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Developing An Aggregate Index For Measuring Financial Stability In The Balkans

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Abstract

Financial stability continues to grow in importance and remains a hotly debated topic since the turn of the new century brought a string of financial episodes that culminated with the Global financial crisis of 2007. While the Balkans have traditionally been considered to lie on the periphery of financial phenomena, this wide assessment of the region has changed with the large-scale turmoil caused by the Greek Sovereign Debt crisis. Therefore, to curb nascent instability, financial authorities should remain alert and devise a mechanism able to effectively detect stress in their respective financial systems. So far – in the quest to build a comprehensive and universal Early Warning System – a number of broad measures and indicators have been proposed; however, none of them have been specifically tailored to reflect the distinct character of the Balkan countries with their diverse, yet analogous political, social and economic idiosyncrasies. This paper attempts to tackle this issue from a financial policy standpoint by contributing to the current literature on the subject in three separate ways. First, it builds upon the most recent findings in this area to develop an aggregate financial stability index that measures financial stability levels in nine countries geographically belonging to the Balkan region, entirely or at least in part. Most importantly, this index juxtaposes some well known IMF-backed Financial Soundness and macroprudential indicators with World Bank development indicators and CESifo measures of world economic climate. Second, the authors perform a Chanut-Laroque analysis of contribution to volatility levels in the aggregate stability index in order to explore which sub-indexes can explain the improvement or deterioration of the index value for the 1995-2011 period. Third, this paper compares and contrasts the evolution of financial stability of two sub-indices reflecting the diverging nature of the two groups of countries (Western Balkans vs. EU members) regarding their standing relative to European Union status.

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1. Introduction

Seldom have there been more reasons than at the present to examine and evaluate financial stability in the Balkan region. After being enveloped in the fold of the Global financial crisis of 2007/09 – despite the widespread perception of Balkan countries as peripheral players insulated from the international arena – and with the initial shocks now having subsided, the region remains plagued by episodes of instability and slow recovery. Therefore, the timing is opportune and the stakes are high to revisit the idea of measuring financial stability for the Balkan region as a whole.

The stability of the financial system is *condicio sine qua non* in any economy which tasks its policymakers to achieve balance in the twin objectives of price stability and sustained growth. Safeguarding financial stability is therefore an imperative for every government, requiring a significant devotion of resources while continuously looking for ways to improve the ability to anticipate and restrain future spells of instability. Instrumental in these efforts have been the various techniques developed to measure and monitor the economy's performance.

Aggregate index construction, in addition to early warning systems and stress testing, has been recognized as a useful policy tool for identifying trends, drawing attention to various phenomena, benchmarking country performance, interpreting results, and communicating the findings to the general public. A number of studies have been published comparing different countries, different periods, and their overall financial stability levels. None of them, however, have focused on the Balkans as whole, choosing to direct its attention on a single country instead.

For that reason, this paper proposes the construction of an aggregate financial stability index for the Balkan region. The model in question is based on the methodology first advanced by Albulescu (2008, 2009) and later on developed by Morris (2010), where a financial stability index is derived based on the aggregation of constituent indicators covering various dimensions of financial stability, ranging from financial development, vulnerability, and soundness, to the global economic climate. The specific contribution of this paper is in its breadth and complexity, where aggregate measures have been derived to cover a diverse region consisting of 9 different countries, each with different levels of economic activity, financial development and stages of European integration. Converging all of this information into a single quantitative measure for the 1995-2011 period reveals interesting implications for the Balkan region as a whole and its financial stability levels as evaluated through index volatility.

The remainder of this paper is organized as follows: section 2 gives an overview of the financial stability literature. Section 3 covers the methodological intricacies of aggregate index construction. Section 4 goes into further detail, by defining and describing the selected variables and applying the normalization, weighting and aggregation techniques to the particular case of the Balkan region. Section 5 discusses the obtained results, while section 6 provides additional information about the index dynamics by measuring the contribution of each constituent part to the volatility of the aggregate financial stability index. The last section concludes by imparting some policy implications and recommendations for the region.

2. Literature Overview Of Financial Stability Literature And Aggregate Index Development

Various techniques for aggregate index development are circulated in the existing literature. In its essence, an index attempts to grasp complex multidimensional phenomena by aggregating a set of indicators into a single quantitative measure whose value can reflect the multilayered reality of a national economy. This reality is captured by a collection of "basic" indicators, which represent observable variables that quantify phenomena and trends that are often conspicuous in their manifestation but elusive and perplexing in their nature. While the convergence of a set of individually meaningful measures into a single simplified value may seem misleading and reductive, a number of different techniques have been developed into their own strands of research within the financial stability literature.

From Hyman Minsky's (1986) now resurgent Financial Instability Hypothesis until today, the notion of what financial stability is and what it is not has undergone numerous attempts of definition and analysis, as documented in

current literature (Schinasi, 2004). While financial stability can be a difficult concept to explain as no widely accepted definition exists, the wording proposed by the International Monetary Fund (2006) will suffice for the purposes of this paper:

> "...a financial system, regardless of size and complexity, is stable when it has the capacity to facilitate economic performance and to correct any imbalances that may occur as a result of adverse shocks"

In addition to this, the role of indicators as the building components of an index has been thoroughly examined by a number of authors in a variety of different contexts. In a comprehensive review of measures available to government authorities tasked with maintaining financial stability, Hawkesby (2000) suggests the label 'macro-prudential' to refer to broader indicators that might signify risks facing financial institutions in general and include banking system indicators, macroeconomic indicators as well as information from financial markets. Moreover, reacting to recent vulnerabilities in the global financial markets, an international endeavor jointly initiated in 1999 by the IMF and the World Bank aimed at better safeguarding global financial stability has established the Financial Sector Assessment Program (FSAP), consisting of a financial stability assessment component and a financial development assessment component, thus allowing basic indicators to officially be recognized as indispensable to institutional methodology in creating country findings and recommendations. Another attempt launched concurrently with the FSAP and spearheaded by the IMF in conjunction with national governments focuses on formulating a definition and single methodology for the compilation of Financial Soundness Indicators (FSI) so as to enable international comparison across countries and regions.

