

## Firm-Level Output and Competitiveness in the Great Recession: The Role of Firm Characteristics and Qualitative Factors

Tibor LALINSKÝ\*

---

### Abstract

*We investigate the developments of output volatility and competitiveness during the recent global recession using a unique firm-level database. The database combines Slovak balance sheet and trade data with results of a qualitative questionnaire survey on the firm competitiveness. The results of our quantitative analysis show that younger, less export oriented and more productive firms with comparative advantage weathered the crisis better. In addition, we find that highly efficient leadership, professional management and strong orientation on cost reduction helped firms to recover from the crisis and reach higher than the pre-crisis level of competitiveness within a short time period since the outset of the crisis.*

**Keywords:** *firm performance, volatility, competitiveness, recovery, qualitative factors, firm-level data, quantitative analysis, Great Recession*

**JEL Classification:** D22, L25

---

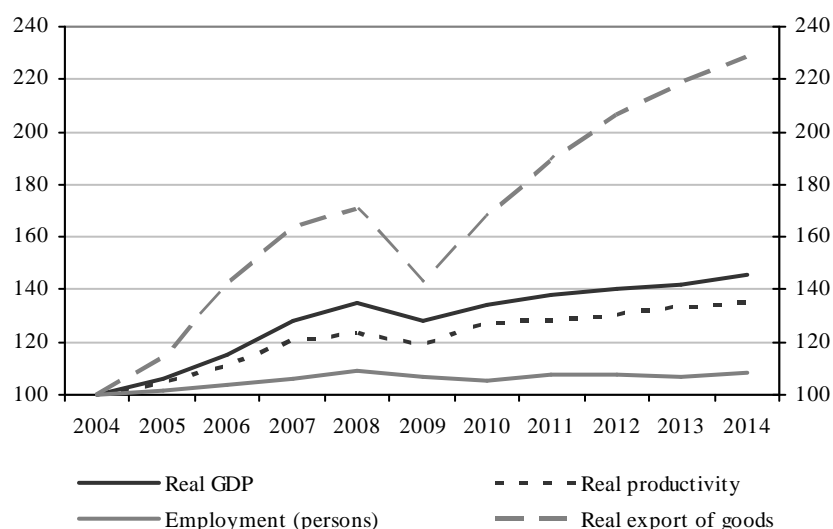
### Introduction

The Great Recession that according to the (IMF, 2009) developed into the deepest global post-World War II recession in 2009, hit particularly hard small, highly open, export-oriented new EU member states. In the pre-crisis period Slovakia was enjoying high economic growth that reach 10.8% in 2007. The unprecedented drop in foreign demand resulted in 5.5% fall in the Slovak real GDP in 2009. Fidrmuc et al. (2013) show that, unlike in Slovenia and Estonia, the recovery was strong, bringing GDP back to its pre-crisis level in 2011. In Figure 1 we can see that also export and productivity reached their pre-crisis level relatively quickly.

---

\* Tibor LALINSKÝ, Národná banka Slovenska, Odbor výskumu, Imricha Karvaša 1, 813 25 Bratislava, Slovak Republic; e-mail: tibor.lalinsky@nbs.sk

Figure 1  
Macro-level Development of the Slovak Economy



Source: Eurostat; own calculations.

Similarly volatile developments were recorded at the firm-level, drop in foreign demand resulted in a steep decline in sales and real value added. Labour productivity based on number of employed persons temporarily decreased. At the outset of the crisis firms were reluctant to lay off workers and preferred decrease in working hours instead. Based on our sample, cuts in number of employees that followed helped to restore the pre-crisis level of labour productivity as early as in 2010. However, firms reacted heterogeneously, in 2012 there still was about one third of firms that did not succeed to recover to their pre-crisis levels of sales or value added (in real terms).

We study this period of elevated volatility to identify factors that helped firms to survive the foreign demand shocks, recover the economic crisis and increase their competitiveness. We start with analysing the relationship between firm characteristics and firm output volatility based on the representative micro-data prepared in line with the procedure developed within the CompNet (Competitiveness Research Network) project (see Lopez-Garcia and di Mauro, 2015, for more details). We find that the impact of the assessed sources of volatility changed over the business cycle. Firm size and age, the main determinants of output volatility in the boom period, became less important in the crisis, when trade and competitiveness related factors dominate.

Empirical studies do not offer clear answer to the direction of exporting and trade openness on output volatility. For example, Buch, Döpke and Strotmann

(2009) show that exporters record lower volatility. Our results contribute to the stream of Vannoorenberghe (2012) and Nguyen and Schaur (2010), who find that a large export share is related to higher sales volatility. Besides positive effect of trade openness, we identify statistically significant negative effect of technological competitiveness (represented by total factor productivity) and international competitiveness (represented by revealed comparative advantage) on output volatility in the period of increased overall volatility.<sup>1</sup>

After identifying technological competitiveness to be a significant factor of the output stability during the crisis, we focus on explanation of its development using a panel data analysis. Following mainly Bartelsman and Doms (2000), Melitz (2003), Van Biesebroeck (2005a) or Van Biesebroeck (2005b) we investigate whether firm size, age, exporting, but also labour costs or capital intensity are associated with higher total factor productivity. We again find a dominant role of trade openness (i.e. foreign demand) and the decreased relevance of traditional time variant explanatory variables in the crisis period.

