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Measures of Financial Stability in Macedonia

Abstract: This paper aims at reviewing the work done towards developing quantitative measures of financial stability in Macedonia. The approach to the development of these measures concerns the macro-prudential dimension of financial stability. Constructing a single indicator to indicate the level of stability of the financial system is a very difficult task given the complex nature of the financial system and the existence of numerous interactions between financial market participants, non-financial sectors and financial institutions. Our empirical work started with constructing an aggregate banking stability indicator as an attempt to assess the risks to financial stability by focusing on a set of key financial soundness indicators of banks. But given the complex interactions of different elements of the financial system among themselves and the real economy, from the analysis of an early warning indicator to monitor the state of the banking system, the analytical focus has been shifted towards a broader system-wide assessment of risks to the financial markets, institutions and infrastructure. In other words, we developed a financial conditions index which provides a signal of financial stress and broad coverage of the areas that could indicate it. Both composite measures of financial stability can be used to gauge the build-up of imbalances in the system even in the absence of extreme events. In addition, we also demonstrate that it is possible to use our financial measures to improve, although only marginally, upon forecasts of measure of economic activity over short horizon.

Key words: Banking Stability Index; Banking Sector's Financial Strength; Financial Conditions Index; Financial Stability; Principal Component Analysis

JEL: E5, E17, E44

1. Introduction

Over the past decade, financial stability has become one of the objectives of central banks, in addition to price stability as their primary objective. In this field of literature, but also in practice, there are many definitions of financial stability. In the first Financial Stability Report for 2006 prepared by the National Bank of the Republic Macedonia (Financial Stability and Banking Regulation Department), financial stability was defined as the requirement for smooth operation of all segments of the financial system, with each of them providing the highest possible level of flexibility to absorb potential shocks.

In order to minimize future crises, financial market participants and regulators need to effectively determine potential stress in the financial system. Therefore, the construction of indicators which will provide timely warning of potential risks, composed of a set of economic and financial indicators, is very important for the prevention (minimizing) of financial crises.

Our empirical work started with the construction of the *aggregate banking stability index* for Macedonia. Given the dominance of the banking system in the entire financial system this index refers only to the banking system. But considering complex interactions of different elements of the financial system among themselves and with the real economy, from the analysis of an early warning indicator to monitor the state of the banking system, the analytical focus has been shifted towards a broader system-wide assessment of risks to the financial markets, institutions and infrastructure. In other words, we developed a *financial conditions index* which provides a signal of financial stress and a broad coverage of the areas that could indicate it.

One of the key observations to come out of the recent financial crisis is that financial innovations have made it difficult to capture broad financial conditions in a small number of variables covering just a few traditional financial markets. Thus, monitoring financial stability now explicitly requires an understanding of both how traditional and evolving financial markets relate to each other and how they relate to economic conditions. Indices of financial conditions are an attempt to quantify these relationships (Brave and Butters, 2011).

Thus, when policymakers decide upon the appropriate stance of monetary policy, they must take account of the possible macroeconomic implications of developments in the financial sector. To do so, they must monitor not only risk-free interest rates and equity prices, but also risk spreads on various instruments, the financial health of businesses and households, the financial health of intermedi-

aries, and the operation of financial markets. With this information in hand, they then need to assess the likely implications of the financial developments for the economic activity (English et al., 2005).

Further on we first describe the methodology employed for constructing our banking stability index. We review how we combine the key variables into this composite indicator for the purposes of monitoring the banking sector stability in Macedonia. In this research paper we also review the work done towards developing the financial conditions index for Macedonia. We further concentrate our analysis on highlighting the contribution of different sectors of the financial system to our financial conditions index, as well as the systemically important indicators among them. Next, we show that both composite measures of financial stability can be used to gauge the build-up of imbalances in the system even in the absence of extreme events. Given the interdependence of financial and economic conditions we also demonstrate that it is possible to use our measures to improve, although only marginally, the forecasts of measure of economic activity over short-term horizon.

2. Measures of financial stability - a brief literature review

Some central bank publications have recently attempted to construct a single indicator to indicate the level of stability of the financial system in the country concerned. This is a very tough task given the complex nature of the financial system and the existence of numerous links between financial market participants, non-financial sectors and financial institutions. Most of the attempts focus on constructing an aggregate indicator for the banking sector, which is the most important part of the financial system with respect to financial stability. A relatively simple aggregate indicator of banking sector stability can be constructed as a weighted average of partial indicators of the financial soundness of banks. Such an index is used, for example, by the Turkish central bank (CBRT, 2006). Its financial strength index consists of six sub-indices covering asset quality, liquidity, foreign exchange risk, interest rate risk, profitability and capital adequacy. Before aggregation the individual sub-indices are normalized in order to achieve the same variance (variance-equal weighting scheme) (Geršl and Heřmánek, Czech National Bank).

An alternative approach is to construct an aggregate indicator of financial stability by using daily data from the financial markets (such as stock prices of banks and other financial assets). These data can signal any problems in the financial sector in advance as indicated by market perceptions about their probability Fi-

nancial fragility indicator presented by experts from the U.S. Federal Reserve System (Nelson and Perli 2005) and the financial stress index calculated by the experts from the Central Bank of Canada (Illing and Liu 2003) are practical examples of this approach (Geršl and Heřmánek, Czech National Bank).

In addition, financial market information can be combined with data from the financial statements of banks. This approach has been accepted by the Central Bank of Switzerland in the construction of stress index for the banking sector (Swiss National Bank, 2006). In parallel with the use of indicators calculated on the basis of the financial statements of banks (e.g., changes in profitability, capital, asset quality, number of branches, etc.) market indicators (change in prices of bank stocks and bonds) and other information are used such as the amounts of interbank exposure and additional supervisory information (share of assets of banks under enhanced supervision) (Geršl and Heřmánek, Czech National Bank).

Central Bank of the Netherlands calculates the so-called Financial Stability Conditions Index (Van den End 2006), which is constructed by extending the so-called monetary conditions index with the so-called index of financial conditions. Monetary conditions index is based on the interest rates and the effective exchange rate, while real estate and stock prices, the solvency of financial institutions and the volatility of the stock market index of financial institutions are covered by the index of financial conditions. Certain acceptable levels of the index (lower and upper limit) have been set. Too low an index value means increased instability, whereas too high a value may result in the accumulation of financial imbalances, since very positive developments and minimal market volatility may lead to distortion of relative prices, inefficient fund allocation and lower prudence and risk limits. Therefore, the ideal evolution of the index is one within a particular financial stability band (Geršl and Heřmánek, Czech National Bank).

