Assessing Romanian financial sector stability: the importance of the international economic climate

Albulescu, Claudiu Tiberiu

Université de Poitiers

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Assessing Romanian Financial Sector Stability: The Importance of the International Economic Climate

Claudiu Tiberiu Albulescu♣

Abstract

The aim of this paper is to develop an aggregate stability index for the Romanian financial system. The index which is meant to enhance the set of analysis used by the central bank to assess the financial stability accurately reflects the financial stability dynamics and the periods with financial turbulences during 1997-2007 in Romania. By the application of a technique which enables the measurement of the components' contribution to the aggregate index volatility, we show that some individual stability indicators require a close monitoring by the authorities in order to detect the instability periods.

Several attempts to set up a financial stability aggregate index can be found in the literature, but none of these studies took into consideration the spillover effect between different financial markets. One of the contributions of our paper is the introduction within the aggregate index of an indicator capable of highlighting the international economic climate. The deterioration of the world economic climate can represent the background for the contagion phenomenon.

The outcome of the study shows an improvement of the Romanian financial stability during the analysed period. The aggregate index volatility also decreased starting with 1999. The financial vulnerability and financial soundness indicators have a significant contribution to the volatility of the aggregate index in the periods foregoing the crisis appearance. On the contrary, the volatility of the world economic climate indicators is reduced before the crisis, rising immediately after its burst out.

Key words: *financial stability, quantitative methods for assessing systemic stability, aggregate financial stability index, world economic climate index*

JEL classification: *C43, E58, F15*

♣ PhD Candidate, West University of Timişoara – Faculty of Economics and Business Administration and University of Poitiers – Faculty of Economic Sciences (E-mail: claudiual@yahoo.com; Phone: 0040743089759).

1. Introduction

Systemic financial stability became during the last years one of the major concerns of supervision authorities and of central banks. The calculation of an aggregate financial stability index (AFSI) represents, besides the early warning systems and the *stress-tests*, one of the quantitative methods measuring the stability of a financial system. Each of these techniques involves both advantages and inconveniences related to the capacity to provide accurate information in respect of the stability level[1]. Therefore, the early warning systems enable the forecasts related to the probability of financial crisis appearance, but they neither offer the possibility to include in the calculations all the risks to which the system is exposed, nor do they provide information related to the shocks response capacity. The *stress-tests* techniques allow the identification of potential shocks and estimate the financial system resistance, but there is no possibility in this case to compare the stability level during different periods or the stability level of financial systems in two or more countries.

On the other hand, financial stability aggregate index offer the possibility to make comparisons between different periods, different financial systems and they also enable the observation of the stability level trend. Even if this technique is considered to be simple, rigid and mechanical, it presents numerous advantages as compared to the other methods: high transparency, possibility to easier identify necessary statistic data and simplicity of calculations. The main impediments in the creation of an AFSI consist in the selection of the individual indicators, normalization method and weighting system.

The financial stability represents a dynamic process and therefore the stress must fall on the evolution of this index in time. Consequently, in our empiric study we use quarterly data, which allow a more accurate analysis as compared with annual data. At the same time, we took into account different categories of individual indicators connected with the financial stability, having also in mind the availability of the information: indicators characterizing the financial system

[1] The stability of a financial system refers to the capacity to carry out appropriately its functions during an undetermined period, by correcting the imbalances frequently occurring in its operational mechanisms. At the same time, systemic stability refers to the capacity of the financial system to protect itself against shocks that can destabilize its components. The concept is often defined as lack of instability.

development, its vulnerability, the banking sector soundness (the sector with the highest importance in the Romanian financial system), but also the international economic climate which, as we have seen, plays an important role in the destabilization of the investors' confidence.

The study has the following structure. In section 2, different methods used by specialists to create an AFSI are briefly described. The next section presents the construction method for the Romanian financial system aggregate stability index, starting with the selection of the individual indicators and passing to their normalization and aggregation. This part also highlights the improvement of the financial stability in Romania, identifying at the same time the crisis periods (the year 1998 for Romania). Section 4 is dedicated to an exercise which gives us the opportunity to analyze the AFSI volatility in the period 1997-2007, as well as the contribution of individual indicators to this volatility. This is a special exercise because it indicates the most volatile variables during financial instability periods. The last section points out the findings of this study.

2. Different methods for the aggregate index development

An indicator represents an observable variable used to describe a phenomenon which is difficultly seized. Nevertheless, a multidimensional economic phenomenon can only be seen by means of a synthetic index, an index which aggregates different so-called "basic" indicators. The concentration of a multidimensional reality within only one number could appear as an exercise with a lot of restrictions, but in the financial stability literature several such attempts exist.

We can thus discover various techniques used to create a financial stability index. One simple method is that enabling a mechanical comparison between the individual stability indicators characterizing different financial systems and it consists of a hierarchy of individual indicators values (the aggregate index components). The inconvenience of this non-parametric method comes from the minimum differences between the values of the indicators having the same weight within the aggregate index.

The aggregate index can also be built as a weighted average of individual indicators (see Călin (2004) and Rouabah (2008)). The National Bank of Turkey uses at present such a method. In a recent study about the Romanian financial system stability, made in order to asses the opportunity of Romania's accession to the eurozone, we also used an individual indicators weighted average (Albulescu, 2008).

An ample presentation of the literature on this subject is carried out by Gersl and Hermanek (2006) who calculate an aggregate index for the Czech banking sector, using again the normalization and aggregation procedures. This index is called "banking stability aggregate index". The indicators were selected based on current international practice, and their weights were established based on the authors' experience and judgements.

A third method consists in the construction of an aggregate index, based on daily financial markets data (share prices or prices of other banking assets). Nelson and Perli (2005) describe such an index, called "financial fragility index". Their study concentrated on the United States financial system, and the authors demonstrated that this aggregate fragility index can bring its contribution to forecasting the probability according to which a turbulent period occurs. The index construction follows a two-step process: a) the information included in 12 individual variables were grouped in three indicators which took into account their level, volatility and correlation; b) a *logit* model is estimated to obtain the probability that, at any given time and based on the three summary statistics, the behaviour of financial markets is analogous to that of previous financial crisis.

$$P_t = L\,(\beta_O + \beta_1\,\lambda_t + \beta_2\delta_t + \beta_3\gamma_t)$$

where: λ denotes the level indicator, δ represents the rate-of-change indicator, and ρ is the co-movement indicator.

