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Measuring financial stress and economic sensitivity in CEE countries

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Abstract

This report presents the methodology for the construction of the Financial Stress Index (FSI) and the Economic Sensitivity Index (ESI) and investigates the economic situation in twelve Central and East European Countries (CEECs) between 2001 and 2012. The objective of this paper is to capture key features of financial and economic vulnerability and examine the co-movement of economic turmoil and financial disturbances that strongly affected the CEECs in the last decade. Our main finding is that the FSI can be used as a leading indicator and can be used to recognize changing trends in the index. A shift in the value of the index proves that EU accession has a positive, but minor influence on financial stability in the CEECs. On the other hand, the impact of the introduction of the euro in Estonia, Slovakia and Slovenia is ambiguous. For most of the countries in our sample, in 2007, the FSI started to grow rapidly, reaching its peak around the third quarter of 2008. Consequently, financial stress remained high for a few quarters and started to fall gradually. For a number of countries, we observe higher financial stress in the latest period of our analysis, i.e. 2010-2012. However, the value of the FSI was significantly lower than three years earlier. The results show that indices might be helpful in predicting future recessions. However, forecasting properties seem to be limited at this stage of our work.

1. Introduction

The reason why economists often like to describe reality using a single number that captures complex developments is the striving for simplicity, intellectual appeal and transparency of comparisons. Complex developments – such as the stages of a business cycle, financial conditions, and banking sector performance – are usually depicted by means of a set of indicators. When a number of indicators is used to describe trends or certain conditions, there are usually a few problems interpreting them when these indicators point in the same direction. However, when they send conflicting signals, interpreting the course of events they describe jointly is not clear. These conflicting signals have to be weighted in an attempt to overcome the problem of ambiguity.

A single synthetic number is supposed to overcome this weakness. This is why economists try to construct single indices which aggregate many indicators. A price index such as the CPI is a simple example of this procedure. Hundreds of price trends are aggregated into a single digit. This procedure has been applied to measure risk or stability as well, even though financial vulnerability or economic instability is unobservable, contrary to prices. This distinction makes constructing indices that are meant to describe such phenomena a daunting exercise. Nevertheless, we attempted to construct two indexes which could help us recognize turning points in the economy, taking into consideration as many factors as possible.

The paper is organized as follows. Chapter 2 introduces hindrances in the quantification of unobserved economic phenomena. Chapter 3 presents the concept and reviews the literature on the measurement of financial stress and economic instabilities. Chapter 4 describes the methodology used to capture financial stress and economic sensitivity. The results shown in Chapter 5 justify the structure and validate the estimation technique. The chapter also presents the main findings and provides an in-depth analysis of country-by-country financial stress and economic sensitivity, and the last chapter concludes.

2. Concept

The motivation behind our construction of financial stability and economic soundness indices is twofold. Firstly, the recent global financial crisis, which morphed into the public debt crisis in the euro area, has brought the financial stability of the countries to the fore. The literature on constructing financial vulnerability, stress or stability is vast. the antecedent of our index is the index developed by economists at Bank of Canada (Illing and Liu, 2006) and the Federal Bank of Kansas City, KCSFI (Hakkio and Keaton, 2009). Our research capitalizes on their experience. However, their findings do not discuss Central and East European Countries (CEECs). In general, few attempts have covered CEECs so far (Albulescu, 2008, 2009). Thus, our second motivation is to differentiate ourselves by focusing on the New Member States (NMS) and candidate countries to the EU. This is particularly relevant in light of serious claims in the literature (see IMF, OECD, EU) that CEECs have been the most affected by the financial crisis due to their exposure to foreign capital flows, be it FDI inflows or bank funding. Furthermore, most CEECs have banking systems that are overwhelmingly owned by foreign banks.

Financial stability is difficult to define and measure. A very broad definition would be as follows: Financial stress is a disruption of the normal functioning of the markets. One common feature is uncertainty about the fundamental values of assets, which usually manifests itself by increased volatility. Economic sensitivity is defined as a lack of both balanced economic growth and stability of the public finances. The main aim of the Economic Sensitivity Index (ESI) is to monitor the development of the economy in the long run.

As mentioned, the problem of conflicting signals has motivated us to construct indices that would grasp the financial and economic stability of various countries. Therefore an important objective of the Financial Stress Index (FSI) and the ESI is to figure out whether financial vulnerability or/and economic instability has reached levels that should raise concern, which should be interesting for policymakers and investors. On the other hand, condensing the information into one single indicator leads to an obvious loss of information and the authors of the indices realize this weakness.

The two indices have been separated for various reasons. Increased uncertainty about the values of assets can be caused by increased uncertainty about

the economic prospects of a country or specific sectors of the economy. This conclusion has led us to single out the variables that describe the health of an economy and to aggregate them into the ESI. A high positive correlation of the trends can either be interpreted as evidence that financial stress is implanted by economic uncertainty or that both kinds of stress are due to a common exogenous factor: the expected returns on bonds, equities and loans all depend on future economic circumstances. This could be, for example, a domestic political event or a global disturbance. To capture the global economy effects we have included a measure of the state and global economic climate.

The ESI may be behind the elevated financial stress, but the causality may run the other way around, i.e. an increased FSI may cause economic prospects to deteriorate and lead to higher economic risk. Thus, the examination of both indices may reveal which comes first. Financial conditions affect economic soundness through the following factors: tightened standards of lending, increased volatility of asset prices that may lead to deteriorated expectations of future returns on assets, and the wealth effect that causes households to cut spending. Firms may do the same with regard to investment plans as the volatility of prices makes the evaluation of investment projects a daunting task. Financial stress usually leads not only to increased volatility, but also to an increase in interest rates as the asymmetric information, the circumstances under which it is believed that borrowers know much more about their financial standing than lenders do, becomes more pervasive. The rise in the cost of financing also means a downward revision of spending plans. Unfortunately, our index is unable to catch the effect of tightening the credit standards, as it is price-based. We concentrate on the risks and vulnerabilities of a financial system that can be relatively easily quantified and understood as well.

In anticipation of criticism, we realize that all these variables can move due to different causes but we assume that financial stress is the most important one, an assumption which allows us to combine them into one index. This factor is identified by means of principal components. The choice of variables is based on economic theory and in particular literature on early warning indicators, see Kaminsky et al. (1998). These variables typically cover the banking system, the foreign exchange market, the equity market and the bond market. Risk spreads and liquidity measures are used as well. Limitations of the data also weigh on our choice.

As previously pointed out, the data availability has influenced the shape of the indices and limited the scope of our study on stability. Since only a sample of CEECs was chosen and we decided that the index should be compiled on a quarterly basis, the shortage of data that could allow for inter-country comparisons became evident.

The index is a snapshot of the current situation. It reflects the current financial conditions and tells us whether they are improving, staying the same or worsening. It is not a forecast of what will happen. It should be emphasized that it is unclear how well the FSI would perform in signaling the onset of a financial crisis since there are too few crises to evaluate the FSI's effectiveness in forecasting them. Elevated levels of the index signal rising stress (either economic or financial) in examined economies, but even the historically record-high levels need not be accompanied by a financial crisis.

Our interpretation is modest. The index is more relevant qualitatively than quantitatively. It signals trends in financial stress or economic sensitivity. The levels cannot be compared among countries since the scale is different. An important objective is to help investors or policymakers verify whether financial stress has reached proportions that should be a matter of concern. To this end, the behavior of the FSI can be analyzed during the historical periods identified as periods of financial stress. One common feature is the global financial crisis of 2008. Comparing indices for the various countries in the sample, it is also possible to distinguish between the idiosyncratic features and common ones.

However, with regard to the future, a few propositions can be examined:

a) If the index is a number of standard deviations above the mean, e.g. typically one or two standard deviations above the historical mean, then it can be treated as of particular concern. Criticism: it is subject to adding new observations (information), in particular extreme ones. A new crisis such as the recent global crisis of 2008 may be so big that it annuls the identification of a previous episode as a crisis.

b) This problem may be overcome to a great extent by using percentiles. For example, an index can be considered high when its value falls above the 90^{th} percentile of data. Adding extreme observations will have much less impact on the threshold in this case than on the standard deviation as the mean is sensitive to extreme values.

c) The final possibility is to use a benchmark from the past that was unambiguously identified as a crisis quarter. This approach is even less sensitive to the adding of extreme observations to the sample.

d) In some situations, not only the relative value of the index would matter, but also the length of the episode during which the index remained above some critical value. Comparing such episodes may also help formulate qualitative judgments concerning whether the conditions are graver than before or vice versa.

3. Methodology

3.1. Principal component analysis

Out of various methods to aggregate sub-indicators that use, e.g. weighting schemes and cumulative distribution functions, we applied principal component analysis (PCA). PCA is primarily a data-analytic technique that obtains the linear transformation of a group of correlated variables such that certain optimal conditions are met. The most important of these conditions is that these transformed variables are uncorrelated. PCA uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, it accounts for as much of the variability in the data as possible), and each subsequent component in turn has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components. This is why the first few principal components contain the vast majority of information about the investigated phenomenon, allowing for a reduction in the number of principal components with as little loss of input information as possible.

Principal components are guaranteed to be independent only if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables. It can be done by eigenvalue decomposition of a data covariance (or correlation) matrix or a singular value decomposition of a data matrix, usually after mean centering and normalizing the data matrix for each attribute. The results of PCA are usually discussed in terms of component scores, sometimes called factor scores (the transformed variable values corresponding to a particular data point) and loadings (the weight by which each standardized original variable should be multiplied to get the component score). PCA is the simplest of the true eigenvector-based multivariate analyses. Often, its operation can be thought of as revealing the internal structure of the data in a way that best explains the variance in the data. If a multivariate dataset is visualized as a set of coordinates in a high-dimensional data space (one axis per variable), PCA can supply the user with a lower-dimensional picture, a "shadow" of this object when viewed from its

(in some sense) most informative viewpoint. This is done by using only the first few principal components so that the dimensionality of the transformed data is reduced.

3.2. Structure of indexes

In the literature on the topic of the health of financial systems, financial stress is associated with an episode of when the financial system is under strain and its ability to intermediate is impaired (Hakkio & Keeton, 2009). This phenomenon could be exposed by (see e.g. Cevik et al, 2012):

- large shifts in asset prices,
- an abrupt increase in risk and/or uncertainty about the fundamental value of assets and a decreased willingness to hold risky assets,
- liquidity droughts, a decreased willingness to hold illiquid assets,
- concerns about the health of the banking system.

System-wide financial stress affects, *inter alia*, the following blocks of countries' financial systems:

- Markets: equity market, bond market, money market, foreign exchange,
- Intermediaries: banks, insurance,
- Infrastructure: payment, settlements and clearing systems.

Since financial systems have many components and financial stress could be associated with a range of symptoms, it is necessary to build a **compound, well-structured** index that covers the aforementioned aspects. On the other hand, because of poor data availability, to **ensure long time series without missing data, simple instruments of financial stress components** can only be taken into account. By putting together data availability for countries taken with the structure of the problem, we built an FSI that consists of the following blocks:

1) uncertainty about the current and future value of assets on stock, bond and FX market,
2) asymmetry of information in the interbank system and stock exchange,
3) a decreased willingness to hold risky and illiquid assets,
4) world economic climate and country's financial markets perspectives.

The aspect measured by the second index (Economic Sensitivity Index – ESI) seems to receive less attention in the economic literature. A generally known fact is that financial markets nowadays are closely linked to the economic situation. What is more, crises in financial markets lead to economic crises or financial

crises, which strongly affect the health of public finance. This is why we decided to provide a backbone to the FSI in the form of the ESI.

We associate **economic sensitivity** with the sustainable economic growth and the fulfillment of fundamental conditions necessary for such growth in longer term. By these conditions we mainly understand a stable economic environment. All in all, the ESI has the following components:

- a deviation of GDP growth from the long-term trend,
- inflation rate,
- debt structure,
- foreign currency reserves,
- current account balance.

3.3. Data

During the process of estimating both indices, various data sources were used. Data on GDP, public debt and EU countries' deficits were available from the EUROSTAT. For non-EU countries, data were extracted from statistical offices or government websites. The Financial Stress Index was partly based on stock market data. In all analyzed countries that operate a stock exchange, statistics on turnover, volume of stock traded or basic indices are publicly available. Basic interest rates on government bonds were extracted from the ECB Statistical Data Warehouse or from Ministries of Finances' websites. If some countries (Macedonia, Croatia etc.) have not issued ten-year government bonds yet, the longest yield-to-maturity was taken into the analysis. Estonia is an example of a country that does not issue government bonds and does not have a substitute for long-term interest rate. Due to this fact, in the case of Estonia, long-term interest rate spreads could be taken into consideration as a financial stress component. Daily data on foreign exchange fluctuations were obtained from the EUROSTAT for all countries. Interbank interest rate spreads were calculated based on data from central banks. However, for five countries (Croatia, Macedonia, Hungary, Lithuania and Slovenia), data on interbank interest rates were not available in public, open sources. Statistics on the banking sector, external debt (if net was not available, gross values were used), reserves, inflation and current account were obtained from particular central bank publications and their official statistical databases. Repeatedly, we faced the problem of missing data or short time-series. As a result, the principal component method

was heavily vulnerable to missing data in time series; for three countries (Macedonia, Romania and Bulgaria), the sample size was reduced to 8, 16 and 12 quarters, respectively. For some single cases of missing data, the average values from the previous and following quarters were taken or the average value for the time series was used. Despite the fact that most data lagged only by one quarter, the government statistics (including public debt and deficit) lagged by two quarters. For that reason, the index was estimated for the third quarter of 2012 as the last reference period.

3.4. Financial Stress Index

One of the goals of constructing the FSI was to account for **uncertainty about the current and future value of assets on the stock, bond and FX markets**. We expect that the stock market becomes more uncertain in a period of financial stress. Since each of the analyzed countries has a sufficient history of stock exchange transactions, to grasp this uncertainty we follow the common fashion of computing conditional variance on time series of main stock exchange indices. For our analysis, we employed the Auto-Regressive Conditional Heteroscedasticity model proposed by Engle (1982). The model that best fits daily times series of conditional variance of stock exchange index is ARCH(1,1), which is described by the following equations:

$$i_t = \alpha + \beta i_{t-1} + \varepsilon_t, \tag{1}$$

$$\sigma_t^2 = \gamma + \delta \varepsilon_{t-1}^2, \tag{2}$$

where i_t stands for the value of the stock market index, σ_t^2 is conditional standard variance of the index and ε_t is white noise process with unit variance. Conditional variance estimated on a daily time series is averaged so that the final factor shows average conditional variance in each quarter – the time frame of the FSI.

To quantify **uncertainty on the FX market,** we follow the same approach – Auto-Regressive Conditional Heteroscedasticity with one lag of error term and one lag of conditional variance (i.e. ARCH(1,1)) on the exchange rate of domestic currency to euro. The model has the following form:

$$e_t = \alpha + \beta e_{t-1} + \varepsilon_t, \tag{3}$$

$$\sigma_t^2 = \gamma + \delta \varepsilon_{t-1}^2, \tag{4}$$

where e_t stands for the exchange rate, σ_t^2 is conditional standard variance of the index and ε_t is white noise process with unit variance. As in the case

of stock exchange volatility, the conditional variance of FX estimated on a daily time series was averaged for each quarter. Moreover, we assume that countries that entered the Eurozone got rid of the problem of the volatility of their currency. Thus, in a quarter during which a particular country entered the Eurozone, the conditional variance of its currency became zero.

To measure the **uncertainty** prevailing on the **bond market** we compare the yield of domestic 3-month treasury bills with the yield of the bills issued by the U.S. Treasury in the same time and with the same maturity. We assume that the higher the difference, the expected stress on a particular financial market is higher. This is due to investors who show their assessment of uncertainty through transactions on the market and prices assigned to particular bonds.

Asymmetry of information in the interbank system and the stock exchange are elements of stress on financial markets that are very difficult to quantify. Following Heider et al. (2009), we assume that the spread of offered and bid rate on the interbank market indicates the value of the premium that banks pay as a result of the prevailing asymmetry of information. For the purpose of computing the asymmetry of information that stems from stock exchange transactions, we quantified "financial market liquidity". As financial market liquidity, we perceive the total value of transactions on stock exchange (stock exchange turnover).

Decreased willingness to hold risky and illiquid assets was exposed in two sub-indexes. We define illiquid assets as long-term deposits and risky ones as stocks. Thus, the willingness to hold illiquid assets was measured by the change in value of long-term deposits. On the other hand, the willingness to hold risky assets was depicted by the value of main stock exchange indexes.

We expect that sub-indexes accounting for uncertainty, asymmetry of information and willingness to hold risky and illiquid assets do not sufficiently capture the stress arising from "international" sentiments. This is why, as one of the components of financial stress, we use the **World Economic Climate** Index. We think that the perspectives of a country's financial markets might be grasped with an international survey-based index[1].

[1] The World Economic Climate Index is published on a monthly basis by the IFO Institute. It is based on Internet surveys and is one of the most influential indexes.

3.5. Economic Sensitivity Index

One of the key elements of the ESI **is the sustainability of GDP growth**. Following numerous empirical results showing a negative connection between volatility and growth in developing countries (see e.g. Ramey & Ramey (2000), Acemoglu et. al. (2003) or Hnatkovska and Loayza (2005)), we assume that both above-potential and sluggish growth affect economic soundness negatively. To determine how the pace of a country's growth is positioned, we applied the Hodrick-Prescott (HP) filter[2]. A sustainable growth path is a non-cyclical component – long-term trend grasped with the HP filter on quarterly data with the value of parameter $\lambda = 1600$.

We assume that sound economic times could be characterized by a low **inflation rate**. In the ESI, the consumer price index (CPI) is used as a measure of inflation. The stability of an economy is also influenced by the **current account**. The current account reveals the structural competitiveness of the economy. However, trying to define the competitiveness of a nation is really problematic. Competitiveness cannot simply be measured by the ability of a country to sell more abroad than it buys. Paul Krugman gives the example of Mexico, which was forced to run huge trade surpluses in the 1980s in order to pay interest on its foreign debt (Krugman, 1994). On the one hand, large deficits may lead to serious economic problems. On the other, a trade surplus might be a sign of national weakness. Among other consequences, it can cause a fall in **foreign exchange reserves** (which happens in countries under fixed ER regimes), which are also an important element that assures stability in small open economies. The more reserves a country has, the less it is vulnerable to speculative attacks on a currency, all other things being equal. We assume that the lower the current account balance, the less sound the situation is. The last component of economic stability of the indicator is connected to a country's indebtedness.

