

Application of stress index model in the Albanian Banking System

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Abstract - Central banks and supervisory authorities try to maintain a stable situation in the banking sector and in doing so; they ensure stability to the entire financial system. There are always raised two important questions: what is the present situation of the banking sector and how it will develop in the future? The core objective of this paper will be achieved through the establishment of a forecasting model for the situation of the banking system. We can not foresee the crisis, because even numerous developed countries can not do such a thing, but given the status of the current data t , we can predict the situation for a time period $t + 1$. This article will focus on the calculation of a "stress index" on the current situation of the banking sector and, subsequently, will continue to build an econometric model to try to predict the situation for a certain period of time.

Index Terms - banking system, forecast, early warning system, stress index, variables.

1. STRESS INDEX MODEL OF BANKING SHOCKS FORECAST

Banking sector crises and their determination factors, have always been the focus of a lot of economists' studies. Many variables, which determine whether the banking sector is in crisis or not, are already established in the literature. But while banking crises are rare in developed countries, the determining variables are many and although the banking sector is not in crisis, this does not mean that everything goes well [1]. During a year, the banking sector may have problemson some indicators, but not by default we have banking crisis.

Illing and Liu (2003), built a sub-index for the banking sector (evaluating the *beta* indicator in the bank portfolio) and used it in financial stress index. In another study, Bordo et al (2000), proposes a global financial index without focusing on the banking sector. To calculate the stress index for the case of the Albanian banking sector, we are based on a model Hanschel and Monnin (2003). Also, in order to determine the variables, we focused on that literature, which is consistent with the terms of the Albanian banking sector and economic development of this country.

1.1 Variables included in the index

Initially we calculate an index, which assesses the situation of the banking system [2]. The index is calculated annually and the time period used for the study starts from 1994 until 2009. The country's economic conditions and availability of data have influenced in selecting the time period and the relevant variables. The main problem (like in many other cases in Albania) is exactly the availability of data and their accuracy as far as the used source of information is concerned. The lack of data conditions us to use this period of time and simultaneously, these variables.

As mentioned above, the index is calculated on annual basis, thus, for the quarterly data the annual average is used. Selected variables are as follows:

- ↳ Deposits. A typical symptom of the banking crisis is the decline of deposits, which shows the decline of trust towards the banking system. This criterion is used by Kaminsky and Reinhart (1996, 1999), Demirguc-Kunt and Detragiache (1998) and Vila (2000) [3]. In our index will use Interbank deposits [4] and this for the simple reason that these deposits are liquid and reflect better the situation of the banking system. This helps, that banks are well-informed on the status of their rivals. Interbank deposits are recognized as the main source of crises transition from one banking institution to another.
- ↳ ROA (*return on assets*)[5]. A non-profitig banking system does not mark a good situation and may be associated with problems for the entire banking sector.
- ↳ Treasury bill rate. Illing and Liu (2003)[6] suggest this variable. Higher rates for treasury bills, meaning fewer deposits (above noted their importance in the stability of the banking sector). Deposits are the primary source of liquidity, lack of which is considered a possibility of occurrence of problems in the banking sector. During a crisis period, we observe higher rate bond. The index uses Treasury bill rates for a 12 months period.
- ↳ Provisions. Is a factor, where banks assess the current situation by themselves. If a bank thinks that there is a problem, it accumulates provisions. The index rate uses the provisions norm of the banking sector. In general, in cases of panic the possibility to increase provisions in the banks is reduced. So, Gonzales-Hermosilo (1999)

used such a rate [7].

- ☞ NPLR (*non performing loans ratio*). The rate of problematic loans is widely used also in literature, as the leading indicator of crisis. Demirguc-Kunt and Detragiache (1998) [3], Corsetti et al (1998), Gonzales-Hermosillo (1999)[7] use the rate of problematic loans as a sign of the banking crisis.
- ☞ Number of Bank Branches. It is an indicator applied from Bordo (2000). This indicator is used to view the closure or reorganization of branches of banks during the crisis period.
- ☞ The Private Sector Loan [8]. In an economy, loan to the private sector is important, but needs to be followed carefully if this rate of growth is comparable to the rate of growth of GDP. If for example, the rate of credit growth is higher than the domestic product of a country, then this gives a sign of lower standards for lending by banks. Another reason why choosing this variable, has to do with the great risk, these types of loans, carry per se. This means that, when the economy goes into recession (which translates lower GDP growth rates), then the difficulty on the part of borrowers to repay the loan will be much higher.
- ☞ Last variable used is interest of deposits. It is a variable, that certainly affects the banking sector deposits. This criterion is used by Kaminsky and Reinhart (1996, 1999), Demirguc-Kunt and Detragiache (1998) and Vila (2000).

