PANOECONOMICUS, 2020, Vol. 67, Issue 4, pp. 491-508
Received: 01 June 2017; Accepted: 07 January 2019.

UDC 336.71:061.1EU
https://dx.doi.org/10.2298/PAN170601021S
Original scientific paper

Larysa Sysoyeva
Sumy State University,
Ukraine
larysa.sysoyeva@gmail.com

Financial Stability of the Banking Sector in European Countries: A Comparative Analysis

Summary: The outburst of the financial crisis in 2008 raised a number of questions about financial stability and banking development, given that the crisis originated in advanced economies, where the financial sector had grown both very large and very complex. This study presents the results of research into ways of ensuring financial stability in the banking sectors in European and EU associated countries. The empirical analysis for EU member and associate countries is carried out for the period 2004-2014 and shows that significant heterogeneity in the member states' descriptions of their banking sectors not only led to different levels of Z-score, but also to principally different factors influencing the stability of banking activities in EU countries and countries associated with the EU.

Key words: Banking sector, Financial stability, EU integration.

JEL: F15, F36, G21.

In EU countries the study of the mechanisms governing the functioning and effectiveness of the banking sector has been established as one of the priorities for assuring the development, the stability and the sustainability of economic systems. Consistently, the necessity of fundamental banking sector reforms has been brought on the agenda for the countries being associated with the EU, facing the challenge of the fast implementation of new operation principles, the establishment of banking regulation bodies, and the build-up of financial capabilities.

Due to the dynamic development of the financial system, the presence of the integration process and the development of financial instruments, it is necessary to identify scientific and methodological approaches to the understanding of the mechanism for ensuring financial stability. Taking into consideration the importance of early detection of the most destructive signals that affect the banking sector, the objective of this paper is detect factors that show the increase of the likelihood of the violation of financial stability in the country to show the need for increased financial regulation. To this aim, in the empirical analysis we show that these factors can have a different strength depending on the group of countries considered (the "old" EU members, the "new" member states and EU-associated countries).

1. Literature Review

In the theoretical discussion on determining the economic category of "financial stability", two basic approaches can be identified. The first approach is systemic and, according to scholars (Roger W. Ferguson 2002; Garry Schinasi 2004) argue that financial stability is related to the ability of the financial system to meet endogenous and exogenous shocks. The second approach is functional and based on the premise that the financial instability in a country makes it impossible for the financial (banking) sector to perform the main functions in the economy. As is the case in most European countries, the banking sector is a critical component of the financial sector and serves as an important element in the sustainable development of the economy. Frederic S. Mishkin (1999) emphasizes that the asymmetric information is a feature innate in the banking sector and further reduces its transformational function. E. Philip Davis (2001) defines financial instability as the precursor of a financial crisis that leads to the collapse of the financial system and its inability to redistribute financial resources in the state. John Chant (2010) proves that financial stability should be considered through its absence, namely through the polar economic category of "financial instability". The European Central Bank (2017) defines financial stability as the state in which the banking sector can prevent the build-up of systemic risk, but key risks "continue to stem from imbalances and vulnerabilities in the fiscal, macroeconomic and financial sector domains". Heiko Hesse and Martin Čihák (2007) has proposed that financial stability at the systemic level relates to the absence of system-wide episodes in which the financial system fails to function and about resilience of financial systems to stress. Mario Strassberger and Larysa Sysoyeva (2016), argue that financial stability should be understood as a permanent capacity of the banking sector to the continuous performance of its functions without adverse negative effects on the real sector. Maria-Eleni K. Agoraki, Manthos D. Delis, and Fotios Pasiouras (2011) show that financial stability of banks depends on the different country-specific institutional characteristics. In addition, some authors think, that the role of capital regulation on banking sector stability are necessary. Patrick Van Roy (2004) determined that rigorous capital requirements in the early 1990's resulted in financial stability and reduced credit risk in the G10 countries. Jahn Nadya and Thomas Kick (2014), using the panel regression model, try to identify determinants of banking sector stability in Germany. The indicator consists of three parameters: probability of default of certain bank, credit spread and stock market index for the banking sector. Charles Goodhart and Miguel Segoviano (2015) also presented some empirical results that are based on the Banking Stability Index (BSI) as an indicator, which try to predict the amount of banks that become bankrupt as a result of bankruptcy of certain banks.

The stable operation of the banking sector is an important factor in ensuring financial development in EU countries and associated countries. Bearing this is mind, this paper aims at studying the factors able to assure the stability of banks and the banking sector and to identify the factors that render it vulnerable, hence increasing the probability of a financial crisis.

The indicator of financial stability we use as our dependent variable is the so-called Z-score. The choice is based on the following reasons: first of all this indicator is recognized by the World Bank as a measure of the stability of the banking system.

Secondly, we follow Asli Demirgüç-Kunt and Vojislav Maksimovic (2002), Hesse and Čihák (2007), Demirgüç-Kunt and Enrica Detragiache (2011) and Deniz Anginer, Demirgüç-Kunt, and Min Zhu (2012), and use the Z-score as a rough measure of systemic soundness. Third, the individual bank's Z-score is widely used as a measure of bank distance to default (John H. Boyd and David E. Runkle 1993; Thorsten Beck and Luc Laeven 2006; Laeven and Ross Levine 2009).

We compute the Z-score by weighted aggregation of all individual banks' Z-score in the country *j* at time *t*. The higher the probability of failure, the lower the Z-score will be. It is calculated using the formula:

$$Z\text{-}score = \frac{ROA + \frac{Equity}{Assets}}{sd(ROA)}, \quad (1)$$

where *ROA* is the profitability of bank assets, %; *Equity* is the value of a bank's equity; *Assets* is the value of bank's assets; *sd(ROA)* is standard deviation in terms of return on assets of the bank.

Z-score methods are used for the bank stability analysis through the prism of different financial risks and economic factors under which the financial institutions work. A high value of Z-score means long distance to the capital consumption and low probability of the bank insolvency.