All of these developments have allowed for several different quantitative methods for measuring the stability of a financial system to expand its research in different directions, resulting in stress testing, early warning systems (EWS) and aggregate financial stability index techniques present in the literature. Each of them has its own advantages and disadvantages and neither should be used for policy advice in isolation.

The most primitive attempt at index aggregation concerns a non-parametric approach of mechanical comparison of basic indicators hierarchically ordered as index components with equal weights given to the minimum differences between the indicator values. In order to solve the first problem appearing in aggregation – that is, the different nature and value ranges of employed variables – most authors resort to normalization, a common technique used in order to allow for different variables first to be quantified, then measured on the same scale, and finally evaluated across comparable values and within a distinct interval.

Geršl and Hermanek (2006) give an extensive overview of the various approaches in constructing an aggregate financial stability indicator along with a discussion on methodology of select FSI's for the Czech Republic. The idea of having a composite index is sanctioned by Fell and Schinasi (2005) who insist on having a quantifiable framework for an objective and consistent evaluation of financial stability. To that end, van den End (2006) constructs a composite index with critical boundaries for the Netherlands and six other OECD countries which is an extension of the Financial Conditions Index (FCI) as well as the Monetary Conditions Index (MCI). A completely different approach was earlier attempted by the same author, based on the Merton option model, by calculating the default risk at the level of the entire financial system (van den End and Tabbae, 2005), later pursued by Čihák for the Czech Republic (2007).

Borrowing some ideas from them and further expanding them into the concept of a synthetic index, Albulescu (2009) developed an Aggregate Financial Stability Index (AFSI) for Romania by using a stochastic simulation model to provide a forecast for the country's banking system. In the same venue, Morris (2010) uses banking system data from 1997 to 2010 to build an AFSI for Jamaica and validates the sensitivity of the index to variability in key macroeconomic indicators, adding a Monte Carlo simulation for a one-year forecast of financial stability.

Another strand of literature explores index aggregation techniques based on financial markets data. Nelson and Perli (2005) construct a financial fragility index and then estimate a logit model using weekly data for the U.S. markets from 1994 to 2002 to detect whether the country's financial system is under stress. Using several different techniques, including factor analysis, econometric benchmarking and generalized autoregressive conditional heteroscedasticity (GARCH), Illing and Liu (2003) extract information about financial stress from Canadian market data in order to develop an index of financial stress (FSI). The authors present a single continuous measure of financial stress which varies over a spectrum of values, so that those values found in the extremes are indicative of financial crises. Based on a more complex method which, in addition to market data also includes balance sheet data

and subjective assessments by experts, Hanschel and Monnin (2005) construct a stress index for Switzerland from 1987 until 2002.

3. The Methodology Behind Composite Index Construction

This section describes the technical and methodological procedure for constructing an aggregateindex of financial stability. According to Albulescu, "the design of an AFSI does not represent an arbitrary exercise" (2008); therefore, a chain of steps should be followed so that the index could exhibit robustness and methodological soundness when finally utilized for policy or other purposes. In order to avoid data manipulation and misrepresentation, the OECD and the Joint Research Centre of the European Commission have prepared a Handbook on Constructing Composite Indicators (2008) as methodology and user guide recommending an "ideal [ten-step] sequence", ranging from developing a theoretical framework to the presentation and dissemination of a composite index. For the purposes of this study, however, those steps will be condensed in a more concise arrangement, without skipping or omitting any stages of the process.

The first step in index construction concerns laying down the theoretical groundwork for the selection, definition, and combination of variables to be included in the index. The financial stability phenomenon consists of multiple dimensions, each of which is reflected by an individual indicator which should be both relevant and quantifiable.

The second step deals with detecting the underlying structure of the data along the two main dimensions, namely individual indicators and countries. This multivariate analysis serves to identify groups of indicators or groups of countries which exhibit statistical similarity and may therefore be comparable in the process. If this step is omitted in the process, comparability across countries may arise as an issue since an indicator selected as pertinent to a bank-centric economy may render itself as an irrelevant or utterly useless measure for a capital market-centric country.

In order to allow for comparability across indicators, the third step takes into account scale adjustments, measurement unit problems, and accuracy levels via a suitable normalization procedure. A number of different normalization techniques are present in the literature, each with its own strengths and weaknesses, as discussed by Freudenberg (2003)[1]. For the purposes of this paper the technique of empirical normalization – which falls under the max-min method – will be employed. The formula used for the normalization process is as follows:

$$I_{qc}^{t} = \frac{x_{qc}^{t} - min_c(x_q^{t0})}{max_c(x_q^{t0}) - min_c(x_q^{t0})} \quad (1)$$

where, according to the OECD notation, I_{qc}^{t} represents the normalized indicator $\underline{q}$ for country c at time t, $x_{qc}^{t}$is the value of indicator q for country c at time t, while $max_c(x_q^{t0})$ and $min_c(x_q^{t0})$ are the best and worst values of each indicator, respectively. The numerical values calculated using this procedure are in the [0;1] range, with values close to zero indicating a weak and unstable situation, while those close to the opposite extreme of one representing a strong and stable value state. Most importantly, this technique has rendered all the indicators comparable on the same scale, thus facilitating further analysis.

The fourth step in index construction includes aggregation and weighting, where the normalized variables are aggregated in a chain index by the means of arithmetic, geometric, or a non-compensatory multi-criteria approach (MCA). Nevertheless, the major difficulty in this step relates to the weighting process itself, as there is no objective way to determine the correct assignment of weights to each indicator, even though they carry a significant effect on the overall composite index. While weights are in essence value judgments and measures of importance, implying that each variable is worth the same within a composite is considered the standard weighting procedure (EW). In addition, several other techniques can be found in the existing literature (OECD, 2008)[2†]. Some of the reasons why

[1]Normalization includes the following methods: ranking, standardization (z-scores), min-max, distance to a reference country, categorical scales, indicators above or below the mean, cyclical indicators, balance of opinion, and percentage of annual differences over consecutive years.

