Analysis of Financial Stability: The Construction of a New Composite Financial Stability Index for Euro Area

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Abstract

This paper develops new tool for the analysis of the Euro Area financial system using a composite financial stability index (CFSI). The index was successful in capturing key periods of financial instability during the sample period and reflected a general improvement in financial stability. The econometric results come to support the presence of a positive trend in the CFSI during 1998-2006 and a recent reduction in volatility. To predict the level of stability and financial sector analysis, we used Monte Carlo simulation method that gives us further information about the future of European financial sector. Moreover, our study results surprised the impact of the financial crisis on the main macroeconomic indicators in the Euro Area. The analysis covers the period 1998-2012, quarterly data used were obtained from the ECB – Area Wide Model (AWM) Database, Federal Reserve of Saint Louis and OECD.

Key words: financial stability; composite financial stability index; stochastic modeling and simulation; quantitative methods for assessing systemic financial stability.
J.E.L. classification: C53; E27; G01; G17.

1. Introduction

In recent years, the issue of financial stability has become one of the most important concerns for monetary authorities. The analysis of financial stability has gained increasing importance in the context of higher growth of markets and institutions interdependencies (both financial and non-financial), the emergence of new engineers in the finance sector, the creation of financial and non-financial groups and intensifying international capital flows. Euro area financial crisis has confirmed the important role of financial stability in the international system.

Vulnerability in financial sector has a negative impact on the real economy. Today, financial stability analysis is a complex exercise which must be based on the analysis of the main pillars (institutions, markets, risk management methods) and should continue to identify risks that could destabilize the financial system. The various sources of risks tend to have different implications in terms of financial crisis prevention, remedies and relief policies. However, unlike these, exogenous disturbances are difficult to anticipate. This is because that the corrective action shall be exercised by the macroeconomic policies pursued by the authorities. However, the effects of macroeconomic policies manifest only after a certain period of time (lag), which size varies greatly and in an unpredictable way.

The policies of this kind can be regarded as attempts to mitigate the impact of exogenous disturbances and maintaining its ability to absorb economic shocks and to keep safe vital information. Past experience also shows that financial stability analysis also implies what traditionally is called "macro-prudential analysis" Evjen et al. (2004). We need to realize that efficient allocation of resources and minimize the risks the economy has to ensure the financial health of individual banks and the banking system as a whole.

2. Motivation and relevant literature

Given that economic phenomena are multidimensional and complex, is quite difficult to analyze a synthetic index which aggregates different indicators called "base indices". In fact, the technique of concentration of a multidimensional reality in one variable may seem a complicated exercise with many restrictions. However, the literature review shows that there are some attempts in this direction. We could find many methods used to construct an index of financial stability.

For example, Gersl and Hermanek (2006) calculates an aggregate index for the banking system in the Czech Republic, using the same method. This index, as the bank stability aggregate index is composed of individual indicators, normalized: Capital adequacy (5%); asset quality (25%); profitability (25%); liquidity (25%); interest rate risk (10%) and currency risk (10%). Moreover, the selection of indicators was made according to international practice, while the weights were determined based on the experience and intuition of the authors (judgments).

Some authors, Nelson and Perli (2005) use such an index, under the name of "financial fragility index". The analysis covered the U.S. financial system, finally demonstrated that a fragility composite index may contribute to estimate the probability that the system is or not in a state of shock.

The authors use two stages in the construction of the index, namely: a) the information was included in the 12 individual variables that were grouped into three indicators that refer *t* volatility and correlation; b) a logit model that predicts a likelihood based on statistics that financial markets have at any time a similar behavior to that recorded during the previous financial crisis.

$$Pt = L(\beta 0 + \beta 1 \times \lambda t + \beta 2 \times \delta t + \beta 3 \times \gamma t) \quad (1)$$

where λ is the level and δ is the volatility indicator, when γ is the correlation coefficient.

Another method that supposes combining market data with balance sheet data is used by Swiss National Bank (2006), who built a similar pressure index for the banking sector. The specialists of the Central Bank of the Netherlands have opted to use the original technique of building a stability index and Van den End (2006) included in the model indicators characterizing monetary conditions: interest rates, real exchange rate, volatility of financial asset prices, solvency of financial institutions. The novelty of the study refers to the adoption of the critical upper and lower ends of these indicators in order to detect potential non-linear effects. In this way, a low value of the indicators associated with a high increase of the instability in the model is associated with the accumulation of imbalances.

