What Need Central Banks to Do to Incorporate Financial Stability Considerations in Their Models?

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Introduction

- Fundamental phenomenon and concept underlying macro-prudential supervision and regulation is systemic risk
- Relevance made crystal clear by the financial and economic crisis
- One definition of systemic risk (ECB 2009): Risk that financial instability becomes so widespread that it impairs the functioning of a financial system to the point where economic growth and welfare suffer materially
- Can involve all components of financial systems ("horizontal") and two-way relationship with the economy at large ("vertical")
- Macroprudential supervision and regulation
  - Public surveillance and regulatory policies to identify, assess and contain systemic risk
  - Two variants
    1) Preventing crises or creating buffers against them ("asymmetric")
    2) Managing the credit cycle ("symmetric")

Outline

- Introduction and definitions of systemic risk and macroprudential policy
- Outline
- A look back at the conference
- What should central banks do in their modelling efforts?
- An example of an empirical macro model with systemic financial instability
- Concluding remarks and way forward

A look back at the conference I

- **BIS CCA research network very important**
- **Has some important points in common with the ESCB Macroprudential Research Network (MaRs), which we run since 2010**
- **Papers with high academic quality and I learnt a lot**
  - **In particular (calibrated/estimated) theory**
  - **Rich on country characteristics (important for macropru)**
- **Main themes**
  - **How can financial sectors and frictions (tailored to country specificities) be incorporated in standard macro models?**
  - **How do shocks affect the business cycle in such macroeconomies?**
  - **How do different policies affect macro dynamics?**
- **Less featured**
  - **Empirical models (example later in my presentation)**
  - **Models of "optimal" macroprudential policies (systemic financial risk, benefits and costs of policy etc.)**

A look back at the conference 2

- **Not so clear in the presentations**
  - **How close to policy support are/will be models presented?**
  - **Role of non-linearities**

What should central banks do? I

- Humility: Our views and choices may not be the right ones for others
- Prior: We want policy to be supported by high quality research and models of high academic standards
- What central banks (with financial stability mandates) need to do their policy job(s)
  - Identify and quantify financial instability and systemic risk
  - Forecast financial stability problems and do early warnings about crises
  - Assess the macroeconomic effects of financial factors and crises and integrate them in macroeconomic forecasting models
  - Develop models to assess macroprudential policies
  - Integrate financial instability in monetary policy models for assessing non-standard policies
  - Compare the relative roles and relationships between monetary and macroprudential policy
- "Tall order"; my focus today on macropru policies, a bit on quantifying systemic instability and assessing the effects of crises

What should central banks do? 2

- **Two basic approaches for putting financial instability in macro (new finance-macro synthesis)**

  1) "Gradualistic": Introduce financial frictions in DSGE, start solving them non-linearly etc.

  2) "Unconventional/Risky": Deep characterisation of financial instability and build macro model around it (monetary policy later)

  - **Generate some robustness through diversity of toolkit**
- **Key elements of macro models assessing macroprudential policies**
  - **Credible characterisation of policy objective, (widespread/ systemic) financial instability**
  - **Two-way interaction between financial sector and real economy**
  - **Coverage of a range of regulatory policy instruments and their benefits and costs**