Our analysis suggests that there are substantial differences in debt intolerance in CEE countries. The term "debt intolerance" was introduced by C. Reinhardt et. al (2003) and manifests itself in times of extreme duress that many emerging markets experience at debt level that would seem manageable by an advanced country. Thus, including the level of public debt and deficit appeared to change the consistency of parameters in the ESI. On the other hand, it appeared that

[2] The Hodrick–Prescott filter is a tool used on macroeconomic time series to separate the cyclical component of time from raw data. Drawing the non-cyclical component of the series is an optimization problem with a *priori* given value to parameter λ that determines the curvature of the component.

the structure of debt is very informative in explaining the stability of public finance. For countries outside the EMU, we employed the ratio of foreign debt in total public debt as an element determining the volatility of the cost of public debt. Studies show that external debt in emerging market economies is often a source of macroeconomic volatility (Kletzer 2005). Moreover, a high level of public foreign debt could raise the riskiness of private borrowing (Ağca and Celasun 2009).

4. Main results

4.1. Sampling adequacy

The prerequisite for applying factor analysis is a strong correlation between variables in a dataset. It should be assured that reducing the number of variables will not lead to a significant loss of information. If this condition is not satisfied, i.e. the variables are uncorrelated, the first few principal components will not contain the vast majority of information about the investigated phenomenon.

In order to decide whether or not to apply PCA to measure financial stress and economic sensitivity, we used Kaiser-Meyer-Olkin (KMO) statistics and Bartlett's test.

KMO statistics are the sum of correlation and partial correlation coefficients which measure sampling adequacy. A large value of the KMO statistics indicates that the correlation between the two variables can be explained by other ones. The value of the KMO indicator shows both the degree of correlation in the dataset and multicollinearity, i.e. if one variable can be linearly predicted from the others with a non-trivial degree of accuracy. Bartlett's test is designed to check null hypotheses, or whether the variables are orthogonal, i.e. whether the correlation matrix is not an identity one.

If there is a strong correlation between each variable and the correlation matrix differs significantly from the identity matrix, PCA can be applied. KMO overall statistics vary from 0 to 1 and according to the literature, KMO should take a value of .50/.60 or higher in order to proceed with the factor analysis.

This prerequisite is fulfilled for the vast majority of computed indicators. **In the case of the FSI, the KMO statistics range from 0.498 (Croatia) to 0.587 (Slovenia). In the case of the ESI, the KMO statistics vary from 0.431 (Poland) to 0.612 (Romania).** In total, out of 24 datasets, the KMO indicator takes values below .50 in only three instances.

On the other hand, the adequacy criterion verified with **Bartlett's test is satisfied for each of the datasets**. It means that for all 24 datasets (12 countries and two types of computed indexes) we rejected the null hypothesis (with a significance level of 0.05) that the correlation matrix is an identity matrix.

4.2. Parameter values

The second step necessary to verify the adequacy of a factor analysis is to check the relevance of any assumptions made. We were able to grasp economic sensitivity and financial stress if and only if FSI and ESI parameters were consistent with our intuition. For example, we expected that the higher the variability on the stock market, the higher the financial stress. Thus, the expected value of the FSI parameter should have a positive value. Moreover, we assumed that the value of parameters did not vary substantially across countries, and that a significant load of information was explained by each first principle component. However, to account for these phenomena, we modestly expect not all but the vast majority of raw indices/components of final indices to have a proper sign. We also expect that first principal components account for the large variability of datasets.

FSI – the first principal component of the dataset with the raw-indices of financial stress explains, on average, almost 40% of variability of the entire set of variables. The small diversity of principal components across the sample could be evidence that, although financial stress is partially idiosyncratic, its components are similar in all CEE countries. Values of parameters for the FSI are shown in Table 1 below.

Table 1. FSI parameters

	BGR	CRO	CZE	EST	HUN	LTU	LVA	MKD	POL	ROU	SVK	SVN
bond market spread	0.9	0.9	0.9	N/A	0.9	0.9	0.9	-0.8	0.9	1.0	0.9	0.9
stock market variability	-0.5	0.1	0.4	-0.1	0.4	0.2	0.3	0.2	-0.5	-0.5	-0.3	-0.3
FX variability	0.0	0.0	0.4	N/A	0.8	0.2	-0.3	0.6	0.2	0.7	0.5	0.9
interbank rates spread	0.6	N/A	0.4	0.7	N/A	N/A	0.6	N/A	0.9	-0.5	0.4	N/A
financial markets liquidity	-0.7	-0.7	-0.1	-0.4	0.2	0.0	-0.3	-0.6	-0.3	0.2	-0.1	0.9
longterm financial liabilities	-0.5	-0.7	-0.5	-0.2	-0.3	-0.6	-0.8	0.6	0.6	0.0	0.0	-0.1
change in the SE index	-0.5	-0.8	-0.9	-0.8	-0.4	-0.8	-0.7	-0.4	0.0	-0.7	-0.5	0.3
WEC	-0.7	-0.7	-0.8	-0.9	-0.7	-0.9	-0.7	-0.2	-0.4	-0.7	-0.7	-0.3
yield of 10y-maturity bonds	0.8	0.7	0.4	N/A	0.8	0.8	0.8	-1.0	0.9	0.6	0.6	1.0

Source: own calculations.

ESI, the first principal component of the dataset with the raw-indices of economic sensitivity, explains from to 39% to 63% of total variability. The values of parameters, the first principal components for CEE countries, are presented in Table 2.

Table 2. ESI parameters

	BGR	CRO	CZE	EST	LTU	LVA	MKD	POL	ROU	SVK	SVN	HUN
GDP deviation	0.8	0.0	0.4	0.8	0.4	0.3	0.4	-0.3	0.3	0.3	-0.4	0.1
CPI	0.8	0.2	0.3	0.4	0.3	0.7	0.4	0.8	0.7	-0.7	0.8	0.4
FX reserves	0.8	-0.9	-0.9	0.8	-0.6	-0.6	-0.3	0.2	-0.9	-0.9	0.8	-1.0
debt structure	0.2	0.7	0.9	0.8	-0.8	-1.0	-0.7	0.9	0.9	0.8	1.0	-1.0
current account	-0.7	-0.8	0.9	0.2	-0.9	-0.9	-0.8	-0.7	-1.0	0.6	0.3	-1.0

Source: own calculations.

As in the case of the FSI, signs of parameters are in most cases in line with expectations. Over 80% of all the components of indexes have a projected direction of influence on economic sensitivity. Although the PCA method was used for each country separately, we can observe some similarities between parameter values. For instance, an increase in the bond market spread by 1 enhances financial stress by approximately 0.9, while a better economic climate reduces financial stress significantly across the whole sample. We need to point out that our method could not provide us with the same parameter values. We believe that due to the heterogeneity of our sample, some factors might have a different influence on financial stress or economic sensitivity in the groups of countries. For instance, it's possible that the negative current account balance could have a positive impact on economic soundness and national competitiveness (see Krugman (1994)).

4.3. Overall results

Our main finding from constructing the FSI is that in each country from our sample, financial stress can be recognized by the same pattern. Table 3 below presents the correlation matrix of the changes in the Financial Stress Index (q/q) between CEE countries. The highest correlation is observed between the Czech Republic and Slovakia and amounts to 0.92. Significantly high correlation values

can be seen among Baltic countries and Hungary. However, for some countries, FSI growth rates are negatively correlated. This might be explained by the fact that financial stress does not appear simultaneously in all countries, and this might be due to idiosyncratic causes. During the analyzed period, countries were exposed to very different financial risks.

Table 3. Correlation matrix of ΔFSI (q/q)

ΔFSI	BGR	CRO	CZE	EST	HUN	LVA	LTU	MKD	POL	ROU	SVK	SVN
BGR	1.00											
CRO	-0.27	1.00										
CZE	0.08	-0.01	1.00									
EST	0.18	0.08	-0.30	1.00								
HUN	0.11	-0.12	-0.14	0.38	1.00							
LVA	0.35	-0.02	-0.04	0.29	0.23	1.00						
LTU	0.50	-0.17	-0.07	0.39	0.28	0.29	1.00					
MKD	-0.18	-0.09	0.24	-0.22	-0.09	-0.32	-0.15	1.00				
POL	0.11	-0.03	0.20	-0.24	-0.14	0.01	-0.33	0.39	1.00			
ROU	-0.27	0.21	-0.03	-0.04	0.00	-0.11	-0.15	-0.17	0.28	1.00		
SVK	0.02	0.00	0.92	-0.17	-0.02	-0.03	0.09	0.25	-0.02	-0.08	1.00	
SVN	-0.08	-0.08	-0.04	-0.35	-0.14	0.17	-0.06	0.07	-0.02	-0.02	-0.05	1.00

Source: own calculations.

Table 4 presents the matrix of correlations of quarterly change in ESI between countries. The values are generally lower than for the FSI. The reason for that might be that economic sensitivity seems to be driven by rather internal than external factors. Fiscal and monetary authorities have a direct impact on external debt or foreign currency reserves. Moreover, economic policy should be designed to smooth output fluctuations and keep price levels stable. We believe that governments have a set of tools to keep economic sensitivity low. Nevertheless, the effectiveness of these tools might be very different across countries. On the contrary, financial stress comes rather from international financial markets. Usually, investors consider CEE a homogenous group of countries, so asset prices or exchange rates change more or less simultaneously. Structural problems of the economies will increase the ESI, but the FSI can be caused by exogenous shocks.

Another explanation of the low and sometimes negative correlation between countries is the long time horizon, which was also taken into consideration. We have to bear in mind that the analyzed sample consists of transition economies, however, the time horizon and the process of market transition varies across countries. Nevertheless, if we look at the most recent period, i.e. 2005-2012, we can observe that local peaks of indices generally follow the same pattern.

Table 5 presents the highest values of the FSI and the ESI registered between 1q2005 and 4q2012. For 7 out of 12 countries, the largest financial stress was observed in 1q2009, while for 10 countries, peaks appeared between 4q2008 and 2q2009. This was the peak of the global financial and economic crisis. For Slovenia, the highest FSI value was reached during 3q2012, which might be a sign of later turmoil on the Slovenian financial market. Similarities in economic sensitivity between countries cannot be seen so easily. However, in 7 CEEs, the highest economic sensitivity was observed in 2008. The results suggest that our index might be considered a leading indicator. We can see that, generally speaking, a peak in financial stress is followed by the highest economic sensitivity. Only in Hungary, Macedonia and Slovakia, lack of economic soundness comes later. The lag in the FSI peak is usually less than 4 quarters.

Table 4. Correlation matrix of ΔESI (q/q)

ΔESI	BGR	CRO	CZE	EST	HUN	LTU	LVA	MKD	POL	ROU	SVK	SVN
BGR	1.00											
CRO	0.44	1.00										
CZE	0.00	0.00	1.00									
EST	0.03	0.01	-0.20	1.00								
HUN	-0.10	-0.10	0.16	0.14	1.00							
LTU	0.12	0.21	-0.10	-0.30	-0.10	1.00						
LVA	-0.10	0.05	0.03	0.00	0.00	-0.10	1.00					
MKD	0.20	-0.10	-0.10	0.03	0.01	-0.30	-0.10	1.00				
POL	0.05	0.47	0.04	0.09	0.14	0.04	0.27	0.00	1.00			
ROU	0.00	0.36	0.03	-0.10	-0.20	0.11	0.00	-0.10	0.09	1.00		
SVK	0.62	0.61	0.00	0.11	-0.10	0.11	-0.30	0.17	0.09	0.48	1.00	
SVN	0.03	-0.10	0.00	-0.30	-0.10	-0.10	-0.10	0.48	-0.10	-0.10	0.11	1.00

Source: own calculations.

Table 5. Peaks of FSI and ESI (2005-2012)

	BGR	CRO	CZE	EST	HUN	LTU	LVA	MKD	POL	ROU	SVK	SVN
FSI	1q09	1q09	4q08	1q09	1q09	1q09	2q09	1q08	1q09	3q09	1q09	3q12
ESI	3q08	3q05	3q08	2q08	4q11	4q08	2q08	1q09	2q08	2q05	4q12	4q09

Source: own calculations.

Figure 1 shows the correlations between average quarterly growth rates of both indices in each country in the two sub periods: 2005-2008 and 2009-2012. Between 1q2005 and 4q2008, the ESI was increasing at a low pace, while the growth rates for the FSI fluctuated around 0 or were slightly decreasing. The two outliers were Bulgaria, where the economic sensitivity grew quickly, and Romania, which had a large decreasing value of ESI. Since 2009, when

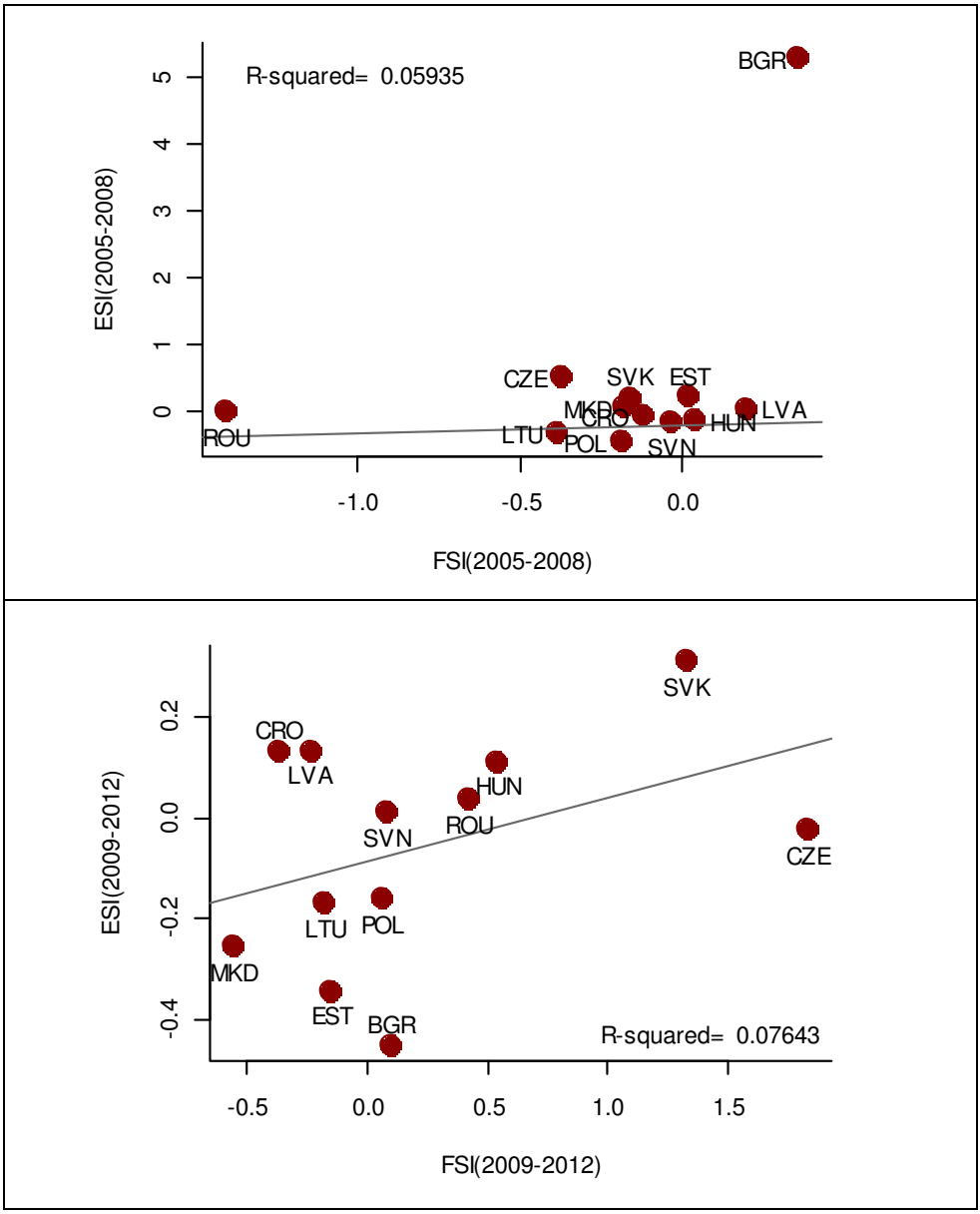
the financial crisis struck, a structural change in the growth rates of indices in CEEs has been observed. The values of the ESI and the FIS are not so condensed among the countries. For the analyzed states, the growth of the ESI and FSI slowed down, while in Slovakia and the Czech Republic, the problems with the lack of economic and financial soundness can be clearly seen.

The next step in our analysis is to check how the indices are correlated with GDP growth. We focused on the most recent years: 2007-2012, taking the average quarterly values of FSI and GDP growth. In Figure 2, we present scatterplots for each year separately. The horizontal axis represents the value of the FSI and the vertical axis shows GDP growth. Surprisingly, the 2007 correlation between the values of the FSI and GDP growth seems to be positive, while in the next years the trend reversed. Especially in 2009 and 2012, the values are close to the fitted trend line. We might explain this by the fact that before the crisis, the economy was probably overheated. Using an HP filter we estimated the potential value of output and observed that the highest positive deviation from the trend between 2007 and 2008, which might be a sign of an overheated economy. GDP grew rapidly, while the first signs of financial stress could be observed on the markets. This might lead us to the conclusion that financial stress can be recognized first but its peak is followed by high economic sensitivity.

The correlation between GDP growth and ESI was, generally speaking, positive or close to 0 in the years 2007-2010. Since 2011, the trend has been reversed (see Figure 3). We have to bear in mind that GDP is one of components of the index. If the economy is both overheated and in deep recession, the ESI should increase. The cooling down of an overheated economy is a sign of decreasing economic sensitivity. We might see that in 2011, most CEE economies were on their way back to a stable growth path, however, no clear trend could be observed. This might be explained by a high uncertainty about the prospects of emerging markets.