The method of constructing a composite financial stability index (CFSI) is similar to the early warning systems (EWS) and to the shock resistance stress-tests, one of the most comprehensive quantitative methods that measures the stability of a financial system. Even if each of these techniques has advantages and disadvantages related to the ability of providing detailed information about the financial stability, some clarifications must be made. If early warning systems (EWS) allow to predict the likelihood of a financial crisis (especially of a currency crisis) thus to include in the calculations all system risks, they don't give us information about the shock response ability. However, another type of techniques "stress testing" allow to identify potential shocks by estimating the strength of the financial system.

Nonetheless, these don't offer the possibility to make comparisons for different periods in terms of stability or to manage the financial discrepancies between two or more countries (in other words they do not follow the dynamics of phenomena). Instead, a composite financial stability index would enable us to make comparisons between different periods and systems, allowing also the observation of the stability level of development.

The model we used is based on the methodology used in the literature by Albulescu (2008), which uses a single financial stability index for the Romanian economy based on the aggregation of constituent indicators or sub-indices that aim to cover microeconomic and macroeconomic measures and of international vulnerability. Also, a similar method is the used by Morris (2010). The author develops a similar aggregate index of financial stability for Jamaica, by using data for a period of 14 years, 1997-2010. Both authors show by means of Monte Carlo simulations, the main performances and vulnerabilities faced by the financial system of each analyzed country.

3. Building Composite Index of Stability for the Euro Area Financial System

For constructing the CFSI we use quarterly data benchmark for each analyzed time period. By normalizing, individual indicators take values between [0;1], thus their aggregation and analysis is facilitated. The value "1"denotes a situation of stability and is equivalent to the best value recorded by that indicator in the analyzed period, while the value "0"reflects the opposite. For normalization, the variables were logarithmized. We used an axiological normalization, one of the four techniques known up to now.

The individual indicators, grouped initially into four categories of parameters (composite indexes), which reflect the external sector, the real sector, the financial sector and the global economic climate index represented by the global economy index, are presented in Table1, see Appendix.

4. Methodology

The 25 individual indicators we presented in Table 1 are often used in quantifying financial related literature. As the stock market has recorded a continuous upward evolution in the last years, we have considered "the stock capitalization / GDP"– indicator which reflects the market development in the EMU. The first indicator in the composite index is related to the external sector. For this we used the following individual indicators: *non-government credit in euro/GDP*, *real effective exchange rate, imports growth rate*, *net trade index*, *current deficit account/GDP*, *euro/dollar exchange rate*.

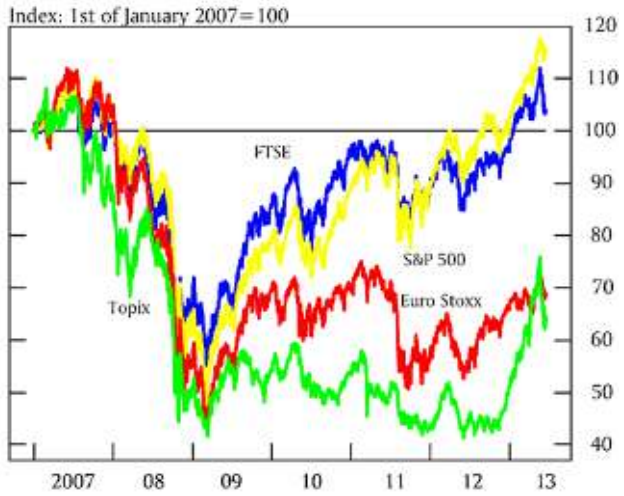
The main objective of the ECB is to maintain price stability within the limits considered to be sustainable. Inflation provides information on the economic policies and its low increases investor confidence in the European economy. Along with this indicator that reflects rather the monetary policy performance of the central bank, we chose another indicator which expresses the government fiscal policy performance. This is the ratio of the *budget deficit to the GDP*. The bigger the deficit, the more will be affected the trust of the economic agents and the system's ability to ensure a sustainable grow this questionable. We were also able to use the GDP and public debt, indicator which measures public finance sustainability.

