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# A FINANCIAL SYSTEMIC STRESS INDEX FOR ALBANIA

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## ABSTRACT

*The latest financial crisis reflected the need to properly understand, measure and possibly project the systemic events, which have a high probability of interrupting of the normal functioning of the financial markets, resulting in a suffering of the economic growth. The aim of this paper is to present a Financial System Stress Index for Albania, which aims to capture the level of financial stress of the economy in a single and comprehensive index (FSSIA). We assess the interlinkages of the different market segments through evaluating their impact on economic growth, hence providing a clear method in discussing the evolution of the subindices of the banking sector, money market, foreign exchange rate and housing market into the financial stress. The results indicate that FSSIA captures the pressures in the form of the financial stress, not only from the different market segment, but also from their interaction through cross correlation.*

# INTRODUCTION

The latest financial crisis reflected the need to properly understand, to measure and possibly project the systemic events, which have a high probability of interrupting the normal functioning of the financial markets, resulting in a suffering of the economic growth. The recent fast financial developments have led to the growth of interlinkages between financial institutions and markets which in case of shocks, can spread widely in the form of systemic risk. Even though the set of information available to the policymakers has also increased, it still remains difficult to fully capture the vertical and horizontal linkages among the different financial markets and institutions. As a result, research on measuring the financial stress through constructing indices that capture systemic stress, is currently very active. The aim of this paper is to present a Financial System Stress Index for Albania, which aims to capture the level of financial stress of the economy in a single and comprehensive index (FSSIA).

The Financial System Stress Index aims to aggregate into a single composite indicator the developments of the different markets of the financial system. As the composite indicator is based on the development of different segments of the markets, it provides a good estimation of the interlinkages, as well as of the individual market developments. Typically, in the case of a negative shock of the financial system, several market segments are affected through higher co-movements between each other. Therefore, the FSSIA considers time-varying correlations to take into account the different relationship among the markets in normal as well as stressful financial system. We base our work on the paper presented by Hollo et al (2011) where the authors propose a composite indicator for the systemic stress index in the financial system of the euro area. However, we enhance our application with a the recent work of Louzis and Vouldis (2011), who propose to incorporate a GARCH approach to time varying correlations between different market segments. They also propose relying on balance sheet data to the system stress indicators, which in the case of Albania is crucial due to the lack of market data. Finally, we propose to incorporate the housing price index, which is widely taken in consideration during the financial stress periods, as an important component of the financial stress.

The rest of the paper is organized as follows. The first section defines the financial stress and systemic risk as the crucial component to be taken into consideration in our work. The next section considers the main characteristic of the FSSIA, through discussing the variables as well as their possible impact on the financial stress. We then proceed to present the aggregation scheme into four subindices which capture the development in the banking sector, money market, exchange rate market as well as housing market. We construct three versions of the Financial Systemic Stress Index for Albania, ranging from a simple aggregation of all the information provided by the data, to two versions of time varying correlations: relying on an estimation of the variance and allowing the data to determine the variance using a multivariate GARCH model. We present and discuss the results of these approaches in the final section of the paper.

# 1. DEFINING FINANCIAL STRESS AND SYSTEMIC RISK

In order to propose a measure of financial stress of the Albanian economy which captures the systemic risk of the market, we first discuss the nature of the financial stress. An early work of Illing and Liu (2003) defines financial stress as the force exerted on economic agents by uncertainty and changing expectations of loss in financial markets and institutions. In this context, the main characteristics of the stress in the financial system are defined in the form of higher expected financial loss with risk (a widening in the distribution of probable loss), or with uncertainty (lower confidence about the shape of the distribution of probable loss).

Other authors such as Hakkio and Keeton (2009) argue that the main reflection of the financial stress is the interruption of the normal functioning of the financial markets. Given the broad view of what can be considered "a normal functioning" of the financial markets, they determine a list of phenomena whose presence may indicate a larger financial stress, such as: a. Increased uncertainty about the fundamental value of assets, which typically translates into greater volatility in the market price of the assets; b. Increased uncertainty of the behaviour of other investors; c. Increased asymmetry of information leading to adverse selection or moral hazard, which result in higher borrowing costs; d. Decreased willingness to hold risky assets (flight to quality), which results in a higher spread between the rates of return on the risky and safe assets; e. Decreased willingness to hold illiquid assets (flight to liquidity) which again widens the spread of the rate of return between liquid and illiquid assets and, in general, a higher cost of borrowing.

