Exchange Rate Level, Innovation, and Obstacles to Growth. Who Needs a Weak Zloty?[1]

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Abstract

We have adopted Rodrik's "undervaluation" hypothesis to verify the conjecture that innovative firms in Poland opt for a weak currency because they face obstacles in the labour and financial markets. We do it by exploring a new database on Polish manufacturing exporters in order to find some interrelations between the exchange rate level and innovation activity. Our findings suggest that a weak Zloty is preferred by exporting firms that have carried out product and process innovations and registered a trademark, patent or claimed a copyright. We confirmed that financial constraints and labour market regulations were important factors preventing the growth of innovative firms. Based on the research on Polish firms, we claim that although innovative companies use technology to gain competitive advantage, their success and innovation activity also hinge on prices in general and on a weak exchange rate in particular because it helps to overcome market imperfections related to financial and labour resources.

Keywords: *exchange rate, innovation, firm, growth*

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Introduction and Related Literature

When it comes to the issue of the exchange rate and economic activity, we can distinguish at least four strands of literature. The first one, mostly considered, is that dealing with the exchange rate volatility and its influence on economic

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variables, which is not the subject of this paper.[2] The second one, which is of our interest, addresses the issue of the exchange rate level and economic growth. The third one belongs to the literature on investment decisions and focuses on the relation between the exchange rate level and R&D activity. The fourth one concerns the exchange rate level and innovation activity. The latter two are very scarce and this paper aims at filling this gap.

Although the exchange rate level is not at the centre of the growth theory, its influence on economic growth and firms' performance is often emphasized in empirical research. The traditional view, supported by the Washington Consensus assumptions, indicates that the exchange rate level should be in line with its equilibrium level that satisfies external and internal balances (Schröder, 2013). Otherwise, any misalignment (undervaluation or overvaluation) has negative consequences for the balance of payments and economic growth. Overvaluation can lead to misallocation of resources and hamper economic growth because it undermines price competitiveness, increases imports and decreases exports, spurring resource relocation from tradable to non-tradable sector – the case of Dutch Disease and PIGS (Portugal, Italy, Greece, Spain) countries. These negative consequences of a prolonged period of currency overvaluation provoked economists to coin the "fear of appreciation" notion (Levy-Yeyati, Sturzenegger and Gulzmann, 2013). The exchange rate undervaluation may harm growth because it petrifies the current economic structure and does not give incentives to restructure it and to move up the technological ladder (Eichengreen, Park and Shin, 2013). A weak currency may also make imported technology more expensive and wages low by international comparison, leading to brain drain of the most qualified workers (Harris, 2001). Based on that the best choice of macroeconomic policy is to keep the exchange rate level close to its equilibrium level.

An opposite view postulates that an overvalued currency poses obstacles to growth but an undervalued currency increases economic growth, productivity and employment (Rodrik, 2008;[3] Mbaye, 2013). According to the literature, there are at least three channels leading to such an effect. , an undervalued currency is useful for exporting companies because the tradable sector is more susceptible to institutional weaknesses which may play the role of additional "taxes" on entrepreneurs (Rodrik, 2008). Market failures related to financial constraints,

[2] The exchange rate volatility is believed to have a negative impact on macroeconomic variables, investment decisions, trade and economic growth (Aghion et al., 2006). Mahagaonkar, Schweickert and Chavali (2009) confirmed that exchange rate volatility affects negatively innovation activity, but rather in the manufacturing sector.

[3] Rodrik (2008) states that "Just as overvaluation hurts growth, so undervaluation facilitates it". He also noticed that a positive impact of undervaluation is bigger in low income economies and with low quality of institutions (like the lack of property rights, poor contract enforcement, corruption, etc.).

information asymmetry and "red tape" may be more prevalent in the tradable sector because exporting is a difficult and risky task, which is also confirmed by the new trade theory (Melitz, 2003).[4] A weak currency as a source of capital helps to overcome these difficulties. It can be also seen as some kind of premium for higher risk related to export activity. Secondly, an undervalued exchange rate and a concomitant increase in revenues in local currency encourage higher saving and investment leading to capital accumulation in the tradable sector helping financially constrained firms (Levy-Yeyati, Sturzenegger and Gulzmann, 2013). Higher "capital accumulation" may also be a result of resource relocation from non-tradable to tradable sector (Rodrik, 2008).Thirdly, export companies are usually more able to gain from learning by doing activity and technological spillovers and as a consequence are also more productive (Mbaye, 2013; Eichengreen, 2007). An undervalued exchange rate may help to stimulate structural changes in the economy and can be used as an important instrument to promote development of the tradable sector (Gala, 2008). It can also help to avoid the Dutch disease and premature deindustrialization (Palma, 2004).

While the above arguments are in favour of the undervaluation approach, the debate over the optimal exchange rate level is still open and even currency misalignment measures are not perfect indicators (Gala, 2008). Many factors may influence the role of the exchange rate level and economic growth (openness, propensity to import, firms' resources and modes of internationalization, etc.). Despite Rodrik's convincing "undervaluation" hypothesis, there are also alive arguments that any misalignment from the equilibrium level may lead to reduced growth. Schröder (2013) claims that previous research advocating an undervalued exchange rate could be based on an inappropriate assumption on long-run real exchange rate patterns and growth regression misspecification. One of the main problems faced by empirical research in this area can be the fact that the equilibrium exchange rate level, which plays the central role in defining over- and undervaluation, is not an observable variable, so results of research may be vulnerable to the estimation method.

Missio et al. (2015) suggest that the growth effect from undervaluation tends to be nonlinear and positive for a moderate level of undervaluation. Nouira, Plane and Sekkat (2011) claim that persistence of undervaluation may also matter. Sokolova (2015) points out the positive effects of exchange rate undervaluation

[4] The new trade theory uses the term "sunk costs" including all costs and problems related to conducting activity abroad. They are usually important, so only the most efficient companies can afford them. It means that only a small fraction of companies export goods, which is really reflected in data describing export performance in developing and developed countries. Interesting review of the evolving trade theory of export determinants and empirical research on these issues in the seven new EU countries offers e.g. Cieślik et al. (2015).

on growth in the case of trade relations with partners beyond regional trade agreements. It seems that this nonlinearity means that benefits from undervaluation may be conditional on many individual characteristics.

