INTEGRATION BETWEEN THE ROMANIAN AND THE EURO AREA BANKING MARKETS: AN APPLICATION OF THE JOHANSEN COINTEGRATION TEST TO INTEREST RATES ON LOANS TO NON-FINANCIAL CORPORATIONS[1]

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Abstract:

The aim of the present paper is to investigate if there is any level of integration between the Romanian and the euro area banking markets – with focus on lending activities of monetary financial institutions (MFIs) to non-financial corporations (NFCs) – and to assess this level of integration through using both quantity- and especially price-based data. The main empirical instrument used is the Johansen cointegration test applied to pairs of interest rates for euro-denominated loans granted by MFIs located in the two markets to NFCs for different loan maturities and amounts. By employing recent data, the results of the test indicate the existence of a cointegration relationship between the interest rates for loans with floating rate / period of initial rate fixation of up to 1 year and up to and including EUR 1 million euro. These findings suggest that, although Romania is not yet part of the Economic and Monetary Union (EMU), the two markets are not completely disintegrated especially with regard to short-term bank lending operations. Although further investigation is necessary, the findings are relevant from the perspective of Romania entering the EMU and have implications for Romanian NFCs' access to finance.

Key words: banking market integration, interest rate spread, cross-border loans, euro area, Romania, Johansen co-integration test, Granger causality

1. Introduction

Financial integration in general and financial markets integration in particular, has gained considerable and increasing attention considering the recent financial shocks that hit the European Union (EU) member states, particularly the euro area countries. The objective of achieving a high level of financial integration at EU and euro area levels derives from and is consistent with the objective of creating a single market for financial services. The reasons why financial integration counts and should be fostered are related to the issues of (i) monetary policy transmission in the euro area, (ii) financial stability and (iii) functioning of the payment systems, it positively impacting on all of those three areas, in the view of the

European Central Bank (ECB, 2014). De Guevara et al. (2007) synthesize the macroeconomic benefits of financial integration previously highlighted in literature, i.e. an expanded set of financial assets and services, a decrease in their prices and an improvement in portfolio composition. But financial integration is not only important from a macroeconomic and monetary perspective. It has also implications and benefits at microeconomic level. Lucey and Zhang (2011) argue that, based on the expected benefits at country level following financial integration, firms are stimulated to adjust their capital structure by taking advantage of an expanded range of financing resources and a lower cost of capital. Micro-level implications of financial integration can be also traced at household-level (ECB, 2014; Pungulescu, 2013; Maudos, 2013). Maudos (2013), for instance, states that the introduction of euro benefited to firms and households alike by leading to a decrease in their real borrowing costs. According to de Guevara et al. (2007), the awaited benefit of lower financial costs stemming from financial integration, can be viewed as the outcome of tighter competition. In this paper, the implications for NFCs are given priority.

Integration in financial markets can be traced along four main segments – money markets, bond markets, equity markets and banking markets (ECB, 2014). The present paper focuses on banking markets and aims at investigating if there is any level of integration between the Romanian and the euro area banking markets with respect to the MFIs' lending activities to NFCs as this has implications on the access to and the financing conditions for the Romanian NFCs. The decision to focus on this issue given that Romania is not yet part of the euro area can be justified, on one side, by the high presence of foreign banks on the domestic banking market especially banks headquartered in EU and euro area countries. According to the National Bank of Romania (BNR, 2014), 24 out of the 40 credit institutions have a dominant share of foreign capital ownership and hold 80.2% of the aggregate net balance sheet assets. Also, based on the consolidated statistics reported by the Bank of International Settlements (BIS, 2014), it results that the average quarterly level for 2007-2013 of foreign claims by banks located in the euro area (Austria, Belgium, Germany, Greece, Italy, Netherlands, Portugal, Spain) to foreign claims reported by banks located in the EU countries on Romanian counterparts, is 79.8%. These figures are not negligible and underpin the assumption that the two markets are not completely disintegrated much more that some papers suggest that a high presence of foreign-owned banks with facile access to international (euro area) capital (interbank) markets, as is the case of Romania, is indicative of a high level of financial integration (see Owen and Temesvary (2014) and Popov and Ongena (2011)). On the other side, the choice to focus on the banking markets is explained by the fact that, according to the ECB (2014), fragmentation on this market negatively affects the economic recovery in the euro area by restricting the access to finance for firms, especially for small and medium-sized enterprises (SMEs).

The paper uses recent data (2007:1-2014:11) on monthly interest rates on loans to NFCs charged by MFIs located in the euro area and Romania, respectively, which serve as dataset for the empirical tests conducted, as well as monthly / quarterly (transformed to annual) data (2007-2013) on the claims (loans) held by MFIs located in the euro area on Romanian counterparts (volume-based measures) and vice versa which is analyzed in a descriptive manner. The empirical test is the Johansen's test of cointegration applied to the interest rate pair series followed, where co-integration hypothesis is confirmed, by the estimation of the vector error correction model (VECM) and the Granger causality test. The Johansen cointegration test prevailed over the Engle-Granger (1987) procedure given that it

has been recently used in studies of cointegration in financial markets (Boubakri et al., 2012; Demian, 2011). In the main analysis, the overall euro area market is taken as the benchmark market while the German and the Austrian markets are used as benchmarks in the robustness checks section.