Balakrishnan et al. (2009) also argue that financial stress is characterized by a number of circumstances similar to Hakkio and Keeton (2009), but also take into account potential concern for the financial health of the banking system. They define financial stress as a period when the financial system is tense and its capacity to accomplish its intermediation function is impaired.

In a later work by Grimaldi (2010) financial stress is defined as the level of stress provided by the interaction between financial vulnerabilities and the size of shocks. Following this definition, not only the size of the shock becomes important but also the interaction between the market, which given the financial conditions may result in stress. The systemic risk is an important component of these interactions as negative shocks spread more quickly and broadly when markets are tightly joined than when markets are loosely related. As a result, the tensions caused by a negative shock such as when banking, financial and currency crisis hit the economy, are observed at the same time in several market segments rather than focused on a single development (Duka and Peltonen, 2011). The larger and the broader the shock (therefore, the more systemic), the higher the co-movement among the different components of the financial system becomes. Therefore, the approach of using aggregated data of the different market segments by capturing also their co-movement in the form of systemic risk becomes crucial to the discussion of the financial stress in the country.

The index we propose for Albania puts a special focus on the importance of incorporating systemic risk to the overall financial stability assessment. The approach we follow is that systemic risk is the materialization of shocks when financial instability becomes so widespread that it impairs the functioning of the financial system to the extent that economic growth and welfare suffer materially (Hollo et al, 2011). As Caruana (2010) argues, systemic risk has two dimensions: a cross-sectional dimension and a time dimension. In the cross-sectional dimension, rising systemic risk is due to the structure of the financial system and the way it responds as well as amplifies shocks. Such spillover effects can arise, for instance, from common exposures across institutions or from network interconnections. The focus in this case is on how the financial system has distributed the risk at a given point in time, due to the interconnected balance sheets and the direct common exposures. On the other hand, in the time dimension, the build-up of risk over time interacts with the macroeconomic cycle and the financial sector endogenously generates systemic risk. Capturing both dimensions of the systemic risk is crucial for the selection of proper policies dealing with financial stability.

In this paper, we propose a first step in measuring the financial stress and systemic risk in Albania, through incorporating the elements of both dimensions and market segments. Our approach is to view the financial stress as a situation where one or more market segments indicate financial stress, which may be due to common exposure or common co-movements. This information is aggregated in the form of a composite index, enhanced by including time varying correlations, where systemic events are meant to increase these correlations. The advantage of utilizing such an index is its ability to put together different pieces of information, as well as facilitating the identification of the main characteristics of the financial stress: increased uncertainty (foreign exchange volatility), liquidity restraints (spreads), banking system soundness and housing markets trends. It also offers the possibility to identify the source of the financial stress following the development of these subcomponents (banking sector related, foreign currency related, housing market related or a combination of these components).

The research on the measurement of financial stress and the construction of indices capturing systemic events is currently very active. The first work on this topic was presented by Illing and Liu (2006). It continues with Hakkio and Keeton (2009) and the IMF (2008, 2009), presenting the work by Cardarelli et al. (2009) and Balakrishnan et al. (2009), who construct financial stress indices for a broad set of advanced and emerging economies. Finally, Fidora and Straub (2009) show a Financial Stress Index for the global economy currently presented by the ECB.

## 2. A FINANCIAL SYSTEMIC STRESS INDEX FOR ALBANIA

The empirical estimation of the financial systemic stress uses a set of indicators that reflect the main characteristics of the stress, representing the different market segment taken into consideration. When constructing a financial stress index, we have to consider several implications: which indicators should be included, how to make these indicators comparable and what weight should be given to them during the aggregation process. Using the economic theory, the recent literature on the financial stress and the composite indices, we select a set of variables that reflect the development in the financial market segments: a) the banking sector, b) the money market; c) the exchange rate, and d) the housing market. When choosing the variables representing each of these market segments, we rely on the features as presented by Hollo et.al (2011):

a) Data should be available in high frequency with a short publication lag. Generally, this feature is satisfied by using market data, which in the case of Albania are not available. Therefore, we rely on the balance sheet data, which are the best information available for the banking sector in Albania.

b) The stress indicators should represent market wide developments. Therefore we refer to indicators that are wide representatives of the markets, rather than indicators with particular characteristics.

