What Has Europe Taught Us about Banking Integration and Financial Stability?

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Abstract
Financial theory advocates cross-border banking integration to lead to greater financial stability, as risks are spread around the world. The financial crisis has also shown us that in the integrated banking system the instability is easily propagated to otherwise healthy banking systems. This study is the first empirical examination of European cross-country relationship between banking integration and stability of the banking system. The study employs panel cointegration analysis to establish a highly significant negative impact of banking integration on financial stability in European countries.

Keywords: banking integration, financial stability, panel cointegration analysis
JEL codes: F36, F65, G15

1. Introduction

It is a generally accepted view that cross-border banking integration increases cross-country risk sharing, which implies greater financial stability of individual banking systems (for thorough discussion, see Kalemli-Ozcan et al., 2008). However, in crisis situations the higher connectivity of banking systems enhances the transmission of risk from banking systems in distress to otherwise financially healthy countries. Under different definitions this risk is usually called systemic. In Europe, where cross-border banking activities are more frequent and bigger in volume than anywhere else in the world, it is crucially important to understand whether the process of banking integration should be continued to a higher degree through the creation of banking union or whether its deceleration could bring the higher sense of financial stability. This dilemma is not only important for European countries, either they are advanced economies on the verge of sovereign debt crisis or still developing economies considering the accession of euro. In other parts of the world, different countries are looking up to European integration as the way to ensure their economic and financial development in the globalized world by, for example, benefiting from banking integration. In this regard, the question of the impact of banking integration on financial stability of individual countries is highly important and, fortunately, might be answered just by analyzing the situation in broader Europe.

In this paper, we examine the long-run relationship between banking integration and financial stability in Europe. Taking into consideration the ongoing debate and wide interest in the matter, the empirical evidence on the impact of banking integration on financial stability is somewhat limited. To our knowledge, there are no empirical studies directly connecting these two processes. The majority of studies attempt to find the determinants of financial crises, in which banking integration certainly plays a crucial role (e.g., Kleimeier et al. 2013). However, the reliability of such panel regression analyses is limited, since adding one more variable can dramatically alter the existing estimates. Therefore, we should exploit an econometric procedure, which is invariant to model extensions and test long-term properties of the data.

As for the theoretical framework to complement our empirical investigation, there are two theoretical models building up the direct linkage between financial integration and stability. Fecht et al. (2012) model the implications of cross-border financial integration for financial stability when banks' loan portfolios adjust endogenously. Their analysis shows that integration weakly reduces the probability of individual banking crises (individual risk), while at the same time it increases the risk of contagion and the probability of widespread banking failures (systemic risk). Schoenmaker (2011) goes a little further in his reasoning by formulating a so-called financial trilemma, which states that financial stability, financial integration and national financial policies are incompatible. His preposition clearly affirms that when cross-border banking integration increases, national financial policies are not able to produce a stable financial system. Conclusions from this theoretical model mostly advocates for European-based system of financial supervision to ensure the stability of the financial system as well as the benefits of financial integration.

2. Data and Methodology

The scarce empirical evidence on the connection between cross-border banking integration and financial stability is probably due to difficulties in measuring these two processes. In our study, we use the somewhat simplistic approach, which is widely used in the World Bank and ECB studies. The description of variables and their data sources are given in Table 1.

Table 1: Description of variables and data sources

Variable	Description	Source
Z-score (Financial stability)	Ratio of the sum of equity capital to total assets and ROA to standard deviation of ROA	Bankscope, Financial Development and Structure Dataset
Foreign bank claims to total assets (Banking integration)	Bank foreign exposures (European bank claims only) as share of banking system's total assets	Bank for International Settlements consolidated banking statistics, Helgi Analytics
Private credit to GDP (Financial depth)	Private credit by deposit money banks as a share of GDP (%)	Bankscope, Financial Development and Structure Dataset

