

Financial Integration at Times of Financial Instability

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Outline of the presentation

1. What we attempt to do
2. Why central banks care about financial integration
3. Measuring financial integration
4. Data sources
5. Empirical results
6. Conclusions

1. Financial Integration and the law of one price

- Financial market integration should take place when financial assets having similar risk factors and yields are priced identically by the markets no matter where they are traded. This follows from the law of one price.
- *In a fully integrated market the same asset traded in different locations should have the same price everywhere.*
("law of one price")

Background paper:

Babecký, J. – Komárek, L. – Komárková, Z. (2013): Financial Integration at Times of Financial Instability. *Czech Journal of Economics and Finance (Finance a úvěr)*, 63(1), pp. 25-45: <http://journal.fsv.cuni.cz/mag/article/show/id/1264>

Follow-up results / paper:

BABECKÝ, J. - KOMÁREK, L. - KOMÁRKOVÁ, Z. (2013): Convergence of returns on Chinese and Russian stock markets with world markets: national and sectoral perspectives. National Institute Economic Review. No. 223, February, R16-R34.

Czech National Bank (2011, 2012, ...): *Analyses of the Czech Republic's current economic alignment with the euro area*, Ch. 1.3.5. Financial market integration: http://www.cnb.cz/en/monetary_policy/strategic_documents/emu_accession.html

1. The focus of the paper

The paper:

- focuses on the integration of financial markets in line with the definition prevailing among the monetary policy makers or central bankers in general;
- measures integration for three inflation-targeting economies – Czech Republic, Hungary, Poland – vis-à-vis Euro area (for *money, FX and stock* markets) and Germany (*bond* market);
- provides a cross-check with selected economies outside euro area – Sweden and United Kingdom.

1. The focus of the paper (continued)

The paper provides answers to four questions concerning FI:

- ***Does it exist?** Do the spreads between yields of a country asset and benchmark yields stay persistent?*
- ***How fast is it?** What is the speed of elimination of the shocks to spreads between yields of a country asset and benchmark yields over time?*
- ***Does it change over time?** Do the yields of a country asset and benchmark become more similar over time?*
- ***What is the role of global versus national factors?***

2. Motivation

- Central banks in the EU care about financial integration (FI): The more integrated financial markets are, the more effectively monetary policy is transmitted through the financial system;
- The Czech National Bank assesses progress in FI in its regular euro area accession document “Analyses of the Czech Republic's current economic alignment with the euro area”.
- Quite large evidence on FI available for the euro area, for example:
 - Adam et al. (2002), Baele et al. (2004), Goldberg and Verboven (2001), Adjouté and Danthine (2003), Bekaert and Harvey (1997) ⇒ financial market integration can be measured by comparing the returns of assets (e.g. in terms of beta and sigma convergence);
 - European Commission (1999), Hartmann, Maddaloni and Manganelli (2003), Ayuso and Blanco (1999) ⇒ financial market integration between stock markets of the euro area has increased during the nineties.

2. Motivation

- Quite little, but growing, evidence available for the Central European economies:
 - Hanousek and Filer (1997) – Czech capital market is closely integrated with the German market while Hungarian and Polish more closely follow movements in the US market;
 - Horská (2004) – basic correlation analysis (standard) of stock markets in selected EU countries;
 - Capiello et al. (2006) – factor model for market returns, they measure integration as the amount of variance explained by the common factor relative to the local components;
 - Tomfort (2006) – financial integration has been measured by international investment positions and financial liberalization measures;
 - Komárková and Komárek (2007) – application of sigma and beta convergence to the FX Market;
 - Babetskii, Komárek and Komárková (2007) - stock market integration among new EU member states and the euro area.

2. Motivation

- What is unique in this paper?
 - focus on a rich spectrum of markets;
 - estimation of several measures of complementary nature;
 - evaluation of 2 periods – a pre-crisis (Jan. 1995 – Jul. 2007) and a crisis period (Aug. 2007 – Jul. 2010)

Potential Benefits of Financial Integration

- (i) **Consumption smoothing:** by allowing the country to borrow in "bad" times (say, during a recession or a sharp deterioration in the country's terms of trade) and lend in "good" times
- (ii) **Domestic investment and growth:** the ability to draw upon the international pool of resources that financial openness gives access to may also affect domestic investment and growth.
- (iii) **Enhanced Macroeconomic Discipline:** the free flow of capital across borders may induce countries to follow more disciplined macroeconomic policies and, thus, reduce the frequency of policy mistakes - Obstfeld (1998)

Potential Benefits of Financial Integration

- (iv) **Increased Banking System Efficiency and Financial Stability:** it may enhance the depth and breadth of domestic financial markets and lead to an increase in the degree of efficiency of the financial intermediation process, by lowering costs and "excessive" profits associated with monopolistic or cartelized markets, thereby lowering the cost of investment and improving resource allocation.

Potential Costs of Financial Integration

- (i) **Concentration of Capital Flows and Lack of Access** - Many developing countries (including oil producers) are able to borrow on world capital markets only in "good" times, whereas in "bad" times they tend to face credit constraints.
- (ii) **Domestic Misallocation of Capital Flows** - Although capital inflows that are associated with an open capital account may raise domestic investment, their impact on long-run growth could be limited, if such inflows are used to finance speculative or low-quality domestic investments.
- (iii) **Loss of Macroeconomic Stability** - Large capital inflows induced by financial openness can have undesirable macroeconomic effects, including rapid monetary expansion, inflationary pressures, real exchange rate appreciation and widening current account deficits.

Potential Costs of Financial Integration

- (iv) **Pro-cyclicality of Short-Term Flows** – (1) economic shocks tend to be larger and more frequent in developing countries. A common adverse shock to a group of countries may cause a deterioration in some countries' creditworthiness, as a result of abrupt changes in risk perception. (2) second, asymmetric information problems may trigger herding behavior because partially-informed investors may rush to withdraw "en masse" their capital in response to an adverse shock.
- (v) **Herding, Contagion, and Volatility of Capital Flows** – A high degree of financial openness may also be conducive to a high degree of volatility in capital movements, a specific manifestation of which being large reversals in short-term flows associated with speculative pressures on the domestic currency.

