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Some Financial Stability Indicators for Brazil*

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Abstract

This Working Paper should not be reported as representing the views of the Banco Central do Brasil. The views expressed in the paper are those of the authors and do not necessarily reflect those of the Banco Central do Brasil.

We present a methodology to construct a Broad Financial Stability Indicator (FSI^B) based on unobserved common factors and a Specific Financial Stability Indicator (FSI^S) for the Brazilian economy combining observed credit, debt and exchange rate markets indicators. Rather than advocate a particular numerical indicator of financial stability, our main goal is methodological. Our indicators, calculated in sample and ex-post, seem to capture three periods of considerably high financial instability in Brazil: (i) the 1998/1999 speculative attack on the Real, (ii) the government transition of 2002/2003 and (iii) the intensification of the 2008/2009 subprime financial crisis triggered by the collapse of the Lehman Brothers. We also propose an alternative methodology that decomposes business cycle fluctuations in two components – a Financial Factor (FF) and a Real Factor (RF) – which are identified from co-movements of financial and non-financial variables. The results are similar to the ones pointed out by our FSI^B and FSI^S measures.

JEL Classification: E44, E58, G28.

Keywords: Financial stability, Composite indexes.

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1 Introduction

Modern central banks in both emerging market economies and developed economies have a dual mandate: (i) the pursuit of price stability and (ii) the maintenance of financial stability. A good example is the current institutional mission of the Central Bank of Brazil (BCB):[1]

To ensure the stability of the currency's purchasing power
and a solid and efficient financial system

Although an institutional commitment to price and financial stability is a crucial element of policy backdrop by itself, both are not clear-cut. The theory and practice of monetary policy, however, rounded this problem by the adoption of an explicit nominal anchor that ties down exactly the meaning of price stability. There are many measures of price stability (e.g. GDP deflator, producer price index, consumer price index) that tend to be highly correlated, so most central banks focus on a 'headline' or 'core' measure of inflation.[2] As a result, inflation targeting widespread around the world, with diverse sizes and shapes, but with the common views of keeping inflation low and stable.

The same is not true for financial stability issues. Besides the absence of a widely accepted definition, there is a lack of consensus about the measurement of financial stability. So, one of the priorities in a wider program of work on financial stability should be to find a metric for measuring financial stability. The indicator employed to quantify financial stability must be made up of different components of the financial system, as financial stability can be seen as being consistent with a combination of the conditions of its constituent parts. This metric, however, should take the specific characteristics of the financial system under consideration.

In most middle-income countries, as in Brazil, commercial banks are an important part of the financial system. Equity issues remain limited, despite recent progress in deepening local capital markets and changes in the ownership structure of firms. Although privatization and cross-border acquisitions have improved the degree of banking sophistication in many countries in recent years, their financial systems continue to lag behind developments in industrial economies. In particular, and despite some exceptions, the expansion of nonbank financial intermediaries, the shift toward the "originate and distribute" model of banking, and the development of opaque, off-balance sheet instruments, have not reached the same importance as in advanced economies.

[1] The mandate of the BCB was established by Federal Law n^o 4.595 on December 31, 1964. The current strategic guidelines were set in March 2010 (http://www.bcb.gov.br/?PLAN).

[2] Currently, all inflation targeting (IT) countries have chosen CPI, excluding or not some of its components. See Petrova (2012) and Little and Romano (2009).

Considering the Brazilian case, Mello and Garcia (2012) compare Brazilian credit data with other 32 countries for which data was available for both 2003 and 2008 on the World Bank dataset (World databank).[3] In 2003, domestic credit by the banking sector was 29% of GDP in Brazil. In 2008, it was 54% of GDP, a significant improvement. In 2003, the size of the Brazilian banking sector was way below the median size of 53% of GDP among the 32 countries in their sample. In 2008, Brazil was right at the median. Not surprisingly, Brazil improved its relative position, from 20th to 17th in the ranking. Although improving, the Brazilian banking system was mid-sized in 2003 as well as in 2008. However, this data is silent about the size of the Brazilian banking system given the institutional development. In comparison, the authors show that equity markets recorded issues of R$ 165 billion between June 2007 and June 2008, which set a record, but represents only 5.6% of GDP.

The traditional ("old") approach to financial regulation is focused on the task of ensuring the soundness of individual financial institutions. In the case of banking regulation, the focus on soundness of individual institutions has been given specific form with, for example, requirements on minimum capital for banks as a proportion of the risk-weighted assets of the bank. However, there is now a common view that the very traditional approach based on the loss absorbency of capital does not address directly excessive asset growth during booms. During a lending boom, high bank profitability and low measured risks tend to bolster bank capital ratios. However, as pointed out in Hahm, Mishkin, Shin and Shin (2012), experience has shown repeatedly that rapid loan growth is achieved only at the cost of lowering lending standards. At the same time, vulnerabilities arise from the reliance on unstable short-term funding and short-term foreign currency debt in order to support the lending boom. In an open emerging economy, rapid increases in the liabilities of the banking system show up as capital inflows through increased foreign exchange-denominated liabilities of the banking system.