Illing and Liu (2003) constructed a "financial stress index" using market data. A more complex method consists in combining market data and balance sheet data and the Switzerland National Bank built a "stress index" for the banking sector using this method.

Experts from the Netherlands Central Bank had an original approach to the construction of the index (Van den End, 2006). The "financial stability conditions index" is built based on indicators characterising monetary conditions, namely: interest rates, effective exchange rate, real estate prices, stock prices, solvency of financial institutions and volatility of financial institutions stock index. The innovation of this index resides in the introduction of some upper and lower critical limits to take account of potential non-linear effects. A low value of the indicators means increased instability, whereas too high values may result in the accumulation of financial imbalances. Therefore, the ideal evolution of the index is the one within a particular financial stability band.

The last method consists in the construction of an ASFI by calculating the default rate for the entire financial system using the Merton approach (Van den End and Tabbae, 2005). A similar index assessing the systemic risk, based on the stochastic distribution of individual financial institutions default, was also proposed by Čihák (2007). The advantage of this method is the interconnection between financial perturbations and business cycle. However, the application of this method supposes liquid capital markets with active banks, which represents an inconvenient for the stability analysis of a less developed financial system.

The design of an AFSI does not represent an arbitrary exercise. It is necessary to follow several well defined steps. First of all, different dimensions defining the multidimensional concept have to be identified. For example, the total credit refers to governmental and private credit, which can be denominated in different currencies, having different maturities, etc.

These multiple dimensions are afterwards split in variables out of which some will be selected as individual indicators, depending on their relevance and quantification possibility. For example, if the banking sector represents the dominant sector within the financial system as compared with the insurance sector or capital markets, the indicators selected for the financial stability analysis are mainly those reflecting the banking institutions situation.

After the indicators are defined, they have to be quantified. The accuracy level and measurement scale have to be established. It often happens that the individual indicators do not have the same accuracy or the same units of measurement, situation which is obviously complicating the aggregation into a synthetic index. The indicators' values have thus to be normalized.

Several normalization methods can be taken into account, as neither of them is satisfactory enough. The use of some methods has to take into consideration the number and the type of the indicators (quantitative or qualitative). The most common normalization methods are:

- *Statistical normalization* consists in expressing all values in standard deviation, so that the variables average is equal to zero.

- *Empirical normalization* supposes different techniques. Usually the benchmark is represented by the value of the indicator in a reference year.

Another method gives the 0 value (Min) to the most unfavourable observed value and 1 or 10 (Max) to the best recorded value. All intermediary values are calculated based on the following formula: Y = X – Min/(Max – Min).

- *Axiological normalization*, resembling to the empirical approach with *min* and *max* limits, characterized by the fact that the limits are not statistically identified, being chosen based on the undesirable situation, which receives the "0" value, and on the ideal situation, which can or can not correspond to a strategic objective and which receives the value "1".

- *Mathematical normalization* consists in transforming data by means of a mathematic function in order for the values to range between an upper and a lower limit (e.g. -1 and +1 or 0 and 1).

The next step in index construction is the aggregation of individual values. This equals with an answer to the following questions: Do all criteria have to have the same weight or different weight are needed, and if so, which are these different weights? Which is the relation between the aggregate index and the individual indicators? A sum or an arithmetic average has to be calculated?

In order to reach an answer, it is necessary to build up a hierarchical decision tree which will enable the weighting of the indicators based on their importance. This supposes the classification of *m* versions, either based on a unique criterion made up by the aggregation of the *n* objectives, or based on several criteria (multicriteria approach).

Even if the normalization and the aggregation methods raise important theoretical and practical problems, the major inconvenient relates to the indicators weighting. We can choose either to give the same importance to all the variables or to apply a different weight based on the decision making criteria.

The standard procedure consists in giving the same weight to all the variables which are included in the aggregate index. Another possibility is to transform the variables in percentiles, using their sample cumulative distribution function – CDFs (Rouabah, 2008). In this case, the last percentile corresponds to a high instability period, while the value of the first percentile characterise a low stress level. The other values around the median reflect an average risk level. Before building the aggregate index, the normalised variables are aggregated in a chain index and the connection between them can be established using the arithmetic mean as well as the geometric mean, according to the formulae:

Arithmetic mean: $$AFSI = \frac{\sum_i (X_{it} w_{it}) + \sum_i (X_{it} w_{it-1})}{2} \quad (1)$$

Geometric mean: $$AFSI = \sqrt{\sum_i (X_{it} w_{it}) * \sum_i (X_{it} w_{it-1})} \quad (2)$$

Where (X_{it}) represents the individual transformed variables and (w_{it}) stands for their weight within the index in the (*t*) period. The weight is calculated based on the ratio between the normalised variable and the sum of all the variables at the (*t*) moment.

A last possibility to calculate the aggregate index, method which is identified in the literature, is to use a factor analysis. The principal components analysis represents a reliable method used as a tool in exploratory data analysis. The method resides in identifying some axes to explain most of the variables' inertness. After the identification of the main components, the aggregate index will be calculated by means of a standard method.

In the following section we will describe the construction method of an AFSI for the Romanian financial system, using the standard procedure. This method goes in line with the exercises made by Călin (2004), Gersl and Hemanek (2006), and Albulescu (2008). The difference consists in including within the aggregate index, variables characterizing the world economic climate, besides variables reflecting the financial system soundness, development and vulnerability. At the same time, we have monitored this phenomenon dynamics based on quarterly data for a ten years period, using the empirical normalization method, which allows the identification of crisis periods. Another contribution to the economic literature lies in the AFSI volatility analysis and in the assessment of the contribution of each individual (composite) indicator to AFSI volatility.

3. Aggregate financial stability index for the Romanian financial system

In order to build an AFSI we used quarterly data and the benchmark was represented by the worst and the best indicators values in the analyzed period. Another solution could be to choose as benchmark indicators values during crisis periods (e.g. the indicators values during the banking crisis in 1998 in Romania). Because the second approach would have led us directly to the results, we preferred the first method.