Taking into account the lack of consensus among researches, a reasonable strategy is to expect that the role of the exchange rate under- or overvaluation for the economic growth and investment decisions may differ between countries, sectors and companies. Probably, the importance of the exchange rate undervaluation may evolve over time in line with the level of development. What is noticeable in the literature is that a weaker currency is usually seen as more useful for developing countries than developed ones (Rodrik, 2008; Mbaye, 2013). The reason for that can be that a more developed country usually uses more sophisticated modes of internationalization, including Foreign Direct Investment(FDI). A strong currency may help companies to invest money abroad in the form of outward FDI, which constitutes an important channel of innovations. It means that a weak currency may favour growth in developing countries but reaching a certain level of development may demand a strong currency. Such justification is in line with the Investment Development Path (Narula and Guimón, 2010).[5]

The interrelations between the exchange rate level and innovation activity are solely the subject of the literature considerations. Some incidental publications relate to the exchange rate level and R&D activity and do not give a clear-cut view. Funk (2003) claims that (in the case of US manufacturing companies) appreciation affects negatively R&D spending of domestic firms and does not have such influence in the case of exporting companies. Moreover, exchange rate depreciation increases R&D spending. On the other hand, Chen (2017) suggests that undervaluation of a currency may retard R&D spending and technological innovation, but this problem mainly affects developed countries. The main channel might be an increase in imported technology cost (Boler, Moxnes and Ulltveit-Moe, 2015).

Unfortunately, there is poor literature about the relationships between the exchange rate and innovations. However, the specific features of innovation activity (vulnerability to market distortions, more difficult access to financing, more sophisticated needs in terms of labour skills) and its complementarities to export activity lead us to assume that the above general arguments related to the tradable sector should also play an important role in the case of innovations. Our

[5] The concept which combines the evolution of a country's FDI position in terms of inward Foreign Direct Investment (IFDI) and outward Foreign Direct Investment (OFDI) and its level of development is the Investment Development Path (IDP). According to this approach, there is a long-term relation between the level of development and the country's net investment position (NIP) defined as the difference between its outward and inward direct investment stock. The evolution of the country's position, accompanied by increasing GDP per capita, is a result of firms' ability to accumulate assets and engage in outward direct investment (Narula and Guimón, 2010).

aim is to adopt Rodrick's "undervaluation" hypothesis, related to the tradable sector, to verify the assumption that innovative firms in Poland opt for a weak currency because they face serious obstacles in the labour and financial markets. We do it by exploring a new database on Polish manufacturing exporters in order to find some interrelations between the exchange rate level and innovation activity.[6] Thus this paper contributes to the debate on the influence of exchange rate level on economic long-term growth performance.

Our analysis provides two insights into the importance of the exchange rate undervaluation for the functioning of innovative firms in Poland. First, a weak Zloty is preferred by exporting firms that have carried out product and process innovations and registered a trademark, patent or claimed a copyright. Second, we found that financial constraints and labour market regulations were important factors preventing the growth of innovative firms. In particular, firms that indicated these market distortions as the main obstacles to their growth have carried out product and process innovations and registered a trademark, patent or claimed a copyright. Thus, the answer to the title question is that more innovative firms need a weaker Zloty and that this might be due to the financial and labour market imperfections which they find binding.

A more general observation from our research is that non-cost competition factors (innovations) should be seen as complementary to cost competition (exchange rate level). It seems to be an interesting conclusion because intuitively we used to think that the relation between the exchange rate level and innovation should be weak. For innovative firms the price factor embodied in the exchange rate should not have direct influence on trade because we are keen to believe that innovative firms do not compete by prices but mainly by quality and technology. Because of companies and industry heterogeneity, as well complexity of competition processes, even technology frontiers have to adjust prices to the market. Based on the research among Polish firms, we claim that although innovative companies use technology to gain competitive advantage, their success and innovation activity also hinge on prices in general and on a weak exchange rate in particular because it helps to overcome financial and labour market difficulties. Moreover, undervaluation shifts the local demand from abroad to the local market because importing becomes more expensive. In that channel a lower value of local currency increases the size of the local market, which should spur demand for innovative products. The test of these predictions is discussed in section 2.2 and 2.3. It is preceded by a description of methodology in section 2.1. Section 3 is devoted to a succinct summary.

[6] We examined 650 industrial companies with more than 10 employees, that is about 3% of the total population of manufacturing industrial companies with more than 10 employees, which amounted to approximately 22 000 entities in 2013.

1. Empirical Strategy and Results

This section presents the evidence in favour of the proposition that a low value of the Polish Zloty can stimulate innovation activity among manufacturing industry companies.

First, we describe the dataset and methodology employed. Our main argument, based on Rodrik's model, is developed in two steps. In the second subsection we investigate the determinants of the preferred level of the exchange rate, with the aim of uncovering the significance of firms' innovativeness. As we stated at the beginning, our research was inspired by Rodrik's assumption and related "undervaluation" literature concentrated on the tradable sector indicating the usefulness of a low value of the exchange rate. Because of poor recognition of the relation between the exchange rate level and innovation in the literature, we decided to adopt this way of justification for innovation activity. Till know the issue of innovation and exchange rate has been usually considered as part of the industry sector and investment decision phenomena (Gala, 2008).

In the last subsection we look at the characteristics of firms complaining about the obstacles in the labour and financial markets that hinder their development. We verify the hypothesis that more innovative firms face more challenges in both markets. We assumed that if the tradable sector is vulnerable to the exchange rate level due to more sophisticated and difficult operations, innovation activity should be probably affected in a more meaningful way than "traditional". Innovative companies deal with more sophisticated operations and transaction costs can be higher for them. Moreover, innovation is a risky activity, so access to financing can also be more difficult (Aghion et al., 2012). An important feature of innovative companies is tacit knowledge embodied in human capital, so access to qualified workers may also be critical. Innovative companies also operate in a more competitive environment because they compete with other innovative companies. So problems faced by such companies are similar to those considered in the case of the tradable sector. The same holds true for financial and labour constraints: they should be also more visible in the case of innovative firms. An important argument to see innovation activity as similar to exporting is also the complementarity of and a dynamic virtuous circle between export and innovation activity (Golovko and Valentini, 2011).

1.1. Data and Methodology

The data used in this paper comes from an original survey of around 650 manufacturing firms with more than 10 employees in Poland. The survey was conducted in 2014 and mostly in January 2015 and the main part of the questionnaire was

based on the EU-EFIGE/Bruegel-UniCredit dataset (Altomonte and Aquilante, 2012).[7] The scope of the survey was extended to include respondents' opinions on the consequences of the Euro adoption in Poland. The firms were asked to assess the opportunities and risks associated with the Polish accession to the Euro area concerning internationalization, innovativeness, finances, competitiveness, exchange rate risk and exchange rate preferences.[8]

The data used in the regression analysis cannot be classified as a simple random sample. The establishments were selected with complex sampling designs including stratification and unequal selection probabilities. These features raise the issues of the representativeness of the sample and the necessary adjustment of the Ordinary Least Squares Method to obtain estimates of population variances and standard errors.