Therefore, in terms of policy, the 2008/2009 financial crisis has highlighted the need to go beyond a purely microprudential approach to financial stability adding a macroprudential overlay to address systemic risk, and has spurred renewed efforts in financial stability monitoring. In order to better deal with the increasing complexity of the external and domestic financial environment, and as has occurred in many central banks after the subprime crisis, the Central Bank of Brazil established a Financial Stability Committee (FSC) on 2011. The FSC is in charge of guiding the central bank's board on regulation and supervision of financial markets, capital, insurance, private pension plans and other

[3]The countries considered are: Denmark, United Kingdom, United States, Switzerland, Japan, Hong Kong SAR - China, Canada, Sweden, Australia, Thailand, China, Malaysia, Chile, Israel, United Arab Emirates, Saudi Arabia, Czech Republic, Poland, Iran, Egypt, Russian Federation, Romania, Colombia, Nigeria, Turkey, Indonesia, Peru, Venezuela, Mexico, Argentina, Algeria.

similar national and international forums; maintaining financial stability by defining strategies and guidelines for the conduct of the central bank; allocating responsibilities between the internal units involved, to ensure integrated and co-ordinated action; and ordering ongoing studies, research and work on financial stability, as well as preventing systemic risk. In addition, it is worth to mention that since 2003 the Central Bank of Brazil has been already publishing a semiannual Financial Stability Report (FSR) that describes recent National Financial System (SFN) dynamics, presenting on-going analysis of its resilience to eventual shocks and system perspectives.[4]

This paper contributes to highlight ongoing efforts to develop aggregate measures that could indicate the degree of financial soundness in Brazil. Composite quantitative measures of financial system stability that could signal these conditions are intuitively attractive as they could enable policy makers and financial system participants to: (a) better monitor the degree of financial stability of the system, (b) anticipate the sources and causes of financial stress to the system and (c) communicate more effectively the impact of such conditions. Rather than advocate a particular numerical indicator of financial stability, our main goal is methodological. Our indicators were calculated in sample and ex-post.

The paper is structured as follows. In the next section, we follow the current practice and present a financial stability measure using a broad set of financial variables. Then, we present a very simple and intuitive single aggregate measure of financial stability specific for the Brazilian economy. We argue that major events in Brazilian financial history are well captured by the histories of our indexes. As a robustness check, we also propose a methodology to decompose business cycle fluctuations in two factors – financial and real – which are identified from co-movements of financial and real variables, and compare the resultant financial factor with our two previous measures of financial stability. The results show that this new index, built on a different methodology, is highly correlated with the previous measures. Although the present work does not focus on the predictive power of these indexes, this robustness encourages us to extend our analysis towards this research line.

2 Measuring Financial Stability

We propose three methods to measure overall financial stability: (i) a Broad Financial Stability Indicator (FSI^B), (ii) a Specific Financial Stability Indicator for the Brazilian economy (FSI^S) and (iii) a business cycle decomposition into Financial (FF) and Real

[4]See http://www.bcb.gov.br/?FINANCSTAB to see the available FSRs.

(RF) Factors. All variables are in log-variations.[5]

2.1 Broad Financial Stability Indicator (FSI^B)

Indexes of financial conditions are typically constructed as weighted averages of a number of indicators of the financial system's health. Our first broad FSI is constructed in a similar fashion.

Definition 1 (FSI^B) *The Broad Financial Stability Indicator (FSI_t^B) is a weighted average of $K \times 1$ unobserved financial factors ($\mathbf{UFF}_t$)*

$$FSI_t^B = \boldsymbol{\omega}'_{UFF}\mathbf{UFF}_t, \tag{1}$$

capturing a time-varying common source of variation in the $N \times 1$ matrix of standardized and stationary observed financial indicators $\mathbf{X}_t$

$$\mathbf{X}_t = \boldsymbol{\Gamma}\mathbf{UFF}_t + \boldsymbol{\epsilon}_t, \tag{2}$$

where $\boldsymbol{\omega}_{UFF}$ is a $K \times 1$ vector of weights representing the impact of the unobserved financial factor in real activity and $\boldsymbol{\Gamma}$ represents $N \times K$ loadings of the variables in $\mathbf{X}_t$ onto the factors in $\mathbf{UFF}_t$.

As is common in the literature, we obtain the elements of **UFF** using the principal factor method (PFM).[6] The benefit of PFM 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.

There are several methods for determining the weights $\boldsymbol{\omega}_{UFF}$ of the variables in our FSI^B. Considering that judgments about the performance of the financial system must be based on how well the financial system is allowing economic resource allocation, the savings and investment process, and, ultimately, economic growth, we follow van den End (2006) and regress a measure of real activity y over the j-lag of our financial unobserved factors:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \boldsymbol{\beta}'_{UFF}\mathbf{UFF}_{t-j} + \varepsilon_t, \tag{3}$$

where we use the $K \times 1$ vector $\boldsymbol{\beta}_{UFF}$ of coefficients to calculate the weights

$$\boldsymbol{\omega}_{UFF} \equiv \frac{1}{\mathbf{1}'\boldsymbol{\beta}_{UFF}}\boldsymbol{\beta}_{UFF}, \tag{4}$$

[5] See subsection 2.4 for data and estimation details.

