

Price- and News-based Measures of Financial Integration among New EU Member States and the Euro Area*

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Abstract

The paper focuses on integration of financial markets (money, foreign exchange, bond and stock markets) in five new European Union Member States (Czech Republic, Hungary, Poland, Slovakia and Slovenia) and selected old EU members (Germany, Austria, Portugal and Sweden) in comparison with the euro area. The main objective is to test for the existence of and determine the degree of financial integration among these economies relative to the euro area aggregate over the past decade. The analysis is performed by applying (i) the price-based measures of financial integration by means of the concepts of beta convergence (to identify the speed of integration) and sigma convergence (to measure the degree of integration) and (ii) news-based measures of financial integration to investigate the propagation of shocks. Overall, we find evidence of increasing financial market integration of the new EU members' markets with the ones in the euro area economies. At the same time we find differences between individual Central European countries which confirm that the group of new EU Member States is far from being homogeneous.

JEL Classification: C23, G15, G12

Keywords: financial integration, financial crisis, new EU Member States, beta convergence, sigma convergence, propagation of shocks

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1. Introduction

In a monetary union, integration of financial markets (e.g. money, foreign exchange, bond and equity markets) plays the key role in assuring the effective transmission of common monetary policy. The importance of conducting an assessment of the degree of financial integration across the euro area member countries is stressed by both central banks and academic institutions, see among others Trichet (2008, 2007, 2006, 2005), Papademos (2008a, 2008b), and Yam (2006). The more integrated financial markets are, the more effectively monetary policy is transmitted through the financial system, particularly within the monetary union. As financial markets expand, their fluctuations have stronger effects on real economic variables such as private consumption. Thus, along with a number of benefits, financial integration brings certain costs. It is widely believed that the benefits outweigh the costs, provided that mechanisms of controlling for financial stability are implemented.¹

Joining the euro area without a sufficient degree of financial market integration can cause problems in terms of transmission of the common monetary policy and common shocks. A high degree of financial market integration implies that Euro area-wide shocks dominate; hence, the common monetary policy can be effectively applied to react to common shocks. On the other hand, in the case of weak financial market integration, local (i.e. country-specific) shocks prevail, which diminishes the effectiveness of the common monetary policy. In the case of new EU Member States, which are committed to adopting the Euro at some point, it is especially important to analyze the alignment of their markets, including the financial ones, with those of the euro area countries.

In this paper, we focus on the financial integration of money, foreign exchange, bond and stock markets in five new EU Member States (the Czech Republic, Hungary, Poland, Slovakia and Slovenia) with the euro area.² Notice that while stock market stand relatively minor compared to the other three markets, as stock markets grow in size, they represent an increasingly important but not yet well-examined segment of the financial system. We test for the existence and determine the degree of financial integration of the selected new Member States relative to the euro area. The empirical analysis is conducted at the country level using national indices.

¹ Detailed discussion of the costs and benefits of financial integration is provided by Agénor (2003).

² Slovenia joined the euro area on 1 January 2007 followed by Slovakia on 1 January 2009. However, since our sample covers largely January 1995 to January 2009, we consider Slovenia and Slovakia together with non-euro area EU Member States.

How can the degree of financial market integration be measured in practice? Financial integration, which is a broad concept, can be quantified using three main dimensions, namely price-based, news-based and quantity-based measures. In this paper we focus on the first two classes of measures. Price-based measures could be viewed as a direct check of the law of one price on the condition that the compared assets have similar characteristics. They can be quantified through the use of time series techniques. Our evaluation consists of: (1) the application of the concept of beta-convergence to identify the speed of integration; and (2) the application of sigma-convergence to measure the level of integration. We perform our analysis on weekly returns, collected for the period from January 1995 to January 2009 for the foreign exchange and stock markets, 2001–2009 for the money market and 2002–2009 for the bond market.

We find evidence of financial integration between the Czech Republic, Hungary, Poland, Slovakia and Slovenia vis-à-vis the euro area. The results unambiguously point to the existence of beta-convergence. Moreover, the speed at which shocks dissipate is quite high, particularly less than half of a week. We do not observe a major impact of the EU enlargement or the announcement thereof on beta-convergence. In fact, the high speed of beta-convergence was achieved much earlier, during the 1990s. Regarding the effect of a recent financial turmoil, the results are less clear-cut. Next, the dynamics of the sigma-convergence suggest an overall convergence, yet there is a clear indication of an increase in volatility since the second half of 2007. Furthermore, transmission of shocks is substantial, with highest impact being observed on the stock markets. Overall, taking the results together, we find evidence of increasing integration of the new EU members' markets towards the levels of the mature euro area economies.

The news-based approach aims at determining whether the returns on assets across countries and segments of financial markets are influenced by local or worldwide news. This enables to identify existing market imperfections such as frictions and barriers, because in the integrated area new information of a local character should have a smaller impact on particular assets than global news. To the extent that the markets are not integrated, local news may continue to influence asset prices significantly. To operationalize the news-based approach, the price movements of benchmark assets are used as a proxy for global news. This approach was applied to foreign exchange, government bond and stock markets in the Czech Republic, Slovakia, Hungary, Poland and Sweden compared to the euro area. The results indicate considerable propagation of shocks across the considered financial markets. At the same time,

this propagation was changing relatively slowly during the analyzed period, with only limited evidence of increasing transmission in recent years.

The paper is organized as follows. Section 2 briefly discusses the alternative approaches to measure financial integration and provides the examples of empirical evidence for the four financial segments covered by our study. Section 3 and 4 gives methodological details on the chosen indicators of price- and news-based convergence. Data used in this study are discussed in Section 5. Section 6 presents the results and Section 7 concludes.