The next sector included in the analysis is the financial one. The set of indicators for this sector include both indicators characterizing macroeconomic stability and indicators that relate to the financing structure. Investors often consider this category of indicators (more accessible to the public) when making the decision to invest or disinvest in a country's economy. If the values of the macroeconomic indicators are sustainable, we believe that the system is less vulnerable to potential shocks. It should be added that these indicators have been analyzed also by central banks, which include the macroeconomic models used for monetary policy formulation and for building scenarios such as stress-tests.

Therefore, we used *rate of growth of M1*, *rate of growth of M2, Total Loans/GDP, total loans/deposits, average price actions, total bank deposits/GDP, stock index volatility, real interest rate, capital)/assets total.* We did not include in the analysis indicators that characterize the insurance sector, because this area may not have yet a potential source of systemic risk. Further, for a better explanation the indicators we will make a presentation for each of them. A first individual indicator used in the financial sector index is the *rate of M1 growth*, we used this index because it can reflect the situation in the European financial markets. We also consider that the stock price is very important in analyzing the financial sector, so we included it in the composite indicator.

The volatility of the stock index is an indicator that characterizes the development and extent of the capital market. In the euro area the stock index has experienced a sustained growth since 1999, reflecting an improved investor confidence in the market. A sudden increase in capitalization maybe the result of a speculative bubble, which can be a sign of vulnerability.

Figure no. 1: Stock index in the world



Source: Thomson Reuters Datastream

5. Data

The identification of the individual stability indicators involved checking many databases. The data series used in the empirical analysis have quarterly frequency. Some data were obtained from the database of the Area Wide Model (AWM) (for more details see Fagan et al. (2011)), others were taken from their Federal Reserve of Saint Louis and the OECD. The analyzed periods are 1998:4–2012:4, thus we obtained 57 pieces of data. A particular problem was the lack of quarterly data for public debt and budget deficit. The annual data we found were transformed into quarterly data by using a linear interpolation with Eviews.

6. Econometric estimation and validation of CFSI

After the normalization of the individual indicators we proceeded to establish the weights they will have in the aggregate index. One possibility is to assign an equal weight to all individual indicators (in case of unavailability of data for a particular indicator, the index is calculated as the arithmetic mean of the available data).

$$\text{CFSI} = \frac{\sum_{i=1}^{4} I_{ij}}{25} \tag{4}$$

and

$$\sum_{i=1}^{4} I_{ij} = \sum_{i=1}^{6} I_{dj} + \sum_{i=1}^{7} I_{vj} + \sum_{i=1}^{9} I_{sj} + \sum_{i=1}^{3} I_{cj} \tag{5}$$

So we get:

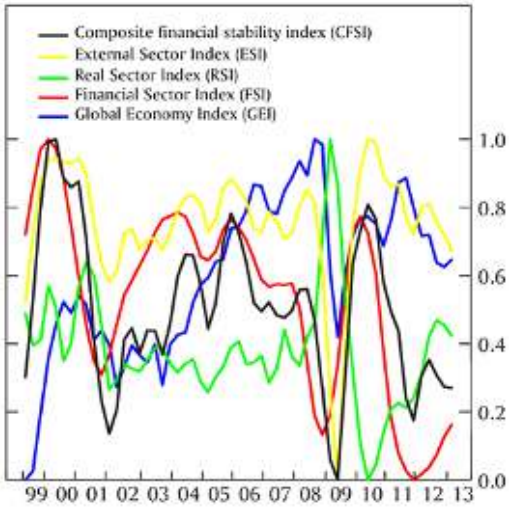
$$\text{CFSI} = \frac{6\overline{I_{dJ}}}{25} + \frac{6\overline{I_{vJ}}}{25} + \frac{6\overline{I_{sJ}}}{25} + \frac{6\overline{I_{cJ}}}{25} \tag{6}$$

where I_{ij} is composite index for stability.

This approach for the standard method allows us to assign equal weights to all the individual indicators of stability. The CFSI is calculated for any period of time as an arithmetic average of the available data. The method chosen to build the composite index is still poor because although the number of indicators included in each category should reflect its importance to the stability of a system (financial development, macroeconomic and financial vulnerability, soundness of banks and the global economic climate), this is difficult to be justified.