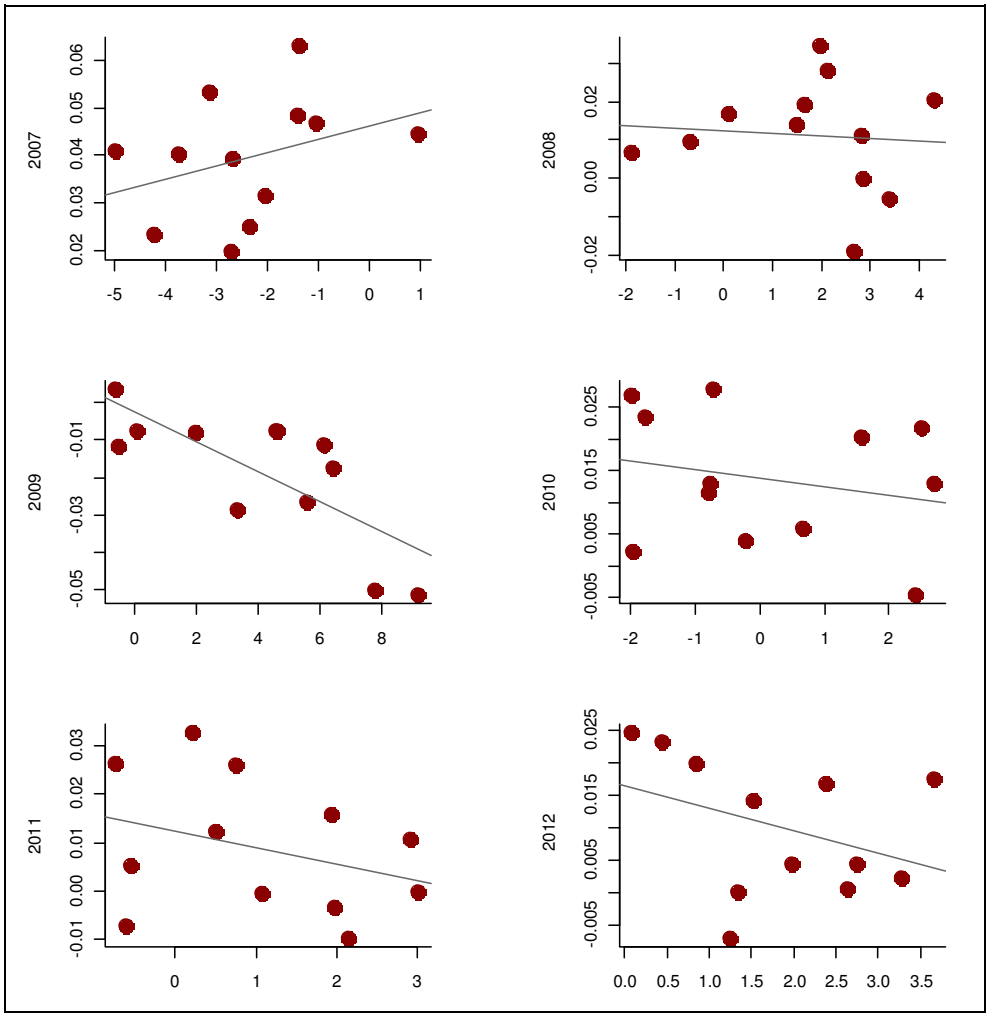
We have to stress that investors usually treat CEE countries as more homogenous than they, in fact, are. The next step of our paper is to examine which factors play a crucial role in high financial stress and the lack of economic soundness in each country, separately. This will show us the level of heterogeneity between emerging economies in Europe. Comparing the values of the indices with the most important events on international and domestic markets, we will investigate whether the ESI and the FSI are able to reflect the current situation and if they might be useful as a leading indicator.

Figure 1. Quarterly growth rates of ESI and FSI in (1q2005-4q2008) and (1q2009-4q2012)



Source: own calculations.

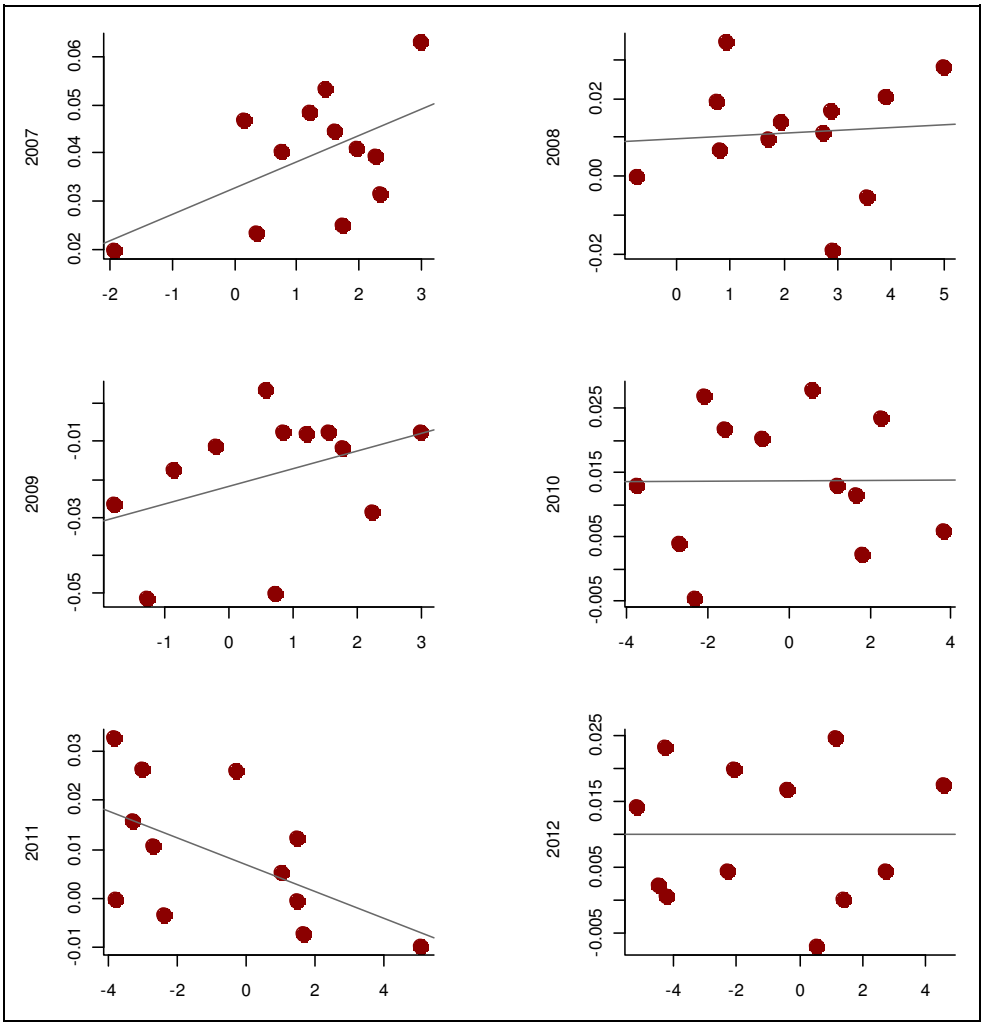
Figure 2. FSI and GDP growth, 2007-2012[3]



Source: own calculations.

[3] Graphs present relationships between average quarterly growth of GDP and the value of Financial Stability Index for 2007-2009. X-axis represents the FSI and Y-axis – GDP growth.

Figure 3. ESI and GDP growth, 2007-2012[4]



Source: own calculations.

[4] Graphs present relationships between average quarterly growth of GDP and the value of Economic Sensitivity Index for 2007-2009. X-axis represents the ESI and Y-axis – GDP growth.

4.4. Country-by-country financial stress and economic sensitivity

Bulgaria

Because of poor data availability, Bulgarian financial stress and economic sensitivity was examined starting from the first quarter of 2004. At this time, the Bulgarian economy remained on a rapid growth path, rebounding after the burst of the internet bubble and the aftermath of the Russian flu. Even though the government elected in 2001 did not manage to implement sound financial policies and pursue structural reforms, the levels of both economic and financial stress in the period preceding the global financial crisis were very stable. After the EU accession (1st Jan 2007), which coincided with the beginning of the global financial crisis, the economic and financial situation started to change rapidly. The lack of economic soundness was a result of rapidly growing inflation, which at the end of 2007 rose by almost 10 percentage points and reached 16% (CPI yoy) in 2008. The growth of nominal GDP per capita fell from roughly 6.2% in 2008 to less than -4% (yoy) in the four subsequent quarters. The decline in GDP together with the very rapid growth of prices negatively affected the soundness of the economy in the 2007q2-2008q4 period. The IMF indicates that in the fall of 2008, the Bulgarian economy was hit by two shocks. Firstly, capital inflows declined significantly, reducing domestic demand. Secondly, the recession in trading partners impacted Bulgaria's exports (IMF, 2010a). As Figure 7 in the Appendix reveals, the sudden growth in financial stress was observed 3 quarters earlier.

The growth of financial stress in Bulgaria followed the increase in economic sensitivity in the domestic economy and the world financial market incidences after the collapse of Lehman Brothers investment bank. It started rapidly increasing at the end of 2007 to reach its peak in 2009q1. As seen in Figure 8 (see Appendix), the FSI was shaped mostly by the worsening world economic climate and the decrease in trust in Bulgarian bonds. In response, the government elected in 2009 undertook steps to reduce economic sensitivity and to decrease the level of financial stress. The decline in stress in 2009, exhibited by Figure 7, Figure 8 and Figure 9 (see Appendix), are evidence that the fiscal discipline proved successful. These led to the Standard and Poor's (2009q4) and Moody's (2010q1) upgrade, which placed the Bulgarian economy on a growth path and improved economic soundness. Financial stress and economic sensitivity was significantly reduced, even compared to the years preceding the crisis.

Croatia

At the beginning of the observation period, the Croatian economy was facing considerable economic problems. Rapid privatization, war damages, the Russian crisis and Tudman's reign were the most important reasons for the lack of economic soundness in Croatia at the beginning of the 21st century. From that period on, the economy entered a stable growth path. A decrease in the current account deficit, an improvement of the debt structure and an increase in foreign exchange reserves played a key role in diminishing economic sensitivity (see Figure 11 in Appendix). Sound and sustainable growth might be visualized by the growing amount of foreign currency reserves. Dani Rodik (2006) shows that increasing reserve accumulation leads to greater liquidity, which might reduce the likelihood of financial crisis, and reduces the future costs of borrowing. Croatia's GDP almost doubled while foreign currency reserves more than quadrupled between 2001 and 2012. Since Croatia's economic sensitivity is only slightly dependent on GDP deviating from the trend, the entire observation period 2001-2012 can be regarded as a time of growth due to structural progress in the economy and productivity growth.

Financial stress between 2001 and 2007 also decreased. A reduction of the national bonds yield, growth on the stock exchange and increasing trust in risky and long term financial assets led to a decline of financial stress that shadowed the situation on the global financial markets. After an ample liquidity period between 2003 and 2007, and following the world financial situation from the second quarter of 2007, the level of financial stress sky-rocketed. Even after a significant decline in 2009q1-2010q1, it stopped at a level above pre-crisis levels. The IMF indicates that in 2010, after recovering from the peak of the crisis, the financial market remained relatively stable. However, financial institutions are slowly recovering from the crisis (IMF, 2010b). In recent years, the financial sector in Croatia experienced some further turbulences due to the global economic situation and the internal financial stress reaching a "local" peak in 2012q1.

Czech Republic

Fueled by export growth and high investment rates, the Czech economy was sounder in 2001 than in other countries in the region. In the first quarter of 2001, real GDP growth was fluctuating around 4.5 percent points (pp), the CPI inflation rate remained slightly above 4 pp and foreign debt accounted just for 7% of the total public debt. The current account balance in relation to GDP amounted approximately to -5%. These indicators made the Czech Republic the leader across

CEE countries in terms of low economic sensitivity. GDP growth fluctuated quarterly from 2.1 to 7% year-over-year until the global financial crisis, when all of the components of economic sensitivity started pulling it up. In the third quarter of 2008, as a response to growing financial stress, the ESI reached its peak. A cooled-down economy, (reduced inflation and decreased GDP), along with the appreciation of the currency, restored some economic stability in subsequent quarters. From 1q2009 to 4q2012, economic sensitivity kept fluctuating around a stable level.

At the beginning of 2001, financial stress remained at high levels. The large conditional variance of the koruna's exchange rate, the low value of the stock exchange index and the high yield on national bonds were the reasons for the extensive levels of stress. Following the tide of optimism from the global financial markets, subsequent years brought a deterioration in information asymmetry and a growth in confidence in investment in long term and risky assets, which before the global financial crisis kept financial stress at low and stable levels. The progression of the crisis in the Czech Republic coincided with the world economic climate. We can observe a global peak of stress in 2009q1 and a local peak in 2012q1 (see Figure 13 in Appendix). During the latest crisis, real GDP started to fall in the last quarter of 2008. Both the ESI and the FSI could be considered the leading indicators. The latest forecasts indicate that in 2013, economic activity will bottom out and the recovery will consolidate in 2014 (EC, 2013a). The downward trend of the FSI at the end of 2012 seems to support these forecasts.

Estonia

A very similar outline of financial stress in the 2001-2012 period can be observed in Estonia. As a small economy that is strongly dependent on the global financial situation, Estonia experienced a stable decrease in financial stress from 2001q1 to 2007q3. Due to the crisis, stress levels peaked in 2009q1 and also subsequently in 2012q1. The first period of rapid increase in financial stress was initiated when Lehman Brothers collapsed, the second a year after the adoption of the euro. The Eurozone Sentix Index[5], which measures sentiment and European investor confidence, started to fall in 2q2011 and reached the bottom at the end of 2012. The FSI for Estonia started to grow rapidly around the third quarter of 2011. The key drivers of these upsurges were: world economic climate,

[5] See: www.sentix.de.

fluctuation on the stock market and increased yield of national bonds due to worsened economic soundness and S&P downgrading (see Figure 18 in Appendix).

In the observed period, economic sensitivity did not vary as rapidly as financial stress. Because of a drastic fall in Estonia's GDP during the crisis, the country's economy cooled down. Even though public debt was not a burden to the economy since it used to be the lowest in the region, the public finance deficit was affected by the crisis and may have increased economic sensitivity. Fiscal consolidation and GDP growth, restored in 2010, resulted in upgrading the economic soundness to the level from the period before the crisis (see Figure 17 - Appendix).

Hungary

Even though Hungary experienced a similar pace of growth to the Czech Republic in the early 2000s, its economy was not in such a good state. In the first quarter of 2001, the indebtedness of the general government exceeded 55 percent of GDP and the inflation rate was more than 10 pp yoy. Despite some small fluctuations, economic sensitivity remained at a stable level. After the elections in 2006, an austerity package to reduce the budget deficit was introduced. This led to a halt in the pace of growth but did not substantially affect the country's economic sensitivity. An increase in economic stress happened at the beginning of the global financial crisis, after Hungary's public debt breached the 60-percent threshold. It was the only NMS country to do so, and it happened exactly at the time when Hungary got under the umbrella of the IMF's rescue program. In November 2008, the IMF approved a loan for Hungary amounting to 15.7 billon USD. The program was introduced due to high financial market stress in CEEs and concentrated on government finances and the banking sector[6]. At the same time, the ESI started to grow rapidly and the FSI reached its peak (see Figure 19 – Appendix). Following Hungary's vulnerability to a capital flows reversal, the Hungarian forint plummeted in 2008q3, resulting in a drastic change in a number of economic indicators. In 2009, GDP shrank by more than 6%. Firstly, there was an increase in the value of foreign exchange reserves relative to GDP. Secondly, there was a sudden decrease in the current account deficit preceded by years of deficits above 8% GDP. Thirdly, a weakened currency led to growth in the country's indebtedness denominated in forint. The ESI shows (see Figure 19 - Appendix) a structural change, an improvement in economic

[6] http://www.imf.org/external/pubs/ft/survey/so/2008/car110608a.htm (access: 2013/12/10).

soundness that appeared after the depreciation of the forint. Although we may compare only the direction of changes in the ESI, the values of macroeconomic indicators suggest that even after the shift that took place in 2008, there is still high economic sensitivity in Hungary.

The IMF and EU assistance did not cause a reduction in economic sensitivity. The elimination of the exchange rate band in early 2008 that removed a potential conflict between monetary policy objectives could have boosted confidence in counter-inflation policy and dampened the volatility of asset prices. In 2008q4, Hungary was granted financial assistance of 25 billion USD, which should have bolstered market confidence, but it could not have had an immediate positive impact on macroeconomic performance. Indeed, the aid positively impacted the FSI (see Figure 21 in Appendix). Ultimately, the program helped restore stability in the financial sector and created the conditions for an economic recovery.

Over the twelve year period, financial stress in Hungary underwent two substantial upswings. The first started in the first quarter of 2008 as a rebound of the global financial crisis (this was the period of the Bear Stearns bailout). The peak was reached after a year in the first quarter of 2009 when the spread of interbank rates, the yield of ten-year domestic bonds and the world economic climate were not favorable for the domestic financial market. The second peak was reached in 2012q1 as a result of downgrading the Hungarian economy by three major agencies and launching the Excessive Debt Procedure by the European Commission. The second peak was almost as high as the peak in the beginning of the crisis. It was driven by the variability of the forint, the increasing yield on government bonds and the interbank rate spread. Figure 21 in the Appendix presents the decomposition of two sudden upsurges of the FSI.

Latvia

The Latvian economy was the fastest growing in Europe for a number of years before the global crisis broke out. the growth of real GDP between 2001 and 2007 varied from 7.1% to 11.0% (Eurostat). It was fueled by easy credit that financed a housing boom. The high deficit in the current account of around 8% of GDP in 2001 started to quickly widen with the booming economy and reached record highs of 22.5% of GDP in 2006 and 2007. Inflation accelerated (HICP rose by 15.3% in 2008), giving a clue that the economy was overheating. Along with rapid wage growth, this led to a loss in international competitiveness under the fixed exchange rate. Public finances were almost balanced as the headline deficit was below 1% of GDP in 2006-07, however the structural deficit remained

high: Latvia should have had a big surplus at that time. Therefore a dramatic decline in GDP in 2008 and 2009 led to a large increase in the deficit.

The boom ended abruptly after the collapse of Lehman Brothers, but the economy started gradually slowing down at the end of 2007, when credit expansion slowed. Economic stress in the Latvian economy experienced constant growth until 2009. However, its rise due the largest deterioration of GDP in Europe by almost 18% in 2009 was mitigated by the rapid cyclical turn-around of the yawning current account deficit, which also helped increase official foreign exchange reserves. A downswing that improved the current account balance and increased the relative value of foreign currency reserves is visualized in Figure 23 in the Appendix.

The FSI has fluctuated around a stable level from the beginning of the observation period. The global financial crisis dramatically changed the situation. After Latvia's economy started to nose-dive in 2008, financial stress experienced a sudden huge increase until 2009. As of the third quarter of 2009, after the inception of rescue programs by the EC, IMF and WB that amounted to €7.5 billion, financial stress started to slow down, with a reduction of the spread on the interbank market and the yield of national bonds playing an important role in this shift.

Lithuania

The course of financial and economic stress in Lithuania resembles shifts of the FSI and the ESI in Latvia over that period. Compared to other Baltic countries, ESI growth between 2001 and 2007 was less volatile and less steep, with the pace of GDP growth increasing from 7.4 to 10.3% of GDP in EUR. After experiencing a sudden decline in GDP (14.1% in 2009), the economy started to recover its soundness. This was mostly due to the depreciation of lit and a simultaneous improvement of the current account balance, debt structure and the increased value of foreign currency reserves.

The FSI in Lithuania before the crisis was characterized by a downward trend. Key symptoms of these were: reduction of interbank spreads and growth of OMX Vilnius. The course of financial stress in the crisis was very sudden, with a similar shape and mechanism to Latvia. The peak was reached in 2009q. After a sudden decrease in financial stress at the end of 2011, the FSI started to grow again. In 2012, real GDP expanded by 3.7%, mostly due to net exports and domestic demand. According to the forecasts, the Lithuanian economy will be growing at an average rate of 3.5% over the next 3 years (EC, 2013b). The diminishing

value of the ESI reflects the strength of the real sector. After an increase in 2011, the FSI maintained itself at a stable level in 2012, with a slight downward trend.