2. Data, Empirical Model and Methods

The time horizon of the study covers the period from 2007 to 2014. The object of the study are parameters characterizing the state of the banking sector in EU countries (EU-28 countries, with the exclusion of UK, due to missing information on the explanatory variables) and countries associated with the EU (Ukraine, Moldova, Georgia). All the statistical information was formed on the basis of data provided by the Federal Bank of St. Louis Economic Research (2016)[1] and the World Bank (2016a)[2] because the usage of this information allows comparing the development level of the banking sector in different countries by the indexes developed and calculated using the same method that significantly improves the accuracy of the results. These features of further analysis will promote synchronization of received payment according to the requirements and standards adopted at the supranational level.

The set of factors identified as the drivers of financial staibilty include: bank branches per 100,000 adults (*branch*); bank concentration, in % (*conc*); bank cost to income ratio, in % (*cost*); % of bank credit on bank deposits (*cred*); bank deposits to GDP, in % (*deposit*); bank net interest margin, in % (*int_marg*); bank noninterest income to total income (*nonint_inc*); % of bank nonperforming loans on gross loans (*np_loans*); % bank overhead costs on total assets (*overhead*); % of bank regulatory capital on risk-weighted assets (*reg_cap*); bank return on assets, in %, before tax (*ROA*) and bank return on equity, in %, before tax (*ROE*).

[1] **Federal Bank of St. Louis Economic Research.** 2016. Bank Credit to Bank Deposits for United States. https://fred.stlouisfed.org/series/DDSI04USA156NWDB (accessed November 30, 2016).
[2] **World Bank.** 2016. World Development Indicators. http://data.worldbank.org/indicator (accessed November 15, 2016).

The relevance of mentioned statistics, firstly, consists in the fact that the study of the highlighted significant indicators provides a comprehensive assessment of the steady state of the banking sector taking into consideration the impact nature of these criteria on general indicators, Z-score. Secondly, the choice of these parameters is due to their relevance regarding the effectiveness of independent variables; the empirical model obviously included a more limited set of variables, in order to avoid factors collinearity.

The features and the expected impact of the factors listed above need to be discussed. The indicator "bank credit to bank deposit ratio" determines the financial resources provided to the private sector by domestic money banks as a share of total deposits. A ratio above one demonstrates that private sector lending is also funded with non-deposit sources that could lead to financial instability. We can observe such situations in banks of many countries in Central and Eastern Europe. Studies by Robert G. King and Levine (1993) have shown that countries with higher levels of private credit to GDP grow faster and experience faster rates of poverty reduction. Demirgüç-Kunt and Detragiache (1997) indicate that credit growth is a positive crisis predictor. Norman Loayza and Romain Ranciere (2006) point out that there is a short-term negative relationship between credit levels and growth in GDP *per capita*.

According to Beck, Demirgüç-Kunt, and Levine (2019) net interest margins have decreased. The higher level of net interest margin and overhead cost, the lower level of banking efficiency. Banks in rich countries, as a rule, have lower cost-income coefficients. Beck, Demirgüç-Kunt, and Levine (2019) examined the NPL impact on the probability of a systemic crisis in the banking sector using data on 69 countries over the period of 1980-1997 years. In particular, these authors define a systemic banking crisis as a situation when distressed assets exceed 10% of total bank assets or when the government takes extraordinary steps such as a moratorium or the nationalization of the big part of the banking sector.

At the present stage of the economic development, among the issues that arise during the process of restoring the financial stability in the country with the financial crisis, the creation of an effective structure of the banking system takes an important place. While examining the literature in the context of analyzing the concentration ratios of the banking sector and the financial stability we can determine the existence of two opposite approaches. Concentration might have a positive impact on the financial stability of the banking system. According to several studies (Santiago Carbó-Valverde, Luis Enrique Pedauga, and Francisco Rodríguez-Fernández 2013) with the methodology on a panel of banks belonging to twenty-three in the period 1996-2010 that rely on Z-score as a measure of bank stability and concentration or Lerner measures for competition, banking concentration promotes financial stability while a decrease of competition produces financial instability. J. Juan Fernández de Guevara and Joaquin Maudos (2011) find that financial development promotes economic growth as well as more competition and financial instability, suggesting that banking competition can have a negative effect on the availability of finance for more opaque companies.

However, other authors contend that concentration migh have a negative impact on the stability of the banking system. They argue that monopolistic or oligopolistic

situations in the banking system lead banks raise interest rates on loans, which in turn increases the risk of portfolio loans through adverse selection (worse projects are funded) and moral hazard. They believe that the large number of banks in the banking sector that leads to the capital fragmentation increases overall operating costs in the banking system and reduces the bank profitability. The solution to this problem lies in stimulating assets concentration in the banking sector. In general, the large size of the banking sector, high density, and interdependence of banks in the EU countries creates significant systemic risks to the mitigation efforts of EU member states. Sandrine Corvoisier and Reint Gropp (2002) concluded that increased concentration in the banking market has led to the reduction in competition and reducing rates on the deposit market. On the other hand, in pricing investigations in banks after mergers in Italy, it was concluded that during long-term period the deposit price increases, especially, in the most efficient banks that confirm the lack of management motives in absorption (Dario Focarelli, Fabio Panetta, and Carmelo Salleo 2002; Sijn Claessens and Laeven 2003) find a very low correlation between concentration and banking competitiveness. Empirical studies of the Spanish banking sector conducted by Gabriel Jiménez, Jose A. Lopez, and Jesus Saurina Salas (2010) found no evidence of a direct relationship between bank competition and system stability. Nevertheless, this indicator is still the most readily available market structure indicator across countries. King and Levine (1993) believe that countries with deposit money banks have high levels of financial development.

The indicators return on equity and return on assets are quite different in high-income countries and low-income countries.

Our baseline empirical model therefore reads:

$$\begin{aligned} Z-score_{i,t} &= \alpha_i + \tau_t + \gamma Z-score_{i,t-1} + \beta_1 branch_{i,t} + \beta_2 \beta conc_{i,t} + \beta_3 \cos t_{i,t} + \beta_4 cred_{i,t} + \\ &+ \beta_5 deposit +_{i,t} \beta_6 in\_mar_{i,t} + + \beta_7 non\,\text{int}\_inc_{i,t} + \beta_8 np\_loans_{i,t} + \beta_9 overhead_{i,t} + \\ &+ \beta_{10} reg\_cap_{i,t} + \beta_{11} ROA_{i,t} + \beta_{12} ROE_{i,t} + \varepsilon_{i,t}\,, \end{aligned} \tag{2}$$

where subscripts i and t refer to countries and years, respectively (i = 1, …, 30; t = 2007, ..., 2014); α_i and τ_t are country and time specific effects, respectively, and ε_{it} is the idiosyncratic error term. The acronyms indicate the variables as described above.