What should central banks do? 3

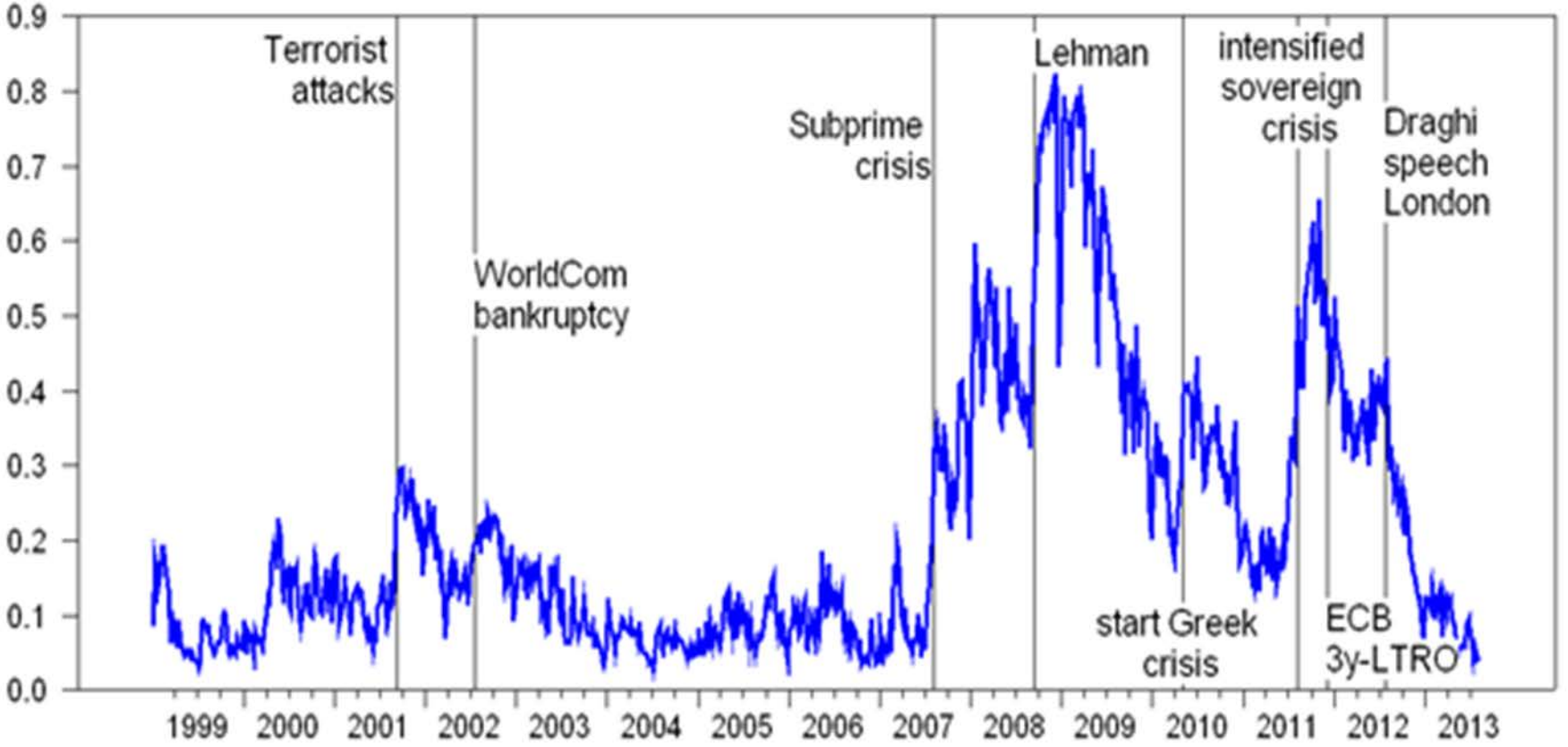
- **Key features of (widespread) financial instability**
  - **Central role of (heterogenous) banks and credit**
  - **At least some financial markets**
  - **Some of the three "forms" of systemic risk (ECB 2009, 2010)**
    - **Contagion**
    - **Endogenous build-up and unravelling of financial imbalances**
    - **Aggregate shocks**
  - **Room for drastic and widespread adjustments (finance theory): Non-linearities, discontinuities, endogenous risks, feedback and amplification mechanisms (related to bank defaults, bank losses, drastic market illiquidities, fire sales etc.)**
    - **Within financial system**
    - **Between financial system and real economy**

Example of a novel empirical macro model with systemic financial instability

- **Hartmann, Hubrich, Kremer and Tetlow (2013), Melting down: Systemic financial instability and the macroeconomy**
  - **Capture systemic financial instability with the ECB's Composite Indicator of Systemic Stress ("CISS"; Hollo, Kremer and Lo Duca 2012)**
  - **Embed the CISS in a richly specified Markov-Switching Bayesian Vectorautoregression (MS-VAR; Sims, Waggoner and Zha 2008) model otherwise featuring standard macro and financial variables**
    - **Regime switches/non-linearities (estimated parameters and error variances are allowed to switch independently)**
    - **Two-way interactions (feedbacks), in particular between instability in the financial sector and the real economy**
- **Variables: output growth (ΔIP), inflation, 3-month money market rate, loan volume and CISS (S)**
- **Data: euro area, monthly, 1987-2010**

- **This model not for assessing regulatory policy instruments, but for assessing the non-linear effects of financial crises on the real economy**