A new approach to the construction of an aggregate financial stability indicator consists in calculating default risk at the level of the entire financial system, or its main sectors, for instance using the Merton model (Van den End and Tabbae, 2005). A similar systemic risk indicator based on the stochastic default risk distribution of individual institutions as an operational financial stability indicator is proposed, for example, by Čihák (2007). The advantage of these indicators lies in their close linkage with problems in the financial sector (default of major financial institutions or a sector) and with the business cycle. The disadvantages include, however, demanding analysis and in some cases also the existence of a liquid stock market with a good representative sample of individual sectors (Geršl and Heřmánek, Czech National Bank).

When it comes to the financial conditions indices (FCIs), "springing out from the literature on monetary conditions indexes (MCIs), intended to capture the overall stance of monetary policy, the more comprehensive FCIs are created to provide information about the broader financial conditions and their impact on economic activity. As methods and financial variables differ between FCIs, the exact focus, use and interpretation varies across indicators. In some cases FCIs measure the tightness/accommodativeness of financial factors relative to their historical average, while other indexes illustrate financial conditions' contribution to growth. Some indexes are closely related to policy making in as much as index values can be interpreted in terms of interest rate equivalents (see e.g. Beaton, Lalonde and Luu (2009)). Other indexes are more oriented towards forecasting and may be used as leading indicators as they can provide timely information about economic activity. Whether an FCI mainly captures financial variables' response to economic activity, or if it is more of an indicator of financial conditions' impact on real activity, depends on how it is constructed, although this distinction is not always made clear. However, in both instances an FCI can provide early and leading information as financial data typically are available well in advance of quarterly national statistics", (Vonen, 2011, p.2) .

In the literature, a variety of methodologies for constructing FCIs have been developed, but there are two prominent approaches: a weighted-sum approach and a principal-components approach. In the weighted-sum approach, each financial variable in the index is assigned a weight that reflects an estimate of its impacts on real GDP. These estimates are obtained through simulations of large-scale macroeconomic models, or through the estimation of reduced-form demand equations or vector autoregression (VAR) models. Examples of FCIs using a weighted-sum approach are the indexes estimated by Macroeconomic Advisors, the OECD, Goldman Sachs, Bloomberg FCI, and Citigroup. The second approach is based on the principal component analysis, whereby a common factor is estimated from a group of several financial variables and interpreted as the unobserved common variable underlying the variation of all the financial variables included in the index. Examples of this type of FCIs include the indexes estimated by the Deutsche Bank and the Federal Reserve Bank of Kansas City (Osorio et al. 2011).

3. Banking stability index for Macedonia

In this section we review the work done towards developing an aggregate index for the stability of the Macedonian banking system, i.e. the banking stability index. The banking stability index for Macedonia uses selected quantitative

indicators of the set of basic FSI (Appendix 1), with its calculation being tested for the period from December 31, 2005 to December 31, 2012, on a quarterly basis. Indicators that are included in the index are selected on the basis of their relevance to the stability of the banking system, given its nature and size. Also, the choice of individual indicators was based on international practice. The index does not include macroeconomic variables or some qualitative indicators (such as the regulatory framework).

Banking stability index includes only banks. It is constructed as a weighted sum of indicators that represent the following bank risks: insolvency risk, credit risk, profitability, liquidity risk and currency risk.

Banks' capital adequacy and profitability show their capacity to deal with potential risks. Capital adequacy measures banks' capital buffer size to address expected or unexpected losses. Excessively low levels of this ratio point to potential defaults and can be forerunners of a banking crisis.

Return on equity is a bank profitability indicator intended to measure deposit takers' efficiency in using their capital. In addition, noninterest expenses to gross income ratio measures the size of administrative expenses within gross income—that is, it measures the efficiency of deposit takers' use of resources.

Asset quality is assessed through two indicators related to the credit risk as well as the liquidity risk of the banks. The rate of non-performing loans is the key indicator to measure the level of credit risk and it identifies problems with the loan portfolio quality, while the annual growth rate of non-performing loans is an indicator of credit risk trending.

Liquidity ratios measure banks' readily available short-term resources that can be used to meet short-term obligations.

Currency risk is measured by the ratio calculated as a share of net open position in foreign exchange position in banks' own funds. It shows banks' exposure to exchange rate risk compared with capital and it measures the mismatch of assets and liabilities in foreign currency and its vulnerability to exchange rate movements.

Table 1: Employed key financial variables

Risk	Indicator	Weight
Insolvency	Capital adequacy ratio	0.25
Credit risk	Nonperforming loans / Total loans	0.25
	Annual growth rate of non-performing loans	
Profitability	Return on equity	0.20
	Non-interest expenses / Gross income	
Liquidity risk	Liquid assets / Total assets	0.25
	Liquid assets / Short-term liabilities	
Currency risk	Net open position in foreign exchange / Own funds	0.05

3.1. Adjustment of data

In order to place the values of the indicators to a scale, the data passed through a process of adjustment before the final aggregation.

First, indicators (non-performing loans / total loans; net open position in foreign exchange / own funds; non-interest expenses / gross income) which in opposite directions show improvement / deterioration in terms of the direction of other indicators, their reciprocal value is taken, while the annual growth rate of non-performing loans is multiplied by (-1).

In the second phase, indicators were normalized through the process of so-called empirical normalization that placed all indicators in the same scale in the interval from 0 to 1.

Empirical normalization adjusts the indicators in the interval from 0 to 1. The formula that represents this method is as follows:

$$I_{it}^{n} = \frac{I_{it} - Min(I_i)}{Max(I_i) - Min(I_i)}$$

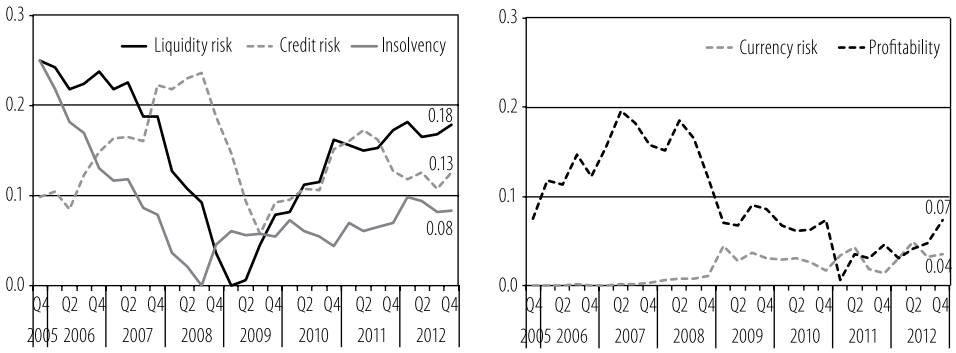
Where: I_{it} is the value of indicator i in period t; $Min(I_i)$ and $Max(I_i)$ are the minimum and maximum of the indicator in the analyzed period.