The first stage to obtain the sample was to group the firms at the regional level. Establishments were selected from all industrial sectors and regions to ensure the representativeness of the sample. 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, establishments from the Mazowsze region represent a large fraction, close to 18%, of total firms in Poland. Stratification ensured geographical coverage of the sample and allowed obtaining reliable estimates for firms located in all regions. Moreover, stratification improves the precision of estimates if it reduces the variance of some variables within the strata.[9] As shown in Maćkowiak (2011), the share of exports to the EU of Polish voivodships is highly differentiated, generally increasing from the east to the west.[10] It can therefore be argued that firms' internationalization and their preferred level of exchange rate are region-specific.

The selection of establishments at the second stage of sample design was dependent on employment level. We decided to disproportionately increase the selection probability of large firms (50 employees or more) because of their higher degree of internationalization. This device is desirable because it improves the precision of parameter estimates of the determinants of the preferred level of exchange rates for companies more engaged in international business.

[7] A more in-depth explanation of our database is included in papers which were also based on its content: Gajewski and Tchorek (2017) and Brzozowski and Tchorek (2017).

[8] Some results of the survey are presented on the website: <www.eurocompetitiveness.eu>.

[9] On this and other issues related to the analysis of survey data, see Heeringa, West and Berglund (2010).

[10] Gajewski and Tchorek (2017), based on companies' survey, established that as regards export performance, the traditional division between Eastern and Western regions in Poland still exists but is diminishing, because the Eastern region improved its competitive capacity profoundly.

Firms were not grouped into larger clusters, that is the Primary Sampling Units were defined to be individual establishments, which means that cluster sampling was not applied. Although the omission of one stage of complex sampling reduces the variation of probability of being selected into the sample, the use of sample weights remains a necessity due to oversampling.

Oversampling affected the 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 Polish manufacturing at the NACE 2-digit level broken down by size classes to calculate the inverse of probability of selection. It was calculated 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, which should yield unbiased estimates of population parameters.

Solon et al. (2015) express their scepticism in regard to thoughtless weighting in order to correct for endogenous sampling. They recommend using standard heteroskedasticity diagnostics because if the error term was homoskedastic prior to weighting it will become heteroskedastic after weighting, which will lead to imprecise estimation. We estimated the model without weighting and relied on the Breusch-Pagan test for heteroskedasticity. We found that it presented evidence against the null hypothesis of homoskedasticity.

In summary, the sample used in the research consists of about 515 manufacturing firms in Poland surveyed et the end of 2014 and mostly in January 2015, with most of the data related to year 2013. We used sampling weights to correct for unequal selection probability. We also took account of stratification to get the correct value of standard errors, that is we used *t* statistics with the degrees of freedom equal to the difference between the number of observations and the number of strata.

1.2. The Preferred Level of Exchange Rate

The respondents were asked to indicate the expected, optimal exchange rate level for fixing the Zloty to the Euro. This continuous variable is the regress and in our model.[11] The respondents were asked to indicate the preferred value of the exchange rate in the range of 3 – 5 Zlotys per 1 Euro. This restriction precludes declaring preferences for unrealistically weak Zloty.

It is evident that a weaker currency has two effects on firms: on the one hand, it improves the competitiveness, on the other it raises the burden of foreign-currency denominated debt. To control for these consequences of devaluation, we have included in the set of independent variables a dummy variable constructed on the

[11] Summary statistics of all variables can be found in Table A1b in the Appendix.

basis of firms' answers to the following question: *Is the net effect of the Polish Zloty depreciation on export and debt non-beneficial, neutral or beneficial*? The dummy *Beneficial net effects of depreciation* equals one if a firm indicated that the net effect of depreciation is beneficial. We expect that a favourable impact of depreciation should translate into a higher preferred level of the exchange rate.[12]

The second variable describes the competitive factor that determine the success of firms. It was obtained from the request to rank the quality of the firm's product on the scale 0 – 100 and it is called *Product quality rank*. We expect that the price competitiveness brought about by depreciation is less important for firms with high quality products.

As was mentioned in the discussion of the stratification issue, firms' size can matter for their responsiveness to the value of the Zloty. Therefore we included the size of firms measured by the level of employment, denoted *Employment*. Provided that larger companies are more globally engaged and at the same time have wider access to domestic financial markets, thus are less dependent on foreign financing, we expect the sign of the estimated coefficient of *Employment* to be positive. As an alternative measure of firms' size, we also used the level of turnover. This variable has been grouped into seven subsets in the survey (less than 1 mil. Euros, 1 – 2 mil. Euros, 2 – 10 mil. Euros, 10 – 15 mil. Euros, 15 – 50 mil. Euros, 50 – 250 mil. Euros, more than 250 mil. Euros). Since the categories are not equally spaced, we could not treat this variable as ordinal. Instead we created a dummy variable for each category, coded as one for this range of values of turnover which was selected by a firm.

It is important to recognize that nowadays the location of production facilities is not constrained by national boundaries, which is certainly true for a European Union member country. If a firm has a subsidiary abroad, its exports may not be sensitive to the level of exchange rate. To find out whether export activities carried out directly from Poland shape firms' choice of the optimal exchange rate, we have included in the set of regressors a dummy variable named *Direct exports*, which equals one if a company sold abroad directly from its home country. Its sign is expected to be positive.

Foreign ownership is another aspect of openness which alters the dependence of firms on the value of domestic currency. Depreciation reduces the costs, expressed in the investor's currency, of local inputs employed in a foreign subsidiary. Moreover, in the case where external financing is provided by the parent company, the costs of foreign currency denominated debt are less of a concern.

[12] This control variable supposedly captures also the effects of depreciation on the cost of imported components and this is why the intermediate goods imports to turnover ratio turned out to be an insignificant variable in our model.

For these reasons we expect that foreign owned companies would welcome depreciation. The dummy variable *Owner's nationality* has the value of one when the main shareholders are foreign. The percentage of employees with tertiary education, labelled *Tertiary education employees*, should have positive sign as we can expect that innovativeness is closely related with these resources and could decrease sensitivity to price competition.

Finally we included a composite measure of firms' innovativeness, *Innovativeness index*, which is an aggregate indicator comprising inputs as well as outputs of the innovation processes. Basing an empirical study of innovative activities on a single indicator or a small number of indicators is an inappropriate procedure in view of the complexity of the innovation process (Hollenstein, 1996). The index used in this paper is based on five indicators of firms' innovativeness. Two of them belong to the category of innovative outputs: they are dummy variables that take on the value of one if a company confirmed that it had carried out a process innovation or a product innovation in 2010 – 2013. The remaining three indicators can be classified as innovative inputs: they are dummy variables that take on the value of one if a company confirmed that it had registered a trademark, patent or claimed a copyright in 2010 – 2013.