These variables are used in a single index, which standardizes them, in order to express in the same unit as well as aggregates with the same weight. The formula for index calculation is [2]:

$$I_t = \sum \frac{X_{i,t} - \bar{X}}{\sigma} \quad (1)$$

where, k is the number of variables in the index,

\bar{X} – is the average variable
 σ – is the standard deviation.

After its calculation, the main problem is the validity of the index. Illing and Liu (2003) suggest comparing this index with literature. Caprio and Klingebil (1996), Dziobek and Pazarbasioglu (1997), Bordo and Eichengreen (1999) and Lingren et al (1996) use the same technique, that of comparison. But there is a problem: not always specialists agree on the difficult periods of the banking sector.

Index's results shown by the graph 1, gives the evaluation of index calculated for the banking sector for the time- period between the years 1994 to 2009.



Graph 1. Stress index for the Albanian Banking Sector
Source: Author's calculation. The data source – Bank of Albania[9][10].

Index identifies periods where stress is above average and this shows that the state banking system was not sustainable¹. Such situations are assessed in the years 1996 to 1998. Thus, the graph represents a stable situation of the banking sector for the period of time from 1999 to 2006. Then, for the past can be viewed again the volatility of the sector, time which coincides with unfavorable situations transmitted by the global crisis. What is worth mentioning here, is that in periods before years of turmoil in the banking system, known as the year 1997² and 2002, the situation is rated as not positive. The year 1996 reflects a poor situation which coincides with the development of pyramid schemes.

In Figure 2, we will be able to look at the origin of problems in the banking sector. The highest value of stress has resulted in 1997, during the emerging of financial crisis in the system at the time of the collapse of pyramid schemes. High positive value of this index, shows the grave situation of the banking system during 1997. Of course, this negative situation is reflected in 1998. After these years, the banking system reflected a period of stability and steadiness, a period which begins in 2000. Index appears positive in 2001, which although very small in value 0.051558 coincides with the problems, which showed the sector in early 2002.

The year 2002 appears positive, despite the trauma it suffered. The reason is that the banking panic occurred early (in March) by enabling the system to recuperate. Banking

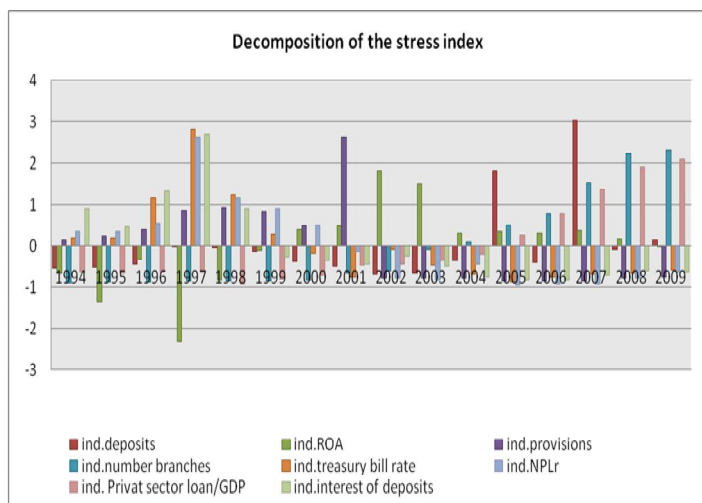
¹ For positive values of the index, the banking sector appears as not good (positive)

² Banking system knows two difficult moments; year 1997, which coincides with the collapse of pyramid schemes, and year 2002, which is known as the year of banking panic. The banking panic could not merge in the entire banking system, but only in few isolated banks.

panic failed to spread or take the form of a financial crisis. Then, the stability of the banking system terminated in 2007 and continues to feature elements of shock and for the years 2008 and 2009. This is normal if we consider the consequences, which Albania inherited from the global crisis (such as withdrawal of deposits, reduced remittances, credit limit, etc.).