In addition, following Bloom and Van Reenen (2007), Koman et al. (2013), Lawless, O'Connell and O'Toole (2014), or Paunov (2012), who study effect of management practices, size, foreign ownership and other firm characteristics on the firm survival, investment decision or other aspects of firm's evolution, we analyse contribution of qualitative time invariant firm-level factors identified by a survey to recovery of the technological competitiveness after the crisis. We find that firms with more efficient leadership, professional management and stronger focus on cost reduction before the crisis recorded higher probability of increase in total factor productivity after the crisis.

To our knowledge, this is the first study that explains the Slovak firm-level development during the crisis using a combined micro-level balance sheet and trade data. The next section introduces the methodology and model specifications. The third section describes our data. The fourth section presents the main findings, and the last section summarises the results.

## 1. Methodology

We start with a cross-section analysis of output volatility to estimate the impact of main firm characteristics, where volatility of output is computed over a four-year period.<sup>2</sup> This specification allows us to split the original sample to a crisis and pre-crisis sample. Following Cede et al. (2016) in order to address

---

<sup>1</sup> We use the term technological competitiveness to distinguish between the competitiveness associated with higher quality and/or better technology and competitiveness associated with higher ability to compete on foreign markets.

the endogeneity issue, we use a specification that is strict in the chronological sequence of the firm characteristics and volatility.

We estimate the parameters of the following equation (1) with the ordinary least squares methodology.

$$\begin{aligned} volatility_{i,t+1\dots t+4} = & \beta_0 + \beta_1 \log(TFP_{i,t}) + \beta_2 \log(employment_{i,t}) + \\ & + \beta_3 \log(age_{i,t}) + \beta_4 fdi_{i,t} + \beta_5 export\_share_{i,t} + \beta_6 rca\_share_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

The variable  $volatility_{i,t+1\dots t+4}$  denotes the standard deviation of real sales growth over four years. The output volatility depends on total factor productivity ( $TFP$ ), size ( $employment$ ), firm age ( $age$ ), foreign ownership ( $fdi$ ), the share of exports in sales ( $export\_share$ ) and the share of exports with reveal comparative advantage on total firm exports ( $rca\_share$ ). All the explanatory variables are from period  $t$ , while the volatility is from period  $t + 1$  to  $t + 4$ . It ensures that the unobserved productivity shock from the same period cannot affect both diversification and volatility. We expect the coefficient  $\beta_1, \beta_2, \beta_3 < 0$  if more productive, larger and more experienced firms have lower volatility and  $\beta_4, \beta_5 > 0$  if firms with higher export share and foreign owned subsidiaries of multinationals have higher volatility.

We continue with the analysis of competitiveness developments in the crisis and pre-crisis period. We consider a panel specification to verify the impact of key determinants of total factor productivity representing the firm-level indicator of technological competitiveness. Motivated by previous studies, mainly Foster (2006) and Foster, Haltiwanger and Syverson (2008), we assume high persistence of total factor productivity.<sup>3</sup> Therefore the analysed problem may be expressed in the form of a dynamic specification with lagged dependent variable. More precisely, the following linear dynamic panel model with individual effects is estimated:

$$\begin{aligned} \log(TFP_{it}) = & \gamma \log(TFP_{i,t-1}) + \beta_1 \log(employment_{it}) + \beta_2 \log(age_{it}) + \\ & + \beta_3 \log(export\_share_{it}) + \beta_4 \log(capital\_intensity_{it}) \\ & + \beta_5 \log(labour\_costs_{it}) + \alpha_i + \varepsilon_{it} \end{aligned} \quad (2)$$

where  $TFP_{it}$  represents total factor productivity of a firm  $i$  in time  $t$ , that is assumed to be dependent on its lagged value  $TFP_{i,t-1}$ , size ( $employment$ ), age ( $age$ ), the

---

<sup>2</sup> Alternatively we could apply a panel data approach. However, a panel specification where one observation in the time dimension is defined by a four year interval would leave many firms out of the panel and the results would not be sufficiently robust.

<sup>3</sup> The correlation coefficient between the current and lagged value of TFP in our sample reaches 0.98.

share of exports in sales (*export share*), capital per employee (*capital\_intensity*) and labour costs per employee (*labour\_costs*) of a firm  $i$  in time  $t$ . Finally,  $\alpha_i$  is a company individual effect and  $\varepsilon_{it}$  represents error term.<sup>4</sup>

In addition to the analysis of the main sources of the crisis and pre-crisis competitiveness developments, we estimate a model to identify the role of available qualitative company factors on competitiveness recovery to the pre-crisis level.<sup>5</sup> We assume a baseline probit model, where the dependent variable takes values 0 and 1 conditional on whether the firm increased its total factor productivity between 2008 and 2012.

$$\Pr(TFP\_increase_i = 1) = \phi[\beta_0 + \beta_1 X_i + \beta_2 Z_i + \varepsilon] \quad (3)$$

where  $\phi$  is the cumulative normal distribution. The probability of the TFP increase in firm  $i$  depends on the firm's main characteristics ( $X_i$ ) covering size, age, the share of exports in sales, capital per employee, labour costs per employee, foreign ownership dummy and the firm's qualitative factors ( $Z_i$ ), more precisely level of the top 5 company factors of the future firm-level competitiveness identified by the survey.

