uncertainty. The main findings were that the linear model was mostly outperformed by each of the nonlinear forecasting methods. In particular, semiparametric forecasts were the most competitive under scenarios of large or unusual volatility. It should be noted that the relation between trade and exchange rate volatility lacked homogeneity across countries and imports vs. exports.

A threshold effect model is an alternative methodology used to detect nonlinear relationships. It assumes that there exists a threshold value of exchange rate volatility where the effect on the trade volume changes. Zhang *et al.* [2006] used the GARCH model to estimate the conditional variance of the bilateral exchange rate and computed the threshold value by grid searching and minimizing the conditional sum of the squared residuals of the objective equations. The analysis of bilateral exports from Germany, France, the UK, Canada, Japan, and Italy to the United States confirmed that threshold effects exist for all countries except Germany. Moreover, when volatility exceeds the threshold value, volatility impacts are generally significant and positive, while they are insignificant below the threshold value.

"New" new trade theory approach

A relatively recent strand of empirical literature on "new" new trade theory indicates that researchers should turn to the microeconomic approach and data in order to explain nuances related to export performance and its determinants [Melitz, 2003]. According to this framework, exporting is associated with sunk costs because it requires learning about foreign market conditions, finding partners and intermediaries, maintaining an export unit or logistics center, and product adaptation. In other words, foreign market entry has to be preceded (at least partly) by irreversible investment, which can be delayed when a firm operates in an uncertain environment. These sunk costs are paid in one period and at a given (known) exchange rate, but revenues depend on a different exchange rate in the future [Russ, 2007]. That is why exchange rate volatility is one of the prominent sources of uncertainty for exporters. Exchange rate volatility imposes additional costs on firms engaged

in international market activities. According to the approach to international trade based on firm heterogeneity, only the most efficient enterprises may export because they can cover the fixed costs of trade. In the case of exchange rate changes, exporters would need to raise their productivity levels; otherwise, they would have to exit the foreign market. From this (microeconomic) point of view, exchange rate variability may have a negative influence on trade, but its burden depends on companies' productivity, which is highly differentiated among and within economic sectors.

Asymmetric effects of exchange rate direction changes

Most researchers trying to explore the relationship between the exchange rate and trade treated exchange rate volatility symmetrically, assuming the same channels of companies' adjustment to appreciation and depreciation episodes. One strand of literature highlights the fact that exchange rate risk affects exports asymmetrically depending on the direction of exchange rate changes—appreciation or depreciation of a local currency [Fang *et al.*, 2009; Marczewski, 2002]. If the local currency becomes more expensive (appreciates), meaning higher prices paid by foreigners, a company that wants to keep its market share is usually prone to reducing margins and profits (in the short term) and keeps foreign prices unchanged [Fang *et al.*, 2009]. In the long term, adjustment might be made through lowering the costs of production [Marczewski, 2002]. In the currency depreciation scenario, companies are prone to maintaining rather than increasing margins and lowering foreign prices, while simultaneously increasing sales volume. One explanation of this asymmetric reaction to the direction of exchange rate changes is the "inaction band" phenomenon described below.
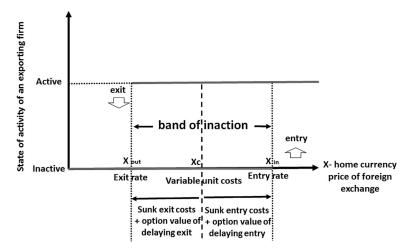
"Inaction band" as a source of the "export hysteresis loop"

The "inaction band" concept can explain the weak relationship between trade and the exchange rate. It posits that a "pain threshold" exists and that the reaction of exports to exchange rate movements should only occur after this rate or band of rates is passed. It means that every company has its own "pain threshold" determined by its competitiveness, margins, liquidity, productivity, and so on.

The "inaction band" is limited by two borders—see Figure 1. The first one describes such a level of the exchange rate that companies are prone to enter the export market [Xin], and the second assumes such a level of the exchange rate that companies are prone to exit [Xout]. Somewhere in between, there is an exchange rate level that covers a variable unit cost [Xc]. But export activity is also burdened with the sunk cost, which should be compensated. That is why we expect that when the exchange rate moves to the right (devaluation),

it increases the chances of market entry, but makes it economically reasonable only after the Xin point is reached.

Figure 1. Discontinuous micro hysteresis loop

Source: Belke *et al.* [2009].

When the local currency appreciates, the exchange rate moves to the left. But even below the Xc level, a firm may adopt the "wait and see" strategy and decide not to exit the export market, adjusting on the costs or revenue side. If the appreciation is temporary, it would be unreasonable to exit too early. This adaptability of companies results in the "inaction band" being characterized by a relatively weak relation between the exchange rate level (and its changes, as a given exchange rate level is a result of some volatility) and trade intensity.

Monetary unification effects

Another strand of literature indicates an important role of the currency union as a specific form of exchange rate risk elimination. Interestingly, despite the lack of firm empirical evidence on a negative relationship between exchange rate volatility and foreign trade, expectations related to the euro's influence on trade were more optimistic. The reasons to believe that the European monetary union is a reliable and irreversible form of exchange rate commitment were the relatively high level of economic and financial integration among core countries in the past (Deutsche mark zone) and the creation of many institutions (Maastricht Treaty, ECB, Stability and Growth Pact) which should be complementary to the Common Market.

