4. PRICE INDICATORS AS A MEASURE OF CREDIT MARKET INTEGRATION IN THE VISEGRAD COUNTRIES[1]

Pavla VODOVÁ*

Abstract

In this paper we assess with price indicators the extent to which credit markets in the Visegrad countries are integrated with the Eurozone countries and we test the hypothesis that the markets of loans provided to nonfinancial companies are more integrated than the markets of loans provided to households in the Visegrad countries. Analysis is based on monthly values of four interest rates for the period January 2005-March 2010. Convergence is taking place in all the analyzed segments of credit market. However, the speed of convergence and the degree of convergence differs among market segments and countries. The tested hypothesis has not been fully confirmed: the markets of loans to nonfinancial companies are more integrated than the consumer loan markets, but less integrated than the mortgage loan markets.

Keywords: credit market integration, price indicators, beta convergence, sigma convergence, Visegrad countries

JEL Classification: F36, C23, G21

1. Introduction

The aim of this paper is to assess with price indicators the extent to which selected segments of credit markets in the Visegrad countries are integrated with the Eurozone countries.

Loans provided to nonfinancial companies and to households typically represent the biggest part of the banks' credit portfolios. Our analysis is therefore based on the monthly values of two interest rates charged for loans to households (interest rate on mortgage loans and consumer loans) and two interest rates for nonfinancial companies (interest rate on short term and long term loans).

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* *Silesian University in Opava, School of Business Administration in Karviná, Department of Finance, Univerzitní nám. 1934, 733 40 Karviná, Czech Republic , E-mail: vodova@opf.slu.cz.*

Some studies[3] come to the conclusion that wholesale markets are usually more integrated than the retail markets. That is why we would like to test the hypothesis that the markets of loans provided to nonfinancial companies are more integrated than the markets of loans provided to households in the Visegrad countries.

The remainder of the paper is structured as follows. Chapter II defines the credit market integration and methods how to measure it. The following chapters focus on the integration of credit markets in the Visegrad countries with the Eurozone countries: Chapter III analyses the alignment of credit markets, Chapter IV measures the beta convergence and Chapter V shows results of sigma convergence. The last chapter captures the concluding remarks.

II. Credit Market Integration and Its Measuring

The European Central Bank (2008) considers the market for a given set of financial instruments or services to be fully integrated, when all potential participants in such market:

- are subject to a single set of rules when deciding to buy or sell those financial instruments of services;
- have equal access to this set of financial instruments or services;
- and are treated equally when they operate in the market.

Adam *et al*. (2002) define financial markets as integrated when the law of one price holds. This states that assets generating identical cash flows command the same return, regardless of the domicile of the issuer and of the asset holder. Otherwise, the arbitrage opportunity exists and it should adjust prices to the same level.

Credit markets are integrated when terms of credits (both financial and non-financial) are not influenced by the geographical location of the bank.

In practice, measuring credit market integration is quite complicated. The key to an accurately measured integration is to find assets which have the same level of risk and generate identical cash flows. Then, it is possible to choose which method to use:

- method based on price indicators, which refer to the definition of integration, based on law of one price;
- method based on quantity indicators, which should quantify determinants of demand and supply of investment opportunities and capture the importance and size of financial connections between countries;
- method based on indicators of new information, which are designed to distinguish the information effects from other frictions or barriers.

Because the aim of this paper is to assess with price indicators the extent to which selected segments of credit markets in the Visegrad countries are integrated with the Eurozone countries, only price indicators will be described here[4].

[3] *For list of such studies see Adam* et al*. (2002).*

[4] *For the description of quantity indicators see for example Adam* et al*. (2002), Baele* et al*. (2004), Cabral* et al*. (2002) or Vodová (2009). Characteristics of news-based indicators can be found for example in Baele* et al*. (2004), Čermák (2006) or Vodová (2009).*

Price indicators as a measure of integration refer to the definition of integration, based on the law of one price. According to Cabral *et al*. (2002), prices can refer to investment returns which, in integrated markets, should converge to the same levels, provided that the risk features are identical. In addition, they can refer to bank service charges, which should be similar in integrated markets.