Macedonia

With its currency pegged to the euro and an economy based on agriculture, Macedonia was not exposed to sudden shifts in economic sensitivity during the analyzed period. Nevertheless, the ESI trended upward since 1Q2006 until 4Q2007 mainly for two reasons: the ESI was driven upward by unfavorable changes in the public debt structure and the increasing current account deficit. Right before the crisis, the ESI showed a see-saw pattern as the impact of various factors changed: the current account shortfall was a steady factor, but GDP growth, CPI inflation and changes in the debt structure fluctuated, partially offsetting each other. After 2003, inflation was kept at a low level as the economy experienced growth, but it grew in 2008 due to hikes in food and energy prices. GDP recorded only a small drop during the global crisis (0.9% in 2009). Partially due to the exchange rate regime, the soundness of the economy was assured. After the first wave of the crisis, the economy's sensitivity even diminished due to a more stable debt structure and a decline in the current account deficit.

Financial stress in Macedonia, on the contrary, was subject to more volatility. It has been increasing since the beginning of the financial crisis in 2007q3. The MBI10 index that was established at the value of one at the end of 2004 reached its bottom in March 2009 after an 84% decline from a peak in August 2007. Although banks, due to their rigorous rules, were not affected strongly by the crisis, the mechanism of the growth stress could be mainly seen in the variability of the stock exchange. After the crisis, Macedonia continued to pursue sound economic policies. Growth has picked up, underlying inflation has remained low and international reserves have remained broadly stable.

Poland

The Polish economy was heavily affected by the global recession in the early 2000s. Thus, at the beginning of 2001, Poland had a high level of financial stress and an unfavorable level of economic sensitivity. A lot of stress appeared to be due to running expansionary policies after the Russian crisis in 1998. To some extent, the stress was also inherited from the "Russian flu" and the dot-com bubble in 2000. The high inflation rate (average CPI was up 10.1% in 2000) was substantially reduced by means of a very restrictive monetary policy (the key

policy rate was hiked to 19% in August 2000 from 13% in January 1999 and cut gradually in 2001): it averaged 5.3% in 2001. Decreasing inflation, a rapidly falling current account deficit and decreasing government external debt after 2001 restored stability in the economy. The ESI increased from a very low level before the EU accession in May 2004 and directly after it due to a one-off increase in the CPI price level that was caused by regulatory changes. Decomposition of inflation in New Member States on country-specific components shows that the EU inflation rate has a statistically significant impact on price indexes in Poland (DG-ECFIN, 2008). This impact was also statistically significant in Latvia, Slovenia, Bulgaria and Romania.

Over the course of 2003-2007, a four-year period of optimistic tides on global financial markets, the economy returned to a sustainable growth path, owning a safe amount of foreign currency reserves and ran a moderate current account deficit, which fluctuated around 4% of GDP. Real GDP growth reached 6.8% in 2007, the year when the economy started overheating (wage growth strongly exceeded productivity growth and bottlenecks showed up). The global crisis did not substantially affect the soundness of the economy. Even though GDP growth fell in 2009 to 1.6%, the 2008q3 peak in the economic stress, which coincided with the Lehman Brothers investment bank collapse, was even lower than its 2001 levels. After the depreciation of the zloty, some economic stress was reduced (EUR/PLN depreciated in just two quarters 2008q3-2009q1 from 3.2 to 4.9) because the current account deficit started improving. When the exchange rate recovered in 2009, the ESI started a period of oscillation around a horizontal trend. For the last three years, its volatility was driven by deviations in GDP and fluctuations of the national currency, changing the value of the government external debt and foreign reserves denominated in zloty.

In Poland, financial stress seemed to be driven by economic sensitivity and the situation on the world financial markets (see Figure 33 in Appendix). The peak in financial stress was reached in the second quarter of 2009, two quarters after the peak in the ESI. In recent years, financial stress has been caused mostly by the variability on the stock market and the yield of government-issued bonds.

Romania

Similarly to Bulgaria, Romanian FSI and ESI were analyzed over a shorter time period, from 2005q1 to 2012q4. The economic boom in 2004-2008, when GDP grew at an average rate of 6.6%, caused the economy to overheat: the current account deficit increased to 12.3% of GDP, inflation picked up to over 8% yoy in mid-2008, and the expansionary fiscal policy led to a general government

deficit of 5.5% of GDP. However, the cyclically-adjusted shortfall was even higher, at 8.5% of GDP in 2008. The shape of the curve indicating economic sensitivity in Romania suggests the very important role of EU accession on the county's economic soundness: the ESI downtrended in this period from a high level as GDP growth offset the rising macroeconomic imbalances. Since the series is short, the positive deviation between actual growth and potential growth is not pronounced and it did not tend to raise economic stress. The concern about these developments caused a significant tightening of capital flows to Romania and stress in the banking system (see FSI). Pressures on the exchange rate increased, resulting in a more than 30% cumulative depreciation between August 2007 and January 2009. A sharp decline in exports plunged the economy into a severe recession in late 2008. Thus, the global crisis changed the fortunes of the country and, similarly to Hungary and Latvia, it had to seek financial support from the international organizations, namely the IMF. Rapid depreciation exerted sudden positive effects on the country's macroeconomic safety. Some of the decrease in economic sensitivity was due to structural reforms and the current account deficit drop from 12.3% of GDP in 2008 to 5.5% of GDP in 2009 and further to 4% in 2012. Other imbalances improved as well. Financial stress in Romania follows a similar pattern to other countries in the region. An increase in the FSI started with the beginning of the global financial crisis. It reached its highest values between 2009q1-2009q3. Compared to the other CEE countries, the fall in the FSI thanks to the depreciation of the currency came later (2009q4). A $20 bn loan, along with the depreciation of the currency, stabilized the economy so it had a positive influence on both economic and financial soundness. After a period of decreased stress, there was a rebound and a second peak of stress in 2012q1. The exchange rate variability was the main factor and this is related to bouts of the crisis in the Eurozone as well as political developments.

According to the winter EC forecasts, the Romanian economy was expected to recover modestly, mostly due to an increase in private demand. A higher inflation rate and the labor market structural problems will reduce the pace of growth (EC, 2013c).

Slovakia

Over the course of ten years, economic stress in Slovakia has been following an upward trend. During 1q2003 and 1q2005, economic sensitivity was diminished through a more advantageous debt structure and because of an increasing amount of foreign exchange reserves. Starting in 2005, economic sensitivity started

increasing as the amount of reserves decreased, debt structure became less safe, and GDP deviated from the trend. In January 2009, Slovakia entered the EMU. This event, however, did not have a sudden substantial immediate influence on the soundness of the economy.

As in Poland, financial stress in Slovakia (see Figure 39 - Appendix) in the beginning of the observation period was high compared to succeeding years. This was due to extensive yields of government bonds stemming from the lack of trust in the country's economic condition, as well as the impact of the Russian crisis and the burst of the internet bubble in 2001. 2007-2008 was a period of increased financial soundness due to more optimistic investors and the development of trust depicted by lower conditional variance of stock exchange index and lower interbank spread. It is interesting that the level of financial stress during the global financial crisis did not reach 2001 levels. This fact, and the fall of stress after the accession to the EMU could be evidence that EMU Member States are less vulnerable to financial stress in hard economic times. Slovakia experienced its highest stress levels during the crisis in 2009q1 and 2012q1.

Slovenia

Similarly to Croatia, in the early 2000s, the Slovenian economy was still experiencing the aftermath of the Balkan conflict. However, between 2001q1 and 2007q1, economic sensitivity in Slovenia was considerably reduced, mainly as a result of sound public finance and a successful anti-inflation policy that led to a decrease in inflation (from 8.9pp in 2000 to 2.5pp in 2006 yoy, HICP). The adoption of the euro in 2007 had a significant short-term positive influence on the ESI (Figure 41 in Appendix). During the global financial crisis, Slovenia encountered problems which can be observed by the reversal of the ESI trend. Problems could be regarded as partially structural and connected to the EMU accession. As a result of imbalances, general government deficits emerged, leading to a rapid increase in the public debt. Between 2008 and 2012, public debt rose from 22% of GDP to almost 55%.

Similarly, in the early 2000s, financial stress was steadily decreasing following a reduction in the value of the ESI (see Figure 40 in Appendix). The global financial crisis at first had only a small influence on the FSI. In the long-term, the downward trend preceding the global financial crisis reversed. The FSI started to increase, which could be regarded as an early warning of the banking sector crisis that would emerge in 2013. A moderate increase in the FSI and the volatility of asset prices in the period 2010-2012 shows that financial markets were only partially aware of the approaching problems.

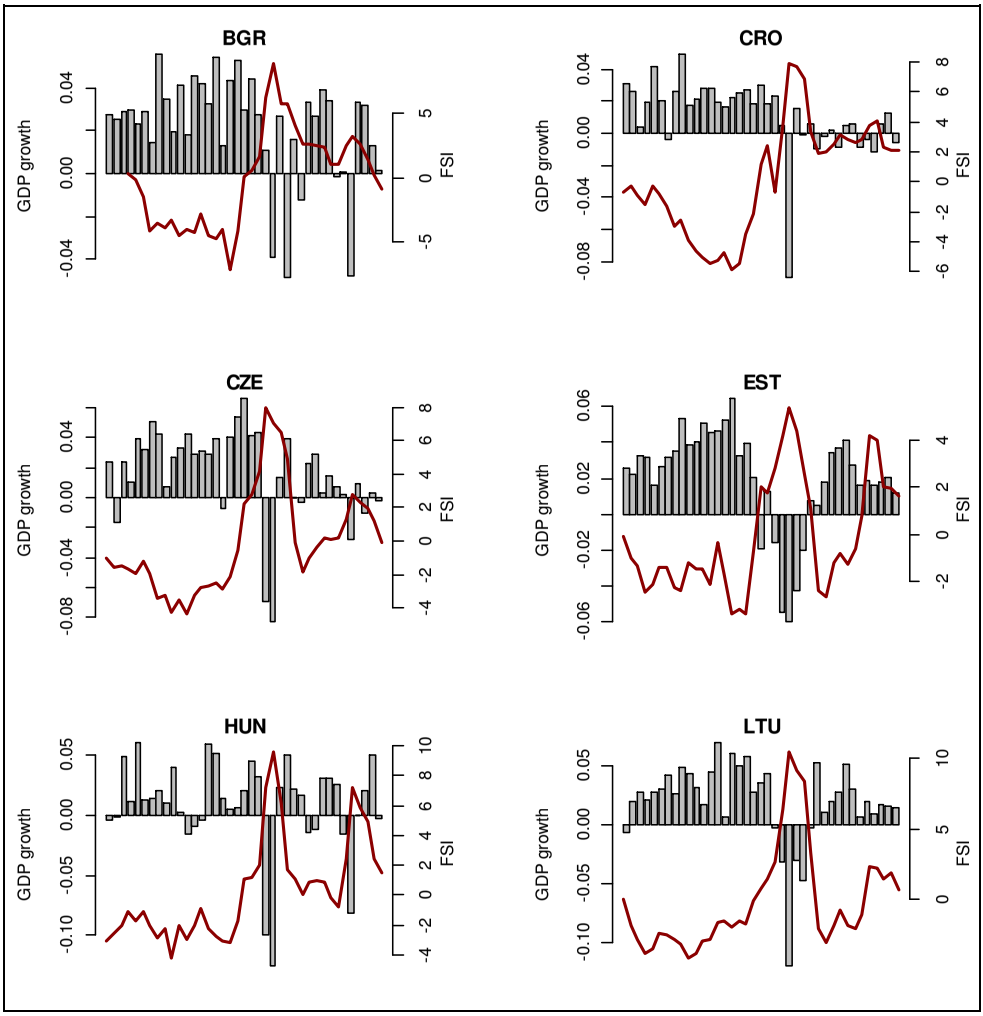
4.5. FSI as an leading indicator

While constructing our indices, the question arose about whether we could treat them as leading or early-warnings indicators. To answer this question, we compared the FSI index with GDP growth in each country (see Figure 4 and Figure 5). We observed that the periods with the highest FSI values were the times of the deepest recessions. The charts indicate that the 2008-2009 recession was followed by significant changes in the FSI trend. Usually, financial stress started to increase rapidly about four to five quarters before the downturn in economic activity. If we were able to recognize the change in the main trend of the index, we could use it as an early-warning indicator.

We compared the FSI with the Composite Leading Indicator (CLI) constructed by the OECD during the 2003-2012 period. The CLI is designed to recognize the turning point in the business cycle. It is often considered an early-warning indicator. CLI components are slightly different for each country, but they are based not only on the real sector of the economy, but also consist of financial and monetary variables (e.g. share prices, money supply M1) or expectations (e.g. expected economic situation) (OECD, 2013). For most of the countries, we can see very similar patterns in fluctuations of both indices (see Figure 6). The correlation between financial stress and the Composite Leading Indicator seems to be weakest in Slovakia. For other countries, FSI peaks and bottoms occurred simultaneously with CLI peaks and bottoms. Financial stress might be useful in forecasting future fluctuations in GDP or might itself be the cause of such fluctuations. To check that, a time series analysis is used in order to construct reactions functions of shocks in the FSI on economic activity.

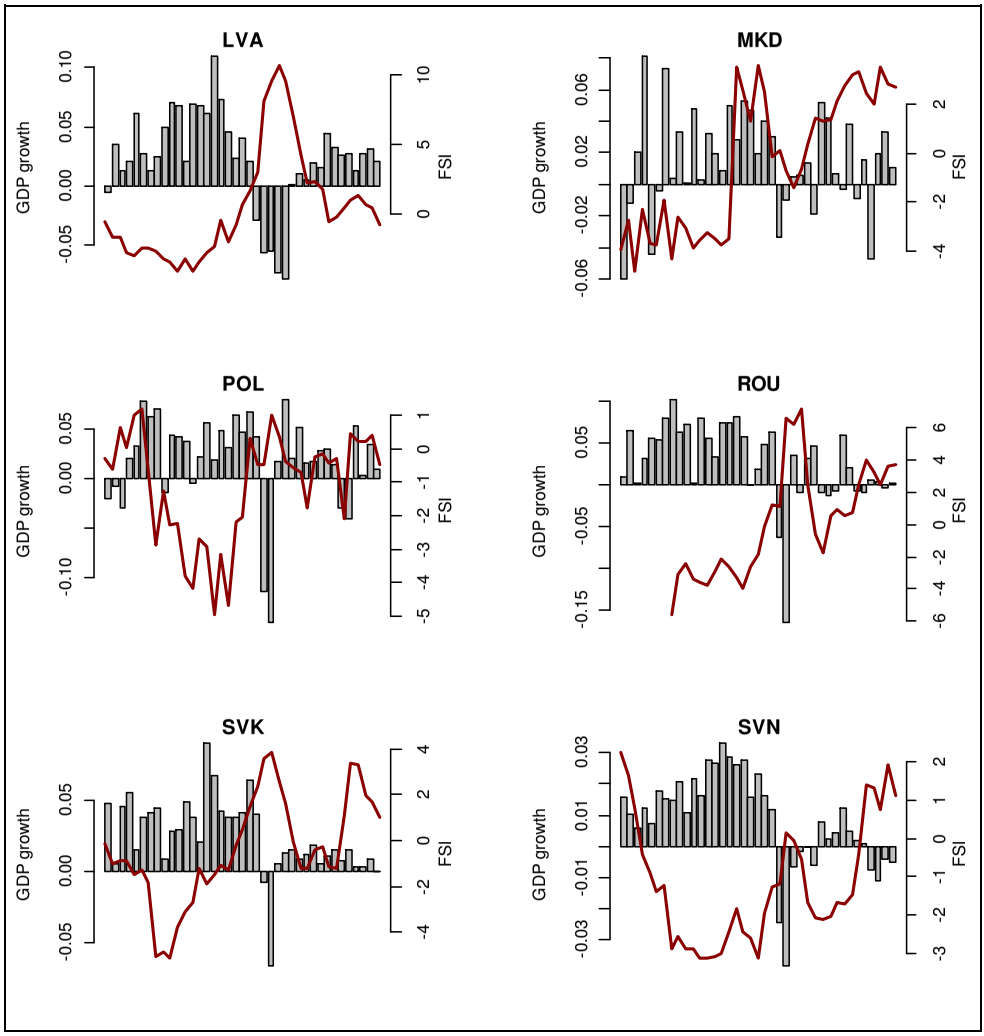
The econometric test of unit root, the Granger causality test and VAR modelling as proposed in Cevik et al. (2012) and Cevik et al. (2013) are restricted with the number of observations. Constructing the FSI based on monthly data from the early 1990s would provide a sufficient sample. However, for some countries, the data availability seems to be too low. Yet the VAR analysis and the constructing impulse response function of an FSI shock on economic activity for some CEEs is undoubtedly worth considering as a topic of future research.

Figure 4. FSI and quarterly GDP growth (2q2003-4q2012) (1)



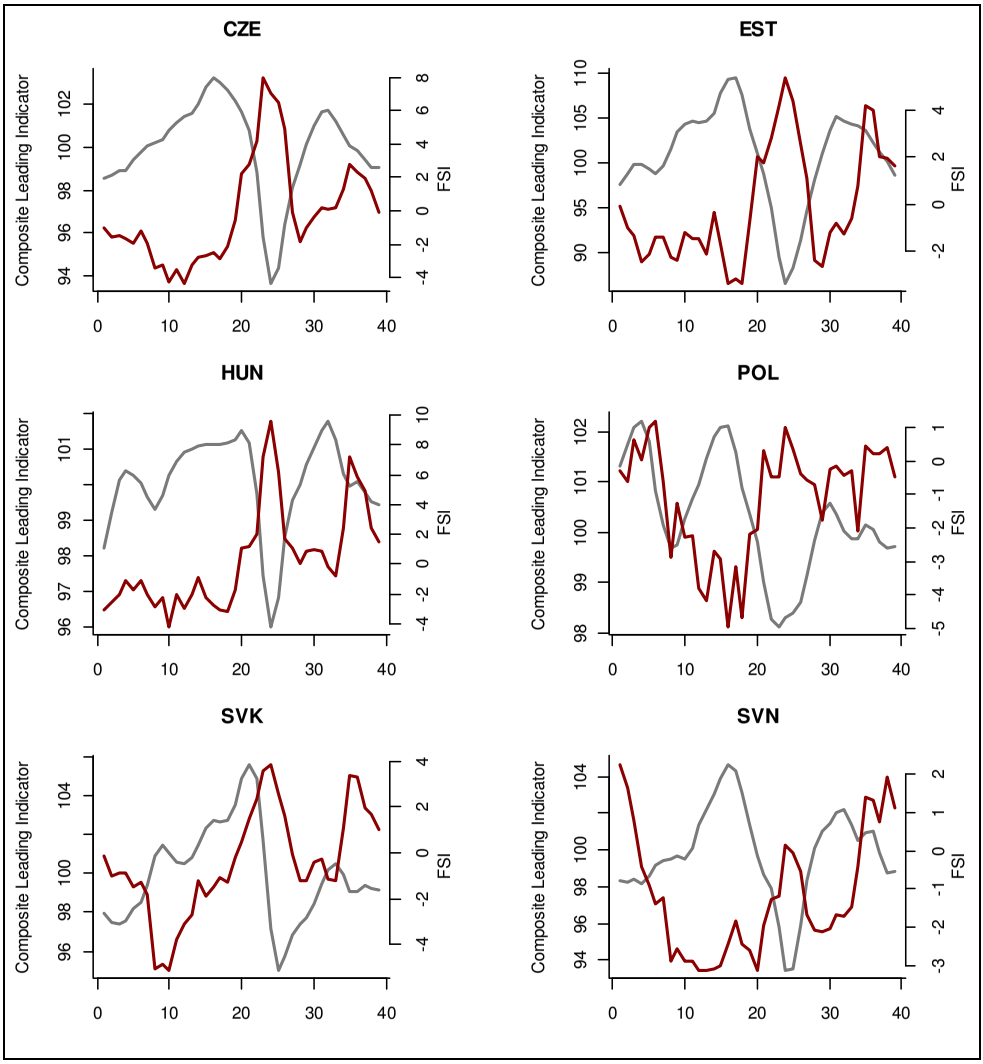
Source: own calculations.