[2]Some weighting methods include, but are not limited to: participatory methods such as budget allocation processes (BAP), analytic hierarchy processes (AHP), and conjoint analysis (CA), or statistical methods such as principal components analysis (PCA), factor analysis (FA), data envelopment analysis (DEA), unobserved component analysis (UCM), and benefit-of-the-doubt analysis (BOD)

unequal weighting may be preferred in certain instances would include penalizing or rewarding specific components, based on the statistical quality of the data or on each indicator's influence as determined by theory, expert opinions or policy priorities. It is important to note the finding of van den End (2006) during the construction of his Financial Conditions Index that the discrepancy between equal weighting and weighting by econometric validation was small. Consequently, the sub-index weights used in this paper will be specifically distributed, reflecting the optimal contribution of each variable to the aggregate.

Finally, the last step in index construction serves to assess the robustness of the aggregate index in terms of the mechanism for including or excluding a specific indicator, the choice of normalization and weighting techniques as well as the aggregation method itself. Only after all of these checks are performed can one proceed to conduct an analysis of volatility contribution of the sub-indexes relative to the aggregate and determine the sources of instability.

4. Aggregating a Financial Stability Index For the Balkans

Any operational framework designed for synthetic index construction requires a number of assumptions so as to ensure the correct methodological sequence. The main assumption about the sample is therefore geographical and concerns its breadth; nine countries – Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Montenegro, Romania, Serbia, and Slovenia – are included within the umbrella term 'Balkan region' even though a case could be made for the inclusion or the omission of a few more[3]. Walking down the integration path at various speeds – and simultaneously dealing with the crisis – is another matter not to be dismissed, as some of these countries are already full-fledged EU members, others have achieved candidate status, while some are still patiently knocking on the door of the Union, as noted by Gjosevska and Karanović (2014). From a chronological standpoint, the length of the sample covers the period between 1995 and 2011, for an overall of 17 annual observations. Furthermore, the choice of variables capturing the financial dimensions deemed relevant for financial stability are in effect specific indicators often used in the financial stability literature. For easier data management, they can be grouped in different ways – ranging from functional to sectoral – so as to form larger chunks, or sub-indexes. This study, however, uses grouping by partial dimensions of stability, where each of them represents a separate pillar which captures a distinct dimension of financial stability, namely: financial development, financial vulnerability, financial soundness, and world economic climate, as can be seen in Table 1.

[3]Kosovo was not included in the sample due to unavailable data. Turkey was excluded due to the small portion of its territory belonging to the Balkans and the large weight of the entire economy relative to the rest of the Balkan region, which would skew the entire aggregate. Despite of the fact that Greece geographically does belong to the Balkan region, it was excluded from the sample because politically it has long associated itself with the EU

Table 1 The structure of the Balkan Aggregate Financial Stability Index (BAFSI)

Individual indicators	Notation	Impact	Index
Total Credit / GDP	Id1	+	Financial Development Index (FDI)
Market Capitalization / GDP	Id2	+	
Interest Spread	Id3	-	
Herfindahl – Hirschmann Index	Id4	+	
Inflation Rate	Iv1	-	Financial Vulnerability Index (FVI)
General Budget Deficit / Surplus (%GDP)	Iv2	+	
Current Account Deficit / Surplus (%GDP)	Iv3	+	
Official Exchange Rate	Iv4	-	
Credit to Deposits	Iv5	-	
Bank Capital / Assets	Is1	+	Financial Soundness Index (FSI)
Non-performing Loans to Total Loans	Is2	-	
Z-score	Is3	+	
Liquid Reserves to Bank Assets	Is4	+	
World Economic Growth	Iw1	+	World Economic Climate Index
World Inflation	Iw2	-	
World Economic Climate	Iw3	+	

As presented in the above table, a total of 16 selected indicators have been used for the construction of the aggregate financial stability index for the Balkans. The first column gives the full name of each indicator used in the aggregation. The second column shows the shortcut notation for the indicators, while the third column shows the impact of each indicator on the overall index. The final column contains the four separate dimensions to which each indicator belongs, divided into sub-indexes. Due to the bank-centric nature – and consequently, data availability – of the financial systems instituted in the Balkan countries included in the aggregate, most of the indicators refer to banks.

The first sub-index (FDI) consists of variables chosen to measure the level of financial system development. The ratio of total credit to GDP (I_{d1}) provides information on the ability of lending institutions to perform their basic function of financial intermediation – the higher the value of the indicator, the more developed the banking system in the economy. The second indicator in the FDI sub-index is market capitalization as share of GDP (I_{d2}),which measures the level of development of capital markets as seen through the value of listed shares relative to total output. An increase in the value of this indicator is also considered a positive development leading to an improved economy overall. The third indicator, interest spread, (I_{d3}), is defined as the difference between lending and deposit rates and is reflective of the competition and efficiency in the banking sector. A hike in the interest spread may be a symptom of an unstable period, when financial institutions seek additional insulation against potential risks, hence an inverse relationship is observed here. The last indicator included in the first pillar is the Herfindahl – Hirschmann Index (I_{d4}), a commonly accepted measure of bank concentration, which is consistent with the findings of a positive relationship, i.e. that concentration implies banking system stability (Beck et al., 2006).

The second sub-index (FVI) has a number of macroeconomic and funding structure variables selected to evaluate each country's financial vulnerability and resistance to shocks. Inflation rate (I_{v1}), the first indicator in this pillar, not only measures the general level of price stability in the country, but is also one of the initial variables under scrutiny should the economy experience a slowdown. It is one of the first telltale signs of vulnerability and its overall impact on the aggregate is negative, as suggested by economic literature. The following indicator, general budget

deficit/surplus (I_{v2}), is also a broad measures of government performance and investor confidence. Susceptibility to external shocks is best depicted through the third indicator, current account deficit/surplus relative to GDP, (I_{v3}). Deterioration in the respective values of both the budget deficit and the current account would pose danger to long-term sustainability, implying a positive relationship. Due to scarce data, the official exchange rate indicator, (I_{v4}), as the rate determined in the legally sanctioned exchange market, assumed the position of REER within the aggregate, where the inverse relationship holds true. The next indicator, credit to deposit ratio, (I_{v5}), assesses the banks' capacity to respond to shock cash withdrawals and their ability to perform their basic intermediation function when pressure amounts.