The most common price indicator is the difference of interest rates charged in different countries to borrowers of the same risk class and for the same maturity. This measure can be computed for interest rates on consumer credits, mortgage credits, corporate credits and on public debt as well. If markets are integrated, rates should move together.

Except for the differences in interest rates, Pungulescu (2002) recommends some other price indicators. Most important are correlations among the interest rates in different countries.

Price indicators allow analyzing the progress towards financial integration with two special measures: beta convergence and sigma convergence (these measures use for example Adam *et al*., 2002; Babetskii, 2007; ECB, 2008 or Komárková *et al*., 2008). Convergence is understood as convergence to an average across the countries in the sample.

Beta convergence concept is typically used for the analysis of integration of economic growth when the average growth rate of gross domestic product is regressed to its initial level and a negative correlation is interpreted as a sign of convergence. However, it is possible to apply this methodology on credit market. Beta convergence enables us to measure the speed of integration of the specified market segment by the following equation (1):

$$\Delta R_t = \alpha + \beta R_{t-1} + \sum_{k=1}^{L} \gamma_k \Delta R_{t-k} + \varepsilon_t \,, \tag{1}$$

where: R is the difference between the average interest rate in a country and the benchmark interest rate (the benchmark interest rate is usually the average interest rate in a selected group of countries, which is based on the assumption that the benchmark interest rate signals the level to which interest rates in other countries should converge), Δ is the differential operator, α is a constant, L means number of periods lagged, t represents time, ε is the error term that denotes exogenous shocks that force interest rate differentials between the considered countries and β is the indicator that signals the speed of convergence.

According to Adam *et al*. (2002), negative β signals convergence (if β =0 there is no convergence); furthermore, the magnitude of β denotes the speed of convergence. Komárková *et al*. (2008) state that the closer to -1 the value of β is, the greater the speed of convergence is and that the value of coefficient γ should be close to zero and the error term should have attributes of normal distribution in case of "ideal" estimation.

Country specific effects are captured by the constant α. Such effects could be barriers of integration (legislative, economic or other). High values of α indicate the existence of heterogeneous markets; therefore, more integrated markets should have lower values of α.

In order to measure the degree of financial convergence it is possible to use the σ-convergence. The cross-sectional standard deviation of interest rates as a measure of σ-convergence can be calculated with equation (2):

$$\sigma_t = \sqrt{\left(\frac{1}{N-1}\right)\sum_{i=1}^{N}\left[log(y_{it}) - log\left(\overline{y_t}\right)\right]^2} \quad (2)$$

where: y_{it} is the yield on asset in country i at time t, $\overline{y}$ is the cross-section mean yield at time *t* and *i* represents countries (i = 1, 2, …, N).

The cross-sectional standard deviation can be only positive. The lower the value of cross-sectional standard deviation, the higher degree of convergence has been achieved. If the cross-sectional distribution collapses in a single point and the standard deviation converges to zero, full integration is achieved.

It is important to note that the two convergence indicators have different informational contents: β-convergence does not imply σ-convergence. The reason is that mean reversion does not imply that the cross sectional variance decreases over time (in fact, β-convergence could even be associated with σ-divergence).

However, it should be noted that differences in the interest rates can be caused not only by insufficient integration, but also by:

- different conditions in the national economies (such as credit and interest rate risk, size of companies, industrial structure, the degree of capital market development);
- institutional factors (taxation, regulation and supervision, consumer protection law);
- financial structure (whether economic subjects prefer financing through capital markets or bank credits);
- variability of bank products (product are often different in banks and countries, which is caused also by different preferences of customers).