The normalized indicators values range between [0;1], facilitating their aggregation and analysis. The value "1" indicates a stability situation and it is equal to the best recorded value of each indicator and the value "0" reflects the opposite case. The formula used for the normalization process is:

$$I_{it}n = \frac{I_{it} - Min(I_i)}{Max(I_i) - Min(I_i)} \qquad (3)$$

where: I_{it} represents the value of type *i* indicator during *t* period; $Min(I_i)$ and $Max(I_i)$ is the minimum respectively the maximum value recorded by type *i* indicator in the analyzed period; $I_{it}n$ is the indicator's normalized value.

The individual indicators, grouped based on the composite (partial) stability index to which they belong, are listed in Table 1:

Table 1: Individual indicators for financial stability analysis

Individual indicators		
Total Credit / GDP	I_{d1}	*Financial Development Index (FDI)*
Interest spread	I_{d2}	
Market capitalisation / GDP	I_{d3}	
Banking reform & interest liberalisation	I_{d4}	
Inflation rate	I_{v1}	*Financial Vulnerability Index (FVI)*
(Reserves / Deposits) / (Note & coins / M2)	I_{v2}	
General Budget Deficit (% GDP)	I_{v3}	
Non Governmental Credit / Total Credit	I_{v4}	
Loans as a percentage of deposits	I_{v5}	
Deposits / M2 (variation %)	I_{v6}	
Non-performing loans / Total loans	I_{s1}	*Financial Soundness Index (FSI)*
Regulatory capital / Risk weighted assets	I_{s2}	
Own capital ratio (Own capital / Total assets)	I_{s3}	
Liquidity Ratio (Effective liquidity / Required liquidity)	I_{s4}	
General risk ratio	I_{s5}	
Economic Climate Index	I_{w1}	*World Economic Climate Index (WECI)*
World Inflation	I_{w2}	
World Economic Growth Rate	I_{w3}	

The selected indicators (a total of 18) are often used in financial stability literature. Due to the fact that banking sector stands as the sector with the most significant importance within the financial system, most indicators refer to banks. We also took into consideration the indicator “market capitalisation to GDP”, indicator reflecting the development of the capital market, because this market knew a continuous ascendant trend during the last years in Romania. We left aside from our analysis indicators related to the insurance sector, still poorly developed in Romania, as this sector does not represent at present a potential systemic risk source.

In order to analyze the *financial system development* level, many studies appeal to indicators such as “banking assets to GDP” and “total credit to GDP”. In this case we preferred the second indicator which provides information related to the financial intermediation level. The highest this level is, more developed and more mature the banking system is considered.

The “interest spread”, calculated as the difference between the average lending rate and the average borrowing rate, represents another indicator which reflects the system’s development level. In the context of increased competition and penetration of important banking groups on Romanian banking market, the interest spread shows a decreasing trend, even if a few years ago its level was quite high. An increased real interest spread characterizes a high profitability of the banking sector necessary to guarantee its stability, offering at the same time signals that this sector is immature and poorly developed. An increased interest spread can point out financial instability periods when the credit institutions undertake additional protection measures against potential risks.

The last indicator in this category reflecting the financial system development is a European Bank for Reconstruction and Development (EBRD) calculated indicator, which shows the status of banking reforms and the interest for liberalisation.

The starting-point in assessing *financial vulnerability* is represented by the analysis of the indicators that the International Monetary Fund (IMF) presents in its country reports. In this set of indicators we can distinguish a group which characterizes the macroeconomic stability and another group which describes the funding structure. These indicators are more accessible to the public and therefore are often analyzed by the investors. The sustainable values of the vulnerability indicators show that the financial system is sound and capable to respond to potential shocks.

The first indicator retained in this category is the “private credit to total credit ratio”. In our study, the private credit is represented by the non governmental credit. After 1990, many banks financed public companies in Romania and an important part of these loans became non performing loans. That is why a decline of the indicator’s value reflects a favourable situation.

The banks reserves represent a guarantee related to the bank’s capacity to respond to severe withdrawals of money. In Romania, the minimum reserve required has been used as an important monetary policy instrument against prices increase. The reserves to deposits ratio is above the level registered in other financial systems. At the same time, the liquidity preference is important because the stronger the cash payments preference manifests, the more significant the increase of withdrawals probability is. To highlight these assumptions, we have retained as indicator the ratio between “reserves to deposits” and “note & coins to M2”.

The specialists also consider the “inflation rate” as a macroeconomic vulnerability indicator. The Central Banks main objective is price stability. A sustainable level of these indicators increase the investors’ confidence and it is very important for the financial stability. Another macroeconomic indicator which describes the government performance is the “general budget deficit to GDP”. If the budget deficit is high, the investors lose their confidence in the government capacity to ensure a future sustainable economic growth.

The last two vulnerability indicators retained in our analysis have the capacity to issue signals about an eventual financial crisis. The credit boom which is not accompanied by a deposits’ expansion shows a potential imbalance within the financial system (the confidence in the national currency diminishes). The “deposits to money supply - M2” ratio reflects the relation between savings and consumption. A deterioration of this indicator’s value shows at the same time, the currency depreciation, the savings reduction and the consumption increase.

The third category of selected indicators is related to *financial system soundness*. These indicators are proposed and used by the international financial institutions in assessing financial system soundness exercises. The access to these data is not easy, especially when we need quarterly data. That is why we have used several databases, including the IMF country reports.

The first soundness indicator is represented by the “NPL to total loans ratio” and reflects the loans quality. Even if the indicator shows an improvement in the last period, we have to say that the volume of non-performing loans considerably increased once the credit boom occurred.

The second indicator in this category – "own capital to total assets" - reveals the banking system capitalization level. The Romanian banking system is well capitalized and the NBR had an important role in this direction.

The third indicator, "regulatory capital to risk weighted assets ratio", also characterizes the banking sector capitalization, but the most important information offered by this indicator is related to banking institutions' solvability.