3. Approaches to Measure Financial Integration

Price-based measures (PBM)

- a direct check of the law of one price, which in turn must hold if financial integration is complete;
- **beta convergence** is an indicator of the speed at which markets are integrating, i.e. of the speed of elimination of the shocks to yields differentials; **1st and 2nd question**
- similarly, cross-sectional dispersion (**sigma-convergence**) of asset yields differentials can be used as an indicator of how far away the various market segments are from being fully integrated. **3rd question**

News-based measures (NBM)

- aims at determining to what extent common or global news (i.e. the arrival of new economic information of a common or global nature) dominates in impacting on prices; to the extent that the markets are not integrated, local news may continue to influence asset prices significantly;
- the price movements of benchmark assets are used as a proxy for global news. **4th question**

Quantity-based measures (QBM): *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 (not focus of this presentation)*

3.1 Does FI exist and how fast is it?

- Concept of beta-convergence (PBM I)

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

$$\begin{aligned} Y_{i,t} &= [\ln(A_{i,t}) - \ln(A_{i,t-1})] \\ Y_{i,t}^B &= [\ln(A_{i,t}^B) - \ln(A_{i,t-1}^B)] \\ R_{i,t} &= Y_{i,t} - Y_{i,t}^B \\ \Delta R_{i,t} &= R_{i,t} - R_{i,t-1} \end{aligned}$$

R - the yields (Y) spread of specific class of assets between country i and the benchmark at time t,

Δ - difference operator; α_i - country specific constant;

ε - white-noise disturbance; L - lag length is set upon the Schwarz information criterion.

- β** - the size of coefficient β may be interpreted as a direct measurement of the convergence speed;
- a negative beta coefficient indicates occurrence of convergence, and the absolute value of the beta coefficient indicates the convergence speed;
 - the closer to 1 the absolute value of the β coefficient, the higher the speed of convergence, and if $\beta=0$, no convergence is observed.

Originally from the growth literature: Barro, R. J., Sala-i-Martin, X. (1992) "Convergence", *Journal of Political Economy* 100, pp. 223–251.

3.2 How deep is FI and does it change over time?

- Concept of sigma-convergence (PBM II)

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

y - return (yield) on asset;

\bar{y} - mean value of the yield over the over the sample period;

i - separate countries ($i = 1, 2, \dots, N$).

σ - takes only positive value in theory;

- the lower σ is, the higher degree of convergence has been reached; yields become more similar;

- in theory, full integration is reached, where the standard deviation is zero, while high (several digit) values of σ reflect a very low degree of integration;

- for the chart type expression, the results were filtered using the Hodrick-Prescott filter with the recommended weekly time series coefficient $\lambda=270400$.

Degree of financial integration increases when the cross-sectional standard deviations of asset returns is trending downward over time.

3.3 Do the yields react to the same factors?

$$\Delta Y_{i,t} = \alpha_{i,t} + \gamma_{i,t} \Delta Y_{b,t} + \varphi_{i,t}$$

NBM for money, FX and bond market

- Y – return (yield) on asset over time t,
- i – countries ($i = 1, 2, \dots, N$)
- b – benchmark country (Euro Area, Germany)
- α – specific constant for each country
- φ – error term
- γ – degree of identical response of an asset of a selected country and a comparable benchmark asset to certain news.

Increase of integration requires: $\alpha \rightarrow 0, \gamma \rightarrow 1$

γ higher value of estimated parameter \Rightarrow higher integration

$\gamma > 1 \Rightarrow$ multiplication effect of news, $\gamma < 0 \Rightarrow$ asymmetric reaction to news

3.3 Do the yields react to the same factors?

$$\Delta Y_{i,t} = c_{i,t} + \gamma_{i,t}^b \Delta Y_{b,t} + \gamma_{i,t}^{US} \Delta Y_{us,t} + u_{i,t}$$

NBM: **for stock market**

Y – return (yield) on asset over time t,

i – countries ($i = 1, 2, \dots, N$)

b – benchmark country (Euro Area)

US – United States

c – specific constant for each country

v – error term

γ – degree of identical response of an asset of a selected country and a comparable benchmark asset to certain news.

Increase of integration requires: $\alpha \rightarrow 0, \gamma \rightarrow 1$

γ higher value of estimated parameter \Rightarrow higher integration

4. Data (Jan. 1995 - Jul. 2010)

	Money market	Foreign exchange market	Government bond market	Equity market
	1999 – 2010	1995 – 2010	2001 – 2010	1995 – 2010
CZ	PRIBK3M	PRUSDSP	BMCZ05Y	CZPXIDX
DE	–	–	BMBD05Y ^B	–
HU	HNIBK3M	HNUSDNB	BMHN05Y	BUXINDEX
PL	POIBK3M	POUSDSP	BMPO05Y	POLWIGI
UK	LDNIB3M	UKDOLLR	BMUK05Y	FTSE100
SW	SIBOR3M	SDUSDSP	BMSD05Y	SESEALI
EA	BBEUR3M ^B	USECBSP ^B	–	DJES50I ^B
US	–	–	–	S&PCOMP ^B

Notes: CZ – Czech Republic, HU – Hungary, PL – Poland, SW – Sweden, UK – United Kingdom, EA – euro area, US – United States. ^B – benchmark.

Source: Thomson Reuters

5. Empirical Results (PBM)

- PBM I: beta-convergence (speed of convergence)

	Money market		Foreign exchange market		Government bond market		Equity market	
	1/99-7/07	8/07-7/10	1/95-7/07	8/07-7/10	1/01-7/07	8/07-7/10	1/95-7/07	8/07-7/10
CZ	-0,5674	-0,3831	-0,9331	-0,9029	-0,7318	-0,6880	-0,7898	-0,7742
HU	-0,7929	-0,9476	-0,8691	-0,9678	-0,8666	-0,6207	-0,8121	-0,9460
PL	-0,6766	-0,7159	-0,8715	-1,0124	-0,8212	-0,7766	-0,8175	-0,8819
UK	-0,7061	-0,8190	-0,8102	-0,9054	-0,9306	-0,9632	-0,8944	-0,8333
SW	-0,5995	-0,9022	-0,9478	-0,8466	-0,8602	-0,9276	-0,9545	-0,9041

Notes: Estimates statistically significant at the 1% level;
 Convergence: if $-2 < \beta < 0$. Perfect convergence: if $\beta = -1$;

5. Empirical Results (PBM)

- PBM I: beta-convergence (speed of convergence)

	Money market		Forex market		Bond market		Stock market	
	1/03–7/07	8/07–7/13	1/03–7/07	8/07–7/13	1/03–7/07	8/07–7/13	1/03–7/07	8/07–7/13
CZ	-0.65	-0.39	-1.11	-0.88	-0.70	-0.74	-0.94	-0.80
AT	-	-	-	-	-0.68	-0.88	-0.88	-0.67
DE	-	-	-	-	B	B	-0.79	-0.88
PT	-	-	-	-	-0.68	-0.88	-1.04	-0.92
HU	-0.84	-0.78	-0.95	-0.90	-0.92	-0.69	-0.85	-1.04
PL	-0.52	-0.42	-0.78	-0.97	-0.84	-0.80	-0.91	-0.87
SI	-	-	-	-	-	-	-0.73	-0.83
SK	-0.55	-0,56*	-0.98	-	-0.70**	-0.85	-0.69	-0.94
EA	B	B	B	B	-	-	B	B

Note: The closer the value of the beta coefficient is to -1, the higher is the speed of convergence. The first time interval is the period before the outbreak of the financial crisis (up to August 2007); the second is the period containing the impacts of the financial crisis. Other symbols: B – benchmark, “-” – data not available, * – up to 31 December 2008, ** – from 22 June 2002. All the estimates were statistically significant at the 1% level.