2. Financial integration: concept and evidence

2.1 Indicators of financial integration³

Baele et al. (2004) propose to quantify financial integration using three main dimensions, namely (i) price-based, (ii) news-based and (iii) quantity-based measures⁴. The first class of measures could be viewed as a direct check of the law of one price on the condition that the compared assets have similar characteristics. Price-based measures can then be quantified by means of, for example, beta and sigma convergence. The second class of measures makes it possible to identify existing market imperfections such as frictions and barriers, because in the integrated area new information of a local character should have a smaller impact on particular assets than global news. The third class of measures quantifies the effects of mainly legal and other non-price frictions and barriers from both the supply and demand sides of the investment decision-taking process.

(i) Price-based measures

The price-based approach constitutes a direct check of the law of one price, which in turn must hold if financial integration is complete. If assets have sufficiently similar characteristics, we can base these measures on direct price or yield comparisons.⁵ Otherwise we need to take into account differences in systematic (or nondiversifiable) risk factors and other important characteristics. Given these considerations, we can construct a number of specific integration measures. The cross-sectional dispersion (sigma-convergence) of interest

³ Chen and Knez (1995) and Baele *et al.* (2004) provide more details including in particular the weaknesses of each of the proposed measure.

⁴ The aim of these measures is to quantify the effects of frictions faced by the demand for and supply of investment opportunities. When they are available, we will use statistics giving information on the ease of market access, such as cross-border activities or listings. This paper will not cover such analysis.

⁵ Since asset pricing models are difficult to estimate and require long time series to provide reliable estimates, Adam *et al.* (2002) and Baele *et al.* (2004) consider the correlation of stock market returns as an alternative indicator.

rate spreads or asset return differentials can be used as an indicator of how far away the various market segments are from being fully integrated. Similarly, beta convergence, a measure borrowed from the growth literature, is an indicator of the speed at which markets are integrating. In addition, measuring the degree of cross-border price or yield variation relative to the variability within individual countries may be informative with respect to the degree of integration in different markets.

(ii) News-based measures

These measures are designed to distinguish information effects from other frictions or barriers. In a financially integrated area, portfolios should be well diversified, and the degree of systematic risk should be identical across assets in different countries. Hence, common or global news (i.e. the arrival of new economic information of a common or global nature) should dominate in impacting on prices. To the extent that the markets are not integrated, local news may continue to influence asset prices significantly.

In our study we explore indicators of financial integration belonging to the class of price-based and news-based measures. If the law of one price did not apply, there would be scope for arbitrage. If we assume a fully integrated market with no barriers (economic, legal, cultural, etc.), then any investor will be able to use this arbitration opportunity, causing the law of one price to apply again. Nevertheless, we also acknowledge the limitations associated with such an approach.

2.2 Evidence from the key segments of the financial system

(i) FX market

Aguilar and Hördal (1998) try to evaluate eligibility for the introduction of the euro by means of correlation analysis of national currencies against USD and alternative benchmarks. The application of a similar methodology can be found in the study by Castrén and Mazzotta (2005). Babetskaia-Kukharchuk, Babetskii and Podpiera (2008) use dynamic correlations to analyse convergence in exchange rate volatilities between the NMS and the euro area. Komarkova and Komarek (2007) evaluated the FX market integration of the selected new EU Member States (the Czech Republic, Hungary, Poland and Slovakia) by means of analysis of harmonizing (standard and rolling correlation analysis), the concept of beta-convergence (state-space model and panel regression analysis) and the concept of sigma-convergence.

(ii) Money market

Money market integration has been studied – with application to the euro area countries – by, for example, Baele *et al.* (2004) and Adam *et al.* (2002). Adam *et al.* (2002) investigate the speed and degree of financial integration using the concept of beta and sigma convergence on 3M interbank rates. The authors show that this segment of the money market became strongly integrated before the introduction of euro. Similarly, Baele *et al.* (2004) investigate financial integration on the unsecured, secured and interest rate swap segments of the market. A high degree of financial market integration is found among the euro area countries; the introduction of the euro played an important role in this process.

(iii) Bond market

The integration of the bond market has been analysed by Adam *et al.* (2002), Adjaouté and Danthine (2003), Codogno *et al.* (2003), Kim *et al.* (2004), Baele *et al.* (2004) and Barr and Priestley (2004). Barr and Priestley (2004) investigate the question of how strongly bond yields are determined by world versus local factors. The authors argue that the world bond market is not integrated, as world factors have only a 70% influence on the development of domestic returns. Codogno *et al.* (2003) find that movements in yields on the government bond market are explained by changes in international risk factors.

(iv) Stock market

A European perspective of financial market integration, oriented primarily towards the capital market, is included in European Commission (1999) and Hartmann, Maddaloni and Manganelli (2003). Ayuso and Blanco (1999) find that financial market integration between stock markets in the euro area increased during the 1990s. An analysis of sectoral and national effects on the European capital market is presented by Baca, Garbe and Weiss (2000) and Heston and Rouwenhorst (1995).

Bekaert, Harvey and Lumsdaine (2000) search for the steps of world equity market integration by identifying structural breaks in the size of international capital flows. Portes and Rey (2000) and Martin and Rey (2001) analyse the timing and geographical pattern of cross-border equity flows and the size of the asset market. Bekaert and Harvey (1995) attempt to remedy this problem by constructing a time-varying measure of financial market integration. Using data on equity returns, they find that a number of markets exhibit time-varying integration, thus allowing them to identify the reasons for rejecting the international CAPM, which instead assumes perfectly integrated markets.