Following Hollenstein (1996), who stresses the similarity and thus the correlation of innovation indicators, we used the principal component analysis to reduce the number of innovativeness indicators and obtain their linear combination that contains most of the variance (that is the first principal component). Since all innovation indicators combined in the overall innovativeness index are binary variables, we used estimates of the tetra choric correlation coefficients to create the pairwise correlation matrix. The correlations were computed by the maximum likelihood estimator obtained from bivariate probit without explanatory variables. Next we performed a principal component analysis using the tetra choric correlation matrix. The first principal component which is our innovativeness index explains more than 41% of the total variance. It has positive loadings of comparable size on all variables (see Table A1a in the Appendix).

To examine the linear relation between the desired level of the exchange rate, y_j, and the independent variables defined above, we estimated the following model:

$$y = \beta x + \varepsilon$$

where x is the vector of independent variables and ε is a vector of random error terms which follow a normal distribution with a zero mean and are independent of each other. To deal with data from a complex sample, the estimator for β is the weighted least squares estimator:

$$b = (x'wx)^{-1}x'wy$$

where b is the unbiased estimator of β, w is the matrix of sampling weights described in section 2.1. The estimation results are displayed in Table 1.

T a b l e 1

The Determinants of the Preferred Level of Exchange Rate

	Size proxied by employment	**Size proxied by turnover**
Innovativeness index	0.195*** (0.056)	0.149*** (0.053)
Beneficial net effects of depreciation	0.135** (0.061)	0.100* (0.058)
Direct exports	0.117* (0.060)	0.150** (0.058)
Owner's nationality (0 = Polish, 1 = foreign)	0.150** (0.074)	
Tertiary education employees	–0.394*** (0.139)	–0.546*** (0.132)
Product quality rank	–0.002*** (0.001)	–0.002** (0.001)
Employment	8.35e-06*** (6.12e-07)	
Turnover 1 – 2 mil. Euros		0.050 (0.057)
Turnover 2 – 10 mil. Euros		0.096 (0.071)
Turnover 10 – 15 mil. Euros		0.073 (0.096)
Turnover 15 – 50 mil. Euros		0.257*** (0.081)
Turnover 50 – 250 mil. Euros		0.223 (0.198)
Turnover > 250 mil. Euros		0.385*** (0.133)
Constant	3.626*** (0.134)	3.780*** (0.131)
R-squared	0.207	0.255
Observations	507	503

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1; sectoral dummies included.
Source: Own compilation.

The most important conclusion stemming from Table 1 is that more innovative companies opt for a lower value of the local currency. It may confirm Rodrik's assumptions related to the tradable sector, which we tried to adopt and verify in terms of innovation. The indicator of innovative activities has an expected positive sign. It is puzzling that the estimated coefficient of the percentage of employees with tertiary education is negative. It can be argued, however, this counterintuitive finding can be true for the Polish companies, because Poland has one of the highest educational attainments at the tertiary level in the EU. Simultaneously, the Polish labour market permanently suffers from the structural

mismatch between qualifications obtained at the university level and demanded by firms and high-skilled labour is often misallocated (Adalet McGowan and Andrews, 2015).

The sign of the coefficients of other variables conforms with expectations. Large firms, as well as those reporting a beneficial impact of depreciation, prefer a lower value of the Zloty. Similarly, foreign ownership predisposes firms to prefer depreciation. By contrast, companies competing on other factors than the price level (distribution channel and product quality) opt for a stronger Zloty.

Having found that more innovative firms seem to need a weaker Zloty, we turn to Rodrik's second hypothesis. It states that industrial companies (in our case innovative) are more vulnerable to market distortions and a weak currency allows them to prosper and overcome the difficulties they encounter more frequently than other firms. In the next section we verify the hypothesis that more innovative firms complain more about the obstacles in the labour and financial markets.

1.3. Are Innovative Firms Hindered by Obstacles in the Labour and Financial Markets?

As accurately stated by Smith (2000, p. 73), "innovation involves complex interactions between a firm and its environment. (...) [E]nvironment involves broader factors shaping the behaviour of firms: the social and perhaps cultural context; the institutional and organizational framework; infrastructures; the processes which create and distribute scientific knowledge, and so on". In this section we investigate the institutional and organizational framework and infrastructure affecting the functioning of manufacturing firms in Poland.

More specifically we focus on labour and financial markets imperfections that impinge on the development of innovative firms. To that end we use data from the survey described above and construct two binary variables derived from firms' spontaneous answers to the following request: *Indicate the main factors preventing the growth of your firm*. The variables are coded as one when a firm pointed to labour market regulations and financial constraints, respectively, as an obstacle to its successful development.

In Table 2 and Table 3 we report the estimation results of the models of labour market and financial constraints faced by firms. We used logistic regression because both independent variables are dummies. Some of the independent variables were used in the previous section, some new explanatory variables proved to be statistically significant.

The likelihood function for probit models estimated using the techniques designed for complex survey data takes the following general form.

$$\ln L = \sum_{j \in S} w_j \ln \Phi(x_j \beta) + \sum_{j \notin S} w_j \ln\left\{1 - \Phi(x_j \beta)\right\}$$

where

Φ – the cumulative normal,

S – the set of all observations j, such that the dependent variable for observation

j – different from zero, x stands for the vector of independent variables described above,

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. In the tables we also report the average marginal effects for all covariates, that is the derivatives of the responses.

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 were confined to rely on F-test to test the hypothesis that all estimated coefficients are simultaneously equal to zero.

With regard to the labour market bottleneck, a few novel explanatory variables were introduced. The product quality rank was replaced with the dummy *Competitive factor: quality* that takes on the value of one if the product quality was, in the eyes of respondents, a competitive factor that determines the success of their firms. Another indicator variable, *Domestic competitor*, has the value of one if a firm indicated that its main competitors are domestic, that is located in Poland. Another explanatory variable captures the competitiveness factors that determine the success of firms. The respondents were asked to assess, among others, the importance of the distribution network and the indicator variable *Competitive factor: distribution network* is equal to one in the case of an affirmative answer.

There is abounding evidence that foreign ownership is associated with higher wages (Hijzen et al., 2013). One of the theories that explain this empirical regularity relies on labour market imperfections. The heterogeneous firm theory, in the terminology of Malchow-Møller, Markusen and Schjerning (2013), states that in imperfect labour markets this wage premium can reflect efficiency wages induced by higher supervision costs faced by foreign firms in a different cultural environment. On this basis we expect that firms with foreign investors are more likely to report harsh difficulties in the labour market. We test our prediction using the *Owner's nationality* variable defined in the previous section.