c) The set of indicators should be available for sufficiently long data samples. Even in this case we have to make a compromise with the availability of the data for Albania. We construct the set of variables from October 2000 to December 2011. The frequency of the data is in monthly terms, the highest frequency available for the whole set of data. Normally, longer time series provide more information and thus better statistical properties. However, one should also consider how relevant some historical data may be regarded for the current situation. The choice of the time period should therefore be based on two factors: accessibility to data and relevance of

accessible data (Sandahl at al. 2011). Given that the current situation requires that the focus of evaluating the financial stress in Albania be on the developments in the banking sector, foreign exchange and housing markets, which represent the main exposures of our economy, we should take care of this consideration. Prior to 2001, the banking sector in Albania was not as developed as currently, the interbank market was missing, there were no indicators of the developments in the real estate market while only the foreign exchange market had the major implications on the economy. Official data on these major indicators are missing prior to 2000, but even if we had them, their relevance prior to this period cannot be regarded as representative of financial stress, as we refer to it in this paper.

Finally, the indicators included in each of the subindices are intended to supply complementary information about the stress level of the different market segment rather than provide similar information. The indicators should also by comparable and this is taken in consideration through the standardization process. The raw data are standardized by first demeaning them and then dividing them by their standard deviation.

The section below describes the considerations we had while constructing the index as we present the main variables and the economic rationale behind them.

### a) Banking sector –balance sheet data

A typical symptom of the financial crisis is deterioration in terms of balance sheet data, mainly deposits, credits and return. Given the lack of market data for Albania, balance sheet data are the main indicators capturing the financial stress in the banking system. In order to capture this stress, we incorporate the following variables: total deposits, total loans and bank profitability. Deposits and loans are measured in the form of gaps in order to capture the macroeconomic imbalances rather than the direct development of the variables (Hanschel and Monnin, 2005). Imbalances are

considered to be a common risk exposure of financial institutions and therefore might create stress in the future. We measure these imbalances as the gap between the variable and its trend, the latter considered as the long term fundamental value of the variable. A positive or negative gap means that the actual variable lies above or below its trend. When using a gap approach, we put "the focus on cumulative processes, since macroeconomic imbalances can build up either through a strong above (below) trend growth in one period or through a sequence of years with small above (below) trend growth. The larger and the more numerous the macroeconomic imbalances are in an economy at the same time, the more likely it is that the stress in the banking sector will rise later." (Hanschel and Monnin, 2005).

a) Deposit gap - the difference between the deposits and their trend estimated using the Hodrick-Prescott filter. A negative deposit gap indicates a level of deposits below the trend, showing a sign of stress in the banking sector due to an increased need of banks for liquidity (Reinhart and Rogoff 2009). Deposits below the trend may reflect a pressure on the confidence on the part of depositors in the banking system which may also result in liquidity issues for the banks (Kaminsky and Reinhart (1996, 1999), Demirgüç-Kunt and Detragiache (1998) and Vila (2000).

b) Loan gap - it is defined in the same manner as the deposit gap. During financial stress, a negative loan gap may reflect unwillingness of the banks to credit the economy or a lower demand for credit by the borrowers.

c) Bank profitability (interest rate margin) - as a measure for bank profitability we use the interest rate margin. Higher interest margin measures the banks' ability to obtain profit from their lending activities and pressure from the development of this indicator might reflect financial stress (Louzis and Vouldis, 2011). We choose to rely only on this indicator as a measure of profitability rather than on common measures such as ROA, as we want to focus on the financial result of the main activity of the banks in Albania, which is lending.

### b) Money market

The money market is an important source of short-term funding for the financial system. As the latest financial crisis indicated, financial stress put a lot of pressure on the money market with interbank market tension resulting in liquidity issues. Even though in the case of Albania, liquidity constraints from the money market have not been an issue, we believe that the exposure in terms of securities is still relevant. We focus on short-term funding up to three months and measure the stress indicators as the difference between the interest on a risky asset and a relatively risk-free one. This difference represents the extra return that investors require over and above the risk-free interest in order to take a risk. During a financial stress, spreads widen due to higher expectations of future losses or greater uncertainty leading to lower confidence in the shape of the distribution, implying a higher dispersion of probable loss (Illing and Liu, 2006). Both factors are indicative of financial stress. We take into account both measures of stress in the financial market as follows:

a) The spread between the 3-month Albanian T-Bill and the 3-month German T-Bill - The German bills are considered a benchmark and a risk-free rate, while the Albanian T-Bills are an important instrument used by the Albanian banks. The spread is a good representative of the liquidity risk as well as the counterpart risk. Periods of financial stress are associated by higher spread both because interest rates on Albanian T-Bills might rise and interest rates on risk-free rate might fall.