[6] A recent example of this type of index can be found in Brave and Butters (2011).

where $\mathbf{1}$ is a $K \times 1$ vector of ones.

We use a j-lag of our financial unobserved factors in order to obtain an early warning indicator and to disregard endogeneity problems. This specification allows us to use OLS regression to estimate $\boldsymbol{\beta}_{UFF}$.

2.2 Specific Financial Stability Indicator (FSI^S)

Although, in developed economies, financial innovation has made it difficult to capture broad financial conditions in a small number of variables covering just a few traditional financial markets, this is not true for most middle-income countries. As a result, we also propose a very simple and intuitive financial stability indicator specific for Brazil, a small open economy where the banking system has a major role in the supply of credit.

Definition 2 (FSI^S) *The Specific Financial Stability Indicator (FSI^S) is a weighted average of indicators of the financial system's components (FSC): (i) Credit Market Indicator (CMI), (ii) Debt Market Indicator (DMI) and (iii) Exchange Rate Market Indicator (EMI):*

$$FSI_t^S = \boldsymbol{\omega}'_{FSC}\mathbf{FSC}_t, \tag{5}$$

where $\mathbf{FSC}_t \equiv \begin{bmatrix} CMI_t & DMI_t & EMI_t \end{bmatrix}'$ *is a financial system's component vector and* $\boldsymbol{\omega}_{FSC} \equiv \begin{bmatrix} \omega_{CMI} & \omega_{DMI} & \omega_{EMI} \end{bmatrix}'$ *is a vector of weights calculated as in (3) and (4).*

Although the FSI^S disregard possible relevant information contained in the broad set of indicators when compared with the FSI^B, it is easily interpreted due to the use of observed indicators such interest and exchange rates. As our results suggest, a small set of observed indicators may suffice to track financial stability if it is representative of the economy being modelled. Besides, the use of FSI^S may improve the analysis of FSI^B by indicating if financial stability is being driven by variables other than the usual ones.

2.3 A Business Cycle Decomposition (BCD)

An alternative approach, which is also useful as a robustness check of the dynamics of our financial stability indicators, considers that variations in output are associated with both financial and non-financial factors. Therefore, we propose a methodology to decompose business cycle fluctuations in two factors – a Financial Factor (FF) and a Real Factor (RF) – which are identified from co-movements of financial and non-financial variables. We use the Kalman filter to estimate these indexes according to the following state-space representation:

Definition 3 (FF) *The Financial Factor (FF) driving the business cycle is the common component among financial variables in the $N^F \times 1$ vector X_t^F that affects real activity y_t according to the following state-space representation:*

$$\textit{Signals} \begin{cases} y_t = \alpha y_{t-1} + FF_t + RF_t + v_t \\ \mathbf{X}_t^F = \mathbf{\Lambda}^F FF_t + \boldsymbol{\xi}_t^F \\ \mathbf{X}_t^R = \mathbf{\Lambda}^R RF_t + \boldsymbol{\xi}_t^R \end{cases} \tag{6}$$

$$\textit{States} \begin{cases} FF_t = c_1^F FF_{t-1} + c_2^F FF_{t-2} + \varepsilon_t^F \\ RF_t = c_1^R RF_{t-1} + c_2^R RF_{t-2} + \varepsilon_t^R \end{cases} \tag{7}$$

where real variables in the $N^R \times 1$ vector $\mathbf{X}_t^R$ has a common component RF. The vectors of coefficients $\mathbf{\Lambda}^F$ and $\mathbf{\Lambda}^R$ have dimensions $N^F \times 1$ and $N^R \times 1$.

The last set of equations, expressed in (7), shows that the financial and non-financial factors, FF_t and RF_t, follow an $AR(2)$ process. The other equations characterize the idea we have just described: while the first equation in (6) tells that, except for shocks, we can use the two factors to explain the business cycle fluctuations, the other equations shows that financial and real variables in $\mathbf{X}_t^F$ and $\mathbf{X}_t^R$ co-move with the financial and real factors, FF_t and RF_t.

2.4 Data and estimation

We use quarterly data from 1995:Q1 to 2011:Q4 to cover the period after the Real stabilization plan. Although the Real plan was implemented in July, 1994, we disregard the first two observations for characterizing a transition period from high to low inflation.

We treat all variables presented in Table 1 accordingly to four steps: (i) we used the IPCA index to deflate the series that are expressed in the Brazilian currency, the Real, (ii) we took the quarterly mean of all monthly series, (iii) except for GDP and IPCA, we took the log of the variation of two consecutive quarters[7] and (iv) we normalized all series in order to obtain zero mean and unit variance.