Our interest lies in the identification of possible differences in the drivers of financial stability for different sets of countries. Due to non-uniform level of the development and infrastructure of their markets, the 28 EU members are grouped based on the EU accession principle – the old European states (EU-15 minus UK), new member states (EU-13) and associated states (Ukraine, Moldova, Georgia).

To estimate the heterogeneity in the impact of the explanatory variables for different groups of countries, we interact each right hand variable with the following dummy variables: EU_13, which is one for new EU member states and zero otherwise; and EU_ASS, which is one for the associated countries (Ukraine, Moldova and Georgia) and zero otherwise. In this augmented model, the coefficients of the interaction variables describe, if significantly different from zero, the difference in the impact of the explanatory variables compared to the reference group (EU-15 member countries).

The dynamic specification (2) allows accounting for the fact that the stability of the financial sector (our dependent variable) might be characterized by high inertia and can be viewed as a time-persistent phenomenon. However, the presence among the right-hand side variables of $Z\text{-}score_{t-1}$, which is correlated with the composite error ($\alpha_i + \varepsilon_{i,t}$), leads to inconsistent parameter estimates when country heterogeneity is accounted for by means of conventional fixed- or random-effects estimators (Badi H. Baltagi 2001). Moreover, specification (2) can be characterized by the presence of other endogenous regressors and reverse causality issues. In particular, the solidity of the financial sector might have a positive or negative effect on profitability of financial institutions (as measured by ROA and ROE).

To deal with all these issues simultaneously, Generalized Method of Moments (GMM) estimation techniques can be employed. First, the first difference GMM estimator proposed by Manuel Arellano and Stephen Bond (1991), which is based on first-differencing the regression equation to eliminate the country-specific effect and uses lagged dependent variables as instruments, can be considered. For the aims of the present analysis, the main issue of using this estimator is related to the specific nature of Z-score persistency: the cross-sectional variation embodies a large part of the information since within-country Z-score level is quite persistent.

In this respect, although the first-difference GMM estimator allows controlling for possible measurement errors, country-specific heterogeneity, and endogeneity bias, it does not exploit the variation in levels, which is predominant. Ignoring cross-sectional variation may affect the precision of the estimates and give rise to estimation biases. Moreover, as pointed out by Richard Blundell and Bond (1998), the lagged levels of the explanatory variables are weak instruments for the variables in differences when explanatory variables are persistent.

The system GMM estimator (Arellano and Olympia Bover 1995; Blundell and Bond 1998; Arellano 2014) allows addressing these shortcomings, by fully exploiting the cross-country variation in the data. In the system GMM approach, specifications in first-differences and in levels are combined. Based on mild stationarity restrictions on the initial condition processes, the system estimator augments the difference GMM by including an equation in levels and by estimating simultaneously in differences and levels, with the two equations distinctly instrumented. Adding the original equation in levels preserves the cross-country dimension and allows exploiting additional moment conditions that may improve both consistency and efficiency of the estimates.

The system GMM estimator uses internal instruments (i.e., lagged values of the endogenous explanatory variables) and thus requires a more stringent set of restrictions than the difference GMM. Variables in levels are instrumented with lagged first differences and, in order to consider these additional moments as valid instruments for levels, the identifying assumption that past changes of the explanatory variables are uncorrelated with current errors in levels, which include fixed effects, is required (David Roodman 2009). If the moment conditions are valid, Blundell and Bond (1998) show that the system GMM estimator performs significantly better than the first-difference GMM estimator. The validity of the moment conditions can be tested by means of the test of over identifying restrictions proposed by John D. Sargan (1958) and Lars Peter Hansen (1982) and by testing the null hypothesis of no second order serial

correlation in the error term. Furthermore, the validity of the additional moment conditions associated with the level equation can be tested with the difference Sargan/Hansen test.

3. Preliminary and Descriptive Evidence

We provide here some descriptive statistics, preliminary to the presentation of the outcomes of the estimated model. Table 1 presents some summary statistics of our dependent variable. The EU-15 member states exhibited the following: 5 "high" Z-scores (Austria, Germany, Italy, Luxembourg, Spain), 8 "average" (Belgium, Denmark, Finland, France, the Netherlands, Portugal, Sweden, the United Kingdom), and 2 "low" Z-scores (Greece, Ireland). Only one country among the EU-13 member states, namely Malta, had a Z-score factor at the "high" level. The Z-scores for countries such as Estonia and Poland was measured at 12, or the "average" level. It is important to note that the EU-associated states, Ukraine, Moldova and Georgia, had similar Z-score levels. In general, it can therefore be stated that "new" EU member states (EU-13) exhibit banking-system stability levels that are obviously lower than the levels featured by "old" member states (EU-15).

Table 1 Descriptive Statistics Regarding Z-scores for EU-28, Ukraine, Moldova, and Georgia

Country	Min	Max	Average*	Level of Z-score
Austria	17,88	40,75	26,50	high
Belgium	3,52	13,00	8,52	average
Bulgaria	-12,61	4,87	3,11	low
Croatia	3,57	5,67	4,95	low
Cyprus	1,00	6,75	4,43	low
Czech Republic	3,29	6,01	4,23	low
Denmark	6,41	10,76	9,18	average
Estonia	3,89	11,30	7,48	average
Finland	7,07	20,80	12,48	average
France	6,6	13,48	10,82	average
Germany	8,32	20,18	14,12	high
Greece	-4,11	4,13	1,94	low
Hungary	4,42	6,04	5,13	average
Ireland	0,02	8,43	4,45	low
Italy	6,38	31,40	14,21	high
Latvia	1,40	2,78	2,44	low
Lithuania	0,80	4,53	3,22	low
Luxembourg	21,68	32,70	25,91	high
Malta	9,73	24,53	17,17	high
Netherlands	3,24	11,05	7,84	average
Poland	6,63	8,71	7,89	average
Portugal	7,67	15,54	11,08	average
Romania	3,21	4,93	3,82	low
Slovak Republic	7,05	16,15	12,39	average
Slovenia	-0,34	5,85	3,30	low
Spain	7,30	15,52	13,73	high
Sweden	5,34	8,73	6,98	average
United Kingdom	4,35	13,34	7,86	average
Ukraine	2,94	8,42	5,40	average
Moldova	7,39	10,08	8,65	average
Georgia	4,13	7,65	6,24	average

Notes: * average from 2004 to 2014.