The fourth indicator is a "liquidity indicator" calculated by the NBR as a ratio between effective and required liquidity. The last financial soundness indicator is represented by a "general risk indicator" presented by the NBR in its monthly bulletins. The choice of financial soundness indicators was made in order to include in the analysis some important aspects of banking institutions soundness such as: lending activity performance, capital adequacy, liquidity and solvability.

The last category of individual stability indicators characterizes the *world economic climate*, such as "world inflation", "world economic growth", and an index calculated by the Center for Economic Studies & Institute for Economic Research (CESifo) using the business climate perception about investment opportunities – "economic climate index". All financial systems are interconnected and a deterioration of these indicators has a negative impact at national level, both for economic and financial stability.

The data used in our analysis were extracted from several databases. The lack of quarterly data on some financial soundness indicators, for the entire analyzed period, represented a big problem. Most of the indicators were collected from the NBR monthly bulletins. The "NPL to total loans ratio", on annual basis, was found in the IMF country reports. We transformed these data into quarterly data using the linear interpolation. The other two indicators, calculated by means of linear interpolation and extracted from the EBRD database, are "banking reform & interest liberalisation" and "general budget deficit to GDP". All the other individual indicators were extracted on a quarterly basis from the Eurostat database, International Financial Statistics database (IMF) and CESifo database.

The individual indicators were grouped into four composite index[2], presented in Table 1 above: *a financial development index* (with four individual indicators), a *financial vulnerability index* (with six individual indicators), a *financial soundness index* (with five indicators) and a *world economic climate index* (with three indicators).

We assigned the same weight to all individual indicators in order to calculate the composite index (in the case of unavailable data, this method makes possible the calculation of the composite index based on available observations). The exception is represented by the WECI, where the economic climate index calculated by the CESifo (which contains the business climate anticipation based on world macroeconomic context) receives a more important weight as compared to world inflation and world economic growth (a different weight can be applied only if we dispose of complete statistical data).

$$FDI = \frac{\sum_{j=1}^{4} I_{dj}}{4} \quad (4)$$

$$FVI = \frac{\sum_{j=1}^{6} I_{vj}}{6} \quad (5)$$

$$FSI = \frac{\sum_{j=1}^{5} I_{sj}}{5} \quad (6)$$

$$WECI = 0{,}5 * I_{w1} + 0{,}25 * I_{w2} + 0{,}25 * I_{w3} \quad (7)$$

The AFSI was built by giving the same importance (0,6) to the individual financial stability indicators which describe the financial system vulnerability, development and soundness. A lower weight was assigned to the world economic climate indicators, because these indicators must be carefully analyzed, depending on capital account liberalisation degree, foreign investment, trade partners' economic situation, etc. The aggregate index calculation formula is[3]:

$$ISF = 0{,}24 * IDF + 0{,}36 * IVF + 0{,}3 * FSI + 0{,}1 * WECI \quad (8)$$

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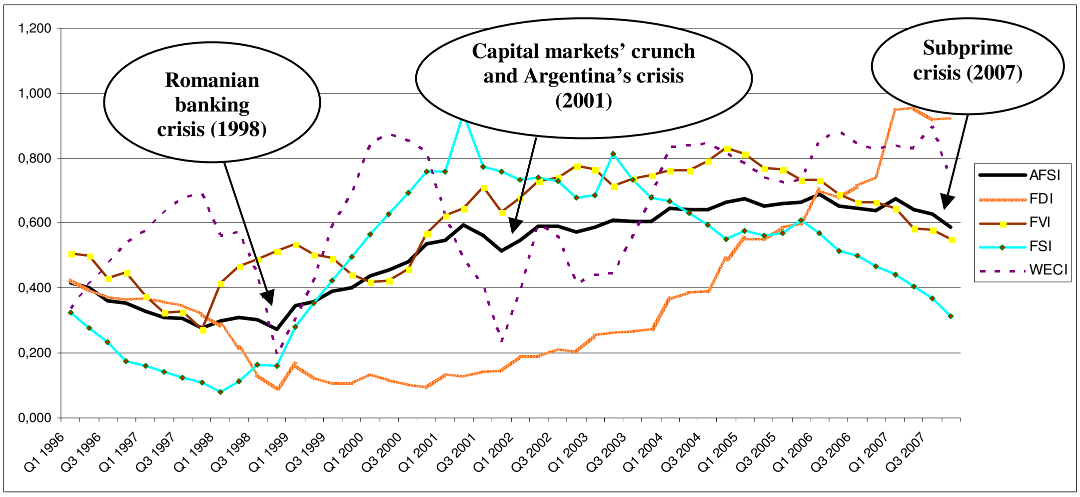
[2] There must be no confusion between a composite and the aggregate financial stability index. The composite index includes the individual indicators and is included in the aggregate index.

[3] The detailed calculation of the aggregate index is: AFSI = 0,6*(I_{d1} + I_{d2} + I_{d3} + I_{d4}) + 0,6*(I_{v1} + I_{v2} + I_{v3} + I_{v4} + I_{v5} + I_{v6}) + 0,6*(I_{s1} + I_{s2} + I_{s3} + I_{s4} + I_{s5}) + 0,5*I_{w1} + 0,25*I_{w2} + 0,25*I_{w3}= 4*0,6(I_{d1} + I_{d2} + I_{d3} + I_{d4})/4 + 6*0,6(I_{v1} + I_{v2} + I_{v3} + I_{v4} + I_{v5} + I_{v6})/6 + 5*0,6(I_{s1} + I_{s2} + I_{s3} + I_{s4} + I_{s5}) /5 + 0,1*(0,5*I_{w1} + 0,25*I_{w2} + 0,25*I_{w3})= 0,24*FDI + 0,36*FVI + 0,3*FSI + 0,1*WECI

The normalized values of the individual financial stability indicators are presented in Annex 1 and the tendency of the aggregate index and composite index is shown in the Figure 1.

Figure 1: Aggregate index and composite index trend



Source: author's calculations

A general positive evolution of the AFSI can be observed beginning with 1999. The deterioration of the AFSI occurs before and during the 1998 Romanian banking crisis, and also during the second half of 2001 and 2007 (global capital market crisis). It is also important to observe the WECI trend, which decreases after the Asian financial crisis in 1997 and before the 2001 capital market crisis. The financial soundness index (FSI) substantially declines before the 1998 crisis (the high level of NPL was the main reason of banks' bankruptcy) and also after 2002, once the credit boom begins.