The results suggest the existence of a certain level of integration between the Romanian and the euro area banking markets. Specifically, the results showed that the interest rates on new euro-denominated loans with floating interest rate / period of initial interest rate fixation of up to 1 year and of up to and including 1 EUR million euro are co-integrated. The acceptance of the co-integration hypothesis means that there is a long-run equilibrium relationship between the respective interest rates series. However, the estimation of the ECM model showed that the adjustment speed towards the equilibrium is slow especially when the test is conducted for the euro area as a whole (0.03). The convergence speed is higher when the benchmark is considered to be the Austrian market (0.05) and especially the German market (0.08).

The paper is subsequently organized as follows. Section 2 briefly reviews the relevant literature while section 3 presents the data and the method used. Section 4 presents and discusses the results and section 5 briefly concludes the paper.

2. Literature review and research question

2.1. Banking market integration – Euro area and Romania

This section begins with a brief review of the recent evolutions in the euro area banking markets in the light of the recent financial crisis. Maudos (2013) states that the recent financial crisis has cancelled the benefit of lower cost of capital and brought about divergence in the euro area interest rates on loans to firms and to households as well. According to ECB (2014), the fragmentation trend induced by the financial crisis was reverted starting with mid-2012 but, as regards the banking segment, a still large dispersion in the interest rates for loans to NFCs and a reduced level of cross-border lending to the same sector are acknowledged. The widened interest rate differentials on loans to NFCs among the euro area countries are particularly higher for SMEs (ECB, 2014; Maudos, 2013) and this finding should be given special consideration given the SMEs' high reliance on bank financing (ECB, 2014; Blundell-Wignall, 2011). During the sovereign debt crisis, considered one of the causes of the segmentation among the euro area banking markets (ECB, 2014), Maudos (2013) documents that the interest rates on loans to NFCs and households in distressed countries have on average increased while in the other euro area countries they have decreased, especially for smaller loans to NFCs.

Given that Romania is not yet part of the EMU, it is interesting to see whether and how the creation of the EMU impacted on the euro area financial markets integration. Two conflicting opinions can be identified. On one side, some studies support the idea that the EMU contributed to the integration in stock markets in the post-euro period (Gębka and Karoglou, 2013; Bley, 2009; Spiegel, 2009; Kim et al., 2005) as well as to the interest rate convergence on banking markets (Maudos, 2013). Moreover, some of these studies indicate that the positive effect upon integration in stock markets manifested even in the anticipation of the introduction of the single currency (Gębka and Karoglou, 2013; Bley, 2009). This opinion contrasts with that of Bekaert et al. (2013) who document the existence of a positive intrinsic EU membership effect on financial and economic integration, regardless of the

adoption of the euro currency by EU countries. These conflicting results not only stimulate the debates on the topic but also underpin the research question of the present paper by making plausible the hypothesis that a certain level of integration with the euro area might exist even for EU countries not taking yet part in the EMU but aiming to achieve it, as it is the case of Romania. However, this hypothesis was formally tested by Boubakri et al. (2012) who assessed the level of integration between 10 Central and Eastern European EU countries, including Romania, with the euro area and concluded that the integration process is not yet complete – finding consistent with Pungulescu (2013) who additionally found that the process is not yet complete even for the UE15 group – and depends on the institutional monetary arrangements of these countries. The authors also showed that the integration is strongest for countries that are already part of the Exchange Rate Mechanism II (ERM II).

While the literature on financial integration, including banking (credit) markets integration, is quite rich, the references to Romania, especially with regard to banking market, are much less frequent. With respect to integration in credit markets for the 12NMS, Pungulescu (2013) shows improvements in interest rate convergence compared to Germany for three instruments – money market, Treasury Bills and Government bonds. Among the 12NMS, Romania is found to be one of the countries that exhibit the highest speed of convergence in money market interest rates over the period analyzed. With reference to the interbank market integration and its impact on firms' borrowing conditions in 14 old and new EU countries, including Romania, Popov and Ongena (2011) found that Romania was the most non-integrated country prior to its EU accession (1998-2005), finding that authors explain by the changing fiscal and monetary policies leading to high and variable inflation. However, the present study employs data for the period following the Romania' accession to EU.

2.2 Measurement of banking market integration

Regarding the measurement of financial integration, several approaches are possible and have been used in the previous literature. Generally, the literature distinguishes between *de jure* and *de facto* measures of financial integration as well as between *price-based* and *quantity-based* measures (ECB, 2014; Friedrich et al., 2013; Bekaert et al., 2013; Lucey and Zhang, 2011). The use of price-based measures appears natural given that in integrated markets, according to the *law of one price*, identical assets – in terms of risk and maturity – should be identically priced, regardless of the markets they are traded on (Pungulescu, 2013; Yeyati et al., 2009; Bekaert and Harvey, 1995). The opposite of integrated markets is segmented i.e. fragmented markets (Harm, 2001; Bekaert and Harvey, 1995). Regarding the difference between *de jure* and *de facto* measures, Lucey and Zhang (2011) make the following distinction: the first type of measures relate to changes in regulations on cross-border capital flows while the second type reflects the extent to which a country effectively accesses the international capital markets.