Adam et al. (2002) show that the most appropriate indicators of stock market integration, based on stock returns, require the specification and estimation of sophisticated asset pricing models, which make them inadequate for prompt policy analysis and evaluation. Alternatively, this study proposes a simpler indicator based on the dynamics of the correlation of stock market returns in EU countries. While the correlations are easy to compute and update, they have no necessary relation to the degree of financial integration, since they may also reflect changes in the correlation structure of real and policy shocks in the individual countries. This implies that correlations measure the degree of financial integration only if the stochastic process of common shocks is constant over time. This is an issue of serious concern, given that Europe is undergoing a process of real economic integration.

3. Price-based measures of financial integration

3.1 Beta-convergence

Following Adam et al. (2002), we apply the concepts of beta-convergence and sigma-convergence to assess the state of financial market integration in the selected EU countries.⁶ The concept of beta-convergence enables identification of the speed at which shocks are eliminated on the individual financial markets. A negative beta coefficient signals the existence of convergence, and the magnitude of the beta coefficient expresses the speed of convergence, i.e. the speed of elimination of shocks to the yield differential vis-à-vis the euro area. The higher the absolute value of the beta coefficient, the higher the speed of convergence.

For quantification of beta-convergence, it is useful to apply common regression analysis or the panel estimate method, in the form of the equation:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t-1} + \sum_{l=1}^L \gamma_l \Delta R_{i,t-l} + \varepsilon_{i,t}, \quad (1)$$

where $R_{i,t} = Y_{i,t} - Y_{i,t}^B$ is the difference between the asset yields of country i and a selected reference territory (a benchmark, the euro area stock index) at time t , Δ is the difference operator, α_i is a dummy variable for the respective country, L is the maximum lag length and $\varepsilon_{i,t}$ is a white noise disturbance. The size of coefficient β may be interpreted as a direct measure of the convergence speed. A negative beta coefficient indicates occurrence of

⁶ The terms beta-convergence and sigma-convergence originate from the literature on economic growth and its dynamics; see, for example, Barro and Sala-i-Martin (1992).

convergence, and the absolute value of the beta coefficient indicates the convergence speed. The β coefficient can take values ranging from 0 to -2. The closer the absolute value of the β coefficient to 1, the higher the speed of convergence, and if $\beta = 0$ or $\beta = -2$, no convergence is observed. β values from 0 to -1 indicate monotonous convergence, while fluctuating convergence occurs for values from -1 and -2.

3.2 Sigma-convergence

The concept of sigma-convergence captures the differences between the yields on identical assets in different countries at a given time, identifying the degree of integration vis-à-vis the euro area achieved in the individual financial market segments in the countries under review at that time. Sigma-convergence arises if and when the sigma coefficient falls to zero. Beta-convergence may be accompanied by sigma-divergence, so both concepts must be tracked concurrently in order to observe financial integration. For quantification of sigma-convergence, a calculation is used of the (cross-section) standard deviation (σ), according to the formula:

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

where y is the asset yield, \bar{y} is the mean value of the yield over the sample period and i stands for separate countries ($i = 1, 2, \dots, N$). For the purposes of this analysis, we introduce $N = 2$, i.e. we examine the evolution of sigma-convergence over time between the euro area and one of the countries under review. σ takes only positive values in theory. The lower is σ , the higher is the level of convergence. In theory, full integration is reached when the standard deviation is zero, while high (several digits) values of σ reflect a very low degree of integration.

4. News-based measures of financial integration

An important sign of financial market integration is that asset prices respond to common (global) news to such assets rather than to local news, i.e. news typical of a specific country. If markets are financially integrated, yields on financial assets of different countries, but having the same risk characteristics, should depend on global rather than local news. The news-based approach thus aims at determining whether the returns on assets across countries and segments of financial markets are influenced by local or worldwide news. In practice, however, it is difficult to measure news. To operationalize the news-based approach, Baele et

al. (2004) argue that the price movements of benchmark assets are a good reflection of all relevant common news. The news-based approach is relevant to studies on foreign exchange, government bond and stock markets. Following Baele et al. (2004), the degree of integration of shocks can be estimated using the following regression:

$$\Delta r_{i,t} = \alpha_{i,t} + \gamma_{i,t} \Delta r_{b,t} + \varepsilon_{i,t} \quad (3)$$

where r_{it} represents the return on specific assets (currencies, bonds, interbank rates and stock exchange indexes) in country i at time t , and b denotes the benchmark country (Germany for the government bond market, otherwise the euro area). α_i is the country specific constant (converging to zero), Δ is the time difference operator and ε is the white-noise disturbance (country specific shock). The parameter γ is a measure of convergence. We do not use any lags, since news spreads much quicker (within minutes) compared to the frequency of our data (daily or weekly). The time-varying parameter γ can be estimated by the Kalman filter in a similar way as parameter β in equation (3).

The magnitude of parameters γ expresses the degree of identical response of an asset of a selected country and a comparable benchmark asset to certain news. Simply stated, parameter γ shows to what extent an asset of a selected region responds to news in the same way as the benchmark asset, assuming that the benchmark asset responds to global news only. The higher the value of the parameter, the higher the integration of the assets under comparison. As in reality credit, liquidity and foreign exchange risks are not identical across individual countries and assets, the change in the yield on a local asset is not expected to be explained fully and solely by the impact of global (common) news.