The third sub-index (FSI) is comprised of four indicators used to assess the soundness of the financial system by gauging the solvency and liquidity of its credit institutions. The first indicator, the ratio of bank capital to assets, (I_{s1}), represents the banks' level of capitalization, while the second indicator, non-performing loans to total loans (I_{s2}) shows the quality of loan placement made by banks. Bank z-scores, as shown by the third indicator (I_{s3}), depict the probability of default of a country's banking system as it explicitly compares buffers, such as capitalization and returns, with risk, defined as volatility of returns. The last indicator is liquid reserves to bank assets ratio (I_{s4}) and has been included as a measure of banks' resilience to sudden cash withdrawals.

The last sub-index (WECI) captures the world economic climate as quantified by several measures. The first indicator retained within this index, world economic growth, (I_{w1}), measures the average growth rate of the global GDP, while the second indicator, world inflation, (I_{w2}), provides the levels of international price stability. The last indicator within this dimension, world economic climate, (I_{w3}), measures the business climate perception for investment opportunities. All of these indicators are essential to global investors' confidence levels, and any sudden drops or spikes may signal tectonic shifts in global markets.

All of the indicators retained in the aggregate financial index for the Balkans were sourced from records available through the World Bank's DataBank and the IMF's International Financial Statistics (IFS) databases, except for the world economic climate index, derived from the CESifo Group Munich, which independently manages and collects data on a number of important international business and investment-related issues.

After selecting, defining, grouping and normalizing the variables included in the aggregate index, weighting by GDP per capita averaged over 1995-2011 per indicator for the 9 countries included was done for each year in the sample. This method of assigning weights was chosen in order to prevent one country from having an undue influence on the other countries comprising the index:

$$\text{annual aggregate indicator index,} \quad \bar{A}_t = \sum_{i=1}^{9} (I_{qc}^{t} * w_{qGDPpc}) \tag{2}$$

Once the values per each indicator for the entire region were calculated, equal weighting was assigned to indicators within each sub-index, respectively:

$$\text{financial development index (FDI),} \quad \bar{D}_t = \frac{\sum_{i=1}^{4} I_{dc}}{4} \tag{3}$$

$$\text{financial vulnerability index (FVI),} \quad \bar{V}_t = \frac{\sum_{i=1}^{5} I_{vc}}{5} \tag{4}$$

$$\text{financial soundness index (FSI),} \quad \bar{S}_t = \frac{\sum_{i=1}^{4} I_{sc}}{4} \tag{5}$$

$$\text{world economic climate (WECI),} \quad \bar{W}_t = \frac{\sum_{i=1}^{3} I_{wc}}{3} \tag{6}$$

The table with normalized and weighted data can be found in Appendix 1. For the last step, each of the first three sub-indexes was allocated equal weight of 0,3, while the last one received a smaller weight of only 0,1. This means

that within different sub-indexes, certain indicators could receive different weights so long as the allocated weights of each sub-index would remain fixed according to the following formula[4]:

$$\text{Balkan aggregate financial stability index (BAFSI)}, \quad \bar{B}_t = 0{,}3\bar{D}_t + 0{,}3\bar{V}_t + 0{,}3\bar{S}_t + 0{,}1\bar{W} \qquad (7)$$

5. The Evolving Nature of Financial Stability In the Balkan Region

The aggregate financial stability index for the Balkans is constructed using annual data for the 1995-2011 period. The normalized and weighted values of the composite sub-indexes along with their totals can be seen in Table 2, while their visual rendition is presented in Figure 1. Overall, the BAFSI index illustrates some relatively low values, well below 0,5, which go as low as 0,198 for 1996, reflective of the post-war years in former Yugoslavia and restructuring woes in the other Balkan countries that were transitioning from centrally-planned to market-oriented economies.

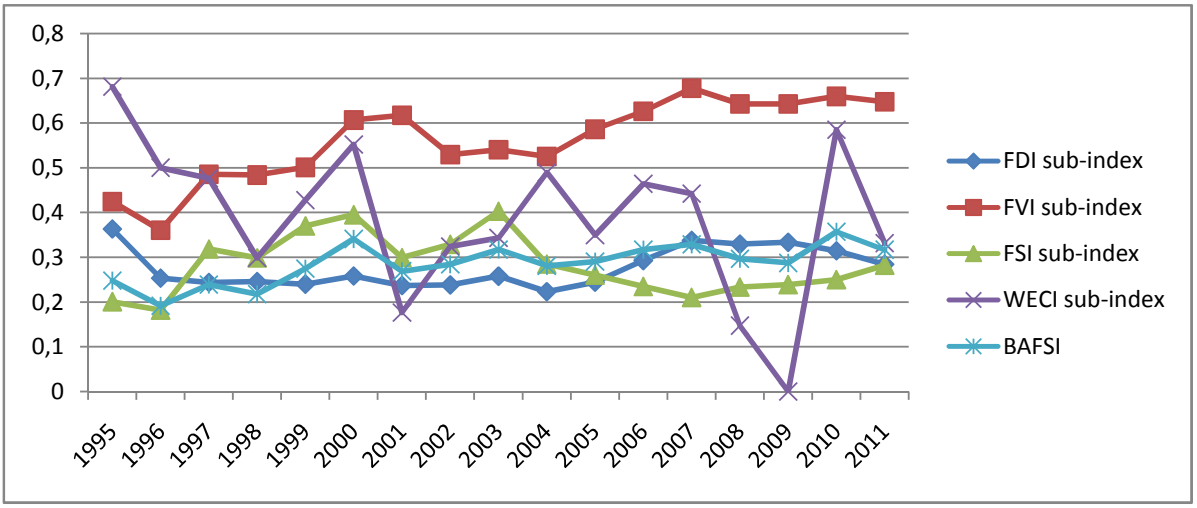

Figure 1 Balkan Aggregate Financial Index and Constituent Sub-indexes

After the turn of the century, a spike in the trend can be noticed in 2001, 2003, 2007, and 2010 with values for the aggregate index at 0,341, 0,317, 0,329, and 0,357, respectively, explaining periods of relative growth and exuberant economic activity. Two of these episodes, in 2000 and 2007, were followed by falls in the values of the BAFSI index down to 0,269 in 2001 and a much longer and protracted slide first to 0,297 in 2008 and then to 0,288 in 2009. This shows that the Balkan economies remained vulnerable and in bad shape long after the initial recovery seen in other parts of the world after the Global crisis of 2007.