For measuring credit (debt) market integration, a price-based measure is the most frequent approach – be it the interest rate or sovereign yields spreads (Bekaert et al., 2013; Pungulescu, 2013). However, some authors warn on the caveats associated with the approach based on interest rate differentials as they can be explained by differences in risk characteristics of the clients serviced by banks located in different markets (Spiegel, 2009) and that their declining trend may be driven by factors other than financial market integration (Pungulescu, 2013). As quantity-based measures of integration in credit markets,

Lucey and Zhang (2011) use the ratios to GDP of outstanding international debt securities and outstanding loans from non-resident banks, respectively. Similarly, Friedrich et al. (2013), considered measures such as: the ratio of the total foreign assets and liabilities over GDP; the ratio of change in net foreign assets over GDP; share of the number of foreign banks in all banks. As it can be seen, quantity–based measures are the results of the effective financial transactions that took place between the markets under analysis. In this paper, I employ several measures of integration that are related to both quantity- and price-based measures of financial integration. They will be described in the data section along with the corresponding data series used to calculate them.

Based on the above findings of the previous literature, the aim of this paper is to investigate, the existence and the level of integration between the Romanian and the euro area banking markets with focus on the assets side i.e. lending activity of the MFIs balance sheets.

3. Methodology

3.1. Data

This section will briefly describe the data series used to investigate the level of integration in banking markets between Romanian and euro area, taken as a whole. Data series come from the European Central Bank (ECB) and the National Bank of Romania (BNR) databases respectively. Data on cross-border loans between the MFIs located in the euro area and counterparties located in Romania and vice-versa comes from the ECB database. The specific data series collected for the 2007-2013 period are as follows: (a) loans by euro area MFIs to non-MFI sector located in Romania; (b) loans by MFIs located in Romania to the MFI and non-MFI sectors located in the euro area; (c) loans by MFIs located in Romania to the MFI and non-MFI sectors in EU countries not belonging to the euro area. By dividing these data series by the Romanian GDP (Eurostat), quantity-based measures of banking market integration are obtained.

The ECB and the BNR databases provided data on interest rates charged by MFIs on loans to NFCs located in the respective areas. Five monthly interest rates (2007:01-2014:11) were used corresponding to the following categories of loans: (a) new loans – total maturity and total amount (ITN_EA, ITN_RO); (b) new loans of up to and including EUR 1 million and with period of initial rate fixation (euro area) or floating rate / period of initial rate fixation (Romania) of up to 1 year (IS1_EA, IS1_RO); (c) new loans of over EUR 1 million and with period of initial rate fixation (euro area) or floating rate / period of initial rate fixation (Romania) of up to 1 year (IS2_EA, IS2_RO); (d) outstanding loans – total maturity and total amount (ITE_EA, ITE_RO); (e) outstanding loans with a maturity of over 5 years and total amount (IL_EA, IL_RO). The series for the euro area are corresponding to a changing composition of the EMU.

3.2. Method

To analyze the data, a descriptive analysis is combined with empirical tests of co-integration and causality. Co-integration was traditionally used as an empirical method for investigating financial integration (see Harm (2001)) and it was recently used, for instance, in Demian (2011) and Boubakri et al. (2012). Even Engle and Granger (1987) mentioned that cointegration analysis could be adequate for investigating the existence of common

trends in e.g. short-term and long-term interest rates or in the price of the same commodity in different markets. Testing for co-integration between the interest rates for Romania and euro area banking markets means testing for the existence of a long-run or equilibrium relationship between the two data series.

This paper employs the Johansen co-integration test implemented in EViews. An alternative earlier procedure is that of Engle and Granger (1987). The idea behind the co-integration tests is to test the nature of the static relationship i.e. the relationship in levels between two (or more) non-stationary time series integrated of the same order (usually 1). If the static relationship is integrated of a lower order (usually 0), then the series are called co-integrated i.e. and the static relationship becomes the cointegration relationship or the long-run equilibrium relationship; otherwise the static relationship is a spurious regression (for a more detailed presentation see Vogelvang (2005) p. 254, p. 266, p. 293).

The Engle-Granger (1987) procedure consists of testing the series for the presence of a unit root in order to establish their degree of integration and, if this is the case, the estimation of the static relationship between them. If the residual series of this equation is stationary then the initial series are called cointegrated (Bourbonnais, 2004 p. 283). The more complex Johansen's test was developed in Johansen (1988), is based on the maximum likelihood theory, and consists of estimating the space of the cointegration vectors in an unrestricted vector autoregressive process (VAR) with Gaussian i.i.d. errors and then test the number of its dimensions using a likelihood ratio test. The work was further extended in papers such as Johansen (1991).

If the series are cointegrated, then a (vector) error correction model (VECM) can be estimated based on the Granger representation theory (Bourbonnais, 2004 p. 283). The error correction model is a dynamic model which contains both the long-run relationship, given by the error correction term, and the short-run deviations from the equilibrium relationship embedded in the variables expressed in first differences (Vogelvang, 2005 p. 254). The coefficient of the error correction term is the adjustment speed towards the equilibrium relationship and is expected to be negative for the (vector) ECM specification to be correct; otherwise, the series depart from the long-run target (Vogelvang, 2005 p. 269; Bourbonnais, 2004 p. 284). The ECM approach was used to assess the level of integration in European interbank markets by Ongena and Popov (2011).

