

INTEGRATION OF CEE AND EU-15 MONEY MARKET, DEPOSIT AND LENDING  
MARKETS: DOES BANK OWNERSHIP MATTER?

MARUŠKA VIZEK AND IVA ČONDIĆ-JURKIĆ<sup>1</sup>

ABSTRACT

The intention of this paper is to examine whether money markets and banking sector integration exist among CEE countries and EU-15 countries. In sample of CEE countries we include both selected new EU member states and candidate countries. Many studies have demonstrated that money markets of EU-15 members exhibit high degree of integration primarily due to introduction of common currency. We feel that some evidence of integration in the direction of Europe-wide money market integration, i.e. integration between CEE countries' money markets and EU-15 money market might be expected and can be tested. Potential for money market integration between CEE and EU-15 exists due to major role of banks from EU-15 in CEE countries' banking industries in form of their significant ownership stakes in CEE banking, major role in general of commercial banks on money markets in CEE countries, increasing level of euroization and process of CEE countries' joining EU and EMU. However, results of Johansen cointegration procedure suggest that only in case of Croatian and Bulgarian money market there is evidence of integration with EU-15 money market.

Contrary to EU money market, national banking industries within EU-15 countries exhibit rather weak form of integration. However we feel that integration among CEE and EU-15 banking sectors might still be present because, the process of banking industry consolidation took place mainly through entrance of foreign (mainly EU-15) banks into national banking industries. This process could have facilitated integration in both deposit and credit markets with EU-15 countries and therefore we used cointegration tests and Granger causality test in order to determine degree of integration in deposit and lending markets between six CEE countries and five EU-15 countries. We find cointegration only in case of Italian and Austrian banking on EU-15 side and Croatian, Bulgarian and Polish banking on CEE side. Granger causality tests partially confirm cointegration results, but also provide evidence of interest rate pass-through from Germany and Belgium to Hungary. Czech banking seems the most segmented. Also, lending markets in CEE are much more integrated with EU-15 countries lending market when compared to CEE deposit markets.

Policy implications of empirical results are discussed in the final part of the paper.

Key words: banking sector, money markets, financial integration, cointegration, CEE.

JEL CLASSIFICATION: C22, F34, F36, G15.

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INTEGRATION OF CEE AND EU-15 MONEY MARKET, DEPOSIT AND LENDING  
MARKETS: IS THERE ANY EFFECT ON INTEREST RATES?

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EXTENDED NON-TECHNICAL ABSTRACT

The intention of this paper is to examine whether money markets and banking sector integration exist among CEE countries and EU-15 countries. In sample of CEE countries we include both selected new EU member states and candidate countries. Many studies have demonstrated that money markets of EU-15 members exhibit high degree of integration primarily due to introduction of common currency. We feel that some evidence of integration in the direction of Europe-wide money market integration, i.e. integration between CEE countries' money markets (Bulgarian, Croatian, Czech Republic, Hungarian, Polish and Romanian money market) and EU-15 money market might be expected and can be tested. Potential for money market integration between CEE and EU-15 exists due to major role of banks from EU-15 in CEE countries' banking industries regarding their significant ownership stakes in CEE, major role in general of commercial banks on money markets in CEE countries, increasing level of euroization and process of CEE countries' joining EU and EMU. Moreover, we expect that some level of interest rate pass-through from EU money market rates to CEE countries money market rates could also be present.

However, results of Johansen cointegration procedure suggest that only in case of Croatian and Bulgarian money market there is evidence of integration with EU money market which we contribute mostly to intensive Croatian banks borrowing of funds from their foreign EU-15 owners (mainly Italian and Austrian banks) and Bulgarian currency board regime. In addition, by using Granger causality tests augmented with error correction term where needed, we find evidence of money market rate pass-through from EU-15 money market rates to Croatian and Bulgarian money markets rates in our sample, suggesting that considerable segmentation of other CEE money markets is still present despite previously mentioned factors that might have facilitated the integration.

Contrary to EU money market, national banking industries within EU-15 countries exhibit rather weak form of integration since retail lending products are less exposed to international competition pressures as physical distance between banks and customers is quite important. In addition, the presence of asymmetric information and country-specific bank behavior in order to cope with it, as well as transaction costs, cannot be neglected since they also lead to segmentation of both deposit and lending markets. However we feel that integration among CEE and EU-15 banking sectors might still be present. Similarly to the case of money markets, this could also be explained by high degree of foreign ownership (in particular, EU-15 banks ownership) of CEE banking industries that just in new EU member states on average

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exceeds 70 percent of total banking sector assets. Even more pronounced are the cases of Czech Republic and Croatia where EU-15 banks ownership stakes exceed 90 percent of their total banking sector assets. Such high ownership stake of EU-15 banks in CEE banking industries offers not only potential for possible integration and faster interest rate convergence, but also presents an impediment for implementation of monetary policy measures in CEE economies, since foreign owned banks in CEE countries respond to the monetary policy impulses coming from ECB and not from their national central banks. As well, these CEE banks are more prone to lending with currency clause or in euro currency as a way of removing increasing exchange rate mismatch from their balance sheets thus creating unofficial financial system euroization as another monetary policy impediment.

Furthermore, it is important to note that unlike the case of EU-15 where the process of banking industry consolidation took place mainly through mergers and acquisition within national borders which impeded EU wide banking integration, in CEE countries banking consolidation was conducted through entrance of foreign (mainly EU-15) banks into national banking industries which could have facilitated integration in both deposit and credit markets with EU-15 countries having significant ownership stakes in CEE banking sector. To test for presence of integration we use bivariate Johansen cointegration procedure in order to detect co-movements in deposit and lending interest rates between individual CEE countries and those EU-15 countries whose banks have significant ownership stakes in selected CEE country banking sector. Furthermore, we also test for presence of lending and deposit interest rate pass-through using Granger causality tests augmented with error correction term where needed. Therefore we search for possible cointegration relationships in deposit and lending markets between six CEE countries (Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania) and five EU-15 countries (Austria, Belgium, Germany, Italy and the Netherlands) in period from 1996 to 2005.

We find cointegration vectors in case of following deposit markets: Croatian and Italian, Croatian and Austrian, Polish and Italian and Bulgarian and Italian. We also confirmed cointegration relationship between lending markets in following countries: Croatia and Italy, Croatia and Austria, Czech Republic and Austria, Poland and Italy, Romania and Italy, Romania and Austria, Bulgaria and Italy and Bulgaria and Austria. It is therefore evident that trend co-movements between countries' banking interest rates are more frequent in lending rates which makes sense since lending activity (especially corporate lending) is less tied down to certain geographic location than deposit activity. Intuitively one would expect that EU-15 banking industries (like Belgian and Dutch) which are more concentrated would be the ones showing higher degree of integration with corresponding CEE banking industries since banks in such EU-15 countries are expected to have more influence over their own national interest rate level, but the results of this study suggest otherwise. Out of five EU-15 member states in our sample only Italian and Austrian banking industry seem to exhibit signs of integration with CEE banking industries. We explain that result with the fact that Austrian and Italian banks have relatively high ownership stakes in those countries' banking industries; namely in Croatian, Polish and in Bulgarian banking industry, although it could also be that Italian and Austrian banks are simply leading more active interest rate policy in CEE countries. Moreover, examining interest rate pass-through from EU countries deposit and lending rates to CEE countries deposit and lending rates enabled us to confirm the robustness of the results obtained by conducting cointegration tests. In other words, deposit and lending interest rate pass-

trough can mostly be found only in cases of countries which exhibit some level of banking sector integration. As expected, pass-through is also more frequent with lending interest rates than with deposit rates. Moreover, interest rate pass-through was determined for countries that are not found to be integrated like Hungary on one hand and Germany and Belgium on the other, where German deposit and lending interest rate and Belgian lending interest rate exhibit significant pass-through towards Hungarian banking rates. This means that although German and Belgian banks can not influence trend movements of domestic (Hungarian) interest rates, they still have enough market power to cause interest rate changes. Czech Republic is the only country among CEE countries that does not seem to be affected by changes in EU-15 deposit and lending interest rate which is rather counterintuitive since Czech banking industry is almost completely foreign-owned. This finding suggests that in Czech interest rate determination obviously prevail domestic factors.