A key variable used in the literature to measure financial stability is the z-score, which explicitly compares buffers (capitalization and returns) with the potential for risk (volatility of returns). The z-score has gained traction as a measure of banking systems' soundness and widely covered by the World Bank (for the construction of the measure see Čihák et al., 2012). The z-score (distance to default) is defined as

$$z = \frac{\mu + k}{\sigma}, \tag{1}$$

where k is equity capital as percent of assets, μ is return as percent of assets, and σ is standard deviation of return on assets as a proxy for return volatility. The popularity of the z-score stems from the fact that it is inversely related to the probability of a banks' insolvency, i.e. the probability that the value of assets becomes lower than the value of debt. The probability of default is given by

$$p(\mu < k) = \int_{-\infty}^{k} \varphi(\mu) d\mu \, . \tag{2}$$

If μ is normally distributed, then

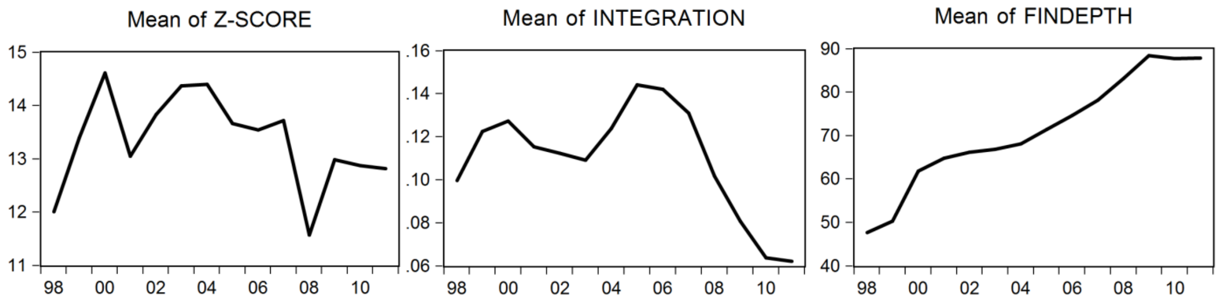
$$p(\mu < k) = \int_{-\infty}^{z} N(0,1) d\mu, \tag{3}$$

where z is the z-score. In other words, if returns are normally distributed, the z-score measures the number of standard deviations a return realization has to fall in order to deplete equity. Even if μ is not normally distributed, z is the lower bound on the probability of default (by Tchebycheff inequality). A higher z-score therefore implies a higher stability.

For the estimation of cross-border banking integration, we employ the ratio of foreign bank claims (European bank claims only) to total assets. The measure takes into account only inward integration or diversification against funding shocks, which creates a situation of banking instability inside the country due to bank insolvencies or liquidity shortage in other countries. Foreign exposures in BIS consolidated statistics include the exposures of foreign offices under banks' control but exclude inter-office positions. Thus, the chosen measure also allows for cross-border ownership linkages.

To account for probable benefits of financial integration, we should also add the measure of country's financial development (depth). The variable that has received much attention in the empirical literature on financial development is private credit, defined as deposit money bank credit to the private sector as a percentage of GDP. There is a wide literature demonstrating the link between financial depth, approximated by private sector credit to GDP, on one hand, and long-term economic growth on the other hand (e.g., Demirgüç-Kunt and Levine 2008).

Figure 1: Means of studied variables



Source: author's calculations, based on data aggregation

Figure 1 depicts the general evolution of financial stability, banking integration and financial depth in 37 European countries for the period 1998-2011. As seen in Figure 1, the chosen variables illustrate the conventional wisdom on financial development, integration and stability in Europe. We can clearly observe the impact of the global financial crisis on financial development and integration, while stability measure also demonstrates noticeable banking markets shocks, such as local banking crises in European developing countries in the end of 1990s or dot-com bubble.

The study employs panel cointegration analysis and follows theoretical formations summarized in Choi (2013). The panel cointegration models are directed at studying questions that surround long-run economic relationships encountered in macroeconomic and financial data. Cointegration does not explain the causality between the variables or determine the effects of one variable on the other; instead, it models the long-lasting equilibrium between them. The important implication of finding cointegration is that additional variables are not needed to account for the omitted variables problem: the result for long-run relationship between banking integration, financial stability and financial development would also hold if we include additional independent variables in the model (for theoretical and practical explanation see Juselius, 2006).