For the case of two (cointegrated) variables, the long-run and the short run (ECM) models can be written as in equations (1) and (2), respectively (Vogelvang, 2005 p. 298), where *s* and *p* denote the number of lags and γ is the coefficient of the error correction term.

$$y_t = \beta_1 + \beta_2 x_t + e_t \quad (1)$$

$$\Delta y_t = \beta_0 + \sum_{i=1}^{s-1} \gamma_i x_{t-i} + \sum_{j=1}^{p-1} \beta_j y_{t-j} + \gamma e_{t-1} + u_t \quad (2)$$

As an additional check of the results of the Johansen's test of cointegration, a Granger causality test was run. Given that the series are supposed to be non-stationary and potentially cointegrated, the Granger test cannot be run in the typical way. If this is the case, the procedure in Toda and Yamamoto (1995) is one of the recommended approaches. It consists of testing linear restrictions on parameters, such as the one implied by the Wald test for Granger non-causality, in an integrated (and cointegrated) VAR by re-estimating the VAR with an additional number of lags given by the maximum number of integration in the process. Subsequently, the coefficients of the additional lagged vectors are ignored and the

linear restrictions can then be tested only for the first coefficients based on the standard asymptotic theory.

4. Results and discussion

4.1. Cross-border loans and interest rates for loans to NFCs

Before presenting the results of the cointegration tests, the evolution of the quantity-based measures since 2007 will be presented.

The most obvious feature in the evolution of series in figure 1 is the enormous difference in magnitude between the levels of cross-border loans from the euro area to the Romanian non-MFI counterpart sector compared to that of cross-border loans from Romania to the euro area non-MFI sector. The general government and the private sector are included in the non-MFI sector. Specifically, the level of cross-border positions initiated by MFIs located in the euro area to GDP reached an average annual level of 8.73% during the period 2007-2013 compared with only 0.21% for the cross-border positions initiated in Romania. The maximum value (11.03%) in the sample (2009) is reached two years after Romania's accession to the EU and is reasonable to suspect that it was stimulated by this event. After that date, the share of cross-border loans from the euro area decreases again without reaching yet the level from the beginning of the period. This average level of 8.73% suggests that there is a certain level of integration between the Romanian and the euro area banking markets following the Romania's entrance to the EU.

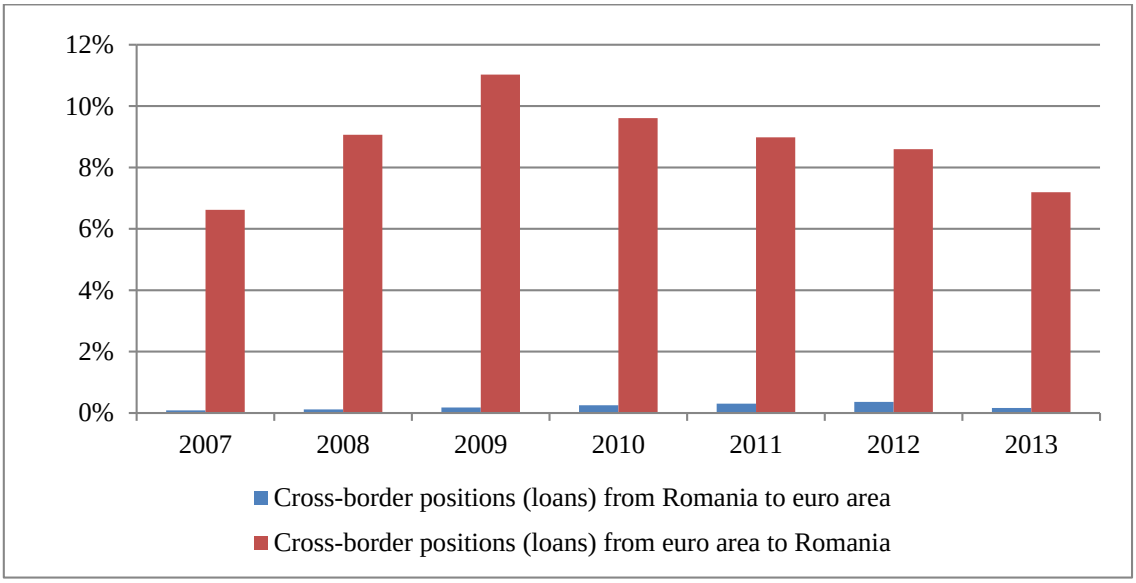

Figure 1. Proportion to GDP of cross-border loans to the non-MFI sector between Romania and the euro area

Source: Own elaboration based on ECB (2014) monthly / quarterly data for cross-border positions (outstanding amounts at the end of the period; the annual value was considered the value for December that year) and on Eurostat data for Romania's GDP (2014).

In order to strengthen the importance of the linkages between the Romanian and the euro area banking markets it is worth to compare the evolution of cross-border loans from Romania to euro area countries and EU non-euro area countries, respectively. This is illustrated in figure 2. It can be noticed that, unlike the positions initiated in the euro area, the cross-border loans initiated in Romania with the MFI sector as counterpart prevail over

those with the non-MFI counterpart, regardless that the euro area or the EU non-euro area is considered. At the euro area level, the share to GDP of loans granted by Romanian MFIs to the corresponding MFI sector is significantly higher than that for the non-MFI sector which can be explained by the high presence on the Romanian banking market of foreign banks headquartered in the euro area.

