Financial Crisis and Financing Constraints of SMEs in Visegrad Countries[1]

Petr KORÁB – Jitka POMĚNKOVÁ***

Abstract

The paper investigates the access of small and medium-sized enterprises to external financing during the recent financial crisis via non-parametric density estimation. The kernel density estimation is applied on a firm-level measure of financing constraints and evaluates its distribution on a balanced panel of SMEs. For application and cross-country comparison we use panel data on Limited Liability enterprises in the Czech Republic, Poland, Slovakia and Hungary. Our results reveal asymmetric impact of the financial crisis on the ability of SMEs to secure external financing. We identify that there is no sizeable difference in access to credit of SMEs in Hungary and Poland before and during the crisis. In Slovakia and the Czech Republic our results suggest that firms were more constrained during the crisis and their financing constraints did not largely improve after the end of financial crisis. We argue that economic recession was the driving factor of financing constraints in Slovakia and the Czech Republic.

Keywords: *financing constraints, KZ index, credit crunch, financial accelerator, non-parametric estimation, kernel density*

JEL Classification: C14, D22, E51

* Petr KORÁB, Mendel University in Brno, Faculty of Business and Economics, Department of Finance, Zemědělská 1, 613 00 Brno, Czech Republic; e-mail: petr.korab@mendelu.cz

** Jitka POMĚNKOVÁ, Brno University of Technology, Faculty of Electrical Engineering and Communication, Department of Radio Electronics, Technická 3082/12, 616 00 Brno, Czech Republic; e-mail: pomenkaj@feec.vutbr.cz

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Introduction

The recent financial crisis strongly affected the interbank market and this crucial source of liquidity for banks in Europe started to experience significant tensions, resulting in the dramatic drop of corporate lending and leading to credit crunch in several Eurozone countries (Ivashina and Scharfstein, 2010; Hernando and Villanueva, 2012), threatening the stability of the European monetary union (EMU) (Koráb and Kapounek, 2013). Not only Eurozone countries but several Central and Eastern European (CEE) economies were also hit particularly hard by the financial crisis. An example is Hungary that obtained an aid package including IMF and EU loans (Lutz and Kranke, 2010). In the group of Visegrad countries, liquidity of Czech banks declined between 2007 and 2009 but improved during consequent period and liquidity of Slovak banks decreased in 2009 and 2010 due to the changes in interbank market transactions. The development of liquidity ratios in Hungary and Poland was very similar because of structural weaknesses such as high loan-to-deposit ratios, high shares of foreign debts, and negative net positions in the interbank market (Vodová, 2013).

Worsening conditions for providing credit raise the question whether the small and medium-sized firms (SMEs) in the Central and Eastern European countries were financially constrained during the financial crisis, and if so to what extent. By financial constraints we mean frictions which prevent a firm to realize all desired investments not only due to credit constraints but also due to the inability to issue equity or due to problems to issue new bonds (as suggested by Lamont, Polk and Saá-Requejo, 2001). Since our dataset consists of SMEs, we use the term for access to bank credit. Credit decline may be reasoned either by shortage of bank capital, due to the impact of a macroeconomic shock, by weak performance of borrowers or by the drop in demand for credit (Bernanke and Lown, 1991). In this paper we are working with firm-level observations and examine the performance of borrowers as the determinant of credit provided during the financial crisis.

Our work is related to Bernanke, Gertler and Gilchrist (1996) who introduced the financial accelerator theory, and the theory of asymmetric information developed by Joseph E. Stiglitz. The principle of financial accelerator refers to the amplification of initial macroeconomic shocks brought about by changes in credit-market conditions. Since small and medium-sized companies often face higher agency costs of borrowing in credit markets due to their size, asymmetric information (Berger and Udell, 1998), or procyclical variation in sales, they should experience reduced access to credit, relative to other borrowers in times of the crisis. As a result of an economic crisis they should also reduce their economic activity earlier and more sharply than other economic agents. Similarly,

they should be the first to respond when the economy begins to grow (Bernanke, Gertler and Gilchrist, 1999). It is evident that credit to SMEs involves overcoming important problems of asymmetric information, since almost all credit received by small and medium-sized enterprises is intermediated. Stiglitz and Weiss (1981) argue that banks make higher expected returns on some of their borrowers than on others and model credit rationing in which among observationally identical borrowers some are credit constrained and some others are not. Asymmetry of information then matters when some borrowers receive loans and others do not (Stiglitz, 2002).

We employ a dataset of small and medium-sized enterprises in Poland, Hungary, Czech Republic and Slovakia. To make a cross-country comparison we select unlisted Limited Liability companies which are more vulnerable when credit shocks occur. SMEs constitute an interesting group to focus on because asymmetric information problems are likely to be particularly important for these firms, which usually have limited access to external financial markets and have weak banking relationships. These firms are more likely to be affected by financing constraints than large, listed firms (Lamont, Polk and Saá-Requejo, 2001). Since we work with identical balanced samples of enterprises, our approach is limited by the availability of data within Amadeus database. We face the limitation that our samples are not representative. Our contribution is nevertheless in two areas. Firstly, we estimate financing constraints of enterprises in our sample. Secondly, we propose application of non-parametric Kernel estimation on the measure of financing constraints, the *KZ* index (Kaplan-Zingales Index).