Notice that the above-described measures of market integration are based on the idea that markets are efficient, which is not true in reality – see Shleifer (2000). Inefficiencies could be present even in clearly integrated markets. Although a comprehensive analysis of market inefficiencies is beyond the scope of this paper, we intend to address the issue of inefficiencies by looking at the country- and sector-specific risk premia. This can be done in two ways. First, we can compare country risk assessments performed by different agencies with our results (beta and sigma coefficients). The objective of such a comparison is to check whether countries with higher risk have different betas and sigmas compared to lower-risk countries. Second, we can examine whether the risk premia are due to primarily country- or sector-specific factors. In other words, we can check whether the risk premia are related to a particular sector across all the countries considered, or whether the risk premia are rather

country-specific. This can be done by analysing cross-sectoral dispersion in both sector and country index returns. Finally, in order to better understand and interpret the empirical results, we will discuss the institutional developments in the countries of our sample.⁷

5. Data

The calculations were made using weekly data (averages of daily data) from Thomson Datastream, covering January 1995 to January 2009 for the foreign exchange and stock markets, 2001–2009 for the money market and 2002–2009 for the bond market – see Table 1. Three-month interbank rates were used for the money market, national currencies quoted against the US dollar for the foreign exchange market, five-year government bonds for the bond market and national stock indices for the stock market. Table 1 summarizes data coverage.

⁷ There are alternative measures of stock market integration based on GARCH (linear and non-linear) type analysis – see Hardouvelis, Malliaropulos and Priestley (2006), Capiello et al. (2006) and Bekaert et al. (1997). The degree of stock market integration could also be assessed upon the co-dependence between two random variables (called the co-movement box) – see Capiello, Gérard and Manganelli (2005) or by using the Dynamic Conditional Correlation (DCC) method originally proposed by Engle (2002) and subsequently extended by Capiello, Engle and Sheppard (2003). Another alternative methodology for testing financial market integration based on the intertemporal asset-price model with time-varying discount factors is proposed by Flood and Rose (2005).

Table 1: Data coverage

| | Money market | Foreign exchange market | Bond market | Stock market |
|-------|----------------------|-------------------------|---------------------------|-------------------------|
| | 1999-2009 | 1995-2009 | 2002-2009 | 1995-2009 |
| CZ | PRIBK3M | PRUSDSP | BMCZ05Y-(RY) | CZPXIDX |
| AT | n.a. | n.a. | BMOE05Y-(RY) | ATXINDEX |
| DE | n.a. | n.a. | BMBD05Y-(RY) ^B | DAXINDEX |
| PT | n.a. | n.a. | BMPT05Y-(RY) | POPSI20 |
| HU | HNIBK3M | HNUSDNB | BMHN05Y-(RY) | BUXINDEX |
| PL | POIBK3M | POUSDSP | BMPO05Y-(RY) | POLWIGI |
| SI | SJIBK3M | SJUSDSP | n.a. | SLOESBI |
| SK | SXIBK3M | SXUSDSP | SXGOVT1-(RY) ^b | SXSAS16 |
| EU-13 | BBEUR3M ^B | USECBSP ^B | n.a. | DJES50I ^{B, a} |

Notes: ^B – benchmark, n.a. – data not available, ^a DJES50I is made up of the following weights of the national stock indices of the selected euro area countries: 34.9% France, 23.3% Germany, 13.5% Spain, 12% the Netherlands, 11.8% Italy, 3.5% Finland and 0.9% Ireland); ^b – data from 2002 onwards.

Source: Thomson Datastream.

6. Results

6.1 Price-based measures of financial integration

January 1995 – July 2007

The results of the beta-convergence analysis, as applied to the individual segments of the financial market, are given in Table 2. The results show that yields on the Czech and Hungarian stock and bond markets converged towards those on corresponding euro area financial instruments relatively quickly in this period, at a faster pace than in Portugal and Austria. Hungary, Slovakia and Slovenia have a comparable degree of stock market convergence as the selected euro area countries such as Austria and Portugal. On the foreign exchange market, the speed of convergence of all five new EU Member States is broadly comparable. On the money market the speed of convergence is somewhat lower in the Czech Republic and Slovakia.⁸ Yield convergence towards the euro area (towards Germany in the case of bond markets) occurred in all the countries under review. In this period, the absolute values of the beta coefficient were close to one for all the countries and markets except the money market, which means that the leveling of newly arising differences in yield differentials between the relevant national economy and the euro area can be labeled as fast.

⁸ Yields on money market assets are affected to some extent by the monetary policy decisions of the state in question, so the validity of the law of one price is somewhat limited. Therefore, the speed of beta convergence is lower on the money market than on the other markets.

A comparison of the periods 1995–2002 and 2003–2007 reveals that the pace of beta-convergence of the stock markets of the new EU Member States under review (except Slovakia) increased over time. The speed of convergence of the money market increased in the Czech Republic and Hungary; the pace of convergence of the foreign exchange market was faster particularly in the countries heading towards the euro area – Slovakia and Slovenia. Nonetheless, the new EU Member States are generally achieving high levels of beta-convergence of their financial markets towards the euro area.