Source: International Monetary Fund (2013), author's calculation.

The crisis processes in the financial markets since 2007 displayed the capability of influencing the market economy to a greater extent than had been expected. In this way, the interdependence of the financial and real sectors of the economy increased significantly, because the transmission of destructive processes between these segments was observed to have occurred quite rapidly. The plummeting of macro indicators data for the EU as a whole and for many "new" EU member states fell together with the financial crisis and the Lehman shock.

Table 2 Change over Time of the Z-score for EU-28, Ukraine, Moldova, Georgia (2004, 2008 and 2014)

Country	2004	2008	2014
Austria	21,62	25,02	17,88
Belgium	7,61	3,52	13,00
Bulgaria	4,57	4,74	-12,61
Croatia	3,57	5,48	5,67
Cyprus	4,42	3,74	4,10
Czech Republic	4,29	3,98	4,63
Denmark	10,76	6,41	10,70
Estonia	6,51	6,20	9,15
Finland	20,80	10,96	7,09
France	13,48	6,96	7,78
Germany	11,33	8,32	20,18
Greece	3,05	2,13	3,66
Hungary	6,04	4,42	5,29
Ireland	8,30	2,65	8,43
Italy	31,40	13,47	6,38
Latvia	2,62	2,20	2,78
Lithuania	3,61	3,21	3,42
Luxembourg	22,26	21,68	27,20
Malta	20,90	11,31	9,73
Netherlands	8,14	3,24	9,63
Poland	8,66	6,82	8,39
Portugal	10,26	8,58	15,54
Romania	4,93	3,65	3,86
Slovak Republic	10,45	14,26	14,84
Slovenia	4,22	3,62	5,85
Spain	15,52	14,17	15,68
Sweden	7,38	5,34	7,73
United Kingdom	13,34	4,35	10,19
Ukraine	8,42	5,14	4,84
Moldova	10,08	9,68	7,60
Georgia	6,88	4,13	6,25

Source: International Monetary Fund (2013), author's calculation.

Table 2 shows that states in EU-15 in the period prior to the crisis (2004-2008) had a high level of financial stability in the banking sector. However, the world financial crisis significantly reduced the level of financial stability in the European banking sector, as reflected in the reduction of the Z-score indicator.

Only the banking sector in Austria has demonstrated an improved Z-score indicator. Austria already implemented macroprudential measures by 2008 because minimum standards for granting foreign currency loans and loans with repayment vehicles were introduced there as early as 2003. These minimum standards were tightened substantially in October 2008 when the Austrian Financial Market Authority (FMA) issued a new recommendation, and when, in 2010, the FMA and the Oesterreichische Nationalbank (2016) jointly issued guiding principles for doing business.

In the period with the crisis (2008-2014) in most EU-15 countries, namely in Belgium, France, Germany, Ireland, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom, the banking sector shows a gradual restoring to their level of financial stability. In particular, this table shows a drastic decline in financial stability for Italy's banking sector during the 2004-2014 period, which is shown by the decline in its Z-score level from 31.40 (2004) to 6.38 (2008). This can be explained by the strong increase in nonperforming loans (NPL) to about 14 from 2007 until the end of 2012.

Table 2 contains significant Z-score fluctuations in the "new" EU member states in the period of the crisis. Between 2008 and 2014, the Z-score level further declined for 2 "new" countries – Bulgaria and Malta – and with no significant changes taking place in Latvia, Lithuania, Romania, and an increase in Z-score level in the Slovak Republic. In general, in the period with the crisis it can therefore be stated that "new" EU member states exhibit banking-system stability levels that are obviously lower than the levels featured by "old" member states.

Table 3 provides a preliminary correlation analysis aimed at identifying factors affecting the EU banking sector's financial stability that highlight a co-movement with the Z-score and with other explanatory variables. The analysis proved that the indicators "bank return on equity" and "bank return on assets" were closely associated with each other, so that only one indicator was left for further analysis. The indicators "bank cost to income ratio", "bank credit to bank deposits", "bank noninterest income to total income", "bank overhead costs to total assets", "bank regulatory capital to risk-weighted assets" had very little impact on the Z-score.

Additionally we used to the variance inflation factor (VIF) (see John Neter, William Wasserman, and Michael H. Kutner (1985)) to calculate a measure of the amount of multicollinearity in a set of multiple regression variables (Table 4).

Table 3 Correlations between the Variables Used in the Model

		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	branch	1												
2.	conc	-0,370	1											
3.	cost	-0,185	0,017	1										
4.	cred	-0,108	0,323	0,114	1									
5.	deposit	0,508	-0,261	-0,251	-0,397	1								
6.	int_marg	-0,036	-0,239	-0,178	-0,200	-0,298	1							
7.	nonint_inc	-0,089	-0,049	-0,054	0,044	0,106	-0,302	1						
8.	np_loans	0,010	-0,032	0,007	-0,060	-0,070	0,189	-0,042	1					
9.	overhead	-0,169	-0,213	0,115	-0,136	-0,324	**0,814**	-0,065	0,136	1				
10.	reg_cap	-0,152	0,040	-0,072	-0,132	0,093	-0,017	0,115	0,143	-0,085	1			
11.	ROA	-0,086	-0,098	-0,094	-0,065	-0,107	0,372	0,014	-0,362	0,318	-0,015	1		
12.	ROE	-0,049	-0,027	-0,319	-0,077	-0,025	0,312	0,047	-0,428	0,239	-0,093	**0,718**	1	
13.	Z-score	0,123	-0,175	0,038	-0,201	0,455	-0,301	0,075	-0,330	-0,248	0,115	0,173	0,064	1
	p-value	*0.10*	*0.03*	*0.45*	*0.37*	*2.6E-6*	*0.03*	*0.19*	*0.001*	*0.80*	*0.11*	*1.3E-6*	*0.098*	*x*
	Significancy	*	**	*n/s*	*n/s*	***	**	*n/s*	***	*n/s*	*n/s*	***	*	

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level, n/s - non significant.