The purpose of the paper is to investigate whether small and medium-sized enterprises in Visegrad countries experienced decline of access to external financing during the financial crisis. We employ standard method of financing constraints identification based on calculation of the *KZ* index as the measure of financing constraint, and contribute to the literature by application of nonparametric kernel density estimation on calculated *KZ* index values. In the literature, the standard is to use the *KZ* index for classification of firms into categories according to their rate of financing constraints. We instead focus on the firm-level distribution of *KZ* index during the financial crisis, which we date from 2008 – 2009, and the pre-crisis and post-crisis periods. The fact that the financial crisis recently ended enables us to compare the pre-crisis, crisis and post-crisis levels of financing constraints and argue for the impact of the financial crisis.

The paper is structured as follows: after the introduction the first part reviews the literature, in the second part we present the data, the following part introduces the methodology, the fourth part provides results, in the fifth part we discuss our results and in the last part we make conclusions.

1. Literature Review

Empirical research on financing constraints and the recent financial crisis in the European Union mostly focuses on Eurozone countries analysing survey data by logit and probit models. Casey and Toole (2013) argue that bank-lending constrained SMEs in the Eurozone countries were significantly more likely to use alternative forms of external finance during the crisis, which reduced the likelihood of business fixed investment. This effect is not evident for business innovation. Kremp and Sevestre (2013) identify that French SMEs do not appear to have been strongly affected by credit rationing since 2008. Artola and Genre (2011) evaluate perceptions of financing crunch of Eurozone SMEs and argue that credit constrained firms tended to be small and young. Ferrando and Griesshaber (2011) find firm age and ownership to be the most robust predictors regarding the existence of financing constraints. The importance of other factors such as firm size and economic branch is not supported by their findings. Hölzl (2010) examines the access of Austrian SMEs to banking loans and finds that 38% of SMEs experienced a deterioration of the conditions for new loans in the wake of the financial crisis. Holton, Lawless and McCann (2012) find that at the country level three aspects of the crisis affect the firm credit: weak real economy, financial condition of enterprises and the level of debt. In general, larger and older firms faced the lowest risk of having loan applications rejected.

Regarding the impact of the financial crisis on SMEs in Visegrad countries, Tvrdoň and Bernatík (2010) conclude that SMEs appeared to suffer from continued difficult access to short-term finance, including export credits and trade finance. Konings, Rizov and Vandenbusschedet (2003) study internal financing constraints in transition economies in pre-crisis period and conclude that firms in Bulgaria and Romania are less sensitive to internal financing constraints than firms in Poland and the Czech Republic. Pospíšil and Schwarz (2014) focus on financial constrains in the Czech Republic between the years 2006 – 2011 covering the financial crisis. Using investment-cash flow sensitivity they find that there is robust evidence of the existence of financial constraints mainly after 2008 and in small and medium-sized enterprises. Majková (2011) focuses on the problems of SMEs with obtaining financial resources in Slovakia concluding that the most important factors are information, interest about new information, capital requirements and experience.

There is literature on credit rationing in the Czech Republic. Pruteanu (2004) estimates disequilibrium on the Czech credit market between 1997 and 2000 concluding that the market for new loans was characterized by a state of moderate excess demand only between January 1999 and December 2000. The remaining period is characterized by excess supply. Janda (2011) compares different forms

of government support with the regard to elimination of credit rationing, whereas Janda (2009) contributes to the literature with theoretical considerations related to the optimal design of credit contracts in both developed and developing economies. Horváth and Podpiera (2012) estimate the pass-through from market interest rates to banks interest rates in the Czech Republic. They provide evidence of relationship lending and their results indicate heterogeneity in bank pricing only in the short run.

2. Data

Our empirical analysis is based on firm-level observations for small and medium-sized enterprises from the Amadeus Bureau van Dijk database. We use data on small and medium-sized enterprises from Hungary (HU), Poland (PL), Slovakia (SK) and the Czech Republic (CZ). Our sample consists of yearly observations of 1 100 firms in Poland, 10 123 firms in the Czech Republic, 278 in Hungary and 956 in Slovakia in the period 2005 – 2011. We excluded observations where sales, tangible fixed assets, long-term debt or loans had negative values.

Sample selection process significantly reduced the sample size. Amadeus database provides unbalanced panel data, but our aim is to observe the development of financing constraints of the identical sample of firms over the time period. We were therefore forced to exclude all firms which do not provide complete data for the calculation of *KZ* index during the whole time period. Additionally, to make the results comparable across countries, we focus on Limited Liability companies since they have, as a legal form, similar features in all Visegrad countries (shareholders are liable to the amount of unpaid capital and the enterprises cannot issue shares and be traded at stock exchange). Based on the available data within Amadeus database, Limited Liability company is the most common legal entity of SMEs in the Czech Republic (54.2% of total number) and in Slovakia (78.8% of overall number). In Hungary and Poland this legal entity rather creates a minor fraction of all SMEs (0.8% and 15.9%, respectively). However, the total number of SMEs is highest in Poland. These facts explain the heterogeneous numbers of enterprises in the countries of our sample.