Figure 5. FSI and quarterly GDP growth (2q2003-4q2012) (2)



Source: own calculations.

Figure 6. OECD Composite Leading Indicator (grey line) and FSI (red line) (2q2003-4q2012)



Source: own calculations.

5. Conclusions

The volatility of domestic financial markets and their influence on CEECs' economic soundness in the early 2000s underscores the importance of understanding the co-movement of financial vulnerability and economic instability. With the help of two indices, the ESI and the FSI, that were created to grasp these phenomena into two single digits, we were able to explain the formation of important events in domestic economies and explain their links with global financial markets. Our quantitative tools proved to offer results consistent with historical "qualitative facts".

Our analysis confirms that the global financial crisis had a sudden and very significant negative impact on all CEECs. In the 2008-2009 period, financial stress for almost the entire group of countries substantially exceeded the levels that these economies had experienced before. Only three countries that were the most resistant to the crisis in these years, i.e. Poland, Slovakia and Slovenia, were affected more strongly by the global recession in 2001 than in the period of the global financial crisis. The shape of the FSI offers evidence of the positive impact of the IMF, EC and WB bailout programs that were applied in Hungary, Latvia and Romania in 2008-2009. In each of these countries, a fall in financial stress coincides with the announcement of granting loans by these international institutions.

The formation of the FSI and ESI over the twelve-year period enables us to draw some conclusions on the effects of the European integration process. The shape of the indices proves that EU accession has a positive, but not significant influence on financial stability in CEE countries. For a number of quarters after EU-accession, the FSI decreased slightly. However, we did not observe such a relationship with the ESI. The Lehman Brothers bankruptcy in September 2008 was a turning point in the subprime crisis and at these times, the values of the ESI and FSI usually reach their peaks. Three countries from our sample, Slovenia (2007), Slovakia (2009), and Estonia (2011), became members of the Eurozone. As presented in Figure 16, Figure 37, and Figure 40, the impact on the ESI and the FSI is ambiguous. For instance, in Estonia we can observe an increase in financial stress after the 1st of January 2011. However, in 2009, the FSI for Slovakia started to fall, while the ESI increased. In Slovenia, one or two quarters after the EMU accession, both indexes declined slightly. We think that

the global financial crisis played an unprecedented role in those changes, especially for Estonia. In Slovenia, we observe a positive, but not significant effect of the introduction of the euro in 2007. In the years 2008-2012, the basic scenario for FSI development is nearly the same for the whole sample. After a sudden drop in the financial stress in 2009, in 2010, we observed an increase in our index. Although the volume of this upswing differed from country to country, financial stress was substantially lower than at the end of 2008.

Overall, the constructed indices give evidence that a synthetic measurement that monitors both financial markets and the evolution of economic stability can give a clear picture of the system's vulnerabilities. Not only could it be used for a retrospective analysis of the important economic events but also to show current trends and recent fluctuations. However, it should be treated with caution when used as a leading indicator.

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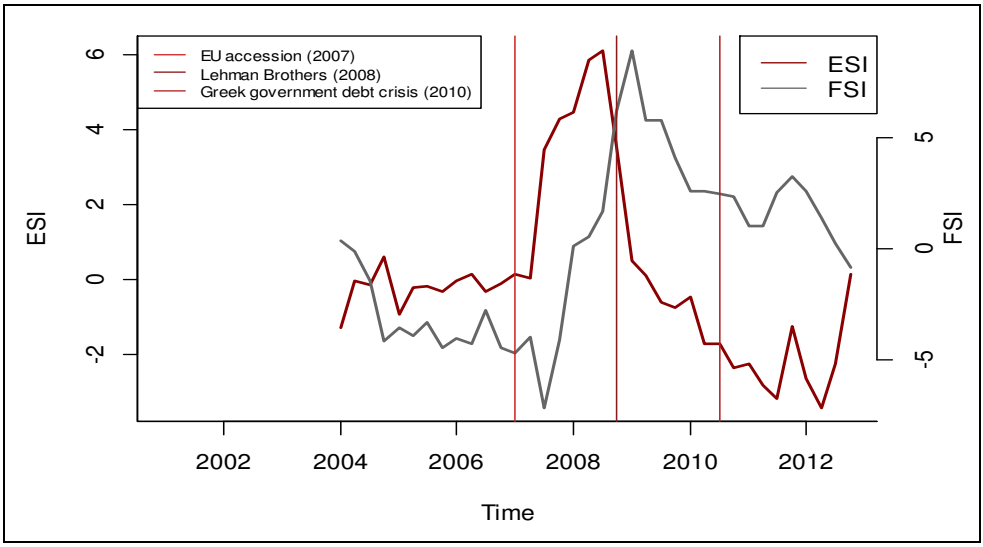
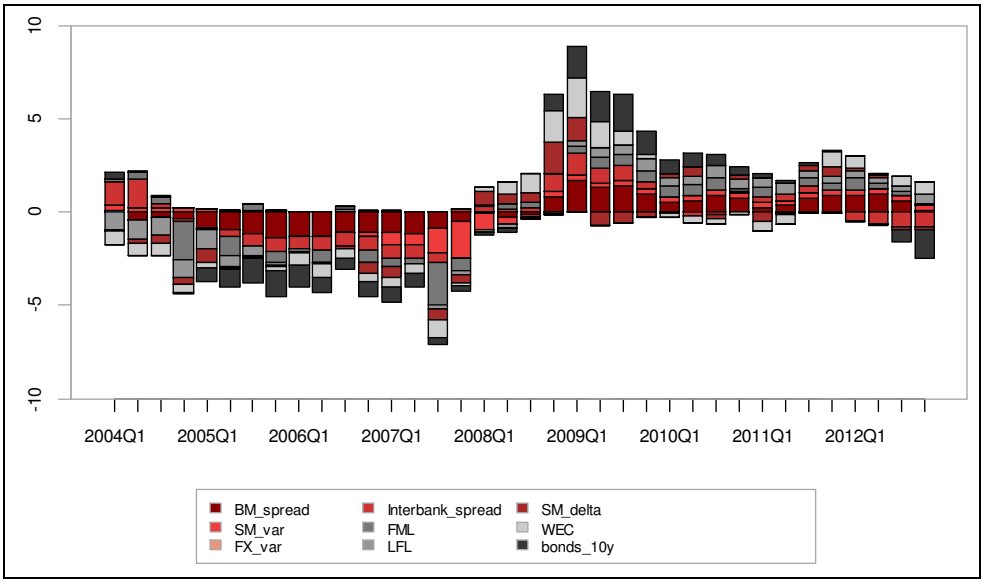
Annex

Figure 7. FSI and ESI (Bulgaria)



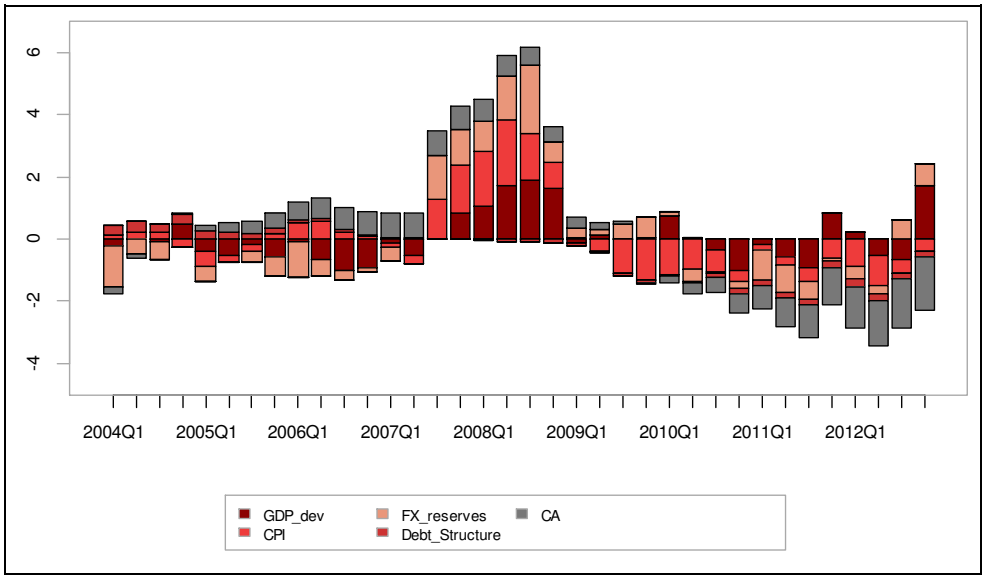
Source: own calculations.

Figure 8. Decomposition of FSI (Bulgaria)



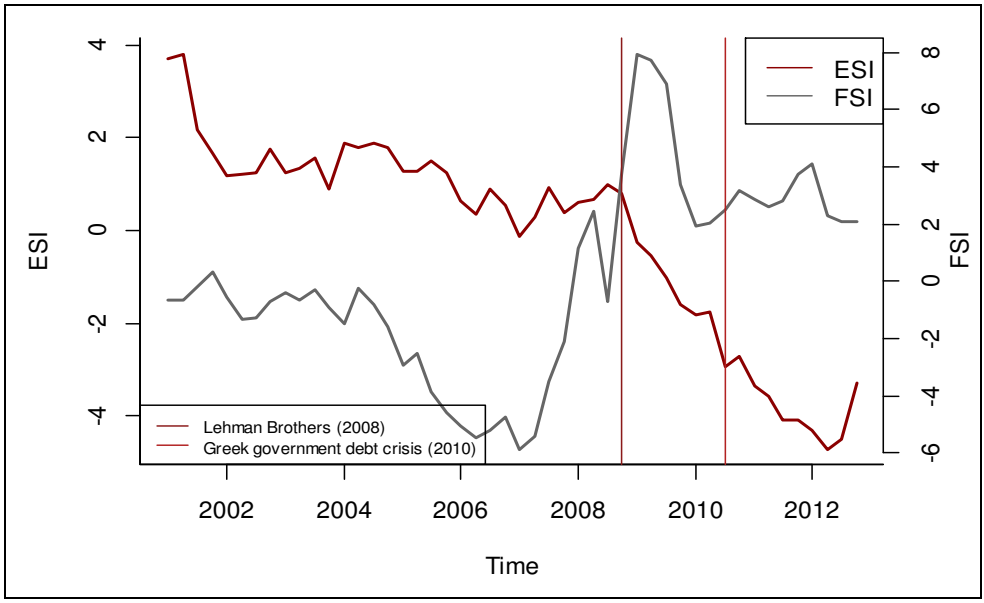
Source: own calculations.

Figure 9. Decomposition of ESI (Bulgaria)



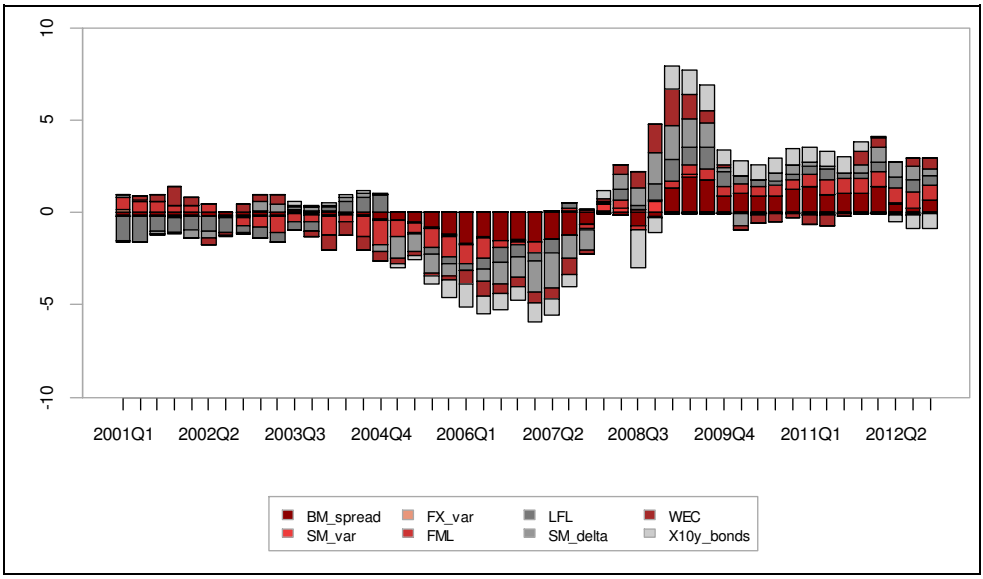
Source: own calculations.

Figure 10. FSI and ESI (Croatia)



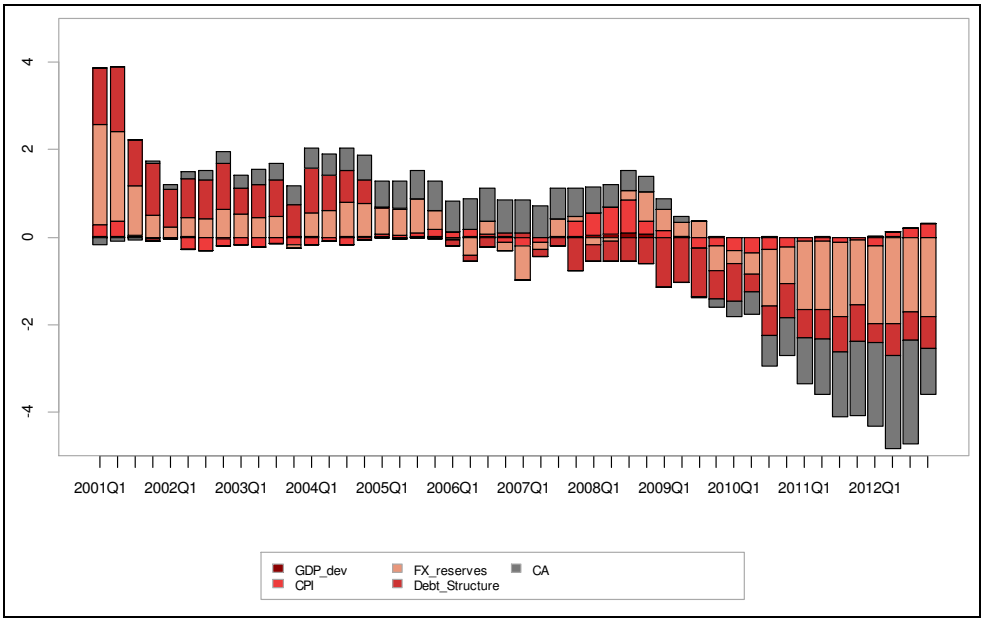
Source: own calculations.

Figure 11. Decomposition of FSI (Croatia)



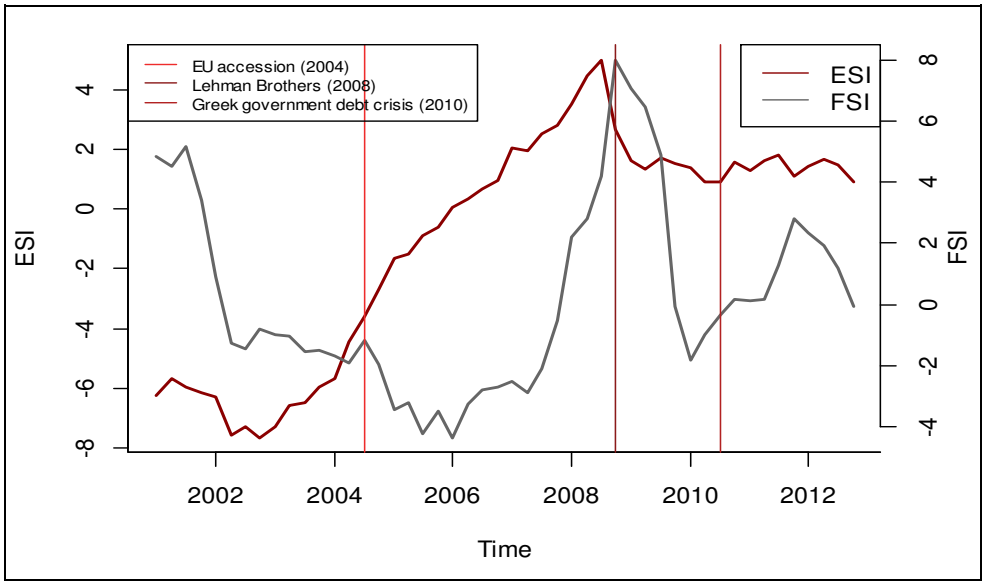
Source: own calculations.

Figure 12. Decomposition of ESI (Croatia)



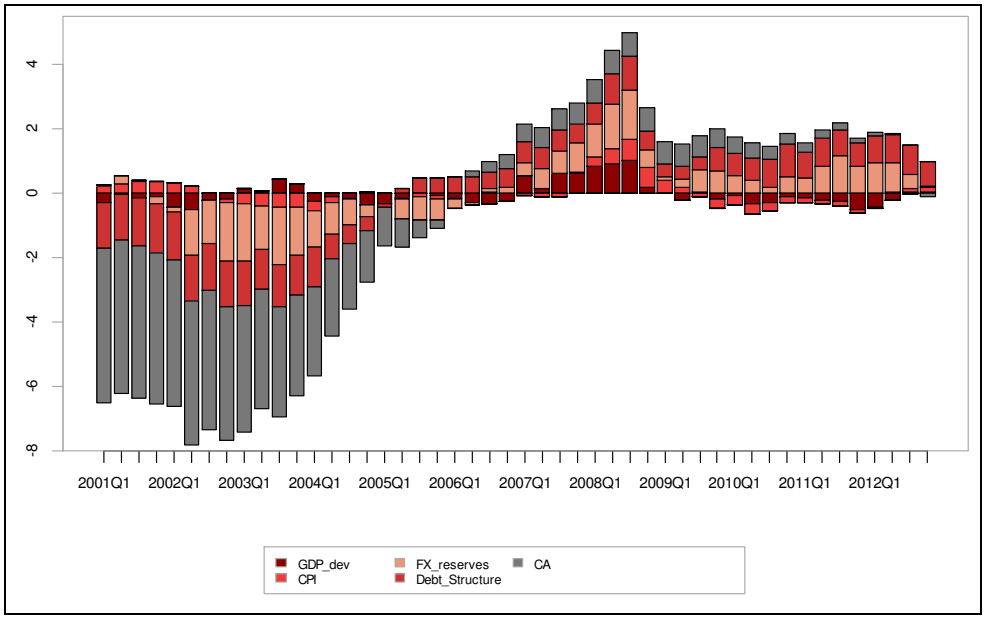
Source: own calculations.