T a b l e 2

Labour Market Obstacles

	Size proxied by employment		**Size proxied by turnover**	
	Coefficient	Marginal effects	Coefficient	Marginal effects
Innovativeness index	0.785*** (0.165)	0.260*** (0.050)	0.463*** (0.172)	0.155*** (0.056)
Domestic competitor	0.456** (0.200)	0.151** (0.066)	0.507** (0.202)	0.170*** (0.066)
Competitive factor: quality	0.770*** (0.182)	0.254*** (0.057)	0.717*** (0.188)	0.240*** (0.059)
Competitive factor: distribution network	–0.504** (0.199)	–0.166** (0.065)	–0.577*** (0.222)	–0.193*** (0.072)
Owner's nationality (0 = Polish, 1 = foreign)	0.457** (0.204)	0.151** (0.066)		
Employment	–0.001** (0.000)	–0.0002** (0.0001)		
Turnover 1 – 2 mil. Euros			0.228 (0.192)	0.077 (0.064)
Turnover 2 – 10 mil. Euros			0.226 (0.181)	0.076 (0.061)
Turnover 10 – 15 mil. Euros			0.312 (0.315)	0.105 (0.107)
Turnover 15 – 50 mil. Euros			–0.152 (0.362)	–0.049 (0.114)
Turnover 50 – 250 mil. Euros			–0.209 (0.542)	–0.067 (0.167)
Turnover > 250 mil. Euros			–0.202 (0.532)	–0.064 (0.164)
Constant	–1.896*** (0.424)		–1.443*** (0.361)	
Observations	505		515	
F	2.993***		2.025***	

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1; sectoral dummies included.
Source: Own compilation.

The estimation results displayed in Table 2 support the notion that labour market obstacles impede the growth of firms that undertake innovative activities because the coefficient of *Innovativeness index* is positive and statistically significant at the one per cent level. The firing and hiring decisions of companies that have successfully carried out innovative activities seem to be more challenging.

Moreover we found that larger firms are less constrained by these obstacles, as are firms competing on distribution network. By contrast, these barriers seem to hurt more firms competing on quality and feeling competitive pressure mainly from domestic producers. Foreign investors seem to lack experience in dealing with host country labour market issues and find them more difficult.

Turning to financial constraints, their severity turned out to be significantly associated with our *Innovativeness index*. The average marginal effect of innovativeness on the probability of complaining about financial constraints is lower

compared to effect on the probability of complaining about labour market constraints but only if firms' size is measured by the level of employment. When turnover is used as a proxy for firms' size we find that the average marginal effects are similar for both probabilities.

We have added two important control variables that are considered to be among the crucial determinants of access to credit in imperfect financial markets. They are the duration of the firm-main bank relationship, denoted *Firm-main bank relationship duration*, and the share of total debt denominated in the Polish Zloty, called *Share of PLN denominated debt*. An established relationship with a financial intermediary is expected to facilitate access to external financing, thereby loosening financial constraints.[13] The firms were not inquired about the level of their indebtedness. Hence it can be conjectured that a large share of debt denominated in the Polish Zloty is correlated with the level of debt owed to the main bank of the firm. On this basis we expect the positive sign of the estimated coefficient of *Share of PLN denominated debt* because banks are reluctant to extend loans to agents already overburdened with debt.

In the previous section we attributed the finding that foreign-owned firms prefer a weaker currency to, among others, their access to parent company financing. To corroborate that supposition, we include the dummy *Owner's nationality* among the explanatory variables and predict the negative sign of the estimated coefficient. The results are presented in Table 3.

We focus attention on the estimated coefficients of innovativeness index. Table 3 shows is a robust determinants of firms' dissatisfaction with the access to external financing. The estimated coefficients and average marginal effects are positive and statistically significant at the 1% level, regardless of the proxy for firms' size used in the model, pointing to the fact that innovativeness aggravates the risk of liquidity constraint.

The obtained results also reveal that larger, foreign owned firms with more educated employees tend to overcome difficulties they encounter in the financial markets. The control variable intended to capture the established relationship with a financial intermediary, *Firm-main bank relationship duration*, was found to be negatively associated with financial constraints, whereas the debt burden does not seem to be an insurmountable obstacle to access to external financing.

Unfortunately the *Firm-main bank relationship duration* variable had a high percentage of non-responses which reduced the sample size for the financial constraints model by almost one half compared with the labour market constraints model. To ensure the robustness of our results we re-estimated the financial

[13] Cosci, Meliciani and Sabato (2016) offer interesting examination of different proxies of relationship lending.

constraints probit model on a larger sample of firms without the *Firm-main bank relationship duration* variable. The results are presented in Table A3b in the Appendix. It turned out that the share of total debt denominated in the Polish Zloty was not significant in the larger sample and it was dropped from the set of covariates. Other results remain largely unaffected. In particular, the coefficient and the average marginal effect of the innovativeness index are positive and significant at the five per cent level pointing to the financial market hardship experienced by more innovative firms.

T a b l e 3

Financial Constraints

	Size proxied by employment		**Size proxied by turnover**	
	Coefficient	Marginal effects	Coefficient	Marginal effects
Innovativeness index	0.598*** (0.227)	0.166*** (0.061)	0.678*** (0.256)	0.191*** (0.067)
Product quality rank	0.012*** (0.004)	0.003*** (0.001)	0.017*** (0.004)	0.005*** (0.001)
Share of PLN denominated debt	0.006* (0.003)	0.002* (0.001)		
Firm-main bank relationship duration	–0.073*** (0.018)	–0.020*** (0.004)	–0.067*** (0.020)	–0.019*** (0.005)
Owner's nationality (0 = Polish, 1 = foreign)	–0.646** (0.289)	–0.180** (0.080)	–0.573* (0.315)	–0.162* (0.087)
Tertiary education employees	–2.154*** (0.635)	–0.600*** (0.159)	–1.846*** (0.638)	–0.521*** (0.164)
Employment	–0.001** (0.000)	–0.0003** (0.0001)		
Turnover 1 – 2 mil. Euros			–0.355 (0.322)	–0.103 (0.092)
Turnover 2 – 10 mil. Euros			–0.430 (0.273)	–0.124 (0.079)
Turnover 10 – 15 mil. Euros			–0.364 (0.370)	–0.105 (0.106)
Turnover 15 – 50 mil. Euros			–1.208** (0.524)	–0.325*** (0.121)
Turnover 50 – 250 mil. Euros			–0.781 (0.572)	–0.221 (0.153)
Constant	–0.078 (0.566)		–0.073 (0.613)	
Observations	286		236	
F	2.544***		2.170***	

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1; sectoral dummies included.
Source: Own compilation.