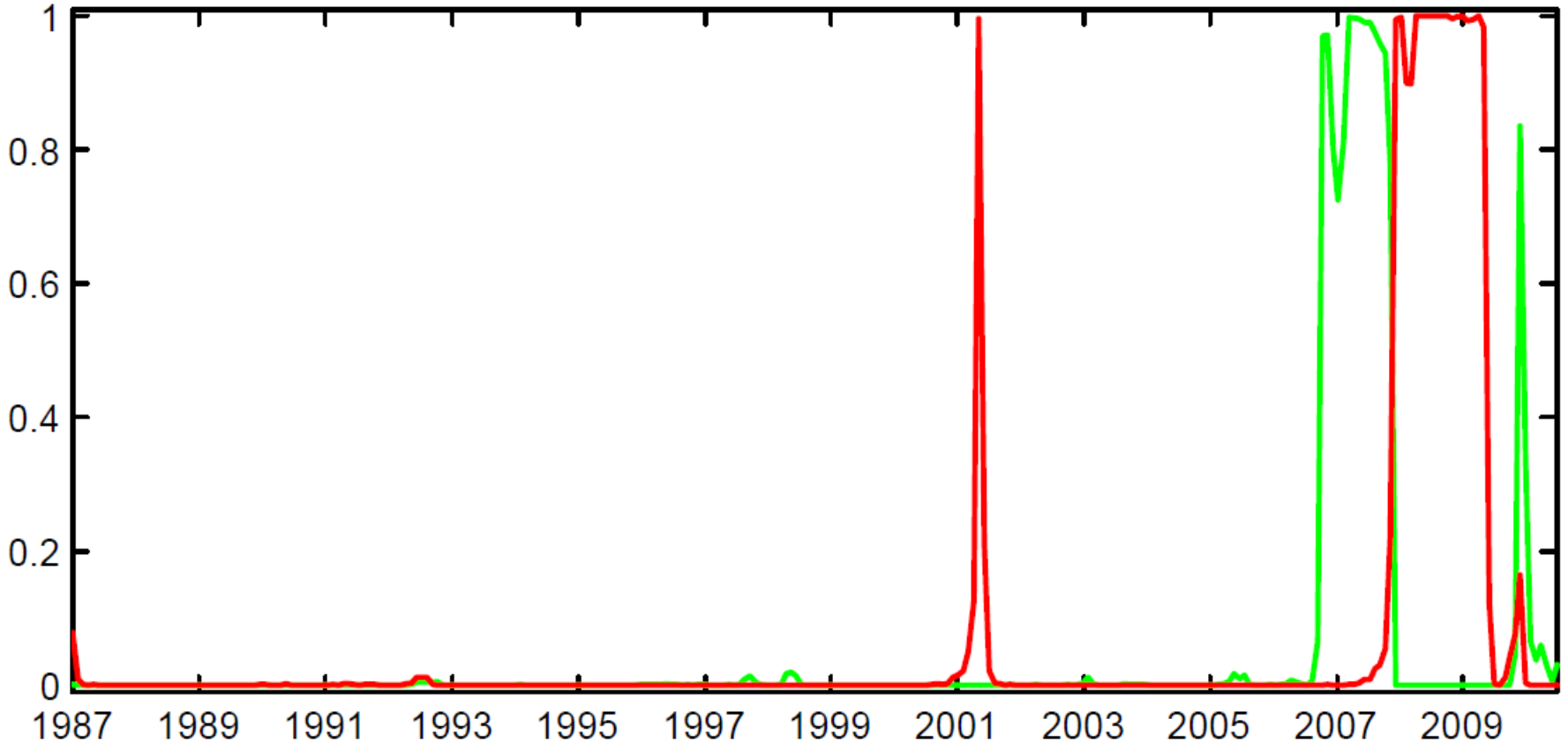
Composite indicator of systemic stress ("CISS")



- **Scope: Equity, bond, money and FX markets plus banking (various sub-items) - real time**
- **Basic sub-measures include volatilities, trends, spreads, recourse to marginal lending (weekly data)**
- **Normalisation between 0 and 1 and aggregation weighted with correlations ("systemic")**

Source: Hollo, Kremer and Lo Duca (2012)