As expected, from what can be observed in the figure, the biggest fluctuations in value appear in the world economic climate (WECI) sub-index, which experiences some sharp spikes and declines, falling down to 0 during the 2007 crisis. The financial vulnerability (FVI) sub-index depicts generally the highest values in the aggregate, and after the 2001 crisis it shows a marked improvement, going as high as 0,677. The financial development (FDI) sub-index maintains low and stable levels which begin to gradually improve in starting in 2005 and reaching its peak in 2007 at 0,337 during the high tide of financial euphoria on the Balkans. Finally, the financial soundness (FSI) sub-

[4] Another way to resolve the weighting issue would have included allocating equal weights to each indicator, thus giving each sub-index different relative influence, depending on the number of constituent indicators found within:

$$\bar{B}_t = \frac{4I_{dc}+5I_{vc}+4I_{sc}+3I_{wc}}{16}$$

index most closely tracks the evolution of the aggregate and can be considered as signaling mechanism for financial stability, as it improves together with the aggregate, most notably in 2000 and 2003 with values of 0,395 and 0,403, respectively. Still, with the onset of the crisis, it deteriorates in 2007 to a low of 0,210, anticipating a whole year before anyone else that there will be a destabilizing period ahead.

6. Measuring the Volatility Of the Balkan Aggregate Financial Stability Index

The previous analysis, no matter how descriptive, does not impart sufficient in-depth information about those indicators which require particular attention nor does it reveal any additional knowledge about the dynamics of the financial stability index. Therefore, to better understand the volatility of the Balkan aggregate financial stability index as well as the contribution of each of its sub-indexes individually, a more sophisticated examination is required. This approach was first proposed by Chanut and Laroque (1979) as a calculation method for measuring the contribution of the volatility of the components to the aggregate index' volatility.

The evolution in *t=1,….,T,* years of the aggregate indicator index $A(t)$ and its m components $Ci(t)$, where *i=1,….m* is represented by the formula:

$$A(t) = \sum_{i=1}^{m} Ci(t) \tag{8}$$

so that the growth rate of the aggregate is:

$$x(t) = \frac{[A(t)-A(t-1)]}{A(t-1)} \tag{9}$$

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

$$xi(t) = \frac{[Ci(t)-Ci(t-1)]}{A(t-1)} \tag{10}$$

implying that:

$$x(t) = \sum_{i=1}^{m} xi(t), \text{ for } t = 2, \dots T \tag{11}$$

For the particular case of the Balkan aggregate financial index, the aggregate index growth ratio is therefore:

$$x(t) = 0{,}3x_{FDI}(t) + 0{,}3x_{FVI}(t) + 0{,}3x_{FSI}(t) + 0{,}1x_{WECI}(t) \tag{12}$$

Assuming independence, $[x_1(t), \dots, x_m(t), x(t)]$represents the performance of a random stationary process of second order on date *t*. Then:

$$x = \sum_{i=1}^{m} x_i \tag{13}$$

so that $Ex_i$is the expected value of x_i, as in:

$$E(x) = \sum_{i=1}^{m} Ex_i \tag{14}$$

while σx_i is the standard deviation of $x_i$and $corr(x, x_i)$ the correlation factor between x and x_i, respectively.

$$\sigma = \sum corr(x, x_i) \times \sigma x_i \tag{15}$$

After replacing the moments of the random variations with the associated empiric moments, the growth contribution of the components is:

$$GC_i = \frac{E(x_i)}{E(x)} \tag{16}$$

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

$$VC_i = \frac{corr(x_i, x) \times \sigma x_i}{\sigma x} \tag{17}$$

Visually, the volatility of the Balkan aggregate financial stability index is portrayed in Figure 2, with a progressive 3-year rolling window. Due to data limitations, any attempts at increasing data accuracy would have resulted in loss of additional observations, thus reducing the interval and possibly omitting potential episodes of instability pertinent to this analysis.

At any rate, this graph is more telling given that a large spike in volatility can be observed in the period building up to the crisis in 2001, directly attributable to a jump in volatility in financial soundness as a signaling mechanism of troubles ahead. Moreover, the next relatively large jump in volatility of the BAFSI comes in the period following the Global crisis of 2007, when the fallout percolates into Balkan markets more than a year later. Nevertheless, it is significant to note that this is preceded by a large jump in volatility of the FDI sub-index, signifying an explosion in financial intermediation development which ultimately exacerbated the volatility of financial stability in the Balkans.

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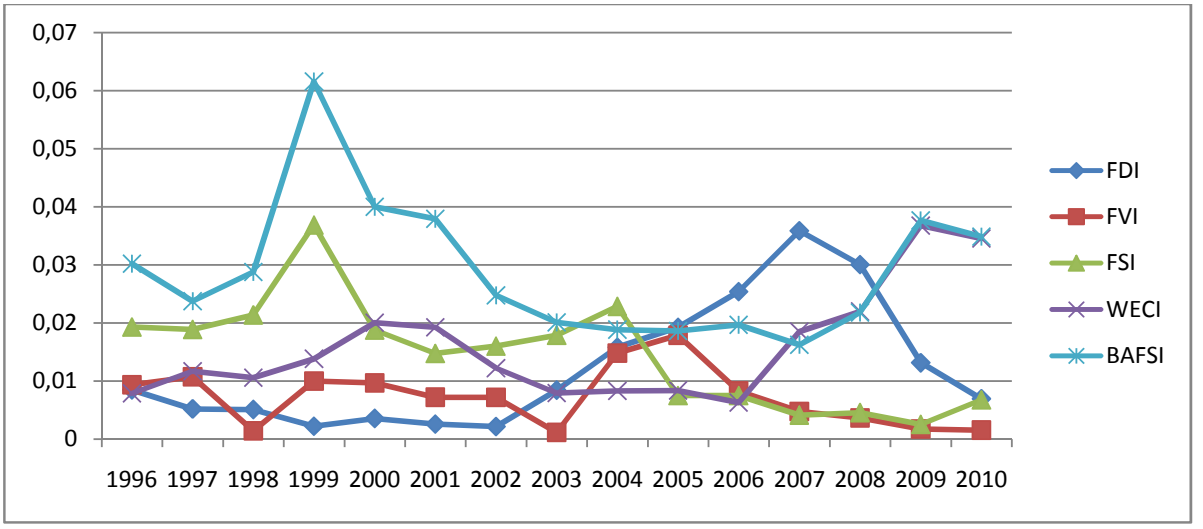