The basic econometric specification to examine long-term relationships between chosen variables is a conventional bivariate panel cointegration model of the form:

$$\log(stab)_{it} = \beta_1 \log(integr)_{it} + \beta_2 \log(fin\_dev)_{it} + \varepsilon_{it} \quad (4)$$

where $i = 1,2,3 \dots, N$ is the country index and $t = 1,2, \dots, T$ is the time index.

From the estimation of equation (4), we expect to find negative impact of banking integration on financial stability and positive impact of financial deepening (development) on financial stability. In the equation (4) we drop the intercept, since there are no theoretical implications of an initial level of the long-run relationships between variables calculated as ratios. The assumption is later confirmed by testing.

Before estimating our baseline model, we should address several econometric issues. As seen in Figure 1, the underlying variables exhibit trended non-stationary behavior. To allow for cointegration between the variables, the trends should be stochastic rather than deterministic and thus we should find a presence of a unit root. If this assumption is correct, the linear combination of integrated variables must be stationary, so that $\log(stab)_{it}$, $\log(integr)_{it}$ and $\log(fin\_dev)_{it}$ must be cointegrated. In order to investigate these properties of the data formally, we conduct panel unit root tests: Levin, Lin and Chu (2002) and Fisher-type test using ADF and PP tests by Maddala and Wu (1999) and Choi (2001).

In order to ensure that relationships between $\log(stab)_{it}$, $\log(integr)_{it}$ and $\log(fin\_dev)_{it}$ is not spurious, we test for cointegration using the standard panel and group ADF and PP test statistics suggested by Pedroni (1999, 2004) and Kao (1999) and Fisher-type test using Johansen's test methodology (Maddala and Wu, 1999).

For panel cointegration estimates, we use twoestimators, namely fully-modified OLS (FMOLS) and dynamic OLS (DOLS) for pooled and group-mean panels, so we can ensure the robustness of our findings. However, the DOLS estimator is generally considered to be superconsistent, asymptotically unbiased and normally distributed, even in the presence of endogenous regressors. Pooled estimations (i.e., pooling observations over the cross-sectional units) may yield inconsistent and potentially misleading results, when there is significant cross-sectional difference in individual units. To allow for cross-country variance we use group-mean estimator, which involves estimating separate regressions for each country and averaging the long-run coefficients $\hat{\beta} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_{ind}$.

3. Empirical Findings

The statistics of panel unit root tests strongly point to the presence of a stochastic trend in each of three series for all countries in the panel (see Table 2). The existence of stochastic trends in the data implies low reliability for usual panel regression estimations and measures of significance in such models.

Table 2: Results of Panel Unit Root Tests

Variable	Levin. Lin and Chu	ADF-Fisher chi-square	PP-Fisher chi-square
log(stab)	0.1144	0.7160	0.8073
Δ*log(stab)*	0.0000	0.0000	0.0000
log(integr)	0.9850	0.9991	0.9998
Δ*log(integr)*	0.0000	0.0000	0.0000
log(fin_dev)	1.0000	1.0000	1.0000
Δ*log(fin_dev)*	0.0000	0.0000	0.0000

Note: P-values in parentheses.
Source: author's calculations

These results of cointegration tests (Table 3) indicate that there is a long-run relationship between the studied variables. The ADF and PP (group and panel) statistics on different specifications of the model reject the null hypothesis of no cointegration at the 1% level of confidence. Johansen-Fisher test specify a cointegration rank or number of long-term relationship to achieve an equilibrium suggested by the data. For further model specifications, we accept the rank of one (or one long-run relationship).

Table 3: Cointegration tests

Test	Statistic	No intercept or trend	Intercept, no trend	Intercept and trend
Pedroni	Panel v	0.627 (0.265)	0.407 (0.342)	-1.828 (0.966)
	Panel rho	-0.678 (0.249)	-0.238 (0.406)	0.944 (0.827)
	Panel PP	-3.641 (0.000)	-6.445 (0.000)	-10.20 (0.000)
	Panel ADF	-3.537 (0.000)	-6.193 (0.000)	-9.986 (0.000)
	Group rho	3.070 (0.998)	2.787 (0.997)	4.559 (1.000)
	Group PP	-2.275 (0.012)	-11.98 (0.000)	-15.37 (0.000)
	Group ADF	-2.489 (0.006)	-9.128 (0.000)	-12.19 (0.000)
Kao	ADF	-	-5.093 (0.000)	-
Johansen Fisher	r=0	354.1 (0.000)	807.3 (0.000)	292.2 (0.000)
	r≤1	145.8 (0.000)	280.0 (0.000)	268.9 (0.000)
	r≤2	63.48 (0.044)	112.9 (0.000)	157.2 (0.000)