3. Methodology

3.1. Methodology of *KZ* Index

To study the impact of financial crisis on financing constraints of SMEs, the enterprises in the sample were evaluated with a *KZ* index employing the methodology of Lamont et al. (2001). The *KZ* index is calculated as follows:

$$KZ_{it} = -1.001909\frac{CF_{it}}{K_{it-1}} + 3.139193\frac{B_{it}}{TK_{it}} - 39.3678\frac{D_{it}}{K_{it-1}} - 1.314759\frac{C_{it}}{K_{it-1}} + \\ + 0.2826389Q_{it} \quad (1)$$

where

CF – cash-flow,
K – refers to property, plant and equipment,
B – long-term debt plus short-term loans,
TK – total capital which comprises long-term debt, short-term loans and total shareholder's funds,
D – refers to total dividends,
C – to cash holdings, *Q* is the Tobin Q,
t – refers to time dimension,
i – refers to cross-sectional dimension.

The *KZ* index is a relative measurement of external financing constraints. Companies with higher *KZ* index scores are more likely to experience difficulties when financial conditions tighten since they may have difficulty financing their ongoing operations. Increasing *KZ* index values imply rising external financing constraints.

The coefficients of the *KZ* index in (1) are constructed by Lamont, Polk and Saá-Requejo (2001) from an ordered logit model in Kaplan and Zingales (1997) on the sample of low-dividend paying firms. We use the exact specification of the *KZ* index according to Lamont, Polk and Saá-Requejo (2001), but use the dataset from Amadeus Bureau van Dijk database.[2] Within Amadeus we measure property, plant and equipment with tangible fixed assets. The value of *D* always takes the value of 0 since we work with unlisted firms which do not pay dividends.

A firm needs to provide information on all of the components of the *KZ* index for the whole coverage period (2005 – 2011) to be included in the sample. This sample selection strategy excludes the enterprises which went bankrupt. The difference between balanced and unbalanced panel accounts to approx. 5% of firms. We assume that these differences do not significantly change the results. Instead, we observe financing constraints of identical sample of firms which enables us to identify the differences more clearly.

Employing the *KZ* index as the measure of financing constraints implies problems with empirical estimation of Tobin Q. Tobin Q is typically defined as the market value of the firm over the book value of its assets. As the firms in our sample are unlisted, we are unable to assess their market value. Following Konings, Rizov and Vandenbusschedet (2003), Bakucs, Ferto and Fogarasi (2009),

[2] The Lamont, Polk and Saá-Requejo (2001) results were estimated using COMPUSTAT database.

Guariglia, Tsoukalas and Tsoukalas (2010) and Behr, Norden and Noth (2013), we use the firm's sales growth as the proxy for Tobin Q, i.e. for growth and investment opportunities. The proxy for Tobin Q is then calculated as:

$$Q_{it} = -(S_{it} / S_{it-1}) \tag{2}$$

where

S – denotes sales,
t – refers to time dimension,
i – refers to cross-sectional dimension.

The negative coefficient of Tobin Q proxy reflects the fact that financing constraints increase when an enterprise's sales decrease. An investor or a bank are less willing to finance a firm with negative sales growth since this signals worse company performance, risk of decreasing creditworthiness or risk of lower possible future revenues from the investment.

The *KZ* index is commonly applied for classification of firms into "constrained" and "unconstrained" categories when the first tercile of firms are classified as constrained, the lower tercile then as unconstrained (see Lamont, Polk and Saá-Requejo, 2001; Almeida, Campello and Weisbach, 2002; Kaplan and Zingales, 1997; Behr, Norden and Noth, 2013). We nevertheless study the development of distribution of *KZ* index as the relative measure of financing constraints during the period of financial crisis (2008 – 2009), and pre-crisis (2005 – 2007) and post-crisis (2010 – 2011) periods. The shift of the distribution toward higher values of *KZ* index implies that enterprises face higher financing constraints, i.e. their access to credit worsened, relative to other years.

3.2. Methodology of Density Estimate

Because in the preliminary analysis we find that data are not normally distributed, we apply non-parametric approach to kernel density estimate (Wand and Jones, 1995). As Cameron and Trivedi (2005) argue, this type of estimation is useful for comparison across different groups. Compared to the histogram density estimates are smoother and therefore provide better comparability. The kernel density estimator is a generalization of histogram $\hat{\boldsymbol{f}}(\boldsymbol{x}_0)$ centered at $\boldsymbol{x}_0$:

$$\hat{\boldsymbol{f}}(\boldsymbol{x}_0) = \frac{1}{\boldsymbol{N} \cdot \boldsymbol{h}} \sum_{\boldsymbol{i}=1}^{\boldsymbol{N}} \frac{1}{2} \cdot 1\left(\frac{\boldsymbol{x_i} - \boldsymbol{x}_0}{\boldsymbol{h}} < 1 \right) \tag{3}$$

where

$\boldsymbol{x_i}, \boldsymbol{i} = 1,..., \boldsymbol{N}$ – the measured *KZ* index values,
h – the bandwidth (Rice, 1984).