Figure 13. ESI and FSI (Czech Republic)



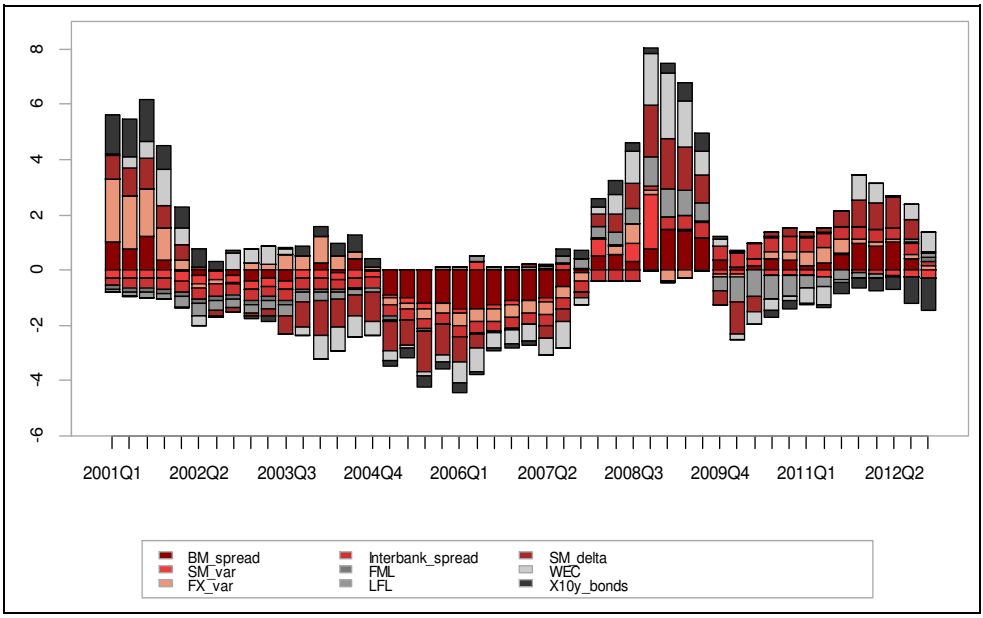
Source: own calculations.

Figure 14. Decomposition of ESI (Czech Republic)



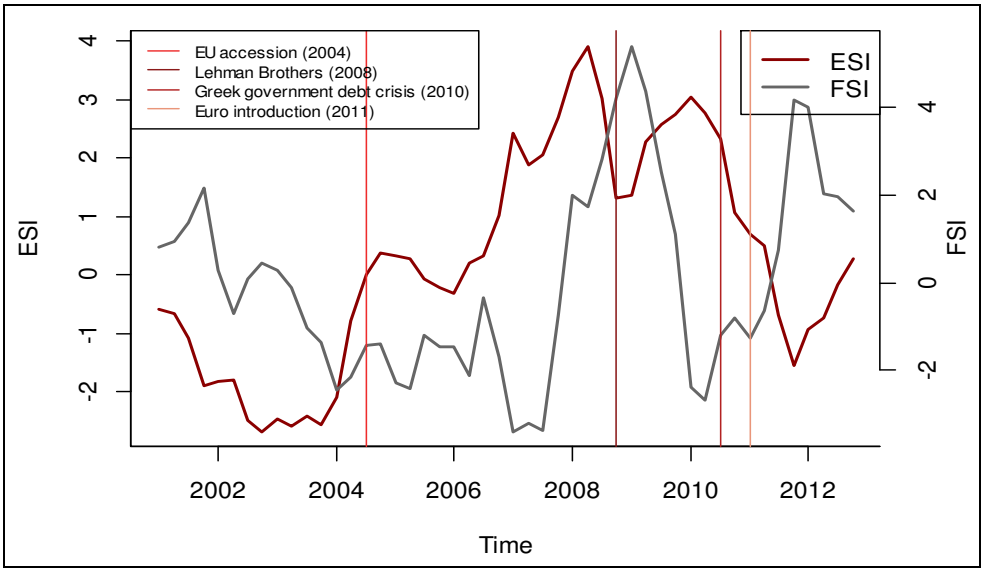
Source: own calculations.

Figure 15. Decomposition of FSI (Czech Republic)



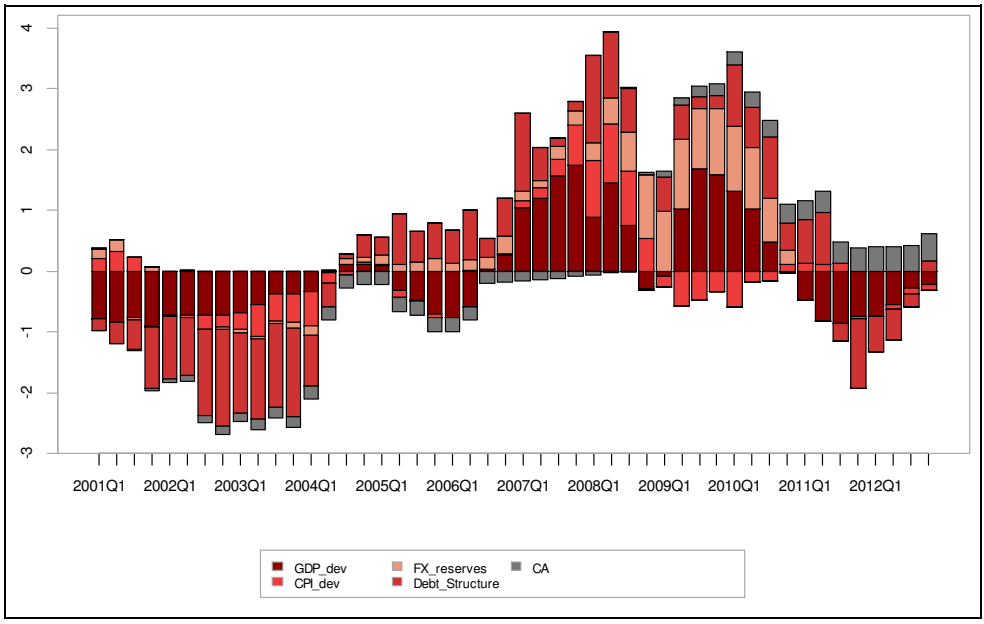
Source: own calculations.

Figure 16. FSI and ESI (Estonia)



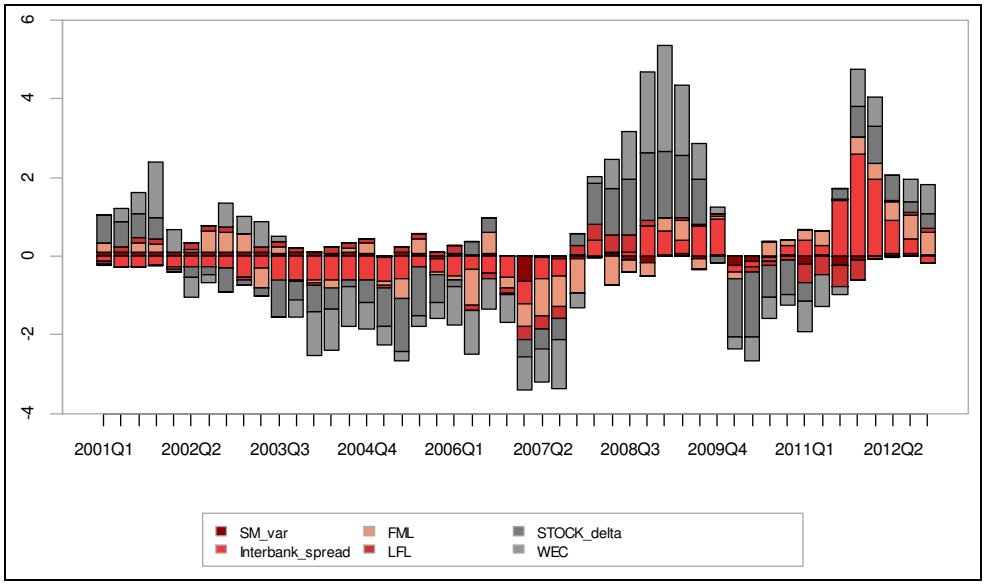
Source: own calculations.

Figure 17. Decomposition of ESI (Estonia)



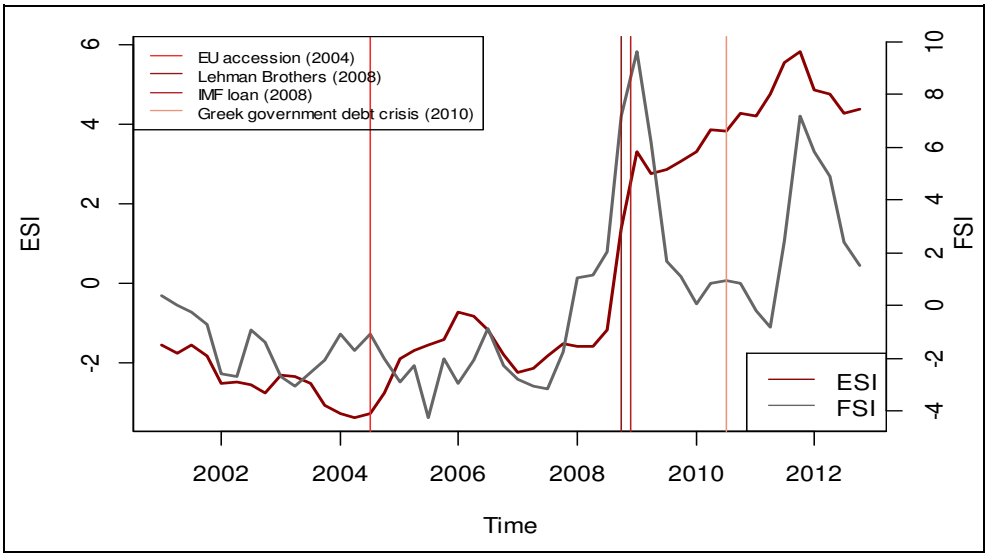
Source: own calculations.

Figure 18. Decomposition of FSI (Estonia)



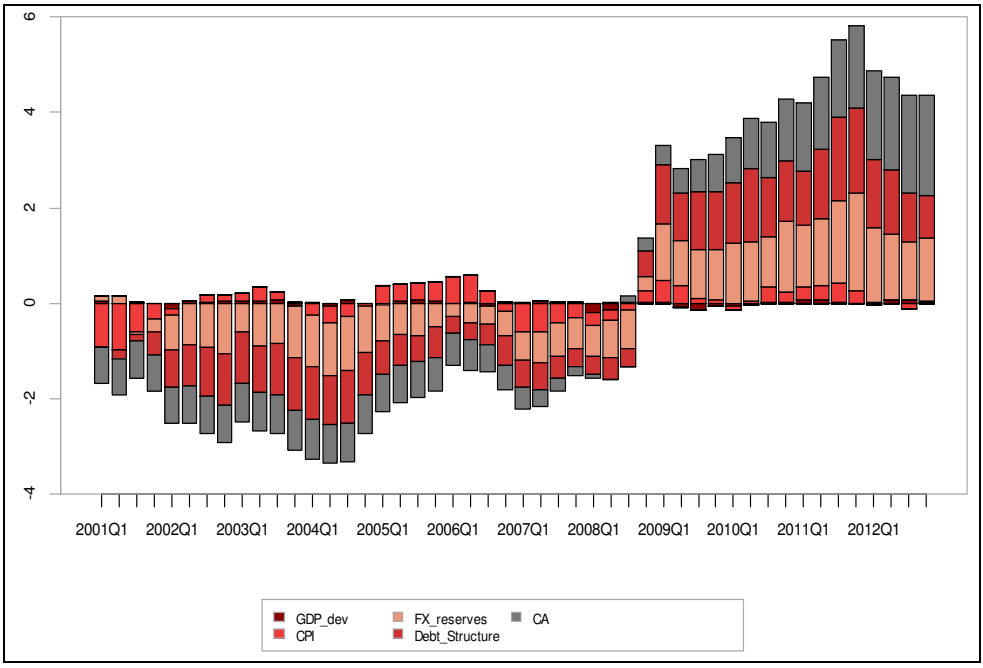
Source: own calculations.

Figure 19. FSI and ESI (Hungary)



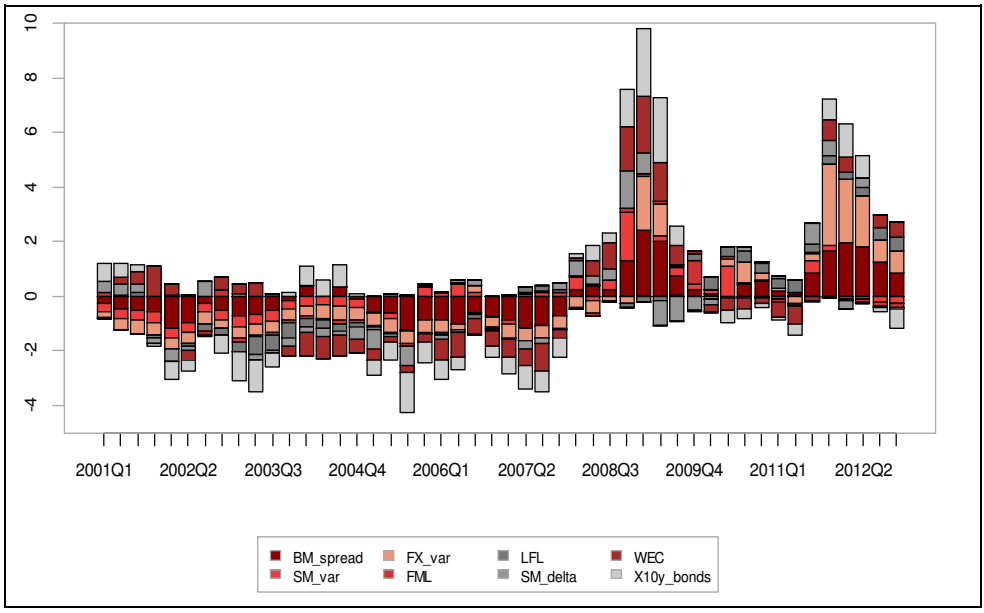
Source: own calculations.

Figure 20. Decomposition of ESI (Hungary)



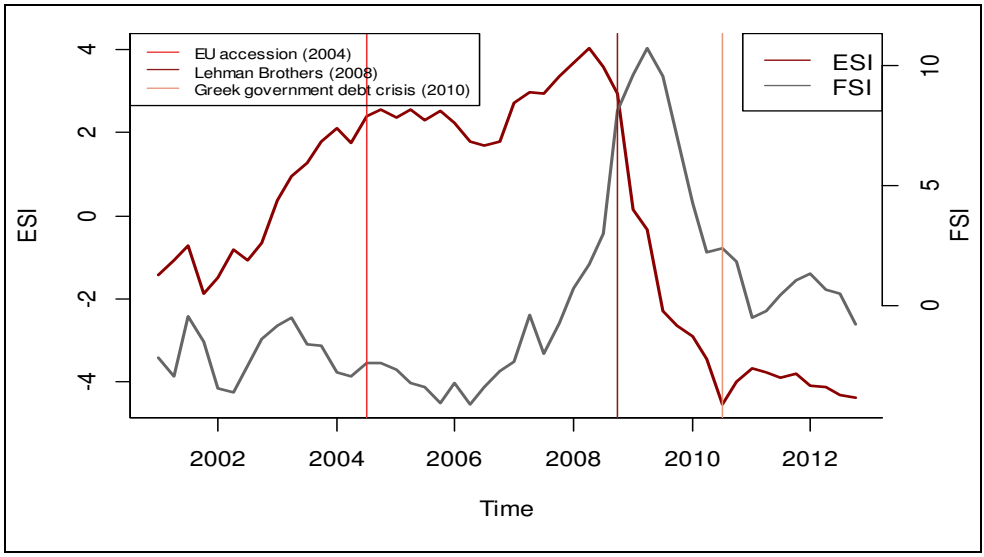
Source: own calculations.

Figure 21. Decomposition of FSI (Hungary)



Source: own calculations.

Figure 22. FSI and ESI (Latvia)



Source: own calculations.