Source: Author's calculation.

Table 4 Variance Inflation Factor (VIF) for Correlation Analysis Results

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. branch	x												
2. conc	1.159	x											
3. cost	1.035	1.000	x										
4. cred	1.012	1.116	1.013	x									
5. deposit	1.348	1.073	1.067	1.187	x								
6. int_marg	1.001	1.061	1.033	1.042	1.098	x							
7. nonint_inc	1.008	1.002	1.003	1.002	1.011	1.101	x						
8. np_loans	1.000	1.001	1.000	1.004	1.005	1.037	1.002	x					
9. overhead	1.029	1.048	1.013	1.019	1.117	**2.960**	1.004	1.019	x				
10. reg_cap	1.024	1.002	1.005	1.018	1.009	1.000	1.013	1.021	1.007	x			
11. ROA	1.007	1.010	1.009	1.004	1.012	1.161	1.000	1.151	1.112	1.000	x		
12. ROE	1.002	1.001	1.114	1.006	1.001	1.108	1.002	1.225	1.060	1.009	**2.064**	x	
13. Z-score	1.015	1.031	1.001	1.042	1.261	1.100	1.006	1.122	1.065	1.013	1.031	1.004	x

Source: Author's calculation.

4. Results

Table 5 presents the results of the baseline model, estimated on the unbalanced panel we were able to collect. Due to high correlation and the consequent multicollinearity in the econometric model, we excluded the following variables from the baseline estimation: Bank noninterest income to total income (*nonint_inc*) and bank overhead costs to total assets (*overhead*), both, higly correlated to *int_marg*; and returns on assets (*ROA*), hihgly correlated to *ROE*. As indicated in the bottom part of Table 5 (and the same holds for Tables 6 and 7), all specifications pass the test for the overall significance of the regression, the Arellano-Bond tests for serial correlation, and the Sargan test for overidentifying restrictions.

Results of the estimation of the baseline model first of all clearly indicate a strong pattern of persistence of the dependent variable, as measured by the positive, strong and statistically significant coefficient of the lagged dependent variable. The stability of the financial system in the previous year is an important and significant predictor of the current level of financial stability. A higher Z-score is associated with a higher share of deposits to GDP and higher profitability. Bank concentration, the number of branches and the occurrence of non-performing loans result in a lower Z-score.

Table 5 The Drivers of Z-score in EU Countries and EU Associated Members (2007-2014), Baseline Model

Explanatory variables	Acronym	Coeff. sig.
Lagged dependent variable (Z-score L1)	L1 Z_score	0.5968***
		(0.0439)
Bank branches per 100,000 adults	Branch	-0.0219*
		(0.0120)
Bank concentration, %	Conc	-0.0457***
		(0.0144)
Bank cost to income ratio, %	Cost	0.0427*
		(0.0253)
Bank credit to bank deposits, %	Cred	0.0055
		(0.0042)
Bank deposits to GDP, %	Deposit	0.0221***
		(0.0047)
Bank net interest margin, %	int_marg	-0.1520
		(0.1395)
Bank nonperforming loans to gross loans, %	np_loan	-0.0932*
		(0.0525)

Bank regulatory cap. to risk-weighted assets, %	reg_cap	0.0151
		(0.0695)
Bank returns on equity	ROE	0.1383***
		(0.0376)
Observations		205
Time dummies		Yes
Joint significance of time dummies		[0.000]
Wald test		2671.14 (18)***
A-B AR(1) test		-6.07***
A-B AR(2) test		1.40
Sargan overid.test		1.26

Notes: *T* statistics are based on robust standard errors and reported in brackets; A-B AR(1) and A-B AR(2) are tests for first- and second-order serial correlation in the first-differenced residuals (Arellano and Bond 1991); * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$.

Source: Author's calculation.

Tables 6 and 7 describe the heterogeneity of the effects of the various drivers of financial stability across the three groups of countries of our interest here. To this aim, the baseline empirical model is estimated in a parsimonious version (i.e., keeping only the statistically significant variables) (column 1 of Table 6), and then but adding for each variable separately its interactions with the country groups dummies (EU-13 and EU-ASS). By so doing, the benchmark group is EU-15 countries (main coefficient of the variable and the coefficients of the two interaction variables describe the difference in the effects of the variable for the remaining two groups. So, for example column 2 of Table 6 reports the estimates aimed at investigating if the lagged dependent variable has a different effect in the three groups of countries. The coefficient of the variable L.z_score is 0.6048; this is the effect for EU-15 (the benchmark group) of the lagged level of stability (i.e., stability in the previous year) on the current level of stability. The coefficient of the first interaction variable (L.z_score *EU-13) is -0.1757; this means that the effect of the variable, for the group of new EU member countries (EU-13) is weaker than for the EU-15, and equals 0.4291 (0.6048 – 0.1757). So, the effect for EU-13 is still positive, but weaker compared to EU-15. For the associate countries the effect of the variable is even weaker. The coefficient of the second interaction variable (l_z_score*EU-ASS) is indeed -0.2079, so the effect of the past level of stability of the financial sector is, for this group of countries 0.3969, again obtained by summing up the coefficient for the reference group (0.6048) and the coefficient for the relevant interaction variable (-0.2079). The fact that the coefficients of the interaction variables are statistically significant means that their differences compared to the reference group are also statistically significant. This evidence suggests that the past level of stability of the financial system is a more powerful predictor of current financial stability in EU-15 economies; in EU-13 and even more in EU-ASS the effect is still positive but significantly weaker, signalling that here stability in the past is a much weaker guarantee of stability in the present.

Column 3 of Table 6 shows that also the number of branches has a heterogeneous effect over the group of countries considered. More precisely, the overall negative effect emerged in the baseline model (Table 5) is in fact entirely driven by what happens in the EU-13 group (variable *branch*EU-13*). The effect for the benchmark group (variable *branch*) is indeed not significantly different from zero; the effect for the EU-ASS countries is not significantly different from the benchmark, and is therefore also to be considered equal to zero.