After, we proceed as follows:

- FSI^B: There are two distinct parts of a factor object specification. The first part of the specification describes which measure of association or dispersion, typically a correlation or covariance matrix. The second part of the specification defines the properties of the factor model. We use balanced sample ordinary Pearson

[7]For GDP, we took the log of the annual variation of the series, expressed as $\Delta \ln y_t = \ln((y_t + y_{t-1} + y_{t-2} + y_{t-3})/(y_{t-4} + y_{t-5} + y_{t-6} + y_{t-7}))$. For the IPCAf, we computed $\pi_t = \ln(IPCAf_t/IPCAf_{t-3})$ for each end-of-quarter observation. For any other series x, we computed $\ln(x_t/x_{t-1})$.

correlations as the measure to be fitted by the principal factor method in order to obtain factors comprising 50% of the total variance, resulting in four latent factors[8]. After, we perform an OLS regression of equation (3) using the second lag of each factor. We are then able to combine the weights with the latent financial factors to obtain our FSI^B;

- FSI^S: (i) we choose an extremely simple definition of $\mathbf{FSC}_t$, with only one variable to each market, as highlighted in Table 1, to simplify the interpretation and analysis of our results, (ii) we perform an OLS regression of equation (3) using the second lag of each component, (iii) we are then able to combine the weights with the financial components to construct our FSI^S;

- BCD (FF): we use the Kalman Filter performing the Berndt-Hall-Hall-Hausman (BHHH) optimization algorithm to estimate the model (6)-(7) with just two financial variables and two real variables (highlighted in Table 1) to obtain the common unobserved Financial Factor FF.

We present our results in Table 2 and our financial stability measures in Figure 1. Although the small number of observations, Table 2 shows that, with only one exception in the Kalman Filter estimation of FF, all variables are significant. Our three measures, FSI^S, FSI^S and FF, present similar dynamics[9]. Moreover, considering our FSI^S, the coefficients have the expected sign, which means that any financial system's component rising above its normal level may lead to imbalances and potential instability. Note, however, that the weight associated with the credit market indicator is substantially higher than the other, reflecting the prominent role of banks regarding the supply of credit in the Brazilian economy. This does not mean that the credit market component will completely dominate the index since its dynamics is considerably smooth when compared to the debt and exchange market indicators. We present the financial system's components of FSI^S in Figure 2 and the contribution of each component to financial stability in Figure 3.

We are now able to analyze if our measures of financial stability capture the main crises that occurred in recent past.

[8] We obtain similar results with thresholds up to 75%. Our results, however, may not be robust to some of the several methods to obtain the latent factors.

[9] The correlation between FSI^B and FSI^S is 0.95, while the correlations between these two indicators and FF are 0.57 and 0.66.

2.5 Gauging Financial Stability

One way to judge the validity of our indicator as a measure of financial stability is to follow the narrative approach and link their values to significant events in Brazilian financial history. Accordingly to Figures 1 to 3, three periods deserve attention: (i) end of 1998 to the first quarter of 1999, (ii) end of 2002 to the first quarter of 2003 and (iii) end of 2008 to the beginning of 2009.

Considering 1, the initial low but increasing values presented by our measures of financial stability seems to capture the aftermath of the Mexican Crisis (1995:Q1). The recovery ended in 1997:Q2, just before the Asian Crisis. During the following quarters, our measures of financial stability continued to deteriorate due to the Russian Crisis and the subsequent speculative attack that led to devaluation of the Real at 1999:Q1. In 1999:Q3, financial stability started recovering after the formal adoption of an inflation targeting regime by the Brazilian government in July of the same year.

The year of 2002 was heavily influenced by the uncertainty associated with the presidential election. The year had begun with an improved international environment that allows some flexibility in the conduct of monetary policy. In this context, a monetary policy easing cycle started in the beginning of the year, with the Selic rate being reduced from 19% p.y. in February to 18% p.y. in June. However, later in the year, the uncertainty associated with the presidential election and the potential victory of a left-wing opposition candidate set off an unprecedented confidence crisis leading to sharp exchange rate depreciation and to an unfavourable debt-dynamics. From September 2002 to December of the same year the BCB increased its policy rate from 18% p.y. to 25% p.y.. However, the sharp exchange rate depreciation during the year yielded a considerable increase of inflation, which ended 2002 at 12.5%, and a modest GDP growth of 1.9%. The deterioration of financial stability measures clearly shows the evolution of the confidence crisis during the years of 2001 and 2002. The commitment assumed by the new President to sustain sound macroeconomic policies, combining fiscal discipline, a floating exchange rate regime, and the inflation targeting framework, was crucial to dissipate the fear associated with changes in the course of the economy and related to debt sustainability. This movement appears in our measures as an increase in financial stability.

The second period was triggered by the collapse of the Lehman Brothers in September of 2008 that greatly intensified the 2008/2009 subprime crisis, which were easily detectable in our measures after the third quarter of 2007. Although the Brazilian economy was better prepared for the crisis than in previous episodes, the crisis has triggered a constriction of the financial conditions, which has deleterious effects on confidence and economic activity. The depreciation of the real was a symptom of a global shortage of dollar

liquidity and worsening terms of trade due to falling commodity prices. The restriction of dollar liquidity is evidenced in several ways. The volume of disbursement of advances on exchange contracts (ACCs) fell 30% between September and October 2008, while the rollover rate of long-term debt was reduced from 167% between January and October 2008 to only 22% in November. The short-term loans to Brazilian banks had a significant contraction from net outflows in August, would amount to $ 11.4 billion in the second half of 2008. From another point of view, the volume of domestic credit to foreign funding, adjusted for the exchange rate variation, declined by 11% between August and October 2008.