Figure 2 Volatility of BAFSI and its constituent sub-indexes measured in 3-year standard deviation rolling window

When sub-index volatility contributions are examined relative to the entire aggregate, some interesting revelations emerge in Figure 3. Up until 2004, the FSI sub-index gives the most important contribution to the aggregate index, after which period it begins a steady slide which bottoms out at -0,33. Around 2005, the world economic climate

sub-index begins growing and taking over the volatility contribution to a skyrocketing 1,43, in line with the global exuberance indicative of the period. Interestingly, at about the same time the FVI sub-index takes a nosedive, falling to -0,75 and showing how international trends take over domestic macroprudence. The contribution of the financial development sub-index remains relatively stable until 2007, when it also experiences a sharp fall in its contribution to the BAFSI. Please refer to Appendixes 2 and 3 for data calculations.

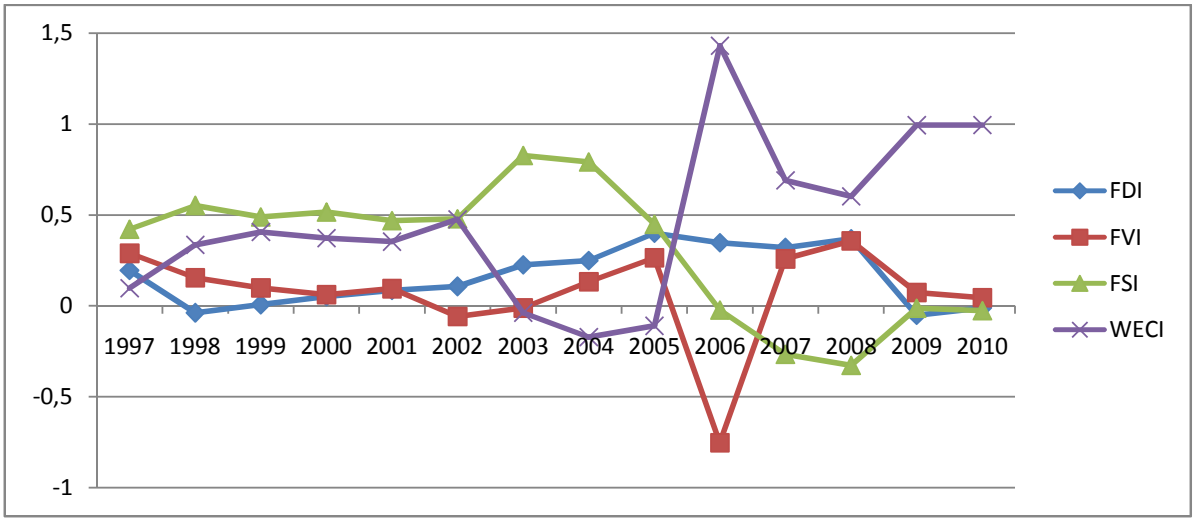

Figure 3. Contribution of the constituent sub-indexes to BAFSI's volatility

Finally, if the same aggregate index construction method was followed in order to build two separate aggregates, one representing EU members geographically positioned in the Balkans (BAFSI-EU), while the other representing the remaining aspiring EU members currently addressed as the Western Balkans (BAFSI-WB), the results will visually look as in Figure 4. This graph shows a very similar evolution in the financial stability aggregates, where the BAFSI-EU consistently outperforms the BAFSI-WB in financial stability levels. The two series intersect in 2006, after which the EU member have another significant jump while the Western Balkans move in the opposite direction of financial stability, which can be explained by the improved legal and macroprudential framework for those Balkan countries that had joined the EU during the period in question as well as the increased level of financial development. It is curious to note, however, that in 2007 the EU aggregate begins a slow slide while the WB aggregate continues its ascendancy which had begun in 2008, peaking in 2010. This phenomenon can be attributed to integration levels, where the transmission channels for the EU members were open to spillovers from their older and more developed peers, while the other Western Balkan countries remained relatively insulated due to lower levels of movement of goods and capital with the so-called 'old EU'. For them, the Global crisis of 2007 simply arrived a couple of years later.