The last column of Table 6 reports the outcomes of the model augmented with the group dummies interacted with the variable *conc*. Results show that bank sector concentration is detrimental to financial stability in all three groups; however, the size of this effect is stronger in the EU-13 (-0.0861) and EU-ASS (-0.0648) countries compared to the benchmark group of EU-15 (-0.0487).

Table 6 The Drivers of Z-score in Europe (2007-2014), Parsimonious Model (Country Group Specific Effects on Lagged Z-score, Branch, conc)

Acronym	Coeff. sig.	Coeff. sig.	Coeff. sig.	Coeff. sig.
	(1)	(2)	(3)	(4)
L.z_score	0.5983***	0.6048***	0.5619***	0.5590***
	(0.0431)	(0.0427)	(0.0436)	(0.0437)
L.z_score *EU-13		-0.1757**		
		(0.0754)		
l_z_score*EU-ASS		-0.2079*		
		(0.1183)		
Branch	-0.0177	-0.0239**	-0.0006	-0.0247**
	(0.0110)	(0.0116)	(0.0115)	(0.0112)
branch*EU-13			-0.0713***	
			(0.0158)	
branch_EU-ASS			-0.0836	
			(0.0518)	
Conc	-0.0379***	-0.0492***	-0.0631***	-0.0487***
	(0.0133)	(0.0143)	(0.0146)	(0.0133)
conc*EU-13				-0.0374***
				(0.0086)
conc_EU-ASS				-0.0197*
				(0.0108)
Cost	0.0437*	0.0317	0.0232	0.0200
	(0.0250)	(0.0254)	(0.0249)	(0.0250)
deposit	0.0213***	0.0174***	0.0116**	0.0160***
	(0.0043)	(0.0045)	(0.0046)	(0.0043)
Nploan	-0.1225**	-0.1121**	-0.1066**	-0.1163**
	(0.0495)	(0.0497)	(0.0486)	(0.0480)
ROE	0.1200***	0.1290***	0.1349***	0.1290***
	(0.0360)	(0.0361)	(0.0357)	(0.0349)
Observations	205	205	205	205
Time dummies	Yes	Yes	Yes	Yes
Joint sig. of time d.	[0.000]	[0.000]	[0.000]	[0.000]
Wald test	2685.9 (15)***	2734.5 (17)***	2845.51 (17)***	2874.47 (17)***
A-B AR(1) test	-6.15***	-6.11***	-5.39***	-5.99***
A-B AR(2) test	1.42	1.38	1.54	1.53
Sargan overid. test	4.53	2.19	1.91	2.03

Notes: *T* statistics are based on robust standard errors and reported in brackets; A-B AR(1) and A-B AR(2) are tests for first- and second-order serial correlation in the first-differenced residuals (Arellano and Bond 1991); $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$.

Source: Author's calculation.

Table 7 The Drivers of Z-score in Europe (2007-2014), Parsimonious Model (Country Group Specific Effects on Cost, Deposit, nploan, ROE)

Acronym	Coeff. sig.	Coeff. sig.	Coeff. sig.	Coeff. sig.
	(1)	(2)	(3)	(4)
L.z_score	0.5523***	0.5661***	0.5773***	0.5841***
	(0.0445)	(0.0496)	(0.0432)	(0.0461)
Branch	-0.0294**	-0.0259**	-0.0244**	-0.0190*
	(0.0116)	(0.0130)	(0.0117)	(0.0110)
Conc	-0.0658***	-0.0614***	-0.0624***	-0.0460***
	(0.0152)	(0.0210)	(0.0153)	(0.0150)
Cost	0.0388	0.0250	0.0297	0.0337
	(0.0244)	(0.0283)	(0.0249)	(0.0263)
cost*EU-13	-0.0506***			
	(0.0119)			
cost*EU-ASS	-0.0435***			
	(0.0148)			
Deposit	0.0153***	0.0166***	0.0167***	0.0186***
	(0.0044)	(0.0056)	(0.0043)	(0.0047)
deposit*EU-13		-0.0391		
		(0.0327)		
deposit*EU-ASS		-0.0547		
		(0.0442)		
Nploan	-0.0973**	-0.1042**	-0.0547	-0.1295***
	(0.0487)	(0.0503)	(0.0511)	(0.0496)
nploan*EU-13			-0.2314***	
			(0.0594)	
nploan*EU-ASS			-0.1863**	
			(0.0836)	
ROE	0.1332***	0.1297***	0.1200***	0.1534***
	(0.0352)	(0.0357)	(0.0353)	(0.0455)
ROE*EU-13				-0.0869
				(0.0741)
ROE*EU-ASS				-0.0922
				(0.1018)
Observations	205	205	205	205
Time dummies	Yes	Yes	Yes	Yes
Joint sig. of time d.	[0.000]	[0.000]	[0.000]	[0.000]
Wald test	2869.15 (17)***	2823.73 (17)***	2810.56 (17)***	2706.95 (17)***
A-B AR(1) test	-5.90***	-5.78***	-5.93***	-5.98***
A-B AR(2) test	1.60	1.59	1.48	1.46
Sargan overid. test	3.11	2.43	2.78	6.86

Notes: *T* statistics are based on robust standard errors and reported in brackets; A-B AR(1) and A-B AR(2) are tests for first- and second-order serial correlation in the first-differenced residuals (Arellano and Bond 1991); $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$.

Source: Author's calculation.

Results in the first column of Table 7 show that positive and not very significant effect of *cost* (bank cost to income ratio) emerged in the baseline model (Table 5) in fact hides remarkable hereogeniety across groups of countries; when the interaction variables are included in the model, the effect for EU-15 countries is not significant, wherease higher cost to income ratios are associeted to lower financial stability (as expected) in EU-13 and EU-ASS.

The inclusion of interactions for the variables *deposit* and *ROE* (columns 2 and 4 of Table 7, respectively), reveal that no statistically significant differences in the effects of these variables emerge for the three groups of countries; this is, however, not the case for the impact of the share of non perfoming loans (to gross loans). Their negative impact on the stability of the banking sector is indeed limited to the case of EU-13 and EU-ASS countries, while no statistically significant effect emerges for EU-15.