It should be noted, moreover, that like other sectors of the economy, Brazilians banks have used the period of abundant international liquidity and improved sovereign credit rating to raise funds, both in the form of equity and debt in the country and abroad. In particular, in 2007, eleven financial institutions of small and medium-sized, i.e., with net worth less than R$7 billion, picked up R$6.2 billion in equity offerings (primary and secondary), with significant participation of foreign investors. This enhanced capital base allows smaller institutions to intensify the growth of their loan portfolios, already influenced by the presence of these banks in payroll credit.

In the Brazilian case, credit booming by itself has not threatened financial stability because (i) improving macroeconomic conditions and a growing middle class has broadened overall access to financial services, (ii) various legal and regulatory changes allowed for the creation of new credit instruments, as the payroll deductible loans, and facilitated mortgage foreclosures, reducing the lenders' risk, and (iii) mortgage debt still is very low, accounting for less than 6% of Brazil's GDP.

Finally, financial stability started rising again in 2009:Q4, but it fell five quarters latter due to the influence of the European sovereign debt crisis.

Even considering that the methodology used to build our measures $\left(FSI^B, FSI^S, FF\right)$ differ in many directions – series used, estimation method and model –, the results seems to capture the same main movements. Both series show a long period during which financial stability increased, followed by a drop, caused by the subprime crisis, and a subsequent recovery that ends with the European debt crisis. Nevertheless, there are two points worth noting. First, the FF measure anticipates the movements of both FSI^B and FSI^S. Second, there are some discrepancies between the FSI measures and the FF during the year of 2002. While both FSI^B and FSI^S deteriorates, the FF measure remains relatively stable. Despite the fact that the presidential campaign had dominated the news during the whole year of 2001, the economic effects of the confidence crisis were clearly observable only in 2002, which is more closely captured by the FSI measures.

2.6 A Note on Macroprudential Policies

In terms of policy, the recent financial crisis has highlighted the need to go beyond a purely microprudential approach to financial stability, focusing on the likelihood of failure of individual financial institutions, adding a macroprudential overlay to address systemic risk.

Under a macroprudential framework, the use of reserve requirements would be adequate to mitigate the fluctuations in the volume of credit during the economic cycle. In this context, reserve requirements have been used in several emerging countries such as China, Peru and Russia[10]. As pointed out by Montoro and Moreno (2011), the increase in domestic interest rates to control inflation could give rise to inflows of foreign capital, which would finance an expansion of local credit and undesirably mitigate the contractionary effect of monetary policy. In such circumstances, it might be advisable to increase the rates of compulsory.

In Brazil, reserve requirements are calculated by applying rates to the principal deposit modalities: demand deposits, savings deposits and time deposits and, as of January 2008, to interbank deposits contracted with leasing companies. These resources, which also encompass additional reserves on demand resources, time deposits and savings deposits are deposited in cash or maintained in the form of federal public bonds in the Special System of Settlement and Custody (Selic). The Brazilian model divides reserve requirements maintained at the Central Bank into those bearing earnings and those that do not bear earnings, thus making it possible to adjust liquidity through alterations in the opportunity costs of financial institutions.

During the most acute phase of the 2008/2009 crisis, the principal initiatives taken to provide national currency liquidity in Brazil took the form of alterations in the rules governing reserve requirements maintained at the Central Bank by financial institutions. These rules play a fundamental role in stabilizing short-term liquidity in the economy or, putting differently, in stabilizing demand for banking reserves[11]. The changes introduced by the BCB and National Monetary Council (CMN) consisted of reductions in rates, increases in the amounts to be deducted from callable reserves, changes in earnings on reserve requirements, together with discounts on amounts to be deposited as an

[10] Since the 80's, central banks have increasingly focused on short-term interest rates instead of reserve requirements as the primary instrument of monetary policy. Many mature economies have come to completely eliminate reserve requirements (eg: Canada and UK), while others were kept stable, with reduced rates (eg: Japan). Many emerging countries, however, continued to use reserve requirements as a policy instrument. Recent references of the use of reserve requirements in different countries are Gray (2011), O'Brien (2007) for OECD countries, Montoro and Moreno (2011) in South America and Ho (2008), for Asia.

[11] For the use of reserve requirements as a macroprudential policy in Brazil, see the BCB Inflation Report of June 2011 (pages 98-103, in portughese) at http://www.bcb.gov.br/?RELINF.

incentive to negotiation of assets among financial institutions[12]. Viewed as a whole, these alterations resulted in effective release of R$93.9 billion out of the total balance of these deposits in the period extending from September 24 to December 2, 2008[13].

Figure 4 shows the evolution of both our FSI^S and the effective rate of reserve requirements[14]. After a considerable increase in the period before the presidential election of 2002, the effective rate of reserve requirements remained relatively stable until the last quarter of 2008, when the domestic banking system was affected by the financial crisis of 2008/2009. Among other initiatives, the BCB reduced reserve requirements to ensure liquidity and stability of the system. The process of reversing these measures started in March 2010 and was completed in December of that year.