When constructing the banking stability index the so-called *empirical normalization*[1] is being applied, whereas the data rating factor is the interval between

[1] Despite empirical normalization, the indicators that make up the index for banking stability can be adjusted through the so-called statistical normalization. This normalization aligns in-

the minimum and the maximum. This means that each indicator is compared to its limit values (min-max) in the period, and its normalized value represents the deviation from the limit values. The lack of this kind of normalization is that it is based on minimum or maximum value of data within a specified period, which can be unreliable for the entire data series. The advantage is the effect it has in a series of data with minor date-to-date changes, where any change has an obvious effect on the value of the composite indicator.

Figure 1: Movement of components of the banking stability index



Source: NBRM and author's calculation

According to the empirical normalization, the approximation of the index value to 1 (Max), means lower risk, while the movement towards 0 (Min) means larger risk exposure.

In the following stage, the normalized values of the individual indicators are weighted in order to emphasize the significance that the individual risks have on the stability of the banking system. Thus the capital adequacy, the credit risk and the liquidity risk, as the most important risks, register higher weights (by 25%). The currency risk has been reduced to a minimal level in conditions of Denar fixed exchange rate policy, while the profitability weight equals 20%.

The calculation of the aggregate banking stability index is a sum of the weighted, normalized indicators for individual risks (Appendix 2).

dicators in the interval from -3 to +3, with an average value of 0 and standard deviation 1. The correlation between banking stability index calculated by empirical normalization and the one calculated by the method of statistical normalization is 1, which means that their movements overlap.

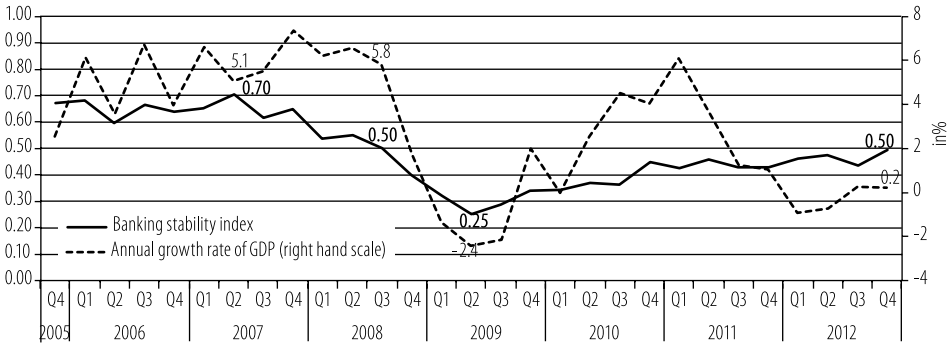
3.2. Results obtained for the banking stability index for Macedonia

According to this procedure, the increase in the index means improved banking stability, while the decrease denotes stability worsening.

In the analysis, banking stability index for Macedonia for December 31, 2005 - December 31, 2012 period, on a quarterly basis, was created. The average weighted value of the index for the entire analyzed period is 0.49, while as of the last date (the data on December 31, 2012), the index continues its upward trend and equals 0.50.

The analyzed period can be divided in two stages. The first stage covers the period from the end of 2005 until Q3 2008, when the average index value is 0.13 higher relative to its average for the entire period.

Figure 2: Banking stability index for Macedonia

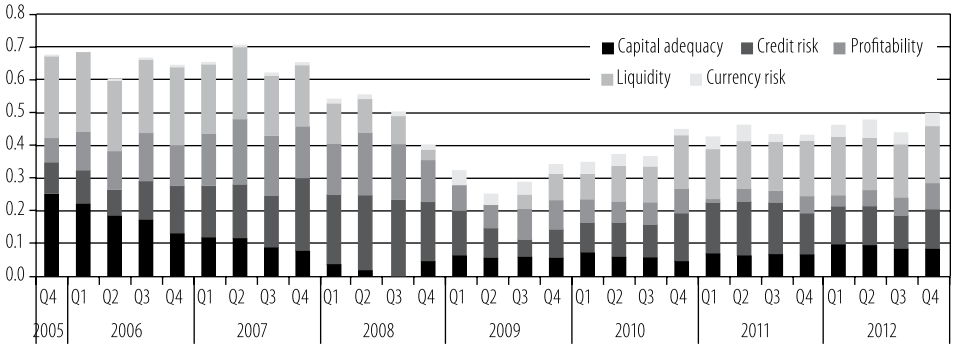


Source: NBRM and author's calculation

The second stage covers the period from the third quarter of 2008 until end-2012, when the average index value was 0.09 lower compared to the average for the entire period. The lower value of the index mirrors the negative effects of the financial crisis spillover on banks. During the analyzed period, the banking stability index plunged to the lowest level in Q2 2009, when the negative effects of the global economic and financial crisis on both the domestic economy and the domestic financial system were most evident.

However, the second stage is the period of recovery evident through the index rising tendency. Figure 2 also shows the correlation between the movement of the banking stability index and the annual growth rate of GDP.

Figure 3: Contributions of individual components in the banking stability index



Source: NBRM and author's calculation

Figure 3 displays the contributions of individual components to the banking stability index over the analyzed period.

The individual components of the banking stability index show different trajectories. In the most recent period, liquidity risk, credit risk, loss risk and the banks' currency risk have been declining, thus contributing to a permanent improvement of the banking stability. In parallel, the banks' solvency ratio remained stable at high level (Appendix 2) and had a relatively constant share in the composite index.

4. Financial conditions index for Macedonia

For constructing our FCI we follow the second strand in the literature, i.e. our index is constructed as a weighted average of a number of indicators of the financial system's health. We used a principal component analysis, or PCA, to estimate the weight given each indicator. The benefit of PCA is its ability to determine the individual importance of a large number of indicators so that the weight each receives is consistent with its historical importance to fluctuations in the broader financial system. Indexes of this sort have the advantage of capturing the interconnectedness of financial markets - a desirable feature allowing for an interpretation of the systemic importance of each indicator. The more correlated an indicator is with its peers, the higher the weight it receives. This allows for the possibility that a small deterioration in a heavily weighted indicator may mean more for financial stability than a large deterioration in an indicator of little weight (Brave and Butters, 2011).