The estimator $\hat{f}(x_0)$ gives all observations in $\hat{f}(x_0) \pm h$ equal weight. The kernel density estimator can be written in the form (Cameron and Trivedi, 2005):

$$\hat{f}(x_0) = \frac{1}{N \cdot h} \sum_{i=1}^{N} K\left(\frac{x_i - x_0}{h}\right) \tag{4}$$

where the weighting function $K(\cdot)$ is called kernel function and satisfies specific mathematical conditions (see Wand and Jones, 1995). The density $\hat{f}(x_0)$ is calculated at a wide range of x_0 values. For the forming of histogram, evaluation at sample values $x_1, ..., x_N$. as the density estimator is used. From the group of kernels we use Epanechnikov kernel (Cameron and Trivedi, 2005; Poměnková, 2008).

The *KZ* index as the measure of financing constraints suffers from several limitations which should be taken into consideration. Firstly, Lamont, Polk and Saá-Requejo (2001) construct the *KZ* index from coefficients of an ordered logit model in Kaplan and Zingales (1997) on the sample of low-dividend paying firms. The coefficients are therefore sample-specific. Despite this fact, Li (2011), Almeida et al (2002) and Yena et al. (2014) applied the Lamont, Polk and Saá--Requejo (2001) approach on their own samples. Secondly, the coefficients from which the *KZ* index is constructed were estimated on the sample of low-dividend paying firms in manufacturing sector.

We nevertheless employ the dataset of unlisted SMEs. In line with our approach are Behr, Norden and Noth (2013) who investigated whether and how financial constraints of private firms depend on bank lending behaviour using a dataset of private SMEs employing the *KZ* index. We could not re-estimate the ordered logit model of Kaplan and Zingales (1997) since we lack qualitative data for the dependent variable.

4. Results

According to the methodology described above we first calculate the *KZ* index. Consequently, we proceed with calculation of kernel density estimates for each country and year. The *KZ* index calculations were performed in Stata 12. All calculations of kernel density estimates were done in Matlab 2011b.

4.1. Preliminary Analysis

The first step of our analysis was focused on descriptive statistics of the annual *KZ* index values. Summarisation of these results provides table 1 below.

T a b l e 1

Summary Statistics of *KZ* Index

	Year	Mean	Median	Min.	Max.	Lowest perc.	Highest perc.	Obs.
Poland	2005	–5.806	–0.396	–525.015	92.794	–92.924	2.777	1 100
	2006	–3.722	–0.334	–514.183	33.407	–82.346	2.791	1 100
	2007	–5.426	–0.334	–706.370	31.644	–123.016	2.942	1 100
	2008	–2.603	–0.015	–574.692	30.037	–58.246	5.686	1 100
	2009	–2.486	–0.042	–479.605	133.598	–57.478	4.677	1 100
	2010	–4.361	–0.201	–575.602	50.071	–105.698	4.815	1 100
	2011	–4.487	–0.120	–494.207	51.334	–133.125	4.357	1 100
Hungary	2005	–4.496	–0.148	–768.258	481.257	–95.689	9.492	278
	2006	–50.763	–0.247	–13 552.962	142.004	–160.874	15.451	278
	2007	–10.429	–0.100	–2 402.288	43.622	–124.061	3.426	278
	2008	–1.123	–0.073	–125.910	195.636	–65.563	3.765	278
	2009	–1.438	–0.089	–298.821	245.268	–63.098	4.192	278
	2010	–8.726	–0.165	–1 433.117	28.609	–93.019	10.180	278
	2011	–3.055	–0.194	–528.975	20.611	–57.140	10.226	278
Czech Republic	2005	–15.498	–1.409	–9 275.931	608.903	–201.916	7.421	10 123
	2006	–16.702	–1.459	–9 448.063	262.593	–234.644	7.126	10 123
	2007	–17.660	–1.513	–31 119.813	6 108.823	–237.784	6.789	10 123
	2008	–14.479	–1.189	–7 906.299	363.434	–211.356	8.060	10 123
	2009	–10.797	–0.942	–6 175.043	2 207.197	–176.453	10.551	10 123
	2010	–9.643	–1.008	–7 535.740	6 816.708	–185.056	10.918	10 123
	2011	–10.284	–0.943	–9 998.732	11 600.570	–185.239	12.606	10 123
Slovakia	2005	–780.618	–1.004	–737 762.875	95.150	–135.794	3.505	956
	2006	–4.833	–0.855	–537.173	104.396	–66.457	4.271	956
	2007	–6.257	–0.789	–2 018.176	101.291	–50.353	6.238	956
	2008	–31.676	–0.786	–10 502.550	315.834	–130.057	2.717	956
	2009	–1.914	–0.405	–95.609	36.961	–35.041	3.197	956
	2010	–3.065	–0.574	–308.380	16.247	–58.452	4.890	956
	2011	–3.694	–0.573	–189.394	22.151	–82.367	3.779	956

Note: Table reports mean, median, minimum (Min.), maximum (Max.), first percentile (Lowest perc.), 99th percentile (Highest perc.) and number of observations (Obs.) of calculated *KZ* indexes for countries in the sample.

Source: Authors' calculations.

Summary statistics (median namely) in Table 1 suggest that during the financial crisis median values of *KZ* index increased in the Czech Republic (to –0.942 in 2009 from –1.459 in 2006) and in Slovakia (change from –0.855 in 2006 to –0.405 in 2009). In Poland and Hungary the increase appears rather marginal (to –0.042 in 2009 from –0.334 in 2006 in Poland and to –0.089 in 2009 from –0.247 in 2006 in Hungary). The biggest difference in the Czech Republic and Slovakia suggests that SMEs in these two countries suffered most from worse access to credit at the end of the financial crisis. Differences in means between 2006 and 2009 are in all countries strongly affected by outlying observations. In all countries large differences between minimum values and 1st percentile, and maximum values and 99th percentile suggest that we have in our sample

enterprises with extremely good performance with very low financing constraints, and enterprises which face high financing constraints due to their very bad indicators.