The FDI does not represent an index which issues signals about the beginning of financial instability periods. The index deterioration takes place after the banking crisis when the banking sector passes through a reforming process. After 1999-2000 the trend is favourable. A decrease in the index value can also be seen in the second part of 2007 when the interest spread augments. The FVI value improves after the banking crisis, but the opposite trend appears after 2005, when the credit to deposits ratio deteriorates. We observed that this index is the first element which signals an instability period, being also correlated with business cycle.

As a conclusion, the improvement of the Romanian financial system stability level occurred after 1999, in the context of financial system development, macroeconomic indicators' improvement and world economic climate amelioration. At the same time, the banking system soundness indicators values decline.

Nevertheless, a simple analysis of these indexes does not provide enough information about the financial stability dynamics or about indicators which require particular attention. Therefore, we will address, in the next section, the volatility of the stability index and the contribution of each composite index to the AFSI volatility in order to achieve a deeper and more refined analysis.

4. Aggregate Financial Stability Index Volatility

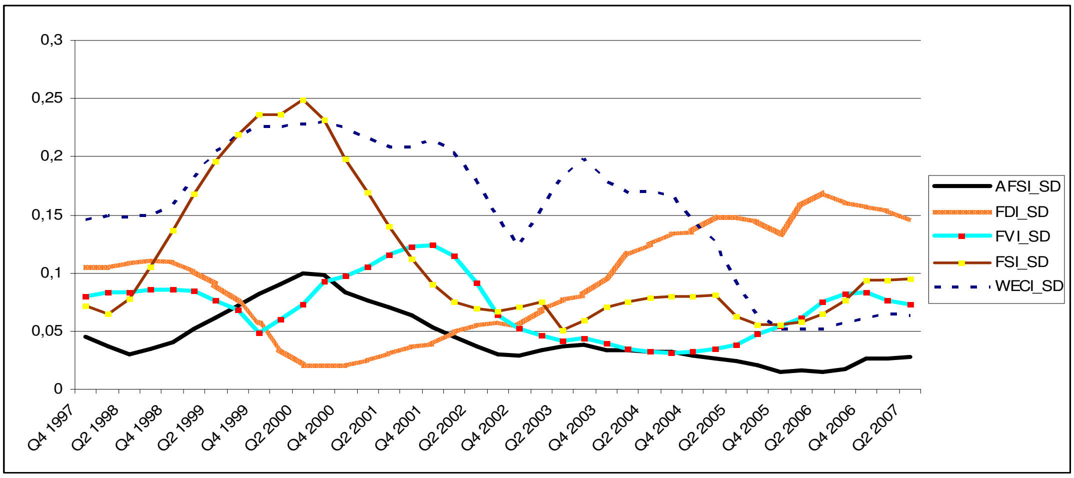
In order to perform this analysis, we have used the Chanut - Laroque method (1979) which we adjusted to integrate the composite indicators weights, resulting in the following relation: $x(t)=\sum_{i=1}^{m} xi(t)$ (for details, see Annex 2). The aggregate index growth ratio will thus become:

$$x(t)=0,24*x_{FDI}(t)+0,36*x_{FVI}(t)+0,3*x_{FSI}(t)+0,1*x_{WECI}(t) \quad (9)$$

where: x_{FDI}, x_{FVI}, x_{FSI} and x_{WECI} represent the contribution of the indicators *FDI, FVI, FSI* and *WECI* to the growth of the *AFSI*.

The indicators' standard deviation is shown in Figure 2. This is calculated based on a 12 quarters rolling window. A more extended time interval for establishing the standard deviation involves, on the one hand, an increase in the volatility calculation accuracy, but on the other hand, a loss of information related to the recent period as well as to the banking crisis in 1998. The chosen solution, namely the calculation of the standard deviation based on progressive intervals of three years, represents a compromise.

Figure 2: Standard deviation of *FDI, FVI, FSI* and *WECI*

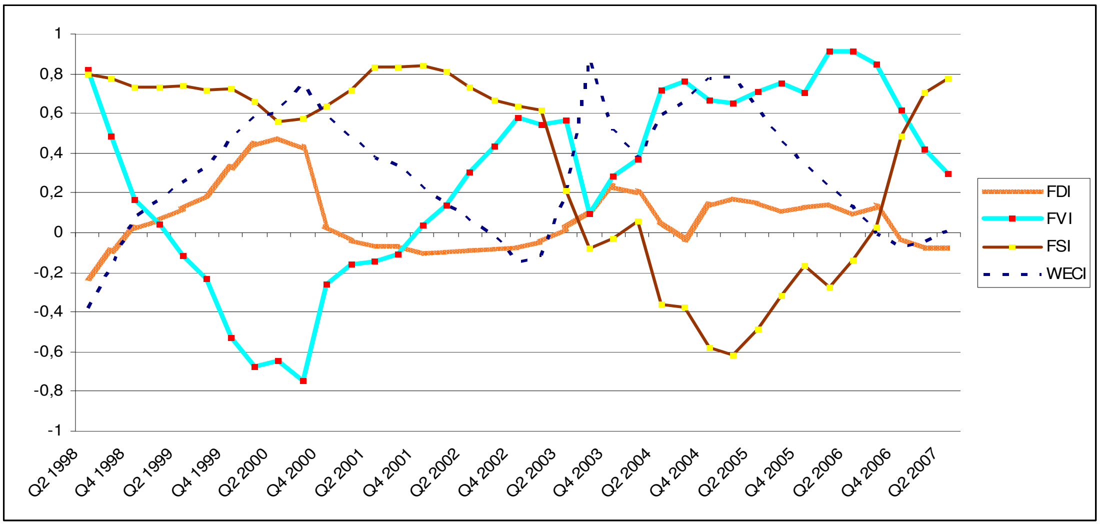


Source: author's calculations

An increase of the indicators' volatility immediately after the crisis from 1998 and a reduction of their volatility starting with 2001 can be observed in Figure 2. The FDI volatility is the exception, being influenced by the financial intermediation development. The AFSI's volatility was high during 1999, period when the system's reforms began.