## **1. Introduction**

Financial integration has become ever interesting issue throughout past couple of years, highly influenced by developments that brought about changes in European financial architecture. Both theoretical and empirical studies have demonstrated the importance of financial integration, implying that integration and development of financial market are likely to contribute to economic growth by removing frictions and barriers to exchange, and by allocating capital more efficiently (Baele et al., 2004).

An increasing interest for this topic and for integration of the banking sector and money market in particular, shown lately by academia as well as by policy makers, can be attributed to challenge of conducting single monetary policy in an enlarged euro zone after new member states fulfill convergence criteria. Since financial systems of the new member states are bank dominated, and hence major providers of financial resources for corporations and households, changes in real economy will depend on the intensity of banks' response to monetary policy measures. Higher level of money market and banking sector integration, and hence more transparent financial system, should set favorable ground for conducting smooth and symmetric single monetary policy.

The intention of this paper is to examine whether money markets and banking sector integration exist among CEE countries (Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania) and EU-15 countries. In particular, we are interested in exploring aforementioned issue in regard to ownership structure of CEE countries' banking industry. We believe that foreign ownership of CEE countries' banking industries dominantly from EU-15 countries, which in new member states exceeds on average two thirds of total banking assets, might be of great influence on facilitating higher degree of integration between an individual CEE country and EU-15 country with significant ownership stake in former, regarding both money market integration and retail banking sector integration.

In order to test the hypothesis of banking industry and money market integration in 1996-2005 period we will use bivariate Johansen cointegration approach. Employed procedure aims to detect co-movements in money market-, deposit- and lending interest rates between individual CEE countries (Bulgaria, Croatia, Czech Republic,

Hungary, Poland and Romania) and those EU-15 countries whose banks have significant ownership stakes in selected CEE country banking sector (Austria, Belgium, Germany, Italy and the Netherlands), on the one hand, and between CEE countries' money markets (Bulgarian, Croatian, Czech Republic, Hungarian, Polish and Romanian) and EU money market. Furthermore, using Granger causality tests augmented with error correction term where needed, we will also test for presence of lending and deposit interest rate pass-through as well as money market rate pass-through from EU money market rates to individual CEE countries' money markets rates.

This paper's objective is to fill the gap in existing analyses of banking sectors and money markets integration by focusing more on developments between CEE countries and EU-15 countries. To our mind, examining possible signs of financial integration between those two groups of countries is of particular interest having in mind undergoing processes of either joining EU or EMU. As mentioned above, the greater the level of financial integration achieved, the more efficient transmission of monetary policy might be expected.

The paper is organized in the following way. Section 2 delivers adopted definition of financial integration, while section 3 briefly reviews the literature on money market and banking industry integration. In section 4. we present recent trends in CEE and EU-15 banking industries' ownership structures. After presenting data and methodology used in section 5, section 6 reveals results of the analysis, followed by discussion and conclusion remarks.

## **2. Definition of financial integration**

A spectrum of literature, when defining financial integration insists on the law of one price in the long run, though deviations in the short run are possible. The law of one price suggests that assets with same risk generating same return should be priced identically regardless the domicile of the issuer and holder (Adam et al., 2002). If law of one price does not hold, investors have opportunity to gain extra returns using arbitrage opportunities.

However, the law of one price can hold only in case of perfect substitutes under the condition of perfect capital mobility<sup>3</sup>. Given aforementioned assumptions, it should be noted that assets on money markets and especially bank assets do not possess such properties. There are several possible explanations for the heterogeneity: physical distance, risk differences; cultural differences; country specific behavior in order to cope with asymmetric information (moral hazard, adverse selection) – utmost pronounced in case of bank loans; differences in laws and regulations; absence of perfect capital mobility across countries etc. (Kleimeier and Sander, 2003). Additional issue that makes measuring degree of integration inaccurate is the exchange rate risk, making returns on a same kind of assets differ across countries. Hence, when assessing degree of integration across EU-15 countries in the period before introduction of the euro, this kind of risk should not be neglected (Baele et al.).

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<sup>3</sup> Typically, government bonds can be treated as perfect substitutes under the condition of perfect capital mobility.

Due to the fact that law of one price can barely exist in the real world, the definition we adopted assesses the degree of financial integration based on the presence of long run co-movement in interest rates among two observed national markets. The disturbances may occur in the short run, but after certain time period interest rates should be driven back to their long term equilibrium (Kleimeier and Sander, 2003). In this context, there are three possible mechanisms that can facilitate removal of deviations working either separately or interactively: *cross-border lending* which will take advantage of international arbitrage opportunity and lead to price equalization; *interest rate pass-through* leading to transmission of (equalized) money market and retail rates; *increased competition* that would eventually lead to harmonization of retail prices. Thus, the presence of cointegration suggests that financial market has reached certain degree of integration.

### **3. Related empirical literature**

Wide range of existing empirical studies on the financial integration of European and CEE countries focused mainly on the integration of the stock markets. However, although the issues of money market and banking industry developments in EU-15 and CEE countries attracted in past couple of years much more interest, we feel that with respect to the importance of the subject, they have been covered insufficiently in the literature.

Centeno and Mello (1999) use Engle and Granger cointegration technique in order to test for existence of the relationship between money markets interest rates and bank lending rates in six member countries of the European Union (Germany, United Kingdom, France, Italy, Spain and Portugal) in period of 10 years, from 1985 to 1994. They find that money markets are closely linked across countries. However, the authors did not provide evidence of closer links within the European loan markets. Possible explanation could be unstable market structure that eventually leads to further strengthening of banks' market power on local markets, impeding the competition and hence possibility for integration to take place.

Baele et al. (2004) present set of different measures (price-, new-, and quantity-based measures) to assess the state and dynamics of evolution of financial integration in different euro area financial markets: money markets, government bond markets, corporate bond markets, bank credit markets and equity markets. According to price-based measures which focus on interest rate differentials between countries, they conclude that the state of market integration in euro area money markets is very advanced. They find that higher level of integration occurred shortly after introduction of common monetary policy. Nevertheless, not all segments of money market follow the same speed pattern in their tendency to reach integration. Namely, the swap market and unsecured segment of money market exhibit more advanced level of integration than euro area repo market. Regarding corporate lending market, short-term interest rates are found to be more segmented than medium- and long-term interest rates. As for households lending market, mortgage loan rates show higher level of harmonization across countries than in the past, while the consumer credit segment fails to show any kind of progress in that respect, continuing to be highly segmented. Quantity based indicators confirms rather limited cross border activity in the retail banking market across euro area.

Except for study of Baele et al. (2004), several other studies deal with effects of the introduction of the euro in 1999 on euro area markets as well. For example, Santillan et al. (2000) measured interest rate differentials and found that unsecured money market segment showed high degree of integration shortly after the euro become common currency, while repo markets still need more room to adjust.

Sander and Kleimeier (2003) argue that European banking market has been changing rapidly since the introduction of common currency, influenced to greater extent by single monetary policy determining interest rates, rather than by cross border activities in lending and borrowing. Their approach in defining financial integration and is the most similar to ours. They propose to assess the degree of financial integration based on existence of co-integration among national markets and EU-15 market. In their view, the concept of integration requires that interest rates exhibit a certain long run equilibrium relationship, though deviations in the short run are possible. They use error-correction model (ECM) to estimate how fast long term equilibrium relationship is achieved after a disturbance. Covering period from mid-nineties, their analysis show rather limited evidence of cointegration in interest rates among credit markets in Europe before 1999. After introduction of the euro, they found evidence of increasing integration in certain retail banking markets, namely corporate lending markets and less in consumer markets, while mortgage lending markets remained segmented.

Similar results are presented by Schueller and Heinemann (2003) analyzing four lending and two deposit markets in wide range of EU-15 countries by testing for bivariate and multivariate cointegration between national interest rate spreads.

Study done by Herrmann and Jochem (2003) explores possibility of money markets integration in CEE countries. Based on the concept of covered interest parity, Engle-Granger and the augmented Engle-Granger procedure are used to test for cointegration. Results show that the money markets in Poland, the Czech Republic, Hungary and the Slovak Republic show a high degree of international integration with the euro area money market in period of 1999 to mid 2002. In this paper, integration is considered to be achieved if exists long term equilibrium between interest rate ratio and swap rate.