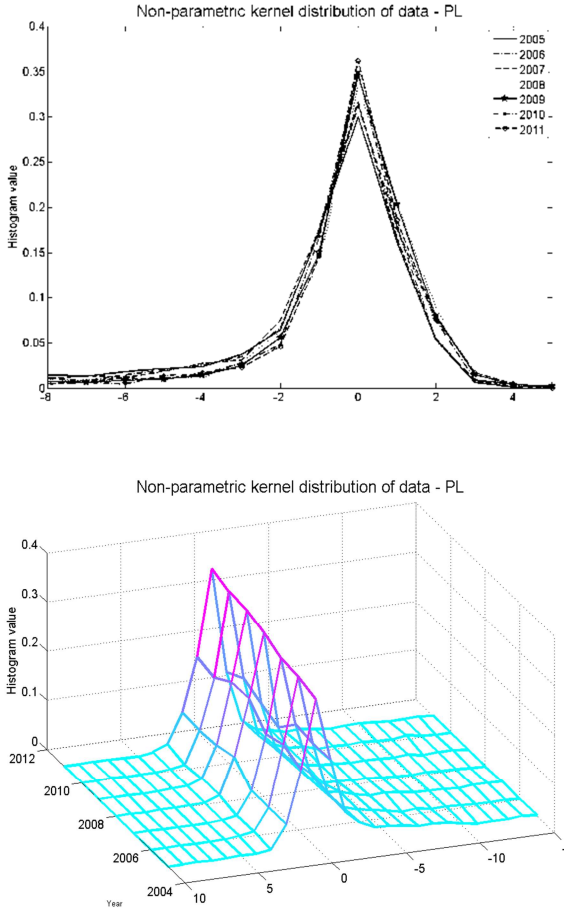
4.2. Results of Density Estimates

Furthermore, we proceed with estimation of kernel densities. The results are presented in two and three-dimensional charts (Figure 1a – 1d). With respect to comparability, the time period 2005 – 2011 was the same for all for all countries (Poland, Hungary, the Czech Republic and Slovakia).

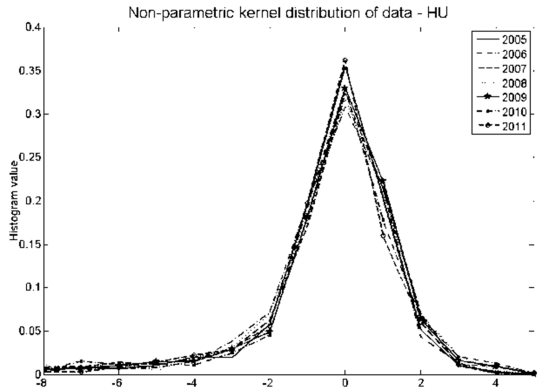
F i g u r e 1

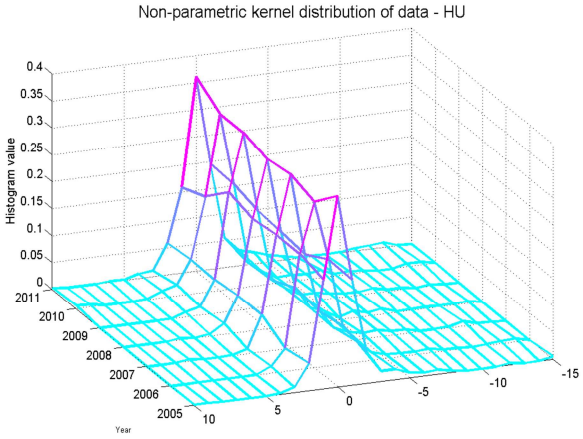
Non-parametric Density Estimates of *KZ* Index for Poland (a), Hungary (b), the Czech Republic (c) and Slovakia (d) in Two- and Three-dimension

a)

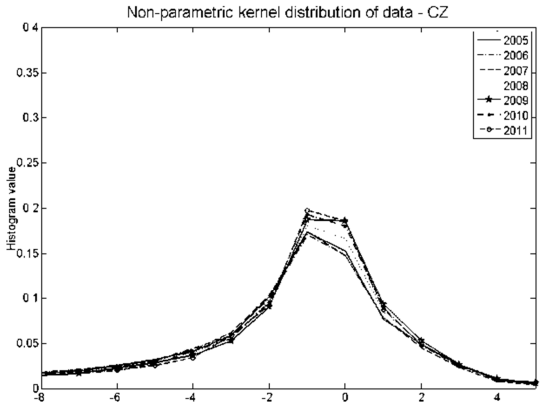


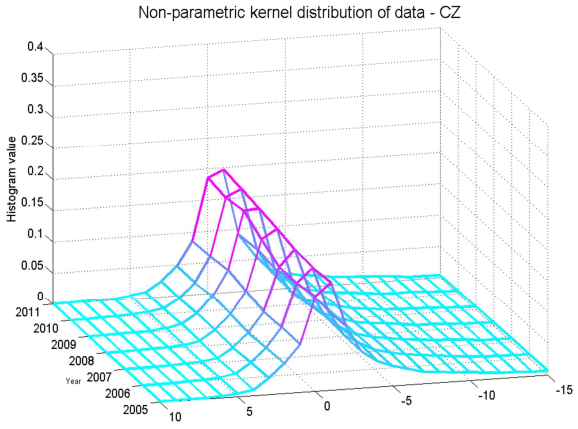
b)