Another approach to the same standard method is to provide the same importance to the four indices, thus giving up the equal weights assigned to individual indicators. By using this technique the inconvenience related to the lack of some data at the beginning of the period is eliminated.

Figure no. 2: Evolution of composite index of financial stability (CFSI) and the component index



Source: Authors' calculations based on data from the initial model

Another possibility for calculating the composite index of stability, as we seen before is by using the chain index method including the geometric mean. The results of this method compared with

However, this simple analysis does not allow us to highlight those indicators which provide information about the possible occurrence of a financial crisis. To highlight this fact, we used another method known as the method Chania – Laroque (1979), which we modified in order to integrate the weights we assigned for the composite index. This method allows the calculation of the composite indexes contribution to the volatility of the CFSI.

The largest contribution to CFSI volatility is that of the FSI, followed by the ESI and RSI. Reducing the volatility of the latter two indices, accompanied by the increased volatility of the GEI manifests in times of crisis (such indicators characterizing the global economic climate are effective to identifying the occurrence of a financial crisis. Also, it plays an important role in amplifying turbulences). The Financial Development Index has a small contribution to the CFSI's volatility of the entire period analyzed. It seems that the vulnerability indicators provide the most important signs regarding the emergence of a crisis, the CFSI's volatility is high before the periods of turbulence. Analyzing the CFSI dynamics we can say that the index identifies successfully the times of crisis that crossed the Eurozone financial system in the last decade. To validate econometrically the CFSI we chosen a dynamic model that captures the change in time of the four indices, by using a model *ar(t).* We believe that these variables have a significant and immediate impact on the investors' beliefs about the stability of the financial system.

6. Conclusions

Some conclusions were drawn after following the evolution of the composite financial stability index (CFSI). First we noticed an improvement in the level of financial stability since the late of 90s in all of the analyzed countries. Then we saw a convergence process of the composite index (at least until the onset of the current crisis). The financial sector, although it had a positive development in recent years, requires a deep and careful supervision. Knowing that the financial vulnerability of the European system rose in the context of the exponential credit growth in the U.S. and the current account and budgetary deficit in the Eurozone countries, which lead to the blockage of economic activity. For this reason the role of supervisory activity should play an increasingly important role. Therefore, building a composite index of stability that includes all the dimensions of this phenomenon (financial development, vulnerability to external factors, macroeconomic fundamentals, bank soundness and global economic climate) is an exercise that is designed to complete the analyzes done by authorities in the evaluation of stability.

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Appendix

Table no. 1: Composite financial stability index (CFSI) for the assessment of financial stability in the Euro Area

Prob	External Sector Index (ESI)		Source
+	Non-government credit in euro / GDP	*Ise*1	AWM Model
+	Real Effective Exchange Rate (REER)	*Ise*2	AWM Model
+	The growth rate of imports	*Ise*3	AWM Model
+	Net barter terms of trade index	*Ise*4	AWM Model
+	Current account deficit / GDP	*Ise*5	AWM Model
+	Exchange rate euro / dollar, deviation from trent	*Ise*6	OECD
Real Sector Index (RSI)			
+	Budget deficit / GDP	*Isr*1	AWM Model
+	Public debt / GDP	*Isr*2	AWM Model
+	Industrial production growth	*Isr*3	AWM Model
+	Harmonised Index of Consumer Prices	*Isr*4	AWM Model
+	GDP growth	*Isr*5	AWM Model
+	Household savings rate increase	*Isr*6	AWM Model
+	Government consumption / GDP, deviation from trend	*Isr*7	AWM Model
Financial Sector Index (FSI)			
+	Growth rate of M1	*Isf* 1	Fed
+	Growth rate of M2	*Isf* 2	Fed
+	Total loans / GDP	*Isf* 3	Fed
+	Total loans / deposits	*Isf* 4	Fed
+	The share price	*Isf* 5	Fed
+	Total bank deposits / GDP	*Isf* 6	Fed
+	Volatility of stock index	*Isf* 7	Fed
+	The real interest rate	*Isf* 8	AWM Model
	Equity / total assets	*Isf* 9	Fed
Global Economy Index (GEI)			
+	Oil price increase	*Ieg*1	AWM Model
+	The interest rate for the U.S. economy	*Ieg*2	OECD
+	Growth of the OECD	*Ieg*3	AWM Model