Table 2: Beta coefficients

| | Money market | | | Foreign exchange market | | | Bond market | | Stock market | | |
|--------------|--------------|-------------|---------------|-------------------------|-------------|---------------|-------------|---------------|--------------|-------------|---------------|
| | 1999-2002 | 2003-7/2007 | 8/2007-1/2009 | 1995-2002 | 2003-7/2007 | 8/2007-1/2009 | 2001-7/2007 | 8/2007-1/2009 | 1995-2002 | 2003-7/2007 | 8/2007-1/2009 |
| CZ | -0.57 | -0.65 | -0.36 | -0.94 | -1.11 | -0.85 | -0.73 | -1.15 | -0.76 | -0.94 | -0.87 |
| AT | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | -1.12 | -0.74 | -0.90 | -0.88 | -0.47 |
| DE | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | B | B | -0.79 | -0.79 | -1.30 |
| PT | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | -0.81 | -0.56 | -0.89 | -1.04 | -1.12 |
| HU | -0.42 | -0.84 | -0.99 | -0.89 | -0.95 | -0.82 | -0.87 | -0.67 | -0.80 | -0.85 | -1.23 |
| PL | -0.77 | -0.52 | -0.62 | -0.91 | -0.78 | -0.34 | -0.82 | -0.79 | -0.80 | -0.91 | -0.75 |
| SI | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | -0.77 | -0.83 | -0.88 |
| SK | -0.77 | -0.55 | -0.56 | -1.09 | -0.98 | -0.61 | -0.77 | -0.90 | -0.74 | -0.69 | -1.14 |
| EU-13 | B | B | B | B | B | B | n.a. | n.a. | B | B | B |

Notes: B – benchmark, n.a. – data not available. All estimations were significant at the 1% level.

Source: Authors' calculation based on Thomson Datastream data.

The results of the sigma-convergence analysis for the individual segments of the financial market and the countries under review vis-à-vis the euro area (Germany⁹ for the bond markets) are shown in Figure 1. The results of sigma-convergence across the individual markets of the new EU Member States show that the highest degree of integration was achieved on the money and foreign exchange markets. The Czech financial market seemed to be the most integrated (especially in the case of the foreign exchange and stock markets) compared to the markets in the other new Member States. Only the Slovenian money and foreign exchange markets achieved a higher degree of integration; this is linked with its completed euro adoption process.¹⁰ However, significant differences in the yields on the Slovenian stock market persisted. The foreign exchange markets may have seemed more

⁹ As in section 1.1.2, for example, any interpretation of the values for Germany should also take into account the fact that the data for Germany have a significant weight in the calculation of the data for the euro area (see the *Methodological Part* for details).

¹⁰ The developments in Slovakia also reflect the adoption of the single currency from January 2009.

volatile until August 2007, but the sigma values were very low there, reflecting the already relatively strong integration of these markets. As regards stock markets, the degree of integration achieved in the Czech Republic was comparable to that observed in Portugal, Austria and Germany. The same could not yet be said in the case of the bond markets. Overall, it can be seen that gradual trend sigma-convergence of stock, bond and money markets was taking place in all the observed countries since 2001–2002.¹¹

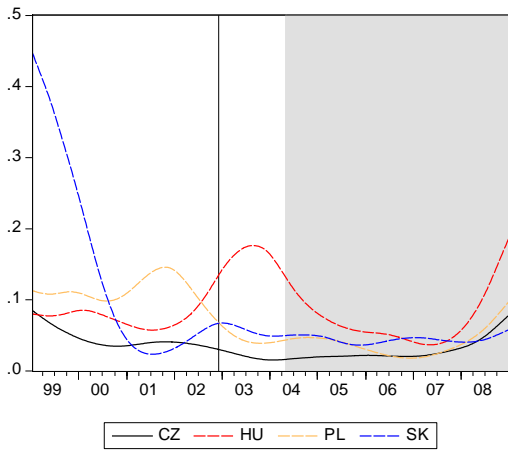
August 2007 – January 2009

The relevant columns of Table 2 (08/2007–01/2009) and the relevant part of Figure 1 describe the developments on the individual markets in the period affected by the financial crisis. The calculations show that most countries recorded a slowdown in convergence of yields towards those in the euro area. Since 2007, integration of money and foreign exchange markets has accelerated only in Slovakia; this is connected with its preparations for euro adoption. From the point of view of the degree of integration of the individual markets with the euro area, it is clear that the present financial crisis has contributed with mixed intensity to divergent developments in the given period on all markets except the money market. However, with the exception of the foreign exchange market, where the indicator for the Czech Republic was affected by strong koruna appreciation in the period under review, the impact of the current crisis on the Czech economy was rather lower compared to the other economies of the Central European region, Hungary in particular. This can be put into context with the ownership structure of banks and other financial institutions in the Czech Republic, the solid economic performance of the Czech economy, and the confidence in the Czech currency.

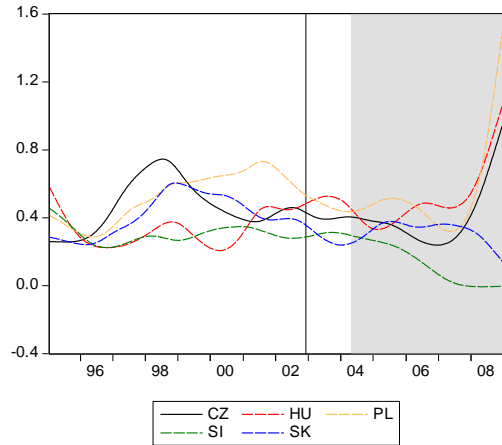
¹¹ This may have been due to the announcement that these countries would join the European Union (12–13 December 2002). This period is illustrated by a vertical line in Figure 1.