Optimistic thinking about the potential influence of the euro on trade was also spurred by the "endogeneity of optimum currency area conditions" doctrine developed in the second half of the 1990s. It was inspired by Andrew

Rose's [2000] research. According to its assumptions, a single currency should increase trade with the related increased business cycle synchronization and decreased costs of giving up national monetary policy. Eventually, Rose's research and endogeneity approach were criticized for many reasons, including sample bias [Baldwin *et al.*, 2008]. The trade increase in the euro area proved to be much smaller than initially expected, estimated at approximately 3–5%, and some research also questions the positive influence of the euro on trade (for an in-depth meta-analysis, see Havránek [2010]). A rather small effect of the euro was pointed out at the aggregate macroeconomic and sectoral levels across countries and industries. Simultaneously, several channels were identified when considering the influence of the euro on companies' export decisions: the "new exporters channel" whereby new companies decide to start export activities, encouraged by lower transaction costs and a reduced exchange rate risk; the "new markets channel," where existing exporters expand their activities to new geographical markets; and the "product variety channel," where exporters introduce new or modified products (for the micro effect review, see Tchorek [2015]).

Based on this evidence and further in-depth literature review, we formulate a set of hypotheses that we verify in the next section.

Hypothesis 1: The financial channel makes companies more vulnerable to exchange rate risk on the liabilities side (financial constraints, financing abroad, negative financial effect of depreciation) and less vulnerable on the assets side (euro-denominated receivables, exports invoiced in the Polish zloty).

The above set of companies' features collected in one hypothesis is justified by their interconnections. In the first case, Hericourt and Poncet [2013] confirmed that companies' vulnerability to exchange rate changes is higher if they are financially constrained in access to financing. The justification of our assumption further stems from the *original sin* phenomenon, which indicates that borrowing money in foreign currencies exposes countries/companies to the risk of losing their ability to service their debt as a result of depreciation of the national currency. Companies that are adversely affected by exchange rate depreciation experience negative balance sheet effects that outweigh the positive effect of competitiveness on trade [Eichengreen *et al.*, 2003]. We assume that euro-denominated receivables and exports invoiced in the Polish zloty are two factors that decrease sensitivity to exchange rate risk. The first factor is about natural hedging, a popular way of reducing exchange rate exposure [Döhring, 2008]. The main advantage of such a strategy is that it is cheaper than financial hedging and involves geographical and product diversification as well as matching companies' revenues and expenditure [Papaioannou, 2006]. The ability to conclude contracts and make payments in the local currency shifts exchange rate risk to the importer.

Hypothesis 2: Non-price competiveness factors—such as reliance on product quality, distribution channel and involvement in the foreign ownership structure—make companies less vulnerable, while innovation activity makes them more susceptible to exchange rate risk.

Competition based on product quality and distribution channels should also increase robustness with respect to exchange rate volatility because such companies usually sell more sophisticated goods and have more opportunities to secure higher margins. The availability of developed distribution channels enables better sales adjustment in the case of exchange rate changes. For example, goods may be distributed faster in the case of exchange rate depreciation or its low level. Moreover, as business studies indicate, competing on quality and channel distribution are complementary strategies [Monerris *et al.*, 2000].

In the case of foreign ownership, less sensitivity to exchange rate risk is a result of the fact that it can provide access to international production networks, knowledge and intangible assets, while also helping solve the problem of financial constraints [Kolasa *et al.*, 2010; Gorodnichenko *et al.*, 2014]. Involvement in global supply chains reduces the impact of exchange rate fluctuations on trade flows within international corporations [Cheng *et al.*, 2016]. Moreover, multinational corporations may dampen exchange rate changes through transfer prices.

In the case of innovativeness, exchange rate volatility is believed to have a negative impact on macroeconomic variables, investment decisions, trade and innovation [Aghion *et al.*, 2006]. Innovation activity is a risky, long-term investment and this is why more instability due to exchange rate changes should have a negative impact on it. Moreover, as indicated in some studies, innovative companies are usually more vulnerable to financial constraints [Aghion *et al.*, 2012]. There are also arguments to regard innovation activity as complementary to exporting [Golovko, Valentini, 2011].

Hypothesis 3: Price competitiveness factors and reliance on imports increase vulnerability to exchange rate risk.

The reasoning behind our conjecture is that competing on prices (cost and economies of scale) should be accompanied by greater vulnerability to exchange rate changes. The intuition behind the expected negative influence of exchange rate variability on a cost-competing company is that it operates in the homogenous goods sector with a low margin and is very sensitive to price shocks.

While most studies concentrate on the relationship between exchange rate volatility and exports, there is also evidence that imports are affected by variability. López and Nguyen [2013] indicate that exchange rate volatility decreases the amount of imported inputs, but does not influence the decision to import. The main channel works through increasing prices paid for imports in a local currency [Huchet-Bourdon, Korinek, 2011].