We expect efficient company leadership, professional and high quality management, orientation on cost reduction and focus on customers to increase probability for recovery (both independently or with combination with the main firm characteristics).<sup>6</sup>

More detailed definitions and sources of the variables used in the regressions are discussed in the following section.

## 2. Data Description

The paper uses annual firm-level balance sheets, profit/loss statements data for a large representative sample of firms with 20 and more employees and combines it with a detailed customs data, additional firm characteristics from the

---

<sup>4</sup> We may consider fixed effect or random effect estimators or general method of moments (GMM) estimator. Although, the GMM approach has several advantages in comparison to fixed effect or random effect estimators, it is much more data demanding. Taking into account the limited number of observations and results of the Hausman test, we decide not to use the GMM or fixed effect estimator and focus on random effects estimator.

<sup>5</sup> Narrowing down the analysis to the largest Slovak companies, which participated in the survey, we lose large number of observations. One of the solutions to overcome the difficulties with insufficient number of observations is to redefine the problem to a probit model.

<sup>6</sup> Concerning the standard firm characteristics we expect more dynamic younger, smaller, foreign firms with higher capital intensity, lower labour costs or lower openness to have higher probability for recovery.

Business Register and results of a questionnaire survey. All datasets, except the results of the survey, originate from the Statistical office of the Slovak Republic. The datasets were anonymized and they were cleaned of outliers using an approach developed by the microdata project of the CompNet.<sup>7</sup> Key firm-level balance sheets and profit/loss statements datasets were first extended by information on employment, date of establishment and type of ownership and then merged with detailed customs data. Yearly trade flows related to products at the 6-digit HS level<sup>8</sup> and trade flows related to destination markets (countries) allow us take into not only export intensity, but also export structure of the non-financial firms.<sup>9</sup>

The descriptive statistics of the variables used in the regressions are presented in Table 1 and in Appendix. Following Cede et al. (2016) the output volatility is measured as the standard deviation of the firm-level real sales growth rate over a period of four years.<sup>10</sup> Export intensity is measured as the export share in the sales. The firms in our sample have high international openness, reaching 50% on average. They are medium sized and medium aged and half of them is foreign owned. Firm-level total factor productivity is estimated using an alteration of Wooldridge (2009) approach proposed by Galuscak and Lizal (2011) (see Lopez-Garcia et al., 2014, for more details). The indicator of international competitiveness is proxied by our firm level indicator of revealed comparative advantage.<sup>11</sup>

Additional qualitative data describing firm competitiveness come from a questionnaire survey undertaken in Slovak top 90 companies (based on total revenue) shortly before the outset of the crisis. The respondents were asked to assess impact of 73 potential factors affecting their competitiveness. The factors referred to 31 company-specific, 17 sectoral and 25 macro-level factors. For each factor

---

<sup>7</sup> See Lopez-Garcia and di Mauro (2015) for more details about the definition of variables and outlier treatment.

<sup>8</sup> Harmonised System of the World Customs Organization.

<sup>9</sup> Our baseline panel covers between 3 933 and 5 241 firms with 20 and more employees (depending on the year).

<sup>10</sup> Sales were converted into real terms using NACE 2-digit industry level deflators published by Eurostat. The choice of four years is chosen as a trade-off between more information about volatility captured by a longer time span and a larger number of firms covered by a shorter time span. The four year interval decreases the number of firms to 1184 in our baseline model specification.

<sup>11</sup> We identify product groups with modified revealed comparative advantage (RCA) at the national level (using the 6-digit HS code level exports) and then for every firm we calculate share of these categories in the total firm exports. The RCA index is calculated as the ratio of the share of a product in a country's total exports to the share of this product in total imports. It corresponds to the World Bank's Export Specialization Index <[http://wits.worldbank.org/wits/wits/witshelp/Content/Utilities/e1.trade\\_indicators.htm](http://wits.worldbank.org/wits/wits/witshelp/Content/Utilities/e1.trade_indicators.htm)>.

respondents were asked to evaluate current state of the factor achieved in their firms, the factor's effect on present firm competitiveness and its effect on future firm competitiveness. The current states were assigned values 1, 2 or 3 (higher value representing higher level or quality) by respondents.<sup>12</sup>

Table 1

**Descriptive Statistics of the Variables – Baseline Output Volatility Equation**

Variable	Mean	St. deviation	Minimum	Maximum
Standard deviation of sales growth	0.22	0.13	0.01	0.69
Export share in sales	0.50	0.39	0.00	1.00
Log (TFP)	0.36	1.77	-4.38	7.56
Number of employees	232	534	21	10 498
Firm age	11.59	4.78	1.00	36.00
Foreign ownership dummy	0.49	0.50	0.00	1.00
Share of exports with RCA	0.002	0.026	0.000	0.672

*Note:* Volatility of real sales growth in the period 2009 – 2012.

