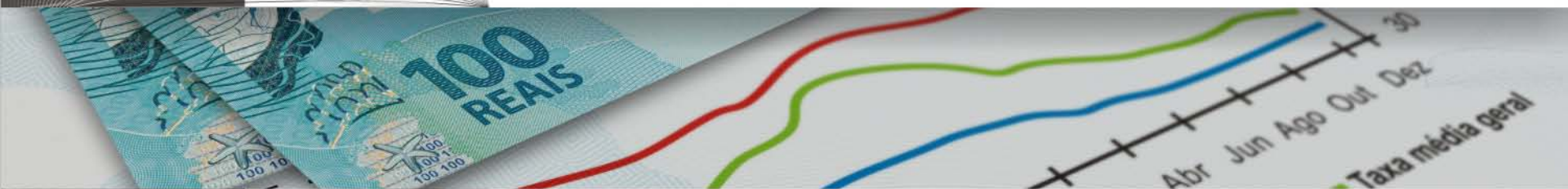


Some Financial Stability Indicators for Brazil

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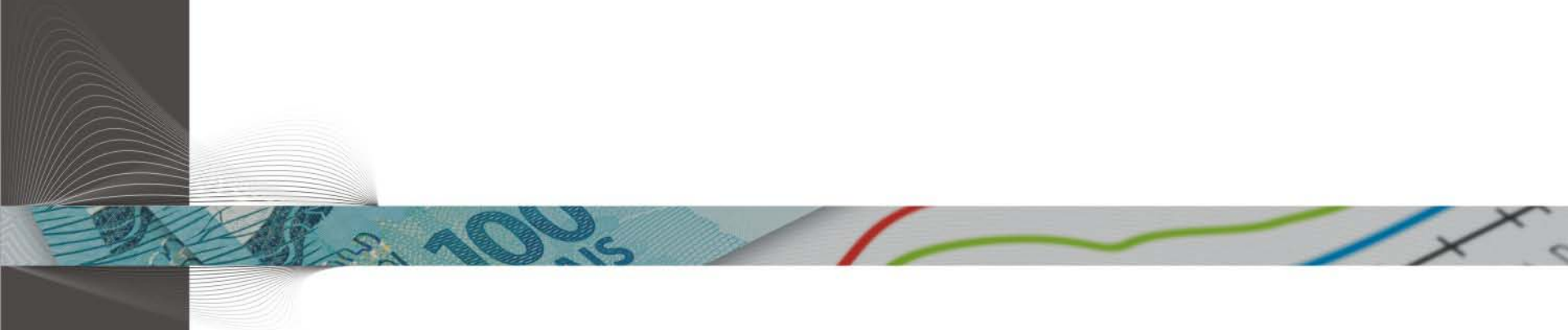


- The views expressed in this work are those of the authors and do not necessarily reflect those of the Banco Central do Brasil or its members.