b) Volatility of the spread between the 3-month Albanian T-Bill and the 3-month German T-Bill - We estimate the monthly realized volatility of the spread between the 3-month Albanian T-Bill and the 3-month German T-Bill using the GARCH estimation approach. Higher spread volatility reflects increased uncertainty in the Treasury bills market, which may put pressure on the financial stress.

c) The spread between the Albanian overnight interbank rate and the EONIA swap rate - It is meant to capture the liquidity constraints in times of financial stress.

d) Volatility of the spread between the Albanian overnight interbank rate and the EONIA swap rate - This indicator is measured as the monthly realized volatility of the spread using the GARCH approach and it is used to evaluate uncertainty in the interbank market.

When considering to include the interbank market for Albania, we are aware that its development is still quite low and the market is shallow. However, developments in the Treasury bill market are important given that banks in Albania rely a lot on investing into these securities. We also believe that even if the interbank market data in Albania may not fully reflect liquidity constraint as banks have not generally suffered in these terms, they still constitute a way of measuring the cost of holding money, which may still provide hints for the financial stress.

### c) Foreign exchange market

An important part of funding for the Albanian banks, businesses and consumers is obtained in foreign currency. Unexpected volatility of the exchange rate creates uncertainty, which affects liquidity and the efficiency of the foreign exchange market (Illing and Liu, 2006). Therefore, smooth functioning of the foreign exchange market is crucial to the welfare of the agents and of the financial system as well (Sandahl et. al., 2011). We take into consideration these developments by including the foreign exchange market in the financial stress index using information on the ALL/USD exchange rate and the ALL/EUR exchange rate. These are the main currencies used by the Albanian banks and private agents when obtaining funding in foreign currency.

a) Exchange rate ALL/USD - There are several ways to estimate pressures of the exchange rate movements. In the first approach, we use the CMAX transformation to indentify periods of sharp movements of the exchange rate in Albania. The CMAX transformation is defined as:

$$CMAX = \frac{P_t}{max[P \ \varepsilon \ (P_{t-j} | j=0,....,12)]} \qquad (1)$$

where $P_t$ is the exchange rate between the Albanian Lek and the foreign currency at month $t$.

b) Exchange rate ALL/EUR - The CMAX transformation is also applied to the exchange rate between the Albanian Lek and the euro.

c) Volatility of the exchange rate ALL/USD - an increase in the monthly realized volatility shows an increased uncertainty in the foreign exchange market. Volatility is estimated using the GARCH approach.

d) Volatility of the exchange rate ALL/EUR – Volatility estimation using the GARCH approach is carried out also for the ALL/EUR exchange rate.

### d) Housing market

In order to tailor the financial systemic stress index to the characteristics of the Albanian economy, we propose to introduce also the housing market due to the direct common exposures it implies for the other markets. By its nature, a nationwide downturn in commercial real estate or housing markets tends to have a systemic impact on the economy. Caruana (2010) also discusses the importance of the housing market. Different authors have discussed the issue of common exposure for the housing market in different prospects. Kiss, Nagy and Balázs Vonnák (2006) explain how an increase in the property prices can affect the demand for credit through the wealth effect. Such an increase can be a good incentive for more construction, which accompanied with higher property prices, becomes more profitable, leading to a higher demand for loans in the banking system.

According to Goodhart and Hofmann (2008), there is also a collateral effect for house prices, as these immovable properties are usually used as collateral for loans. As a result, higher prices enable borrowers to increase the borrowing capacity and their demand for credit. This effect can also influence the credit supply

by the effect of the house prices in the balance sheet of the banks. Hofmann (2001) also argues that the higher the property prices, the higher the lifetime wealth perceived by the households, leading to an increase in the output demand and the credit demand. These increased prices imply also a higher creditworthiness for the households and firms, due to the collateral effect.