*Source:* Author's calculations.

A simple comparison of the most important sources of present and future competitiveness shows the rising significance of company factors and the diminishing relative significance of macro-level factors. It also reveals the increasing power of the customer and the need for a sufficient number of adequately educated employees; this intersects with the increasing pressures to reduce costs.<sup>13</sup>

Although, the survey offers important information on macro- and industry-level factors, taking into account unexpected radical changes in the external business conditions in the period of the Great Recession, we focus our analysis exclusively on the role of the firm-level factors.

More precisely, we are concerned with the current state of variables identified among top five future firm-level factors of competitiveness. As showed in Table 2, the rank of the individual top firm-level factors changes when we distinguish between present and future competitiveness, but the list of top five factors differs in only one factor. Managers of the surveyed top Slovak companies assigned higher importance to customers' needs and this factor replaced the factor related to the use of communication technology. Focusing primarily on the role of factors of future competitiveness, in the probit regressions for the increase in competitiveness between 2008 and 2012 we use information on the pre-crisis level of five most important factors of future competitiveness, which better represent firm's readiness for future development.

<sup>12</sup> Effects of all factors on present and future competitiveness of the company were assigned values between 1 and 5 (higher value representing higher importance).

<sup>13</sup> More details about the survey and its results were published in Lalinsky (2008).

Table 2

**Main Qualitative Factors of Competitiveness Identified by Survey**

Factors of present competitiveness		Factors of future competitiveness	
1.	Professionalism of management	1.	Orientation on cost reduction
2.	Quality of company management	2.	Extent of orientation on customers
3.	Orientation on cost reduction	3.	Quality of company management
4.	Efficiency of company leadership	4.	Efficiency of company leadership
5.	Extent of communication technology utilisation	5.	Professionalism of management

*Note:* The factors are ordered by the average importance assigned by surveyed managers.

*Source:* Lalinsky (2008).

### 3. Main Results

#### 3.1. Firm-level Output Volatility

Following equation (1) we first investigate the impact of main firm characteristics on output volatility. Our results (in Table 3) show that more competitive firms experienced lower output volatility during the crisis. The relationship between total factor productivity and sales volatility is negative and statistically significant even after controlling for a number of firm characteristics. In line with Cede et al. (2016) we assume that more competitive firms with higher productivity enjoyed a larger scope for internal adjustments in the downturn.

Similarly to other authors (e.g. Kurz and Senses, 2013; Luo and Zhu, 2014), we find that older (more experienced) firms record lower volatility. However, in contrast to Fort et al. (2013) or Barba Navaretti, Checchi and Turrini (2003), we do not find statistically significant effect of the firm size or foreign ownership on the output volatility.<sup>14</sup>

Taking into account the fact that the economic development after 2008 was predominantly driven by weak foreign demand, the results presented in Table 3 correctly show that the relationship between export intensity and output volatility is statistically significant and economically large. Firms with higher export share have higher volatility, which is in line with the findings of other authors (Vannoorenberghe, 2012, or Nguyen and Schaur, 2010).

But what is equally important, internationally competitive firms with higher share of exports with reveal comparative advantage experienced lower volatility. The effect of the international competitiveness is strongly statistically significant and economically outweighs both the effect of the technological competitiveness represented by the total factor productivity and the opposite effect of the export intensity.

---

<sup>14</sup> As documented in Appendix, firm size has statistically significant effect only in the pre-crisis period.



Table 3

**Determinants of Output Volatility – Crisis Period (2009 – 2012)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(TFP)	-0.008*** (0.002)	-0.008*** (0.002)	-0.008*** (0.002)	-0.008*** (0.002)	-0.008*** (0.002)	-0.005** (0.002)	-0.005** (0.002)	-0.005** (0.002)
Log(employment)		-0.001 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.003 (0.004)	-0.005 (0.004)	-0.005 (0.004)	
Log(age)			-0.023*** (0.007)	-0.023*** (0.007)	-0.022*** (0.007)	-0.019*** (0.007)	-0.019*** (0.007)	-0.018** (0.007)
FDI					0.009 (0.008)	-0.004 (0.008)	-0.005 (0.008)	
Export share						0.064*** (0.011)	0.065*** (0.011)	0.061*** (0.010)
RCA share							-0.138** (0.054)	-0.144*** (0.054)
Constant	0.228*** (0.004)	0.235*** (0.019)	0.291*** (0.025)	0.291*** (0.025)	0.288*** (0.026)	0.264*** (0.026)	0.263*** (0.026)	0.238*** (0.019)
Observations	1 191	1 191	1 191	1 191	1 191	1 184	1 184	1 184
R-squared	0.012	0.012	0.020	0.020	0.021	0.052	0.053	0.051

Note: OLS, robust standard errors in parentheses, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1, values of explanatory variables from 2008.

Source: Author's calculations.