II. Analysis of Alignment of Credit Markets in the Visegrad Countries with the Eurozone Countries

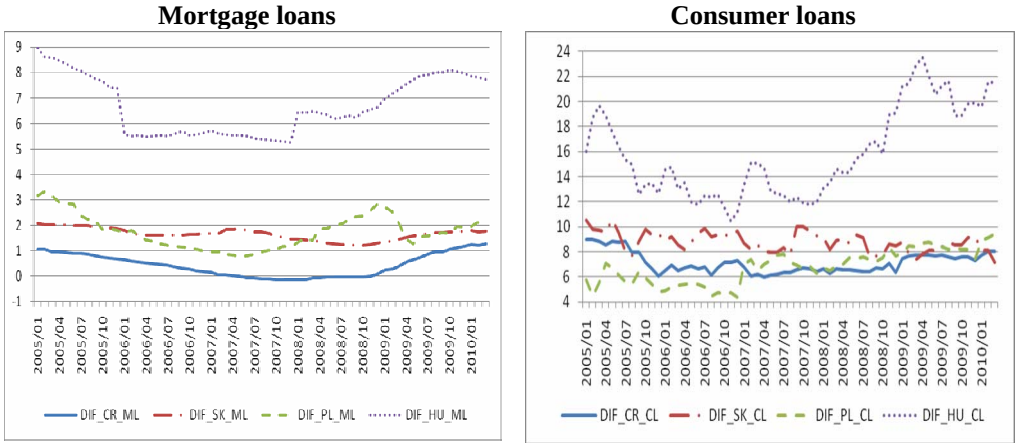
All price measures for credit market integration are based on interest rates of credit institutions on new business reported to the European Central Bank, at monthly frequency. The data covered the period from January 2005 to March 2010. Loans provided to nonfinancial companies and to households typically represent the biggest part of the banks' credit portfolios. Our analysis is based on the monthly values of two interest rates charged for loans to households (interest rate on mortgage loans and consumer loans) and two interest rates for nonfinancial companies (interest rate on short term and long term loans).

Figure 1 shows interest differentials for loans provided to households. As a benchmark, the average interest rate in the Eurozone is used in each case. It is obvious that spreads are significantly lower for the mortgage loans. Especially the Czech interest rates on mortgage loans are almost the same as in the Eurozone. For both types of loans to households, spreads are very similar for the Czech Republic, Slovakia and Poland this year. In contrast, the Hungarian credit market is characterized by substantially higher interest rates (the interest differential for

consumer loans is even higher than 20 %). Beginning with the second half of 2008, almost all interest differentials have increased.

Figure 1

Interest differentials for loans provided to households



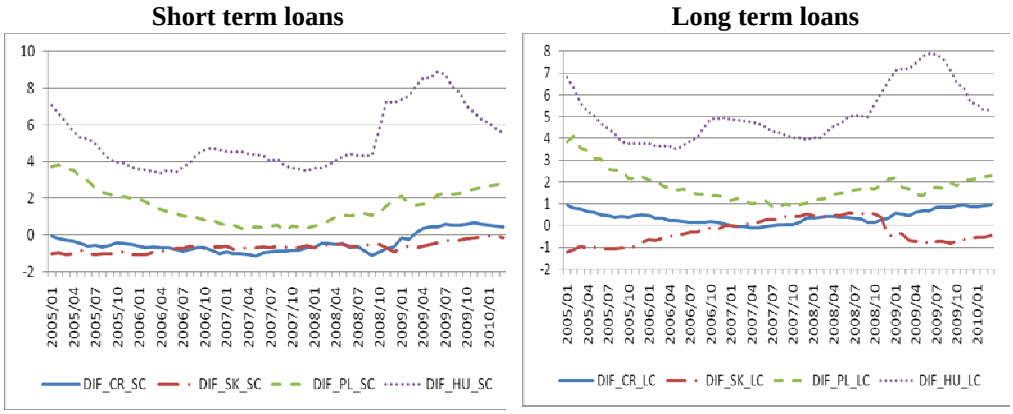
Source: Author´s calculations based on ECB data.

Note: DIF – differential (the difference between interest rate in a country and interest rate in euro area), CR – Czech Republic, SK – Slovakia, PL – Poland, HU – Hungary, ML – mortgage loans, CL – consumer loans.

Interest differentials for loans provided to nonfinancial companies are shown in Figure 2.

Figure 2

Interest differentials for loans provided to nonfinancial companies



Source: Author´s calculations based on ECB data.

Note: DIF – differential (the difference between interest rate in a country and interest rate in euro area), CR – Czech Republic, SK – Slovakia, PL – Poland, HU – Hungary, SC – short term loans to nonfinancial companies, LC – long term loans to nonfinancial companies.