Backé, Égert and Zumer (2005) argue that increases in house prices are reflected in an increase of the credit demand, through a higher amount that has to be spent on purchasing a certain property. Thus the higher purchasing price may need to be financed by credit, meaning that higher house prices may increase the supply of credit to the private sector. However, the origin of the price increase should be considered. The increase may show a higher quality of housing. On the other side, a higher credit growth may be caused by a housing price bubble, which can be viewed as a disequilibrium phenomenon.

Havrylchyk (2010) follows a similar line that an increase in the house prices has a positive impact on the loan repayment, even though the real estate assets are not very liquid, thus borrowers will choose to sell their property and abstain from default.

On the other hand, according to Chang, Selvili and Wu (2003), a distressed real estate sector can contribute to the amount of nonperforming loans and their ratio. They also emphasize the link between the financial markets and the real estate market citing King (2001) that claims that the Asian Financial Crisis was triggered by Japanese commercial banks that were considerably weakened by the collapse of real estate markets. Other authors suggest that the real estate market has had its share in the severity of the crisis and the post-crisis period.

In order to capture the development of the housing market, we include the housing price index as below:

-The House Price Index gap: This indicator is measured by the difference between the House Price Index and its trend, which is

estimated using the Hodrick-Prescott filter.[1] A negative gap is a sign of imbalances in the housing market, identifying systemic stress transmitted to the financial system through the credit channel and to the real economy through the construction sector.

[1] Currently we are missing data on "commercial property prices", which are also relevant for the overall housing price index in Albania. In case these data become available, we plan to incorporate the relevant information in our index.

# 3. THE FINANCIAL SYSTEM STRESS INDEX-METHODOLOGY

## a) Constructing the subindexes

In order to aggregate the whole information provided by the raw data, we first proceed to construct the four subindices, representing the main development in the banking sector, money market, foreign exchange market and the housing market. The principal component analysis provides a good approach to embody the different information (variation) offered by the variables into a single measure. This method is widely used by many authors to derive financial stress, i.e. Stock and Watson, (1989, 1999), Alexander (2008) or even to directly measure systemic risk as suggested by Kritzman (2010). In our case, the four subindices are defined as the first principal component, which explains most of the variation of the raw stress indicators (Louzis and Vouldis, 2011). Next, these subindices are scaled from 0 to 1 through a logit transformation:

$$y_{it}=1/[1+exp(y_{it})] \tag{2}$$

where the $y_{it}$ are the logit transformed subindices for the period $t$.

## b) Aggregation of subindices into the composite indicator

The main methodological innovation of the Financial Systemic Stress Index for Albania (FSSIA) following Hollo et al (2011) is the application of the standard portfolio theory to the aggregation of the subindices. The FSSIA puts more weight on stressful situations for many market segments at the same time, capturing the systemic risk component. As in the portfolio theory, when highly correlated risky assets are merged into a given portfolio, the overall portfolio risk increases as compared to when assets correlation are low or non systemic (Louzis and Vouldis, 2011). Therefore, high correlation increases systemic risk. Finally, the FSSIA is presented as:

$$FSSIA=\sqrt{s_t C_t s_t'} \tag{3}$$

Where $s_t = w * y_t$; $w=(w_1, w_2, w_3, w_4)$; the vector of the weights of the subindices, $y_t=(y_1, y_2, y_3, y_4)$ the vector of the subindices and $w * y_t$ is the vector of the weighted stress variables used for the construction of the index. $C_t$ is the 4x4 matrix of the time varying cross correlations coefficients $\rho_{ij}$ between subindices $i$ and $j$:

$$C_t = \begin{bmatrix} 1 & \rho_{12,t} & \rho_{13,t} & \rho_{14,t} \\ \square & 1 & \rho_{23,t} & \rho_{24,t} \\ \square & \square & 1 & \rho_{34,t} \\ \square & \square & \square & 1 \end{bmatrix} \tag{4}$$

The next step is to evaluate the weights and the time varying cross correlations. For both of these components we use two approaches.