**3.2. Firm-level Competitiveness**

The results of the analysis of the output volatility lead to additional questions related to the firm competitiveness during the crisis. In this section we try to shed more light on the factors that helped firms to increase their competitiveness. We narrow down the analysis to the largest Slovak companies that participated in the questionnaire survey completed shortly before the crisis to explore the role of important qualitative factors of competitiveness.

Table 4

**Key Determinants of Competitiveness – Pre-crisis versus Crisis Period**

Variables	Pre-crisis (2004 – 2008)		Crisis (2009 – 2012)		Entire sample (2004 – 2012)	
	(1)	(2)	(3)	(4)	(5)	(6)
Log(TFP <sub>t-1</sub> )	0.988*** (0.017)	1.000*** (0.023)	0.958*** (0.019)	0.929*** (0.024)	0.994*** (0.010)	0.984*** (0.012)
Log(Capital intensity)	0.054** (0.022)		-0.049 (0.040)		0.003 (0.017)	
Log(labour costs)	-0.038* (0.017)		-0.007 (0.027)		-0.011 (0.015)	
Export share		-1.308 (0.841)		-1.731*** (0.614)		-1.359*** (0.282)
Constant	0.166 (0.228)	-0.049 (0.037)	0.247 (0.231)	0.034 (0.048)	0.086 (0.135)	-0.013 (0.020)
Observations	156	114	158	122	314	236
Number of mark	46	34	47	37	51	39

Note: Panel with random effects, robust standard errors in parentheses, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

Source: Author's calculations.

Table 5

**Determinants of Competitiveness Recovery (Average Marginal Effects)**

Model	Qualitative variable			Control variables		Observations
	Name	Medium level	High level	Log(age)	Log(export share)	
(1)	Efficiency of company leadership	1.837*** (0.158)	1.703*** (0.180)			67
(2)		1.754*** (0.171)	1.633*** (0.188)	-0.110 (0.095)		67
(3)		1.694*** (0.159)	1.523*** (0.192)		-0.260** (0.114)	64
(4)	Professionalism of management	1.788*** (0.165)	1.797*** (0.161)			66
(5)		1.782*** (0.160)	1.791*** (0.156)	-0.173* (0.105)		66
(6)		1.855*** (0.158)	1.811*** (0.146)		-0.276** (0.114)	63
(7)	Quality of company management	0.029 (0.110)	– –			67
(8)		0.029 (0.107)	– –	-0.161 (0.101)		67
(9)		0.075 (0.113)	– –		-0.265** (0.118)	64
(10)	Orientation on cost reduction	1.853*** (0.169)	1.755*** (0.180)			67
(11)		1.752*** (0.154)	1.644*** (0.169)	-0.192* (0.111)		67
(12)		1.741*** (0.149)	1.684*** (0.171)		-0.216** (0.109)	64
(13)	Extent of orientation on customers	-0.094 (0.216)	-0.121 (0.209)			66
(14)		-0.099 (0.214)	-0.096 (0.207)	-0.136 (0.096)		66
(15)		-0.079 (0.225)	-0.113 (0.220)		-0.234** (0.113)	63

Note: Probit model, average marginal effects, robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ , low level of qualitative variable represents baseline value (except quality of company management).

Source: Author's calculations.

Following the methodology described in the section 2, we use a simple model for total factor productivity to assess the impact of key time-varying explanatory variables on the firm (technological) competitiveness. We find a statistically significant negative impact of labour costs and statistically significant positive impact of capital intensity on firm's competitiveness in the pre-crisis period using OLS and panel regression with random effect.<sup>15</sup> However, both relationships become statistically insignificant during the crisis. In contrast to the literature (Bartelsman and Doms, 2000, and Van Biesebroeck, 2005a) we do not find statistically significant impact of the size or age in the crisis period.<sup>16</sup> In addition,

<sup>15</sup> Hausman test confirms use of the model with random effects. Results of the test and comparison of regression results are presented in Appendix.

<sup>16</sup> See Appendix for detail results.

the effect of exporting that is insignificant in the pre-crisis period becomes statistically significant and economically large during the crisis. In contrast to Ospina and Shiffbauer (2010) or Van Biesebroeck (2005b) we find negative impact of the scale of exporting activity. This confirms the strong adverse effect of the foreign demand in the period of the Great Recession. In general, our findings suggest that the long-term behavior changed and the development of the firm competitiveness was driven by other than standard factors during the crisis.

Besides the apparent recovery of the aggregate labour productivity (see Figure 1), approximately one third of Slovak non-financial firms with 20 and more employees was unable to reach their pre-crisis labour productivity or total factor productivity level until 2012. This fact leads to the question why some firms succeeded to recover and increase their competitiveness level and the others did not. Results of our probit regressions (presented in Appendix) indicate that only firm trade openness and age had statistically significant impact on the probability of the increase in total factor productivity. However, further estimates using additional information from the pre-crisis questionnaire survey (in Table 5) show that additional qualitative factors played significant role. Firms with highly efficient leadership, high professional management and strong orientation on cost reduction had significantly higher probability of increase in competitiveness between 2008 and 2012.

## **Conclusion**

Slovakia, representing a small, highly open, export-oriented economy, experienced a sharp decline in the economic activity in 2009. Unlike in other small EU countries, the recovery that followed was strong and brought the GDP level to its pre-crisis level within two years. Similarly volatile developments were observed at the firm level.