Following Hatzius et al. (2010), we also consider adjusting the financial variables for current and past economic activity and inflation prior to construction of the index. Therefore we develop an index that separates the influence of economic conditions from financial conditions. Using quarterly series of the financial variables, each series is regressed on current and two lags of quarterly GDP growth and inflation.

$$x_{it} = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-1} + \beta_3 \Delta y_{t-2} + \beta_4 \Delta z_t + \beta_5 \Delta z_{t-1} + \beta_6 \Delta z_{t-2} + \vartheta_{it}$$

The residuals, ϑ_{it}, or rather, the estimates of these, $\widehat{\vartheta_{it}}$, are in turn used as measures of financial variables purged of the effect of the business cycle and inflation, and the calculation of the principal components is now based on these, $\widehat{\vartheta_{it}} S$.

Our adjusted FCI is motivated by the observation that financial and economic conditions are highly correlated. Removing the variation explained by the latter addresses potential asymmetries in the response of one to the other. For instance, a deterioration in financial conditions when economic growth is high and inflation low may have different effects on the real economy than deterioration in financial conditions when economic growth is low and inflation high. Our adjusted FCI is, thus, likely relevant for isolating the source of the shock to financial conditions. FCI index could serve as useful policy tool by providing a sense of how tight or loose financial markets are operating relative to historical norms. In this sense, for our adjusted FCI, a zero value indicates a financial system operating at the historical average levels of risk, liquidity, and leverage (Brave and Butters, 2011).

4.1. Empirical Approach

In this section, we explain the mathematics behind the PCA[2]. Namely, one may hypothesize that a few underlying factors govern the movement in a larger number of series. Assuming such a factor representation of the data is appropriate, factors are related to the observable variables (in this case a set of financial variables) in the following way: Let N be the number of variables x_i, $i = 1 \ldots N$, and T be the number of time period observations included in the analysis, $t = 1 \ldots T$. The time t observation of a given variable x_i can then be expressed as:

$$\begin{aligned} x_{it} &= \lambda_i \mathrm{F}_t + e_{it} \\ &= C_{it} + e_{it} \end{aligned}$$

[2] For a more in-depth and technical derivation of factor models and the use of principal components see e.g. Stock and Watson (2002a).

where **F** is the underlying factor. The relationship between the given factor and an observable variable is given by the so-called factor loadings λ_i. These loadings will in general differ between the variables, and for each variable there is one factor loading associated with each of the underlying factors. $C_{it} = \lambda_i F_t$ is referred to as the common component of the model. e_{it} is the idiosyncratic or variable specific component reflecting the "uniqueness" in each variable, that is, the part of the variation in a series which is not common to all the included variables. The underlying factors are not observable themselves, and therefore they need to be estimated. Principal components are used for this purpose. The first principal component accounts for the largest share of total variance in the data set. The next principal components are labelled according to the declining share of variance accounted for. Note that all the principal components are orthogonal to each other, i.e. a given principal component is uncorrelated with all the other principal components. In total, the number of principal components is equal to the number of original variables in the dataset. However, a substantial share of the total variance can usually be accounted for by only a few principal components, and the method is thus an efficient way of reducing the data dimension. In order to make the variables comparable, they are standardized before being transformed to principal components. Standardization implies that the variance of each variable equals one, and therefore the total variance in the dataset is equal to the number of variables *N* (Vonen, 2001).

In deciding which factors to use in the construction of the Macedonian financial conditions index, the threshold for the share of total variance explained was taken to be at least 70%. By this measure, the first 5 principal components suffice to summarize the dataset. The financial conditions index is then constructed by summing the selected principal components weighted by the share of total variability explained by them. The resulting index is then further divided by the share of total variance explained. Therefore, the actual importance of each variable in the financial conditions index is equal to the weighted sum of the loadings on each variable across the 5 principal components (Angelopoulou et al., 2012).

In general, interest rates and risk measures receive positive weights in the index. Conversely, leverage has negative weight. This pattern of increasing interest rates and risk premiums and declining leverage is consistent with tightening financial conditions, and provides us with the basis for the index interpretation.

4.2. Systemically important indicators

There are two ways to view the systemic relationship expressed in each indicator's weight: by its sign and by its magnitude. For instance, risk measures with their generally positive weights and leverage measure with its negative weight imply that increasingly positive values of the index capture periods of above-average risk and below-average leverage. Conversely, increasingly negative values of the index capture periods where risk is below average and leverage is above average (Brave and Butters, 2011).

In our adjusted FCI, the process of deleveraging appears as an indicator of deteriorating financial conditions given that this ratio determines the degree of robustness of financial institutions to withstand shocks to their balance sheets (FSIs, IMF).

Our index also includes NPLs net of provision/Own funds ratio. This capital adequacy ratio is an important indicator pointing out to the capacity of banks' capital to withstand losses from NPLs (FSIs, IMF).

The asset price categories included in our adjusted FCI (market capitalization of shares as well as the residential real estate prices) measure risk premiums in their various forms. Therefore, increasing risk premiums denotes tightening real estate and equity market conditions. With respect to the residential real estate prices, "the most recent subprime credits crisis revealed that a belief that house prices would continue to appreciate stimulates easy credits thus increasing the financial vulnerability. The decline in underwriting standards did not directly trigger the crisis, because the gradual changes in standards did not statistically account for the large difference in default rates. In other words, the trend in worsening loan quality is harder to detect with rising housing prices, as more refinancing options are available, keeping the default rate lower (adaptation from Demyanyk and Hemert, 2007)".

The Macedonian stock exchange index (MBI-10) return is also selected as a broader measure of financial conditions. The MBI-10 return measures the "risk - reward relationship" associated with the stock market thus covering the general equity market risk premium with implications for monetary policy, financial stability and economic activity.

Real effective exchange rate is also included in our adjusted FCI. According to (Céspedes et al., 2000) an economy is classified as vulnerable if the real exchange rate depreciations lead to increases in the risk premium faced by firms. This re-

sult is summarized in their dynamic equation for risk premium and crucially, depends on firms' debt burden, i.e. on the steady state debt to investment ratio[3].

Another broader measure of financial conditions reflecting risk premia is the share of FX Deposits including foreign exchange-indexed to total deposits. This ratio refers to the degree of asset substitution (dollarization/euroization) in the economy. With dollarization/euroization, the domestic authorities lose the ability to respond to a sudden run on bank deposits by acting as a lender of last resort. In particular, the authorities are unable to inject an unlimited amount of liquidity into the payment system to prevent a default on deposits (Berg and Borensztein, 2000), as the amount available to purchase bank assets and to recapitalize distressed financial institutions is restricted to the country's stock of foreign reserves (Winkler et al., 2004).