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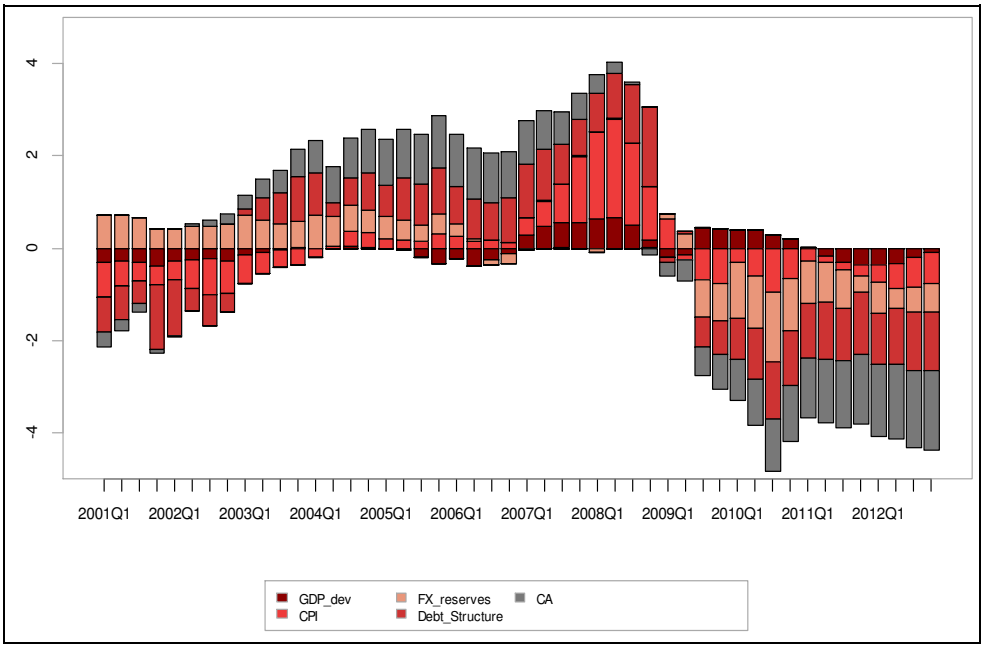

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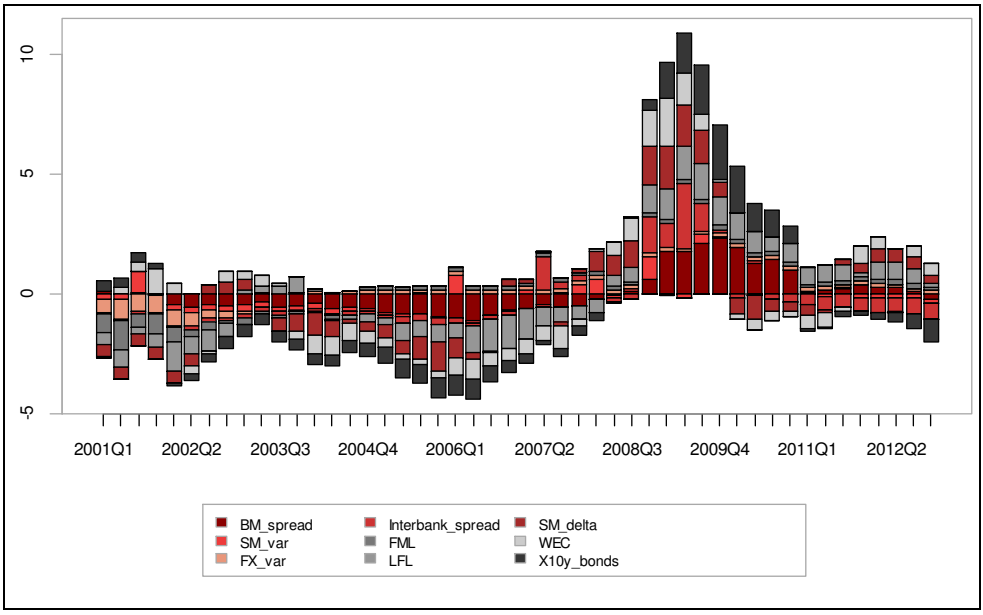
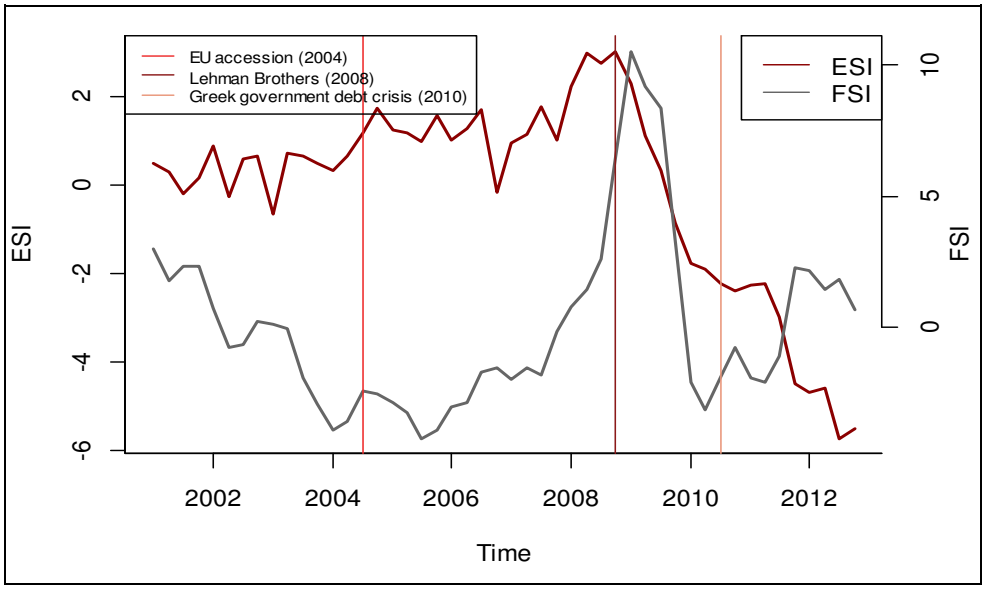


Source: own calculations.

Figure 25. FSI and ESI (Lithuania)



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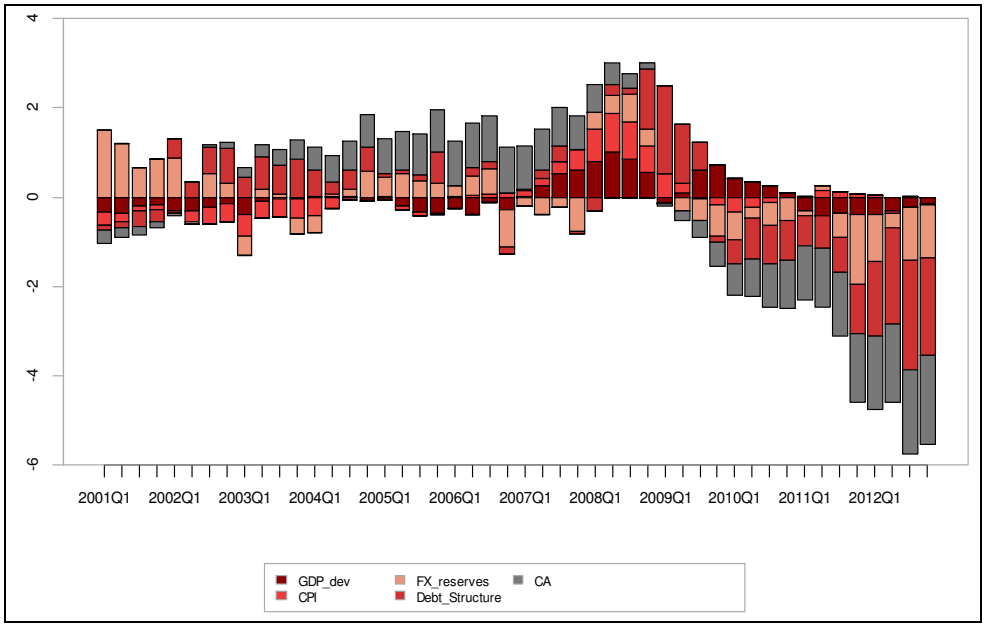

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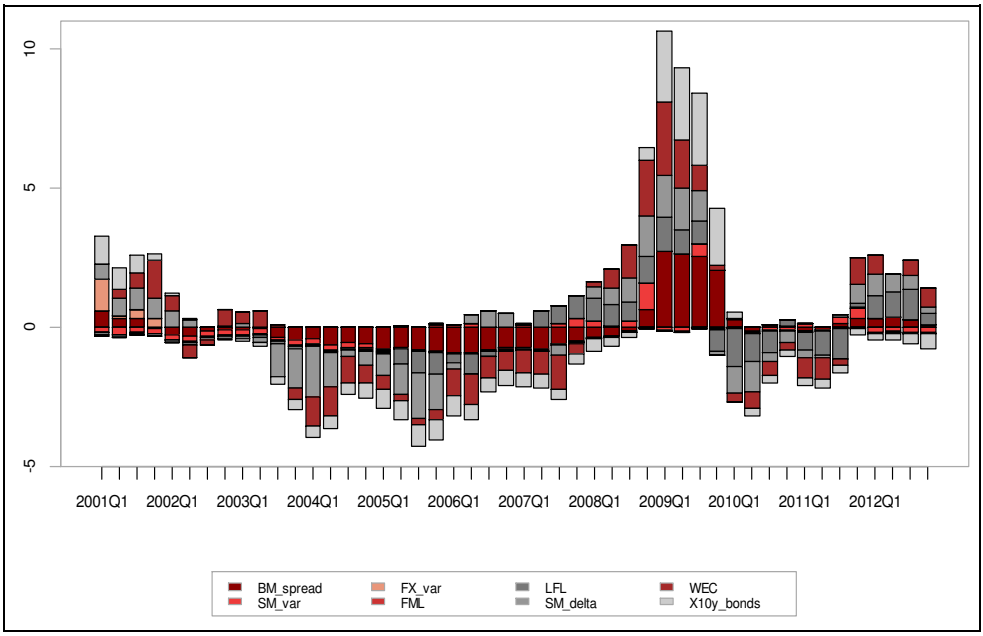
Figure 27. Decomposition of FSI (Lithuania)



Source: own calculations.

Figure 28. FSI and ESI (Macedonia)

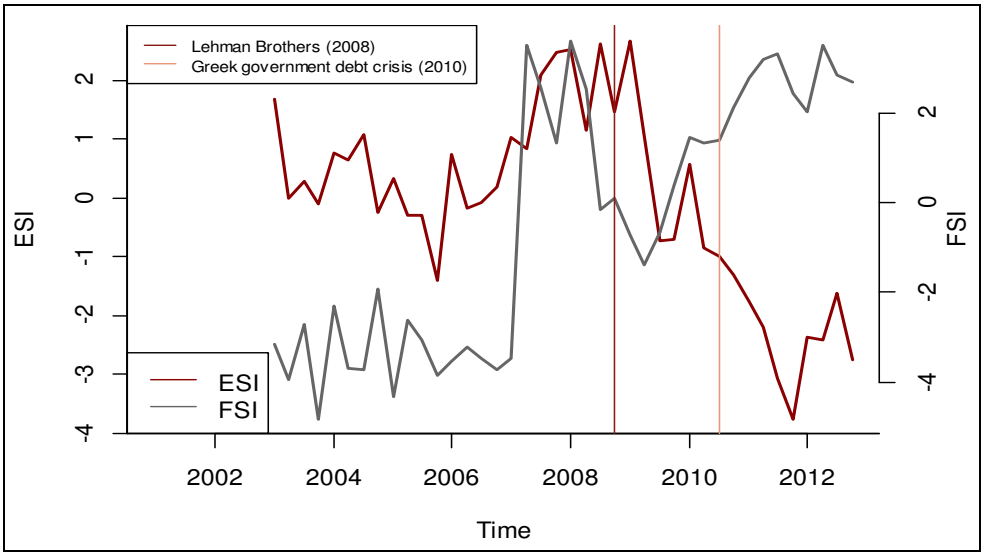


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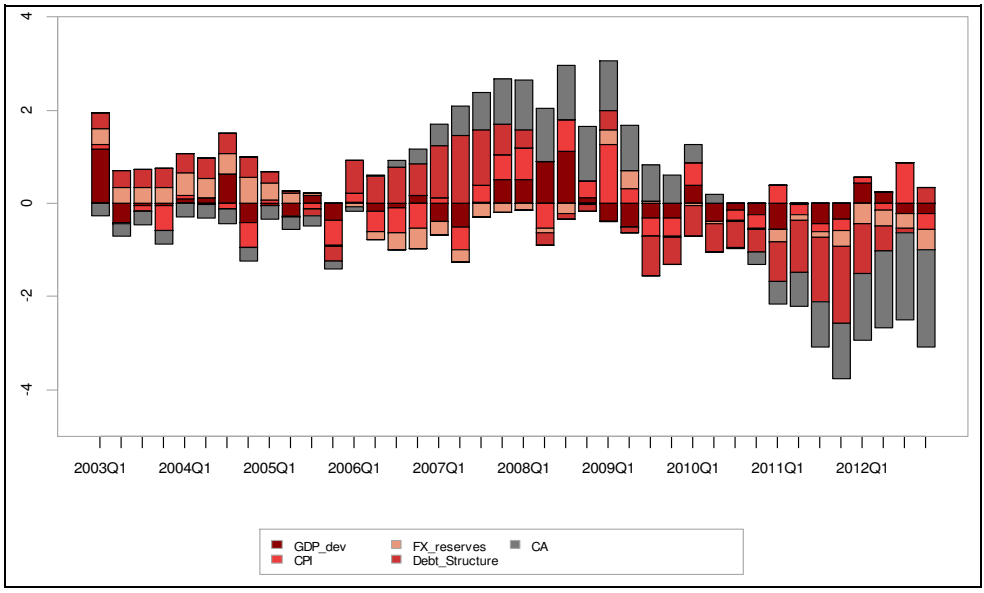
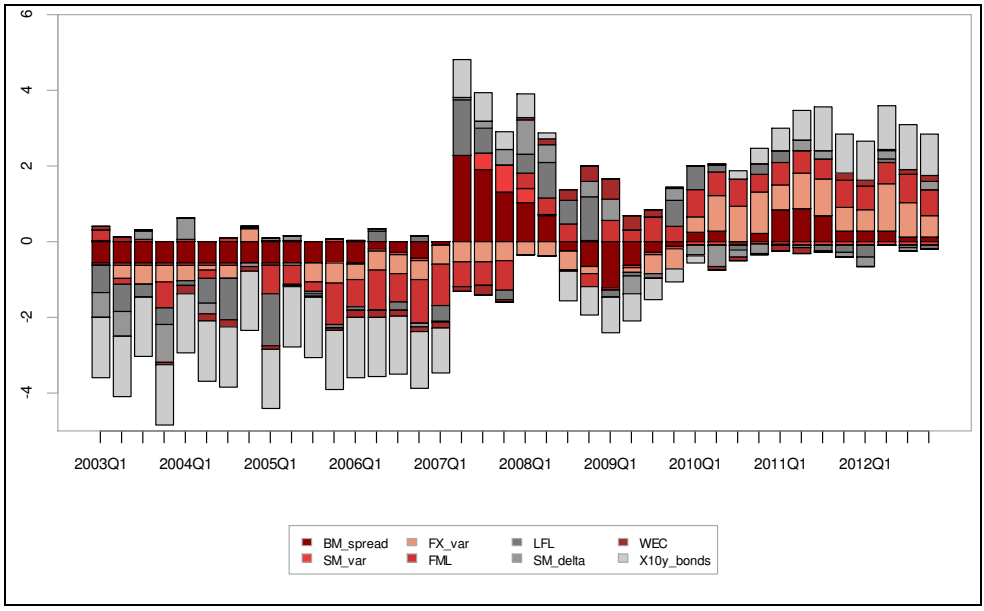
Figure 29. Decomposition of ESI (Macedonia)



Source: own calculations.

Figure 30. Decomposition of FSI (Macedonia)



Source: own calculations.

Figure 31. FSI and ESI (Poland)

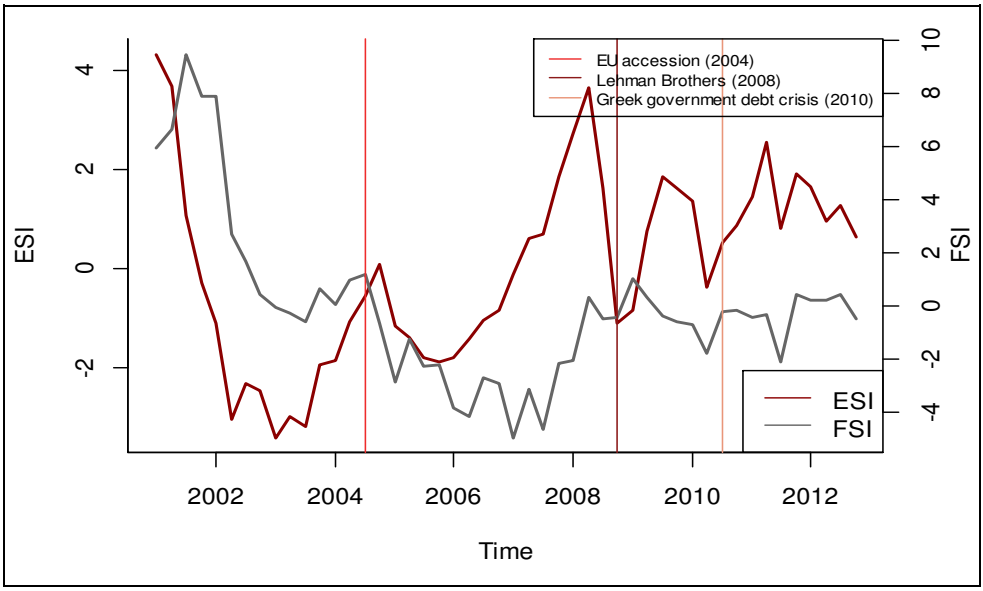


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Figure 32. Decomposition of ESI (Poland)

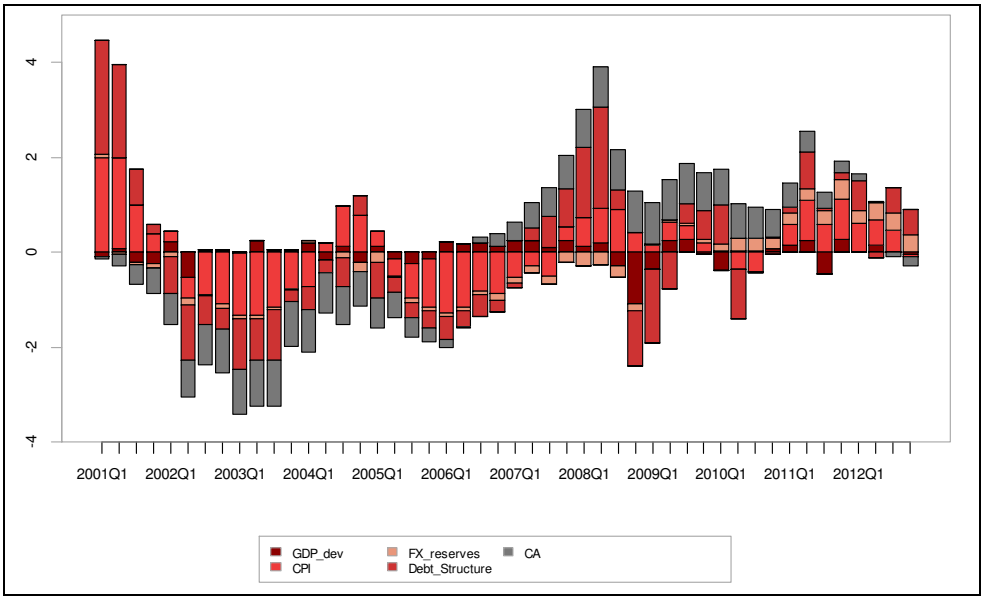

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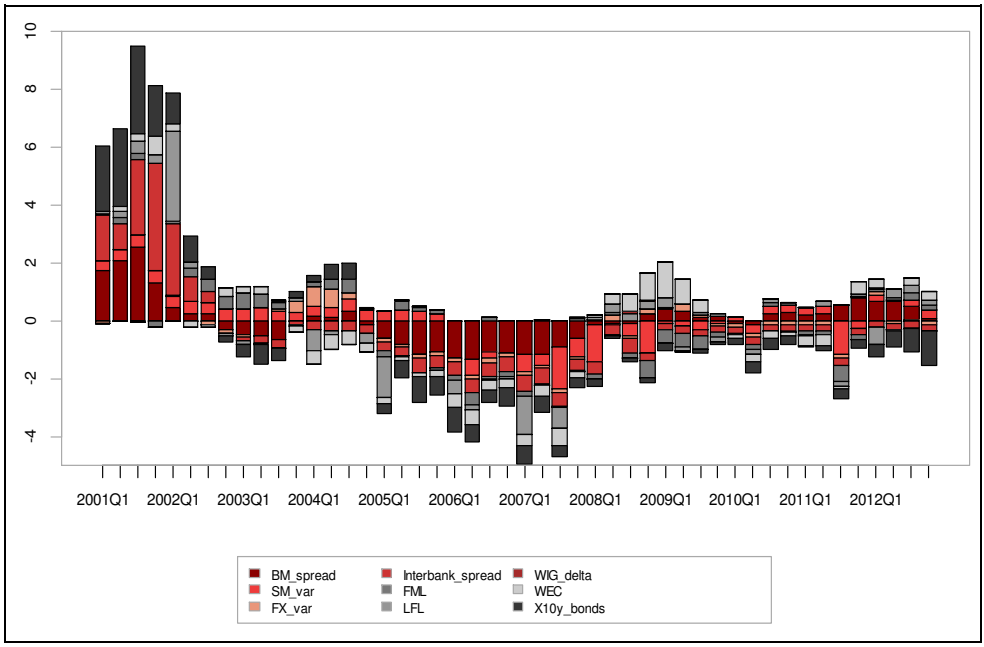
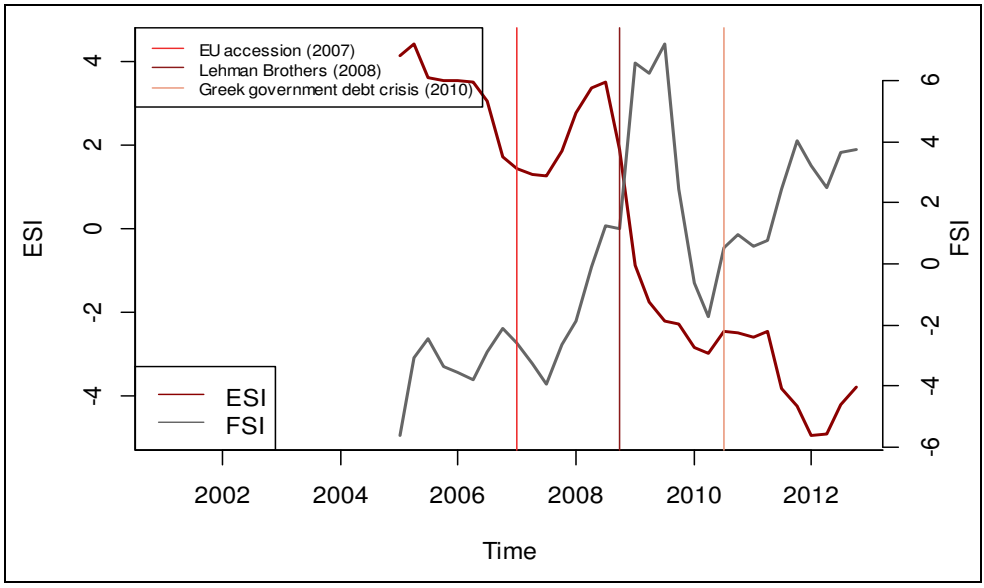
Figure 33. Decomposition of FSI (Poland)