We study this period of elevated volatility to identify factors that helped firms to survive the foreign demand shock, recover to the pre-crisis level of activity and increase their competitiveness. Using a representative firm-level dataset combining detailed balance sheet and trade data we find that the sources of volatility changed over the business cycle. Firm size and age, the main determinants of output volatility in the boom period, became less important in the crisis, when trade and competitiveness related factors dominated. More export-oriented firms with lower total factor productivity and lower share of export products with comparative advantage experienced higher volatility.

After narrowing down the analysis to the largest Slovak companies we confirm the dominant role of the trade openness and the decreased relevance of traditional explanatory variables in the development of the firm-level competitiveness

during the crisis. Applying additional qualitative information received from the questionnaire survey on competitiveness factors, we find that firms with more efficient leadership, professional management and stronger focus on cost reduction before the crisis had higher probability to return to their pre-crisis level of competitiveness.

## References

- BARBA NAVARETTI, G. – CHECCHI, D. – TURRINI, A. (2003): Adjusting Labour Demand: Multinational versus National Firms: A Cross-European Analysis. *Journal of the European Economic Association*, 1, No. 2 – 3, pp. 708 – 719.
- BARTELSMAN, E. J. – DOMS, M. (2000): Understanding Productivity: Lessons from Longitudinal Microdata. *Journal of Economic Literature*, 38, No. 3, pp. 569 – 594.
- BLOOM, N. – van REENEN J. (2007): Measuring and Explaining Management Practices Across Firms and Countries. *Quarterly Journal of Economics*, 122, No. 4, pp. 1351 – 1408.
- BUCH, C. M. – DÖPKE, J. – STROTMANN, H. (2009): Does Export Openness Increase Firm-level Output Volatility? *The World Economy*, 32, No. 4, pp. 531 – 551.
- CEDE, U. – CHIRIACESCU, B. – HARASZTOSI, P. – LALINSKY, T. – MERIKÜLL, J. (2016): Export Characteristics and Output Volatility: Comparative Firm-level Evidence for CEE Countries. [Working Paper Series.] Frankfurt am Main: European Central Bank. [Forthcoming.]
- FIDRMUC, J. – KLEIN, C. – PRICE, R. W. R. – WÖRGÖTTER, A. (2013): Slovakia: A Catching Up Euro Area Member In and Out of the Crisis. [Policy Paper, No. 55.] Bonn: Institute for the Study of Labor (IZA).
- FORT, T. C. – HALTIWANGER, J. – JARMIN, R. S. – MIRANDA, J. (2013): How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size. [Working Paper, No. 19134.] Cambridge, MA: National Bureau of Economic Research (NBER).
- FOSTER, L. – HALTIWANGER, J. – KRIZAN, C. J. (2006): Market Selection, Reallocation, and Restructuring in the U.S. Retail Trade Sector in the 1990s. *Review of Economics and Statistics*, 88, No. 4, pp. 748 – 758.
- FOSTER, L. – HALTIWANGER, J. – SYVERSON, C. (2008): Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability? *American Economic Review*, 98, No. 1, pp. 394 – 425.
- GALUSCAK, K. – LIZAL, L. (2011): The Impact of Capital Measurement Error Correction on Firm-Level Production Function Estimation. [Working Papers 2011/09.] Prague: Czech National Bank.
- IMF (2009): *World Economic Outlook: Crisis and Recovery*. Washington, DC:
- KOMAN, M. – LAKICEVIC, M. – PRAŠNIKAR, J. – SVEJNAR, J. (2013): Asset Stripping, Rule of Law and Firm Survival: The Hoff-Stiglitz Model and Mass Privatization in Montenegro. [Discussion Paper, No. 7821.] Bonn: Institute for the Study of Labor (IZA).
- KURZ, C. – SENSES, M. Z. (2013): Importing, Exporting, and Firm-Level Employment Volatility. [Working Paper, No. 13 – 31.] Washington, DC: Center for Economic Studies (CES).
- LALINSKY, T. (2008): Competitiveness Factors of Slovak Companies. [Working Paper 3/2008.] Bratislava: National bank of Slovakia.
- LAWLESS, M. – O'CONNELL, B. – O'TOOLE, C. (2014): SME Recovery Following a Financial Crisis: Does Debt Overhang Matter? [Working Paper, No. 491.] Dublin: The Economic and Social Research Institute (ESRI).