3 Conclusion

We present a simple methodology to construct a Broad Financial Stability Indicator (FSI^B) based on unobserved common factors and and a Specific Financial Stability Indicator (FSI^S) for the Brazilian economy combining observed credit, debt and exchange rate markets indicators. Our simple methodology seems to capture three periods of considerably high financial instability in Brazil: (i) the 1998/1999 speculative attack of the Real, (ii) the government transition of 2002/2003 and (iii) the intensification of the 2008/2009 subprime financial crises triggered by the collapse of the Lehman Brothers.

We also propose an alternative methodology based on the view that variations on output are associated with both financial and non-financial factors. We decompose business cycle fluctuations in two components – a Financial Factor (FF) and a Real Factor (RF) – which are identified from co-movements of financial and non-financial variables. We use the Kalman filter to estimate these factors. The results are similar to the ones pointed out by our FSI^B and FSI^S measures.

Rather than advocate a particular numerical indicator of financial stability, our main goal was methodological. Our indicators were calculated in sample and ex-post. As part of future research, we intend to extend our analysis towards the predictive power of these indexes, which requires, for instance, performing out of sample tests.

[12]Details about these alterations can be found in the BCB Inflation Report of December 2008 ("Central Bank Measures Aimed at Expanding Liquidity in National Currency") at http://www.bcb.gov.br/?INFLAREPORT.

[13]A recent empirical study about the impact of reserve requirements on credit in Brazil is Dawid and Takeda (2011) (in portughese). See also Montoro and Moreno (2011) and Robitaille (2011) for external views about the use of reserve requirements in Brazil.

[14]Represented by the ratio between the total volume of gatherings and the sum of demand deposits, time deposits and savings.

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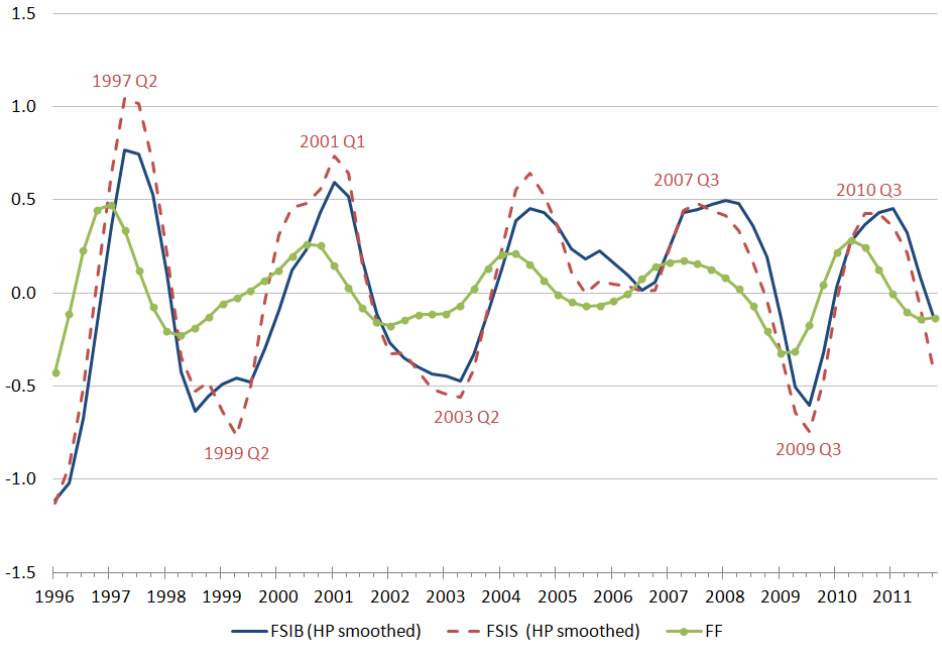

