FINANCIAL STABILITY IN AZERBAIJAN: THE APPLICATION OF FUZZY APPROACH[1]

G.C. Imanov, H.S.Alieva, R.A.Yusifzadeh[2]

Abstract

This paper develops an aggregate financial stability index (AFSI) for Azerbaijan financial system, over the period 2005-2015. The data used includes four composite indices; consisting nineteen individual indicators in total. We use intuitionistic fuzzy to set the weights of sub-indices and define the level of financial stability in Azerbaijan. Determining the weights appropriately across different years is important. This paper concludes the fuzzy assessment of the index is more capable compared to standard approach in capturing the dynamics of financial stability during the observed period.

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2 Authors are researchers on Institute of Control Systems of the National Academy Sciences of Azerbaijan Republic, korkmazi2000@gmail.com (*corresponding author*); rashad.yusifzada@gmail.com; and heyranaliyeva@gmail.com.

I. INTRODUCTION

Financial stability is a broad concept, included different aspects of financial system, such as institutions, infrastructure, and markets. This is an important phenomenon in terms of the real economic growth. The financial system is stable only when it is able to promote the productivity of the economy and to prevent financial imbalances that arise endogenously or as a result of adverse and unforeseen events, Shinasi (2004)

Consequences of the financial and economic crises of the late XX and early XXI extended the necessity for researches on financial stability in central banks, financial institutions and independent experts at the national and international levels. The purpose of these researches was to develop appropriate approaches and evaluation methods for timely identification of sources of financial instability and to design a correct appropriate response to them. The major objective of analysis of financial stability is to examine the different relationships, detecting negative trends, as well as economic, regulatory and institutional determinants for assessing state of the financial system and its vulnerabilities.

Considering the financial stability of the system as a phenomenon within a particular state or region is commonly used a set of indicators that reflect the state of not only the financial sector institutions, infrastructure and the market in general, but also real, public, external sectors of the economy. So that it takes into account changes in the macroeconomic environment, which have a significant impact on the financial system.

From the international comparability of indicators have been developed guidelines for the compilation of financial soundness indicators[3], by IMF and the monetary authorities of countries. Furthermore, the European Central Bank has developed a list of indicators for macro prudential monitoring financial stability of the European Union banking system.

In order to assess and monitor the financial stability for individual country an independent experts and the monetary authorities of the European Union have developed indicators taking into consideration the features of national economies (Gersl (2004)- National Bank of Czech Republic, Van den End (2005)- Central Bank of Netherlands, Rouabah (2007) - Central Bank of Luxembourg and etc.).

The aim of this research is to add new input to the financial stability literature by examining the case of emerging country like Azerbaijan. Specifically, the main objective of the paper is to provide a new approach in weighting procedure to estimate an aggregate financial stability index.

To the best of our knowledge the paucity of studies on financial stability index is very striking in the case of Azerbaijan. Moreover, this is the first attempt to fuzzy estimation of this index.

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3   Financial Soundness Indicators: Compilation guide, IMF, 2006. This compilation includes 39 indicators into two groups. First group reflects set of "base " indicators for banking sector, second group of indicators are called "recommended set", included 27 indicators.

In this paper first on the base of yearly data for the period 2005-2015 was used standard method to estimate an aggregate index (AFSI) and corresponding composite indices, where the weights of sub-indices were taken equal to 0.25. Then to compute the weights we applied intuitionistic fuzzy sets, which allow avoiding subjectivity. However it is worth to note that fuzzy approach allow to acquire some following advantages; *first*, in a standard calculation of financial stability index, the value "0" indicates instability and "1" recorded as a stability of the financial system. But fuzzy approach is convenient to avoid this kind of disjunction by determining a distributed terms such as "very low stability", "low stability" and etc.

Secondly, diversified terms are obtained not only for aggregated index, but also for composite indices. This gives an opportunity to establish a stability level for sub-indices individually.

The third advantage of using fuzzy approach is that in a large empirical literature the weights for individual indicators and for AFSI have assigned equally, but some of them have been defined differently depending on the author's judgments. As mentioned in Albulescu (2004) latter requires complete data and it is difficult to justify and demonstrate the choice of the statistical weight. In our case we assumed an impact of individual indicators on financial stability equally, but composite indexes are weighted by intuitionistic fuzzy sets, which provide obtaining the different weights according to years. For the deepening of the research we are dealing with extension of the list of individual indicators and then to apply fuzzy approach to all indicators in order to obtain different weight for the individual indicators.