Figure 1: Sigma coefficients

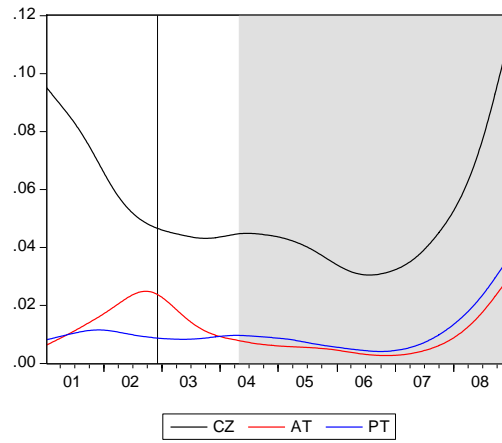
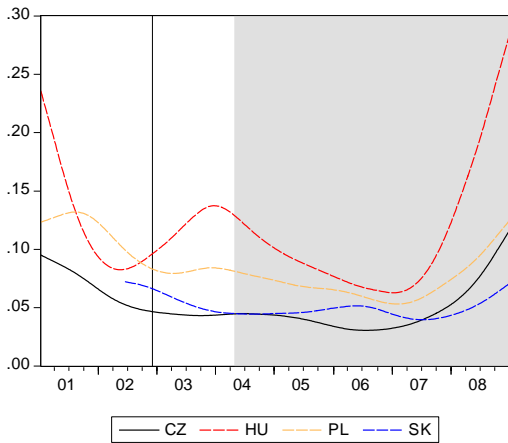
a) money market



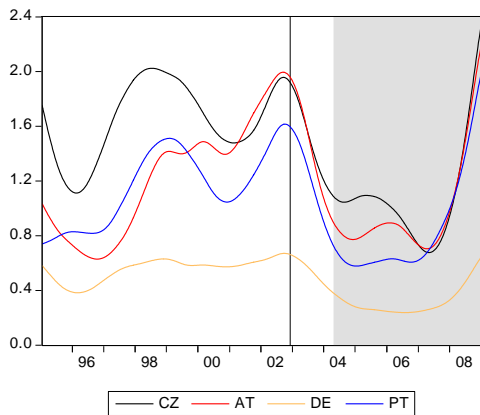
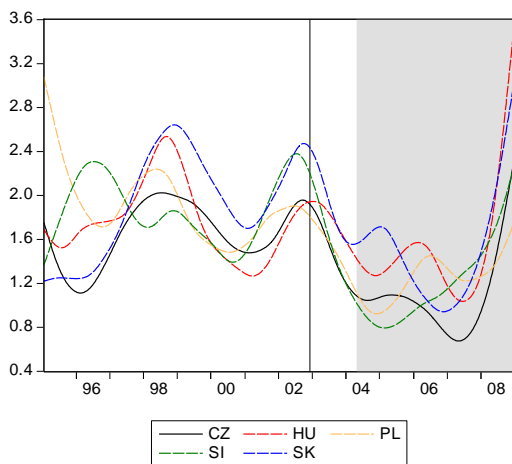
b) foreign exchange market



c) bond market



d) stock market



Note: Lower standard deviation values (vertical axis) correspond to a higher convergence level. The grey area represents EU enlargement on 1 May 2004 and the vertical line represents the announcement thereof on 12–13 December 2002.

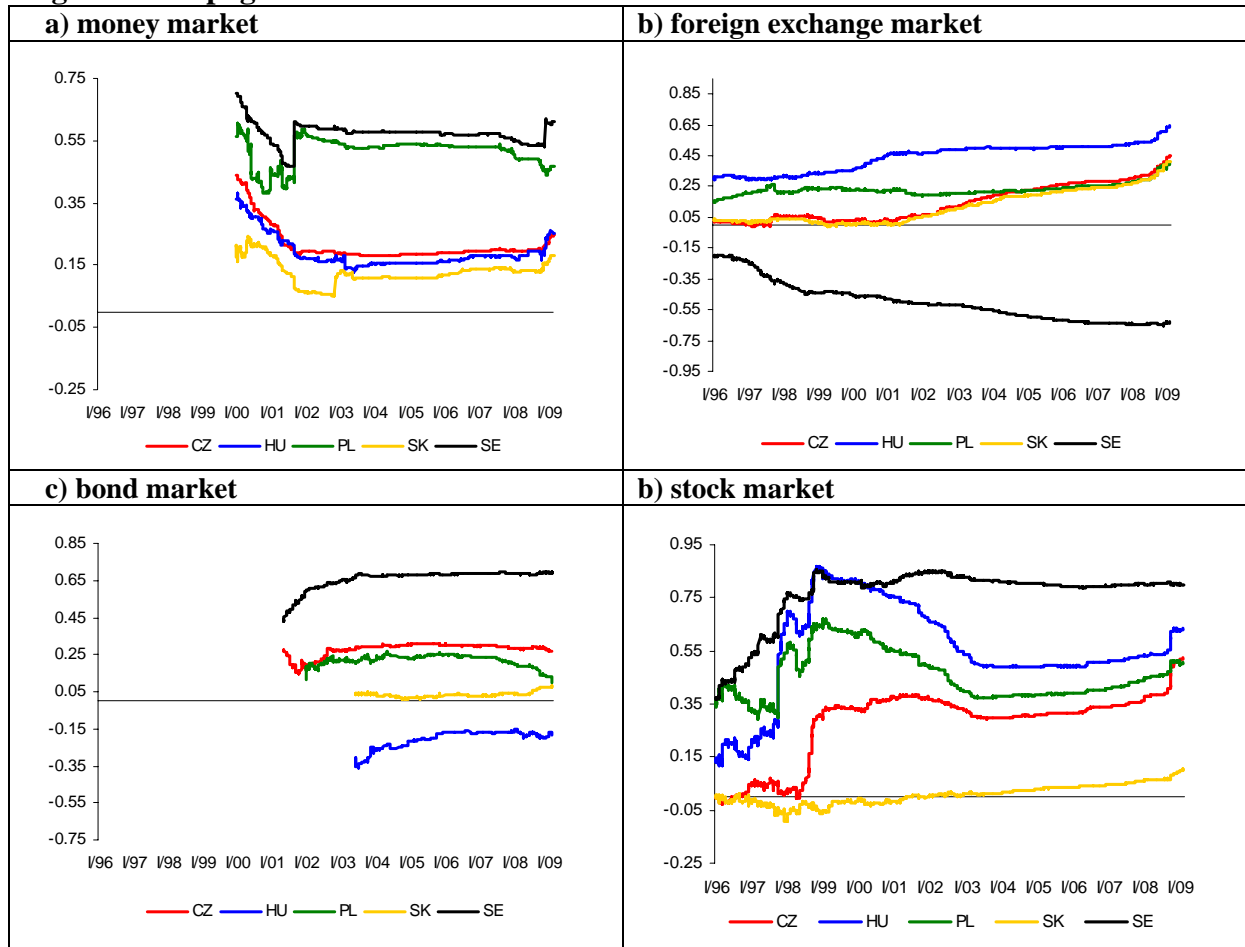
Source: Authors' calculation based on Thomson Datastream data.