Hypothesis 4: Companies that consider deepening foreign market penetration because they wish to exploit economies of scale are more sensitive to exchange rate risk, while those that wish to withstand their competitors and those that could expand activity abroad if the euro were introduced, are less sensitive to exchange rate volatility.

We can assume that the economies-of-scale motive for foreign expansion is based on the cost competition factor. Therefore, the arguments evoked in favor of Hypothesis 3 remain valid here. The assumption is confirmed by some sectoral research indicating that scale-intensive goods are sensitive to exchange rate volatility [Taglioni, 2002]. The experience of the euro's introduction also indicates that this group of products is vulnerable to exchange rate risk [De Santis *et al.*, 2008]. We also adopted the view that firms that wanted to withstand competitors by following them in international markets possess some unique advantages and do not compete on price. It makes them less concerned about the costs of exchange rate risk, because the "band of inaction" is wider for them thanks to higher margins.

In the case of euro introduction, the existing research related to the expected monetary unification in Poland [e.g. Gorynia *et al.*, 2011; Postek *et al.*, 2015] suggests that companies which are more competitive are generally more in favor of joining the process of monetary integration. They are better prepared and equipped with resources to compete internationally, and at the same time they are more optimistic about euro adoption. Exchange rate risk can still be an obstacle for them (as indicated in the aforementioned papers], but it is a minor problem because they are able to overcome it. Companies' unique assets may make them more resilient [Lengnick-Hall *et al.*, 2011].

Description of data

In this paper, we use new data collected through a survey of around 700 manufacturing firms with more than 10 employees in Poland. A large portion of the firms, around 85 percent, are exporters. The survey was conducted in 2014 and 2015, and the main part of the questionnaire was based on the EU-EFIGE/Bruegel-UniCredit dataset [Altomonte, Aquilante, 2012]. We supplemented the original questionnaire with issues related to the consequences of euro adoption in Poland in general and the implications of exchange rate risk in particular.

The data cannot be classified as a simple random sample. The establishments were selected by means of complex sampling designs including stratification and unequal selection probabilities. These features raise the issues of the representativeness of the sample and of the necessary adjustment when the aim is analytic inference (estimation of a statistical model) or the calculation of population quantities such as means or proportions.

The population of firms was split into strata corresponding to 16 Polish regions (voivodships) because the probability of being selected into the sample was not equal for all members of the population. For instance, the number of establishments from the Mazowieckie region represents around one-fifth of the total number of firms in Poland. Stratification ensured geographical coverage of the sample and made it possible to obtain reliable estimates for firms located in all regions. We also decided to disproportionately increase the selection probability of large firms (those with 50 employees or more) because of their higher degree of internationalization. This sample design improves the precision of parameter estimates for companies more engaged in international business.

Ignoring the sample design would lead to biased estimates of population quantities and of parameters of the data generating process. If the aim is to produce estimates of population means or proportions, the standard solution is to use weighted estimators where the contribution of each unit is weighted by the inverse of the probability of selection into the sample.

In our survey, oversampling affected selection probability not only across firms' sizes but also across sectors of activity. Therefore, we used data from the Eurostat on the number of enterprises in the Polish manufacturing sector at the NACE 2-digit level broken down by size classes to calculate the inverse of the probability of selection. It was computed at the industry 2-digit level as the ratio of the share of firms of a given size class in the population divided by the corresponding share in the sample. Each observation in the sample was multiplied by this weight, thereby providing a link between the sample observations and the target population parameters.

In brief, the data used in the research is derived from a recent survey of around 700 manufacturing firms in Poland. We used sampling weights to correct for unequal selection probability. We also took account of stratification to approximate the value of standard errors and we used Wald-test statistics with the degrees of freedom equal to the difference between the number of observations and the number of strata.

Empirical evidence from Polish manufacturing firms

In this section, we present the results of the empirical analysis of Polish firms' opinions on how troublesome exchange rate risk is. First, we investigate the relative importance of several challenges faced by firms that contemplate entering or expanding operations in international markets. Next, we turn to a regression analysis of the characteristics of firms complaining about exchange rate risk.

Barriers to exporting

The export barrier research focusing on developed countries reached its apogee in the 1980s and 1990s. More recently, the worldwide process of firm internationalization shifted attention to export challenges faced by emerging and developing countries. Moïse and Le Bris [2013] provide a long list of potential trade barriers and costs (mainly external to the company) along the whole trade chain including getting to the border, crossing the border and behind the border. These are non-tariff regulatory measures, market access restrictions and even standards that require product adjustment, etc. (for more see Moïse and Le Bris [2013]). In his overview of the discourse on export barriers, Kahiya [2013] classifies export barriers as either internal or external, and we adopt his approach below.

Internal barriers include resource-, managerial-, marketing-, and knowledge-related constraints. Resource constraints arise because of inputs, especially skilled labor shortages or limited access to external financing. Managerial preferences regarding internationalization can also deter firms from entering foreign markets. Identifying international market opportunities, gaining access to distribution channels and modifying products to meet foreign customers' needs are examples of marketing-related obstacles. Constraints associated with the knowledge of export-related procedures and practices can be classified as knowledge-related export barriers.