The remainder of the paper is structured as follows. A brief theory and related literatures are reviewed in section two. Next we present methodology of the construction of the stability indices in the third section. Section four contains the calculation result of the aggregate stability index for Azerbaijan financial system. The last section points out of the findings of this study and conclude the presentation of this paper.

II. THEORY

Recent global financial crisis and changes in world economy have re-kindled the interest of central bankers and policy makers on the financial system stability assessment.

From the empirical prospects a large body of literature has applied various indexes in measurement of financial stability.

Illing and Liu (2003) developed the Financial Stress Index (FSI) for Canada. In the study using daily data from the survey have been chosen variables reflecting banking sector, foreign exchange market and debt market. A standard method and credit weighting techniques were used for calculation.

Experts from Netherlands Central Bank Van den End (2006) created a Financial Condition Index (FCI) for Netherlands and six OECD countries. FCI index was built based on interest rates, effective exchange rate, real estate prices, and stock prices, solvency of financial institutions and volatility of financial institutions stock index. Then the FCI index has been extended to Financial Stability Condition index (FSCI). Weighting of the indicators have been employed by combining backward-looking IS curve and VAR (Vector Autoregressive Model).

In the paper for the Romanian financial system stability, Albulescu (2009) developed a synthetic index in which aggregates different indicators for financial stability. For the purpose of constructing aggregate index based on quarterly data, twenty individual indicators were incorporated into four composite indices: (i) financial development index, (ii) financial vulnerability index, (iii) financial soundness index, and (iv) world economic climate index. The aggregation of these indicators employed standard approach with equal weighting for individual indicators.

In the research developed by Morris (2010) for Jamaica applied normalization and aggregation procedures to create financial stability index. In their study weight of the sub-indices are determined by judgmental approach.

The next paper from a large literature on FSI assessment is Gersl and Hermanek (2006) aggregate index for the Czech Republic banking sector, which was called Banking Stability Aggregate Index (BSAI). The indicators were selected based on current international practice and weights established based on authors experience and judgments.

Nelson and Perli (2005) have constructed a Financial Fragility Index (FFI) for United States financial system in two-step process. First step involves three group indicators which take into consideration the level, volatility and correlation of twelve individual variables. Second step present *logit* model estimation to obtain the probability that the behavior of financial markets corresponds to previous financial crisis.

For the Azerbaijan there are a few papers developed for the financial stability assessment. One of them is employed by Yusifzade and Mammadova (2015). However in the paper is developed panel estimation for developing and developed countries, which aggregated data are obtained by using principle of components. The study captures four aspects of financial system as depth, access, efficiency and stability. Then aggregated index is used to estimate relationship between financial development and economic growth. According to panel estimation results show that as financial stability reaches some intermediate level it starts to ensure economic development. However, economic development reverses if financial system is excessively stable and financial intermediaries keep more capital and liquidity than what is needed.

In the following section, we will describe construction method of financial stability index for Azerbaijan financial system, using standard procedure with fuzzy approach in weighting of sub-indices.

III. METHODOLOGY

3.1. The construction of the stability index for the Azerbaijan financial system.

To measure the aggregated financial stability index, we use four sub-groups of indicators. This includes the Financial Market Index (FMI), Financial Vulnerability Index (FVI), Financial Soundness Index (FSI), and World Economic Climate Index (WEI). Indicators within each sub-indices are explained in detail below.

The indicators of Financial Market Index - FMI

1. Total credit to GDP ratio (DC) - provides information about the ability of credit institutions in performing their intermediation functions. High value of this indicator increases the value of sub-index.

2. Interest Spread (IS) - defined as the difference between credit rates and deposits rates. The high spreads interpreted as incompetence of intermediation and allocation of resources, and low spreads are an indicator of the effectiveness of the banking system. High interest spreads have a negative impact on financial stability.

3. Herfindahl–Hirschman Index (HHI) in assets - demonstrates the concentration level of financial market. US Department of Justice considers markets with HHI value equal to less than 1,000-unconcentrated, 1000-800 - moderately, above 1000 - highly concentrated markets.

4. Market capitalization data was unavailable for analyzed period, thus we were satisfied with data represented above

The indicators of Financial Vulnerability Index - FVI

1. Fiscal deficit to GDP ratio (FD) - is taken as an indicator of financial system stress. High value of the indicator has a negative impact on economic development.