Source: Thomson Datastream, CNB calculations.

Notes: Estimates statistically significant at the 1% level;
 Convergence: if $-2 < \beta < 0$. Perfect convergence: if $\beta = -1$;

5. Empirical Results (PBM)

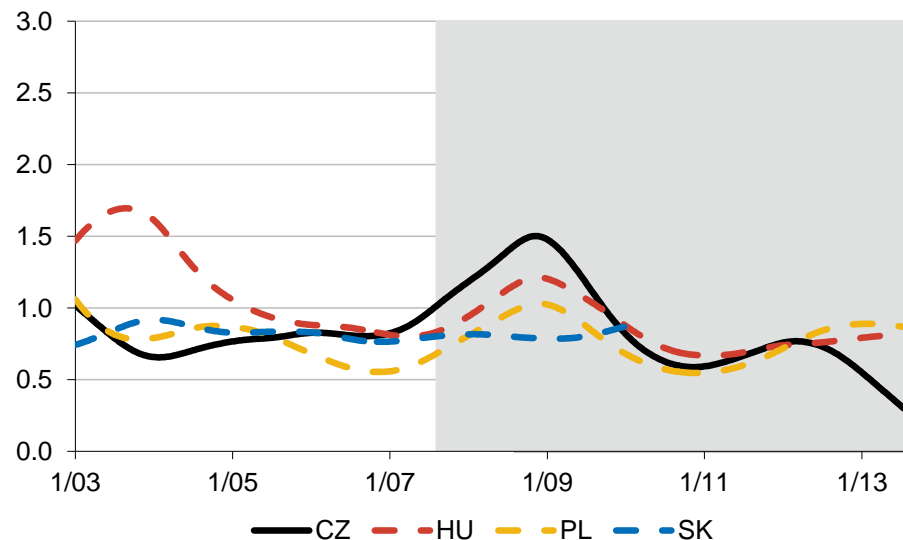
- PBM I: **beta-convergence**
 - the results unambiguously point to the existence of beta-convergence;
 - absolute values of the beta coefficient were close to one for all the countries and markets with the exception of money market - the speed at which shocks are eliminated is quite high;
 - the high speed of beta-convergence was achieved during the pre-crisis period;
 - the effect of a financial turmoil in 2007-2010 has been limited.

5. Empirical Results (PBM)

- PBM II: **sigma-convergence**

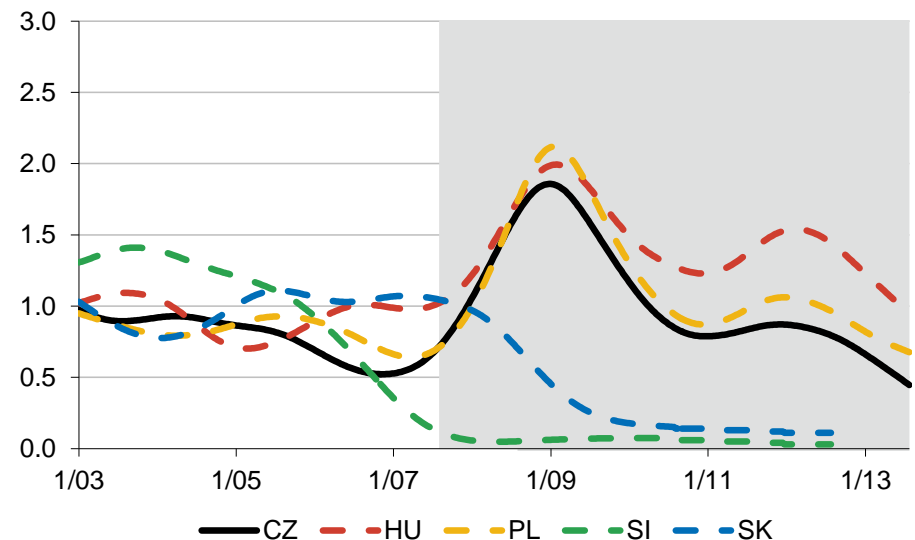
a) Money market

Money market



b) FX market

Forex market

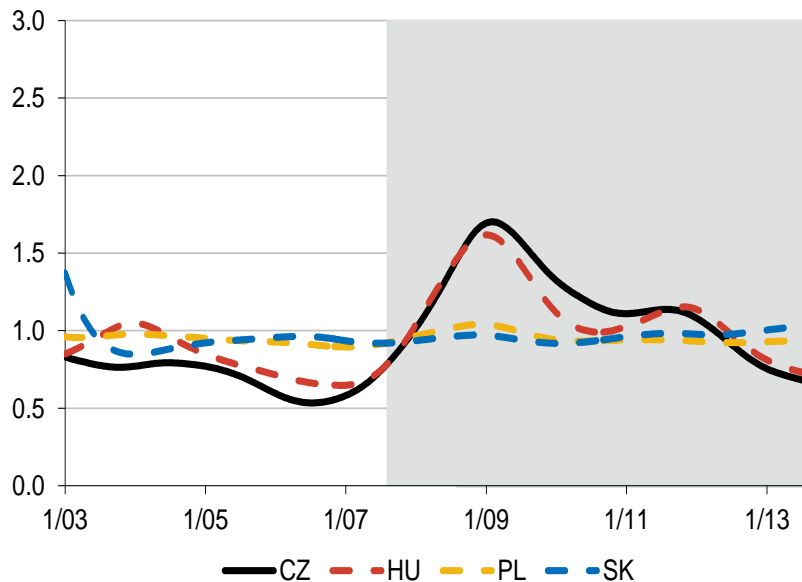


Sigma convergence: decrease in cross-sectional dispersion of yield differentials

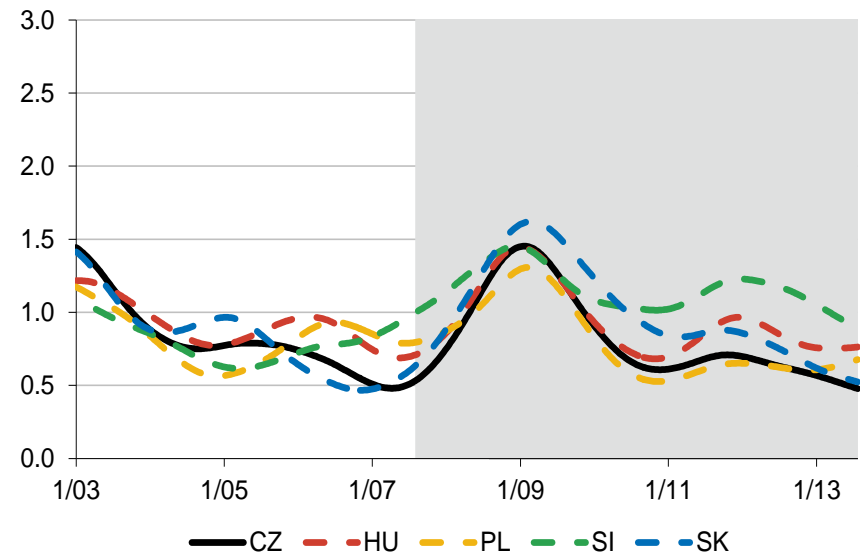
5. Empirical Results (PBM)