### c) Estimating the time varying correlations

We first rely on a recursive estimation of the correlations using the exponentially weighted moving averages (EWMA). This approach is commonly used as it weights the relative new information that the latest data provide compared to older data. The EWMA recursively estimates the volatility using the respective covariances-variances of the subindices as given below:

$$\sigma_{ij,t} = (1-\lambda)\sum_{k=1}^{\infty} \lambda^{k-1}\, \bar{s}_{i,t-k}\, \bar{s}_{j,t-k} = (1-\lambda)\bar{s}_{i,t-1}\, \bar{s}_{j,t-1} + \lambda\sigma_{ij,t-1} \tag{5}$$

$$\sigma_t^2 = (1-\lambda)\, \varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 \tag{6}$$

$$\rho_{ij,t} = \sigma_{ij,t} / \sigma_{i,t}\, \sigma_{j,t} \tag{7}$$

Where $\sigma_{ij,t}$, i=1…4, is the $ij^{th}$ element of the variance-covariance matrix ($\sum t$) of the demeaned stress variables, the latest denoted by $\bar{s}_{i,t}$ and $\lambda$ is the decay parameter with $\lambda \in (0,1)$. For $i \neq j$ Eq. (8) gives estimates of the conditional covariances at time $t$, while for $i=j$ it estimates the time-varying variances. The value of the decay parameter $\lambda$ determines the persistence in the (co)variance process. A high value of $\lambda$ (i.e. $\lambda \rightarrow 1$) means high persistence and low reaction to past shocks on stress variables and vice versa (Alexander, 2008). Following Hollo et al. (2011) we set $\lambda$ =0.93.

The main drawback of the EWMA is that it heavily relies on the assumption used for the smoothing parameter $\lambda$, which is generally an ad hoc selection. Our second approach is to use the multivariate GARCH (MGARCH) to estimate the time varying correlations of the matrix $C_t$ making use of the information provided by the data (Louzis and Vouldis, 2011). The common MGARCH model presented by Engle and Kroner (1995) in its general form, a BEKK (*p, q, K*) model is defined as:

$$\Sigma_t = CC' + \sum_{i=1}^{p}\sum_{k=1}^{K} A'_{ki}\,\bar{s}_{t-i}\,\bar{s}'_{t-i}\,A_{ki} + \sum_{j=1}^{p}\sum_{k=1}^{K} B'_{kj}\,\Sigma_{t-j}\,B_{kj} \qquad (8)$$

where C is *nxn* lower triangular matrix, $A_{ki}$, $B_{kj}$ are *nxn* parameter matrices, *k* specifies the generality of the process while the *p* and *q* are the lags used.

The BEKK model ensures the positive definiteness of the conditional covariance matrices, $\Sigma_t$, by utilizing as a constant term the product of two lower triangular matrices. However due to its complexity in terms of parameter estimation, we impose a diagonal BEKK representation where the $A_{ki}$ and $B_{kj}$ are restricted to be diagonal matrices. This form is a common approach in estimating the variances in the case of multiple variables as it is parsimonious and produces positive definite covariance matrices.

### d) Estimating the weights of the subindices

The second element of the aggregation process is the weighting of subindices in the composite indicator. In our first approach, the subindices are assumed to have an equal impact on the overall stress; therefore, weights are assumed to be constant (25%). However, following our definition that "systemic risk is the materialization of shocks when financial instability becomes so widespread that it impairs the functioning of the financial system to the extent that economic growth and welfare suffer materially", we determine the relative weights of the subindices evaluating their relative impact on the economic growth, through the GDP growth. This exercise is carried out following a minimization process as presented below:

$$\min \sum_{i=1}^{T} (GDP_t - w'y)^2$$

$$\text{subject to and } \sum_{1}^{4} w_i = 1 \text{ and } w_i \geq 0 \text{ for } i=1,\ldots,4 \tag{9}$$

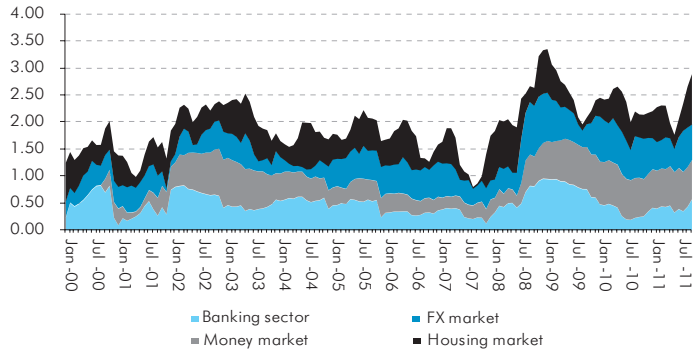
Following this exercise, the weights of the empirical application are as follows: banking sector 27.7%, money market 1.1%, foreign exchange market 37.1% and the housing market 34%. As we already anticipated, the narrow development of the money market as well as our assumption on a direct impact of the financial stress index on the economic growth are reflected on a low weight of the money market. However, the large impact of the foreign exchange market followed by the housing market and the banking sector are well expected.