Comparing with the Eurozone, the Czech and Slovak interest rates for both short-term (with maturity up to 1 year) and long-term (with maturity over 5 years) loans to nonfinancial companies were even lower in some periods. Polish spreads are slightly higher. Highest interest rates are again typical of Hungary; however, comparing with loans to households, the interest differential is substantially lower. As in the case of loans to households, almost all the interest differentials have increased in the last two years.

As shown in Table 1, the Slovak and Polish mortgage loan markets and the Polish consumer loan market are strongly linked with the Eurozone. Although the Czech and Slovak interest differentials are the lowest, their interest rates appear to be uncorrelated. The Hungarian interest rates on both types of loans to households show high correlation with the Czech Republic and Poland, but negative or almost zero correlation with the Eurozone. The same is true for the the Czech Republic.

Table 1

Correlation coefficients of interest rates on loans to households

Mortgage loans						Consumer loans					
	CR	SK	PL	HU	EU		CR	SK	PL	HU	EU
CR	1	0.12	0.66	0.87	-0.29	CR	1	0.19	0.22	0.58	0.16
SK	0.12	1	0.39	0.08	0.67	SK	0.19	1	-0.33	-0.31	0.28
PL	0.66	0.39	1	0.64	0.43	PL	0.22	-0.33	1	0.68	0.46
HU	0.87	0.08	0.64	1	-0.17	HU	0.58	-0.31	0.68	1	0.10
EU	-0.29	0.67	0.43	-0.17	1	EU	0.16	0.28	0.46	0.10	1

Source: Author´s calculations based on ECB data.
Note: CR – Czech Republic, SK – Slovakia, PL – Poland, HU – Hungary, EU – the Eurozone.

Table 2 presents the values of correlation coefficients of interest rates on loans provided to the nonfinancial companies. The results significantly differ from those for the loans to households. The Czech and Slovak interest rates for companies are strongly correlated, on the one hand among themselves and, on the other hand, with the Eurozone. Relatively strong links can be noticed also for the Polish interest rates. However, the Hungarian interest rates show relatively high positive correlation only with the Czech Republic.

Table 2

Correlation coefficients of interest rates on loans to nonfinancial companies

Short term loans						Long term loans					
	CR	SK	PL	HU	EU		CR	SK	PL	HU	EU
CR	1	0.90	0.35	0.44	0.83	CR	1	0.79	0.60	0.42	0.87
SK	0.90	1	0.20	0.18	0.96	SK	0.79	1	0.17	0.14	0.95
PL	0.35	0.20	1	0.30	0.29	PL	0.60	0.17	1	0.17	0.41
HU	0.44	0.18	0.30	1	0.08	HU	0.42	0.14	0.17	1	0.18
EU	0.83	0.96	0.29	0.08	1	EU	0.87	0.95	0.41	0.18	1

Source: Author´s calculations based on ECB data.
Note: CR – Czech Republic, SK – Slovakia, PL – Poland, HU – Hungary, EU – the Eurozone.

Comparing with the Eurozone, the Czech and Slovak interest rates for both short-term (with maturity up to 1 year) and long-term (with maturity over 5 years) loans to nonfinancial companies were even lower in some periods. Polish spreads are slightly higher. Highest interest rates are again typical of Hungary; however, comparing with loans to households, the interest differential is substantially lower. As in the case of loans to households, almost all the interest differentials have increased in the last two years.

IV. Beta Convergence of Credit Markets in the Visegrad Countries with the EuroZone Countries

We estimate equation 1 both for panel data, as well as separately for each country. Therefore, we can compare the results of these two approaches. We lagged the data with one period (L = 1).

Table 3

Beta convergence in the Visegrad countries

	α constant	β R(-1)	γ ΔR(-1)	F-test
Mortgage loans	0.1401* (0.0435)	-0.0564* (0.0161)	0.1748* (0.0617)	F = 4.057 Prob = 0.001
Consumer loans	0.6343* (0.2425)	-0.0644* (0.0248)	0.0649 (0.0638)	F = 1.601 Prob = 0.161
Short term loans to companies	0.0591* (0.0221)	-0.0436* (0.0131)	0.4561* (0.0564)	F = 14.93 Prob = 0.000
Long term loans to companies	0.0881* (0.0259)	-0.0534* (0.0136)	0.3820* (0.0569)	F = 12.45 Prob = 0.000

Source: Author´s calculations based on ECB data.