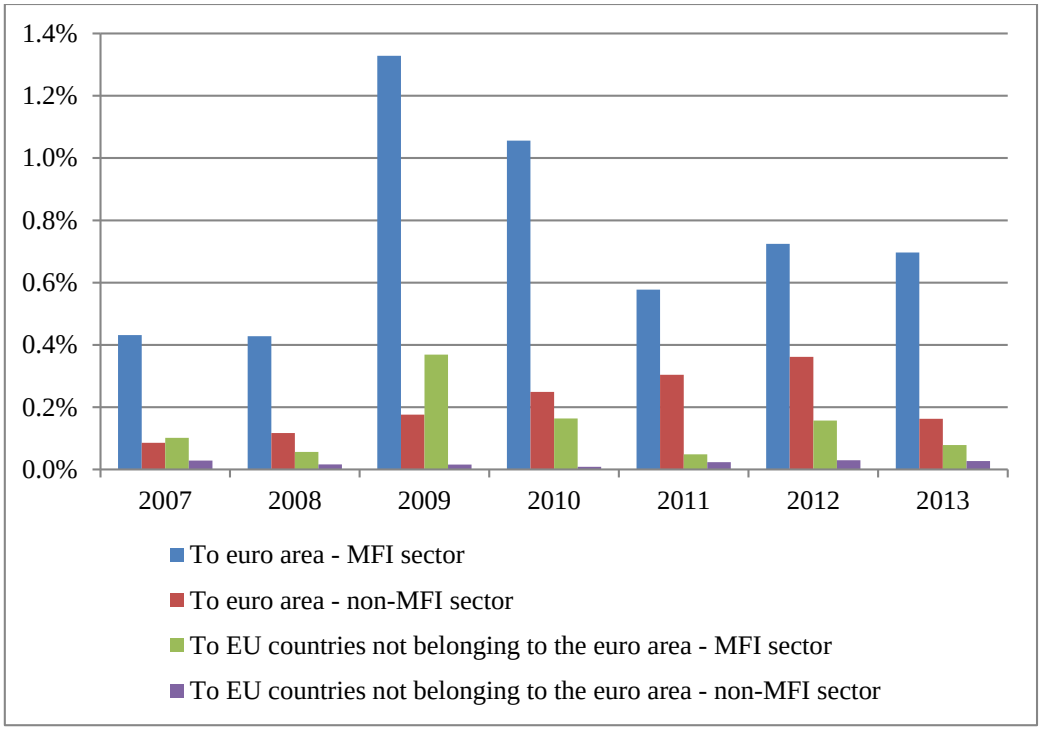

Figure 2. Proportion to GDP of cross-border loans by Romanian MFIs to the MFI and non-MFI sectors from the euro area and EU countries outside the euro area

Source: Own elaboration based on ECB (2014) monthly / quarterly data for cross-border positions (outstanding amounts at the end of the period; the annual value was considered the value for December that year) and on Eurostat (2014) data for Romania's GDP

As a preliminary step before proceeding to the cointegration tests, it is interesting to see if common trends can be grasped from the evolution of the interest rate pairs. Their evolution is presented in figure 3 (the total interest rate series were not presented for reasons of space but their evolution is similar of the others presented). It can be noticed a clear tendency of all the three interest rates to co-move for most of the period. This suggests that a co-integration relationship between the two interest rates for all the three pairs might exist. Next the results of the cointegration tests will be presented.

4.2. Results of the Johansen's test of cointegration in interest rates series

Johansen's test of cointegration can be applied on the necessary condition that the series are non-stationary. Thus the five pair series were tested for the existence of a unit root using the Augmented Dickey-Fuller (ADF) test. As a supplementary check, the Philips-Perron (PP) test was applied. The results are presented in table 1 only for the model with intercept with similar conclusions for the other models, as literature (Vogelvang, 2005 p. 289) considers that this is the specification frequently used for economic variables.