- PBM II: sigma-convergence

c) Government bond market



d) Equity market



Sigma convergence: decrease in cross-sectional dispersion of yield differentials

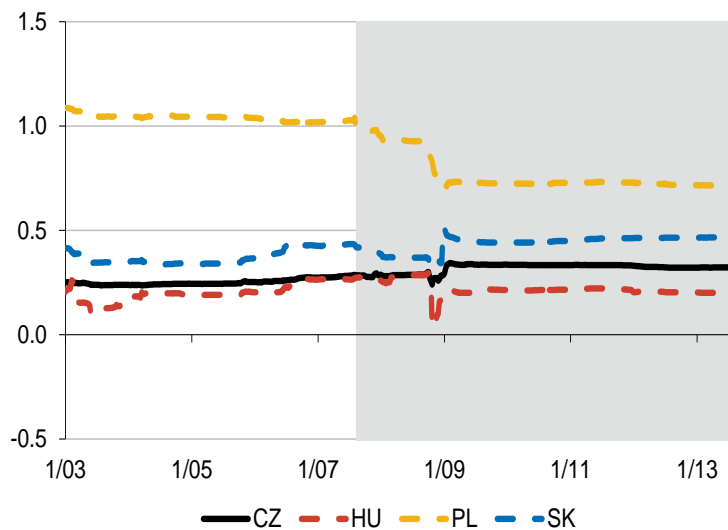
5. Empirical Results (PBM)

- PBM II: sigma-convergence
 - gradual trend sigma-convergence of markets was taking place in all the observed countries until 2007;
 - prior to the financial turmoil the degree of integration was quite similar for all economies (common mispricing in 2005-2007?);
 - there is a clear indication of some disintegration during 2007-2009 (or just an increase in volatility?), following by a return towards trend convergence in 2010.

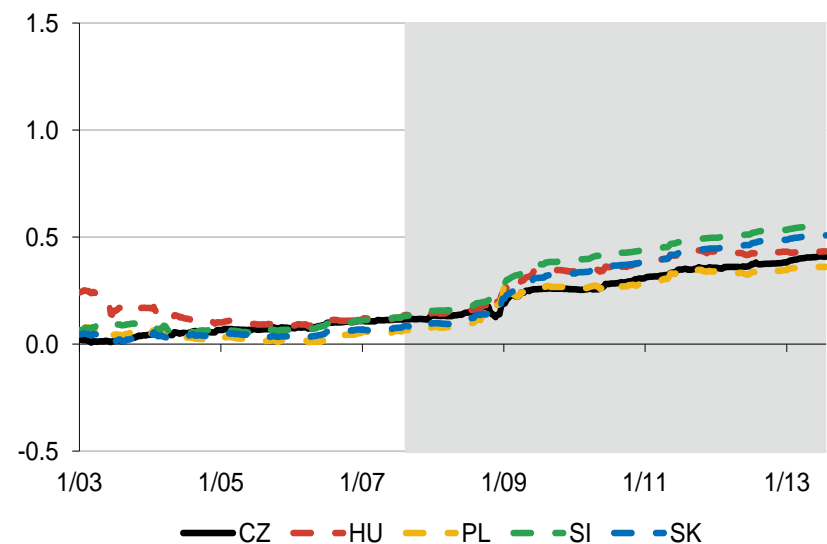
5. Empirical Results (NBM)

- News-based measure: global or local news?

a) Money market



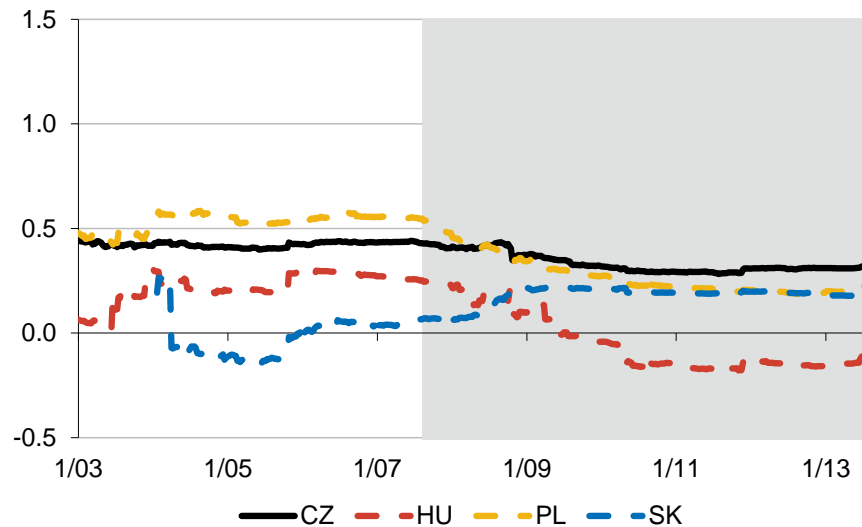
b) FX market



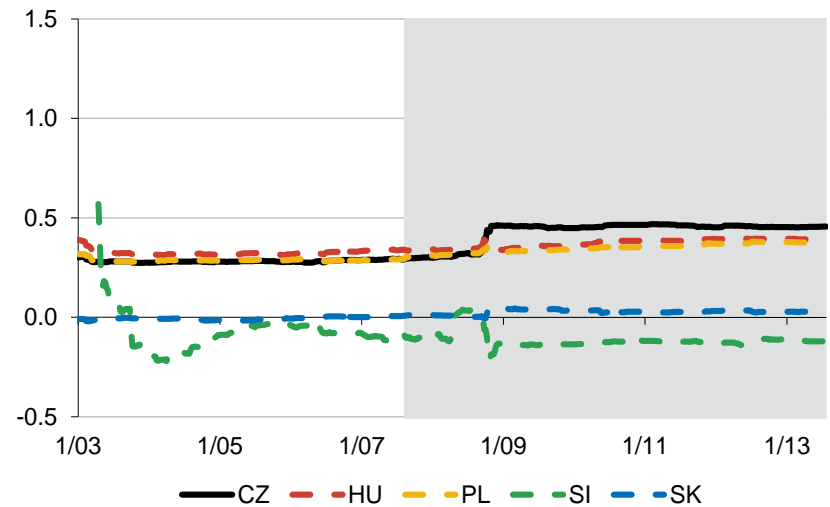
5. Empirical Results (NBM)

- NBM: global or local news?

c) Government bond market



d) Equity market



5. Empirical Results (NBM)

- NBM: global or local news?
 - The results of **news-based measures** indicate that:
 - the local factors affecting the national markets were quite significant in the pre-crisis period.
 - Increased importance of global news is apparent on stock and foreign exchange markets during the crisis.
 - The transmission of global shocks also intensified on these markets in the Czech Republic.
 - Higher sensitivity to global shocks can be expected for both these markets given the greater influence of foreign investors there.
 - The reaction to common news is low in the Czech Republic relative to the advanced euro area countries.
 - On the other hand, it is one of the highest among the Central European countries under review, especially on the stock and bond markets.