Investigating pass-through mechanism in Europe, both in old member countries and in eight CEE countries that joined EU in 2004, studies by Sander and Kleimeier (2004, 2004a) use unifying approach that utilizes VAR and cointegration and ECM methodology as well as TAR and panel models. Their analysis is based on monthly lending retail interest rates (three types of consumer loans, two corporate lending rates and category of other lending rate) and deposit rates (current account deposits, time deposits and savings accounts and category of other deposit rate). Obtained results show that the pass-through process in many CEECs appears to be faster and more complete than in most countries of the EU-15 and there may be a high potential for an emerging homogeneous transmission process across CEECs.

In order to assess the role of banks in monetary transmission mechanism in the new EU member countries, Schmitz (2004) analyses the bank lending channel in the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia, using panel of balance sheet data covering 261 banks in the region. Dividing the banking sectors according to ownership structure, Schmitz sets evidence

of much stronger response to euro zone monetary policy impulses of foreign- than domestic-owned banks. In addition, foreign owned banks show only a very weak reaction to the respective referent domestic interest rates. Analysis shows rather weak evidence for a bank lending channel operating through the bank size.

#### **4. Ownership structure developments in EU-15 and CEE countries' banks**

As already stated, many empirical studies (Centeno and Mello, 1999; Baele et al, 2004; Santillan et al, 2000; Sander and Kleimeier, 2003; etc.) provided evidence about almost total integration within money markets across EU-15 countries. Increasing degree of integration could have been observed since mid-nineties, with stronger impetus occurring dominantly upon introduction of common currency in 1999. Interbank transactions are the most characteristic cross-borders activities among euro area countries (Mero and Endresz Valentinyi, 2003). In contrast to interbank market, cross-border activities in banking retail market within euro area, both lending and borrowing, are still limited, despite quite high degree of harmonization from a legal perspective (Baele et al, 2004).

There are several factors that might explain slow progress. Banking retail industry in euro area is rather segmented since retail lending products are less exposed to international competition pressures. Physical distance between banks and customers is quite important and will have huge impact on the preference of the customer. Even e-banking service where close proximity to customers does not play any significant role has not yet managed to fill the cross-border lending gap, since customers tend to be oriented more on local banks in this type of banking service. Moreover, the presence of asymmetric information manifesting in moral hazard and adverse selection phenomena might cause banks not to set lending rates on market clearing levels. Transaction costs also cannot be neglected since they also lead to segmentation of both deposit and lending markets.

However, the factor that seems to explain best the ongoing situation within EU-15 retail banking markets is ownership structure. Namely, banks in euro area are dominantly domestic owned, on average with only 23.8 percent of total banking assets held by foreign owners (see Table 1.) Except for showing relatively small share of foreign participation in total assets, domestic banks in EU-15 countries experience high confidence by domestic and foreign customers, resulting in fall of relative share of deposits collected from the other countries in euro area, while deposits from outside the euro area exhibit quite robust growth (Mero and Endresz Valentinyi, 2003). The fact that bank consolidation process in EU-15 has taken place through mergers within country might be additional explanation for intrinsic characteristics of retail banking. Cross border mergers and acquisitions took place mainly in cases of expansion to less developed and less efficient markets outside EU-15 borders (CEE countries and Latin America).

From CEE countries' perspective, policy of opening domestic banking sector in 1990-ies derived from the need to transform inefficient and financially fragile banking system into modern, resilient one that could offer wide range of sophisticated state-of-the-art services while meeting international standards. The entry of foreign banks seemed as good solution in transition period, especially because of possibility to attract other foreign investors by guaranteeing stable banking environment.



Table 1: Share of foreign ownership in banking industry of EU-15, measured by share of foreign assets in total banking assets

Country/ year	Austria	Belgium	Denmark	Finland	France	Germany	Ireland	Italy	Netherlands	Spain	UK	EU-15* average
2001	19.5	24.8	16.8	5.7	19.3	4.7	48.5	7.8	11.3	9.5	51.1	<b>23.8</b>

\*Weighted average

Source: Bikker, J.A., Wesseling, A.A.T. (2003): Intermediation, integration and internationalisation: a survey on banking in Europe, Research Series Supervision No. 53, De Nederlandsche Bank.

Today, approximately two thirds of banking total assets in CEE countries are on average held by foreign owners, mostly EU-15 banks. Table 2. presents market shares of leading EU-15 banks in selected CEE countries. In some countries, like Czech Republic and Croatia, share of foreign assets in total banking assets exceeds 90 percent (see Graph 1). We believe that such high ownership stake of EU-15 banks in CEE banking industries offers high potential for integration between EU-15 countries and CEE countries, in both money market and retail banking market segments, although the former has quite minor role in CEE countries despite dominantly bank-oriented financial system<sup>4</sup> (Herrmann, Jochem, 2003). Faster interest rate convergence and possibly integration in retail banking markets can be achieved through following channels. Firstly, foreign owned banks have easier access to cheaper financial resources abroad, either by themselves or through the internal capital markets of their

Table 2: Market share of foreign banks' subsidiaries in the region (end-2001 data\*), by commercial bank

Foreign banks	Market shares (%)								
	HU	CZ	SK	PL	SI	CEEC5-total	HR	BG	RO
KBC Bank	7	15		3	15	7.5			
Bayerische Landesbank	9	0.2				1.2	0.1		
IntesaBci	8	18				2.2	14		
HVB Group	6	5	4	7	3	5.9	6	7	2
Raiffeisen	5	1	9	1	2	2.2	7	4	4
GE Capital	3	3		0.6		1.5			
Citibank	3	3	3	6		4.3			3
Erste Bank	3	16	15				6	7	
Societe General		9	0.4		9	3.3		5	8
UniCredito			2	8		3.9	27	19	0.5
<b>Banking sector total assets (EUR bn)=100%</b>	<b>36.7</b>	<b>87.1</b>	<b>21.6</b>	<b>136.4</b>	<b>17.9</b>	<b>299.7</b>	<b>20.1</b>	<b>6.3</b>	<b>12.7</b>

\*The market shares of individual banks have been defined on the basis of the balance sheet total as of proportion of ownership share. Therefore, the market shares shown in the table 2. may be different from ownership share of a given bank (for example, K&H/KBC Hungary).

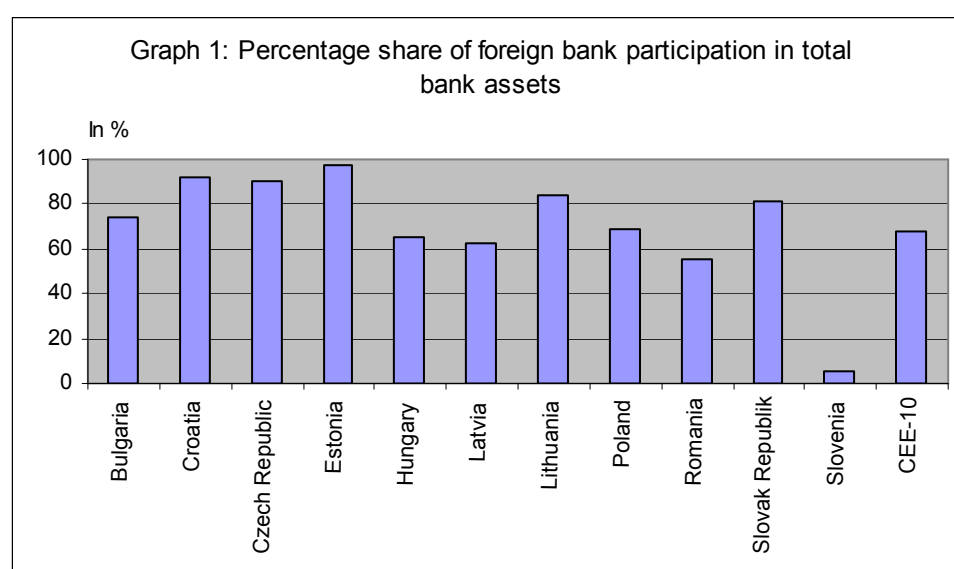
Source: Mero, K., Endresz Valentinyi, M. (2003).