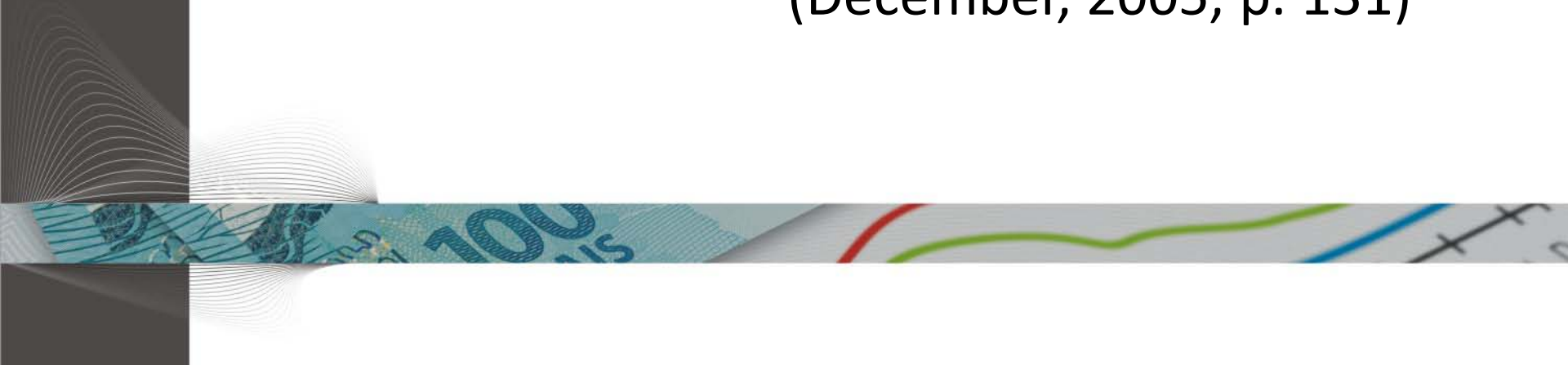
Motivation

- Institutional mission of Banco Central do Brasil:
“To ensure the stability of the currency's purchasing power and a solid and efficient financial system”
- Modern central banks have a dual mandate:
 - price stability => inflation targeting
 - financial stability => ?



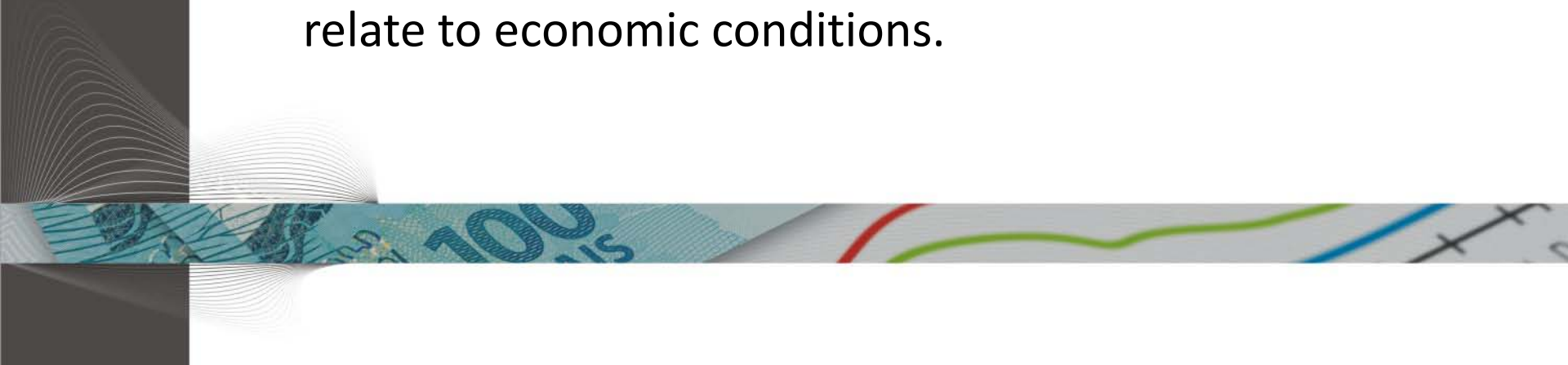
The Problem

- “There is no obvious framework for summarizing developments in financial stability in a single quantitative manner.”
 - ECB Financial Stability Review
(December, 2005, p. 131)



Some Difficulties

- **Financial innovation** has made it difficult to capture broad financial conditions in a **small number of variables** covering just a few traditional financial markets.
- Understanding of both how traditional and evolving financial markets relate to each other and how they relate to economic conditions.



Two Approaches

- Many central banks attempt to assess the risks to financial stability by focusing on a small number of **key indicators**.
- Moreover, there are ongoing efforts to develop a single **aggregate measure** that could indicate the degree of financial fragility or stress.
 - Brave and Butters (2011), van den End (2006) etc.

An Aggregate Measure Approach

- Composite quantitative measures of financial stability are **attractive** as they could enable policy makers to:
 - **better monitor** the degree of financial stability of the system;
 - anticipate the **sources and causes of financial stress** to the system and
 - communicate more effectively the **impact** of such conditions.



This Paper

- We present a methodology to construct
 - A Broad Financial Stability Indicator (FSI^B) based on **unobserved common factors**;
 - A Specific Financial Stability Indicator (FSI^S) for the Brazilian economy combining a small number of observed indicators.
- Alternative methodology :
 - Decomposes business cycle fluctuations into a Financial Factor (FF) and a Real Factor (RF) which are identified from co-movements of financial and non-financial variables.