Other export barriers are external because they pertain to all firms engaged in internationalization and are beyond their influence. This category includes home- and host-based market barriers and industry-level barriers. Home-based market barriers are exemplified by a distant geographic location, labor market rigidities and the associated high labor costs, and a low level of financial and institutional development. Host-based market barriers include tariff and non-tariff barriers. Finally, industry-level barriers arise from competition from domestic and foreign firms in overseas markets, falling sector prices, and insufficient technological capacities.

The classification presented above is not clear-cut, with some barriers falling into several categories. For instance, access to external financing can be limited because of overall financial market underdevelopment (external barrier) or firm-specific credit ratings (internal barrier). In the survey database used in this paper, the numerous potential export barriers were assembled into groups.

More specifically, firms were asked to answer the following question: "For your company, what is a barrier to entering new markets or increasing engagement in foreign markets". Firms could choose between:
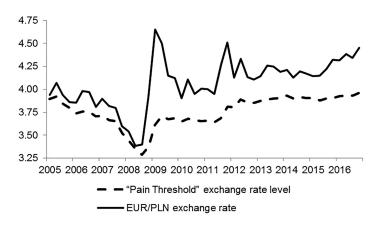• cost of financing in the domestic market,
• access to financing in the domestic market,
• separate currency and related exchange and transaction costs,
• high labor costs,

- strong competition in foreign markets, administrative obstacles, no knowl-
  edge about the market,
- lack of government support,
- other.

Obviously the above list of barriers is not exhaustive. It could also be crit-
icized on the grounds that various host-market-related entry costs such as
strong competition in foreign markets, administrative obstacles, and lack of
knowledge about the market have been amalgamated into one optional an-
swer. However, the formulation "separate currency and related exchange and
transaction costs" is unambiguous and enables an assessment of how difficult
it is to deal with multiple currencies in comparison to other barriers to en-
tering foreign markets.

In the survey which resulted in our database examined in this paper, we
asked companies about "exchange rate risk and related transaction costs".
We assume that respondents assess exchange rate risk on the basis of their
experience and expectations as to exchange rate volatility and the exchange
rate level. Both of these could generally increase risk and the costs of interna-
tional operations, negatively affecting companies' engagement in international
trade. Since our survey was conducted at the end of 2014 and the beginning
of 2015, we can trust that respondents were mainly worried about volatility
rather than the exchange rate level as the latter was at a quite safe distance
from the "pain threshold" (understood as the level below which exports are
not justified economically)—see Figure 2. This means that after 2009 compa-
nies operated in quite favorable conditions with a relative broad adjustment
buffer compared with the 2005–2008 period.

Figure 2. The nominal exchange rate level and the "pain threshold" exchange rate level

The export barrier arising from the use of the national currency and the
associated exchange and transaction costs fall under the heading of external

export barriers. It is not industry-specific and straddles the boundary between home- and host-based market barriers. Home-market factors influence the costs of hedging against exchange rate risk in the local financial market. The volatility of the exchange rate is attributable to the home as well as foreign macroeconomic environment and international capital flows.

The surveyed firms were asked to take a stand on each of the alternative answers. We calculated the proportion of affirmative responses to each answer using the weighted estimator described in the previous section. Figure 3 displays the value of the estimated proportions of all firms in the population that identify a particular barrier as being pertinent to them.
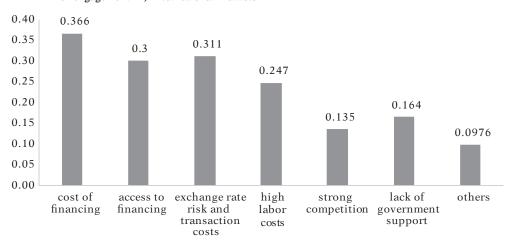
Figure 3. Proportion of firms reporting the following barriers to entry into (or deepening of engagement in) international markets

Notes: the proportions were obtained using weighted estimators.

Above all, it is noteworthy that the list of alternative answers can be regarded as exhaustive. Fewer than 10 percent of the firms meet a barrier to entering—or increasing their engagement in—foreign markets that is not among the listed ones. We also have to admit that we are unable to identify the single most prominent barrier that was unanimously complained about. It seems that Polish firms indeed have to overcome multiple difficulties in internationalization.

High costs of financing in the local financial market were found to be the most significant impediment to foreign operations by Polish manufacturing firms. Exchange rate risk and the associated transactions costs are the second most important barrier. Around a third of Polish manufacturing firms find the use of multiple currencies obstructive to international expansion. A similar proportion of firms complain about limited access to external financing.

The remaining barriers are faced by less than a quarter of firms. The cost of labor was found to be less important than the cost of financing. A lack of government support, strong competition, administrative and knowledge-re-

lated export barriers are only half as important as the costs of exchange rate volatility and risk.

The main conclusion from this section is that the costs of dealing with currency risks rank high among obstacles that hinder Polish firms in their attempts to enter foreign markets or expand exports. In the next section, we look at the characteristics of firms which find this obstacle challenging.

Regression analysis of exchange rate risk

In this section, we present the results of two regression models that attempt to explain the determinants of the probability of giving an affirmative answer to the following questions:

"Does exchange rate risk and the associated transaction costs constitute a barrier for your company to:
- conducting export activities [*model 1*],
- expanding exports to new markets [*model 2*]".