In respect of the contributions to the AFSI's volatility (Figure 3), we can see that the FVI has an important contribution to the aggregate index volatility during the entire analyzed period. The financial soundness indicators show a similar contribution to the AFSI's volatility, but in the opposite direction. It can be observed that during crisis period both indicators represent an important part of the AFSI's volatility. On the contrary, and also due to their more reduced weight within the aggregate index, the FDI and WECI have a less significant contribution to the volatility.

Figure 3: Contribution of the indicators FDI, FVI, FSI and WECI to AFSI's volatility



Source: author's calculations

The aggregate financial stability index has a construction similar to that of the Consumer Price Index (CPI), the only difference being the fact that the CPI measures the price level, while the AFSI measures the stability level. The individual indicators we have used are not the only indicators which can be taken into consideration in such analyses. At the same time, the weight of the indicators can be changed in the same manner as the composition of the basket of goods and services used for calculating the Consumer Price Index (CPI), depending on each financial system features. The AFSI has to be seen as a method to analyze the stability, complementary to the EWS and to the stress-tests.

5. Conclusions

The construction of an aggregate financial stability index represents one of the methods which can be used to measure the systemic financial stability. The AFSI is meant to supplement the early warning systems which allow the detection of financial crisis appearance, but also to supplement the stress-tests that show the system's resistance in front of possible destabilizing shocks.

Its advantages reside in calculations' simplicity, data's accessibility and appropriate transparency level. This index provides the analysts with the possibility to compare different financial systems in terms of stability and also allows them to observe the financial stability dynamics. The inconveniences, or rather the deficiencies, of this method are of a similar importance. It is difficult to exactly predict the probability of a crisis appearance or to measure the system's capacity to withstand potential shocks.

The technique which is based on the calculation of an aggregate financial stability index, even if simple at a first view, is not arbitrary. Several steps need to be followed: selection of individual indicators, selection of the method for their normalization and identification of a weighting method (which relies on the retained criteria and on the established weights). The individual indicators' selection depends on the features of the system, but also on the availability of data. The weight is given by the importance assigned to each individual indicator within the structure of the aggregate index.

In our study, we have built an AFSI for the Romanian financial system, a system where the banking sector prevails. The used individual indicators refer to the system's development level, to its vulnerability, to banks' soundness and to world economic climate. The major contribution of the paper consists in the identification of Romanian financial system turmoil by means of an aggregate stability index. Another contribution of the study is the introduction within the aggregate index of some indicators such as world economic growth ratio or perceptions of the business climate at international level. This is extremely important in the context of globalization. We have observed the way in which the "subprime" crisis in the United States brought forth a credit crisis and a capital market crisis, even in countries where the macroeconomic and financial indicators showed a favourable evolution. The last important contribution of the study is the analysis of the aggregate index volatility. The applied method enables the identification of indicators having a significant importance on AFSI volatility. The technique used in this paper also allows the integration of forecasts within the performed calculations.

The achieved results show an improvement of the stability level of the Romanian financial sector, starting with 2000. A clear degradation of this index during the crisis period (mainly in 1998, but also in 2001 and 2007) can be observed in the analysis of the AFSI evolution. The aggregate index volatility and that of the composite index also manifest a descendent trend, and, during the crisis period, the financial vulnerability indicators, as well as the prudential or banking sector soundness indicators present a considerable contribution to the aggregate index volatility.

The following analyses will focus on a more accurate identification of variables which provide the most significant information about the stability level, by means of the elaboration and development of an econometric model. At the same time, it is relevant to test the relation between the financial and the macroeconomic variables in order to increase the results accuracy.

Bibliography

1. Albulescu, C.T., *Assessing Romanian Financial Sector Stability by Using an Aggregate Index*, in "Oeconomica", Tom XVII, Volume 2, 2008, pp.67-87

2. Călin D., *The Impact of the European Monetary Unification upon Romania,* Doctoral thesis, West University of Timişoara, 2004

3. Cerna, S., Donath, L., Şeulean, V., Herbei, M., Bărglăzan, D., Albulescu, C. and Boldea, B., *Financial Stability*, West University Edition, Timişoara, 2008.

4. CESifo, *World Economic Survey*,Volume 7, No.1, February 2008

5. Chanut, J-M and Laroque, G., *Point de vue sur les fluctuations macroéconomiques de 1949 à 1975*, in „Economie et statistique", No.112, 1979, pp. 73-78

6. Čihák, M., *Systemic loss: A Measure of Financial Stability,* in "Czech Journal of Economics and Finance", Volume1, Issue 2, 2007

7. Gersl, A. and Hermanek, J., *Financial Stability Indicators: advantages and disadvantages of their use in the Assessment of the Financial System Stability*, Czech National Bank, Financial Stability Report, 2006

8. Illing, M. and Liu, Y., *An index of Financial Stress for Canada*, National Bank of Canada, wp/14/2003

9. Nelson, W.R. and Perli, R., *Selected Indicators of Financial Stability*, ECB Conference, 2005, available at:
http://www.ecb.int/events/pdf/conferences/jcbrconf4/Perli.pdf

10. Rouabah, A., *Mesure de la vulnérabilité du secteur bancaire luxembourgeois*, 25th GDRE-CNRS Symposium on Money, Banking and Finance, University of Luxembourg, 2008

11. Schweizerische Nationalbank, *Financial Stability Report*, June 2006

12. Van den End, J.W., *Indicator and Boundaries of Financial Stability*, Nederlandsche Bank, wp/97/2006

13. Van den End, J.W. and Tabbae, M., *Measuring Financial Stability: Applying the MfRisk Model to the Netherlands,* Nederlandsche Bank, wp/30/2005