5. Concluding Remarks

Ensuring sustainable and steady development of the banking sector depends on its stability, i.e. ability to perform its functions under the influence of internal and external destructive factors. This paper investigated the drivers of financial stability in the banking sector in EU countries and EU associated members. In general, the solidity of the banking sector in EU associated members are obviously lower than levels featured by EU-13, and much lower than in the EU-15. This first piece of evidence calls for urgent and appropriate regulatory activities, in EU associated members, primarily from the central bank, able to pose the conditions for a reinforcment of the financial sector. Econometric results of the present paper suggest on which fronts these initiatives could be implemented. Our empirical model employs the Z-score indicator to measure the stability of the banking sector in the short-term period (annual, quarterly): an increase of the value of this indicator shows an improvement of financial stability of the banking sector and *vice versa* – the decline of this indicator signals less resistance and more vulnerability. Z-scores are used as the dependent variable of dynamic panel econometric model of the drivers of financial instability, estimated by GMM-Sys in order to address various issues simultaneously (namely, the persistence of the dependent variable over time and endogeneity issues). Our analysis covers EU member countries and the three associated countries (Ukraine, Georgia and Modavia) for the period 2007-2014. Results indicatate that for the EU associated countries and post-communist countries the potential sources of voulnerability of the banking sector are more numerous and more powerful. The detrimental effect of banking sector concentration is indeed stronger in the new EU-member states and in the associated countries compared to EU-15; in addition, the negative impact of higher costs and non-performing loans is only statistically significant in these two groups, but not for EU-15. On the contrary, the stability of the banking sector in previous years is more powerful in predicting stability than in the current year in EU-15. In the two remaining groups (and particularly for the associated countries), the fact that the sector was solid in the previous year provides a significantly decreased less guarantee that it will be solid in the future. In other words, the banking sector still remains in EU eastern countries and in EU associated countries, relatively more vulnerable and fragile.

In general, integration into the world economy helps countries improve the efficiency of their banking sectors. As Jens Hölscher, Nicole Nulsch, and Johannes Stephan (2017) recognize, EU membership encouraged early – transition countries to improve the efficiency of their banking sectors. The implementation of the approach in EU countries has been reflected in the banking union formation, the introduction of more stringent regulatory requirements for certain banks, bank merger and acquisition procedures, in accordance with the Basel Committee on Banking Supervision recommendations. As Andreas Horsch, Sysoyeva, and Sergii Bogma (2018) argues, countries which are striving for EU membership should be aware of the institutional change that still leads to additional regulation of European financial markets. Although our empirical analysis only covers a limited set of aspects, based on the experience of the EU-15, other measures should be considered equally urgent in order to assure the preconditions for the effectiveness of the initiative now listed. Based on our results, the priority measures to be implemented in order to improve financial stability in EU

associated countries should include the following measures: (i) reduction of banking sector concentration and a further purification of the banking system from financial institutions which are insolvent or do not comply with the law; (ii) tightening of the sheet balance requirements of banks related to costs and non-performing loans and tightening of banks' lending policies that took place (more thorough credit risk analysis of potential loan applicants and more rigorous qualifications for lending criteria); (iii) encouraging a larger size of deposits in the economy; (iv) limiting the concentration of long-term risks (short-term funding of banks, a significant level of dollarization of the banking sector, high share of public capital in the banking sector).

References

Agoraki, Maria-Eleni K., Manthos D. Delis, and Fotios Pasiouras. 2011. "Regulations, Competition and Bank Risk-Taking in Transition Countries." *Journal of Financial Stability*, 7(1): 38-48. http://dx.doi.org/10.1016/j.jfs.2009.08.002

Anginer, Deniz, Asli Demirgüç-Kunt, and Min Zhu. 2012. "How Does Bank Competition Affect Systemic Stability?" World Bank Policy Research Paper 5981. http://dx.doi.org/10.1596/1813-9450-5981

Arellano, Manuel, and Stephen Bond. 1991. "Some Test of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies*, 58(2): 277-297. http://dx.doi.org/10.2307/2297968

Arellano, Manuel, and Olympia Bover. 1995. "Another Look at the Instrumental Variable Estimation of Error-Components Models." *Journal of Econometrics*, 68(1): 29-51. http://dx.doi.org/10.1016/0304-4076(94)01642-D

Arellano, Manuel. 2014. "Uncertainty, Persistence, and Heterogeneity: A Panel Data Perspective." *Journal of the European Economic Association*, 12(5): 1127-1153. http://dx.doi.org/10.1111/jeea.12105

Baltagi, Badi H. 2001. *Econometric Analysis of Panel Data*. 2nd ed. New Jersey: John Wiley & Sons.

Beck, Thorsten, and Luc Laeven. 2006. *Resolution of Failed Banks by Deposit Insurers: Cross-Country Evidence*. Washington, D. C.: World Bank. http://dx.doi.org/10.1596/1813-9450-3920

Beck, Thorsten, Asli Demirgüç-Kunt, and Ross Levine. 2009. "Financial Institutions and Markets across Countries and over Time - Data and Analysis." Policy Research Working Paper 4943.

Blundell, Richard, and Stephen Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Model." *Journal of Econometrics*, 87(1): 115-143. http://dx.doi.org/10.1016/S0304-4076(98)00009-8

Boyd, John H., and David E. Runkle. 1993. "Size and Performance of Banking Firms." *Journal of Monetary Economics*, 31(1): 47-67. http://dx.doi.org/10.1016/0304-3932(93)90016-9

Carbó-Valverde, Santiago, Luis Enrique Pedauga, and Francisco Rodríguez-Fernández. 2013. "Another Look at Bank Consolidation and Financial Stability." http://www.efmaefm.org/0EFMAMEETINGS/EFMA%20ANNUAL%20MEETINGS/2013-Reading/papers/EFMA2013_0266_fullpaper.pdf. http://dx.doi.org/doi=10.1.1.295.2201

Chant, John. 2010. "Financial Stability as a Policy Goal." Bank of Canada Technical Report 95.

Claessens, Sijn, and Luc Leaven. 2003. "What Drives Bank Competition? Some International Evidence." World Bank Policy Research Paper 3113. http://dx.doi.org/10.1596/1813-9450-3113

Corvoisier, Sandrine, and Reint Gropp. 2002. "Bank Concentration and Retail Interest Rates." *Journal of Banking and Finance*, 26(11): 2155-2189. http://dx.doi.org/10.1016/S0378-4266(02)00204-2

Davis, E. Philip. 2001. "A Typology of Financial Instability." Central Bank of Austria Financial Stability Report 2.