As noted above, it is important to understand that a positive index indicates not a calm banking situation, but not necessarily a crisis. Thus, it is worth repeating that the years 1996, 1997, 1998 or even years 2001, 2007, 2008 and 2009, are not years that reflect the financial crisis, but estimate as non positive developments in the banking sector. These instable situations can precipitate later to the financial crisis.

The following analysis gives us clear reason for this instability. See this through the dissolution of the index, to better understand the variables that have caused problems in the system. Figure 2 provides the decomposition and the contribution of each variable in the index. Positive (negative) values indicate that the variable is above (below) average and shows more (less) stress.



Graph 2. Decomposition of the stress index
Source: author's calculation

The graph shows clearly that in the years '96, '97 and '98, the problems in the system have come from the rate of problematic loans, which results in the values respectively 40%, 91% and 55%. Also, in these years appears that the problems come from the Treasury bill rate. These are three years, where Treasury bond rates have resulted in higher values (ie 22.5%, 35% and 22.9%). In the last three years, 2007, 2008 and 2009, the index results in high positive values, respectively, 3.08675, 1.3265 and 1.8761. These problems are generated in the system by the number of branches and loans given to the private sector in percentage towards GDP. Number of bank branches is increased during

these years, causing financial market overload. Problem is identified with the loans to the private sector, which is estimated as a percentage of GDP, respectively 28.9%, 35.6% and 37.8%. In these years loans have flourished, increasing the risk of no return and it coincides with the higher rates of problematic loans, which at the end of 2009 reach a value of 10.2%.

Throughout this presentation, with great interest, certainly appears year 1997 where the index holds the highest value of 5.1368. Another year, where the index is displayed on large positive value, is the year 2007, but the source of problems is different. Also, a sole variable can not create problems in the banking sector, but when you join three or four together, cause shock. The shock does not depend on the number of positive variables, but certainly the weight that each variable has in the banking system.

2. THE EARLY WARNING SYSTEM THROUGH THE MACROECONOMIC INDICATORS

In the literature of recent years, there are increasing talks about early warning system. This model relies on two types[11]: the first types, takes into account the micro variables, namely the failure of a bank, while the second type, is based on macroeconomic variables. Due to the fact that the index calculated earlier applies for the banking system in general and not specifically to financial institutions, in our model we will use macroeconomic variables.

The main purpose of this model is to use of macroeconomic indicators as support to make an assessment of the index as well as to predict the index for next year. In this way, we try to forecast the situation in the banking system through the use of data of previous or the current period. It is clear that, if the stress is predictable, then reaction of supervisory authority and the central bank is higher, thus considering a different aspect of the crisis, now not only long-term but also medium and short term. Particular importance in this assessment shows the selection of macroeconomic indicators, given the close relation between the financial and real market.

2.1 Information about the possible macroeconomic variables

Variables that were taken in the study are those that best suit's stress index calculated already in case 1. Usually, in

these models are used macroeconomic variables. The reason why these variables are taken is that the latter are considered as a common exposure of financial institutions and have the potential to create a stress in the future[12].

The model puts us in 2009 and is not an advantage of the information provided, but simply to make the assessment of the following year, referring to last year and their link to the variable index. Period of years that has been chosen to build this connection is 16 years starting from 1994 up to the year 2009 and where prediction is for the year 2010. The reason, they are getting exactly these years is about, above all, the availability of components of index indicators, but at the same time, the possibility of bringing closer in time the values of this index. Normally, the closer are the values of this index, the greater is the likelihood of a forecast with less errors. In addition, it is important given the limitations of this model, which means that it is really good to see the closeness of these data to current timing. On the other hand, it is also important to have as much value, in order to build a time series as long as possible.

Choosing the explanatory variables of the model

The chosen variables for a EWS model are as follows:

Loan of Private Sector.