Note: P-values in parentheses.
Source: author's calculations

The majority of our estimations show a highly significant negative relationship between financial stability and banking integration as well as positive relationship between financial stability and development (see Table 4). Different estimations produce consistent results. The model without an intercept provides better specification implied by the theory. Given the relatively small number of time series observations (13 years), we would prefer the pooled approach.

Table 4: Estimation results

Sample	Variable	FMOLS (pooled)		DOLS (pooled)		FMOLS (grouped)		DOLS (grouped)	
		no constant	with constant	no constant	with constant	no constant	with constant	no constant	with constant
Full sample	Integration	**-0.4052** **(0.000)**	-0.0155 (0.604)	**-0.2097** **(0.000)**	-0.0156 (0.489)	**-0.4138** **(0.000)**	-0.0566 (0.449)	0.2514 (0.398)	5.879 (0.527)
	Fin Depth	**0.3186** **(0.000)**	**-0.1540** **(0.008)**	**0.3975** **(0.000)**	-0.1092 (0.114)	**0.3236** **(0.000)**	-0.2254 (0.046)	1.7104 (0.000)	-1.644 (0.227)
EMU	Integration	-0.1393 (0.084)	0.0047 (0.882)	**-0.1399** **(0.0035)**	0.0351 (0.176)	-0.0747 (0.541)	-0.0237 (0.827)	-1.6817 (0.009)	-17.343 (0.000)
	Fin Depth	**0.452** **(0.000)**	**-0.4289** **(0.001)**	**0.4361** **(0.000)**	**0.1895** **(0.005)**	**0.4668** **(0.000)**	-0.1639 (0.378)	-0.1980 (0.415)	-6.190 (0.000)
Developing countries	Integration	**-0.2498** **(0.0001)**	-0.014 (0.604)	-0.146 (0.0003)	-0.0192 (0.304)	**-0.2286** **(0.0002)**	-0.0610 (0.238)	3.344 (0.000)	26.036 (0.088)
	Fin Depth	**0.4606** **(0.000)**	**-0.119** **(0.035)**	0.4654 (0.000)	-0.0764 (0.186)	**0.4216** **(0.000)**	-0.1542 (0.145)	3.8424 (0.000)	3.8573 (0.084)
High-income	Integration	**-0.2850** **(0.003)**	-0.0183 (0.551)	**-0.1582** **(0.0001)**	0.0371 (0.181)	**-0.4161** **(0.0002)**	-0.0909 (0.357)	0.6639 (0.113)	-14.731 (0.000)
	Fin Depth	**0.3859** **(0.000)**	-0.2293 (0.018)	**0.4227** **(0.000)**	**-0.5909** **(0.002)**	**0.3418** **(0.000)**	**-0.3544** **(0.014)**	2.4452 (0.000)	-5.750 (0.000)
EU	Integration	**-0.2296** **(0.0004)**	-0.0174 (0.548)	**-0.1637** **(0.000)**	0.0283 (0.218)	**-0.4452** **(0.000)**	-0.0607 (0.516)	0.5134 (0.144)	-14.495 (0.000)
	Fin Depth	**0.4230** **(0.000)**	**-0.2752** **(0.000)**	**0.4330** **(0.000)**	**-0.4824** **(0.0001)**	**0.3197** **(0.000)**	**-0.2562** **(0.024)**	2.0754 (0.000)	-5.0769 (0.000)

Note: The dependent variable is z-score (financial stability). P-values are provided in parentheses. Significant results are highlighted in bold. DOLS grouped estimation of model with constant are seemed to be overspecified (possible explanation is provided in Choi, 2013).
Source: author's calculations

As a further robustness check, we also examine whether the negative long-run relationship between banking integration and financial stability is due to sample selection bias. We have included 37 European countries in our initial dataset. However, in Europe the level of economic development and financial integration is undoubtedly different for individual countries. We therefore perform cointegration estimations on four subsamples: members of the European Monetary Union (Eurozone), developing and graduated developing economies (according to the International Monetary Fund classification), high-income countries (according to the Organization for Economic Co-operation and Development classification) and the European Union members. The results are provided in lower part of Table 4. It appears that the previous findings are robust to sample selection.