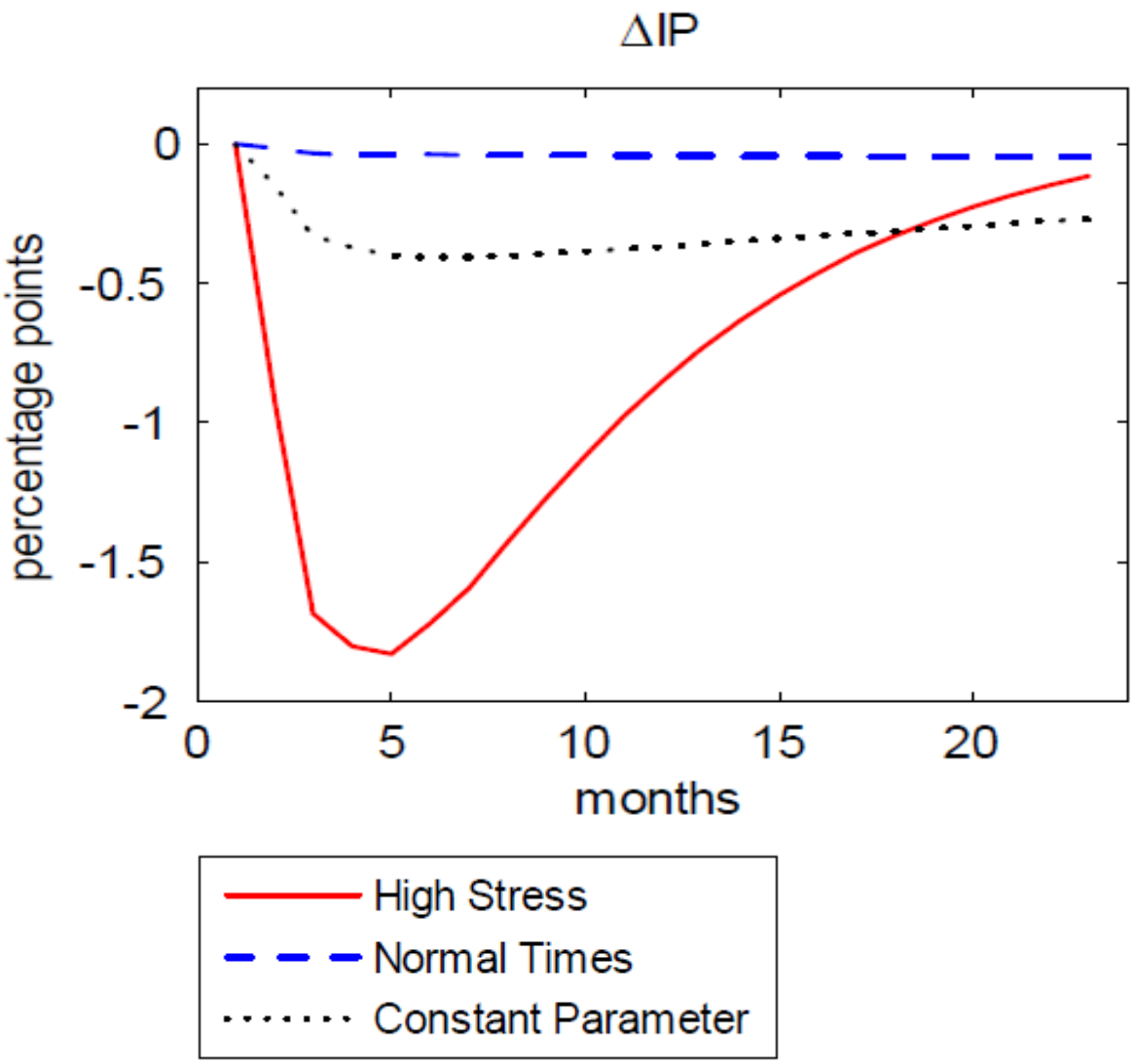
State/regime probabilities



- **Red (regime 6: HV,HC): May 2008 protracted; Sept 2001 short-lived**
- **Green (regime 5: HV,LC): July 2007 protracted ("market turmoil")**
- **Labelling is plausible: Fundamental change in macroeconomy at times of severe systemic events**

Source: Hartmann et al. (2013)

Impulse response functions for CISS shocks



- **Tremendous difference in the effect of 1 SD shock in *S* on Δ*IP* for "bad" regime 6 and tranquil times**
- **CISS increase by 0.1 in "bad" regime leads to an output contraction of 2 pp. over 5 months (in 08/07 and 09/08 systemic stress increases were 3 to 4 times larger)**
- **No effect in normal times**
- **Severe underestim-ation of output effects with traditional models**

Source: Hartmann et al. (2013)