It could be argued that our results discussed in this section are plagued by endogeneity in general and reverse causation problem in particular. It might be that firms are pushed to innovate more because there are labour market or financial constraints. Innovative activities may be influenced by the perceived obstacles in labour and financial markets rather than the other way around. To deal

with the reverse causation problem we re-estimated our models with instrumental variables probit model technique to assert the causal impact of innovativeness on the firms' perception of labour market and financial obstacles.

The first step consisted in the identification of instruments which are highly correlated with the innovativeness index and uncorrelated with the residual term of the dependent variables (labour market and financial constraints). Our choice was guided by the path dependence or persistence of innovation. The innovation process depends heavily on past experience and accumulation of complex capabilities required for R&D activities. The empirical studies on the persistence of innovation have found strong effect of lagged patents on new patent applications (Crépon and Duguet, 1997; Cefis and Orsenigo, 2001) and lagged product and process innovations on the achievement of new product and process innovations (Duguet and Monjon, 2002; Raymond et al., 2010, Tavassoli and Karlsson, 2015).

Therefore we used three instruments for the innovation index: three dummy variables that take on the value of one if a company confirmed that it carried out a process innovation or a product innovation or registered a patent in 2007 – 2009. The three instruments are the lagged values of variables used in the construction of the innovativeness index. The results of the instrumental variables estimates are presented in Tables A2a and A3a in the Appendix. They are not noticeably different from those reported earlier in Tables 2 and 3 except the fact that the average marginal effect of the innovation index on financial constraints (Table A3a) is not statistically significant. However the values of chi-square statistic of Wald test of the exogeneity of the instrumented variable (see bottom lines of Tables A2a and A3a) do not allow to reject the null of no endogeneity. Because there is no endogeneity, a standard probit regression is preferable. Hence the conclusion drawn from the analysis of results displayed in Tables 2 and 3 about the positive impact of innovativeness on the firms' perception of severity of labour and financial markets constraints remains valid.

Conclusion

We used a unique database of more than 500 Polish manufacturing firms' internationalization and innovativeness to examine the determinants of a desire for a weak Polish Zloty. We found that more innovative companies, in terms of product and process innovations as well as trademark, patent or copyright registration, have a more favourable attitude towards a lower value of the Polish Zloty. This result holds true even when controlling for the impact of depreciation on firms' competitiveness and foreign-currency denominated debt as well as their size. In the next step we made an attempt to verify the hypothesis that innovators probably need a weaker Zloty to boost profits. Higher profitability enables innovating

firms to deal with the obstacles they encounter in the labour and financial markets. Our results support the notion that companies more engaged in innovative activities tend to indicate labour market regulations and financial constraints as main obstacles to their growth. These conclusions are robust to the inclusion of control variables such as firms' size, foreign ownership or established relationship with a bank. Moreover, we showed that the causation flows from innovative activities to the perceived severity of labour and financial markets constraints and not the other way around. In summary, we confirmed that a weak currency may be growth-enhancing in general and in countries with not so well-functioning labour and financial markets in particular.

Our research gave some insights into more in-depth recognition and discussion, adding to the following strands of research and literature. Firstly, investigating relationships between exchange rate changes and level with innovation activity, including catching-up economies within the EU. While in the EU exchange rate policy should be a matter of common interest, it would be interesting to know if countries can successfully use competitive devaluation to promote innovation, export and growth activity (with the possible risk of *beggar thy neighbour* consequences). Secondly, competition and competitiveness are elusive concepts difficult to described measure and communicate. Our results confirmed that companies use different possibilities and tools to win competition but it would be valuable to get more detailed knowledge about cost and non-cost competition factors at the companies level (their complementarity and substitutions). Thirdly, accumulation of data with close interrelations with companies during our survey revealed a topic which should be more explored at the companies level. Managers often highlighted differences in their perception and measures related to innovation activity and exchange rate risk phenomena. It would be interesting to recognize if those differences are significant among companies. It could help to put in order puzzling results of the literature indicating that exchange rate undervaluation might spur innovation activity and simultaneous outcomes indicating that a weak currency might retard R&D due to higher import prices. Probably both mechanisms are in place but companies and sectors heterogeneities lead to a varied net effect.

References

ADALET MCGOWAN, M. A. – ANDREWS, D. (2015): Skill Mismatch and Public Policy in OECD Countries. [OECD Economics Department Working Papers, No. 1210.] Paris: OECD Publishing.

AGHION, P. – ASKENAZY, P. – BERMAN, N. – CETTE, G. – EYMARD, L. (2012): Credit Constraints and the Cyclicality of R&D Investment: Evidence from France. Journal of the European Economic Association, *10*, No. 5, pp. 1001 – 1024. DOI: 10.1111/j.1542-4774.2012.01093.x.

AGHION, P. – BACCHETTA, P. – RANCIERE, R. – ROGOFF, K. (2006): Exchange Rate Volatility and Productivity Growth: The Role of Financial Development. [NBER Working Paper 12117.] Cambridge: NBER. DOI:10.3386/w12117.

ALTOMONTE, C. – AQUILANTE, T. (2012): The EU-EFIGE/Bruegel-UniCredit Dataset. [Bruegel Working Paper 2012/13.] Brussels: Bruegel.

BERGER, A. N – UDELL, G. F. (1990): Collateral, Loan Quality and Bank Risk. Journal of Monetary Economics, *25*, No. 1, pp. 21 – 42. DOI: 10.1016/0304-3932(90)90042-3.

BØLER, E. A. – MOXNES, A. – ULLTVEIT-MOE, K. H. (2015): R&D, International Sourcing, and the Joint Impact on Firm Performance. American Economic Review, *105*, No. 12, pp. 3704 – 3739. DOI: 10.1257/aer.20121530.

BRZOZOWSKI, M. – TCHOREK, G. (2017): Exchange Rate Risk as an Obstacle to Export Activity. Gospodarka Narodowa, *3*, No. 289, pp. 115 – 140.

CEFIS, E. – ORSENIGO, L. (2001): The Persistence of Innovative Activities: A Cross-Countries and Cross-Sectors Comparative Analysis. Research Policy, *30*, No. 7, pp. 1139 – 1158. DOI: 10.1016/S0048-7333(00)00139-6.

CHEN, S. S. (2017): Exchange Rate Undervaluation and R&D Activity. Journal of International Money and Finance, *72*, No. C, pp. 148 – 160.

CIEŚLIK, A. – MICHAŁEK, J. J. – MICHAŁEK, A. – MYCIELSKI, J. (2015): Determinants of Export Performance: Comparison of Central European and Baltic Firms. Czech Journal of Economics and Finance, *65*, No. 3, pp. 211 − 229.

COSCI, S. – MELICIANI, V. – SABATO, V. (2016): Relationship Lending and Innovation: Empirical Evidence on a Sample of European Firms. Economics of Innovation and New Technology, *25*, No. 4, pp. 335 – 357. DOI: 10.1080/10438599.2015.1062098.