<sup>4</sup> This short-term refinancing instrument makes up an average of only 10% of the total capital of central and east European credit institutions, this is only half the comparable figure for the Eurosystem. (Herrmann, Jochem, 2003)

Table 3: Percentage share of CEE countries' total banking sector asset owned by EU-15 banks, by domicile

Countries	Croatia	Poland	Hungary	Czech Republic	Romania	Bulgaria
Austria	43	-	24	33.2	4	11
Belgium	-	-	12	5.9	-	-
Germany	0.1	19	13	7.8	2	7
Italy	45	15	-	-	0.5	19
Netherlands	-	-	14	-	-	-

Source: Mero, K.; Endresz Valentinyi, M. (2003) and Slijepcevic (2005).



Source: Hermmann, S. and Jochem, A.(2003).

parent companies (dominantly denominated in euros). Borrowing abroad is largely driven by constantly increasing personal consumption, but it could also be the form of refinancing. Secondly, foreign owned banks are more prone to take deposits and do lending with currency clause or in euro currency as a way of removing increasing exchange rate mismatch from their balance sheets. Euroization phenomena has started to play ever more significant in CEE economies: in 2000 percentage share of credits denominated in foreign currency in total credit volume was 18.5% in the Czech Republic, 38.0% in Hungary and 23.7% in Poland (Schmitz, 2004), while in Croatia amounted to enormous 89% (Croatian National Bank, 2005). However, besides the positive effects that manifest through faster convergence process of interest rates and integration of banking market, aforementioned channels could gain some negative effects as well. They manifest primarily as incapability of enforcement adequate

control over foreign owned banks and hence as partial or even complete loss of monetary autonomy (Mero and Endresz Valentinyi, 2003). Such evidence can be seen from stronger sensitivity of foreign owned banks in CEE countries to monetary policy impulses coming from ECB rather than from national central banks (Schmitz, 2004). Building on these findings, in the reminder of this paper we investigate whether some evidence on money market and banking sector integration could be found, while using in case of banking integration the data on banking ownership linkages between CEE and EU-15 countries.

## 5. Methodology and the data

### 5.1. Methodology

Our study will provide evidence on the integration of money market, deposit and credit markets between EU-15 and CEE countries. It has to be stated that some of investigated CEE countries have already entered EU (Poland, Hungary and Czech Republic) and the reminders are candidate countries that either finished the negotiation process (Romania and Bulgaria) or are negotiating EU joining as we speak (Croatia). Besides searching for empirical evidence on financial integration, we are also interested in finding out whether some kind of pass-through from EU-15 money markets rates and from specific EU-15 country banking rates to CEE countries money and banking interest rates exists. Existence of pass-through should be expected primarily in countries where some degree of integration is detected, but also evidence of pass-through of money market and banking interest rates where no integration can be established could be interpreted as a first sign of future integration process.

In order to investigate whether EU-15 and specific CEE country money and banking markets are integrated we use pairwise Johansen cointegration method. This method has been used in papers investigating stock market integration (Gilmore, Lucey and Mcmanus, 2005 and Voronkova, 2004), while in papers by Sander and Kleimeier (2003, 2004) Engle-Granger cointegration methodology is applied to investigate banking sector integration in EU-15 and CEE countries.

To determine the pass-through from EU-15 to CEE money market, deposit and lending rates we use Granger causality test that is traditional concept for analyzing causation in time series. In accordance with statistical properties of selected time series we re-parameterized Granger causality test by augmenting it for error correction term when evidence of cointegration between EU-15 and CEE countries was found. This is done because conventional Granger test is made for series that are integrated of order 0. Such Granger test specifies a bivariate vector autoregressive model with a lag length set as  $p$  and has a following form:

$$Y_t = c_1 + \sum_{i=1}^p \alpha_i Y_{t-i} + \sum_{i=1}^p \beta_i X_{t-i} + u_t$$

(1)

$$H_0 : \beta_1 = \beta_2 = \dots = \beta_p = 0$$

The Granger causality is examined by testing whether all  $\beta_i$  are equal to zero using a standard F-test, also called Wald test. If we can reject the null hypothesis in equation (1) X is said to Granger-cause Y. The above equations are, however, only valid for series that are stationary - that is I(0). Since most time-series in macroeconometrics

are found to be non-stationary - that is I(1)- we have to apply differencing and thus convert series into an I(0) to which the Granger Causality tests could be applied:

$$\Delta Y_t = c_1 + \sum_{i=1}^p \alpha_i \Delta Y_{t-i} + \sum_{i=1}^p \beta_i \Delta X_{t-i} + u_t$$

(2)

$$H_0 : \beta_1 = \beta_2 = \dots = \beta_p = 0$$

However, later research showed that this procedure is only correct if the two series are not cointegrated. Engle and Granger (1987) and Granger (1988) argue that in the presence of cointegration, causality tests, which ignore the error correction term (ECT) derived from the cointegration relationship are mis-specified and suggest to re-parameterize the model in the equivalent error correction model form (ECM). The causality tests in this case are based on the following equation (Granger, Huang and Yang, 2000):

$$\Delta Y_t = c_1 + \sum_{i=1}^p \alpha_i \Delta Y_{t-i} + \sum_{i=1}^p \beta_i \Delta X_{t-i} + \delta_1 (Y_{t-1} - \gamma_1 X_{t-1}) + u_t$$

(3)

$$H_0 : \beta_1 = \beta_2 = \dots = \beta_p = 0;$$

$$\delta_1 = 0$$

One advantage of ECM-based tests is that they allow us to differentiate between two types of causality based on the short-run dynamics of the VAR and on the disequilibrium adjustment of the ECM. In particular, the F-test on the estimated coefficients  $\beta_i$  provides evidence regarding a short-term adjustment dynamics. The t-test of the estimated coefficient  $\delta_i$  provides evidence of the existence of an error correction mechanism that drives the variables back to their long-term equilibrium relationship that can be embodied in the cointegration vector (Rousseau and Vuthipadorn, 2005; Sander and Kleimeier, 2003).

Taking these considerations into account, we proceed our empirical exercise as follows:

Step 1: We test all time series for unit roots.

Step 2: We test for cointegration among any pair of series that are I(1) by applying standard Johansen procedure.

Step 3: If the series are found to be I(0), causality testing according to equation (1) will be applied. If the series are found to be I(1) and not cointegrated, causality testing according to equation (2) will be applied. If the series are found to be I(1) and cointegrated, causality will be tested based on equation (3). The error correction term using in equation (3) is obtained after testing for cointegration, i.e. it is built up from elements of given cointegration vector. The results will be reported in separately, i.e. firstly for money market and then for deposit and lending markets.

## 5.2. Data

As for money market, our data set consists of eight money market interest rates. Six out of eight series represent CEE countries (Czech Republic, Hungary, Poland Bulgaria, Croatia and Romania), while the remainders are EU money market rates and German money market rate. We are using two EU-15 rates in order to check the robustness of our results. Since EU-15 money market is completely integrated, testing the integration of CEE and EU-15 money market and speed of pass-through from EU-15 money market to CEE countries money market should produce the same results regardless of choice of proxy for EU-15 money market rate. We collected the data from January 1996 until second half of 2005, with the exception of Bulgaria where the data are taken from July 1997 to avoid the period of drastic price instability. The source for money market data is mostly OECDs Main Economic Indicators database, but also web sites of national central banks.

The data for average deposit and lending interest rates of commercial banks are collected for eleven European countries. By applying Johansen procedure and Granger causality test (augmented for ECT when needed) we attempted to investigate the integration of deposit and credit markets between certain CEE countries and those EU-15 countries whose commercial banks have significant ownership stakes in named CEE country banking system. Thus we collected data for the following CEE countries: Croatia, Poland, Hungary, Czech Republic, Romania (only lending rate was available) and Bulgaria. We also gathered data on lending and deposit rates on following EU-15 countries whose banks have entered markets of CEE countries in question: Austria, Italy, Belgium, Germany and the Netherlands. Most of the data range from January 1996 until second half of 2005, with Hungary, Czech Republic and to certain extent Bulgaria being the exceptions. The source for average deposit and loan interest rates is IMF's International Financial Statistics, web sites of national central banks and direct inquiries by central banks statistics offices.