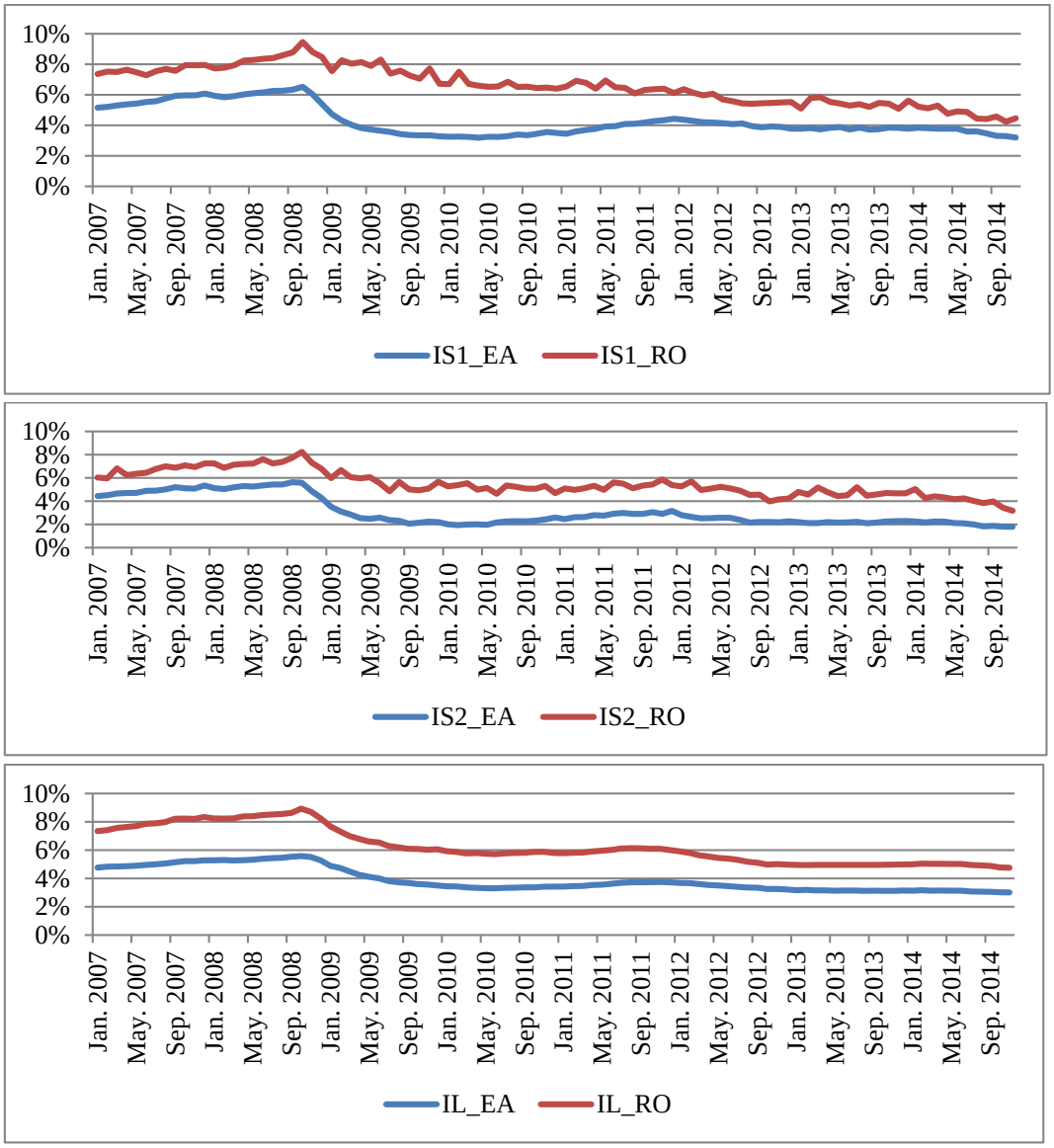

Figure 3. Evolution of MFIs interest rates on loans to NFCs in Romania and euro area between January 2007 and November 2014

Source: Own elaboration based on ECB (2015) and BNR (2015) data for three of the five interest pairs described in the Data subsection

Table 1. Results of the unit root tests

	Levels	First diff.	Levels	First diff.	Levels	First diff.	Levels	First diff.	Levels	First diff.
	ITN_RO		IS1_RO		IS2_RO		ITE_RO		IL_RO	
ADF	0.948	0.000	0.948	0.000	0.904	0.000	0.803	0.000	0.769	0.000
PP	0.927	0.000	0.899	0.000	0.856	0.000	0.835	0.000	0.844	0.000
	ITN_EA		IS1_EA		IS2_EA		ITE_EA		IL_EA	
ADF	0.602	0.000	0.551	0.000	0.656	0.000	0.447	0.024	0.479	0.005
PP	0.676	0.000	0.653	0.000	0.688	0.000	0.751	0.018	0.782	0.005

Source: Own elaboration. The table contains the p-values associated to the null hypothesis that the series are non-stationary

Results in table 1 clearly shows that all the ten series are non-stationary at level but that they become stationary by taking the first difference, according to both ADF and PP tests. Very similar conclusions are obtained based on the results of the KPSS test. Therefore, all the series are integrated of order 1 and the necessary condition is satisfied. To correctly apply the Johansen's test, an unrestricted VAR was previously run in order to determine the optimum number of lags to use in the cointegration test. This was considered to be the one suggested by the majority of the criteria provided that the errors were not autocorrelated in the VAR model; otherwise, the number of lags was increased until the autocorrelation could be rejected using the Breusch-Godfrey LM test of serial autocorrelation.

The results of the cointegration test are given in table 2 for both versions of the Johansen's test i.e. the trace test and the maximum eigenvalue test and for a summary of the models comprising models 2, 3 and 4 as these are considered of practical interest (Sjö, 2008).

Table 2. Results of the Johansen co-integration test – summary of the models 2, 3 and 4

No. of cointegrated relations by model (significant at 5% level)	Model 2	Model 3	Model 4
Group ITN_RO and ITN_EA (no. of lags = 3)			
Trace	0	0	0
Maximum-Eigenvalue	0	0	0
Group IS1_RO and IS1_EA (no. of lags = 4)			
Trace	0	0	1
Maximum-Eigenvalue	1	1	0
Group IS2_RO and IS2_EA (no. of lags = 7)			
Trace	0	0	0
Maximum-Eigenvalue	0	0	0
Group ITE_RO and ITE_EA (no. of lags = 12)			
Trace	0	0	1
Maximum-Eigenvalue	0	0	1
Group IL_RO and IL_EA (no. of lags =7)			
Trace	0	0	0
Maximum-Eigenvalue	0	0	0

Source: Own elaboration; model 2 – intercept (no trend) in the cointegrated equation, no intercept in VAR; model 3 - intercept (no trend) in the cointegrated equation and test VAR; model 4 - intercept and trend in the cointegrated equation, intercept in VAR

Results in table 2 show that there is one cointegrated relation in the case of only 2 group series i.e. short-term interest rates for loans of up to EUR 1 million (IS1_RO and IS1_EA) according to all the three models and the total interest rate for outstanding loans (ITE_RO and ITE_EA) according to the model 4. Consequently, the interest rates on loans granted to NFCs of up to 1 year period on initial rate fixation or floating interest rate and not exceeding EUR 1 million by MFIs from Romania and MFI located in the euro area,

respectively, are co-integrated, meaning that there is a long-term relation between them. The same seem to be true for interest rates on outstanding loans to NFCs as well. The results of the Johansen's test for the specific models for which has been proved that there are cointegrated relations, are given in table 3.