Figure 1: Measures of Financial Stability

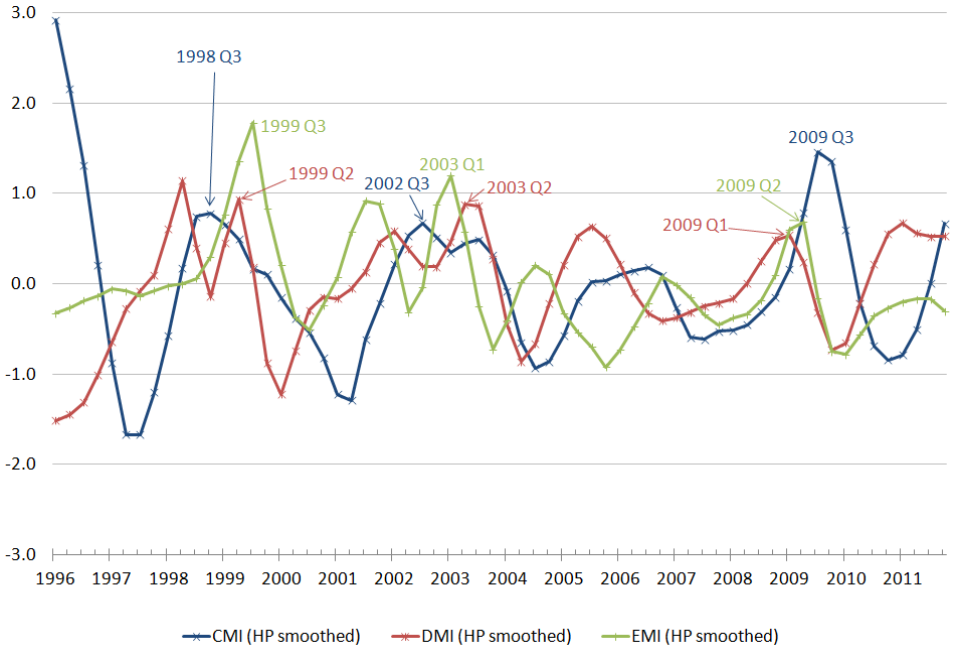

Figure 2: Components of FSI^S

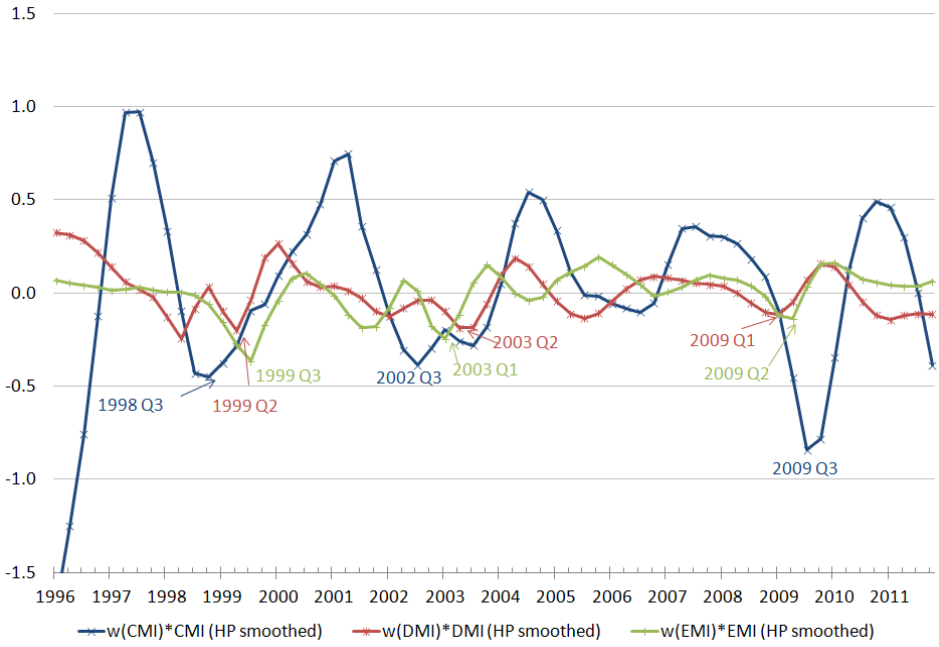

Figure 3: Component Contributions to FSI^S

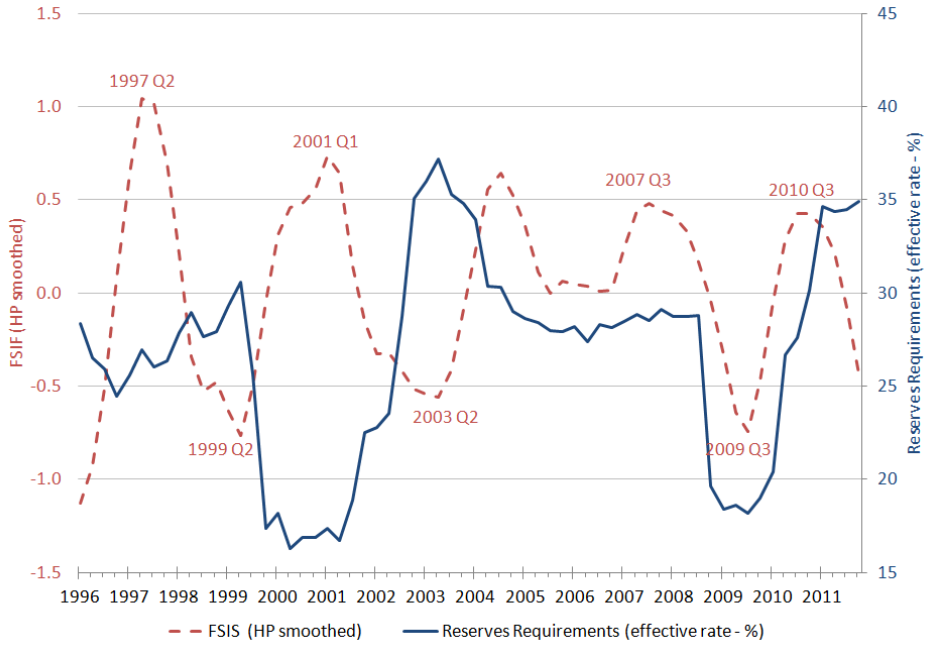

Figure 4: Financial Stability and Reserve Requirements

Table 1: Variables

Variable (unit)	Source (code)	Use FSI^B	Use FSI^S	Use BCD
Quarterly GDP (seasonally adjusted - index - 1995=100)	IPEA[1]	y	y	y
Formal employment - General (index)	BCB[2] (1586)	-	-	X^R_{21}
BNDES system disbursements (R$ millions)	BCB (7415)	X	-	-
Credit operations in the financial system (R$ millions): total	BCB (2052)	X	-	-
Credit operations in the financial system (R$ millions): normal risk	BCB (4404)	X	-	-
Credit operations in the financial system (R$ millions): risk 1	BCB (4413)	X	-	-
Credit operations in the financial system (R$ millions): risk 2	BCB (4422)	X	-	-
Credit operations to private sector (R$ millions): total	BCB (4446)	X	-	-
Credit operations to private sector (R$ millions): normal risk	BCB (4428)	X	-	-
Credit operations to private sector (R$ millions): risk 1	BCB (4434)	X	-	-
Credit operations to private sector (R$ millions): risk 2	BCB (4440)	X	-	-
International reserves (Liquidity concept - US$ million)	BCB (3546)	X	-	-
Exchange rate (period average - R$./US$): purchase	BCB (3697)	X	-	-
Exchange rate (period average - R$./US$): sale	BCB (3698)	X	-	-
Real effective exchange rate (index - Jun-1994=100)	BCB (11752)	X	EMI	-
Banking reserves (R$ thousands)	BCB (1787)	X	-	-
Monetary base (R$ thousands)	BCB (1788)	X	-	-
Extended monetary base (R$ thousands)	BCB (1833)	X	-	-
M1 (R$ thousands)	BCB (1827)	X	-	X^F_{11}
M2 (R$ thousands)	BCB (1837)	X	-	-
M3 (R$ thousands)	BCB (1840)	X	-	-
M4 (R$ thousands)	BCB (1843)	X	-	-
Selic: interest rate (%. p.y.)	BCB (4189)	X	DMI	-