Annexes

Annex 1 – Individual indicators' normalized values

	Q1 1996	Q2 1996	Q3 1996	Q4 1996	Q1 1997	Q2 1997	Q3 1997	Q4 1997	Q1 1998	Q2 1998	Q3 1998	Q4 1998
FDI												
I_{d1}	0,480	0,471	0,479	0,556	0,542	0,410	0,334	0,227	0,274	0,215	0,151	0,173
I_{d2}	0,545	0,440	0,335	0,230	0,335	0,440	0,545	0,650	0,529	0,407	0,285	0,163
I_{d3}	0,006	0,000	0,000	0,000	0,006	0,070	0,082	0,073	0,078	0,063	0,026	0,029
I_{d4}	0,670	0,670	0,670	0,670	0,588	0,505	0,423	0,340	0,255	0,170	0,085	0,000
FVI												
I_{v1}	0,862	0,835	0,771	0,732	0,350	0,000	0,093	0,084	0,456	0,691	0,716	0,768
I_{v2}	0,000	0,076	0,030	0,053	0,175	0,381	0,433	0,415	0,398	0,321	0,259	0,237
I_{v3}	0,544	0,434	0,324	0,214	0,167	0,119	0,072	0,025	0,127	0,230	0,332	0,434
I_{v4}	0,625	0,654	0,597	0,789	0,811	0,801	0,722	0,576	0,607	0,539	0,490	0,492
I_{v5}									0,421	0,483	0,467	0,390
I_{v6}									0,496	0,546	0,679	0,770
FSI												
I_{s1}	0,324	0,279	0,233	0,188	0,150	0,112	0,074	0,036	0,027	0,018	0,009	0,000
I_{s2}				0,164	0,168	0,173	0,177	0,181	0,135	0,090	0,045	0,000
I_{s3}												0,000
I_{s4}												
I_{s5}										0,227	0,438	0,649
WECI												
I_{w1}	0,462	0,519	0,558	0,635	0,654	0,692	0,750	0,731	0,538	0,615	0,462	0,096
I_{w2}	0,000	0,151	0,267	0,357	0,427	0,541	0,598	0,654	0,657	0,686	0,617	0,469
I_{w3}	0,422	0,461	0,499	0,538	0,565	0,592	0,619	0,646	0,512	0,378	0,245	0,111

	Q1 1999	Q2 1999	Q3 1999	Q4 1999	Q1 2000	Q2 2000	Q3 2000	Q4 2000	Q1 2001	Q2 2001	Q3 2001	Q4 2001
FDI												
I_{d1}	0,416	0,204	0,066	0,027	0,152	0,084	0,029	0,001	0,117	0,059	0,031	0,020
I_{d2}	0,127	0,092	0,056	0,020	0,015	0,010	0,005	0,000	0,022	0,045	0,067	0,089
I_{d3}	0,027	0,031	0,047	0,034	0,030	0,029	0,041	0,036	0,059	0,074	0,124	0,128
I_{d4}	0,085	0,170	0,255	0,340	0,340	0,340	0,340	0,340	0,340	0,340	0,340	0,340
FVI												
I_{v1}	0,816	0,771	0,735	0,714	0,710	0,764	0,761	0,780	0,789	0,808	0,837	0,844
I_{v2}	0,284	0,085	0,250	0,297	0,347	0,337	0,427	0,515	0,632	0,673	0,675	0,731
I_{v3}	0,332	0,230	0,127	0,025	0,017	0,009	0,002	0,403	0,505	0,607	0,709	0,403
I_{v4}	0,572	0,284	0,158	0,001	0,094	0,107	0,316	0,303	0,390	0,408	0,563	0,585
I_{v5}	0,237	0,658	0,880	0,974	0,972	0,974	0,955	0,999	0,995	1,003	0,989	0,932
I_{v6}	0,967	0,998	0,806	0,646	0,381	0,357	0,286	0,423	0,437	0,374	0,493	0,316
FSI												
I_{s1}	0,103	0,207	0,310	0,414	0,544	0,674	0,804	0,934	0,944	0,954	0,965	0,975
I_{s2}	0,103	0,206	0,309	0,412	0,492	0,571	0,651	0,730	0,727	0,919	0,957	1,000
I_{s3}	0,055	0,111	0,166	0,221	0,261	0,302	0,342	0,382	0,362	0,934	1,000	0,907
I_{s4}											0,000	0,005
I_{s5}	0,860	0,884	0,909	0,933	0,958	0,968	0,979	0,989	1,000	0,949	0,948	0,906
WECI												
I_{w1}	0,231	0,404	0,654	0,750	1,000	1,000	0,923	0,788	0,500	0,365	0,288	0,000
I_{w2}	0,561	0,595	0,677	0,808	0,803	0,822	0,795	0,809	0,840	0,783	0,841	0,929
I_{w3}	0,200	0,290	0,380	0,469	0,571	0,672	0,774	0,875	0,657	0,438	0,219	0,001

	Q1 2002	Q2 2002	Q3 2002	Q4 2002	Q1 2003	Q2 2003	Q3 2003	Q4 2003	Q1 2004	Q2 2004	Q3 2004	Q4 2004
FDI												
I_{d1}	0,173	0,124	0,079	0,059	0,237	0,190	0,154	0,110	0,333	0,250	0,168	0,205
I_{d2}	0,114	0,139	0,164	0,188	0,242	0,295	0,349	0,402	0,420	0,437	0,455	0,473
I_{d3}	0,126	0,160	0,265	0,228	0,207	0,224	0,229	0,238	0,280	0,353	0,350	0,614
I_{d4}	0,340	0,340	0,340	0,340	0,340	0,340	0,340	0,340	0,423	0,505	0,588	0,670
FVI												
I_{v1}	0,866	0,881	0,898	0,915	0,925	0,936	0,935	0,936	0,943	0,951	0,953	0,964
I_{v2}	0,787	0,841	0,846	0,963	0,958	0,824	0,941	0,960	0,954	0,864	0,940	0,926
I_{v3}	0,505	0,607	0,709	0,811	0,851	0,890	0,929	0,969	0,969	0,969	0,969	0,969
I_{v4}	0,641	0,667	0,720	0,740	0,768	0,794	0,904	0,885	0,904	0,921	0,936	0,959
I_{v5}	0,926	0,879	0,896	0,818	0,759	0,654	0,493	0,493	0,523	0,549	0,570	0,683
I_{v6}	0,342	0,500	0,365	0,422	0,345	0,187	0,210	0,251	0,276	0,331	0,382	0,483
FSI												
I_{s1}	0,981	0,987	0,994	1,000	0,987	0,973	0,960	0,946	0,941	0,936	0,931	0,927
I_{s2}	0,916	0,908	0,861	0,773	0,796	0,678	0,599	0,525	0,550	0,544	0,512	0,460
I_{s3}	0,853	0,907	0,892	0,824	0,898	0,856	0,806	0,735	0,663	0,514	0,451	0,362

