



## AN ECONOMETRIC MODEL FOR FINANCIAL STABILITY INDICATORS

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**Abstract** *The main aim of this study is to estimate an econometric model for describing the evolution of actives/GDP in 18 European countries in 2010. This variable is a proxy for financial stability and it depends on market share of the first 5 banks in each countries and the inflation rate. Moreover, predictions for 2011 and 2012 were made, a slow increase being anticipated in 2012 compared to 2011.*

**Key words:**

Econometric model,  
estimation, financial stability  
indicators

**JEL Codes:**

C12, C13, G15

### 1. Introduction

The financial stability raises a series of complicated issues of definition and measuring. Such concept has no unique definition, accepted by all the economists and all the central banks.

The financial stability plays an essential role regarding the financial system and the overall economy.

The identification of the risks and vulnerabilities of the entire financial system in its entirety and on its elements is necessary, because the monitoring of the financial stability is prevented. The appearance and development of certain defaults, as well as the incorrect evaluation of the risks and the inefficiency of the capital distribution, can affect the stability of the financial system and the economic stability.

On the other side, we may consider that the financial stability is observed in cases in which no systemic crisis is manifested. On the other hand, taking into account the functions the financial system is having, one may appreciate it is stable when it's able to allocate the economic resources effectively (both in space, and inter-temporal), to administrate the financial risks through a proper measuring and to self-correct when it's affected by external shocks. Therefore, we may consider that a financial system, irrespective of its size or complexity, is stable when it's able to facilitate the performances of an economy and to correct the

unbalances occurring as a result of the significant adverse shocks<sup>1</sup>.

### 2. Literature review

As it may be noticed in chart no. 1, the considered indexes, generally relevant for the analysis and the evaluation of the financial stability are those which reflect the vulnerability of the financial sector (mainly the bank prudence stability), as well as certain indexes which reflect the development process of the financial sector, having into view that a developed and sophisticated financial system can face easily the shocks. In other words, for comparable levels of the bank prudence indexes, the vulnerability of a subdeveloped financial sector is more elevated than the vulnerability of a mature and developed financial sector.<sup>2</sup>

<sup>1</sup> Garry J. Schinasi, "Defining Financial Stability", IMF, WP/04/187, p. 8; Raport asupra stabilitatii financiare 2006, BNR

<sup>2</sup> Cerna, S., s.a. (2008), "Stabilitatea financiara", Ed. Universitatii de Vest, Timisoara, p. 74

Chart no. 1. Indexes of the financial system

Indexes	Kaminsky, Lizondo, Reinhart (1998)	Bussière, Mulder (1999)	Krkosha (2000)	Corker, Beaumont, van Elkan, Iakova (2000)	FMI (2000,2000a, 2001)	Johnston, Chai, Schumacher (2000)	Reininger, Schardax, Summer (2001)	Begg, Eichengreen, Halpern, von Hagen, Wyplosz (2002)	BCE (2002)	von Hagen, Zhou (2002)	Brüggemann, Linne (2002)	Bussière, Frantzscher (2002)	Schardax (2002)	Brouwer, de Haas, Ki viet (2002)	Gabrisch (2002)	Komulainen, Lukkarila (2003)	Gibson, Tsakalotos (2003)
<b>Bank system</b>				√	√	√		√	√						√	√	
Total bank assets (% from IGB)									•								•
Weight of the assets held by the state banks in the total of the bank assets				•				•									
<b>Credit</b>	√	√	√	√	√	√	√	√	√		√	√		√	√	√	
Internal credit (% from IGB)	•								•			•					
Internal non-governmental credit (% from IGB)		•						•								•	
Internal governmental credit (% from IGB), as a measure in which the state calls the bank system to finance						•											
Weight of the non-performing credits in the total of the bank credits				•	•	•		•									
Weight of the credits in foreign currency in the total of the bank credits															•		
Level of focus of the bank credits						•											
Weight of the short-term credits in total of the bank credits							•										
<b>Bank deposits</b>	√				√	√	√		√		√	√					√
Bank deposits (% from IGB)	•								•			•					•
Relationship between the bank reserves and bank deposits					•												•
Weight of the deposits on view in total of the bank deposits							•										
Relationship between bank credits and deposits					•	•											
Dynamics of the bank deposits											•						
<b>Money evolutions</b>	√		√		√	√		√		√	√	√				√	√
Increase rate of the monetary mass	•							•									
Level and volatility of the inflation rate			•		•	•		•				•				•	•
Level of currency of the economy, measured through the relationship between M2 and IGB										•		•					
Relationship between bank deposits and M2																	
Currency multiplier	•										•						

Source: Cerna, S., s.a. (2008), "Stabilitatea financiara", Ed. Universitatii de Vest, Timisoara, pp. 74-77

IFS used by the IMF are mentioned in chart no. 2:

Chart no. 2: Indexes of the financial stability (IFS)