5. Empirical Results (NBM)

- NBM: global or local news?
- parameter γ turns out to be (slowly) changing over time, thus documenting a relative constancy of shock propagation across individual markets and countries;
- the importance of global factors increased during the crisis (or just global macrofinancial factors started to dominate over idiosyncratic ones?);
- transmission of shocks across markets and countries is characterized by a dominantly symmetric (positive) response (except for the Hungarian government bond market);
- 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 central bank) may prevail far more on the money market than on the stock market.

6. Conclusions

- The objective of the paper/presentation was to analyze an existence of and changes in the degree of integration in 4 segments of financial markets in selected EU economies;
- Overall, taking the results together, we found evidence of relatively deep and mostly increasing financial integration;
- At the same time we found differences among individual countries;
- Global financial crisis had a negative impact on the integration of some markets in some measures of FI, though the evidence is mixed.

6. Conclusions

- Both methods signal that the **financial crisis and the euro area debt crisis** had a significant impact on the financial market integration of all the countries under review with the euro area.
- Charts show that increased price mismatch, and in some cases divergence, are apparent from the outbreak of the crisis almost until mid-2009, when the situation on most financial markets started to calm gradually. However, divergence re-emerged in some markets at the start of the debt crisis due to increased price volatility.
- Convergence could be observed again for most markets and countries only last year, when asset prices were strongly affected by the ECB's policy.

Thank you for your attention

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Appendix: Composite Indicator of financial integration (CIFI)

$$\omega = \frac{1}{3} \beta' + \frac{1}{3} \sigma' + \frac{1}{3} \gamma'$$

where β' , σ' and γ' are the rescaled and normalized beta, sigma and gama parameters, so that minimum (i.e. zero) values correspond to the highest convergence.

$$\beta = \langle 0, -2 \rangle$$

$$\sigma = \langle 0, \infty \rangle$$

$$\gamma = \langle -1, 1 \rangle$$

$$\beta' = |1 - |\beta|| = \langle 0, 1 \rangle$$

$$\sigma' = \sigma$$

$$\gamma' = |1 - |\gamma|| = \langle 0, 1 \rangle$$

Appendix: Composite Indicator of financial integration (CIFI)

a) Synthetic indicator - equal weights of Beta, Gama, Sigma

	Money market		Foreign exchange market		Government bond market		Equity market		
	1/95-7/07	8/07-7/10	1/95-7/07	8/07-7/10	1/95-7/07	8/07-7/10	1/95-7/07	8/07-7/10	
CZ	1.53	1.89	0.98	1.06	1.11	1.36	1.17	1.08	min: 0.51
HU	1.16	0.84	1.00	1.02	0.93	1.62	1.04	0.81	max: 1.89
PL	1.05	0.89	1.07	0.95	0.96	1.13	1.12	0.90	avg 1.00
SW	1.32	0.78	0.96	1.22	0.60	0.64	0.54	0.71	
UK	1.17	0.89	0.98	0.92	0.51	0.62	0.67	0.81	

b) Synthetic indicator - sector-specific weights of Beta, Gama, Sigma

	Money market		Foreign exchange market		Government bond market		Equity market		
	1/95-7/07	8/07-7/10	1/95-7/07	8/07-7/10	1/95-7/07	8/07-7/10	1/95-7/07	8/07-7/10	
CZ	1.29	1.52	0.90	1.04	1.17	1.43	1.34	1.24	min: 0.53
HU	1.09	0.89	1.05	0.90	1.02	1.72	1.18	0.89	max: 1.72
PL	0.84	0.71	1.09	0.80	1.02	1.21	1.27	1.01	avg 1.00
SW	1.08	0.76	0.85	1.28	0.61	0.65	0.59	0.79	
UK	1.01	0.81	1.16	0.94	0.53	0.64	0.76	0.92	

Lower values of CIFI correspond to higher convergence.

Appendix: Composite Indicator of financial integration (CIFI)

a) Synthetic indicator - equal weights of Beta, Gama, Sigma

Across markets

	1/95-7/07	8/07-7/10
CZ	1.20	1.35
HU	1.03	1.07
PL	1.05	0.97
SW	0.85	0.84
UK	0.83	0.81

Across countries

	1/95-7/07	8/07-7/10
MM	1.25	1.06
FX	1.00	1.03
GB	0.82	1.07
EM	0.91	0.86

b) Synthetic indicator - sector-specific weights of Beta, Gama, Sigma

	1/95-7/07	8/07-7/10
CZ	1.18	1.31
HU	1.08	1.10
PL	1.05	0.93
SW	0.78	0.87
UK	0.87	0.83

	1/95-7/07	8/07-7/10
MM	1.06	0.94
FX	1.01	0.99
GB	0.87	1.13
EM	1.03	0.97

Lower values of CIFI correspond to higher convergence.

Appendix: Composite Indicator of financial integration (CIFI)

Results

Valid before and after the crisis:

- SW and UK are closer to EA/DE (i.e. have higher convergence with EA/DE) than CZ, HU, PL
- CZ is characterized by the lowest convergence with EA/DE among the 5 considered countries