As a final step, through incorporating the time varying correlations with the constant/estimated weights of the subindices, FSSIA captures two crucial characteristics of the systemic stress, "the horizontal view" of the financial instability and "the vertical view", the cost to the economy (Hollo et al. 2011).

# 4. EMPIRICAL ANALYSIS OF THE FSSIA

Figure 1 presents the four subindices used for the construction of the FSSIA. In the case of Albania, the index identifies two main periods of increased financial stress: beginning of 2002 corresponding to the deposit withdrawal and the recent financial crisis starting from October 2008. From the figure, we evaluate the contribution of each of the subindices to the overall stress of the financial system. The banking sector development is the main contributor to the increased stress during the turmoil periods. However during the latest financial crisis, the foreign exchange rate is the prevailing factor following large depreciation mainly of the domestic currency to the euro. During this period, the money market also puts pressure on the financial stress while the housing market continues to have a moderate impact on the overall financial stress.

Figure 1. Composite stress indicators

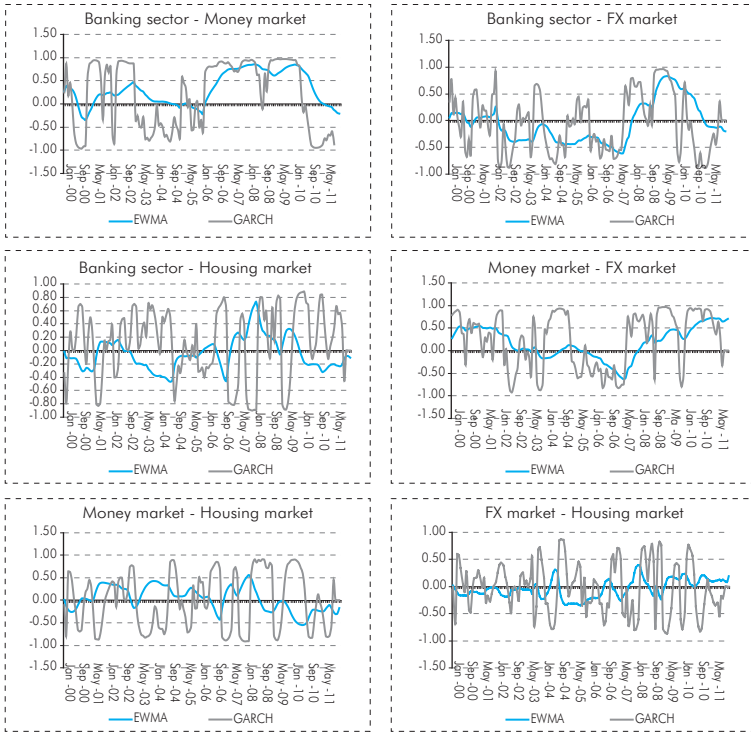



Source: Bank of Albania, authors' calculation.

However, these developments do not take into account the time varying correlations between the subindices which capture the systemic risk component. Figure 2 presents these correlations estimated with two alternative approaches: the EWMA and the diagonal BEKK models. The results indicate that the conditional correlations estimated by diagonal BEKK are more sensitive to the data development relative to the EWMA model. The EWMA provides a clearer way to understanding how the correlation among

the different subindices develops over time, as these data are rather smooth. It appears that the strongest correlation is between the banking sector and the money market, which goes close to one especially during the financial crisis. The banking sector appears to have a strong correlation also with the foreign exchange market. This correlation was obvious during the financial crisis of 2008, while it is missing during the deposit withdrawal crisis of 2002, probably due to the low development level of the banking sectors. Finally, we see a rather low correlation of the housing market with the other subindices probably due to the lack of strong movements in this market segment.