- LOPEZ-GARCIA, P. – di MAURO, F. (2015): Assessing European Competitiveness: The New CompNet Microbased Database. [Working Paper, No. 1764.] Frankfurt am Main: European Central Bank.
- LOPEZ-CARCIA, P. – di MAURO, F. – BENATTI, N. – ANGELONI, C. – ALTOMONTE, C. – BUGAMELLI, M. – D’AURIZIO, L. – BARBA NAVARETTI, G. – FORLANI, E. – ROSSETTI, S. – ZURLO, D. – BERTHOU, A. – SANDOZ-DIT-BRAGARD, C. – DHYNE, E. – AMADOR, J. – OPROMOLLA, L. D. – SOARES, A. C. – CHIRIACESCU, B. – CAZACU, A. – LALINSKY, T. (2014): Micro-based Evidence of EU Competitiveness: The CompNet Database. [Working Paper, No. 1634.] Frankfurt am Main: European Central Bank.
- LUO, X. – ZHU, N. (2014): What Drives the Volatility of Firm Level Productivity in China? [Policy Research Working Papers.] Washington, DC: The World Bank.
- MELITZ, M. J. (2003): The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71, No. 6, pp. 1695 – 1725.
- NGUYEN, D. X. – SCHAUR, G. (2010): Cost Linkages Transmit Volatility Across Markets. [Working Paper Series 2010-03.] Copenhagen: Economic Policy Research Unit (EPRU).
- OSPINA, M. – SHIFFBAUER, S. (2010): Competition and Firm Productivity: Evidence from Firm-Level Data. [Working Paper, No. 10/67.] Washington, DC: International Monetary Fund.
- PAUNOV, C. (2012): The Global Crisis and Firms’ Investments in Innovation. *Research Policy*, Elsevier, 41, No. 1, pp. 24 – 35.
- Van BIESEBROECK, J. (2005a): Firm Size Matters: Growth and Productivity Growth in African Manufacturing. *Economic Development and Cultural Change*, 53, No. 3, pp. 545 – 583.
- Van BIESEBROECK, J. (2005b): Exporting Raises Productivity in sub-Saharan African Manufacturing Firms. *Journal of International Economics*, 67, No. 2, pp. 373 – 391.
- VANNOORENBERGHE, G. (2012): Firm-level Volatility and Exports. *Journal of International Economics*, 86, No. 1, pp. 57 – 67.
- WOOLDRIDGE, J. M. (2009): On Estimating Firm-level Production Functions Using Proxy Variables to Control for Unobservables. *Economics Letters*, 104, No. 3, pp. 112 – 114.

## Appendix

Table A1

### Descriptive Statistics of the Variables – Probit Model for Recovery

Variable	Mean	Std. deviation	Min	Max
Capital per employee	27.71	30.45	2.12	164.14
Labour costs per employee	21 466	34 842	531	199 117
Firm age	11.46	4.23	1.00	20.00
Number of employees	1 462	2668	31	17740
Export share in sales	0.53	0.42	0.00	1.00
Foreign ownership dummy	0.70	0.46	0.00	1.00
Efficiency of company leadership	2.43	0.53	1.00	3.00
Professionalism of management	2.52	0.53	1.00	3.00
Quality of company management	2.42	0.50	2.00	3.00
Orientation on cost reduction	2.48	0.56	1.00	3.00
Extent of orientation on customers	2.45	0.66	1.00	3.00

Source: Author’s calculations.

Table A2

**Determinants of Output Volatility – Pre-crisis Period (2005 – 2008)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(TFP <sub>t-1</sub> )	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.000 (0.002)	-0.000 (0.002)	-0.001 (0.002)
Log(Employment)		-0.010*** (0.004)	-0.011*** (0.004)	-0.011*** (0.004)	-0.012*** (0.004)	-0.012*** (0.004)	-0.012*** (0.004)	
Log(Age)			-0.021*** (0.007)	-0.021*** (0.007)	-0.020*** (0.007)	-0.019*** (0.007)	-0.019** (0.007)	-0.018** (0.007)
FDI					0.011 (0.008)	0.007 (0.008)	0.007 (0.008)	
Export share						0.016 (0.010)	0.016 (0.010)	0.013 (0.009)
RCA share							0.031 (0.053)	0.031 (0.050)
Constant	0.186*** (0.004)	0.235*** (0.018)	0.283*** (0.025)	0.283*** (0.025)	0.280*** (0.025)	0.270*** (0.025)	0.269*** (0.025)	0.216*** (0.017)
Observations	1 035	1 035	1 035	1 035	1 035	1 034	1 034	1 034
R-squared	0.000	0.009	0.017	0.017	0.019	0.021	0.021	0.009

Note: OLS, robust standard errors in parentheses, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1, values of explanatory variables from 2004.

Source: Author's calculations.

Table A3

**Determinants of Competitiveness – Comparison of the Panel Data Estimators**

Variables	Pre-crisis (2004 – 2008)			Crisis (2009 – 12)			Entire sample (2004 – 2012)		
	OLS	FE	RE	OLS	FE	RE	OLS	FE	RE
Log(TFP <sub>t-1</sub> )	1.003*** (0.015)	0.403*** (0.130)	0.988*** (0.017)	0.986*** (0.015)	0.176** (0.082)	0.958*** (0.019)	0.994*** (0.011)	0.393*** (0.050)	0.994*** (0.010)
Log(capital intensity)	0.066** (0.031)	-0.234 (0.160)	0.054** (0.022)	-0.074 (0.048)	0.342* (0.196)	-0.049 (0.040)	0.003 (0.028)	-0.124 (0.091)	0.003 (0.017)
Log(labour costs)	-0.043* (0.026)	-0.138 (0.090)	-0.038* (0.017)	0.010 (0.028)	0.132 (0.217)	-0.007 (0.027)	-0.011 (0.019)	-0.054 (0.082)	-0.011 (0.015)
Constant	0.169 (0.228)	2.237** (0.901)	0.166 (0.228)	0.150 (0.247)	-1.823 (2.353)	0.247 (0.231)	0.086 (0.169)	1.176 (0.714)	0.086 (0.135)
Observations	156	156	156	158	158	158	314	314	314
R-squared	0.957	0.273		0.950	0.067		0.951	0.201	
Number of mark		46	46		47	47		51	51

Note: RE – random effects, FE – fixed effects, robust standard errors in parentheses, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

Source: Author's calculations.