Non-parametric kernel distribution of data - HU
Histogram value
2005
2006
2007
2008
2009
2010
2011

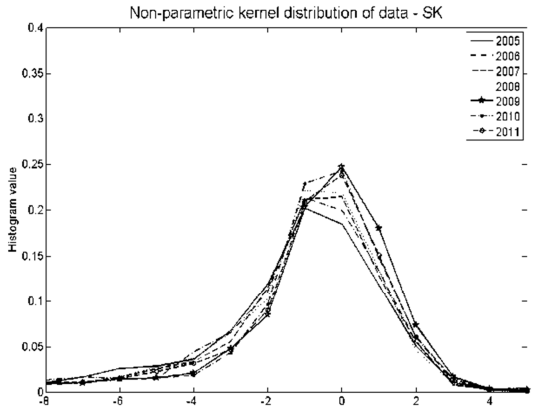

Non-parametric kernel distribution of data - HU
Histogram value
Year

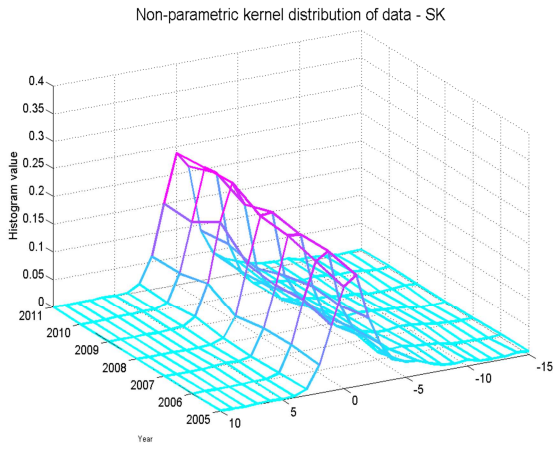
c)


Non-parametric kernel distribution of data - CZ
Histogram value
2005
2006
2007
2008
2009
2010
2011



d)





Source: Authors' calculations.

The two-dimensional charts of estimated densities provide a graphical comparison of individual density estimate corresponding to each year and country (*x*-axis denotes intervals of histograms and *y*-axis value of kernel density estimates of the *KZ* index corresponding to each year). In three-dimensional charts the *x*-axis denotes time, the *y*-axis intervals of the histograms and the *z*-axis value of the kernel density estimates of the *KZ* index.

In the case of Poland (Fig. 1a) we can see a slow increase of values around maximum density estimate with respect to increasing years. As the year is increasing, the histogram curve is steeper. Each curve of density estimate has a similar shape. The distribution function does not change over time which implies that financing constrains of enterprises did not alter during the financial crisis.

The situation in Hungary (Fig. 1b) is similar to Poland. The maximum density estimate achieved the highest level at the start (2005) and at the end (2011) of observed years. Between years 2006 – 2010 the maximum density estimates appear to have stagnant values. There is no big difference before and after the crisis, i.e. there is no structural break in the year 2008. As in Poland, we do not observe any increase of financing constraints of enterprises after the financial crisis erupted.

Our results suggest that that financial crisis did not largely affect financing constraints of SMEs in Hungary. This may be in contrast with the fact that Hungary experienced credit crisis in 2008 (see Egedy, 2012). Hungarian firms and households, particularly liquidity-constrained households to which the size of their monthly payment was important, borrowed in foreign currency, underestimating exchange rate risk. As a result, the households built up a large unhedged foreign currency position which, after the depreciation of forint between September 2008 and March 2009, led the country to request the IMF, which together with the EU Commission provided a 20 billion Euro bail-out (EEAG, 2012). In our paper, we are looking at the financing constraints of SMEs resulting from firm-specific indicators, and our results suggest that their performance was not the key determinant of the drop of credit during the financial crisis. Our measure of financing constraints is essentially a credit rating of enterprises, based on the firm-specific indicators.

In the Czech Republic (Fig. 1c) case we can see slow increase of maximum density estimate as the years increase. In the first two years (2005 and 2006) the maximum value of density estimate is quite similar, while after the year 2007 a larger increase is observable. We observe a shift of the distribution function after the financial crisis started in 2008, which signals that SMEs had more difficulties to access credit. In the case of Slovakia (Fig. 1d) we can see that after 2008 the maximum density estimate achieved higher level and stay at this level. Before the crisis year 2008, i.e. 2005 – 2008, the level of the maximum density

estimate was lower and stagnant. In Slovakia, the shift of the distribution function after 2008 is clearly visible. SMEs faced therefore increasing obstacles to access credit since the financial crisis started. Both in the Czech Republic and Slovakia the distribution function in 2011 did not return to pre-crisis position.