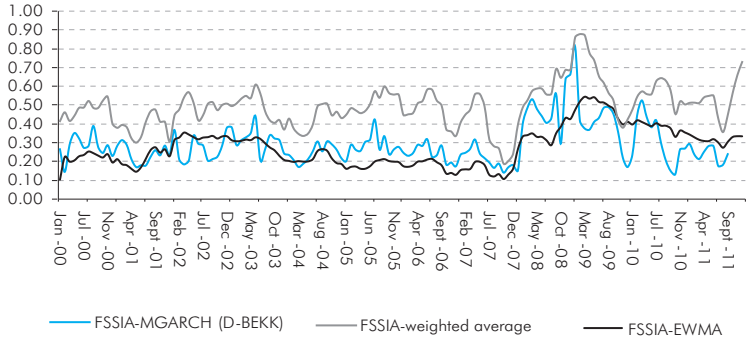
Figure 2. Time varying correlation between the subindices




Source: Bank of Albania, authors' calculation.

In Figure 3, we present the Financial Systemic Stress Index for Albania using three approaches: FSSIA with time varying correlations using EWMA, FSSIA with time varying correlation using MGARCH and FSSIA using a weighted average of the subindices. This final approach is the upper limit of the correlation based indices as it assumes that the subindices are perfectly correlated. The results indicate that all the stress indices depict the relative peaks during the crisis period. The main difference between the FSSIA-MGARCH and FSSIA-EWMA is that, during stress periods, it is much closer to the "weighted average" index and during more tranquil times it improves faster.

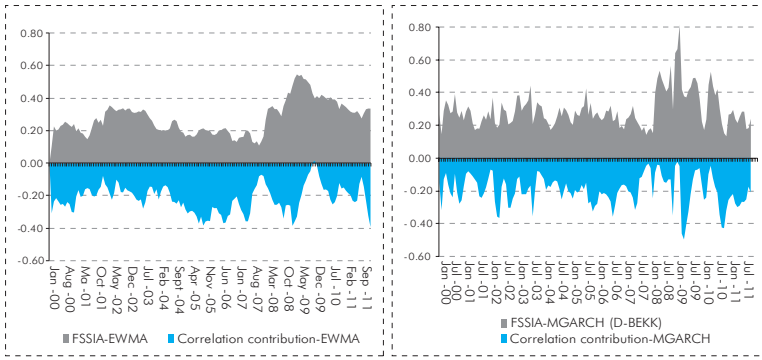
Figure 3. The Financial Systemic Stress Index for Albania




Source: Bank of Albania, authors' calculation.

The MGARCH-FSSIA also reflects a higher volatility compared to the EWMA approach, following the impact of the time varying correlation. The latter has also a higher negative impact, putting downward pressures on the financial stress measured by the data volatility using MGARCH. As a result, the FSSIA-MGARCH has a faster pace of decline in financial stress compared to the moving average approach. In order to capture the contribution of the cross correlations, we make the difference between the "weighted average" index, which assumes perfect correlation with each of the stress indices. The results presented in Figure 4, confirm that when financial stress is high or low in all market segments at the same time, the cross correlations increase and the indices approach to the "weighted average" stress index.

Figure 4. Correlation contribution




Source: Bank of Albania, authors' calculation.

Finally, we discuss the issue of the importance of identifying financial pressures through detecting "financial crisis" or "systemic stress" using our index. There are several methods to be applied ranging from using knowledge on the past events, to using econometric estimation. Illing and Liu (2006) develop an event-based criteria using the results of the survey of senior Bank of Canada policymakers to match with the index of financial stress. In our case, the event -based criteria would not be very helpful given that the stress events in Albania are not common and therefore rather rare events. They can be depicted with simple visualisation.

The second approach of using econometric estimation such as in Hollo (2011) is part of our current research. The main aim is to develop quantitative threshold or regimes for the level of the financial stress indicator based on simple statistical criteria.

# CONCLUSIONS

In this paper, we propose e Financial Systemic Stress Index for Albania (FSSIA) to capture the financial stress as well as the systemic risk in the Albanian economy. Our approach uses information from the banking sector, money market, housing market and foreign exchange rate to derive a common development of stress throughout market segments, through incorporating time varying correlations. The methodology is based on the portfolio theory through aggregating the individual financial stress indicators. We assess the interlinkages of different market segments through evaluating their impact on economic growth, hence providing a clear method in discussing the evolution of the subindices into the financial stress.

The results indicate that FSSIA captures the pressures in the form of the financial stress, not only from the different market segments, but also from their interaction through cross correlation. Our main focus for future research is to derive the threshold levels of the indices of financial stress using econometric estimation. We also want to rebuild the exercise using another approach for the money market such as the spread between the loan rates and treasury bills, in order to capture development in the counterpart risk within the country, considering in this case an internal rate as a risk-free asset.

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