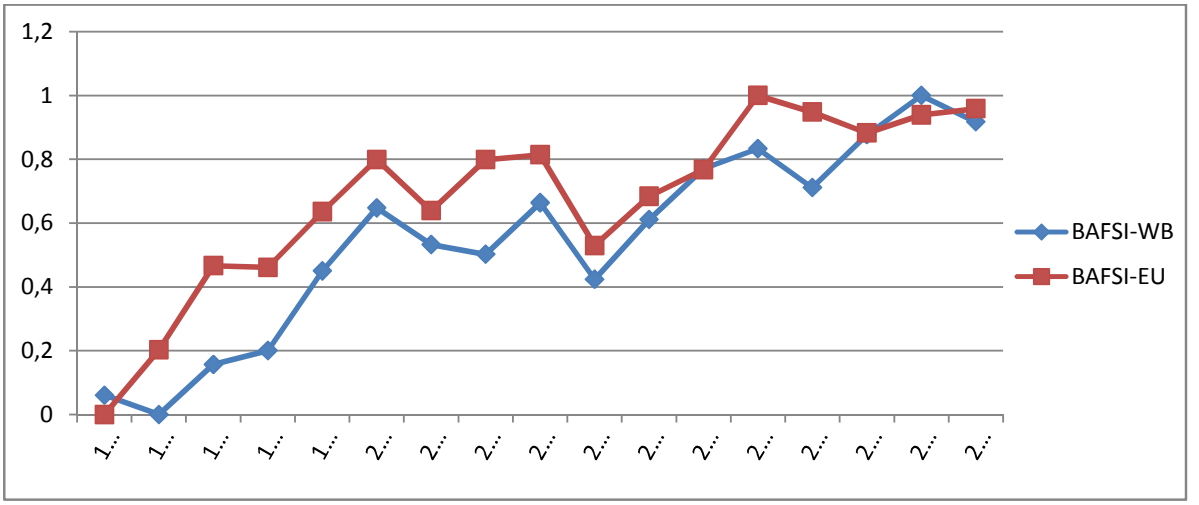

Figure 4. Balkan Aggregate Financial Stability Index: EU members vs. Western Balkans

7. Concluding Remarks: No Country Is an Island Unto Itself

An aggregate index is, above all, the sum of its parts. It is a multidimensional construct that has condensed a substantial amount of data into a single quantitative measure aimed at providing structured information about the potential dangers and sources of instability to the financial system. When poorly constructed and examined in isolation, an aggregate index may prove a simplistic, obscure and misleading policy tool, so it should be used with caution and with awareness to its limitations. Nevertheless, its advantages are numerous – an aggregate index can provide complex, yet transparent measures that can track the evolution of specific variables of interest so that they can be monitored and compared over space and time.

Index construction involves several well-defined steps which include laying down the theoretical groundwork for the selection, definition, and combination of variables, followed by multivariate analysis, normalization, weighting and aggregation. The usefulness of the aggregate can be greatly enhanced or reduced by methodological issues. For the purpose of financial stability analysis, it is recommended that it be used as a complementary tool to the early warning system and stress-test mechanisms built into the countries' existing financial stability framework.

The purpose of this paper was to expand the financial stability analyses found in the existing literature by constructing an aggregate financial stability index for the Balkan region, an endeavor never undertaken before on such a scale. Most authors have focused on a single country so far, leaving a multitude of questions unanswered about regional dynamics and economic performance interplay. The major contribution of this work is exactly its breadth and complexity, focused on aggregate index construction during a 17-year period for a region which itself is an aggregate of nine different countries. All of the above allows for a number of conclusions to be drawn.

The first conclusion reveals that not even the BAFSI aggregate is immune to deficiencies in index construction, most of them stemming from lack of data. The period under scrutiny had to be shortened since a number of countries seceding from former Yugoslavia did not exist prior to the mid-1990's. Similarly, Kosovo had to be excluded from the sample because the time series provided cover a very short period, from 2008 onwards. In addition, only annual instead of quarterly data could be retrieved for certain variables, which further reduced accuracy.

Second, the overall financial stability of the Balkan region is at relatively low levels, owing to the fact that certain financial dimensions are not nearly as developed as in the rest of the EU. There is plenty of room for improvement and due to traditional trade and capital movement ties within the region, steps in the right direction can only be made through a joint effort by all the stakeholders. One such effort could include regularly publishing a financial stability report for the entire region to facilitate the assessment and monitoring of financial stability levels.

Third, despite the low weight assigned to the WECI indicator, signifying a region sheltered from the ebbs and tides of global economic activity, the transmission channels were sufficiently operational to allow for instability

spillovers in both 2001 and 2007, albeit with delayed effects in the latter case. With the number of EU member countries hailing from this area increasing in the future, it will be interesting to examine whether convergence effects appear for financial stability.

Next, the volatility of the index should be taken seriously as each component's contribution to the aggregate demonstrates that a single source of instability originating from within an indicator could trigger a crisis or a prolonged period of instability.

Finally, the EU member countries hold a steady financial stability advantage over their Western Balkans peers. Their indicator levels, and hence the aggregate, are consistently higher due to improved legal and macroprudential framework and higher levels of financial development. While this may be beneficial in times of stability, higher integration levels may provide a reason for concern and potential crisis source in times global instability.

Appendix A.

Table 2 Normalized and weighted data values for individual indicators, sub-indexes and the aggregate