Here we shall be adding one last point to the reasoning made above (case 1.1). Referring to the loan as an indicator of the crisis and, moreover, for a developing country like ours, we decide on the choice of this variable as a significant macroeconomic explanatory, warning for a potential crisis.

Investments

Investments are not always an important or usable factor in the analysis of EWS. Hardy and Pazarbasioglu (1999), in a study on the causes of the crisis in Asia (1990) included the rate of investment. But according to Borio and Lowe (2002), this variable is not always strong. Investments evaluated by Jarvis as the thrill factor of the banking system and therefore are included in the model.

Public Debt in percentage of GDP

It is another variable mentioned by Chris Jarvis (2002) as a potential indicator of the banking system shock. This indicator is very significant in the case of emerging economies as one of the criteria measuring a country's macroeconomic performance and the link which the latter provide with the real economy and consequently, the index that we want to predict. The literature suggests that public debt towards GDP to be taken particularly in the analysis for emerging economies since the debt is highly sensitive to macroeconomic changes.

Economic Growth

Another variable which results as important in the model is the economic growth. This rate is an indicator on annual basis and is based on the level of GDP. While GDP per se is insignificant, probably due to the correlation that this indicator has with other indicators, economic growth is very important.

Other variables used, but have not proved significant in the model are: the GDP of Albania, Europe's GDP, exchange rate, exports, imports and inflation. All these variables are known from literature, but in the case of Albania and for more on this time series, are excluded from the model itself, which it considers them irrelevant.

2.2 Methodology of stress index calculation through EWS.

EWSs are functional, data-driven approaches to draw attention to variables associated with past crises in order to alert policy makers of potential for future crises[13]. They are grounded in economic theories of financial crisis and are designed to provide risk alerts on an objective, systematic basis. In a financial context, they may be used to extrapolate the risk of a single financial institution (micro risk) as well as that of the financial system as a whole (macro risk). They build on two fundamental assumptions: (1) that causality (stability of relations) exists between crises and crisis-driving factors, and (2) that crisis-driving factors can be identified ex ante.

First, the main method used is the regression between the above mentioned variables where as dependent variable we used the index calculated in case 1. This index, as we noted, shows us the breakability or fragility of our banking system.

Secondly, relying on an *Expert Model*, we created a prediction model for the forthcoming year, using the time series through the *best model (Goodness of best Fit)*.

Model

The main result that we do involves assessing output, forecasting and discussing it. Forecasting is the main essence of this model since the model is estimated in a *Time Serie*, which gives value to time $t+1$ with the variable of time t . Dependent variable is index. Meanwhile, other variables were evaluated on the basis of their reacting speed compared to our index.

Theoretically [2] this model is given by the formula:

$$Y_t = \beta X_{1, t-1} + \beta X_{2, t-2} + \dots + \beta X_{k, t-k} \quad (2)$$

The model, since it fits best the model in this time series with 16 years time, (Goodness of best fit) excludes some variables, keeping only those variables that it considers relevant for the index calculated for Albania. It is clear that we have reached at the conclusion of this model only after considering the assumptions that we have a normal distribution among dependent variable and there are no errors in the values of independent variables, and after the relevant tests are done (although in Albania there is always a kind of error on accuracy and sustainability of data). Also, this model is called good, if there are at least three explanatory variables. In order to judge later on the final model, we make an assessment on all of these indicators: *R square*, *global importance* of the model and *particular importance* of variables and the *number of estimates* and (its) *their interpretation*.

The results of the model.

Based on the assumptions and limiting criteria of the model, we may derive this model which has higher global importance compared to other tested models and the defining coefficient, *R square*. The results of this model are presented in Table 1.