Concluding remarks and way forward

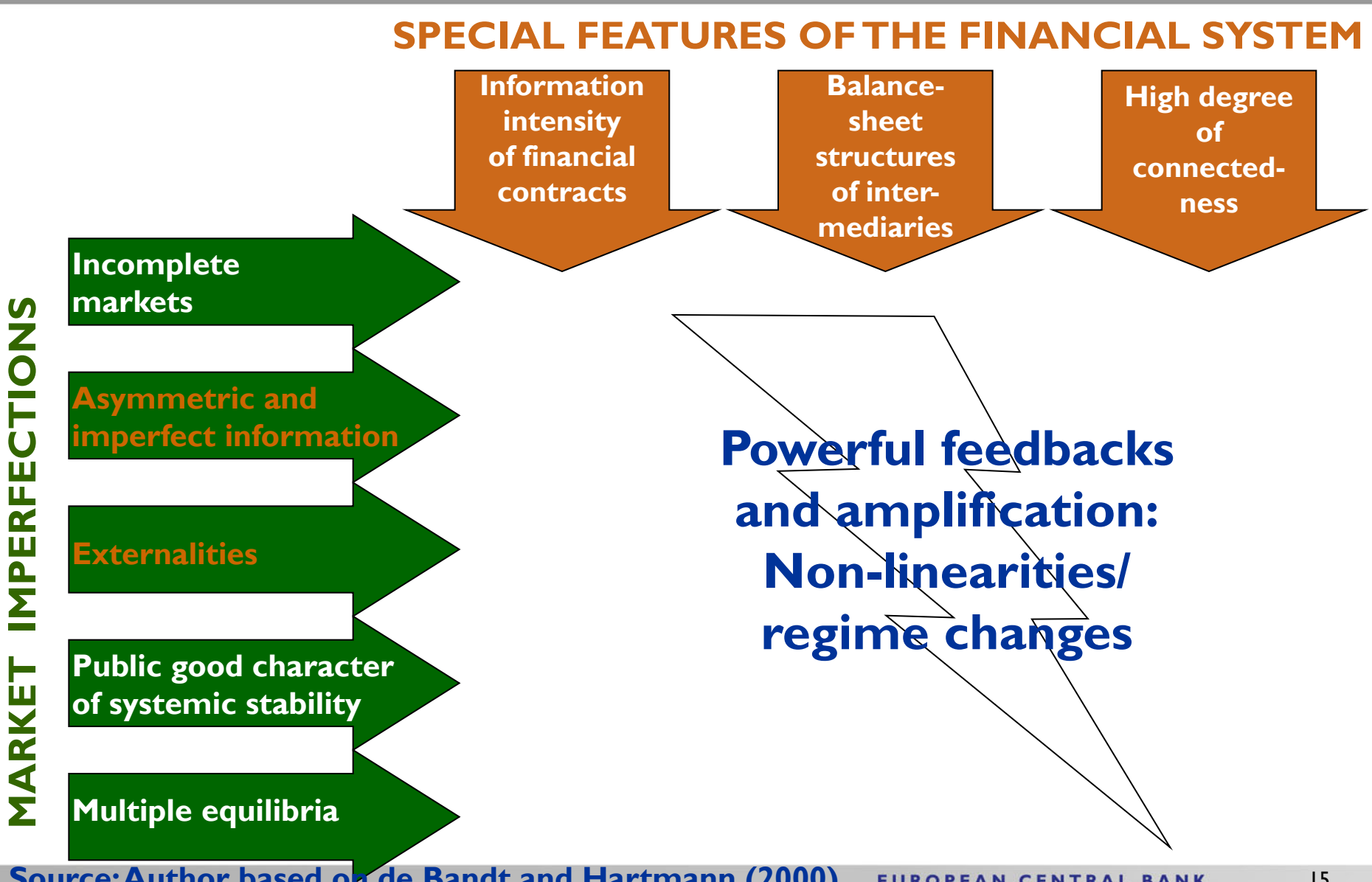
- **Integrating financial instability in macro models may be (one of) the greatest challenge(s) of the economics profession in present times**
- **The nature/complexity of (widespread) financial instability makes it that both the "gradualist" and the "unconventional" approach need to be pursued, in particular from a perspective of supporting macroprudential policies**
- **In the context of MaRs we have made several advances in both dimensions, making sure the second is not crowded out by the first**
- **We invite colleagues from both central banks and academia to join us in also pushing forward the "unconventional" approach that puts realistic characterisations of widespread financial instability at the centre of the attention**
- **One could go even further by using methodologies from other sciences, e.g. agent-based modelling (moving away from rational expectations and general equilibrium), which we do not do at present**