## **6. Review of results**

### **6.1. Money markets**

In Tables 4. and 5. we presented results of unit root tests in levels and first differences for money market rates. Closer look at the data confirms that indeed all money market interest rates exhibit nonstationarity in levels and stationary in first differences. Only series with potential problem is Romanian money market rate that seems could be either nonstationary or trend stationary in levels. We proceed to second step of our empirical exercise by assuming that all money market time series are integrated of order 1, i.e.  $I(1)$ .

Results of bivariate Johansen cointegration procedure are summarised in Table 6. As a proxy for EU-15 money market developments we used both 3-month German money market rate and 3-month EURIBOR. Since EU-15 money market has showed complete integration after common currency had been introduced, using two proxies for EU-15 in testing for cointegration relationship produced the same results. Namely, only for Croatian and Bulgarian money markets we were able to find 1 cointegration vector, meaning that both Bulgarian and Croatian money markets are integrated into EU-15 money market. In Table 7. and 8. we only presented the evidence of those two cases where we established the existence of the same trend co-movements between money market rates; i.e. the evidence on integration between Croatian and EU-15 money market and on Bulgarian and EU-15 money market.

Table 4: ADF and PP unit root tests – in levels

	Name of the variable	Time period	ADF		PP	
			t-value (trend included)	t-value (no trend)	t-value (trend included)	t-value (no trend)
1.	CZ	1996:1 -2005:10	-1.959 (2) [0.6237]	-0.786 (2) [0.8232]	-2.590 (2) [0.2845]	-1.100 (2) [0.7150]
2.	HU	1996:4 -2005:8	-1.909 (1) [0.6501]	-1.704 (1) [0.4291]	-1.685 (1) [0.7575]	-1.583 (1) [0.4922]
3.	PL	1996:1 -2005:7	-4.284*(5) [0.0033]	-1.064 (4) [0.7290]	-2.103 (5) [0.5443]	-1.023 (4) [0.7449]
4.	EU-15	1996:1 -2005:10	-1.671 (1) [0.7633]	-1.138 (1) [0.6996]	-1.909 (1) [0.6501]	-0.739 (1) [0.8363]
5.	GE	1996:1 -2005:10	-1.850 (2) [0.6800]	-1.272 (2) [0.6417]	-1.246 (2) [0.9006]	-0.802 (2) [0.8186]
6.	BU	1997:7 -2005:9	-2.137 (5) [0.1994]	-1.217 (5) [0.1834]	-6.557*(5) [0.0000]	-6.474*(5) [0.0000]
7.	CRO	1996:1 -2005:7	-2.687 (6) [0.2413]	-1.915 (6) [0.3250]	-3.591**(1) [0.0307]	-3.788*(6) [0.0030]
8.	RO	1996:1 -2005:9	-3.398*** (3) [0.0517]	-1.088 (3) [0.7198]	-3.465** (3) [0.0433]	-1.725 (3) [0.4183]

Note: ADF - Augmented Dickey-Fuller test; PP – Phillips-Peron test; optimal number of time lags determined with Schwarz-Bayesian Information Criterion and is presented in parenthesis; P-value in brackets, \* null hypothesis about existence of unit root rejected at 1 percent level, \*\* null hypothesis about existence of unit root rejected at 5 percent level, \*\*\* null hypothesis about existence of unit root rejected at 10 percent level.

Table 5: ADF and PP unit root tests – in differences

	Name of the variable	Time period	ADF		PP	
			t-value (trend included)	t-value (no trend)	t-value (trend included)	t-value (no trend)
1.	CZ	1996:1 -2005:10	-11.238 *(1) [0.0000]	-11.287 *(1) [0.0000]	-9.469* (1) [0.0000]	-5.981* (1) [0.0000]
2.	HU	1996:4 -2005:8	-6.039* (1) [0.0000]	-5.981* (1) [0.0000]	-8.815* (1) [0.0000]	-8.772* (1) [0.0000]
3.	PL	1996:1 -2005:7	-2.913 (3) [0.1581]	-1.064** (3) [0.0410]	-8.546* (3) [0.0000]	-8.583* (3) [0.0000]
4.	EU-15	1996:1 -2005:10	-4.962* (1) [0.0002]	-4.958* (1) [0.0000]	-6.713* (1) [0.0000]	-6.699* (1) [0.0000]
5.	GE	1996:1 -2005:10	-4.888* (1) [0.0003]	-3.369** (3) [0.0120]	-7.323* (1) [0.0000]	-7.459* (3) [0.0000]
6.	BU	1997:7 -2005:9	-4.280* (9) [0.0034]	-6.988* (10) [0.0000]	-24.051* (9) [0.0000]	-16.067* (10) [0.0000]
7.	CRO	1996:1 -2005:7	-5.540* (1) [0.0000]	-5.375* (1) [0.0000]	-7.291* (1) [0.0000]	-7.062(1) [0.0000]
8.	RO	1996:1 -2005:9	-8.786* (2) [0.0000]	-8.736* (2) [0.0000]	-7.644* (2) [0.0000]	-7.646* (2) [0.0000]

Note: ADF - Augmented Dickey-Fuller test; PP – Phillips-Peron test; optimal number of time lags determined with Schwarz-Bayesian Information Criterion and is presented in parenthesis; P-value in brackets, \* null hypothesis about existence of unit root rejected at 1 percent level, \*\* null hypothesis about existence of unit root rejected at 5 percent level, \*\*\* null hypothesis about existence of unit root rejected at 10 percent level.

Table 6: Review of results of Johansen procedure for pairs of countries money markets

Countries	Czech Republic	Hungary	Poland	Croatia	Romania	Bulgaria
EU-15	No	No	No	Yes	No	Yes
Germany	No	No	No	Yes	No	Yes

Table 7: Testing the integration between Croatian and EU-15 money market

Maximum rank	LL	Eigen value	$\lambda_{\text{trace}}$	5 % critical value	$\lambda_{\text{max}}$	5 % critical value
0	-86.600	-	18.8759	12.53	17.5228	11.44
1	-77.839	0.14364	1.3531*	3,76	3.84*	6.51
2	-77.162	0.01190	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using SBIC obtained after VAR estimation of all endogenous variables; maximum likelihood estimation includes a constant in order to account for the trend present in the data; \* null hypothesis accepted at 5 percent level.

Table 8: Testing the integration between Bulgarian and EU-15 money market

Maximum rank	LL	Eigen value	$\lambda_{\text{trace}}$	5 % critical value	$\lambda_{\text{max}}$	5 % critical value
0	-71.843714	-	28.8855	12.53	28.3228	11.44
1	-57.682323	0.25322	0.5627*	3.84	0.5627*	3.84
2	-57.40095	0.00578	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using SBIC obtained after VAR estimation of all endogenous variables; maximum likelihood estimation includes a constant in order to account for the trend present in the data; \* null hypothesis accepted at 5 percent level.

The driving forces behind integration of Croatian money market integration hides behind high degree of EU-15 bank ownership of Croatian banks, which have facilitated Croatian banks easy access to funds from EU-15. Because of this, during last 5 years Croatian banks have borrowed 22 percent of Croatian nominal GDP in order to finance the unprecedent credit expansion boosted by lowering of interest rates and steady growth of personal consumption. Such generation of foreign debt promoted integration of Croatian money markets since it made Croatian banks very sensitive and responsive to developments on EU-15 money market while diminishing otherwise present money market borrowing barriers for non EU-15 banks. Moreover, extremely high euroization of financial systems in Croatia could have facilitated emergence of same trend co-movement of money market interest rates.

As for Bulgarian money market integration, it is probably related to Bulgarian currency board regime since Bulgarian lev was pegged to the German mark when the

board was introduced in June of 1997 and since January 1999 to the euro at an exchange rate corresponding to the German marks exchange rate to the euro. Due to currency board regime, any change of money market interest rates in euro zone might have been directly transmitted to Bulgarian monetary system making the Bulgarian money market seem more integrated than money markets of other countries in the sample.

Granger test was conducted for series in first differences in case of Czech Republic, Hungary, Poland and Romania, i.e. for those countries where no evidence of integration was found. The results summarized in Table 9. indicate that only in Poland evidence of pass-through from EU-15 money market interest rate to Polish money market rate exists, while for other countries no pass-through was found. However, result for Polish pass-through has to be taken with reserve since it is statistically significant in both directions, i.e. endogeneity problem is present.