Note: The starred coefficient estimates are significant at the 1 % (*), 5 % (**) or 10% (***) level. Standard errors are in parentheses.

Table 3 shows the coefficients estimated with a panel regression with fixed effects. Negative values of beta coefficients signal that convergence is taking place in all the analyzed segments of credit market. The size of beta measures the speed of convergence, and it differs: it is the highest for consumer loans, intermediate for mortgage loans and long-term loans for companies and the lowest for short-term loans for companies. These results show that the market segment with the highest interest differential (i.e. consumer loans) has the highest speed of convergence. Conversely, the convergence of market segments with lower spreads (i.e. short- and long-term loans to nonfinancial companies and mortgage loans) is very slow. Relatively large values of the country specific effects α indicate persistent market segmentation related to a variety of barriers of integration.

Table 4

Beta convergence for mortgage loans

	α constant	β R(-1)	γ ΔR(-1)	F-test
Czech Republic	0.0048 (0.0071)	-0.0078 (0.0195)	0. 7366* (0.0922)	F = 32.05 Prob = 0.000
Slovakia	0.0603 (0.0399)	-0.0379 (0.0241)	0.3913* (0.1162)	F = 7.116 Prob = 0.002
Poland	0.1339** (0.0583)	-0.0859* (0.0316)	0.3410* (0.1149)	F = 8.049 Prob = 0.001
Hungary	0.3566 (0.2344)	-0.0554 (0.0347)	0.0892 (0.1268)	F = 1.481 Prob = 0.236

Source: Author´s calculations based on ECB data.
Note: The starred coefficient estimates are significant at the 1 % (*), 5 % (**) or 10% (***) level. Standard errors are in parentheses.

Comparison of convergence across countries and market segments could be useful. Table 4 shows results of equation 1 estimated for mortgage loans separately for each country. In all cases, the beta coefficient is negative, indicating convergence. The speed of convergence is the highest for Poland (statistically significant), intermediate for Hungary and very low for the Czech Republic and Slovakia. This finding is again consistent with the size of interest differentials. The Czech interest rates on mortgage loans are almost the same as in the Eurozone, so that substantial convergence has already been achieved.

Table 5

Beta convergence for consumer loans

	α constant	β R(-1)	γ ΔR(-1)	F-test
Czech Republic	0.9165** (0.4010)	-0.1316** (0.0561)	-0.0875 (0.1257)	F = 3.287 Prob = 0.044
Slovakia	3.7772* (1.0207)	-0.4338* (0.1155)	0.1541 (0.1296)	F = 7.118 Prob = 0.002
Poland	0.7118*** (0.4147)	-0.0926 (0.0603)	-0.0386 (0.1277)	F = 1.471 Prob = 0.238
Hungary	0.7447 (0.6838)	-0.0451 (0.0425)	0.1245 (0.1276)	F = 0.841 Prob = 0.436

Source: Author´s calculations based on ECB data.
Note: The starred coefficient estimates are significant at the 1 % (*), 5 % (**) or 10% (***) level. Standard errors are in parentheses.

As presented in Table 5, the results of beta convergence for consumer loans differ significantly from those for mortgages. The beta coefficient is again negative in all the cases, which signals that convergence is taking place in the consumer loan markets. However, the values of beta coefficients are significantly higher, especially for

Slovakia and the Czech Republic (both statistically significant). The Hungarian consumer loan market converges very slowly with the Eurozone. These results are rather surprising, because no direct relation between interest differentials and the speed of convergence can be found.

Results of beta convergence for short-term loans to nonfinancial companies are presented in Table 6. The values of beta coefficients are negative (which is a signal of convergence), but rather low (which signals speed of convergence). The highest and statistically significant beta coefficients were obtained for the Hungarian and Polish markets. However, the speed of convergence of the Czech and Slovak markets is very low, almost zero. These findings are again consistent with the size of interest spreads.