Background reading

- **Hartmann, Hubrich and Kremer (2013), Introducing systemic financial instability into macroeconomics: How to meet the challenge?, ECB Research Bulletin, no. 19, Autumn (see handout)**

Annex

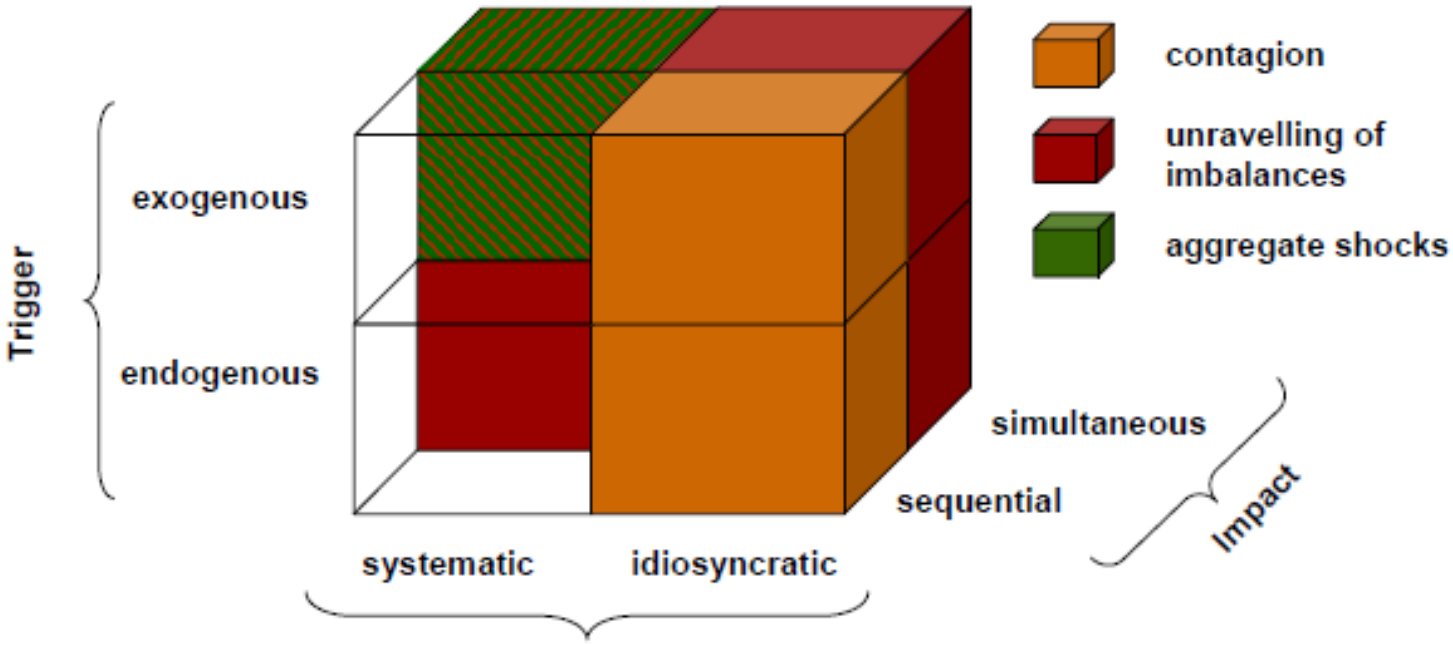
Ultimate sources of systemic risk



Source: Author based on de Bandt and Hartmann (2000)

Forms of systemic risk and analytical approaches

The systemic risk cube:



Analytical models/tools for systemic risk:

- **SR 1: Contagion – Contagion and spillover models**
- **SR 2: Endogenous build-up and unravelling of widespread imbalances – Early warning indicators and models**
- **SR 3: Aggregate shocks – Macro stress testing models**

Source: Author based on de Bandt, Hartmann and Peydró (2009) and ECB (2010a)

Macro-prudential Research Network (MaRs)