Our index also includes measures of banks' profitability. Namely, noninterest expenses/gross income ratio is a profitability ratio, which measures the size of administrative expenses within gross income - that is, it measures the efficiency of deposit takers' use of resources. On the other hand, interest margin/gross income ratio is a profitability ratio, which measures the relative share of net interest earnings - interest earned less interest expenses - within gross income. Determinants of bank profitability can be split between those that are internal and those that are external. Internal determinants of bank profitability can be defined as those factors that are influenced by the bank's management decisions and policy objectives. Management effects are the results of differences in bank management objectives, policies, decisions, and actions reflected in differences in bank operating results, including profitability. Zimmerman (1996) found that management decisions, especially regarding loan portfolio concentration, were an important contributing factor in bank performance. However, the profitability of banks is

[3] When the steady state ratio of debt to investment is large, then the economy is more likely to be financially vulnerable. According to (Céspedes et al., 2000), adverse external shocks cause a larger *impact* real depreciation under flexible rates, but a larger *expected* real depreciation under fixed rates. *Ceteris paribus*, this causes domestic real interest rates to be higher under a peg, adversely affecting current investment and future output. Céspedes et al., 2000, build a model of a small open economy in which real exchange rates play a central role in the adjustment process, wages are sticky, liabilities are "dollarized," and the country risk premium is endogenously determined by the net worth of domestic entrepreneurs. Hence all the basic building blocks are there for unexpected real exchange rate movements to be financially *dangerous*, and for flexible exchange rates to be *destabilizing*. In other words, the authors have shown that if a sharp devaluation wreaks havoc with bank and corporate balance sheets, country risk premia will increase. This combination causes, in some cases, the domestic effects of external shocks to be magnified and made persistent. In others, the expectation of a large devaluation causes one to occur and damage financial health enough to justify the initially pessimistic expectations.

influenced not only by factors related to their management decisions but also to changes in the external macroeconomic environment, as well as by factors related to market share changes (FSIs, IMF & Staikouras et al., 2004)

Loans to deposit ratio as well as the banking system exposure to subsidiaries and shareholders are used to detect liquidity problems - a high ratio might indicate potential liquidity stress in the banking system and perhaps a loss of depositor and investor confidence in the long-term viability of the sector (FSIs, IMF).

To this end, we include in our adjusted FCI, the interest rates as well as the FX interest spread. Increasing both, the interest rates and the spread[4] coincide with tighter banking system conditions.

The rationale behind high deposit rates and tight banking system conditions lies in the fact that some banks might use high deposit interest rates to fund their risky lending strategies. And the high deposit interest rates of these banks might create a negative externality by forcing less risk-loving banks to raise their deposit rates to retain deposits, thus squeezing bank profits and creating a secondary impulse for less risky banks to actually increase the riskiness of their portfolio. Therefore, the first-best policy would be to use high deposit interest rates as a signal of increased risk (Kraft and Galac, 2007).

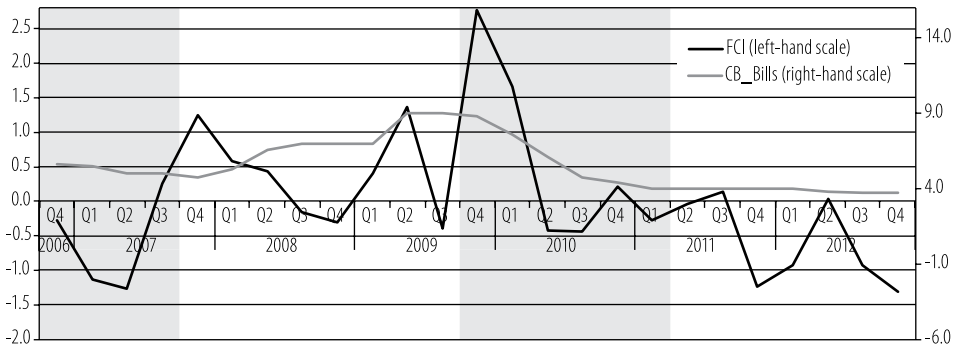
The high bank lending rates are closely associated with the high-risk premiums. When these premiums are far above those justified by the economic fundamentals, they could be called a "fear premiums". These premiums are usually driven by some country-specific macro/liquidity risks. In other words, high lending rates reflect a cautious attitude on the part of lenders - driven by growing uncertainty, elevated funding costs, and tighter financial regulations (Shirai, 2012).

In Figure 4, the movement of the adjusted FCI is plotted. In the first half of 2007, the adjusted FCI slipped well into a negative territory which suggests looser overall financial conditions that leaded to an acceleration in economic growth. The loose financial conditions in this period had been driven largely by favourable movements in equity markets (i.e. sharp increase of the market capitalization of shares) as well as by both the restored capacity of the banks' capital to withstand losses from NPLs (i.e. decrease in NPLs net of provision/own funds), and the increased banks' profitability (that is, a decrease in the noninterest expenses/gross income ratio). In parallel, 2007 coincides with NBRM policy easing cycle. From mid-2007 until mid-2008

[4] Higher spread between the lending and deposit rate reflects higher perceived credit risk. The spread can also be used as a gauge of competitiveness within the sector, i.e. higher spread implies lower competitiveness (FSIs, IMF).

a tight financial conditions had been prevailing. The unfavourable financial conditions in this period were primarily induced by the sharp increase in interest rates on denar deposits as well as by decrease in banks' leverage. In the second half of 2008, financial conditions begin to loosen (the FCI turns downward). Loosening deepens until a trough at the end of 2008 after which a new cycle of tightening financial conditions begins (the FCI turns upward). The favourable financial conditions in the second half of 2008 are driven largely by the decline in short and long term interest rates on foreign currency loans, as well as by further improvement of the capacity of banks' capital to withstand losses from NPLs (i.e. a decrease in NPLs net of provision/own funds). In addition, in this period a significant shrinkage in the general equity market risk (i.e. decline in MBI-10 returns) is observed. Tight financial conditions generally persist during 2009 and 2010 reflecting primarily the adverse movements in credit conditions (most notably surge in banks' denar deposit and lending rates, as well as the increase in banking system exposure to subsidiaries and shareholders (i.e. increased liquidity risk). The period 2008 - Q3 2009 reflects the NBRM's remarkable tightening cycle, as well as deceleration in economic growth. Loose financial conditions that started at the beginning of 2011 and that are still persisting are mainly induced by improved credit conditions (decrease in both, the lending and the deposit interest rates); decrease in liquidity stress in the banking system (i.e. decline in total loans / customer deposits ratio); increase in leverage, as well as in capacity of banks' capital to withstand losses from NPLs; a reduction in banking system exposure to subsidiaries and shareholders is also observed in this period, reflecting reduced liquidity risk. On the monetary side, a pronounced monetary easing cycle has been observed as of end-2009. Namely, in light of recovering international reserves and in order to encourage economic activity, the central bank gradually lowered its key policy rate to 4 percent in December 2010.