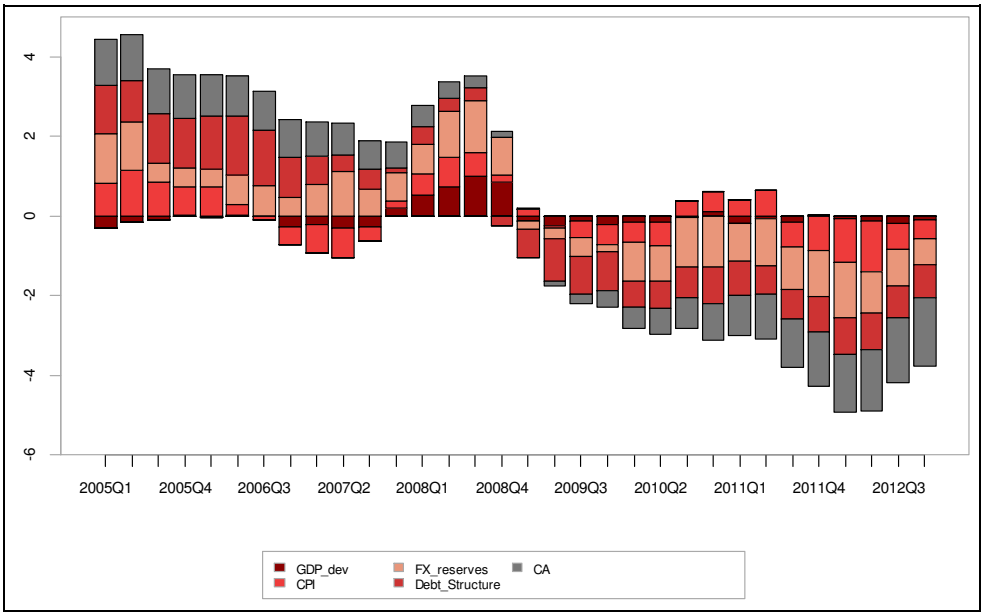
Source: own calculations.

Figure 34. FSI and ESI (Romania)



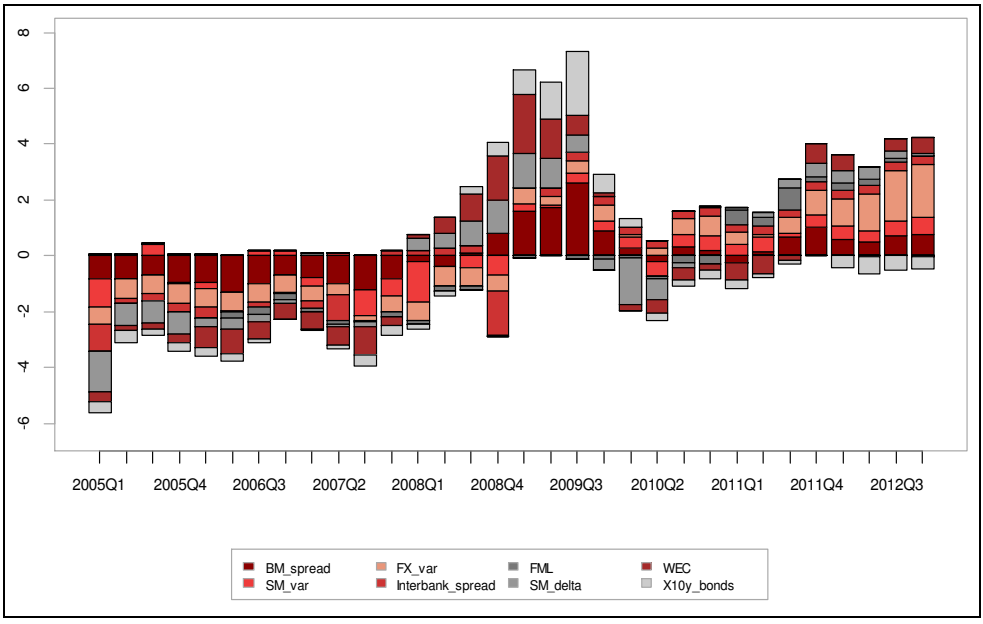
Source: own calculations.

Figure 35. Decomposition of ESI (Romania)



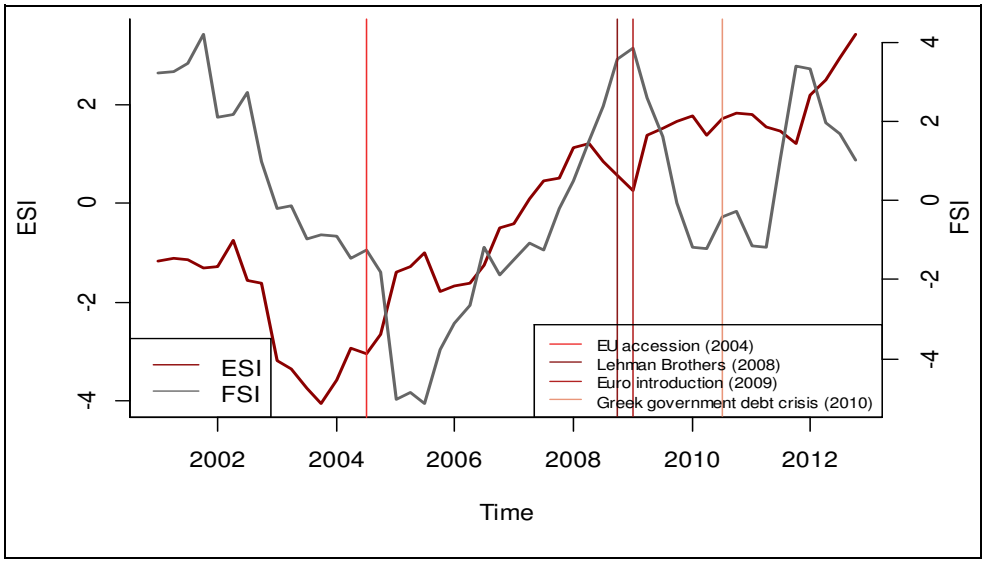
Source: own calculations.

Figure 36. Decomposition of FSI (Romania)



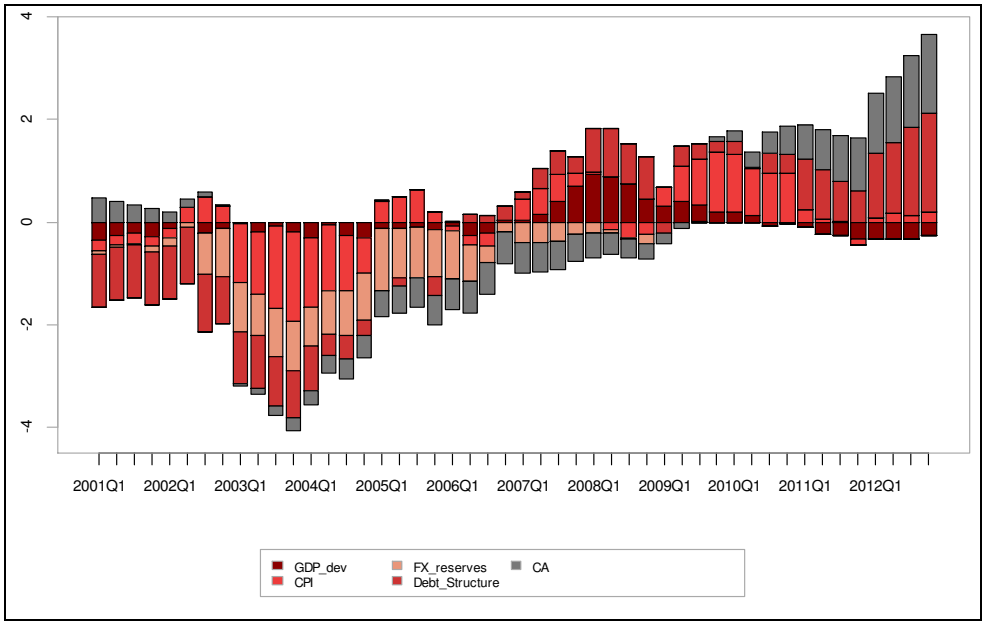
Source: own calculations.

Figure 37. FSI and ESI (Slovakia)



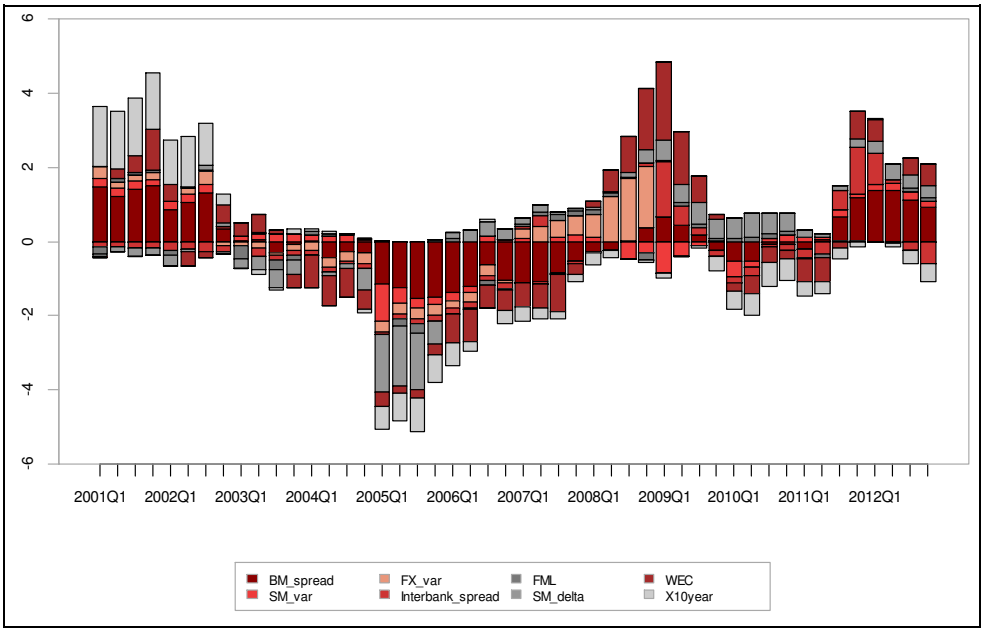
Source: own calculations.

Figure 38. Decomposition of ESI (Slovakia)



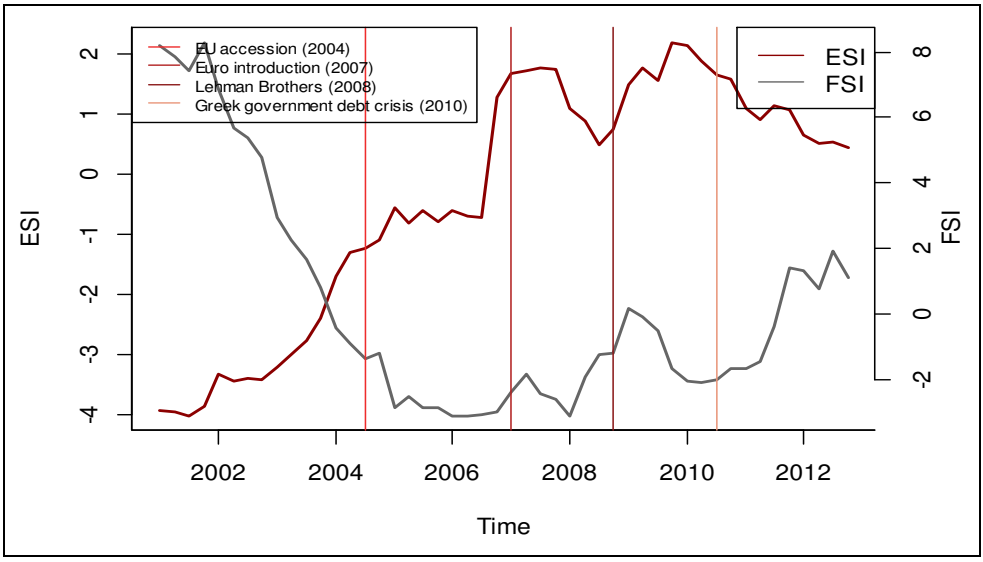
Source: own calculations.

Figure 39. Decomposition of FSI (Slovakia)



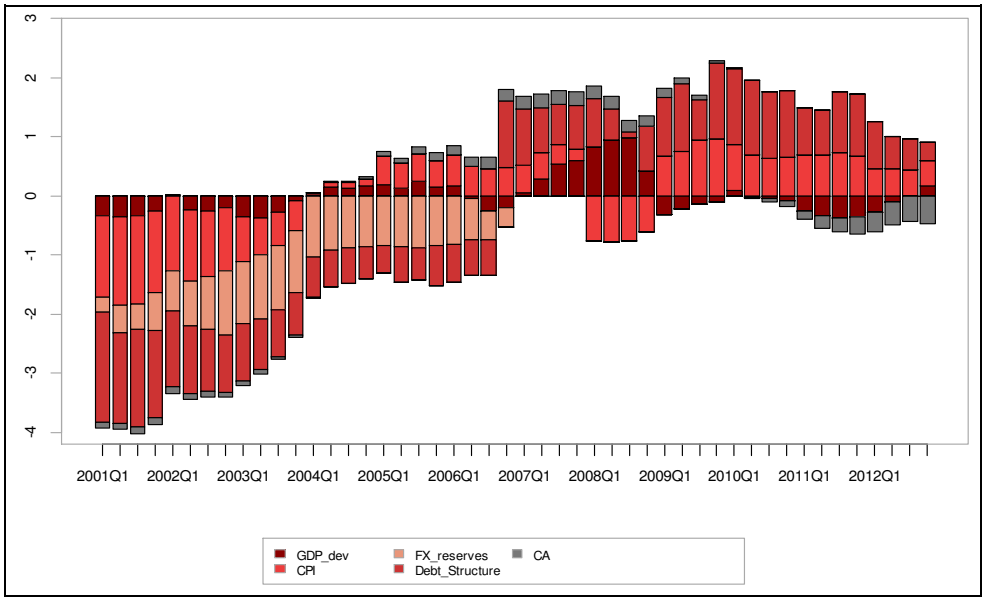
Source: own calculations.

Figure 40. FSI and ESI (Slovenia)



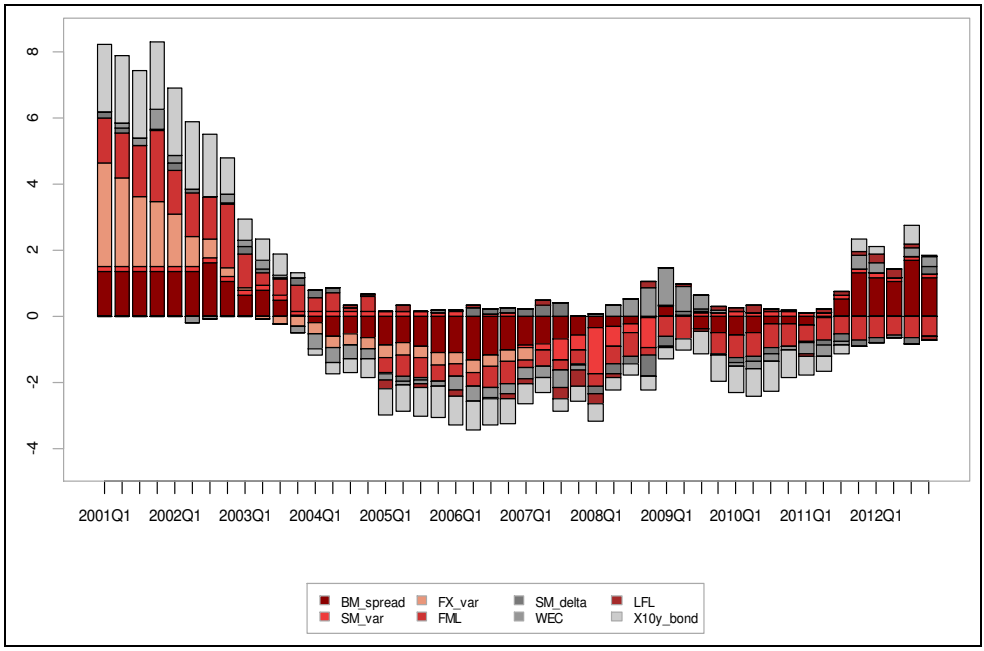
Source: own calculations.

Figure 41. Decomposition of ESI (Slovenia)



Source: own calculations.

Figure 42. Decomposition of FSI (Slovenia)



Source: own calculations.