2. Current account (CA). The indicators of balance of payments allow tracking up the coming external shocks. A significant deficit in current account may indicate to increasing possibility of a currency crisis and reducing the liquidity of the national financial system.

3. Inflation rate (IN) - rising inflation distorts price proportions and profitability indicators of economic processes, which leads to inefficient use of financial resources; deters the inflow of foreign investment; devalues national currency savings.

4. Real Effective Exchange Rate (REER) - this indicator reflects the exports competitiveness. The increase in this indicator expresses the competitiveness of the sector. High volatility negatively affects the financial system.

5. Public Debt to GDP ratio (PD) - a high level of this indicator negatively affects financial stability.

6. International Reserves to Import ratio (IR) - a sufficient level of international reserves allows the monetary authorities to conduct an independent and flexible monetary and currency policy by adjusting the level and volatility of the exchange rate of national currency and provide liquidity to the economic agents of financial markets in a stressful and crisis periods. High value of this indicator positively affects the financial system.

7. Non-government Credit to Total Credit ratio (NGC) - Reduction in the value of this indicator has a negative impact.

8. Ratio of M2 to International Reserves (MIR) - the increase adversely affects the adequacy of reserves.

9. M2 multiplier (MM) - High level of value has a negative influence to financial stability.

Indicators of Financial Soundness Index - FSI

1. Return on Assets (ROA) - High value refers to effectiveness of banking system.

2. Bank Capital to Assets Ratio (BCA) - increase in this indicator has a positive effect on performance of the banking system.

3. Liquid Assets to Total Assets ratio (LAA) - The growth indicates increasing liquidity, while reduction shows decline in the liquidity of banking sector.

4. Bank regulatory capital to risk weighted assets (RCRA) - the growth in the value of this indicator negatively affects banking system.

Indicators of World Economic Climate Index (WEI)[4]

1. World Economic Growth (WEG) - Azerbaijan has new formulated financial system and growth in the global economy positively impact on financial system of country

2. Oil Price in the world market (OPR)[9] - due to Azerbaijan is resource rich country and economy more supported by oil revenues, rise in oil prices has a positive effect in the economy as a whole.

All financial systems are interconnected and deterioration of these indicators such as, world economic growth, world inflation and oil prices has negative impact at national level for economic and financial stability, Albulescu (2010).

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4   CESifo, calculated by Munich group

3.2. Standard Approach on Measuring Aggregated Financial Stability Index

A standard procedure of calculation an aggregate index of financial stability includes the normalization of individual indicators. For this purpose has been used the formula as following:

$$X_{tn} = \frac{X_t - \overline{X_t}}{\sigma_t}$$

where, X_{tn} is normalized value of indicator X in year t, X_t - average value of the indicator X, σ_t - is standard deviation of the indicator X during the period.

After the normalization an individual indicators were grouped into respective four sub-indices by the following formula:

$$FMI = \frac{\sum_{j=1}^{3} X_{mj}}{3}$$

$$FVI = \frac{\sum_{j=1}^{9} X_{vj}}{9}$$

$$FSI = \frac{\sum_{j=1}^{4} X_{sj}}{4}$$

$$FWI = \frac{\sum_{j=1}^{3} X_{wj}}{3}$$

Aggregate index of financial stability is computed as follows:

$$AFSI = w_1 * FMI + w_2 * FVI + w_3 * FSI + w_4 * FWI$$

where, w_i (i=1,..,4) - are weights of corresponding sub-indices.

3.3. Fuzzy Approach to Measuring Financial Stability Index

Measurement performs two quite distinct roles. One is to help ensure the accountability of the authorities responsible for performing the task. The other is to support the implementation of the chosen strategy to achieve the goal in the real time. The former calls for ex post measurement of financial instability, i.e. for assessments of whether financial instability prevailed or not at some point in the past. The latter relies on ex ante measurement, i.e. on assessment of whether the financial system is fragile or not today. While both ex ante and ex post measurement are "fuzzy", the challenges in supporting strategy implementation are tougher (Borio and Drehmann (2009))

The literature mentions several methods for determining the weights of the variables in the FSI. These are econometric estimations with a macroeconomic model, a reduced form aggregate demand function (backward-looking IS curve), or a Vector Autoregression Model (VAR). The weights can also be determined by the way of economic arguments, such as a variable's importance for the financial system. Alternatively, each variable in the index can be given in equal weights. In some studies, the above methods are combined (Van den End, 2006).