CRÉPON, B. – DUGUET, E. (1997): Estimating the Innovation Function from Patent Numbers: GMM on Count Panel Data. Journal of Applied Econometrics, *12*, No. 3, pp. 243 – 263. DOI: 10.1002/(SICI)1099-1255(199705)12:3<243:AID-JAE444>3.0.CO;2-4.

DUGUET, E. – MONJON, S. (2002): Creative Destruction and the Innovative Core: Is Innovation Persistent at the Firm Level? [UCL Discussion Paper 02-07.] London: Department of Economics, University College London.

EICHENGREEN, B. – PARK, D. – SHIN, K. (2013): Growth Slowdowns Redux: New Evidence on the Middle-Income Trap. [NBER Working Paper, No. 18673.] Cambridge: NBER. DOI: 10.3386/w18673.

FUNK, M. (2003): The Effects of Trade on Research and Development. Open Economies Review, *14*, No. 1, pp. 29 – 42. DOI: 10.1023/A:1021247218110.

GAJEWSKI, P. – TCHOREK, G. (2017): Export Performance of Firms in Eastern and Western Polish Regions. European Planning Studies, *25*, No. 12, pp. 2250 – 2271.

GALA, P. (2008): Real Exchange Rate Levels and Economic Development. Cambridge Journal of Economics, *32*, No. 2, pp. 273 – 288. DOI: 10.1093/cje/bem042.

GOLOVKO, E. – VALENTINI, F. (2011): Exploring the Complementarity between Innovation and Export for SMEs' Growth. Journal of International Business Studies, *42*, No. 3, pp. 362 – 380. DOI:10.1057/jibs.2011.2.

HARRIS, R. (2001): Is There a Case for Exchange Rate Induced Productivity Changes? [Canadian Institute for Advanced Research Working Paper 164.]

HEERINGA, S. G. – WEST, B. T. – BERGLUND, P. A. (2010): Applied Survey Data Analysis. Boca Raton, FL: Chapman Hall/CRC.

HIJZEN, A. – MARTINS, P. S. – SCHANK, T. – UPWARD, R. (2013): Foreign-Owned Firms Around the World: A Comparative Analysis of Wages and Employment at the Micro-Level. European Economic Review, *60*, No. C, pp. 170 – 188. DOI: 10.1016/j.euroecorev.2013.02.001.

HOLLENSTEIN, H. (1996): A Composite Indicator of a Firm's Innovativeness. An Empirical Analysis Based on Survey Data for Swiss Manufacturing. Research Policy, *25*, No. 4, pp. 633 – 645. DOI: https://doi.org/10.1016/0048-7333(95)00874-8.

LEVY-YEYATI, E. – STURZENEGGER, F. – GULZMANN P. A. (2013): Fear of Appreciation. Journal of Development Economics, *101*, 233 – 247.

MAĆKOWIAK, H. (2011): The Goods Structure of Trade between Polish Regions and the European Union. Bulletin of Geography. Socio-Economic Series, *16*, No. 16, pp. 57 – 74. DOI: 10.2478/v10089-011-0014-9.

MAHAGAONKAR, P. – SCHWEICKERT, R. – CHAVALI, A. S. (2009): Sectoral R&D Intensity and Exchange Rate Volatility: A Panel Study for OECD Countries. [Working Paper 1531.] Kiel: Kiel Institute for the World Economy.

MALCHOW-MØLLER, N. – MARKUSEN, J. R. – SCHJERNING, B. (2013): Foreign Firms, Domestic Wages. The Scandinavian Journal of Economics, *115*, No. 2, pp. 292 – 325. DOI: 10.1111/sjoe.12001.

MBAYE, S. (2013): Currency Undervaluation and Growth: Is There a Productivity Channel? International Economics, *133*, May, pp. 8 – 28. DOI: 10.1016/j.inteco.2013.04.004.

MELITZ, M. J. (2003): The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity. Econometrica, *71*, No. 6, 1695 – 1725.

MISSIO, F. J. – JAYME, Jr. F. G. – BRITTO, G. – OREIRO, J. L. (2015): Real Exchange Rate and Economic Growth: New Empirical Evidence. Metroeconomica, *66*, No. 4, pp. 686 – 714. DOI:10.1111/meca.12087.

NARULA, R. – GUIMÓN, J. (2010): The Investment Development Path in a Globalized World: Implications for Eastern Europe. Eastern Journal of European Studies, *1*, No. 2, pp. 5 – 19.

NOUIRA, R. – PLANE, P. – SEKKAT K. (2011): Exchange Rate Undervaluation and Manufactured Exports: A Deliberate Strategy? Journal of Comparative Economics, *39*, No. 4, pp. 584 – 601. DOI: 10.1016/j.jce.2011.08.002.

PALMA, G. (2004): Four Sources of De-Industrialization and a New Concept of the Dutch Disease. In: OCAMPO, J. A. (ed.): Beyond Reforms: Structural Dynamics and Macroeconomic Vulnerability. Stanford, CA: Stanford University Press and World Bank.

RAYMOND, W. – MOHNEN, P. – PALM, F. – SCHIM VAN DER LOEFF, S. (2010): Persistence of Innovation in Dutch Manufacturing: Is It Spurious, Review of Economics and Statistics, *92*, No. 3, pp. 495 – 504. DOI: 10.1162/REST_a_00004.

RODRIK, D. (2008): The Real Exchange Rate and Economic Growth. Brookings Papers on Economic Activity, Fall, pp. 365 – 412.

SCHRÖDER, M. (2013): Should Developing Countries Undervalue Their Currencies? Journal of Development Economics, *105*, Issue C, pp. 140 – 151. DOI: 10.1016/j.jdeveco.2013.07.015.

SMITH, K. (2000): Innovation as a Systemic Phenomenon: Rethinking the Role of Policy. Enterprise & Innovation Management Studies, *1*, No. 1, pp. 73 – 102.

SOKOLOVA, M. V. (2015): Exchange Rates, International Trade and Growth: Re-evalution of Undervaluation. [Working Paper Series Working Paper, WP05-2016.] Geneva: Graduate Institute of International and Development Studies International Economics Department.

SOLON, G. – HAIDER, S. J. – WOOLDRIDGE, J. M. (2015): What Are We Weighting For? Journal of Human Resources, *50*, No. 2, pp. 301 – 316. DOI: 10.3368/jhr.50.2.301.

TAVASSOLI, S. – KARLSSON, Ch. (2015): Persistence of Various Types of Innovation Analyzed and Explained. Research Policy, *44*, No. 10, pp. 1887 – 1901. DOI: 10.1016/j.respol.2015.06.001.