I_{s4}	0,046	0,046	0,096	0,037	0,059	1,000	0,877	0,799	0,804	0,712	0,584	0,484
I_{s5}	0,871	0,847	0,805	0,762	0,683	0,559	0,432	0,392	0,376	0,454	0,497	0,523
WECI												
I_{w1}	0,288	0,654	0,558	0,269	0,327	0,269	0,442	0,635	0,865	0,846	0,827	0,712
I_{w2}	0,944	0,979	0,961	0,901	0,837	0,896	0,939	0,953	1,000	0,927	0,876	0,872
I_{w3}	0,053	0,106	0,158	0,210	0,281	0,351	0,422	0,492	0,612	0,732	0,852	0,972

	Q1 2005	Q2 2005	Q3 2005	Q4 2005	Q1 2006	Q2 2006	Q3 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007
FDI												
I_{d1}	0,470	0,410	0,351	0,308	0,655	0,589	0,517	0,453	1,003	0,849	0,764	
I_{d2}	0,501	0,529	0,557	0,585	0,658	0,730	0,802	0,875	0,959	0,966	0,980	
I_{d3}	0,566	0,597	0,776	0,827	0,812	0,721	0,877	0,959	0,824	1,000	0,929	0,848
I_{d4}	0,670	0,670	0,670	0,670	0,670	0,670	0,670	0,670	1,000	1,000	1,000	1,000
FVI												
I_{v1}	0,971	0,965	0,971	0,973	0,972	0,981	0,987	0,994	1,000	1,000	0,993	0,983
I_{v2}	1,000	0,861	0,943	0,931	0,936	0,810	0,758	0,776	0,753	0,602	0,671	
I_{v3}	0,976	0,984	0,992	1,000	0,961	0,921	0,882	0,843	0,796	0,748	0,701	0,654
I_{v4}	0,981	0,978	0,973	0,975	0,986	1,000	1,001	0,990	0,963	0,953	0,963	
I_{v5}	0,695	0,677	0,628	0,526	0,466	0,336	0,249	0,301	0,223	0,111	0,000	
I_{v6}	0,252	0,157	0,097	0,000	0,073	0,088	0,096	0,075	0,136	0,080	0,158	
FSI												
I_{s1}	0,930	0,933	0,936	0,900	0,899	0,899	0,898	0,898	0,895	0,892	0,888	0,885
I_{s2}	0,478	0,438	0,487	0,583	0,531	0,409	0,410	0,382	0,319	0,258	0,204	0,132
I_{s3}	0,304	0,302	0,353	0,466	0,471	0,436	0,438	0,337	0,355	0,323	0,275	0,105
I_{s4}	0,548	0,584	0,543	0,594	0,543	0,580	0,553	0,466	0,516	0,498	0,466	0,393
I_{s5}	0,619	0,543	0,522	0,509	0,404	0,250	0,194	0,253	0,127	0,057	0,000	0,059
WECI												
I_{w1}	0,654	0,577	0,577	0,615	0,827	0,865	0,750	0,731	0,769	0,769	0,923	0,615
I_{w2}	0,903	0,925	0,912	0,906	0,921	0,899	0,918	0,858	0,829	0,800	0,771	0,742
I_{w3}	0,926	0,880	0,835	0,789	0,842	0,894	0,947	1,000	0,993	0,986	0,978	0,971

Annex 2

Calculation method for the contribution of the aggregate indicator's components to its volatility (Chanut, J-M. and Laroque, G. - 1979)

We study on T quarters, t = 1,…..,T, the evolution of an aggregate A(t) and of its "*m*" components Ci(t), where *i* varies from 1 to *m* :

$$A(t) = \sum_{i=1}^{m} Ci(t) \qquad (1)$$

The growth rate of the aggregate is:

$$x(t) = \frac{[A(t) - A(t-1)]}{A(t-1)} \qquad (2)$$

and the contributions xi(t) of each component to this growth rate are defined by:

$$xi(t) = \frac{[Ci(t) - Ci(t-1)]}{A(t-1)} \qquad (3)\text{, which implies}$$

$$x(t) = \sum_{i=1}^{m} xi(t)\text{, for t=2,….,T} \quad (4)$$

The model is the following (under the assumption of independence, we suppose that $[x_1(t), …., x_m(t), x(t)]$ represents the performance of a random stationary process of second order on date *t*. We note Ex_i, σ_{xi} and $corr(x_i,x_j)$ represents the expected value of x_i, the standard deviation of x_i and the correlation factor between x_i and x_j. The result is :

$$x = \sum_{i=1}^{m} x_i \qquad (5),\quad \text{which implies:}$$

$$E(x) = \sum_{i=1}^{m} Ex_i \qquad (6) \text{ and } \sigma x = \sum corr(x, x_i) * \sigma x_i \qquad (7)$$

In (6) and (7), we replace the moments of the random variations for the associated empiric moments:

$$\bar{x}_i = \sum_{t=2}^{T} x_i(t)/T\text{, for } Ex_i;$$

$$\bar{\sigma}_i = \sqrt{\sum_{t=2}^{T} [x_i(t) - \bar{x}_i]^2 / T}\text{, for } \sigma_{xi} \text{ and}$$

$$\sum_{t=2}^{T} [x_i(t) - \bar{x}_i][x(t) - \bar{x}]/T\bar{\sigma}\bar{\sigma}_i\text{, for corr } (x_i, x).$$

The growth contribution of the components will be:

$$GC_i = \frac{E(x_i)}{E(x)} \qquad (8)$$

and the contribution of the components to the aggregate's volatility results from:

$$VC_i = \frac{corr(x_i, x) * \sigma x_i}{\sigma x} \qquad (9)$$