Table 3. Results of the Johansen co-integration test – models 2, 3 and 4

	Unrestricted Cointegration Rank Test (Trace)				Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
Hypothesized no. of CE(s)	Eigen.	Trace Statistic	0.05 Critical Value	Probab.	Eigen.	Max-Eigen statistic	0.05 Critical Value	Probab.**
Model 2: Group IS1_RO and IS1_EA (no. of lags = 4)								
None	0.170	19.335	20.261	0.067	0.170	16.797	15.892	0.036*
At most 1	0.028	2.538	9.165	0.670	0.028	2.538	9.165	0.67
Model 3: Group IS1_RO and IS1_EA (no. of lags = 4)								
None	0.157	15.351	15.495	0.052	0.157	15.328	14.264	0.034*
At most 1	0.000	0.022	3.841	0.881	0.000	0.022	3.841	0.881
Model 4: Group IS1_RO and IS1_EA (no. of lags = 4)								
None	0.161	27.785	25.872	0.029*	0.161	15.775	19.387	0.155
At most 1	0.125	12.001	12.518	0.061	0.125	12.001	12.518	0.061
Group ITE_RO and ITE_EA (no. of lags =12)								
None	0.212	29.130	25.872	0.019*	0.212	19.560	19.387	0.047*
At most 1	0.110	9.570	12.518	0.148	0.110	9.570	12.518	0.148

Source: Own elaboration. * denotes significance at 5%. ** MacKinnon-Haug-Michelis (1999) values

The analysis proceeds with the estimation of the vector error correction model for the series found to be cointegrated.

4.3. Estimation of the VECM and testing for Granger-causality for the cointegrated series

Estimation of the VECM was conducted using the same lag number found to be appropriate for the cointegration test. The VECM model for the interest rate series IS1_RO and IS1_EA is presented in eq. (3) which is according to the model specified in eq. (2).

$$D(IS1\_RO) = C(1)*(IS1\_RO(-1) - 4.951*S1\_EA(-1) + 0.144) + C(2)*D(IS1\_RO(-1)) + C(3)*D(IS1\_RO(-2)) + C(4)*D(IS1\_RO(-3)) + C(5)*D(IS1\_RO(-4)) + C(6)*D(IS1\_EA(-1)) + C(7)*D(IS1\_EA(-2)) + C(8)*D(IS1\_EA(-3)) + C(9)*D(IS1\_EA(-4)) + C(10) \quad (3)$$

In eq. (3), the expression assigned to C(1) is the cointegrating equation between IS1_RO and IS1_EA. The estimation of the eq. (3) by OLS led to the results presented in table 4.

Table 4. Estimation of VECM for the IS1_RO and IS1_EA series

	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)	C(8)	C(9)	C(10)
Coeff.	-0.031	-0.764	-0.558	-0.248	-0.132	0.904	0.335	-0.589	-0.103	-0.000
t-Statistic	-3.376	0.120	-3.863	-1.761	-1.172	3.130	1.056	-1.872	-0.346	-2.409
Probab.	0.001	0.000	0.000	0.082	0.245	0.002	0.294	0.065	0.731	0.0183

Source: own elaboration; Adjusted R-squared = 0.326; probability of F-statistic = 0.000; Durbin-Watson =2.008; the model is robust to: autocorrelation – Breusch-Godfrey serial correlation LM test statistic has a p-value of 0.745 for 12 lags; heteroscedasticity – Breusch-Pagan-Godfrey has a p-value of 0.164 and White test statistic, 0.845; normality: Jarque-Bera test statistic has a p-value of 0.121

The most important result of estimating the VECM relies in the statistics associated with the C(1) coefficient which is the coefficient of the error correction-term. It can be seen that it is statistically significant at 1%. Moreover, it is negative (- 0.031) which, according to the theory (Vogelvang, 2005 p.269; Bourbonnais, 2004 p. 284), mean that the error correction model representation is appropriate i.e. the series converge to the long-run relationship. However, the convergence is slow given that the value is close to zero. Thus, the static relationship between the cointegrated series is not a spurious regression but a long-term equilibrium relation. Its estimation, according to the eq. (1) led to the results given in expression (4) with the main statistics as follows: adjusted R-squared = 0.429, probability of F statistic = 0.000, DW = 0.130. As expected, it presents serial correlation which is corrected in the VECM.

$$IS1\_RO = 0.031 + 0.812*IS1\_EA \quad (4)$$

According to Popov and Ongena (2011), the value of the parameter for the independent variable in eq. (4) is indicative of the degree of integration i.e. if the value is positive and close to 1 it denotes that the two markets are integrated while for disintegrated markets the value is large and positive. In our case, the value is 0.812 which suggests the existence of a high level of integration between the two series.

In the last step of the analysis, the Granger non-causality hypothesis, based on a Wald test, is tested following the procedure recommended in Toda and Yamamoto (1995). The results of the VAR Granger causality test are given in table 5. The additional number of lags (besides the 4 lags previously used which gives the number of d.f.) introduced in the unrestricted VAR as exogenous variables is equal to 1 as the two variables are both integrated of order 1.

Table 5. Results of testing for VAR Granger causality

Excluded	Chi-square	d.f.	Probab.
Dependent variable is: IS1_RO			
IS1_EA	22.152	4	0.000
All	22.152	4	0.000
Dependent variable is: IS1_EA			
IS1_RO	7.029	4	0.134
All	7.029	4	0.134

Source: Own elaboration.