Granger test augmented for error correction term was applied on Croatian and Bulgarian money market interest rate data. In both cases we confirmed that EU-15 money market rate Granger cause Croatian and Bulgarian money market interest rates which confirms the existence of money market rate pass-through for those countries and reinforces the formerly presented evidence on money market integration for these countries.

Table 9: Results of Granger causality test (augmented for EC term)

Countries	Czech Republic	Hungary	Poland	Croatia	Romania	Bulgaria
	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value
EU-15	2.7429 [0.433]	1.5164 [0.469]	5.9081*** [0.052]	17.259* [0.002]	1.1455 [0.564]	43.273* [0.000]

Note: EC term – error correction term number of time lags is 12; p-value in brackets; \* null hypothesis rejected at 1 percent level; \*\* null hypothesis rejected at 5 percent level \*\*\* null hypothesis rejected at 10 percent level; EC term added for pairs of countries shaded with grey colour (Croatia and Bulgaria).



## 6.2. Deposit and lending markets

In Tables 10. and 11. we summarized the results of unit root tests in levels and first differences for countries deposit and lending interest rates. Like in case of money market interest rates, most of the deposit and lending interest rates are undoubtedly nonstationary in levels and stationary in first differences. Since we can not with certainty claim for any investigated series that it is I(1), since either the evidence from Augmented Dickey Fuller test and Phillips-Peron test are mixed or more pointing out towards conclusion that we indeed have a unit root in a series, we proceed assuming that all deposit and lending interest rates are I(1).

Table 10: ADF and PP unit root tests – in levels

	Name of the variable	Time period	ADF		PP	
			t-value (trend included)	t-value (no trend)	t-value (trend included)	t-value (no trend)
1.	AUd	1996:1 -2005:9	-2.452 (3) [0.3521]	-1.473 (3) [0.5470]	-1.769 (3) [0.7195]	-1.434 (3) [0.5660]
2.	AUI	1996:1 -2005:9	-2.344 (3) [0.4095]	-1.124 (3) [0.7055]	-1.646 (3) [0.7737]	-1.107 (3) [0.7123]
3.	BEd	1996:1 -2005:9	-1.822 (1) [0.6943]	-1.439 (1) [0.7035]	-1.436 (1) [0.8499]	-1.129 (1) [0.7035]
4.	BEI	1996:1 -2005:2	-1.130 (1) [0.9239]	-1.138 (1) [0.6996]	-0.739 (1) [0.8363]	-0.739 (1) [0.8363]
5.	GEd	1996:1 -2005:9	-2.023 (2) [0.5887]	-1.632 (2) [0.4664]	-1.404 (2) [0.8598]	-1.240 (2) [0.6560]
6.	GEI	1996:1 -2005:9	-1.554 (1) [0.8101]	-0.924 (1) [0.7799]	-1.600 (1) [0.7926]	-0.978 (1) [0.7614]
7.	ITd	1996:1 -2005:9	-2.172 (3) [0.5055]	-3.544* (3) [0.0069]	-1.441 (3) [0.8485]	-4.086* (3) [0.0010]
8.	ITI	1996:1 -2005:9	-2.583 (3) [0.2876]	-1.389 (3) [0.5877]	-2.261 (3) [0.4559]	-2.791*** (3) [0.0596]
9.	NEd	1996:1 -2005:9	-2.584 (1) [0.2873]	-1.970 (1) [0.3001]	-3.201*** (1) [0.0841]	-2.474 (1) [0.1218]
10	NEI	1996:1 -2005:9	-2.806 (3) [0.1947]	-1.575 (1) [0.6996]	-2.230 (3) [0.4733]	-0.739 (1) [0.5115]
11	CRd	1996:1 -2005:9	-3.088 (2) [0.1092]	-2.843*** (3) [0.0524]	-3.139 (2) [0.1072]	-2.635*** (3) [0.0860]
12	CRI	1996:1 -2005:19	-3.607** (1) [0.0293]	0.188 (1) [0.9716]	-4.290* (1) [0.0033]	-0.072 (1) [0.9522]
13	PLd	1996:1 -2005:9	-3.421** (4) [0.0487]	-0.949 (1) [0.7713]	-1.893 (4) [0.6582]	-0.826 (1) [0.8114]
14	PLI	1996:1 -2005:9	-2.257 (2) [0.4580]	-0.544 (2) [0.8114]	-1.863 (2) [0.6734]	-0.544 (2) [0.8363]
15	HUd	1999:6 -2005:10	-2.174 (1) [0.5046]	-1.880 (1) [0.3416]	-1.816 (1) [0.6971]	-1.712 (1) [0.4248]
16	HUI	1999:6 -2005:10	-2.017 (1) [0.5921]	-1.767 (1) [0.3971]	-1.933 (1) [0.6375]	-2.032 (1) [0.2729]
17	CZd	1996:1 -2005:1	-2.026 (1) [0.5869]	-0.847 (1) [0.8049]	-2.213 (1) [0.4826]	-0.876 (1) [0.7958]
18	CZI	1997:7 -2005:1	-1.585 (1) [0.7983]	-1.292 (1) [0.6328]	-1.571 (1) [0.8036]	-1.259 (1) [0.6478]
19	ROI	1996:1 -2005:10	-1.025 (12) [0.9407]	-0.438 (12) [0.9036]	-2.550 (12) [0.3036]	-0.606 (12) [0.8696]
20	BGd	1997:7 -2005:9	-1.286 (2) [0.8914]	-1.461 (2) [0.5526]	-3.377*** (2) [0.0545]	-1.768 (2) [0.3965]
21	BGI	1996:1 -2005:9	-4.718* (1) [0.0006]	-2.106 (1) [0.2421]	-3.811** (1) [0.0160]	-1.979 (1) [0.2957]

Note: ADF - Augmented Dickey-Fuller test; PP – Phillips-Peron test; optimal number of time lags determined with Schwarz-Bayesian Information Criterion and is presented in parenthesis; P-value in brackets, \* null hypothesis about existence of unit root rejected at 1 percent level, \*\* null hypothesis about existence of unit root rejected at 5 percent level, \*\*\* null hypothesis about existence of unit root rejected at 10 percent level.