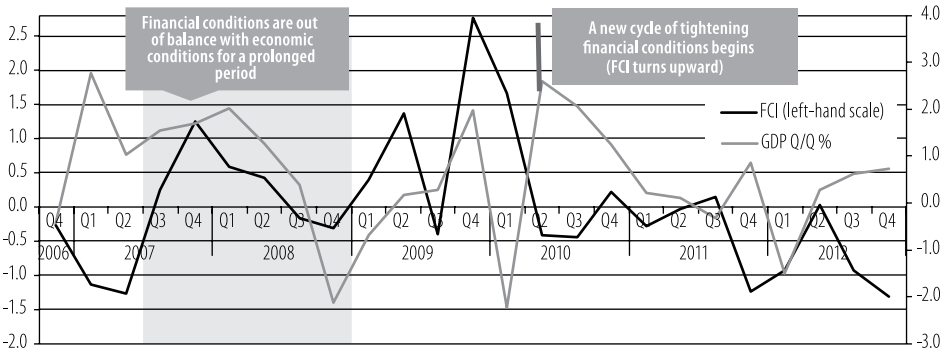
Figure 4: Adjusted FCI (measured in terms of number of standard deviations away from historical mean, LHS), and CB bills interest rate (in %, RHS)



Source: NBRM and author's calculation; Shaded areas are NBRM policy easing cycles

Loose financial conditions in 2007–2008 are associated with the upturn in the global economic activity and a high GDP growth in Macedonia. Prior to this period, Macedonia's international economic standing had also improved, as evidenced by better credit ratings. In 2009-2010, the FCI is generally well into positive territory, implying unfavourable financial conditions. This fast deterioration in financial conditions is to a great extent associated with the global economic crisis and the period that followed. Still, in the subsequent quarters, we observe a fast improvement of financial conditions in Macedonia. The most recent reading of FCI (Q4 2012) shows a record-low level.

Figure 5: Adjusted FCI (measured in terms of number of standard deviations away from historical mean, LHS) and real GDP (Q/Q %, RHS)



Source: NBRM, SSO and author's calculations.

The Macedonian economy has been less affected by the global economic and financial crisis than some regional peers. GDP has recovered from a modest downturn in 2009 to 2.9 per cent growth in 2010, largely attributed to a substantial increase in exports and global demand for commodities. Net foreign direct investment (FDI) has resumed significantly in 2010. Economic performance continued to be relatively strong in the first half of 2011, though industrial production remained somewhat volatile. Inflation accelerated in the first half of 2011 to above 4 percent on an annual basis, but has begun moderating again very soon afterwards. The banking sector remains liquid, mostly owing to stable internal funding sources and conservative asset portfolios. Annual private sector credit growth remained positive throughout the crisis and the level of non-performing loans (NPLs) stood at just below 10 per cent of total loans by the end of 2011. Still, provisions exceed NPLs and the system remained free of pressures on liquidity or solvency. Moreover, the banking system remained

profitable after provisioning, the capital adequacy ratio exceeded 17 percent, thus being well above the regulatory minimum, and bank liquidity was ample. Reliance on domestic deposits as the primary funding source, combined with minimal reliance on external funding and the lack of exposure to risky external assets, have helped shield the banking system from euro area developments. Both deposits and loans have continued to increase modestly. The NBRM left interest rates unchanged from December 2010 until April 2012, while modestly relaxing prudential requirements that had been tightened as a crisis response in 2008–09. In April, it introduced a set of measures aimed at easing credit conditions and furthering money market development, including a gradual reduction in the amount of outstanding 28-day central bank bills, the introduction of a 7 day and overnight deposit facility and a weekly repo auction. In early May 2012, it lowered the maximum rate on central bank bills by 25 bps to 3.75 percent (IMF Executive Board Conclusions, 2012).

Fiscal policy has been prudent throughout the crisis. Despite several anti-crisis measures implemented during the crisis, the government has maintained a budget deficit of 2.5 per cent in 2010 and 2011, relatively low by regional standards. In addition, spending on capital investments also has increased in the post crisis period (IMF Executive Board Conclusions, 2012).

4.3. Forecasting economic conditions

Another test of our index is its ability to predict the impact of changes in financial conditions on future economic activity. Therefore, in this section, we evaluate our adjusted FCI by first seeing how well it predicts the growth of economic activity on a one quarter horizon relative to the AR model. Table 2 summarizes the pseudo-out-of-sample forecasting results based on several OLS regression models. Data entries are the relative RMSEs, using those for the AR model as the benchmark.

To construct forecasts, we began with data from 2006:Q4 through 2009:Q4. One quarter's worth of data was then added on a recursive basis and forecasts were made at a horizon of one quarter ahead until the end of our data in 2012:Q4. The advantage of this framework is that it mimics the production of forecasts in real time (minus the impact of data revisions).

Table 2: Relative pseudo-out-of sample root mean squared forecast errors*

List of employed regressors in each model specification	Relative RMSE
AR(1)	1.00
AR(1) adj_FCI(-1)	1.18
AR(1) adj_FCI(-1) adj_FCI(-2)	1.11
adj_FCI(-1)	1.00
adj_FCI(-1) adj_FCI(-2)	0.99

Source: author's calculations.

* AR is a reference model; Dependant variable in each model specification is first difference of the logarithm of the seasonally adjusted real GDP.

For an evaluation criterion, we used the root mean squared forecast error (RMSE) statistics computed from our sample of forecasts from 2010:Q1 through 2012:Q4 expressed relative to the similar statistics based on forecasts computed using only AR(1) model. This ratio provides a test of model fit, so that a value less than 1 indicates an improvement in forecast accuracy relative to an autoregressive baseline. As expected, the AR benchmark is generally hard to beat. Thus, the results suggest that the OLS regression containing only lagged values of the adjusted FCI term just marginally outperforms the alternative models examined.

5. Conclusion

The recent financial crisis has brought to the fore the importance of financial stability and how it may affect the overall economy.

This paper develops two quantitative measures of financial stability in Macedonia. Both composite measures can be used to gauge the build-up of imbalances in the system even in the absence of extreme events. The behaviour of both aggregate measures reflects the financial system conditions well post facto. These quantitative composite measures of financial system stability are intuitively attractive as they could enable policy makers to better monitor the degree of financial stability of the system and to anticipate the sources and causes of financial stress to the system.