Appendix

Table A1a

The Value of the First Component's Loadings Used to Create Innovativeness Index

Variable	Loading
Product innovation	0.4033
Process innovation	0.3282
Trademark registration	0.5240
Patent registration	0.4878
Copyright claim	0.4659

Source: Own compilation.

Table A1b

Summary Statistics

Variable	Statistic	Value
Innovativeness index	Weighted mean	0.57
Labour market constraints	Share of firms responding YES	0.41
Financial constraints	Share of firms responding YES	0.37
Preferred level of exchange rate	Weighted mean	3.95
Beneficial net effects of depreciation	Share of firms responding YES	0.24
Direct exports	Share of firms responding YES	0.82
Owner's nationality	Share of firms with foreign main owner	0.10
Product quality rank	Weighted mean	77.26
Share of PLN denominated debt	Weighted mean	78.95
Firm-main bank relationship duration	Weighted mean	11.56
Employment	Weighted mean	490.15
Tertiary education employees	Weighted mean	0.20
Domestic competitor	Share of firms responding YES	0.83
Competitive factor: quality	Share of firms responding YES	0.76
Competitive factor: distribution network	Share of firms responding YES	0.16
Turnover < 1 mil .Euros	Share of firms	0.48
Turnover 1 – 2 mil. Euros	Share of firms	0.20
Turnover 2 – 10 mil. Euros	Share of firms	0.20
Turnover 10 – 15 mil. Euros	Share of firms	0.06
Turnover 15 – 50 mil. Euros	Share of firms	0.04
Turnover 50 – 250 mil. Euros	Share of firms	0.02
Turnover > 250 mil. Euros	Share of firms	0.01

Source: Own compilation.

T a b l e A2a

Labour Market Obstacles: Instrumental Variables Probit Estimation Results

	Size proxied by employment		**Size proxied by turnover**	
	Coefficient	Marginal effects	Coefficient	Marginal effects
Innovativeness index	0.752*** (0.204)	0.275*** (0.062)	0.293 (0.214)	0.229*** (0.068)
Domestic competitor	0.455** (0.201)	0.152** (0.066)	0.501** (0.202)	0.177*** (0.066)
Competitive factor: quality	0.770*** (0.182)	0.253*** (0.056)	0.728*** (0.187)	0.239*** (0.059)
Competitive factor: distribution network	–0.507** (0.200)	–0.166** (0.065)	–0.568** (0.222)	–0.192*** (0.072)
Owner's nationality (0 = Polish, 1 = foreign)	0.461** (0.204)	0.151** (0.067)		
Employment	–0.001** (0.000)	–0.0002** (0.00008)		
Turnover 1 – 2 mil. Euros			0.227 (0.190)	0.081 (0.064)
Turnover 2 – 10 mil. Euros			0.230 (0.181)	0.084 (0.061)
Turnover 10 – 15 mil. Euros			0.322 (0.317)	0.108 (0.107)
Turnover 15 – 50 mil. Euros			–0.123 (0.363)	–0.039 (0.117)
Turnover 50 – 250 mil. Euros			–0.246 (0.542)	–0.058 (0.168)
Turnover > 250 mil. Euros			–0.200 (0.535)	–0.059 (0.161)
Constant	–1.879*** (0.432)		–1.338*** (0.369)	
Observations	505		515	
Wald model p-value	0.000		0.006	
Wald exogeneity test p-value	0.798		0.221	

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1; sectoral dummies included.

Source: Own compilation.

T a b l e A3a

Financial Constraints: Instrumental Variables Probit Estimation Results

	Size proxied by employment		**Size proxied by turnover**	
	Coefficient	Marginal effects	Coefficient	Marginal effects
Innovativeness index	0.809*** (0.297)	0.111 (0.082)	0.708** (0.306)	0.111 (0.091)
Product quality rank	0.013*** (0.004)	0.003*** (0.001)	0.014*** (0.004)	0.004*** (0.001)
Share of PLN denominated debt	0.006* (0.003)	0.002* (0.001)		
Firm-main bank relationship duration	–0.074*** (0.018)	–0.021*** (0.004)	–0.059*** (0.017)	–0.019*** (0.005)
Owner's nationality (0 = Polish, 1 = foreign)	–0.646** (0.283)	–0.180** (0.080)		
Tertiary education employees	–2.117*** (0.616)	–0.590*** (0.158)	–1.892*** (0.565)	–0.573*** (0.159)
Employment	–0.001** (0.000)	–0.0003** (0.0001)		
Turnover 1 – 2 mil. Euros			–0.320 (0.286)	–0.095 (0.086)
Turnover 2 – 10 mil. Euros			–0.400 (0.247)	–0.127* (0.073)
Turnover 10 – 15 mil. Euros			–0.287 (0.342)	–0.085 (0.104)
Turnover 15 – 50 mil. Euros			–0.888* (0.522)	–0.264** (0.134)
Turnover 50 – 250 mil. Euros			–0.647 (0.574)	–0.216 (0.162)
Constant	–0.286 (0.620)		–0.598 (0.517)	
Observations	286		276	
Wald model p-value	0.000		0.004	
Wald exogeneity test p-value	0.340		0.423	

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1; sectoral dummies included.

Source: Own compilation.

T a b l e A3b

Financial Constraints: Larger Sample

	Size proxied by employment		**Size proxied by turnover**	
	Coefficient	Marginal effects	Coefficient	Marginal effects
Innovativeness index	0.330** (0.153)	0.106** (0.048)	0.396** (0.169)	0.131** (0.054)
Product quality rank	0.007*** (0.002)	0.002*** (0.001)	0.008*** (0.003)	0.003*** (0.001)
Owner's nationality (0 = Polish, 1 = foreign)	–0.510** (0.214)	–0.163** (0.068)		
Tertiary education employees	–1.460*** (0.443)	–0.467*** (0.138)	–1.044** (0.405)	–0.346*** (0.131)
Employment	–0.001** (0.000)	–0.0002** (0.0001)		
Turnover 1 – 2 mil. Euros			–0.240 (0.201)	–0.081 (0.067)
Turnover 2 – 10 mil. Euros			–0.457** (0.192)	–0.149** (0.060)
Turnover 10 – 15 mil. Euros			–0.184 (0.274)	–0.063 (0.091)
Turnover 15 – 50 mil. Euros			–0.229 (0.425)	–0.078 (0.140)
Turnover 50 – 250 mil. Euros			–0.390 (0.558)	–0.129 (0.172)
Turnover > 250			–1.292** (0.615)	–0.333*** (0.095)
Constant	–0.439 (0.368)		–1.002*** (0.372)	
Observations	505		493	
F	2.015***		1.736**	

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1; sectoral dummies included.

Source: Own compilation.