Demirgüç-Kunt, Asli, and Enrica Detragiache. 1997. "The Determinants of Banking Crises: Evidence from Developing and Developed Countries." International Monetary Fund Working Paper 97-106. http://dx.doi.org/10.5089/9781451947175.001

Demirgüç-Kunt, Asli, and Enrica Detragiache. 2011. "Basel Core Principles and Bank Soundness: Does Compliance Matter?" *Journal of Financial Stability*, 7(4): 179-190. http://dx.doi.org/10.1016/j.jfs.2010.03.003

Demirgüç-Kunt, Asli, and Vojislav Maksimovic. 2002. "Funding Growth in Bank-Based and Market-Based Financial Systems: Evidence from Firm Level Data." *Journal of Financial Economics*, 65(3): 337-363. http://dx.doi.org/10.1016/S0304-405X%2802%2900145-9

De Guevara, J. Juan Fernández, and Joaquin Maudos. 2011. "Banking Competition and Economic Growth: Cross-Country Evidence." *The European Journal of Finance*, 17(8): 739-764. http://dx.doi.org/10.1080/1351847X.2011.554300

European Central Bank. 2017. Financial Stability Review 12/12. https://www.ecb.europa.eu/pub/pdf/other/financialstabilityreview201212en.pdf?9bc3b98825a415f9dd214d292d931a63 (accessed June 05, 2017).

Ferguson, Roger W. 2002. "Should Financial Stability Be an Explicit Central Bank Objective?" Paper presented at the Challenges to Central Banking from Globalized Financial Systems of Conference at the IMF, Washington, D. C.

Focarelli, Dario, Fabio Panetta, and Carmelo Salleo. 2002. "Why Do Banks Merge?" *Journal of Money, Credit and Banking*, 34(4): 1047-1066. http://dx.doi.org/10.1353/mcb.2002.0054

Goodhart, Charles, and Miguel Segoviano. 2015. "Optimal Bank Recovery." International Monetary Fund Working Paper 15/127. http://dx.doi.org/10.5089/9781513584263.001

Hansen, Lars Peter. 1982. "Large Sample Properties of Generalized Method of Moments Estimators." *Econometrica*, 50(4): 1029-1054. http://dx.doi.org/10.2307/1912775

Hesse, Heiko, and Martin Čihák. 2007. "Cooperative Banks and Financial Stability." International Monetary Fund Working Paper 07/02.

Hölscher, Jens, Nicole Nulsch, and Johannes Stephan. 2017. "State Aid in the New EU Member States." *Journal of Common Market Studies*, 55(4): 1-19. http://dx.doi.org/10.1111/jcms.12513

Horsch, Andreas, Larysa Sysoyeva, and Sergii Bogma. 2018. "Deposit Insurance Systems of Post-Soviet Countries: A Comparative Analysis." *Journal of International Studies*, 11(4): 22-44. http://dx.doi.org/10.14254/2071-8330.2018/11-4/2

International Monetary Fund. 2013. "Italy: Financial System Stability Assessment." International Monetary Fund Country Report 13/300.

Jahn, Nadya, and Thomas Kick. 2014. "Early Warning Indicators for the German Banking System: A Macroprudential Analysis." *Credit and Capital Markets*, 47(1): 5-47. http://dx.doi.org/10.2139/ssrn.2131128

Jiménez, Gabriel, Jose A. Lopez, and Jesus Saurina Salas. 2010. "How Does Competition Impact Bank Risk-Taking?" Bank of Spain Working Paper 1005. http://dx.doi.org/10.2139/ssrn.1582331

King, Robert G., and Ross Levine. 1993. "Finance and Growth: Schumpeter might Be Right." *The Quarterly Journal of Economics*, 108(3): 717-737. http://dx.doi.org/10.2307/2118406

Laeven, Luc, and Ross Levine. 2009. "Bank Governance, Regulation and Risk Taking." *Journal of Financial Economics*, 93(2): 259-275. http://dx.doi.org/10.1016/j.jfineco.2008.09.003

Loayza, Norman, and Romain Ranciere. 2006. "Financial Development, Financial Fragility, and Growth." *Journal of Money, Credit, and Banking*, 38(4): 1051-1076. http://dx.doi.org/10.1353/mcb.2006.0060

Mishkin, Frederic S. 1999. "Global Financial Instability: Framework, Events, and Issues." *Journal of Economic Perspectives*, 13(4): 3-20. http://dx.doi.org/10.1257/jep.13.4.3

Neter, John, William Wasserman, and Michael H. Kutner. 1985. *Applied Linear Statistical Models: Regression, Analysis of Variance, and Experimental Designs*. Florida: CRC Press.

Oesterreichische Nationalbank. 2016. Facts on Austria, Stability and Security. https://www.oenb.at/en/Publications/Financial-Market/Facts-on-Austria-and-Its-Banks.html (accessed February 27, 2016).

Roodman, David. 2009. "A Note on the Theme of too many Instruments." *Oxford Bulletin of Economics and Statistics*, 71(1): 135-158. http://dx.doi.org/10.1111/j.1468-0084.2008.00542.x

Sargan, J. Denis. 1958. "The Estimation of Economic Relationships Using Instrumental Variables." *Econometrica*, 26(3): 393-415. http://dx.doi.org/10.2307/1907619

Schinasi, Garry. 2004. "Defining Financial Stability." International Monetary Fund Working Paper 04/187. http://dx.doi.org/10.5089/9781451859546.001

Strassberger, Mario, and Larysa Sysoyeva. 2016. "Die aktuellen Entwicklungen der Bankenaufsicht im Lichte der Stabilität des Finanzsystems." *Wirtschaftsdienst*, 96(7): 486-491. http://dx.doi.org/10.1007/s10273-016-2003-3

Van Roy, Patrick. 2004. "The Impact of the 1988 Basel Accord on Banks' Capital Ratios and Credit Risk-Taking: An International Study." Paper presented at the EFMA Basel Meetings, Switzerland.