Both models are intended to identify the characteristics of firms which see exchange rate risk as a barrier to starting or carrying out export activities [model 1] or increasing the number of export destinations [model 2]. It can be conjectured that expanding exports to new markets can entail an increase in the number of currencies used in foreign transactions by a company, which is thereby exposed to greater exchange rate risk[6]. This is why we estimated two models to identify the characteristics of companies vulnerable to exchange rate risk that are at different stages of internationalization.

The list of firm characteristics that eventually turned out to be significant includes the invoicing of trade in the national currency, the perceived effects of exchange rate depreciation, the source of and access to external financing, the share of foreign currency-denominated receivables, innovativeness and competitive factors, motives for entering foreign markets, the share of imports in intermediate goods purchases, and the nationality of ownership. Contrary to research reports, the size of firms and the number of export destinations as well as the share of export activities in sales did not prove to significantly influence firms' attitudes toward exchange rate risk. Finally, the following explanatory variables were included in the regression models.

The investigated variables which we expect to influence companies' vulnerability to exchange rate volatility are described below.

Exchange risk exposure hinges critically on the number of currencies used in the invoicing of foreign trade transactions. Invoicing in the domestic currency of a firm shifts exchange rate risk to its foreign business partner. Polish firms invoicing in the Polish zloty should be less concerned with exchange

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[6]   Héricourt and Nedoncelle [2015] indicate that multi-destination firms, those that deliver products to many countries, can hedge against exchange rate risk through diversification. This can of course decrease sunk costs related to the exchange rate but will not eliminate them definitively.

rate risk. We control for domestic currency invoicing by including in the set of regressors the dummy variable *pln_exp* coded as 1 if the export prices are denominated in the Polish zloty. The expected sign of the estimated coefficient is negative.

Access to external financing is captured by two variables. The dummy *fin_constr* is coded as one if a firm identified financial constraints as a factor preventing its growth. The binary variable *fin_abroad* takes on the value of one if a firm taps overseas financial sources. Easier access to external financing should reduce dependence on domestic financing, but it may increase exchange rate risk exposure at the same time. This is why we expected the estimated coefficients of both variables to be positive.

The dummy *deprec_neg* equals one if a firm indicated that the net effect of depreciation on exports and debt is negative. Risk-averse firms may fear exchange rate changes because one of its possible outcomes is exchange rate depreciation, which brings about higher debt service costs outweighing benefits from increased export competitiveness. Therefore, we expect a positive sign to be associated with *deprec_neg*.

The impact of depreciation on the costs of intermediate goods imports has not been included in the survey question concerning the net effect of depreciation. Therefore, we included the variable labeled *import_interm*, which equals the share of imported intermediate goods. Firms importing a large share of intermediate goods are averse to both upside and downside movements in the exchange rate. Depreciation raises their production costs and undermines their competitiveness in the local market and, to a lesser extent, abroad while appreciation erodes their external competitiveness. Thus, we expect a positive sign for *import_interm*.

Innovation is measured by the dummy variable *patent* coded as one if a firm applied for a patent in the last three years (2010–2013). Because of the high risk of innovation activity per se, we assume that exchange rate risk increases unpredictability for companies, so we expect a positive value for the estimated coefficient.

It can be conjectured that firms competing on price are more vulnerable to exchange rate risk costs than firms competing on quality and distribution. This is why we expect a positive value of the estimated coefficient in the case of *cost*.

Firms engaged in foreign activities to exploit economies of scale are also probably competing on price and the costs of exchange rate risks are expected to act as a deterrent to them. Hence, the sign of the coefficient of *entry_scale* should be positive.

The variable labeled *receiv_eur* denotes the share of euro-denominated receivables from supplies and services. We argue again that Polish firms are more likely to expect exchange rate depreciation when exchange rate volatility is high. A large share of euro-denominated receivables can lessen concerns about exchange rate volatility if firms assign greater probability to Polish zloty

depreciation, which would increase the local currency value of all foreign currency-denominated assets[7].

Two binary variables, *distribution* and *quality*, are equal to one if a firm listed a developed distribution network and quality of products respectively as the main competitive factor that determines its success. The variable labeled *quality* was obtained from the request to rank the quality of the firm's product on a scale of 0 to 100. We expect a negative value of the estimated coefficients in the case of *distribution* and *quality*.

Among the investigated motives for companies' foreign market entry, three seem to significantly affect their vulnerability to exchange rate risk. These are the prospects of euro adoption in Poland [*entry_euro*] and the need to keep up with competitors [*entry_compet]*. Firms entering international markets withstand competition and most probably possess some ownership advantages, for instance technological capabilities, which compensate for the disadvantages of operating in an unfamiliar environment such as a lack of brand recognition. This could mean that they are not competing on price and are less concerned about the costs of exchange rate risk, which makes it possible to hypothesize that *entry_compet* will take a negative sign. The prospects of euro adoption in Poland could reduce the perceived severity of exchange rate risk because the associated costs can be regarded as temporary and this is why the expected sign of the coefficient of *entry_euro* is negative.