In determining the weights of sub-indices are mainly used expert assessments. However, it should be noted that the values of these weights depend not only on time but also on situation existing in the various financial markets and global economy. In order to define the weights of individual sub-indices of aggregated index, we have used intuitionistic fuzzy set technique.

The intuitionistic fuzzy set, proposed by K.Atanassov (1986), is a generalization of L. Zadeh's fuzzy set. The intuitionistic fuzzy set is defined as:

$$A = \{< x, \mu_A(x), \nu_A(x) > | x \in X\},$$

where,

$$\mu_A : X \to [0,1] \quad \nu_A : X \to [0,1]$$

$$\text{if } 0 \leq \mu_A(x) + \nu_A(x) \leq 1 \qquad \forall x \in X$$

$\mu_A(x), \nu_A(x) \in [0,1]$ numbers indicate the degree of membership and non-membership of *x* to a respectively.

For each intuitionistic fuzzy set *X*, there is intuitionistic index *x* in *A*.

$$\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$$

In this study in order to define weights of financial stability sub-indices, we used generalized entropy measure of intuitionistic fuzzy set *F*, composed of *n* elements, proposed by E. Szmidt and J. Kacprzyk (2001):

$$E(F) = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{\max\ Count\ (F_i \cap F_i^c)}{\max\ Count\ (F_i \cup F_i^c)} \right),$$

where,

$$F_i \cap F_i^c = \langle \min(\mu_{F_i}, \mu_{F_i}^c), max(\nu_{F_i}, \nu_{F_i}^c) \rangle,$$

$$F_i \cup F_i^c = \langle \min(\mu_{F_i}, \mu_{F_i}^c), max(\nu_{F_i}, \nu_{F_i}^c) \rangle.$$

The weights of each individual index are defined on the basis of the following formula:

$$w_i = \frac{1 - E(A_i)}{n - \sum_{i=1}^{n} E(A_i)}$$
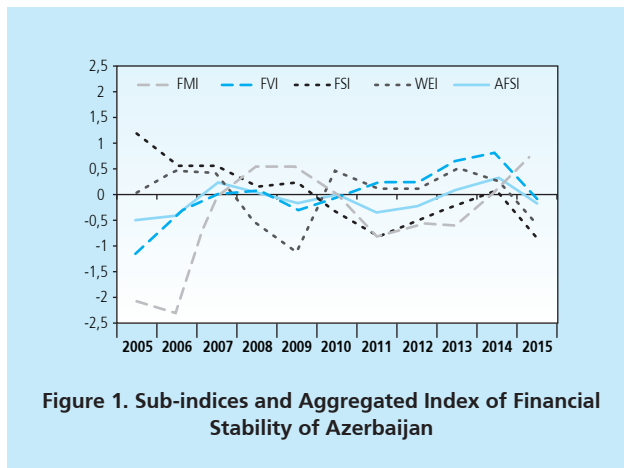
IV. RESULT AND ANALYSIS

4.1. Standard Procedure of Measuring AFSI

Following the standard method on calculating the aggregate financial stability index, we firstly normalize every single of individual indicators. Table 1 shows the normalized value of those indicators for 2005-2015 years.