- **Central bank research network at the level of the European Union launched in spring 2010 (economists under heads of research from EU-27 central banks)**
- **Objective: Develop core conceptual frameworks, models and/or tools that would provide research support to improve macro-prudential supervision in the EU (http://www.ecb.europa.eu/home/html/researcher_mars.en.html)**
- **Three work streams**
  - **WS1: Macro-financial models linking financial stability and the performance of the economy (also this paper!) – incl. structural model for policy assessment**
  - **WS2: Early warning systems and systemic risk indicators – incl. database of crises in Europe**
  - **WS3: Assessing contagion risks – incl. cross-border contagion project**
  - **Overall ca.120 projects, so far >80 draft papers, more than half ECB WPs**
  - **First journal publications, incl. *JFE*, *EJ*, *EP* etc.**
- **Consultants: Hans Degryse (KU Leuven) and Javier Suarez (CEMFI, Madrid)**
- **Report on progress and results after two years (October 2012, http://www.ecb.int/pub/pdf/other/macroprudentialresearchnetworkreport201210en.pdf)**
- **Final report expected in late spring/early summer 2014**

Research questions MaRs work stream 1

Macro-financial models linking financial stability and the performance of the economy

- How can financial instability be represented in an aggregate economic model?
- How does widespread financial instability affect the real economy?
- What are the main transmission channels of financial instability at the aggregate level?
- What role is played by non-linearities, amplification and feedback effects?
- What are the cumulative effects of the two-way interaction between financial instability and the performance of the economy at large, including the build-up and unravelling of financial imbalances?
- How can the leverage cycle be described theoretically and empirically?
- How can these models help understand the causes and features of the recent financial crisis?
- How can models help identify the appropriate macroprudential policies to maintain systemic stability?

Central research area of work stream 1…

- How widespread financial instability can be integrated into aggregate models
- Relatively fundamental research, addressing one of the main weaknesses of contemporaneous economics laid bare by the crisis
- Two steps: 1) Well captured financial sector; 2) Widespread instability in it
- Different models feature different characterisations of financial instability, including endogenous risks, nonlinearities, regime changes, representations of bank default (including bankruptcy rules), fire sales, widespread illiquidity of markets etc.
- Most papers focus on the role of unravelling of widespread imbalances and aggregate shocks (two of three major forms of systemic risk)
  - Asset side: Banks' exposure to bubbles
  - Liability side: Wholesale financing, build-up of aggregate liquidity
- Allows to analyse the channels through which financial instability is transmitted to the real economy
- Improves the understanding of the leverage cycle

…necessary step for policy assessment tools

- A very important area of progress relates to models helping to assess the effectiveness of macroprudential regulatory policy instruments
- Capture the aggregate benefits and costs of regulations
- Different instruments considered so far:
  - Loan-to-value (LTV) ratios, capital requirements, leverage caps, liquidity ratios, dynamic provisioning, limits on FX lending or currency mismatches and margin requirements on repos
  - Most of these instruments are found to be effective, but (i) some suggested to be finetuned and (ii) risks of unintended side effects need to be managed
  - Multitude of market imperfections that contribute to systemic risk cannot be addressed with a single regulatory instrument (indiscriminate combinations of different regulations can, however, also become counterproductive)
  - Critical element: Controlling fire sale risk
- Ongoing unique effort to complete a "canonical model" for assessing macroprudential regulatory policy instruments, code, calibrate and run policy simulations with it (by 9 NCBs and the ECB)

Research questions MaRs work stream 2

Early warning systems and systemic risk indicators

- What are the key macroprudential early warning indicators for groups of countries with relatively similar financial structures in the European Union?
- How can the different indicators be aggregated at the EU level?
- What are the best early indicators of widespread imbalances, asset price bubbles, credit booms and over-indebtedness, distinguishing particularly between credit and valuation developments that are driven by (fundamentally justified) factors in the real economy and developments that involve systemic risks?
- What are the best indicators of current systemic stress or instability?