Table 6

Beta convergence for short-term loans to nonfinancial companies

	α constant	β R(-1)	γ ΔR(-1)	F-test
Czech Republic	-0.0004 (0.0234)	-0.0195 (0.0338)	0.1621 (0.1318)	F = 0.807 Prob = 0.451
Slovakia	-0.0033 (0.0352)	-0.0279 (0.0479)	-0.1440 (0.1356)	F = 0.977 Prob = 0.383
Poland	0.0656 (0.0415)	-0.0508** (0.0233)	0.2929** (0.1199)	F = 5.745 Prob = 0.005
Hungary	0.2184 (0.1361)	-0.0436*** (0.0253)	0.5555* (0.1066)	F = 14.48 Prob = 0.000

Source: Author´s calculations based on ECB data.
Note: The starred coefficient estimates are significant at the 1 % (*), 5 % (**) or 10% (***) level. Standard errors are in parentheses.

Table 7

Beta convergence for long-term loans to nonfinancial companies

	α constant	β R(-1)	γ ΔR(-1)	F-test
Czech Republic	0.0119 (0.0149)	-0.0243 (0.0316)	0.2722** (0.1225)	F = 2.598 Prob = 0.083
Slovakia	-0.0042 (0.0221)	-0.0542 (0.0354)	-0.0384 (0.1284)	F = 1.249 Prob = 0.294
Poland	0.2031* (0.0565)	-0.1332* (0.0300)	-0.0988 (0.1122)	F = 9.884 Prob = 0.000
Hungary	0.1947*** (0.1018)	-0.0382*** (0.0195)	0.7016* (0.0877)	F = 33.29 Prob = 0.000

Source: Author´s calculations based on ECB data.
Note: The starred coefficient estimates are significant at the 1 % (*), 5 % (**) or 10% (***) level. Standard errors are in parentheses.

Finally, Table 7 shows results of beta convergence for long-term loans to the nonfinancial companies. The values of beta coefficients are higher than those for short- term loans, which indicate higher speed of convergence for the long-term loans.

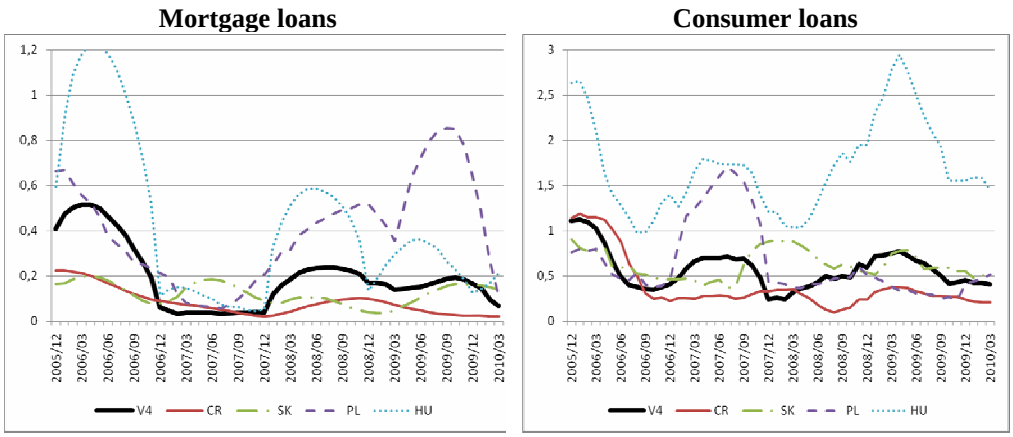
This is quite surprising, because the long-term loans have slightly lower interest differentials than the short-term loans. The speed of convergence is the highest for Poland, intermediate for Hungary and Slovakia and very low for the Czech Republic. The relation between spreads and the speed of convergence in different countries is also not as straightforward as in cases of other credit market segments.

V. Sigma Convergence of Credit Markets in the Visegrad Countries with the Eurozone Countries

The sigma convergence measures the degree of financial convergence with cross-sectional standard deviation of the interest rates. The results for both analyzed types of loans provided to households are shown in Figure 3.

Figure 3

Sigma convergence for loans provided to households



Source: Author´s calculations based on ECB data.