The last explanatory variable is a dummy labeled *foreign_own*, which is coded as one when a firm belongs to or is controlled by a foreign investor or a group of foreign companies. Foreign ownership can ease access to internal financing denominated in foreign currencies and mitigate the negative consequences of exchange rate uncertainty for the costs of servicing debt. For this reason, the estimated coefficient of *foreign_own* should be negative.

The dependent variables are binary indicators coded as one if exchange rate risk was reported to hamper entry or export activities [model 1] or an increase in the number of export destinations [model 2]. We have estimated two logistic regression models using the techniques designed for complex survey data described in section 3.

The likelihood function for the logit model is

$$lnL = \sum_{j \in S} w_j ln \frac{e^{x_{jb}}}{1+e^{x_{jb}}} + \sum_{j \notin S} w_j ln \left\{ 1 - \frac{e^{x_{jb}}}{1+e^{x_{jb}}} \right\}$$

where S is the set of all observations j, such that the dependent variable for observation j is different from zero, x stands for the vector of independent

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7   The euro was the dominant currency used among the examined companies in the sample. On average, about 10% of the total debt and about 20% of the total receivables were denominated in the euro, while trade credit in the euro constituted about 10% of the total liabilities. Around 60% of the companies declared they used the euro in trade transactions and about 20% said they used the Polish zloty. The use of other currencies was negligible.

variables, and w represents the weights equal to the inverse of the probability of selection which were described above. The model's parameters are obtained by maximizing the value of the likelihood function.

While the sample design structure does not affect the construction of the statistical estimates of population quantities or model coefficients, it precludes the derivation of closed-form algebraic expression for the estimated variance of the coefficients. To approximate the estimated variance, we used Taylor series linearization, which enabled estimation of confidence intervals and standard errors. More precisely, Binder [1983] derived the following sandwich-type estimator of the estimated parameter $\hat{\beta}$ variance:

$$var(\hat{\beta}) = (J^{-1})var\left[S(\hat{\beta})\right](J^{-1})$$

where J is a matrix of second derivatives with respect to the (J^{-1}) of the pseudo-log-likelihood for the data and $var\left[S(\hat{\beta})\right]$ is the variance-covariance matrix of the weighted score equations. The score equation is a summation over strata, h, and elements, i, of the individual "scores" for the n survey respondents:

$$S(\beta) = \sum_h \sum_i w_{hi}\left(y_{hi} - \pi_{hi}(\beta)\right)x'_{hi} = 0$$

where w refers to the sampling weight, the term $\pi_{hi}(\beta)$ refers to the probability that the outcome variable is equal to 1 as a function of the parameter estimates and the observed data according to the specified logistic regression model. The term x'_{hi} is a column vector of the design matrix elements.

Some of the independent variables were statistically significant in only one of the models, and they were dropped from the other. To assess the goodness-of-fit in survey data models, one cannot calculate a measure similar to pseudo-R^2. This is due to the fact that pseudo-R^2 is based on the ratio of likelihood values and on the assumption that observations are independently and identically distributed. This assumption is violated because of survey data stratification and weighting. This is why we relied on F-test and the F-adjusted mean residual test [see Archer, Lemeshow, 2006]. The latter is based on the residuals which are sorted into deciles based on their estimated probabilities (the first decile contains the smallest 10% of residuals, the second the next smallest 10%, and so on). The Wald test statistic is given by:

$$\hat{W} = \widehat{M}'\left\{\hat{V}(\hat{M})^{-1}\hat{M}\right\}$$

where $\hat{V}(\hat{M})$ is the estimated variance-covariance matrix and M is a 10×10 matrix of the mean residuals sorted by decile of risk. The chi-squared has been found to be an inappropriate reference distribution, and the F-adjusted Wald statistic (corrected for the number of strata) is used. Since M stands for the survey estimates of the mean residuals, the null hypothesis of the F-adjusted goodness-of-fit test is that there is no evidence of lack of fit. The detailed estimation results and the overall goodness-of-fit tests are displayed in Table 1.

Table 1. Determinants of the probability of complaining about exchange rate risk and associated transaction costs

VARIABLES	Model 1	Model 2a	Model 2b
pln_exp	–0.785**	–0.198	
	(0.336)	(0.271)	
deprec_neg	1.247***	1.091***	1.031***
	(0.291)	(0.271)	(0.249)
receiv_eur	–0.0233***	–0.0200***	–0.0172***
	(0.00677)	(0.00592)	(0.00476)
fin_constr	0.586**	0.481*	0.540**
	(0.274)	(0.252)	(0.226)
fin_abroad	1.153***	0.854***	0.789***
	(0.314)	(0.296)	(0.278)
patent	0.807**	1.133***	1.181***
	(0.365)	(0.325)	(0.304)
cost	–0.535**	–0.593**	–0.577***
	(0.253)	(0.239)	(0.214)
distribution	–0.639*		
	(0.381)		
quality	–0.0219***		
	(0.00518)		
entry_scale	–0.798***	–0.542**	–0.556***
	(0.263)	(0.234)	(0.204)
entry_euro	–0.722**	–0.556**	–0.435*
	(0.340)	(0.259)	(0.237)
entry_compet	–0.883**	0.785***	0.586**
	(0.410)	(0.289)	(0.262)
import_interm	0.0176**	0.00843	
	(0.00683)	(0.00619)	
foreign_own		–0.735**	–0.791**
		(0.339)	(0.318)
Constant	2.171***	0.220	0.225
	(0.536)	(0.314)	(0.253)
Observations	587	587	698
F [p-value]	7.566 [0.0]	5.901 [0.0]	7.779
F-adjusted [p-value]	1.160 [0.319]	3.168 [0.001]	0.689 [0.720]