6.2 News-based measures of financial integration

In the application of news-based measures, we focus on four Central European economies (Czech Republic, Hungary, Poland, Slovakia) plus Sweden, compared to the euro area, or Germany in the case of the government bond market. The results for the Central European countries indicate that (i) parameter γ turns out to be slowly changing over time, thus documenting a relative constancy of shock propagation across individual markets and countries; (ii) the transmission of shocks across markets and countries is characterized by a dominantly symmetric (positive) response (except for the Hungarian government bond and Swedish foreign exchange markets); (iii) on average, the strongest transmission of shocks occurs on the stock markets, the lowest propagation is on the government bond markets (γ being close to zero); (iv) sensitivity to the transmission of news or shocks across individual countries varies, which is due to country-specific risk premia or monetary policy regimes, thus questioning the statement of similar behavior of financial markets in the countries of Central Europe; (v) on average, the lowest sensitivity to shocks is observed for Slovakia (however notice that Slovakia is characterized by the shallowest markets), followed by the Czech Republic and then Poland and Hungary closing the ranking. Overall the results show that the “integration coefficients” for individual markets are significant, with the stock market being characterized by the highest sensitivity to the transmission of news (i.e. being most integrated, in our terms). The differences in credit, liquidity and monetary risks, as well as chosen monetary policy, of the sample countries, which in addition increases from the beginning of crisis, thus play an important role in the process of financial integration. Especially, the degree of integration on the money market may reflect the alignment of the selected states’ monetary policies with that of the euro area. Thus, idiosyncratic local news (a change in the monetary policy rate of the relevant state) may prevail far more on the money market than on the stock market.

By comparing the results of financial integration for Central European countries and Sweden it follows that the Swedish economy is much strongly integrated with the euro area, which is in accordance with economic intuition. The inverse behaviour of γ in the case of the Swedish foreign exchange market reflects a negative relationship between the response of the krona and the euro with respect to the dollar. It may be said that the Swedish krona and the euro behave in these pairs as substitute assets. Global news thus has opposite effects on them.

Figure 2: Propagation of shocks



Note: CZ – Czech Republic, HU – Hungary, PL – Poland, SK – Slovakia, SE – Sweden.

Source: Authors' calculation based on Thomson Datastream data.

7. Conclusion

In this paper we put to an empirical examination the price- and new-based measures of financial integration. For the price-based measures, we analyzed the speed (by means of beta-convergence) and level (by means of sigma-convergence) of the financial integration in the five new EU Member States (Czech Republic, Hungary, Poland, Slovakia and Slovenia) and three old EU members (Germany, Austria, and Portugal) in comparison with the euro area as a whole. The results showed both strong beta-convergence and sigma convergence in all markets up to the beginning of the financial crisis in August 2007. All markets exhibited a substantial degree of integration. The situation changed during the current financial turmoil. The calculations showed that most of the markets in all countries had recorded a lower convergence level towards the euro area. One exception was the convergence of the foreign exchange market in Slovakia and Slovenia with the euro area, due to the euro adoption process in these two countries.

Regarding the new-based approach, the results demonstrated considerable propagation of shocks across the four considered financial markets. Financial integration, measured by the strength of shock/news transmission, was highest for the stock market, followed by the foreign exchange, money and bond markets. Nevertheless, the propagation of shocks was changing rather slowly, with only limited evidence of increasing transmission in recent years.

Taking all measures altogether, we found evidence of relatively strong and gradually increasing financial market integration of the new EU members' markets towards the levels of the euro area economies. However, the results clearly indicated differences between individual Central European countries evidenced, for example, by the insensitivity of shallow Slovak stock markets, asymmetric reaction of Hungarian bond market, differences in the magnitude of beta, sigma and shock convergence. The group of Central European new EU Member States was thus far from being homogeneous.