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Appendix 1

Financial Soundness Indicators of the Macedonian Banking System 2006-2012

Deposit takers	2006Q4	2007Q4	2008Q4	2009Q4	2010Q4	2011Q4	2012Q1	2012Q2	2012Q3	2012Q4
Capital adequacy										
Regulatory capital/risk weighted assets	18.3	17.0	16.2	16.4	16.1	16.8	17.5	17.4	17.1	17.1
Regulatory Tier I capital/ risk weighted assets[1]	17.4	15.7	14.0	13.8	13.4	14.1	14.7	14.7	14.4	14.5
Equity and reserves to Assets	13.3	11.4	11.5	11.4	10.6	11.0	11.4	11.6	11.5	11.2
NPLs net of total provision/own funds[2]	0.7	-5.0	-6.2	-0.6	-0.3	-0.9	-2.0	-2.3	-0.5	-3.7
NPLs net of total provision/own funds[3]			-6.8	-0.8	-0.5	-1.1	-2.2	-2.4	-0.7	-3.8
NPLs net of provision for NPLs/own funds[3]			33.4	13.5	11.9	10.8	10.7	11.5	12.9	10.7
Asset quality										
NPLs/gross loans[2]	11.2	7.5	6.7	8.9	9.0	9.5	9.9	9.7	10.6	10.1
NPLs/gross loans[3]	11.2	7.5	6.8	9.1	9.3	9.9	10.2	10.0	10.9	10.5
Total provisions to Non-Performing Loans[2]	98.3	114.3	118.1	101.4	100.7	101.9	104.2	104.7	100.9	107.1
Total provisions to Non-Performing Loans[3]	n/a	n/a	120.3	101.8	101.2	102.2	104.7	105.1	101.3	107.5
Provisions for NPLs to Non-performing Loans	n/a	n/a	0.0	70.0	74.0	77.4	77.6	75.7	75.5	79.0
Large exposures/own funds[6]	194.7	181.4	118.0	213.3	200.4	189.6	183.8	188.7	181.3	205.1
Number of large exposures[7]					30	20	19	25	22	24
Market share[8]					23.2	24.2	24.0	1.5	1.5	1.5
Large exposures (%)[9]					4.9	7.4	7.2	7.5	1.7	1.9
Net value of foreclosed assets/own funds					13.7	16.2	15.7	17.3	18.0	15.6
Banking system exposure to subsidiaries and shareholders/own funds	5.2	5.6	3.1	4.6	6.3	4.6	4.0	3.9	4.0	3.5
Banking system equity investments/ own funds	6.3	4.9	3.9	1.5	1.5	1.6	1.7	1.7	1.7	1.8
Foreign-Currency-Denominated Loans/ Total Loans	52.7	54.7	57.0	58.5	58.8	59.2	58.3	57.0	55.7	55.4
Foreign-Currency Loans/Total Loans	26.3	24.6	22.9	22.6	25.8	28.2	28.0	27.1	26.0	25.5
Foreign-Currency Indexed Loans/ Total Loans	26.4	30.1	34.1	35.9	33.0	31.0	30.3	29.8	29.7	29.8
Earnings and profitability										
ROAA[10]	1.8	1.8	1.4	0.6	0.8	0.4	-0.3	0.4	0.3	0.4
ROAE[10]	12.3	15.0	12.5	5.6	7.3	3.4	-2.5	3.2	2.3	3.8
Interest margin/gross income [11]	57.1	57.0	58.9	62.6	61.8	60.0	64.2	64.0	64.3	60.7
Noninterest expenses/gross income[12]	63.6	60.3	64.0	64.5	68.2	69.7	67.7	70.6	68.6	65.3
Trading income to total income					0.5	0.5	1.1	0.7	0.5	0.4
Personnel expenses/noninterest expenses	41.1	38.4	36.5	36.9	36.1	34.1	34.6	32.9	33.5	33.1

Interest Rates										
Local currency spreads between reference lending and deposit rates	6.3	4.5	3.2	2.8	2.3	3.2	3.4	3.4	3.4	3.5
Foreign currency spreads between reference lending and deposit rates	6.7	6.5	4.2	4.2	4.4	4.8	4.8	4.8	4.7	4.6
Interbank market interest rate	4.9	3.1	5.3	6.2	2.7	2.2	2.1	2.4	2.2	2.1
Liquidity										
Liquid assets/total assets[13]	18.0	20.9	16.9	20.6	25.3	25.3	26.5	26.5	27.5	29.4
Liquid assets to total short-term liabilities (contractual maturity)[14]	25.2	28.2	24.0	30.1	38.5	39.6	42.1	42.6	44.8	48.2
Liquid assets to short-term liabilities (residual maturity)[14]					33.8	34.3	36.9	36.8	3.8.3	40.6
Customer Deposits/ Total (Non-interbank) Loans	137.1	128.4	107.7	108.2	1 14.3	115.7	1 14.9	111.8	111.9	113.5
Foreign-Currency -Denominated Deposits/ Total Liabilities[15]	59.0	55.0	56.4	63.0	59.4	56.6	55.0	53.4	52.8	52.8
Foreign-Currency -Denominated Deposits/ Total Deposits	56.1	51.5	54.8	60.9	55.5	52.7	51.1	49.3	48.8	48.3
Foreign-Currency Deposits/Total Deposits	51.8	44.5	48.1	56.2	53.5	50.8	49.1	48.6	48.0	47.3
Foreign-Currency Indexed Deposits/ Total Deposits	4.3	7.0	6.7	4.7	2.0	1.9	2.0	0.6	0.8	1.0
Sensitivity to market risk										
Net open foreign exchange position/ own funds	47.0	38.2	25.1	13.0	18.9	21.3	12.5	8.7	12.3	11.4

Sources: NBRM's Financial Stability Unit.

[1] Since 31.03.2009, regulatory Tier 1 capital has been calculated after supervisory deductions

[2] The indicator refers to loans to the financial and nonfinancial sector.

[3] The indicator refers to loans to the nonfinancial sector.

[6] Sum of the large exposures (10% and above 10% from own funds) by individual bank for all banks in the banking system divided with the banking system's own funds.

[7] Number of large exposures within the bank with the highest number of large exposures at the cut-off date.

[8] Market share of the bank with the highest number of large exposures at cut-off date.

[9] Market share of the bank with the highest relative share of large exposures in own funds at cut-off date.

[10] Annualized and adjusted for unrecognized impairment. Since 31.03.2009 these items have been adjusted for unrecognized impairment.

[11] Interest margin in interest income less interest expense. Gross income includes net interest income, fees and commissions income (net) and other income excluding extraordinary income.

[12] Noninterest expenses include fees and commissions expenses, operating expenses excluding extraordinary expenses.