The above established long-run relationship between banking integration and financial stability implies causality in at least one direction, however, it does not specify such direction. We assume that causality may run in either direction, from integration to stability or vice versa. For example, as seen in Figure 1b, the global financial crisis significantly affected the cross-border banking activities.

To test the direction of long-run causality, we follow common practice in the applied panel cointegration literature and employ a two-step procedure. In the first step, we use the DOLS pooled estimation (Table 4) to construct the disequilibrium term:

$$ec_{it} = \log{(stab)}_{it} + 0.2097\log{(integr)}_{it} - 0.3975\log{(fin\_dev)}_{it} \qquad (5)$$

In the second step, we estimate the vector error-correction model:

$$\begin{aligned}
\Delta\log{(stab)}_{it} &= c_{1t} + a_1 ec_{it-1} + \varphi_{11}\Delta\log{(stab)}_{it-1} + \varphi_{12}\Delta\log{(integr)}_{it-1} + \varphi_{13}\Delta\log{(fin_dev)}_{it-1} + e_{it}^{stab} \\
\Delta\log{(integr)}_{it} &= c_{2t} + a_2 ec_{it-1} + \varphi_{11}\Delta\log{(stab)}_{it-1} + \varphi_{12}\Delta\log{(integr)}_{it-1} + \varphi_{13}\Delta\log{(fin_dev)}_{it-1} + e_{it}^{integr} \\
\Delta\log{(fin_dev)}_{it} &= c_{3t} + a_3 ec_{it-1} + \varphi_{11}\Delta\log{(stab)}_{it-1} + \varphi_{12}\Delta\log{(integr)}_{it-1} + \varphi_{13}\Delta\log{(fin_dev)}_{it-1} + e_{it}^{fin_dev} \qquad (6)
\end{aligned}$$

The error-correction term ec_{it-1} represents the error in or deviation from the equilibrium, and the adjustment coefficients a_1, a_2 and a_3 capture how the studied variables respond to deviations from equilibrium. Granger representation theorem (Engle and Granger, 1987) implies that at least one of the adjustment coefficients must be non-zero if a long-run relationship holds. A statistically significant error correction term also implies long-run Granger causality from the explanatory variables to the dependent variable (as specified in VECM). An insignificant error correction term indicates weak exogeneity of explanatory variables. To test the null hypothesis of weak exogeneity (H_0: $a_{1,2,3} = 0$) we use conventional likelihood ratio chi-square test.

Table 5: Test for Long-Run Causality / Weak Exogeneity

Weak erogeneity of	$\chi^2(1)$ statistic	p-values
Financial stability	14.5648	0.0001
Banking integration	1.5325	0.2167
Financial development	0.4051	0.6932

Source: author's calculations

Table 5 reports the results. As can be seen from the first row, the null hypothesis of weak exogeneity is rejected for z-score at the 1% level of confidence. The changes in financial stability are, in fact, triggered by the changes in banking integration and financial development. Further causality effects are not found in the data. Therefore, the statistical long-run causality is not bidirectional, which means that banking integration is the cause of financial instability.

4. Conclusion

There are certainly many lessons to learn from European integration. As shown by our empirical study, one of the lessons is that there is a highly significant negative long-run relationship between financial stability and banking integration. We have also revealed that increasing banking integration leads to declining financial stability. Our findings are consistent with theoretical implication found in the literature.

Even if the cointegration analysis is more difficult to perform than more common panel regression techniques, the advantages of the approach should not be underestimated, especially for panel data studies. Further analysis should examine the short-run dynamics between the investigated processes, in order to understand the situation during the crisis. Robustness of our results should be also tested on alternative, more complex measures of banking integration and financial stability, such as network properties of interbank and loan markets and aggregated indexes of financial stability.

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