The largest increase of financing constraints during the financial crisis experienced SMEs in the Czech Republic, and mainly in Slovakia. Fidrmuc and Wörgötter (2014) argue that the crisis affected Slovak economy severely with GDP decline by 4.9% in 2009. Czech Republic suffered comparably from the impact of the crisis (decline of 4.6% in 2009). We attribute the increase of financing constraints of enterprises in Slovakia and the Czech Republic to a macroeconomic shock and recession which affected the performance of SMEs. This decline was stronger than in Poland where the economy grew by 1.6%. Poland was the only EU country recording positive GDP growth in 2009 (ECB, 2010), financing constraints of enterprises are therefore not expected to rise during the financial crisis in this country. Our results confirm these expectations. Theory of financial accelerator directly explains the linkage of economic recession affecting the performance of SMEs' performance which consequently leads to credit contraction.

Conclusions

This paper investigates whether small and medium-sized enterprises in the Czech Republic, Slovakia, Poland and Hungary experienced decline in access to external financing during the financial crisis. For the analysis we selected only limited liability companies since they have comparable features in all Visegrad countries. We evaluate every firm's financing constraints with the *KZ* index and study the distribution of this financing constraint measure during the financial crisis (2008 – 2009), and in pre-crisis (2005 – 2007) and post-crisis (2010 – 2011) years.

We contribute to the literature by application of non-parametric kernel estimations on the measure of financing constraints, the *KZ* index. Our analyses reveal that there is not any sizeable difference in access to credit of SMEs in Hungary before and during the crisis resulting from firm-specific factors. In Poland the differences are rather marginal. In Slovakia and the Czech Republic our results suggest that firms were more constrained during the crisis. The authors tend to the fact that economic recession was the driving factor of financing constraints in Slovakia and the Czech Republic. Therefore, we observe asymmetric impact of the financial crisis on the access to external financing of SMEs in Visegrad countries. Our analysis suggests that performance of Hungarian SMEs was not the main determinant of credit crisis in Hungary in 2008.

The contribution is in methodological approach studying financing constraints of SMEs through the analysis of non-parametric kernel estimation. We significantly differ from the literature since constraints indexes (KZ index in our case) are commonly used to list the sample of firms using the index value, and consequently to classify the firms into categories using scales between financially constrained and unconstrained. Designed approach has a wide use to tackle the problem of measuring financial constraints via indexes.

References

ALMEIDA, H. – CAMPELLO, M. – WEISBACH, M. S. (2002): Corporate Demand for Liquidity. [Working Paper, No. 9253.] Cambridge, MA: National Bureau for Economic Research.

ARTOLA, C. – GENRE, V. (2011): Euro Area SMEs Under Financial Constraints: Belief or Reality? [Working Paper, No. 3650.] Munich: CESifo.

BAKUCS, L. – FERTO, I. – FOGARASI, J. (2009): Investment and Financial Constraints in Hungarian Agriculture. Economics Letters, *104*, No. 3, pp. 122 – 124.

BEHR, P. – NORDEN, L. – NOTH, F. (2013): Financial Constraints of Private Firms and Bank Lending Behavior. Journal of Banking and Finance, *37*, No. 9, pp. 3472 – 3485.

BERGER, A. N. – UDELL, G. (1998): The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle. Journal of Banking & Finance, *22*, No. 6 – 8, pp. 613 – 673.

BERNANKE, B. – GERTLER, M. – GILCHRIST, S. (1996): The Financial Accelerator and the Flight to Quality. The Review of Economics and Statistics, *78*, No. 1, pp. 1 – 5.

BERNANKE, B. – GERTLER, M. – GILCHRIST, S. (1999): The Financial Accelerator in a Quantitative Business Cycle Framework. In: TAYLOR, J. B. and WOODFORD, M. (eds): Handbook of Macroeconomics. Vol. 1, Part 3, Chapter 21. North-Holland: Elsevier.

BERNANKE, B. S. – LOWN, C. S. (1991): The Credit Crunch. Brookings Papers on Economic Activity, *2*, 1991, pp. 205 – 239.

CAMERON, A. C. – TRIVEDI, P. K. (2005): Microeconometrics: Methods and Applications. Cambridge: Cambridge University Press.

CASEY, E. – O'TOOLE, C. M. (2013): Bank-lending Constraints and Alternative Financing During the Financial Crisis: Evidence from European SMEs. [Working Paper, No. 450.] Dublin: Economic and Social Research Institute.

EEAG (2012): The Hungarian Crisis. [The EEAG Report on the European Economy]. Munich: CESifo, pp. 115 – 130.

EGEDY, T. (2012): The Effects of Global Economic Crisis in Hungary. Hungarian Geographical Bulletin, *61*, No. 2, pp. 155 – 173.

EUROPEAN CENTRAL BANK (2010): The Impact of the Financial Crisis on the Central and Eastern European Countries. ECB Monthly Bulletin, July 2010.

FERRANDO, A. – GRIESSHABER, N. (2011): Financing Obstacles Among Euro Area Firms. Who Suffers the Most? [Working Paper, No. 1293.] Frankfurt am Main: European Central Bank.

FIDRMUC, J. – WÖRGÖTTER, A. (2014): Euro Membership, Foreign Banks and Credit Development During the Financial Crisis in Slovakia: A Case Study. Review of Agricultural and Applied Economics, *12*, No. 1, pp. 12 – 23.