Core Indicators	
Capital adequacy	Capital to risk – weighted assets Tier 1 capital to risk – weighted assets
Asset quality	Nonperforming loans (1/) to total gross loans Nonperforming loans (1/) net of provisions to capital
Earnings and profitability	Return on assets Return on equity (2/) Net interest income to operating income Noninterest expense to operating income (cost to income) Personnel expense to operating income
Liquidity	Liquid assets (3/) to total assets Liquid assets (3/) to short-term liabilities (4/) Liquid assets (3/) to total attracted and borrowed sources
Foreign exchange risk	Net open position in foreign exchange, in percent of capital Lending in foreign exchange, in percent of non-gov. credit Foreign currency liabilities, in percent of total attracted and borrowed source Deposits in foreign exchange, in percent of non-gov. dom. deposits
Encouraged indicators Deposit-taking institutions	Leverage ratio (5/) Personnel expenses to noninterest expenses Customer deposits to total (non-interbank) loans

**Source:** Romanian National Bank

1/ The NPLs represent un-adjusted exposures of loans and related interests overdue for more than 90 days and/or for which legal proceedings were initiated

2/ Return on equity is calculated as Net profit/loss to average own capital

3/ Liquid assets = balance sheet assets and off balance sheets items with residual maturity of up to 3 months

4/ Short term liabilities = balance sheet liabilities and off balance sheets items with residual maturity of up to 3 months

5/ Tier 1 Capital to average assets

### 3. Background research

One index represents an observable variable used for presenting a phenomenon, which is not easily observable. However, a multidimensional economic phenomenon cannot be observed unless there is a synthetic index. In the specialized literature, there are presented several techniques used in the settlement of an index of financial stability:<sup>3</sup>

Gersl and Hermanek (2006), calculate a Czech bank system, hereinafter called aggregate of bank stability, out of which there are the following individual indexes,

appointed as it follows: the properness of the capital (5%), the quality of the assets (25%), the profitability (25%), the liquidity (25%), the risk of the interest rate (10%) and the foreign currency risk (10%). Illing and Liu (2003) on their turn propose a stress index for the financial system, using the market data. Another method consists in the combination of the market data with the balance ones. The Bank of Switzerland (2006) built such a pressure index for the bank sector.

The experts of the Central Bank of the Netherlands chose the elaboration of an original method of construction of a stability index. Van den End (2006) took into account the indexes, which characterize the monetary conditions: the interest rate, the real exchange rate, the volatility of the prices of the financial assets, the solvability of the financial institutions. The new thing, which appears in their study, makes reference to the introduction of the high and low critical limits of such indexes, for the detection of the possible non-linear effects. A low value of the index is associated with the increase of the instability and therefore, a too high value is associated with the accumulation of unbalances. Therefore, an ideal route of the index is that inside the stability corridor.

A last method refers to the construction of an aggregated index of stability through the calculation of the non-reimbursement risk, on the level of the entire financial system, using the template of Merton (Van den End and Tabbæ, 2005).

<sup>3</sup> Albulescu, C.T. (2009), *Stabilitatea sectorului financiar in conditiile aderarii Romaniei la UEM*; [www.researchgate.net/.../Claudiu\\_Albulescu/.../62c1d0da5ed27eed44444a615db24247.pdf](http://www.researchgate.net/publication/221111111/Claudiu_Albulescu/.../62c1d0da5ed27eed44444a615db24247.pdf); pp.345-347

On the settlement of the indexes, several methods of normalization can be taken into account<sup>4</sup>:

- the *statistical normalization*, which consists in the expression of all the values in the standard deviations, after the transformation of the variables, so that their average should be zero.

- the *Empirical normalization*, which comports different techniques on its turn. One of the more often met method is deemed as calculation base of the value of the index in a reference year (the year in which the statistic series starts, for example) and the expression of all the values following by percentage variation to the reference value. Another method consists in allocating the value 0 (min) to the lowest observed value and 1 (or 10 multiplied by 100 if the case may be) to that recording the best score (max). All the interim values will be calculated after the following formula:

$$Y = X - \text{Min}/(\text{Max} - \text{Min}).$$

- the *axiological normalization*, similar to the empirical one, within the min and max limits, is characterized through the fact that the limits are not imposed under the statistic observations, but are chosen according to the action and evaluation context of the situation from which we want to be apart (and to which the value 0 is normally allocated) and the situation considered as ideal (which can or cannot correspond to a strategic scope) and which will receive the value 1.

- the *mathematical normalization*, consists in the transformation of the data with a mathematical formula, insuring the fact that the values will be recorded between a low and high limit (for example -1 and +1 or 0 and 1).