Table 1. Normalized Velues of The Indicators of Financial Stability in Azebaijan during 2005-2015											
Years	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Financial Market Indicators - FMI											
DC	-1.3	-1.08	-0.6	-0.72	0.01	0.071	-0.37	0.27	0.36	1.33	2.04
IS	1.81	0.79	0.20	1.08	0.20	-0.9	-1.12	-1.27	-1.05	-0.02	0.29
HHI	-6.69	-6.69	0.24	1.23	1.36	0.81	0.98	-0.75	-1.04	-1.12	0.24
Financial Vulnerability Indicators											
FD	-1.12	1.031	-0.2	0.49	-1.12	-1.48	1.21	0.672	1.21	-0.76	0.08
CA	-1.68	-0.11	0.75	1.36	0.40	0.86	0.64	0.21	-0.15	-0.5	-1.76
IN	0.37	0.17	1.46	2.09	-0.88	-0.23	0.105	-0.94	-0.74	-0.90	-0.50
REE	-1.57	-1.4	-1.10	0.24	-0.08	0.53	0.86	0.66	0.72	1.48	-0.35
PD	0.76	-0.52	-1.20	-1.72	0.14	-0.15	-0.56	0.06	0.96	1.83	0.39
IR	-1.69	-1.29	-0.50	-0.15	-0.19	0.221	0.43	0.67	1.32	1.59	-0.40
NGC	-1.45	-0.24	0.28	-0.32	-1.31	-0.94	-0.07	0.26	1.28	1.57	0.93
MFR	-2.18	-0.73	-0.50	-0.78	0.42	0.95	-0.25	0.48	0.39	0.96	1.21
MM	-1.62	-0.35	0.92	-0.35	-0.35	-0.35	-0.35	-0.35	0.92	2.20	-0.35
Financial Soundness Indicators											
ROA	0.32	-0.09	0.99	0.45	0.86	-1.16	-1.03	-1.43	-0.49	-0.22	1.80
BCA	0.9	0.02	0.24	0.46	0.90	0.24	-0.57	-0.35	0.46	0.39	-2.69
LAA	1.96	1.86	-0.20	-0.33	-0.85	-0.10	-0.18	0.08	-0.85	-0.53	-0.89
RCRA	1.53	0.49	1.12	-0.02	0.03	-0.44	-1.58	-0.44	0.18	0.75	-1.63
World Economic Index											
WEG	0.67	1.02	0.96	-0.27	-2.54	0.90	0.14	-0.27	-0.21	-0.15	-0.27
OPR	-1.28	-0.76	-0.40	0.77	-0.88	-0.07	1.10	1.14	1.10	0.73	-1.40
ECI	0.73	1.14	0.73	-2.35	0.02	0.58	-0.95	-0.67	0.58	0.30	-0.11

The results of calculation for sub-indices and aggregate index of Azerbaijan during 2005-2015 are given in Table 2 and Figure 1. We have assumed each of the sub-indices have received the weights equal to 0.25.

Table 2. **Sub-indices and Aggregate Index of Financial Stability of Azerbaijan during 2005-2015**											
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
FMI	-2.06	-2.33	-0.05	0.53	0.53	-0.01	-0.82	-0.58	-0.58	0.06	0.85
FVI	-1.13	-0.38	-0.01	0.10	-0.33	-0.06	0.22	0.19	0.66	0.83	-0.08
FSI	1.18	0.57	0.54	0.14	0.23	-0.36	-0.84	-0.53	-0.17	0.10	-0.85
WEI	0.04	0.47	0.41	-0.62	-1.13	0.47	0.10	0.07	0.49	0.29	-0.59
AFSI	-0.49	-0.42	0.22	0.04	-0.18	0.01	-0.34	-0.21	0.10	0.32	-0.17

Figure 1. Sub-indices and Aggregated Index of Financial Stability of Azerbaijan

Conforming with standard method, the outcome describes that AFSI has not received the value of "1" during 2005-2015 period. This indicates the financial system of Azerbaijan has not been stable along this period. This results leave in doubt because after 2006, Azerbaijan enjoy the oil boom era where the banking sector performance was satisfactorily.

4.2. Fuzzy Approach Result on Measuring AFSI

If we use uniform weights, we may not be able to examine the changes in the economy for each single year. Fortunately the Fuzzy approach is competent to close this gap. In a fuzzy approach, to aggregate index of financial stability, we classify the values of sub-indices into four categories below. The matrix of linguistic variables for the years of 2005-2015 is provided in Table 3.

- Very low stability – VLS = (-2.43, -2.43, -1.20);

- Low stability – LS = (-1.23,0.00,0.00);

- Stable – S = (0.00,0.00, 0.65);

- High stability – HS = (0.63; 1.28; 1.28).

Table 3. Matrix of Linguistic Values of Sub-indices in The Period 2005-2015											
Sub-indices	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
FMI	VS	VL	LS	ST	ST	LS	LS	LS	LS	ST	HS
FVI	LS	LS	LS	ST	LS	LS	ST	ST	HS	HS	LS
FSI	HS	ST	ST	ST	ST	LS	LS	LS	LS	ST	LS
WEI	ST	ST	ST	LS	LS	ST	ST	ST	ST	ST	LS
Note : VLS = Very low stability; LS = Low Stability; S = Stable; HS = High Stability											

Based on fuzzy method, the calculation of each sub-indices of financial stability in Azerbaijan during 2005-2015 years, is provided on Table 4.