TABLE 1
 ASSEMENT OF STRESS INDEX

Variables	Coefficients	Standard Mistake
Loan	0.191 (***)	0.056
Investment	-0.136 (***)	0.050
Debt	0.337 (**)	0.088
Growth	-0.193 (***)	0.071
Number of observations	16	
R2	0.669	
R2 revised	0.558	

*Level of importance or significance 5%

** Level of importance or significance 1%

*** Level of importance is 0.5%

Of the variables, which we have mentioned as factors that could significantly affect the index of fragility of our banking system, not all are considered as such. The model has taken consideration among the best, meaning among

those which have a higher impact on the Albanian index, *private sector loans in % versus GDP*, *investments, dept in % versus GDP*, and *economic growth*. Now the ecuation (1) can be written:

$$\text{Index} = 0.191 \cdot \text{loan} - 0.136 \cdot \text{Investment} + 0.337 \cdot \text{Debt} - 0.193 \cdot \text{Economic Growth} \quad (3)$$

In fact, in this model the effect of the constant is eliminated by incorporating it in all the above variables. As shown in the table, the importance coefficient is high and gives a value of approximately 66%, so that these figures explain nearly 66% of the variance of the variable index. Coefficients before the independent variables, all have negative value with the exception of credit and debt coefficient, which is positive.

Binding of the index is right, meaning positive- to debt and loan. Thus, an increase of the value of loan and debt means an increase in the index, causing problems in the banking sector. This conclusion is consistent with previous analysis where high values of loans in the years 2007, 2008 and 2009 showed problems in the banking sector, giving us a positive index value. Binding of the index with other indicators used in the model is negative, if we increase these indicators, the value of the index would fall.

The degree of influence of each variable in the index is given respectively by the value of coefficients. Thus, a decline in investment by one point would cause an increase in the index with 0.136, thus worsening the situation in the banking system. While loan growth to a point, would cause an increase in the index with 0191 points. Index is influenced more by debt, where debt increased by one point increases the index with 0337.

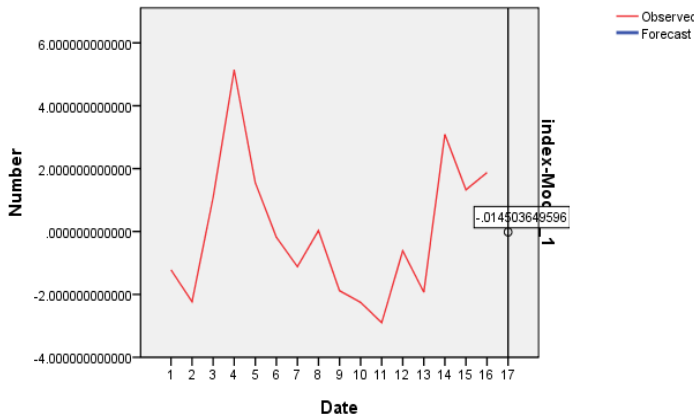
The main results can be viewed from this model and summarized as follows:

- ↳ Macroeconomic variables are the best detectors versus those microeconomic in the case of Albania
- ↳ There is no imbalances of macroeconomic indicators, which means that their effect is immediate, not moved in time.

Forecast for the year 2010

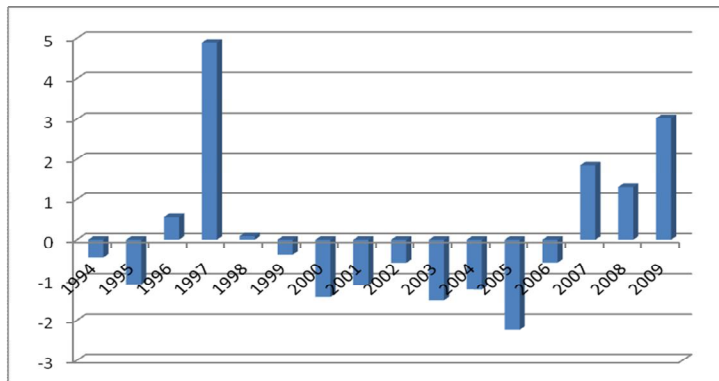
To make a forecast through early warning system and, above all, using the above model, data of the years 1994-2009 are used. So, the model always gives a year in advance warning of any imbalance of any macroeconomic indicator. The model used is the *Time Series*. After implementation of the model, the estimated value of the index for 2010 is - 0.01450, or articulated more clearly: the year 2010 is

estimated as positive for the banking sector developments; however, we have to mention that the positive value is too small. The following is the graphical presentation of total index forecast and consequently, the indicator of our economy stability.