#### 4. Methodology of research

An econometric model for predicting actives per GDP in Romania

Financial intermediation is expressed by a proxy variable like the ratio actives/GDP. This financial intermediation might depend on the market share of the first 5 banks in a country and the inflation rate. Our sample consists in 18 countries for which the values for the three variables were registered. The selected countries in the sample are: Austria, Bulgaria, Czech Republic, Estonia, France, Germany, Greece, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Hungary and Romania. The source of data is represented by the Central European Bank (Statistical Data Warehouse). The data provided by Central European Bank cover the values for 2010, being presented in the following table:

Table 1. The statistical indicators corresponding to 2010

Country	Actives/GDP	Market share of the first 5 banks (%)	Inflation rate (%)
Austria	336.4	35.9	1.7
Bulgaria	109.6	55.2	3
Czech Republic	116.5	62.4	1.2
Estonia	119.1	92.3	2.7
France	420.7	47.4	1.7
Germany	326.5	32.6	1.2
Greece	221.7	70.6	4.7
Italy	257.6	39.2	1.6
Latvia	146.9	60.4	-1.2
Lithuania	80.4	78.8	1.2
Netherlands	402.4	84.4	0.9
Poland	83.7	43.4	2.7
Portugal	335.4	70.8	1.4
Slovakia	84.0	72.0	0.7
Slovenia	147.1	59.3	2.1
Spain	337.4	44.3	2
Hungary	113.9	54.7	4.7
Romania	67.9	55.2	6.1

More econometric models were proposed but the following type of model was valid:

$$\log(\text{actives\_per\_gdp})_i = c + a \cdot \log(\text{market\_share})_i + b \cdot \text{inflation}_i + \text{error}_i$$

The estimated model has the following form:

$$\log(\text{actives\_per\_gdp})_i = 8.15 - 0.68 \cdot \log(\text{market\_share})_i - 0.12 \cdot \text{inflation}_i$$

The assumptions of classical multiple regression model were checked in order to test the model' validity.

According to Breusch-Godfrey Serial Correlation LM test there is not errors serial correlation. The probability associated to the test's statistic being greater than the level of significance (0.05).

Table 1. Breusch-Godfrey Serial Correlation LM Test

F-statistic	3.690484	Prob. F(1,14)	0.0753
Obs*R-squared	3.755053	Prob. Chi-Square(1)	0.0526

The White test used to check the homoscedasticity /heteroscedasticity of the errors was applied. The probability of the statistic test is greater than 0.05. Therefore, for a 5% level of significance we may assume that there is not enough evidence to reject the homoscedasticity hypothesis.

<sup>4</sup> Idem 3, p. 348

The White test used to check the homoscedasticity/heteroscedasticity of the errors was applied. The probability of the statistic test is greater than 0.05. Therefore, for a 5% level of significance we may assume that there is not enough evidence to reject the homoscedasticity hypothesis. The Jarque-Bera test applied to check the distribution normality conducted us to the conclusion that we do not have enough evidence to reject the errors' normality assumption. In the graphical representation we may observe that the

distribution is skewed and the skewness coefficient is very close to zero (0.22).

Table 2. Heteroskedasticity Test: White test

F-statistic	1.057194	Prob. F(5,12)	0.4298
Obs*R-squared	5.504318	Prob. Chi-Square(5)	0.3575
Scaled explained SS	1.562960	Prob. Chi-Square(5)	0.9057

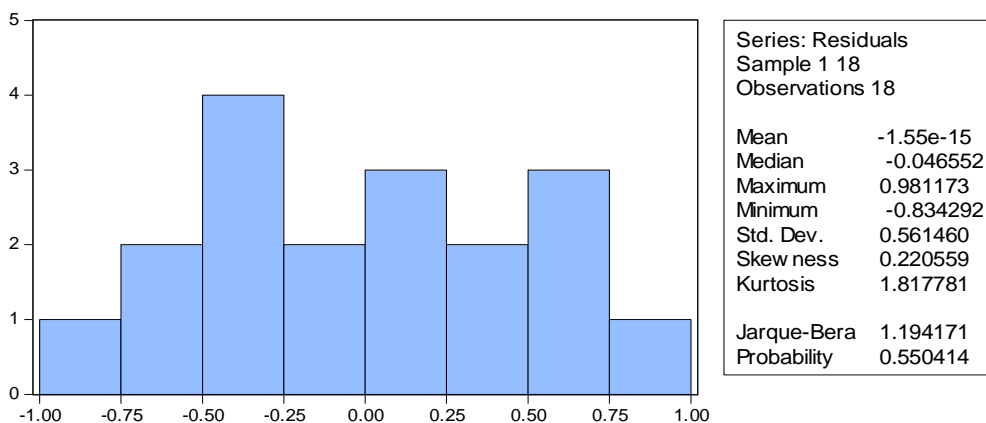


Figure 1. The errors' distribution and Jarque-Bera test

Therefore, we can conclude that the proposed model is valid. This model can be used to make predictions of actives per GDP for any country in the sample. We can make forecasts for Romania on the horizon 2011-2012.

Table 3. Forecasts of actives per GDP for Romania (horizon: 2011-2012)

Year	Actives per GDP forecast (%)
2011	60,258
2012	61,32

On the horizon 2011-2012 the model predicted a slow increase of the actives/GDP in Romania.

### 5. Conclusions

In this study an econometric model was proposed for a proxy of financial stability indicator called ratio actives/GDP. It depends on the inflation rate and market share of the first 5 banks in each of the 18 selected countries (Austria, Bulgaria, Czech Republic, Estonia, France, Germany, Greece, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Hungary and Romania. All the assumptions for error terms were checked and the proposed model was valid. Moreover, predictions were made for 2011 and 2012, observing a slow increase of the ratio actives/GDP.

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