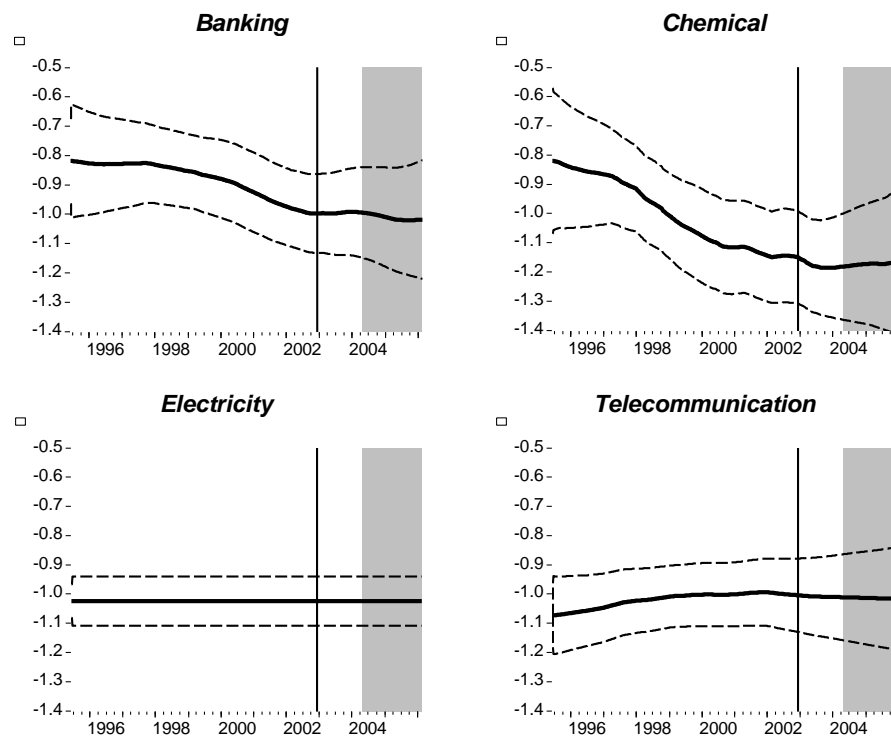
Results affected by the crisis:

- Bond market: had highest convergence before the crisis; during the crises switched to the lowest convergence among the 4 considered markets.

These results are robust to the alternative weighting schemes.

CNB WP & FaU (2007): Sectoral analysis – stock market

FIGURE 9 β -Convergence of Sectoral Indices – State Space Estimations

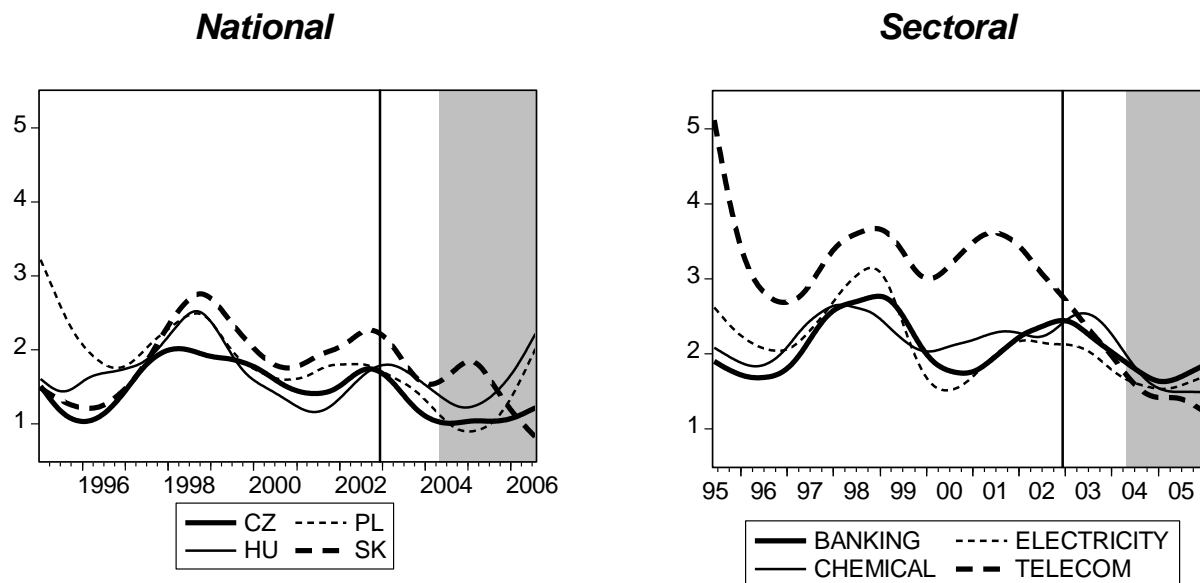


Notes: Kalman filter estimates of eq. (2)–(3); smoothed estimates of the coefficients β_t are displayed along with the ± 2 RMSE bands. The optimal lag length is determined to be zero according to the Schwarz information criterion. The shaded area indicates membership in the EU (1 May 2004), the vertical line announced decision of EU enlargement (12–13 December 2002, Copenhagen).

Source: authors' calculations

CNB WP & FaU (2007): National and Sectoral analysis – stock market

FIGURE 10 σ Convergence of National and Sectoral Indices to Euro Area, 1995–2006

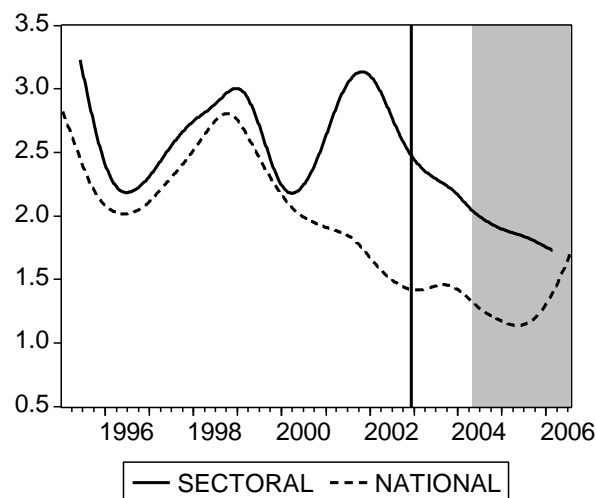


Notes: CZ = Czech Republic, HU = Hungary, PL = Poland, SK = Slovakia. The shaded area indicates membership in the EU (1 May 2004), the vertical line corresponds to the announcement of EU enlargement (12–13 December 2002, Copenhagen). Lower standard deviations (vertical axis) correspond to a higher convergence level.

Source: authors' calculations

CNB WP & FaU (2007): National and Sectoral analysis – stock market

FIGURE 11 σ -Convergence – Comparison between National and Sectoral Indices, 1995-2006



Notes: Lower standard deviations (vertical axis) correspond to a higher convergence level.
National = dispersion across national indices of the EU-3 (Czech Republic, Hungary and Poland).
Sectoral = dispersion across banking, chemical, electricity and telecommunication sectors in the EU-3.
The shaded area indicates membership in the EU (1 May 2004), the vertical line corresponds to the announcement of EU enlargement (12–13 December 2002, Copenhagen).