Index	Indicators	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
FDI sub-index	I_{d1}	0.039	0.024	0.025	0.016	0.017	0.020	0.024	0.025	0.028	0.041	0.060	0.079	0.110	0.151	0.169	0.177	0.183
	I_{d2}	0.000	0.001	0.008	0.018	0.020	0.021	0.026	0.037	0.052	0.067	0.076	0.104	0.175	0.145	0.094	0.098	0.074
	I_{d3}	0.157	0.112	0.110	0.103	0.097	0.099	0.088	0.074	0.064	0.061	0.061	0.052	0.011	0.010	0.038	0.008	0.007
	I_{d4}	0.166	0.116	0.101	0.109	0.106	0.117	0.099	0.102	0.113	0.054	0.047	0.058	0.042	0.024	0.033	0.033	0.020
	$\bar{w}$ FDI	**0.109**	**0.076**	**0.073**	**0.074**	**0.072**	**0.077**	**0.071**	**0.071**	**0.077**	**0.067**	**0.073**	**0.088**	**0.101**	**0.099**	**0.100**	**0.094**	**0.085**
FVI sub-index	I_{v1}	0,024	0.039	0.073	0.049	0.028	0.040	0.044	0.025	0.027	0.023	0.021	0.025	0.030	0.036	0.015	0.005	0.010
	I_{v2}	0.096	0.089	0.100	0.093	0.086	0.088	0.071	0.100	0.104	0.104	0.106	0.108	0.129	0.110	0.026	0.023	0.023
	I_{v3}											0.081	0.085	0.041	0.008	0.128	0.149	0.153
	I_{v4}	0.005	0.015	0.058	0.066	0.090	0.142	0.162	0.155	0.114	0.094	0.093	0.091	0.106	0.099	0.110	0.118	0.112
	I_{v5}	0.060	0.030	0.023	0.027	0.040	0.035	0.016	0.013	0.028	0.041	0.051	0.067	0.101	0.132	0.106	0.100	0.091
	$\bar{w}$ FVI	**0.064**	**0.054**	**0.073**	**0.073**	**0.075**	**0.091**	**0.093**	**0.079**	**0.081**	**0.079**	**0.105**	**0.113**	**0.122**	**0.116**	**0.116**	**0.119**	**0.117**
FSI sub-index	I_{s1}						0.124	0.070	0.049	0.056	0.017	0.031	0.041	0.051	0.062	0.055	0.044	0.043
	I_{s2}			0.068	0.079	0.083	0.082	0.071	0.051	0.052	0.040	0.031	0.010	0.005	0.035	0.072	0.117	0.153
	I_{s3}					0.138	0.143	0.064	0.102	0.167	0.111	0.077	0.082	0.090	0.097	0.074	0.056	0.050
	I_{s4}	0.050	0.045	0.091	0.071	0.057	0.047	0.094	0.128	0.128	0.117	0.121	0.102	0.063	0.039	0.037	0.034	0.036
	$\bar{w}$FSI	**0.015**	**0.014**	**0.048**	**0.045**	**0.083**	**0.119**	**0.090**	**0.099**	**0.121**	**0.085**	**0.078**	**0.070**	**0.063**	**0.070**	**0.072**	**0.075**	**0.085**
WECI sub-index	I_{w1}	0.183	0.212	0.195	0.086	0.247	0.251	0.045	0.208	0.246	0.261	0.151	0.221	0.190	0.026	0.000	0.500	0.110
	I_{w2}	0.250	0.123	0.070	0.066	0.061	0.039	0.033	0.020	0.022	0.018	0.024	0.024	0.029	0.066	0.000	0.018	0.044
	I_{w3}	0.169	0.146	0.190	0.114	0.137	0.250	0.077	0.119	0.112	0.219	0.163	0.213	0.207	0.031	0.000	0.170	0.150
	$\bar{w}$ WECI	**0.602**	**0.481**	**0.455**	**0.267**	**0.444**	**0.539**	**0.155**	**0.347**	**0.381**	**0.050**	**0.034**	**0.046**	**0.043**	**0.012**	**0.000**	**0.069**	**0.030**
BAFSI		**0.248**	**0.192**	**0.239**	**0.218**	**0.275**	**0.341**	**0.269**	**0.284**	**0.317**	**0.281**	**0.291**	**0.317**	**0.329**	**0.297**	**0.287**	**0.357**	**0.317**

Appendix B.

Table 3. Growth rate contributions of each sub-index to the aggregate (second order stationarity)

Growth rate contributions	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
FDI	-0.133	-0.014	0.002	-0.008	0.020	-0.019	0.002	0.021	-0.033	0.023	0.050	0.042	-0.007	0.004	-0.020	-0.025
FVI	-0.038	0.097	-0.001	0.012	0.058	0.005	-0.049	0.006	-0.007	0.095	0.025	0.029	-0.019	0.000	0.010	-0.006
FSI	-0.006	0.178	-0.012	0.176	0.128	-0.085	0.033	0.078	-0.112	-0.026	-0.026	-0.023	0.021	0.006	0.012	0.027
WECI	-0.049	-0.014	-0.079	0.081	0.035	-0.113	0.072	0.012	0.037	-0.057	0.042	-0.010	-0.092	-0.042	0.240	-0.108
BAFSI	**-0.226**	**0.247**	**-0.089**	**0.261**	**0.241**	**-0.211**	**0.057**	**0.116**	**-0.115**	**0.034**	**0.091**	**0.038**	**-0.098**	**-0.032**	**0.242**	**-0.112**

Appendix C.

Table 4. Standard deviations, correlation coefficients and volatility contributions of the sub-indexes to the aggregate based on a three-year rolling window

Aggregates	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
σx_i														
FDI	0.074	0.009	0.014	0.020	0.019	0.020	0.027	0.031	0.042	0.014	0.031	0.026	0.012	0.016
FVI	0.070	0.054	0.031	0.029	0.053	0.031	0.029	0.056	0.052	0.039	0.027	0.024	0.015	0.008
FSI	0.108	0.109	0.098	0.139	0.107	0.084	0.099	0.095	0.049	0.002	0.027	0.023	0.008	0.011
WECI	0.032	0.080	0.082	0.101	0.098	0.094	0.030	0.049	0.056	0.049	0.068	0.041	0.179	0.185
BAFSI	0.244	0.198	0.197	0.267	0.227	0.175	0.120	0.117	0.106	0.031	0.097	0.068	0.180	0.186
corr (x,x_i)														
FDI	0.640	-0.916	0.086	0.681	0.997	0.943	0.994	0.925	0.998	0.763	0.989	0.960	-0.775	-0.132
FVI	1.000	0.570	0.628	0.572	0.400	-0.331	-0.051	0.277	0.535	-0.601	0.937	0.995	0.869	0.986
FSI	0.951	0.999	0.981	0.991	0.999	0.995	1.000	0.975	0.964	-0.428	-0.977	-0.988	-0.305	-0.448
WECI	0.725	0.828	0.972	0.981	0.822	0.881	-0.155	-0.414	-0.210	0.909	0.993	0.989	0.999	0.999
$(\text{corr}\ (x,x_i)^* \sigma x_i)/ \sigma x$														
FDI	0.194	-0.040	0.006	0.051	0.085	0.106	0.225	0.249	0.399	0.347	0.319	0.368	-0.052	-0.011
FVI	0.288	0.154	0.099	0.062	0.094	-0.059	-0.012	0.132	0.263	-0.753	0.258	0.357	0.072	0.044
FSI	0.421	0.550	0.489	0.515	0.469	0.479	0.826	0.792	0.448	-0.024	-0.267	-0.327	-0.013	-0.027
WECI	0.097	0.335	0.406	0.372	0.353	0.475	-0.039	-0.172	-0.110	1.430	0.690	0.602	0.993	0.994

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