Gold (monthly % var.)	BCB (7830)	X	-	-
Ibovespa stock index (monthly % var.)	BCB (7832)	X	-	-
IPCAf: consumer free prices index (monthly % var.)	BCB (11428)	-	-	X^R_{11}
IPCA: consumer price index (index - Dec 1993=100)[3]	IPEA	-	-	-
VIX (index - points)	Bloomberg	X	-	-
EMBI Brazil index (index - points)	Bloomberg	X	-	-
NPL: Non-performing loans (%)[4]	Authors	X	-	-
NPLP: NPL to private sector (%)[5]	Authors	X	CMI	X^F_{21}

1. IPEA: Institute of Applied Economic Research (www.ipeadata.gov.br);

2. BCB: Central Bank of Brazil (http://www.bcb.gov.br/?SERIETEMP);

3. Used to deflate series expressed in the Brazilian currency (R$);

4. Proportion, at the end of each quarter, of loans past due by more than 60 days (BCB series 4413 plus 4422 deflated by IPCA) to the total of loans (BCB serie 2052 deflated by IPCA).

5. Same procedure as in 4 but with series 4434, 4440 and 4446.

Table 2: Results

Methodology	Coefficient	Value	Prob	Weight
FSI^B (R2 adj.: 0.7952)	$UFF_{1,t-2}$	0.1059	0.0635	0.1670
	$UFF_{2,t-2}$	0.1697	0.0031	0.2677
	$UFF_{3,t-2}$	-0.1230	0.0221	-0.1940
	$UFF_{4,t-2}$	-0.2354	0.0001	-0.3713
FSI^S (R2 adj.: 0.8014)	CMI_t	-0.2811	0.0000	-0.5797
	DMI_t	-0.1041	0.0616	-0.2146
	EMI_t	-0.0998	0.0709	-0.2057
BCD (Log likelihood.:-243.7601)	FF_{t-1}	1.5752	0.0000	—
	FF_{t-2}	-0.8890	0.0000	—
	$var(\varepsilon^F)$	0.0037	0.0000	—
	RF_{t-1}	1.3727	0.0000	—
	RF_{t-2}	-0.8626	0.0000	—
	$var(\varepsilon^R)$	0.0237	0.0000	—
	y_{t-1}	0.8560	0.0000	—
	$var(v)$	0.0275	0.0000	—
	$X_{11}^F\,(M1)$	0.4790	0.0571	—
	$var(\xi_{11}^F)$	0.2158	0.0000	—
	$X_{21}^F\,(NPLP)$	-3.7107	0.0663	—
	$var(\xi_{21}^F)$	0.3077	0.0000	—
	$X_{11}^R\,(IPCAf)$	1.0610	0.0031	—
	$var(\xi_{11}^R)$	0.7971	0.2301	—
	$X_{21}^R\,(employment)$	0.3890	0.0089	—
	$var(\xi_{21}^R)$	0.1048	0.0000	—

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