Our Goal

- First methodological exercise of how to build a **index of financial conditions** that may be useful to **monitor financial stability**.
- We judge the validity of our indexes as measures of financial stability following the **narrative approach** and linking their normalized values to significant events in Brazilian financial history.
- Just a first step! This exercise, **in sample and ex post**, does not include:
 - Forecasting;
 - Channels of transmission.

A Broad Financial Stability Indicator

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)*

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

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

$$\mathbf{X}_t = \boldsymbol{\Gamma} \mathbf{UFF}_t + \boldsymbol{\epsilon}_t, \quad (2)$$

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 .

A Broad Financial Stability Indicator (cont.)

- Elements of **UFF**:
 - As is common in the literature, we obtain the elements of UFF using the **principal factor method** (PFM).
 - 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.

A Broad Financial Stability Indicator (cont.)

- Weights on **UFF**:
 - Considering that the **relevance of the financial system** must be based on how well the financial system is allowing **economic resource allocation**, we regress a measure of real activity y over the j -lag of our financial unobserved factors:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta'_{UFF} \mathbf{UFF}_{t-j} + \varepsilon_t \quad (3)$$

$$\omega_{UFF} \equiv \frac{1}{\mathbf{1}'\beta_{UFF}} \beta_{UFF} \quad (4)$$

A Specific Financial Stability Indicator

- 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 may not be true for middle-income countries.
 - We 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.
 - Role of the **specialist** that choose the series.

A Specific Financial Stability Indicator (cont)

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):*

$$FSI_t^S = \omega'_{FSC} \mathbf{FSC}_t, \quad (5)$$

where $\mathbf{FSC}_t \equiv [CMI_t \ DMI_t \ EMI_t]'$ is a financial system's component vector and $\omega_{FSC} \equiv [\omega_{CMI} \ \omega_{DMI} \ \omega_{EMI}]'$ is a vector of weights calculated as in (3) and (4).

A Business Cycle Decomposition

- Idea: variations in output are associated with both financial and non-financial factors.
- We propose a methodology to decompose business cycle fluctuations (BCD) in two factors - a **Financial Factor (FF)** and a **Real Factor (RF)**.
 - Identified from co-movements of financial and non-financial variables.
 - Useful as a robustness check of the dynamics of our FSI's.

A Business Cycle Decomposition (cont.)

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:*

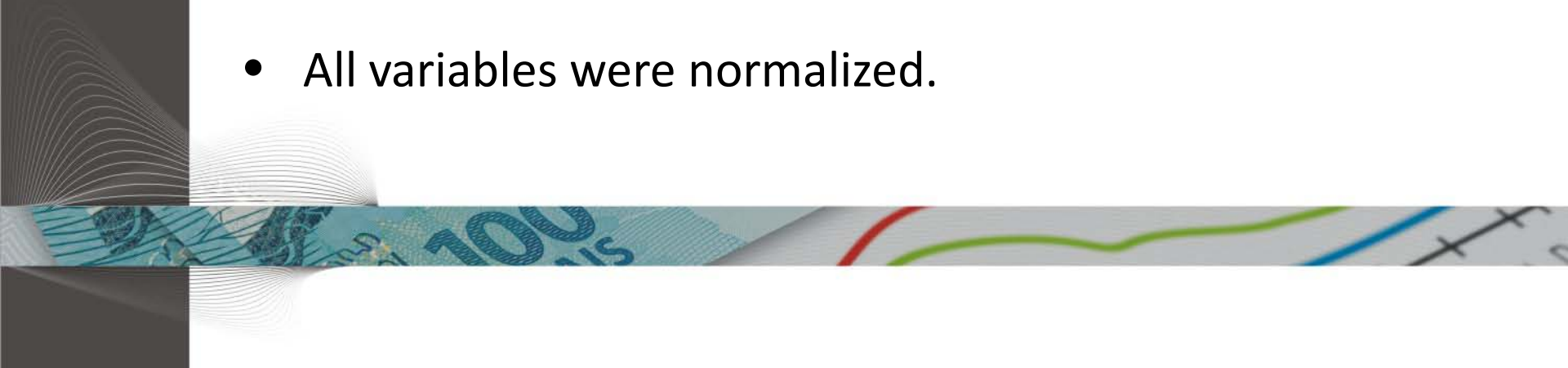
$$\text{Signals} \begin{cases} y_t = \alpha y_{t-1} + FF_t + RF_t + v_t \\ \mathbf{X}_t^F = \mathbf{\Lambda}^F FF_t + \boldsymbol{\xi}_t^F \\ \mathbf{X}_t^R = \mathbf{\Lambda}^R RF_t + \boldsymbol{\xi}_t^R \end{cases} \quad (6)$$

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

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 $N^R \times 1$.