References

- ADAM, K. – JAPPELLI, T. – MENICHINI, A. – PADULA, M. – PAGANO, M. (2002): *Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union*. European Commission, pp. 1-95.
- AGÉNOR, P. R. (2003): Benefits and Costs of International Financial Integration: Theory and Facts. *World Economy*, vol. 26, no. 8, pp. 1089-1118.
- AGUILAR, J. – HÖRDAHL, P. (1998): Exchange Rates and Currency Options as EMU Indicators. *Sveriges Riksbank Quarterly Review*, 2, pp. 58–81.
- AYUSO, J. – BLANCO, R. (2000): Has Financial Market Integration Increased during the Nineties? *Journal of International Financial Markets, Institutions and Money*, vol. 11, no. 3, pp. 265-287.
- BACA, S. P. – GARBE, B. – WEISS, R. A. (2000): The Rise of Sector Effects in Major Equity Markets. *Financial Analysts Journal*, September/October, pp. 35-40.
- BABETSKAIA-KUKHARCHUK, O. – BABETSKII, I. – PODPIERA, J. (2008): Convergence in Exchange Rates: Market's View on CE-4 Joining EMU. *Applied Economic Letters*, 15(5), pp. 385–390.
- BAELE, L. – FERRANDO, A. – HÖRDAHL, P. – KRYLOVA, E. – MONNET, C. (2004): Measuring Financial Integration in the Euro Area. *Occasional paper Series*, no. 14, European Central Bank, pp. 1-93.
- BARR, D. G. – PRIESTLEY, R. (2004): Expected Return, Risk and the Integration of International Bond Markets. *Journal of International Money and Finance*, 23(1), pp.71–97.
- BARRO, R. J. – SALA-I-MARTIN, X. (1992): Convergence. *Journal of Political Economy*, vol. 100, pp. 223-251.
- BEKAERT, G. – CAMPBELL R. H. – LUMSDAINE, R. L. (2000): Dating the Integration of World Equity Markets. *Journal of Financial Economics*, vol. 65, no. 2, pp. 203-247.
- BEKAERT, G. – HARVEY, C. R. (1995): Time-Varying World Market Integration. *Journal of Finance*, vol. 50, pp. 403-444.
- CASTRÉN, O. – MAZZOTTA S. (2005): Foreign Exchange Rate Option and Returns Based Correlation Forecasts Evaluation and Two Applications, *ECB Working Paper*, No. 447.

- CHEN, Z. – KNEZ, P. J. (1995): Measurement of Market Integration and Arbitrage. *The Review of Financial Studies*, Vol. 8, No. 2, pp. 287-325.
- CODOGNO, L. – FAVERO, C. – MISSALE, A. (2003): Government bond spreads, *Economic Policy*, October, pp. 503–532.
- EUROPEAN COMMISSION (1997): The Impact of the Introduction of the Euro on Capital Markets. European Commission, Brussels, *Euro Papers*, no. 3 (July).
- EUROPEAN COMMISSION (1999): Financial Services: *Implementing the Framework for Financial Services: Action plan*. COM (1999)232, Brussels, 11 May.
- HARDOUVELIS, G. – MALLIAROPULOS, D. – PRIESTLEY, R. (2006): EMU and European Stock Market Integration. *Journal of Business*, vol. 79, no. 1, pp. 365-392.
- HARTMANN, P. – MADDALONI, A. – MANGANELLI, S. (2003): The Euro Area Financial System: Structure, Integration and Policy Initiatives. *Oxford Review of Economic Policy*, Spring 2003, vol. 19, no. 1, pp. 180-213.
- HESTON, S. L. – ROUWENHORST, K. G. (1995): Industry and Country Effects in International Stock Returns. *The Journal of Portfolio Management*, Spring, pp. 53-58.
- KIM, S. J. – LUCEY, B. M. – WU, E. (2004): Dynamics of Bond Market Integration Between Existing and Accession EU Countries. *Institute for International Integration Studies Discussion Paper*, No. 25/ June.
- KOMÁRKOVÁ, Z. – KOMÁREK, L. (2007): Integration of the Foreign Exchange Markets of the Selected EU New Member States. *Politická ekonomie*, No. 3, 2007.
- MARTIN, P. – REY, H. (2004): Financial Super-Markets: Size Matters for Asset Trade. *Journal of International Economics*, vol. 64, no. 2, pp. 335-361.
- PAPADEMOS, L. (2008a): *Financial integration, financial innovation and development*. Speech at the Second Symposium of the ECB-CFS Research Network on “Capital Markets and Financial Integration in Europe”, Frankfurt am Main, 13 February 2008.
- PAPADEMOS, L. (2008b): *Financial integration in Europe*. Presentation by Mr Lucas Papademos at the press briefing on the occasion of the publication of the second edition of the ECB Report on financial integration in Europe, Frankfurt am Main, 29 April 2008.
- PORTES, R. – REY, H. (2005): The Determinants of Cross-Border Equity Flows. *Journal of International Economics*, vol. 65, no. 2, pp. 269-296.
- TRICHET, J.-C. (2005): *European financial integration and the management of inflation expectations by the European Central Bank*. Remarks at the conference “The euro: one currency, one financial market” organised by the European Commission, New York, 19 April 2005.
- TRICHET, J.-C. (2006): *Two successes of the euro – the single monetary policy and European financial integration*. Speech at the Conference on experience with and preparations for the euro, Linz, 11 May 2006.
- TRICHET, J.-C. (2007): *Major issues related to the process of European financial integration – the regional and global perspective*. Keynote luncheon remarks at the conference “Transatlantic Roundtable on Finance and Monetary Affairs”, at the invitation of the European Institute, Washington, DC, 13 April 2007.
- TRICHET, J.-C. (2008): *Financial integration in Europe and important financial sector issues*. Keynote speech at the Second Symposium of the ECB-CFS research network on “Capital Markets and Financial Integration in Europe”, Frankfurt am Main, 13 February 2008.
- YAM, J. (2006): *Financial integration and regulation*. Remarks at the conference: The Euro: Lessons for European and Asian Financial Markets, Hong Kong, 24 February 2006.