Table A4

**Hausman Test Results**

<b>Hausman test – period 2004 – 2008</b>				
	FE	RE	Difference	s.e.
Log(TFP <sub>t-1</sub> )	.4031037	.9882832	-.5851795	.0791116
Log(capital intensity)	-.233876	.0537889	-.2876649	.1063628
Log(labour costs)	-.1384483	-.0382	-.1002483	.1022998
b = consistent under Ho and Ha; obtained from xtreg				
B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic				
chi2(3) = 61.85				
Prob > chi2 = 0.0000				
<b>Hausman test – period 2009 – 2012</b>				
	FE	RE	Difference	s.e.
Log(TFP <sub>t-1</sub> )	.1762467	.9578153	-.7815686	.0777629
Log(capital intensity)	.3424663	-.0493897	.391856	.1761367
Log(labour costs)	.1320719	-.0070196	.1390915	.1680736
Test: Ho: difference in coefficients not systematic				
chi2(3) = 114.68				
Prob > chi2 = 0.0000				
<b>Hausman test – period 2004 – 2012</b>				
	FE	RE	Difference	s.e.
Log(TFP <sub>t-1</sub> )	.3932797	.994115	-.6008353	.0528322
Log(capital intensity)	-.1236387	.0034517	-.1270904	.069066
Log(labour costs)	-.053678	-.0111709	-.0425071	.061268
Test: Ho: difference in coefficients not systematic				
chi2(3) = 130.72				
Prob > chi2 = 0.0000				

Source: Author's calculations.

Table A5

**Determinants of Competitiveness – All Firm Characteristics**

Variables	Pre-crisis (2004 – 2008)		Crisis (2009 – 2012)		Entire sample (2004 – 2012)	
	OLS	RE	OLS	RE	OLS	RE
Log(TFP <sub>t-1</sub> )	0.995*** (0.021)	0.974*** (0.022)	0.962*** (0.020)	0.923*** (0.026)	0.977*** (0.014)	0.977*** (0.012)
Log(capital intensity)	0.068 (0.051)	0.040 (0.047)	-0.122** (0.061)	-0.115* (0.062)	-0.026 (0.040)	-0.026 (0.030)
Log(labour costs)	-0.027 (0.113)	-0.054 (0.118)	0.087 (0.121)	0.143 (0.164)	0.093 (0.074)	0.093 (0.062)
Log(Employment)	-0.038 (0.129)	-0.009 (0.113)	-0.089 (0.121)	-0.186 (0.152)	-0.115 (0.078)	-0.115** (0.053)
Log(Age)	0.044 (0.112)	0.051 (0.107)	-0.088 (0.121)	0.004 (0.125)	-0.003 (0.076)	-0.003 (0.057)
Export share	0.349 (1.543)	0.729 (1.684)	-0.239 (2.834)	0.626 (1.675)	-0.744 (2.146)	-0.744 (0.726)
Constant	0.145 (0.388)	0.269 (0.449)	0.373 (0.550)	0.236 (0.654)	-0.034 (0.303)	-0.034 (0.254)
Observations	114	114	122	122	236	236
R-squared	0.949		0.943		0.943	
Number of mark		34		37		39

Note: RE – random effects, robust standard errors in parentheses, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

Source: Author's calculations.

Table A6

**Determinants of Competitiveness Recovery – Main Firm Characteristics**

	(1)	(2)	(3)	(4)	(5)	(6)
	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
Variables	Pr(ltfp_ increase)	Pr(ltfp_ increase)	Pr(ltfp_ increase)	Pr(ltfp_ increase)	Pr(ltfp_ increase)	Pr(ltfp_ increase)
Log(capital intensity)	-0.031 (0.066)	-0.024 (0.072)	-0.018 (0.072)	-0.028 (0.073)	-0.017 (0.074)	-0.012 (0.075)
Log(labour costs)		-0.007 (0.050)	-0.010 (0.050)	0.100 (0.184)	0.041 (0.199)	0.003 (0.208)
Log(age)			-0.202* (0.108)	-0.217* (0.111)	-0.219* (0.114)	-0.199* (0.115)
Log(employment)				-0.113 (0.176)	-0.065 (0.188)	-0.029 (0.198)
Export share					-0.259* (0.135)	-0.282* (0.145)
FDI						0.070 (0.142)
Observations	59	58	58	58	57	57

Note: Probit model, average marginal effects, robust standard errors in parentheses, \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

Source: Author's calculations.