Data and Estimation

- Quarterly data from 1995:Q1 to 2011:Q4.
- Series expressed in the Brazilian currency deflated using IPCA.
- All variables in variation of the logs.
- All variables were normalized.



Data and Estimation (cont.)

- y : Quarterly GDP.
- FSI^B :
 - Monetary indicators (7 series);
 - Credit (9 series);
 - Others: International reserves, Exchange rate, Real effective exchange rate, Selic interest rate, Gold, Ibovespa stock index, VIX, EMBI Brazil, NPL, NPLP.
- FSI^S : Real effective exchange rate, Selic interest rate, NPLP.
- BCD: Formal employment, IPCA free, M1, NPLP.

Data and Estimation (cont.)

- FSI^B: steps
 - Balanced sample ordinary Pearson 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**.
 - Perform an OLS regression of equation (3) using the second lag of each factor to calculate the **weights**.
 - Combine the **weights** with the latent financial factors to obtain our FSI^B.

Data and Estimation (cont.)

- FSI^S:
 - similar to FSI^B, but using a **small number of observable variables**.
- BCD (FF):
 - **Kalman Filter** performing BHHH optimization algorithm to estimate the model with just two financial variables and two real variables to obtain the common unobserved Financial Factor FF.

Results

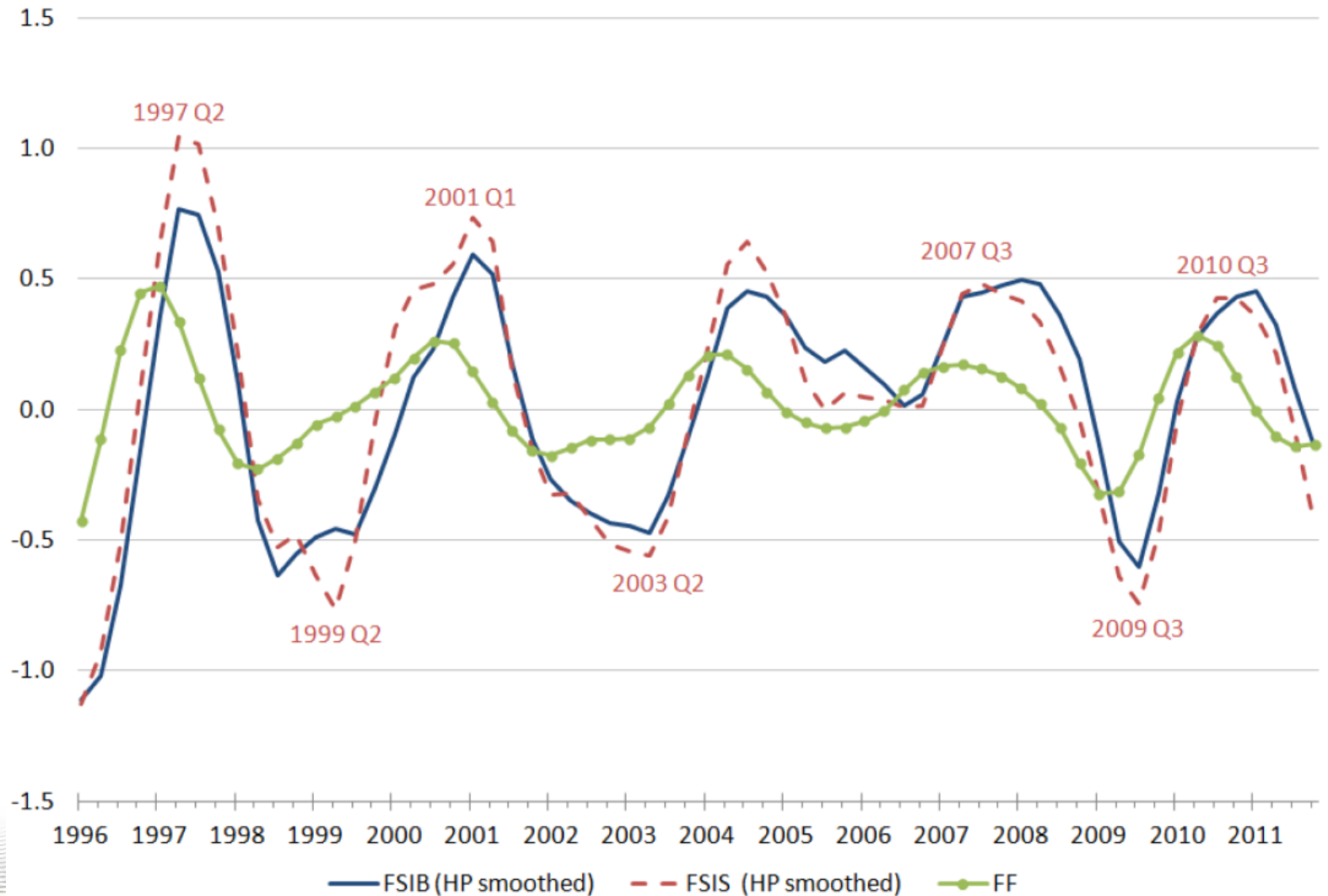


Figure 1: Measures of Financial Stability

Results (cont.)

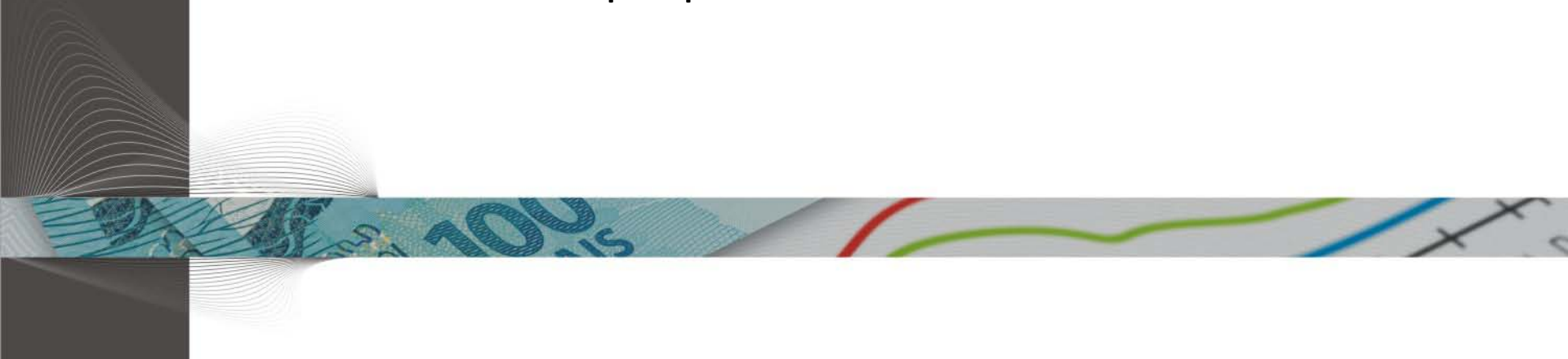
- Three periods of attention:
 - **1998 Q3 to 1999 Q2**: speculative attack on the Real;
 - **2002 Q3 to 2003 Q2**: government transition;
 - **2008 Q4 to 2009 Q3**: Intensification of the subprime financial crisis triggered by the collapse of the Lehman Brothers.

Summing up

- Methodologies to construct **aggregate measures** of financial stability:
 - Simple **methodological exercise** (in sample and ex post);
 - Financial **conditions** versus financial **stability**;
 - Financial stability and **tail risk**;
 - Ad hoc assumptions: number of factors, lags etc;
 - Only quarterly data.

Next Steps

- Just a first step! Looking ahead...
 - Aggregate measure of financial indicators affecting the **conditional tail** of economic activity (e.g. quantile regression).
 - Data with mixed frequency.
 - Out of sample performance.



Thank You!

- For more detailed information, see Central Bank of Brazil Working Paper 287 (2012):
 - <http://www.bcb.gov.br/pec/wps/ingl/wps287.pdf>