Note: V4 – cross-sectional standard deviation of average interest rates in Visegrad countries, CR, SK, PL, HU – cross-sectional standard deviation of interest rates in the Czech Republic, Slovakia, Poland and Hungary.

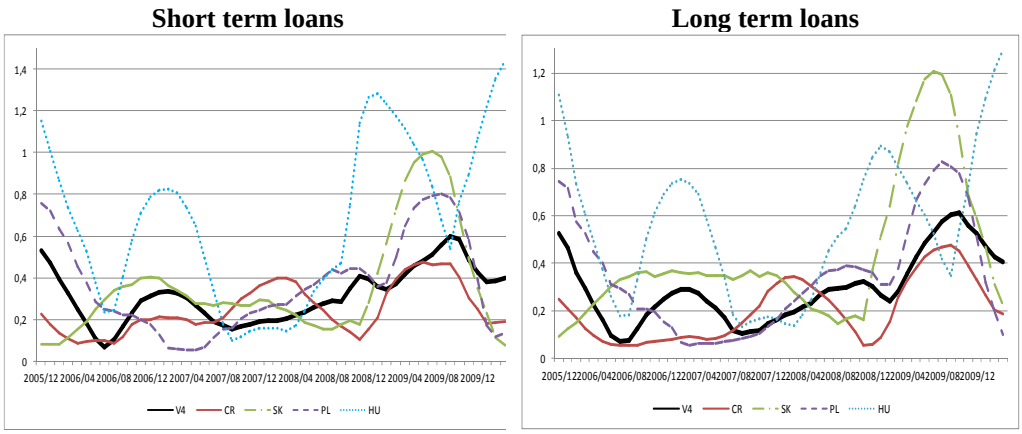
Low value of cross-sectional standard deviation for mortgage loans signals that, comparing with consumer loan market, much higher degree of convergence on mortgage loan markets has been achieved. According to sigma convergence, the Czech mortgage and consumer loan markets are the most integrated markets. This conclusion corresponds to the fact that the Czech interest rates on both types of loans had the lowest interest differentials.

Figure 4 shows results of sigma convergene for short-term and long-term loans to nonfinancial companies. Markets of loans to nonfinancial companies are more integrated than the consumer loan markets, but less integrated than the mortgage

loan markets. However, values of cross-sectional standard deviation for both short-term and long-term loans are very similar. The degree of financial integration is the highest for the Czech markets, intermediate for Slovakia and Poland and the lowest for Hungary. As in the case of loans to households, these findings are consistent with the value of interest differentials.

Figure 4

Sigma convergence for loans provided to nonfinancial companies



Source: Author´s calculations based on ECB data.
Note: V4 – cross-sectional standard deviation of average interest rates in Visegrad countries, CR, SK, PL, HU – cross-sectional standard deviation of interest rates in the Czech Republic, Slovakia, Poland and Hungary.

VI. Conclusion

The aim of this paper is to assess with price indicators the extent to which selected segments of credit markets of the Visegrad countries are integrated with the Eurozone countries and to test the hypothesis that the markets of loans provided to nonfinancial companies are more integrated than the markets of loans provided to households.

The results of the analysis of alignment and beta and sigma convergence concepts suggest the following conclusions. Mortgage loans have significantly lower interest differentials than the consumer loans. However, interest differentials for loans to nonfinancial companies are even lower. This confirms the tested hypothesis.

Convergence is taking place in all the analyzed segments of the credit market. However, the speed of convergence differs: the market segment with the highest interest differential (i.e. consumer loans) has the highest speed of convergence. Conversely, the convergence of market segments with lower spreads (i.e. short- and long-term loans to nonfinancial companies and mortgage loans) is very slow. It can be concluded that the markets of loans provided to households have higher speed of convergence than the markets of loans provided to nonfinancial companies. The

degree of financial integration is the highest for the Czech markets, intermediate for Slovakia and Poland and the lowest for Hungary.

The tested hypothesis cannot be fully confirmed: the markets of loans to nonfinancial companies are more integrated than the consumer loan markets, but less integrated than the mortgage loan markets. The degree of integration of mortgage loan markets and markets of loans provided to nonfinancial companies is almost the same. The analysis showed that barriers of integration are still very important, especially for the consumer loan markets.

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