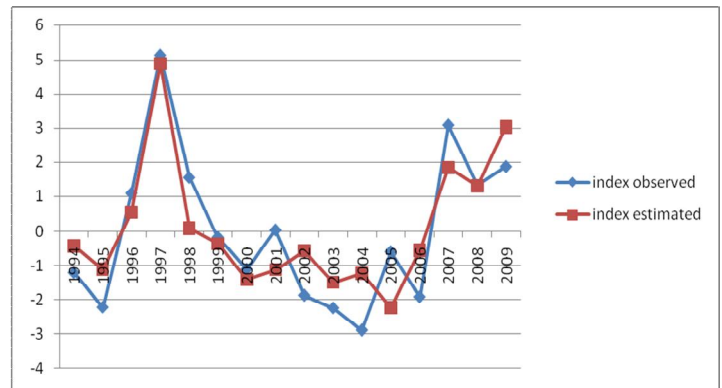
Graph 3 Index forecast for the year 2010.
Source: Bank of Albania (2010), Ministry of Finance (2010), Author's calculations.

Figure 3 gives in advance the estimated value of this model, which means that is the value of 2010. The model allows us to have index values estimated by the EWS model for the entire period of time implemented. These values are presented in Figure 4.



Graph 4. Estimated values of the index from the model
Source: author's calculation

To measure the validity or reliability of this model, we build on the same graphic index values found in the previous case, with the values found by the assessment, the model. Figure 5, provides precisely these two modes of assessment.



Graph 5 Index Assessment through both methods
Source: author's calculation

From Graph 5 it is clearly seen that the two ways firstly match at the signs of the index in this time series. With red color is given the index assessment according to the model, while blue is the index calculated by the formula (in case 1). This estimation approach considers the year 1996 until the year 1999, as a period with positive index. This situation is repeated in 2007, 2008 and 2009. The years 2000-2006 are considered peaceful years. Therefore, also according to the model, our banking system has suffered more in 1997 where we reach the highest positive value. For example, for the problematic year 1997, the value of the index calculated by the formula is 5.136894, while the index value estimated by the model is 4.88979. So both ways comply, with a slight variation. This makes us believe that in 2010 the value of the index will be negative. Thus, one can say with confidence that the banking system has been settled down during 2010.

Sustainability of the Model

In order to evaluate the sustainability of the model, a test or diagnosis we made is the removal of 2009 and recalculating the regression to see whether or not the variables are unwavering. Table of coefficients calculated once including the year 2009, and then excluding it, explains that the importance of four variables in the study is still the same and the model resumes the variables. In terms of coefficients, we can say that they have a very small difference (the difference is the extent of percent). Having said this, we can conclude that the model built and presented above is steady. The same result we can conclude from the logical perspective, since the removal of 2009, can only improve and not bring major changes to the model and, above all, the sign of the index.

Regarding the conclusion of the model, it should be noted that according to an assessment made by the Central Bank for the first half of this year, the status of the banking system results positive. Thus, the system seems to be protected against exchange rate risk, from interest rate risk and, likewise, has already solved the problems of liquidity

resulted from the global crisis of 2008-2009. The system reflects problem on loans and the rate of problematical loans, which has continued to increase for 2010. This rate now is estimated at 12.2% compared with 10.5% at the end of 2009. According to forecasting model, the status of the system is positive, although the index value is low- such prediction that matches the assessment of the Central Bank of Albania.

3 CONCLUSIONS

Financial crises are difficult to predict, and even more difficult to prevent. However, it is interesting to find or build a model forecast or assessment of the situation. This is the reason why, I adapted a forecasting model EWS since the current model of stress test used by Bank of Albania can't predict the real situation but raises only hypothesis. Albania is a country where the financial sector is dominated by the banking sector. Therefore, to calculate the stress index, variables in the banking sector from 1994 to 2009 are used. The model would be much more comprehensive if we had the data since 1990, however including the model of the year 1997 and 2002, gives us a clear picture of the banking sector development in Albania. The predicted result, while showing us the real situation of the banking system, at the same time complies with the assessment of the Bank of Albania for 2010. Index forecast for a period $t + 1$, made possible through an econometric model where macroeconomic indicators give notable consideration to the model. One of the possible improvements in the future model is the inclusion in the financial sector variables such as equity, property, leverage, real estate etc.

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