Table 11: ADF and PP unit root tests – in differences

	Name of the variable	Time period	ADF		PP	
			t-value (trend included)	t-value (no trend)	t-value (trend included)	t-value (no trend)
1.	AUd	1996:1 -2005:9	-3.672** (2) [0.0243]	-3.700* (2) [0.0041]	-9.712 * (2) [0.0000]	-9.762* (2) [0.0000]
2.	AUI	1996:1 -2005:9	-3.644** (2) [0.0047]	-3.660* (2) [0.0047]	-7.874* (2) [0.0000]	-7.893* (2) [0.0000]
3.	BEd	1996:1 -2005:9	-4.038* (2) [0.0078]	-3.244** (3) [0.0176]	-7.690*(2) [0.0000]	-7.805*(3) [0.0000]
4.	BEI	1996:1 -2005:2	-3.298*** (3) [0.0665]	-3.292** (3) [0.0152]	-10.397*(3) [0.0000]	-10.366 *(3) [0.0000]
5.	GEd	1996:1 -2005:9	-3.677** (1) [0.0239]	-3.687* (2) [0.0043]	-8.674* (1) [0.0000]	-8.707* (2) [0.0000]
6.	GEI	1996:1 -2005:9	-7.879* (1) [0.0000]	-7.913* (1) [0.0000]	-10.899* (1) [0.0000]	-10.948* (1) [0.0000]
7.	ITd	1996:1 -2005:9	-4.402* (2) [0.0022]	-3.347 ** (2) [0.0129]	-9.840* (2) [0.0000]	-8.407* (2) [0.0000]
8.	ITl	1996:1 -2005:9	-1.994 (2) [0.6049]	-2.293 (2) [0.1743]	-5.918* (2) [0.0000]	-5.730* (2) [0.0000]
9.	NEd	1996:1 -2005:9	-4.573* (3) [0.0011]	-4.622* (3) [0.0001]	-12.684* (3) [0.0000]	-12.673* (3) [0.0000]
10	NEI	1996:1 -2005:9	-4.428* (2) [0.002]	-4.478* (2) [0.0002]	-10.783* (2) [0.0000]	-10.828* (2) [0.0000]
11	CRd	1996:1 -2005:9	-7.976* (1) [0.0000]	-8.059* (1) [0.0000]	-8.392* (1) [0.0000]	-8.467* (1) [0.0000]
12	CRI	1996:1 -2005:19	-4.317* (2) [0.0030]	-5.464* (1) [0.0000]	-9.235* (2) [0.0000]	-9.058* (1) [0.0000]
13	PLd	1996:1 -2005:9	-4.782* (1) [0.0005]	-4.796* (1) [0.0001]	-6.575* (1) [0.0000]	-6.593 (1) [0.0000]
14	PLI	1996:1 -2005:9	-5.648* (1) [0.0000]	-5.675* (1) [0.0000]	-8.082* (1) [0.0000]	-8.117* (1) [0.0000]
15	HUd	1999:6 -2005:10	-4.280* (1) [0.0034]	-4.337* (1) [0.0004]	-5.142* (1) [0.0001]	-5.185* (1) [0.0000]
16	HUI	1999:6 -2005:10	-3.610** (1) [0.0029]	-3.677* (1) [0.0045]	-4.461* (1) [0.0017]	-4.518* (1) [0.0002]
17	CZd	1996:1 -2005:1	-8.974* (1) [0.0000]	-9.017* (1) [0.0000]	-7.776* (1) [0.0000]	-11.709* (1) [0.0000]
18	CZl	1997:7 -2005:1	-7.776* (1) [0.0000]	-7.757* (1) [0.0000]	-10.065* (1) [0.0000]	-10.057* (1) [0.0000]
19	ROI	1996:1 -2005:10	-3.786** (12) [0.0173]	-4.093* (12) [0.0001]	-11.355* (12) [0.0000]	-11.261* (12) [0.0000]
20	BGd	1997:7 -2005:9	-5.183* (3) [0.0001]	-3.783* (5) [0.0031]	-21.504* (3) [0.0000]	-21.443* (5) [0.0000]
21	BGl	1996:1 -2005:9	-8.251* (1) [0.0000]	-4.822* (8) [0.0000]	-11.245* (1) [0.0000]	-11.197* (8) [0.0000]

Note: ADF - Augmented Dickey-Fuller test; PP – Phillips-Peron test; optimal number of time lags determined with Schwarz-Bayesian Information Criterion and is presented in parenthesis; P-value in brackets, \* null hypothesis about existence of unit root rejected at 1 percent level, \*\* null hypothesis about existence of unit root rejected at 5 percent level, \*\*\* null hypothesis about existence of unit root rejected at 10 percent level.

In Table 12. and 13. we presented the summary of pairwise Johansen cointegration procedure for those pairs of EU-15 and CEE countries which banking industries are related through ownership, i.e. we only investigated potential integration relationship between certain EU-15 country, which banking industry has significant ownership stake in a CEE country and that CEE country. Thus, pairs of countries are based on data presented in Table 2. and Table 3. The complete results of Johansen procedure are not presented in the paper since they would consume a lot of space, but are available upon the request from the authors.

Table 12. gives overview of cointegration tests on pairs of deposit markets, while Table 13. summarises results of cointegration tests for EU-15 and CEE lending markets. A closer look at the Tables reveals that integration is more present in lending markets than in deposit markets. Integration is more apparent in lending markets which makes sense since loans (especially loans to enterprises) can overcome more easily the problem of non-existence of banks geographical proximity than deposits. This result also speaks of business strategy of EU-15 owned banks in CEE that consists of intensive lending activity<sup>5</sup> on CEE lending markets financed partly through funds that originated from EU-15.

In general, it seems that only Austrian and Italian banking industry shows signs of integration with CEE countries. This could mean that commercial banks stemming from these EU-15 countries lead more aggressive interest rate policies. Moreover, one must note that Italian and Austrian banks have relatively larger market share in CEE banking industry when compared to Belgian, Dutch and German banks market shares, which makes their aggressive interest rate policies materialise quickly and more completely in interest rate statistics.

Table 12: Review of results of Johansen procedure for pairs of countries' deposit markets

Countries	Croatia	Poland	Hungary	Czech Republic	Romania	Bulgaria
Austria	Yes	-	No	No	-	No
Belgium	-	-	No	No	-	-
Germany	No	No	No	No	-	No
Italy	Yes	Yes	-	-	-	Yes
Netherlands	-	-	No	-	-	-

Table 13: Review of results of Johansen procedure for pairs of countries' credit markets

Countries	Croatia	Poland	Hungary	Czech Republic	Romania	Bulgaria
Austria	Yes	-	No	Yes	Yes	Yes
Belgium	-	-	No	No	-	-
Germany	No	No	No	No	No	No
Italy	Yes	Yes	-	-	Yes	Yes
Netherlands	-	-	No	-	No	-

<sup>5</sup> Thus bringing the lending interest rates down.

Moving to country analysis, the only country that shows no signs of banking integration is Hungary, while for Czech Republic we could determine only one cointegration vector in case of Czech lending market and Austrian lending market. As in the case of money market integration, Croatian and Bulgarian banking systems appear to be more completely integrated, i.e. both deposit and lending market integration exists with Austrian and Italian deposit and lending market<sup>6</sup>, than the rest of the CEE countries in the sample. Romania lending market also exhibits integration with Italian and Austrian lending markets. Unfortunately, data for Romanian deposit interest rate were not available, which prevented us from investigating integration of Romanian deposit market with EU-15 markets. As far as Poland is concerned, both Polish lending and deposit market seems to be integrated with Italian counterparts.

The results of Granger causality tests (augmented for ECT when needed) partially confirm our guess that interest rate pass-through might be present in those markets where evidence of integration can be found. Bulgaria is one such case, while Croatia and Poland do see some interest rate pass through from EU-15 countries, but not in all of the markets and not from all of the countries with which Croatia and Poland are integrated. Thus we confirmed deposit rate pass-through from Italian to Croatian market and lending rate pass-through from Italy to Poland that is only marginally statistically significant. Just like with cointegration tests, the null hypothesis in Granger tests is rejected more times in lending markets than in deposit markets. The first surprising result is the evidence of more pass-throughs from EU-15 countries to Hungary, the only country for which no evidence of integration was found. Even both Belgian banking rates have pass-through effects on Hungarian rates. This evidence suggests that Hungarian banking sector is probably much more sensitive to short term interest rate volatility than Croatian, Polish and Czech banking sector. The title of the least responsive belongs to Czech Republic which does not seem to be affected by changes in deposit and lending interest rates stemming from EU-15 countries in the short run or the long run.

Table 14: Results of Granger causality test (augmented for EC term) for deposit markets

Countries	Croatia	Poland	Hungary	Czech Republic	Romania	Bulgaria
	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value	chi <sup>2</sup> - value
Austria	4.0172 [0.404]	-	15.388 [0.221]	10.83 [0.546]	-	26.162* [0.010]
Belgium	-	-	17.888*** [0.117]	8.4062 [0.753]	-	-
Germany	11.469 [0.489]	4.2062 [0.979]	24.261** [0.019]	4.086 [0.982]	-	23.23** [0.026]
Italy	14.66* [0.002]	2.6791 [0.613]	-	-	-	1.497 [0.827]
Netherlands	-	-	7.9263 [0.791]	-	-	-

Note: EC term – error correction term; number of lags is 12; p-value in brackets; \* null hypothesis rejected at 1 percent level; \*\* null hypothesis rejected at 5 percent level; \*\*\* null hypothesis rejected at 10 percent level; EC term added for pairs of countries shaded with grey colour.

<sup>6</sup> Except the missing integration between Bulgarian and Austrian deposit market.