[13] Liquid assets are defined as cash and balance with the NBRM, treasury bills, and correspondent accounts with foreign banks. Assets in domestic banks are excluded from total assets. According to the Methodology of NBRM these arc highly liquid assets.

[14] Short-term liabilities are defined as deposits and other liabilities with a maturity of one year or less (without deposits and borrowings from domestic banks).

[15] Foreign currency denominated liabilities refer to liabilities with contractual maturity. Total liabilities refer to all liabilities excluding equity and reserves and current profit.

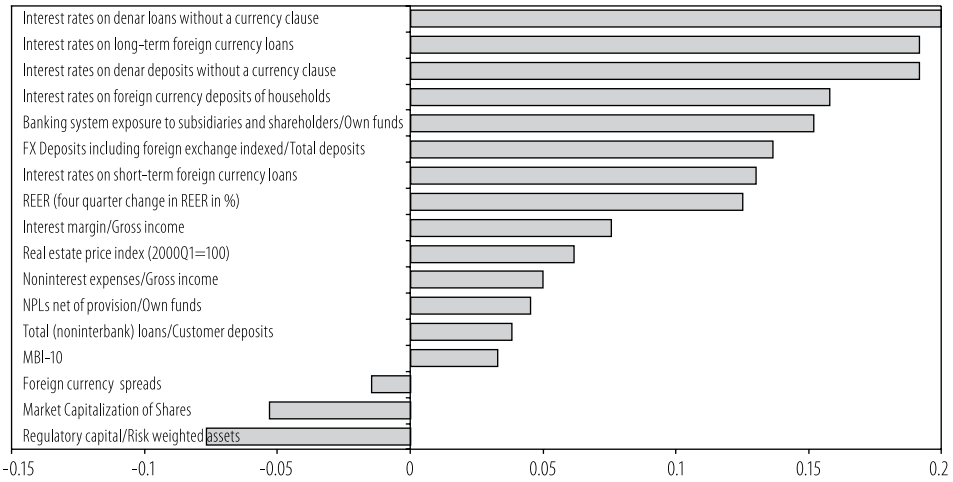
Appendix 2

Quarter	Capital adequacy	Credit risk	Profitability	Liquidity	Currency risk	Banking stability index
2005-Q4	0.25	0.10	0.07	0.25	0.00	0.67
2006-Q1	0.22	0.10	0.12	0.24	0.00	0.68
2006-Q2	0.18	0.08	0.11	0.22	0.00	0.60
2006-Q3	0.17	0.12	0.15	0.22	0.00	0.66
2006-Q4	0.13	0.15	0.12	0.24	0.00	0.64
2007-Q1	0.12	0.16	0.15	0.22	0.00	0.65
2007-Q2	0.12	0.16	0.20	0.22	0.00	0.70
2007-Q3	0.09	0.16	0.18	0.19	0.00	0.62
2007-Q4	0.08	0.22	0.16	0.19	0.00	0.65
2008-Q1	0.04	0.22	0.15	0.13	0.01	0.54
2008-Q2	0.02	0.23	0.18	0.11	0.01	0.55
2008-Q3	0.00	0.24	0.16	0.09	0.01	0.50
2008-Q4	0.04	0.19	0.12	0.04	0.01	0.40
2009-Q1	0.06	0.15	0.07	0.00	0.04	0.32
2009-Q2	0.06	0.09	0.07	0.01	0.03	0.25
2009-Q3	0.06	0.06	0.09	0.04	0.04	0.29
2009-Q4	0.05	0.09	0.09	0.08	0.03	0.34
2010-Q1	0.07	0.10	0.07	0.08	0.03	0.34
2010-Q2	0.06	0.11	0.06	0.11	0.03	0.37
2010-Q3	0.05	0.11	0.06	0.11	0.03	0.36
2010-Q4	0.04	0.15	0.07	0.16	0.02	0.45
2011-Q1	0.07	0.16	0.01	0.16	0.03	0.42
2011-Q2	0.06	0.17	0.04	0.15	0.04	0.46
2011-Q3	0.06	0.16	0.03	0.15	0.02	0.43
2011-Q4	0.07	0.13	0.05	0.17	0.01	0.43
2012-Q1	0.10	0.12	0.03	0.18	0.03	0.46
2012-Q2	0.09	0.13	0.04	0.16	0.05	0.47
2012-Q3	0.08	0.11	0.05	0.17	0.03	0.44
2012-Q4	0.08	0.13	0.07	0.18	0.04	0.50

Appendix 3

Selected variables	Transformation:	Categories:	Selected variables cover:
Real estate price index (2000Q 1 = 100)	First difference of logarithm	Risk preirda	A sustained increase in prices tends to lower the underwritting standards
Market Capitalization of Shares	First difference of logarithm	Risk premia	Financial wealth of corporate sector
FX Deposits including foreign exchange- indexed/Total deposits	First difference of logarithm	Risk premia	Degree of asset substitution
MBI-10	First difference of logarithm	Risk premia	Measures the "risk-reward" relationship associated with the stock market
NPLs net of provision/Own funds	First difference of logarithm	Liquidity risk	Capacity of banks' capital to withstand losses from N PLs
Banking system exposure to subsidiaries and shareholders/Own funds	First difference of logarithm	Liquidity risk	Potential liquidity stress
Total (noninterbank) loans/Customer deposits	First difference of logarithm	Liquidity risk	Potential liquidity stress
Interest rates on denar loans without a currency clause	Level	Interest rate	Systemic implications of interest rate setting
Interest rates on long-term foreign currency loans	Level	Interest rate	Systemic implications of interest rate setting
Interest rates on foreign currency deposits of households	Level	Interest rate	Systemic implications of interest rate setting
Interest rates on short- term foreign currency loans	Level	Interest rate	Systemic implications of interest rate setting
Interest rates on denar deposits without a currency clause	Level	Interest rate	Systemic implications of interest rate setting
Foreign currency spreads	First difference of logarithm	Credit risk	Perceived credit risk
Regulatory capital/Risk weighted assets	First difference of logarithm	Leverage	Robustness of financial institutions to withstand shocks to their balance sheets
REER (four quarter change in REER in %)	Level	Price competitiveness	Risk premium faced by firms
Interest margin/Gross income	First difference of logarithm	Profitability	Profitability
Noninterest expenses/Gross income	First difference of logarithm	Profitability	Profitability

Figure 1: Ranking of variables by their actual importance in the adjusted FCI*



* The actual importance of each variable in the financial conditions index is equal to the weighted sum of the loadings on each variable across 5 principal components; the variables are listed in this order - from those with the largest positive weights to those with the largest negative weights in our adjusted FCI.