Source: authors' calculations

Selected references

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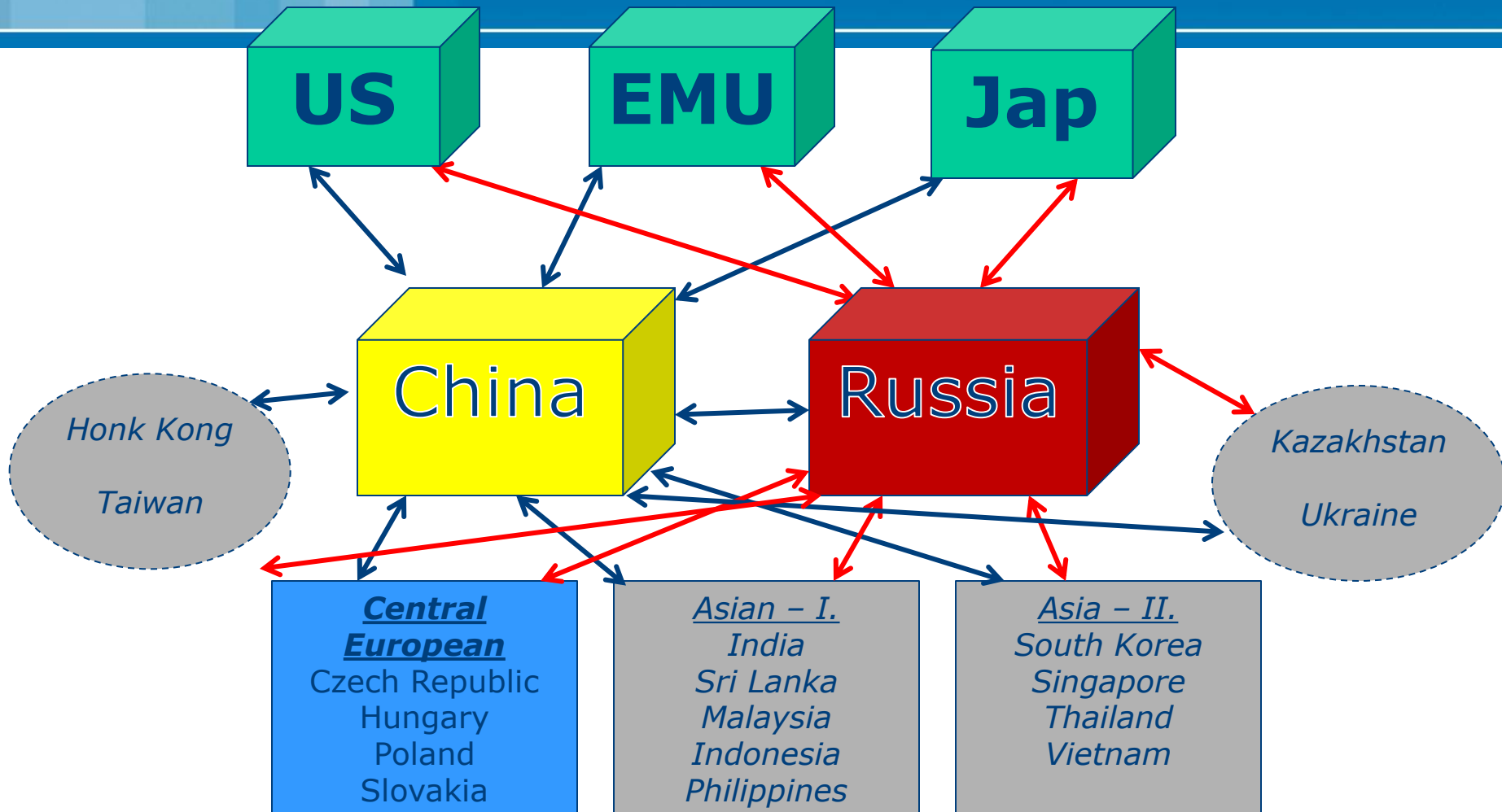
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Our BOFIT paper



Our BOFIT paper

China

Czech

Republic

Euro Area

Hong-Kong

Hungary

India

Indonesia

Japan

Kazakhstan

Malaysia

Philippines

Poland

Russia

Singapore

Slovakia

South Korea

Sri Lanka

Taiwan

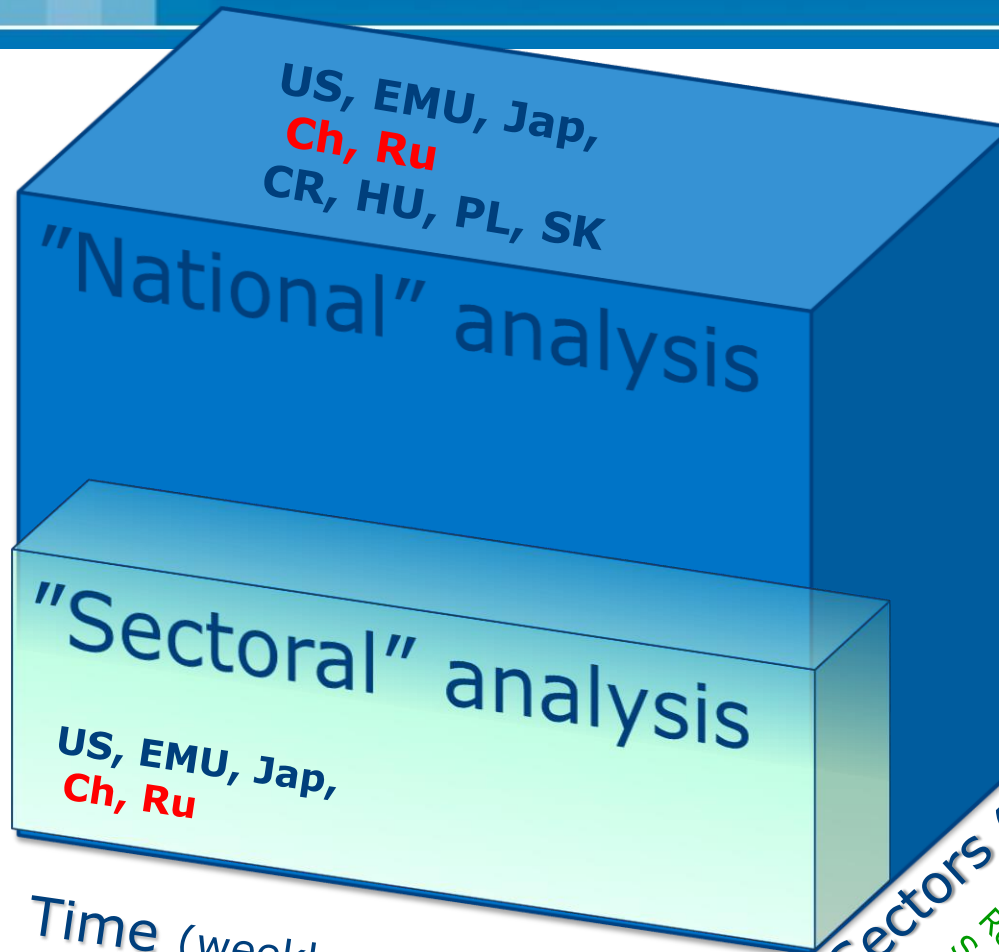
Thailand

Ukraine

United States

Vietnam

Countries (2+3+4(17))=(9)22)