Notes: Standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

A cursory look at the results presented in Table 1 reveals a high degree of similarity between the characteristics of firms hampered by exchange rate risk in efforts to enter (or carry out activities in) a foreign market or expand into new markets. The negative consequences of exchange rate risk are mostly felt by firms that are hurt by zloty depreciation because the effect of an increased burden of foreign-currency-denominated debts offsets the benefits

of improved export competitiveness[8]. Similarly, financial constraints faced in the local market and getting financing abroad amplify the perception of exchange rate risk as a barrier to entering/maintaining exports and penetrating new foreign markets. These results are in line with literature streams related to currency mismatch and exchange pass-through underlining the influence of exchange rate volatility on financial and trade (competitiveness) balance sheet [Endrész, Harasztosi, 2014; Eichengreen *et al.*, 2003].

In line with our predictions, the sign of *patent* is also positive pointing to the fact that more innovative firms find exchange rate risk to be a more severe obstacle in their international operations. Mahagaonkar *et al.* [2009] indicate that exchange rate volatility has negative effects on innovation activity, particularly in the manufacturing sector, which is the subject of our research.

Interestingly, invoicing in the domestic currency facilitates continued involvement in exports, but is insignificant for entering new markets (compare model 1 with model 2a). This is not surprising as domestic currency invoicing does not automatically extend to new export markets in the case of minor or exotic currencies. Because the F-adjusted mean residual goodness-of-fit test suggests evidence of a lack of fit, we re-estimated model 2 without the *pln_exp* variable and display the results in the column labeled *Model 2b* in Table 1.

The competitive factors, namely developed distribution networks and high quality of products, make firms less sensitive to the consequences of exchange rate risk. It should be noted, however, that distribution networks and quality were not statistically significant (and therefore omitted) in models 2a and 2b, which relate to expansion in new markets. However, resilience to exchange rate fluctuations in the case of conducting export activity is in line with literature and our expectations. Companies that rely on these factors are usually able to have higher margins and are also more flexible in terms of currency invoicing [Kamps, 2006].

The share of imported intermediate goods is significant only for firms entering and carrying out their activities in foreign markets. The estimated coefficient is positive, which conforms to expectations. Foreign ownership indeed seems to weaken the exchange rate risk barrier in the case of firms entering and carrying out their activities in foreign markets and firms wishing to expand their operations abroad. This corresponds with generally confirmed evidence that foreign ownership is positively interconnected with internationalization and that a foreign partner might give access to various resources, including financial ones [Navaretti, 2012; Cieślik *et al.*, 2015]. A higher share of euro-denominated receivables from supplies and services decreases the exchange rate volatility influence in the case of conducting and expanding export activity, which is in line with literature assumptions and our expectations as it plays the role of natural hedging [Döhring, 2008].

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[8]   Fang [2009] indicates that even depreciation can boost competitiveness, while increased volatility during the process of depreciation may have negative consequences on trade.

Surprisingly, contrary to our expectations, companies that competed on production costs and considered internationalization based on economies of scale appeared to be insensitive to exchange rate risk. As these two factors are complementary [Martin, 1989], the explanation might be that companies competing by low prices operate in homogeneous, readily available goods markets. In such a case transactions are completed in a short period of time and payments are made relatively quickly, so exchange rate risk exposure is not high [Postek *et al.*, 2015]. Another argument is that since 2009 the difference between the nominal exchange rate level and the exchange rate level, which is profitable for Polish exporting companies, has been relatively high [NBP, 2017]. Not even an increased volatility of the exchange rate appears to drain their profits. It might be also that respondents answering about *costs* as a critical factor for companies' success mean that *cost* is not the only competitiveness factor but accompanies other competitiveness features such as the accommodation channel. This line of explanation is justified by commonly known ways of firms' adjustment. In terms of the needed adjustment, companies cut their margins (in the short term) and decrease costs (in the medium and long term).

Given that Poland is among countries with the lowest prices and labor costs in the EU, it can reasonably be suggested that Polish export competitiveness is based only on low price/cost factors. Meanwhile, there are a lot of arguments to claim that the technological content of Polish exports, the quality of traded goods and their sophistication and diversification have improved significantly, especially after the country joined the EU and during the financial crisis [Benkovskis, Wörz, 2012; Parteka, 2013; Albinowski *et al.*, 2015]. This means that price competitiveness should be considered as a complementary, rather than that the sole, factor of competitiveness. Its importance can increase as an accommodation channel and that is why some companies may identify cost as a source of their success. In other words, companies that base their competitiveness on quality goods also use price/cost channels to adjust to a changing environment.