Based on the Granger's test of causality is can be concluded that there is a one-way causality relation running from IS1_EA to IS1_RO which means that the past values of interest rate IS1_EA in the euro area are influencing the current value of the interest rate IS1_RO in Romania. This result strengthens the results of the cointegration analysis. A reverse way causality would not seem plausible in this case as Romania is not part yet of the euro area and thus it cannot be expected to influence the level of interest rate in the EMU which is taken here as a whole.

The results of estimating the VECM for the ITE_RO and ITE_EA series are not presented given that the coefficient of the error correction model is not significant meaning that the error correction model representation is not valid, although the series were found to be cointegrated.

4.4. Robustness checks

The validity of the results obtained so far by considering the whole euro area as reference were checked against the case where a particular euro area market is considered as reference. This was firstly considered to be the German market since it is traditionally used as benchmark in empirical studies concerning financial integration (see Pungulescu (2013) and Ongena and Popov (2011) among others). In a second robustness check, the Austrian market was taken as reference and this is justified by the high presence on the Romanian domestic market of foreign-owned banks headquartered in Austria. The analysis was conducted in the manner previously described and, in order to save space, the results will be presented in short in this section.

Table 6. Main results in the robustness check

Reference market	No. of lags	Models in the Johansen cointegration test	Coefficient for the independent variable in the long-run relation (t-statistic)	Coefficient of the error correction term in VECM (t-statistic)	VAR Granger causality test Chi-square statistic	
					Dependent variable: IS1_RO	Dependent variable: IS1_DE / IS1_AT
Germany	6	Model 4	0.738 (12.180*)	-0.080 (-3.909*)	14.097**	3.298
Austria	4	Model 2, 3,4	0.734 (11.687*)	-0.051 (-3.888*)	10.562**	7.992***

Source: own elaboration; *, **, *** - significant at 1%, 5%, 10% respectively.

Regarding the number of cointegrating relations, it was higher for the Austrian market than for the German market. As in the main analysis, the series IS1_RO was found to be cointegrated with the corresponding series for Germany (model 4) and Austria (models 2, 3 and 4) which confirm the existence of a long-run relation between the MFIs interest rates for new loans to NFCs of up to and including EUR 1 million and with floating rate / period of initial rate fixation of up to 1 year. Additionally, in the case of Austria, two other cases of cointegration were found i.e. for interest rates on existing loans to NFC for total maturity (ITE_RO) and for maturity of over 5 years (IL_RO). However, the corresponding VECM estimated for these two last cases led to a non-significant coefficient for the error-correction term which means that the error correction specification is not appropriate.

For the interest rate series IS1_RO and the corresponding IS1_DE (for Germany) and IS1_AT (Austria), the main results were synthetized in table 6. It can be seen that the coefficient of error correction term in the corresponding VECM models is negative and statistically significant at 1% in both cases. Although still slow, the adjustment speed is higher yet than in the main analysis (0.03) and even higher in the case of Germany (0.08) compared to Austria (0.05). This result confirms not only that the linkages are stronger between the Romanian banking market and the individual markets of Germany and Austria compared to the euro area banking market as a whole, but also the role of the German market as a benchmark for the euro area. The results of the cointegration test are

strengthened again by those of the Granger causality test. In both cases, there is a significant influence (at 5%) exerted by interest rates in Germany (IS1_DE) and Austria (IS1_AT) on the interest rate in Romania (IS1_RO). In the latter case, a reverse causality can also be accepted for a 10% level of significance.

5. Conclusions

The research conducted in this paper aimed at investigating the existence and the level of integration between the Romanian and the euro area banking markets with focus on the lending activities of MFIs located in Romania and the euro area respectively. Using quantity as well as price-based data series, the results suggest that the two markets are integrated to a certain extent. The annual level of cross-border loans from MFIs located in the euro area to Romanian non-MFI sector to GDP was 8.73% between 2007 and 2013. It increased after Romania joined the EU but consistently decreased starting with 2010 suggesting potentially lower financial flows from abroad in the context of the financial and sovereign crises. Regarding the interest rates on loans to NFCs, the cointegration test conducted on five interest rate pair series for new as well as outstanding loans revealed that there is a consistent cointegrating relation between the interest rate series on new loans of up to EUR 1 million and floating rate or period of initial interest rate fixation of up to 1 year for the Romanian and the euro area banking markets respectively regardless which the benchmark for the euro area is considered to be – the overall euro area, Germany or Austria. The convergence towards the long-run relation is however slow in all three cases with the greatest value associated with Germany. These findings confirm that the Romanian and the euro area banking markets are cointegrated with regard to the lending activities to NFCs especially for short-term and smaller amount lending operations. Moreover, the results seem to be consistent with the results of Bekaert et al. (2013) who showed that there is an intrinsic EU membership positive effect on financial (stock) markets integration irrespective that the country has adopted the single currency or not. More and stronger cointegration relations are expected to be found after Romania will join the ERMII as Boubakri et al. (2012) have shown.

The findings of this study are relevant in the perspective that Romania might join the ERMII and eventually the EMU and have implications for the Romanian NFCs' access to and cost of bank financing. Further investigation is, however, necessary as longer data series will become available which is needed to improve the power of the empirical tests. The deposit side of MFIs balance sheets might represent a complementary avenue for further research.

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[1] **Acknowledgement**
This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/159/1.5/S/134197 „Performance and excellence in doctoral and postdoctoral research in Romanian economics science domain".

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