GUARIGLIA, A. – TSOUKALAS, J. – TSOUKALAS – S. (2010): Investment, Irreversibility, and Financing Constraints in Transition Economies. [Discussion Paper, No. 10/03.] Nottingham: University of Nottingham.

HERNANDO, I. – VILLANEUVA, E. (2012): The Recent Slowdown of Bank Lending in Spain: Are Supply-Side Factors Relevant? [Working Paper, No. 1206.] Madrid: Central Bank of Spain.

HOLTON, S. – LAWLESS, M. – McCANN, F. (2012): Firm Credit in the Euro Area: A Tale of Three Crises. [Research Paper, No. 4/RT/12.] Dublin: Central Bank of Ireland.
HÖLZL, W. (2010): Austria's Small and Medium-sized Enterprises in the Financial Market Crisis. Austrian Economic Quarterly, *15*, No. 5, pp. 121 – 126.
HORVÁTH, R. – PODPIERA, A. (2012): Heterogeneity in Bank Pricing Policies: The Czech Evidence. Economic Systems, *36*, No. 1, pp. 87 – 108.
IVASHINA, V. – SCHARFSTEIN, D. (2010): Bank Lending During the Financial Crisis of 2008. Journal of Financial Economics, *97*, No. 3, pp. 319 – 338.
JANDA, K. (2009): Bankruptcies with Soft Budget Constraint. The Manchester School, *77*, No. 4, pp. 430 – 460.
JANDA, K. (2011): Inefficient Credit Rationing and Public Support of Commercial Credit Provision. Journal of Institutional and Theoretical Economics, *167*, No. 2, pp. 371 – 391.
KAPLAN, S. N. – ZINGALES, L. (1997): Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? Quarterly Journal of Economics, *112*, No. 1, pp. 168 – 216.
KONINGS, J. – RIZOV, M. – VANDENBUSSCHEDET, H. (2003): Investment and Financial Constraints in Transition Economies: Micro Evidence from Poland, the Czech Republic, Bulgaria and Romania. Economics Letters, *78*, No. 2, pp. 253 – 258.
KORÁB, P. – KAPOUNEK, S. (2013): International Fisher Effect under Exchange Rate Regime Shifts: Evidence from 10 Examples. Society and Economy, *35*, No. 4, pp. 451 – 469.
KREMP, E. – SEVESTRE, P. (2013): Did the Crisis Induce Credit Rationing for French SMEs? Journal of Banking and Finance, *37*, No. 1, pp. 3757 – 3772.
LAMONT, O. – POLK, C. – SAÁ-REQUEJO, J. (2001): Financial Constraints and Stock Returns. The Review of Financial Studies, *14*, No. 2, pp. 529 – 554.
LI, D. (2011): Financial Constraints, R&D Investment, and Stock Returns. The Review of Financial Studies, *24*, No. 9, pp. 2974 – 3007.
LUTZ, S. – KRANKE, M. (2010): The European Rescue of the Washington Consensus? EU and IMF Lending to Central and Eastern European Countries. [Discussion Paper, No. 22/2010.] London: London School of Economics.
MAJKOVÁ, M. S. (2011): The Analysis of Barriers and Factors of Small and Medium-sized Enterprises Financing in the Slovak Republic. Ekonomický časopis/Journal of Economics, *59*, No. 10, pp. 1033 – 1049.
POMĚNKOVÁ, J. (2008): Remarks to Optimum Kernels and Boundary Optimum Kernels. Applications of Mathematics, *53*, No. 4, pp. 305 – 317.
POSPÍŠIL, M. – SCHWARZ, J. (2014): Bankruptcy, Investment, and Financial Constraints: Evidence from a Post-Transition Economy. [Working Paper, No. 1/2014.] Prague: Czech National Bank.
PRUTEANU, A. (2004): Was There Evidence of Credit Rationing in the Czech Republic? Eastern European Economics, *42*, No. 5, pp. 58 – 72.
RICE, J. (1984): Bandwidth Choice for Nonparametric Regression. The Annals of Statistics, *12*, No. 4, pp. 1215 – 1230.
STIGLITZ, J. E. – WEISS, A. (1981): Credit Rationing in Markets with Imperfect Information. American Economic Review, *71*, No. 3, pp. 393 – 410.
STIGLITZ, J. E. (2002): Information and the Change in the Paradigm in Economics. The American Economic Review, *92*, No. 3, pp. 460 – 501.
TVRDOŇ, M. – BERNATÍK, W. (2010): Economic Crisis and Its Impact on SMEs: the Case of Visegrad Group Countries. Journal of Women's Entrepreneurship and Education, *2*, No. 1 – 2, pp. 114 – 130.
VODOVÁ, P. (2013): Liquid Assets in Banking: What Matters in the Visegrad Countries? E + M Ekonomie a Management, *16*, No. 3, pp. 113 – 129.
WAND, M. P. – JONES, M. S. (1995): Kernel Smoothing. 1st ed. London: Chapman and Hall.
YENA, J. F. – CHENB, Y. S. – LINC, C. Y. – TSAIB, C. H. (2014): Can Political and Business Connections Alleviate Financial Constraints? Applied Economics Letters, *21*, No. 8, pp. 550 – 555.