When it comes to the exploitation of economies of scale as a motive to expand activity and the simultaneous reluctance to exchange rate risk, the explanation might be that the effect of a market increase might be stronger than the effect of exchange rate risk. Even if a company can hedge against exchange rate risk, it must bear some kind of fixed cost. This is connected to getting specialized knowledge and establishing a foreign exchange and trade finance division or partially outsourcing this activity by buying related services. Therefore, in practice, companies hedge only a part of their transactions or even refrain from doing this in the case of developing countries (such as Poland—Albinowski *et al.* [2015]) and developed ones (such as Germany—Belke *et al.* [2009]). This means that the average cost curve is negatively sloped and the exchange rate risk and sunk cost shift it up. However, the increased level of production and the associated fall in average costs outweigh increased fixed

costs engendered by exchange rate volatility. The net effect of entering the export market is thus positive and makes companies less likely to complain about exchange rate risk.

Regarding euro adoption in Poland, it seems the surveyed firms believe such a move would reduce the costs of exchange rate risk. As we stated before, companies that are in favor of monetary integration are better prepared for competition. This might explain their higher robustness with respect to exchange rate risk. It is worth mentioning that euro introduction would also be related to increased foreign market penetration, which supports our explanation related to the exploitation of economies of scale.

Contrary to our intuition, companies that would like to expand foreign activity, wishing to follow their competitors, appeared to be exchange-rate-risk-sensitive. Firms propelled by competitors to increase the number of export destinations consider exchange rate risk as a serious obstacle. It could be argued that firms expanding foreign operations in a greater number of markets have no sufficient ownership advantages to penetrate all of them. They evaluate the costs of exchange rate risk, which increases with the number of markets served, as a severe or prohibitive barrier. The reason might also be that the extensive margin of trade (activity expansion to new markets), according to Colacelli [2008], is usually more related to innovation and more sensitive to exchange rate fluctuations than the intensive margin (increasing sales on current markets).

Conclusions

Our results suggest that the fears of exchange rate risk are asymmetric in the sense that depreciation and increased foreign input expenses and foreign currency-denominated liabilities cause firms to regard exchange rate risk as a more serious impediment to exports. Using natural hedging (receivables denominated in the euro or invoicing in the local currency) decreases vulnerability to exchange rate risk. In the broader perspective of firm finances, we conclude that liquidity constraints experienced at home and access to external finances abroad increase the stringency of exchange rate risk.

Another general conclusion that emerges from our analysis is that competing on non-price factors at least partially immunizes enterprises against the implications of exchange rate risk. However, exchange rate risk undermines the export activities of more innovative firms. An important factor that increases companies' resilience to exchange rate risk is foreign ownership as it usually solves many problems related to financing and various risks, including exchange rate movements.

Moreover, we found that firms seeking to exploit economies of scale abroad and build their competitive advantage on low costs attach less importance to exchange rate volatility costs. This result comes as a surprise and is worthy of further investigation in future research, especially in terms of respondents'

in-depth understanding of the measures of exchange rate risk and drivers of competitiveness.

The research results could be useful for policymakers and company managers. We delivered some evidence that supports exporting companies' vulnerability to exchange rate risk. It can be taken into account while shaping macroeconomic policy in terms of smoothing exchange rate changes as well as in terms of the availability of hedging instruments. The results can also be useful for exchange rate risk management strategies dependent on companies' competitive factors and internationalization modes.

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RYZYKO KURSOWE JAKO PRZESZKODA W DZIAŁALNOŚCI EKSPORTOWEJ. WNIOSKI Z POLSKI

Streszczenie

Głównym celem artykułu jest określenie czynników determinujących podatność polskich firm przemysłu przetwórczego na ryzyko kursowe. W celu weryfikacji przyjętych założeń korzystamy z unikalnej bazy danych przedsiębiorstw do oceny wewnętrznych i zewnętrznych czynników wpływających na postrzegane ryzyko kursowe. Nasze obserwacje potwierdzają znaczenie ryzyka kursowego jako jednej z przeszkód w przypadku rozpoczynania i prowadzenia działalności eksportowej, a także jej rozszerzania na nowe rynki.

Firmy doświadczające trudności w dostępie do finansowania, korzystające z finansowania za granicą, firmy, które doświadczają dewaluacji kursu negatywnie wpływającego na ich bilans finansowy, firmy innowacyjne i te, które importują, w większym stopniu odczuwają ryzyko kursowe. Jednocześnie firmy mające zagranicznego udziałowca, firmy z większym udziałem należności nominowanych w euro, fakturujące eksport w złotych, firmy konkurujące jakością produktu oraz poprzez kanały dystrybucji oraz te, które rozważają rozszerzenie działalności po wprowadzeniu euro, nie są tak wrażliwe na ryzyko wahań kursu.

Podkreślając znaczenie ryzyka kursowego jako istotnego kosztu w działalności eksportowej przedsiębiorstw, formułujemy sugestie związane z zarządzaniem ryzykiem kursowym na poziomie mikro i makroekonomicznym.

Słowa kluczowe: kurs walutowy, ryzyko kursowe, eksport

Kody klasyfikacji JEL: F31, F18, F14