Table 4. Indicators of Intuitionistic Fuzzy Set											
Sub-indices	FMI			FVI			FSI			WEI		
Years	$\mu_1 t$	$v_1 t$	$\pi_1 t$	$\mu_2 t$	$v_2 t$	$\pi_2 t$	$\mu_3 t$	$v_3 t$	$\pi_3 t$	$\mu_4 t$	$v_4 t$	$\pi_4 t$
2005	0.70	0.30	0	0.08	0.92	0	0.85	0.15	0	0.94	0.06	0
2006	0.92	0.08	0	0.69	0.31	0	0.12	0.88	0	0.28	0.72	0
2007	0.96	0.04	0	0.99	0.01	0	0.16	0.84	0	0.36	0.64	0
2008	0.18	0.82	0	0.85	0.15	0	0.78	0.22	0	0.50	0.50	0
2009	0.20	0.80	0	0.73	0.27	0	0.64	0.36	0	0.08	0.92	0
2010	0.99	0.01	0	0.95	0.05	0	0.70	0.30	0	0.27	0.73	0
2011	0.33	0.67	0	0.66	0.34	0	0.32	0.68	0	0.85	0.15	0
2012	0.53	0.47	0	0.70	0.30	0	0.57	0.43	0	0.89	0.11	0
2013	0.53	0.47	0	0.04	0.96	0	0.86	0.14	0	0.24	0.76	0
2014	0.89	0.11	0	0.31	0.69	0	0.85	0.15	0	0.54	0.46	0
2015	0.35	0.65	0	0.93	0.07	0	0.30	0.70	0	0.52	0.48	0

The calculation of entropy for each individual sub-indices during the year of 2005 is given below:

$$E(A_1) = \frac{(0.35,0.65,0) \cap (0.65,0.35,0)}{(0.35,0.65,0) \cup (0.65,0.35,0)} = \frac{0.35}{0.65} = 0.54$$

$$E(A_2) = \frac{(0.93,0.07,0) \cap (0.07,0.93,0)}{(0.93,0.07,0) \cup (0.07,0.93,0)} = \frac{0.07}{0.93} = 0.08$$

$$E(A_3) = \frac{(0.3,0.7,0) \cap (0.7,0.3,0)}{(0.3,0.7,0) \cup (0.7,0.3,0)} = \frac{0.3}{0.7} = 0.43$$

$$E(A_4) = \frac{(0.52,0.48,0) \cap (0.48,0.52,0)}{(0.52,0.48,0) \cup (0.48,0.52,0)} = \frac{0.48}{0.52} = 0.92$$

The entropy for each individual sub-index in 2005-2014 is:

2005 - $E(A_1) = 0.43$; $E(A_2) = 0.09$; $E(A_3) = 0.18$; $E(A_4) = 0.06$

2006 - $E(A_1) = 0.09$; $E(A_2) = 0.45$; $E(A_3) = 0.14$; $E(A_4) = 0.39$

2007 - $E(A_1) = 0.04$; $E(A_2) = 0.01$; $E(A_3) = 0.19$; $E(A_4) = 0.56$

2008 - $E(A_1) = 0.22$; $E(A_2) = 0.18$; $E(A_3) = 0.28$; $E(A_4) = 1$

2009 - $E(A_1) = 0.25$; $E(A_2) = 0.37$; $E(A_3) = 0.56$; $E(A_4) = 0.09$

2010 - $E(A_1) = 0.01$; $E(A_2) = 0.05$; $E(A_3) = 0.43$; $E(A_4) = 0.37$

2011 - $E(A_1) = 0.49$; $E(A_2) = 0.52$; $E(A_3) = 0.47$; $E(A_4) = 0.18$

2012 - $E(A_1) = 0.89$; $E(A_2) = 0.43$; $E(A_3) = 0.75$; $E(A_4) = 0.12$

2013 - $E(A_1) = 0.89$; $E(A_2) = 0.04$; $E(A_3) = 0.16$; $E(A_4) = 0.32$

2014 - $E(A_1) = 0.12$; $E(A_2) = 0.45$; $E(A_3) = 0.18$; $E(A_4) = 0.85$

The weights of individual sub-indices for the year of 2015 are calculated as follows:

$$w_1(2015) = \frac{1 - 0.54}{4 - 1.97} = \frac{0.46}{2.03} = 0.23$$

$$w_2(2015) = \frac{1 - 0.08}{4 - 1.97} = \frac{0.92}{2.03} = 0.45$$

$$w_3(2015) = \frac{1 - 0.43}{4 - 1.97} = \frac{0.57}{2.03} = 0.28$$

$$w_4(2015) = \frac{1 - 0.92}{4 - 1.97} = \frac{0.08}{2.03} = 0.04$$

Using weights of individual sub-indices and their linguistic values (Table 3), the aggregated index of financial stability is calculated for the year of 2015:

$$AFSI(2015) = 0.23 * HS + 0.45 * LS + 0.28 * LS + 0.04 * LS$$
$$= 0.23 * (0.63,1.28,1.28) + 0.45 * (-1.23,0,0) + 0.28 * (-1.23,0,0) + 0.04 * (-1.23,0,0)$$
$$= (0.15,0.29,0.29) + (-0.55,0,0) + (-0.34,0,0) + (-0.05,0,0)$$
$$= (-0.79,0.29,0.29) = LS - ST$$

For the whole period observed, the weights of sub-indices and aggregated index of financial stability are given in Table 5.

Table 5. Weights of Sub-indices and Aggregated Indices					
Indicators / Years	W_1	W_2	W_3	W_4	AFSI
2005	0.18	0.25	0.28	0.29	(-0.57,-0.08,0.33) LS - ST
2006	0.31	0.19	0.29	0.21	(-0.98,-0.75,-0.04) LS
2007	0.3	0.31	0.25	0.14	(-0.75,0,0251) LS - ST
2008	0.34	0.35	0.31	0	(0,0,0.65) ST
2009	0.28	0.23	0.16	0.33	(-0.69,0,0.228) LS - ST
2010	0.32	0.3	0.18	0.2	(-1,0,0.13) LS - ST
2011	0.22	0.21	0.23	0.35	(-0.55,0,0.37) LS - ST
2012	0.06	0.32	0.14	0.49	(-0.24,0,0.53) LS - ST
2013	0.04	0.37	0.32	0.26	(-0.2,0.47,0.64) LS - ST
2014	0.37	0.23	0.34	0.06	(0.15,0.29,0.79) ST - HS
2015	0.23	0.45	0.28	0.04	(-0.79,0.29,0.29) LS - ST

Having the result above, now we can compare the financial stability from the two approaches; the standard and the fuzzy approach. With respect to the dynamics of AFSI, we may conclude the fuzzy approach is more satisfactory than the standard method. This is because the fuzzy approach can capture the changes in economy. Considering the fact that Azerbaijan is in transition with the new financial system, the results are generally represent low stability during the period of 2005-2007 and 2009-2013.

The aggregate index is higher in 2008 and 2014 which reflects the higher stability of the Azerbaijan financial system. The reason for this was the presence of significant economic growth supported by stimulated banking sector due to the oil boom. With the "Contract of the Century, 1994", Azerbaijan economy is gifted with oil revenues and 2007 year was an oil boom for this country. The changes provided significant oil revenues and contributed to the economy and the financial system.

As a result of global economic crises since 2009, the stability decreased to low stable level. Starting 2010, the economy was in recovery stage and the increasing of oil prices committed to higher stability performed in 2014. However, the declining oil price by the end of 2014 and devaluation of exchange rate in 2015 affected the activity and the performance of banking sector. The result was a low stable level of financial stability.

These dynamics are well captured by the aggregated financial stability obtained with Fuzzy approach. This finding may contribute to the way we construct the financial stability index for any possible use, including forecasting it based on indicators constructing it.

V. CONCLUSION

This paper has developed a method to calculate the weights of composite indices and the quality level of financial stability in Azerbaijan, covering the period of 2005-2015. Main step on this approach is appropriately determining the weights for the years. It is worth to note that uniformly apply equal weights to the aggregate index is not capable to cover the economic changes in 2005-2015. Taking the advantage of using Fuzzy approach, this paper constructed the weights representing each year separately. Moreover instead of using disjunction of the term "stability" and "instability", we manage to categorize the stability index onto four categories, starting from "very low stability" to "very high stability".

This paper concludes that the fuzzy approach is superior to the standard one because it is able to capture key periods of financial stability during the sample period. For future research, one may enhance the result and by extending the list of individual indicators and then apply the fuzzy approach to obtain different weights for all individual indicators.

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