Table 15: Results of Granger causality test (augmented for EC term) for credit markets

Countries	Croatia	Poland	Hungary	Czech Republic	Romania	Bulgaria
	chi <sup>2</sup> - value [0.805]	chi <sup>2</sup> - value	chi <sup>2</sup> - value [0.001]	chi <sup>2</sup> - value [0.828]	chi <sup>2</sup> - value [0.087]	chi <sup>2</sup> - value [0.007]
Austria	1.6215 [0.805]	-	32.156* [0.001]	1.4949 [0.828]	8.1342*** [0.087]	14.013* [0.007]
Belgium	-	-	18.291*** [0.107]	7.7277 [0.806]	-	-
Germany	3.0119 [0.995]	2.3771 [0.999]	81.774* [0.000]	8.3507 [0.757]	6.0154 [0.915]	11.558* [0.482]
Italy	4.8653 [0.301]	7.6635*** [0.105]	-	-	3.0754 [0.545]	20.821* [0.000]
Netherlands	-	-	13.764 [0.316]	-	17.515 [0.131]	-

Note: EC term – error correction term; number of lags is 12; p-value in brackets; \* null hypothesis rejected at 1 percent level; \*\* null hypothesis rejected at 5 percent level; \*\*\* null hypothesis rejected at 10 percent level; EC term added for pairs of countries shaded with grey colour.

The second surprise comes in form of evidence of pass-through of German lending and deposit rates to Hungarian and Bulgarian lending and deposit rates. Same as in case of Hungarian banking sector, German banking sector also showed no signs of integration on both deposit or lending side measured by Johansen cointegration test. This finding tell us that so far German owned banks are able to influence CEE interest rate level in the short run, but are not able to move long run equilibrium rates.

## 7. Concluding remarks

The intention of this paper was to examine whether money markets and banking sector integration exist among CEE countries and EU-15 countries. In sample of CEE countries we include both selected new EU member states and candidate countries. Potential for both money market and banking integration between CEE and EU-15 exists due to major role of banks from EU-15 in CEE countries' banking industries. Namely, unlike the case of EU-15 where the process of banking industry consolidation took place mainly through mergers and acquisition within national borders which impeded EU wide banking integration, in CEE countries banking consolidation was conducted through entrance of foreign (mainly EU-15) banks into national banking industries which could have facilitated integration in money market, deposit and credit markets with EU-15 financial system. Even more, major role in general of commercial banks on money markets in CEE countries, increasing level of euroization and process of CEE countries' joining EU and EMU might have facilitated and fastened the process.

However, results of Johansen cointegration procedure deployed on money market data suggest that only in case of Croatian and Bulgarian money market there is evidence of integration with EU money market. This finding we contribute mostly to intensive Croatian banks borrowing of funds from their foreign EU-15 owners (mainly Italian and Austrian banks) and Bulgarian currency board regime. In addition, by using Granger causality tests augmented with error correction term, we only find evidence of money market rate pass-through from EU-15 money market rates to

Croatian and Bulgarian money markets rates, suggesting that considerable segmentation of other CEE money markets is still present despite previously mentioned factors that might have facilitated the integration. Moreover, the pass-through evidence serve well in confirming cointegration results since one would expect that markets that are integrated experience effective and fast (if not immediate) interest rate pass-through. Moreover, we also found evidence of money market rate pass-through from EU-15 to Poland, but this result could be considered twofold since Granger causality here goes in both direction. On one hand, endogeneity of two interest rate series could be considered as a sign of complete integration since variables are obviously interdependent. However, since the reality is somewhat different, i.e. it is hardly possible to say that Polish money market rates changes (unlike US changes) can transmit easily on EU-15 money market, we feel that in this case endogeneity of two series is exactly what it is; a potential problem with the data used.

Contrary to EU money market, national banking industries within EU-15 countries exhibit no signs of integration, which led us to use EU-15 countries banking interest rate data instead of synthetic EU-15 data. Changes of banking ownership structure that was revolving in CEE countries in last 10 years made us believe that some traces of bilateral integration between EU-15 country and CEE country in which banking market former EU-15 country has entered, could encourage deposit and lending market integration. Very pronounced cases of Czech Republic and Croatia where EU-15 banks ownership stakes exceed 90 percent of total Czech and Croatian banking sector assets only reinforce our belief. Therefore we search for possible cointegration relationships in deposit and lending markets between six CEE countries (Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania) and five EU-15 countries (Austria, Belgium, Germany, Italy and the Netherlands) in period from 1996 to 2005. Evidence from Johansen cointegration procedure suggests that trend co-movements of interest rates between investigated countries is much more present in lending market than in deposit market. This makes sense to us because lending activity (especially corporate lending) is less tied down to certain geographic location than deposit activity.

It also appears that integration is limited on Austria and Italy from EU-15 side and it is spread on all countries from CEE except Hungary. Thus we find cointegration vectors in case of following deposit markets: Croatian and Italian, Croatian and Austrian, Polish and Italian and Bulgarian and Italian. We also confirmed cointegration relationship between lending markets in following countries: Croatia and Italy, Croatia and Austria, Poland and Italy, Romania and Italy, Bulgaria and Italy, Bulgaria and Austria but also between Czech Republic and Austria, Romania and Austria, and Romania and Italy. Intuitively, one would expect that EU-15 banking industries (like Belgian and Dutch) which are more concentrated, would be the ones showing higher degree of integration with corresponding CEE banking industries since banks in such EU-15 countries are expected to have more influence over the level of their own national interest rate level, but the results of this study suggest otherwise.

Out of five EU-15 member states in our sample only Italian and Austrian banking industry seem to exhibit signs of integration with CEE banking industries. We explain that result with the fact that Austrian and Italian banks have relatively higher ownership stakes in those countries' banking industries; namely in Croatian, Polish

and in Bulgarian banking industry. In such cases, leading more active interest rate policy would materialize quicker and more completely in interest rate statistics.

Moreover, examining interest rate pass-through from EU countries deposit and lending rates to CEE countries deposit and lending rates enabled us to partially confirm the robustness of the results obtained by conducting cointegration tests. In other words, deposit and lending interest rate pass-through are partially found in cases of countries which exhibit some level of banking sector integration. As expected, pass-through is also more frequent with lending interest rates than with deposit rates. Even more, interest rate pass-through was determined for countries that are not found to be integrated like Hungary on one hand and Germany and Belgium on the other, where German deposit and lending interest rate and Belgian lending interest rate exhibit significant pass-through towards Hungarian banking rates. German lending rate was also found to Granger cause Romanian lending interest rate.

This means that although German and Belgian banks can not influence long run equilibrium level of domestic (Hungarian and Romanian) interest rates, they still have enough market power to cause short-term interest rate changes. Hungary (together with Bulgaria) even though it shows no signs of banking sector integration, appears to be the most sensitive and responsive to short-term banking rates volatility coming from EU-15 countries. Croatia, on the other end of the spectrum, seems to be the most integrated country, but the least responsive to short-term interest rate dynamics which could suggest that its banking system is the most stable and well consolidated. Polish banking system also seems to be mostly resilient to Austrian and Italian short term interest dynamics, though its state of integration is not as encompassing as Croatian. Czech Republic is the only country among CEE countries that does not seem to be affected at all by changes in EU-15 deposit and lending interest rate while at the same time showing very little signs of integration. This is rather counterintuitive since one might expect that Czech banking industry, almost completely foreign-owned, should be either well integrated or susceptible to short term interest rate dynamics from EU-15 countries or both. So, obviously in case of Czech Republic interest rate determination domestic factors that support segmentation of Czech banking market prevail.

To sum up, our results confirm results of the study done by Sander and Kleimeier (2004) that suggested fast pass-through of retail interest rate indeed exists, thus setting ground for effective common monetary policy in the future. On the other hand this findings are conflicting with results of Herrmann and Jochem paper from 2003. Unlike them, we did not find evidence on integration of Czech and Hungarian money market with EU-15 money market, but we did confirm that Polish money market might be integrated, but in our case we were confronted with endogeneity of the data.

So, although high ownership stake of EU-15 banks in CEE banking industries offers potentially fast and efficient integration of money market, deposit and lending market in to corresponding EU-market accompanied by successful interest rate convergence, it also presents an impediment for implementation of monetary policy measures in CEE economies *until these countries adopt euro*. This is due to the fact that EU-15 owned banks in CEE countries respond mainly to the monetary policy impulses coming from ECB and not from their national central banks. As well, these CEE banks are more prone to lending with currency clause or in euro currency as a way of removing increasing exchange rate mismatch from their balance sheets thus creating unofficial financial system euroization that generates important, but in the literature often neglected, monetary policy impediment.

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