Time (weekly averages)
09/1995-09/2009

Sectors (16)

- Airlines
- Automobiles
- Banks
- Beverages
- Brewers
- Chemicals
- Electricity
- Financials
- Industrials
- Mining
- Oil & Gas
- Pharmacy
- Real Estate
- Software
- Telecom
- Utilities

GAČR – The international transmission of shocks in the context of macro-financial linkages

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Narcisa Kadlčáková, UK FSV

I. Published papers (with impact factors):

I.1 Financial Integration at Times of Financial Instability (Zlataše Komárková, Luboš Komárek and Jan Babecký)

- **Abstract:** This article empirically analyzes the phenomenon of financial integration, focusing primarily on assessing the impacts of the current financial crisis. We start our analysis with an overview of cost-benefit considerations associated with the process of financial integration. We go on to examine the relationship between financial integration and financial instability, emphasizing the priority role of financial innovation. The subsequent empirical section provides an analysis of the speed and level of integration of the Czech financial market and the markets of selected inflation-targeting Central European economies (Hungary and Poland) and advanced Western European economies (Sweden and the UK) with the euro area. The results for the Czech Republic reveal that a process of increasing financial integration has been going on steadily since the end of the 1990s and also that the financial crisis caused only temporary price divergence of the Czech financial market from the euro area market.
- **JEL classification:** C23, G12, G15
- **Keywords:** beta-convergence, financial crisis, financial integration, gamma-convergence, new EU Member States, propagation of shocks, sigma-convergence

I. Published papers (with impact factors):

I.2 Financial Stress Spillover and Financial Linkages between the Euro Area and the Czech Republic (Tomáš Adam and Soňa Benecká)

- **Abstract:** This article analyzes the transmission of financial systemic stress from the euro area to the Czech Republic. We employ a recently developed composite indicator of systemic stress (CISS), which has a unique construction reflecting the correlations between markets and so captures the systemic stress of the financial system. The results from time-varying regression with stochastic volatility estimated using Bayesian inference indicate that the degree of transmission depends significantly on the level of stress, i.e., the intensity of the transmission mechanism itself is given by the magnitude of the shock. Second, the analysis reveals a more complex structure of financial stress linkages between markets on both the domestic and the international level. Finally, the results also support the current findings that the nature of stress is important for the transmission and that the sovereign debt crisis has so far had a limited impact on Czech financial markets.
- **JEL classification:** G01, G10, G20
- **Keywords:** systemic risk, financial crises, financial stress index, financial linkages

Work in progress

II. Finished papers (but not published):

II.1 Identification of Asset Price Misalignments on Financial Markets with Extreme Value Theory - (Narcisa Kadlčáková, Luboš Komárek, Zlataše Komárková, Michal Hlaváček)

- **Abstract:** This paper examines the potential for concurrence of crises in the foreign exchange, stock, and government bond markets as well as identifying asset price misalignments from equilibrium for three Central European countries and the euro area. Concurrence is understood as the joint occurrence of extreme asset changes in different countries and is assessed with a measure of the asymptotic tail dependence among the distributions studied. However, the main aim of the paper is to examine the potential for concurrence of misalignments from equilibrium among financial markets. To this end, representative assets are linked to their fundamentals using a cointegration approach. Next, the extreme values of the differences between the actual daily exchange rates and their monthly equilibrium values determine the episodes associated with large departures from equilibrium. Using tools from Extreme Value Theory, we analyze the transmission of both standard crisis and misalignment-from-equilibrium formation events in the foreign exchange, stock, and government bond markets examined. The results reveal significant potential for co-alignment of extreme events in these markets in Central Europe. The evidence for bubble formation is found to be very weak for the exchange rates, but is stronger for the stock markets and bond markets in some periods.
- **JEL classification:** C58, E44, G12, C38
- **Keywords:** Cointegration, concurrence of extreme values, Extreme Value Theory, financial market

II. Finished papers (but not published):

II.2 Sources of Asymmetric Shocks: The Exchange Rate or Other Culprits? (Michal Skořepa and Luboš Komárek)

- **Abstract:** We analyze and quantify the determinants of asymmetric shocks showing up in the form of medium-term real exchange rate (RER) changes. First, we discuss sources of asymmetric shocks causing exchange rate variability and the role of the RER as a shock generator. Second, we use data for 21 advanced and late-transition economies to gauge the extent to which medium-term bilateral real exchange rate variability can be explained by various fundamental factors. Using Bayesian model averaging, we find that out of 22 factors underconsideration, four types of dissimilarities within a given pair of economies are likely to be included in the true model: dissimilarities as regards (i) financial development, (ii) per capita income growth, (iii) central bank independence, and (iv) the structure of the economy. A regression based on these four factors indicates that these factors explain about one third of the behavior of the three-year RER variability for the whole sample and almost half of the behavior of the three-year RER variability for the RERs involving specifically the euro. The remaining part of the total variability represents an estimate of the influence of the exchange rate market itself (together with the influence of fundamental price level or nominal exchange rate determinants not captured by the regressors used).
- **JEL classification:** E52, E62, F31.
- **Keywords:** Asymmetric shocks, Bayesian model averaging, OCA, real exchange rate.

II. Finished papers (but not published):

II.3 Risk aversion, financial stress and their non-linear impact on exchange rates (Tomáš Adam, Soňa Benecká and Jakub Matějů)

- **Abstract:** This paper examines the reaction of the exchange rate of a small open economy to increased uncertainty in the euro area or the global financial markets. On the example of the Czech koruna, a highly stylized model of portfolio allocation between EUR and CZK denominated assets suggests a presence of two regimes based on a different reaction of the exchange rate to an increased stress in the euro area. The “diversification” regime is characterized by the koruna appreciation in reaction to an increase in the expected variance of the EUR asset, while in the “flight to safety” regime, the koruna depreciates in response to an increased variance. We suggest that the switch from “diversification” to “flight to safety” regime may be related to increase in risk aversion. Next, the presence of these regimes is identified using the Bayesian Markov switching VAR model, where the uncertainty is captured by financial stress indicators. We find that a slight increase in euro area financial stress causes a koruna appreciation, but as financial market tensions intensify (and investors’ risk aversion increases), the Czech currency depreciates as a response to a stress shock.

III. Work in progress

- III.1 Monetary, macroprudential and fiscal policy – an impossible trinity? (Luboš Komárek and Zlatuše Komárková)
- III.2 Modelling of oil price shock (Tomáš Adam)
- III.3 Application of G-VAR (Tomáš Adam and Soňa Benecká)
- III.4 Modelling of yield curve (Filip Novotný and Luboš Komárek)
- III.5 Monetary Policy and Oil Prices (Luboš Komárek and Martin Motl)
- III.6 Sovereign Risk (Zlatuše Komárková, Luboš Komárek and Michal Hlaváček)