Research questions MaRs work stream 3

Assessing contagion risks

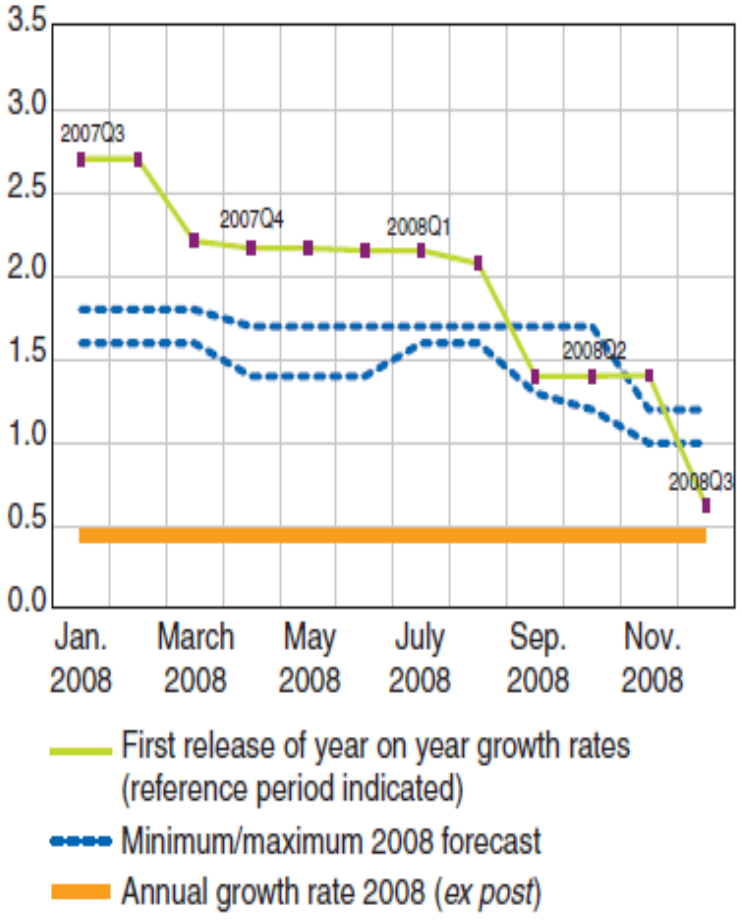
- How large are cross-border bank contagion risks compared to domestic risks?
- How significant are the risks of spillovers between different types of intermediaries?
- Is bank contagion risk significantly enhanced when feedback effects are taken into account?
- Can one distinguish between contagion risk, as one form of systemic risk, and the unravelling of imbalances, the Minsky-Kindleberger type of systemic risk?

Impact of widespread financial instability on growth

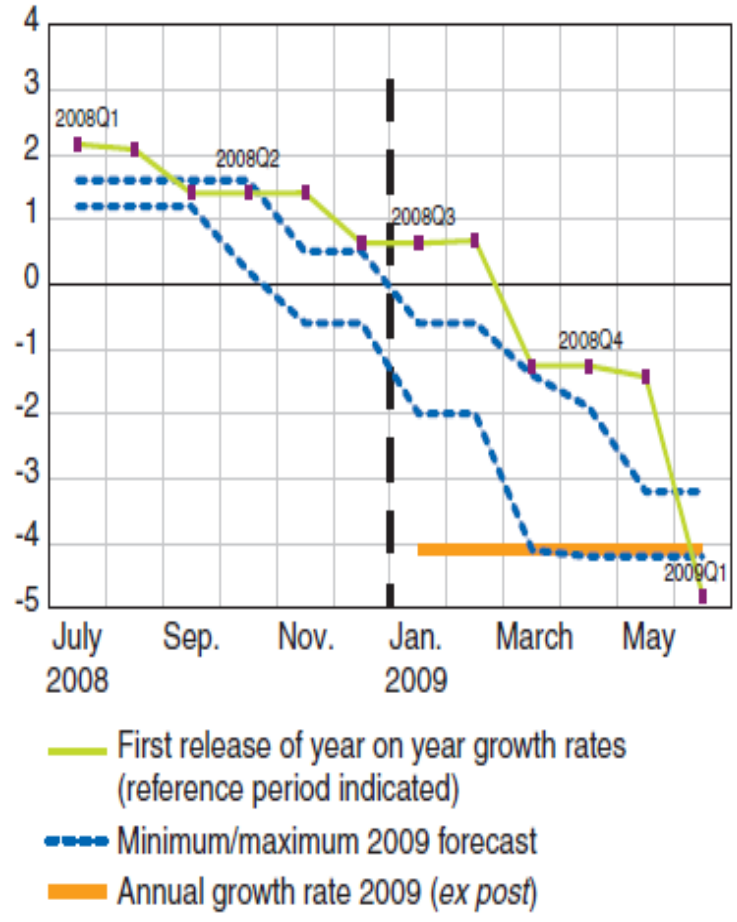
Real time euro area GDP growth forecast errors and coincident growth releases

(%)

a) For 2008

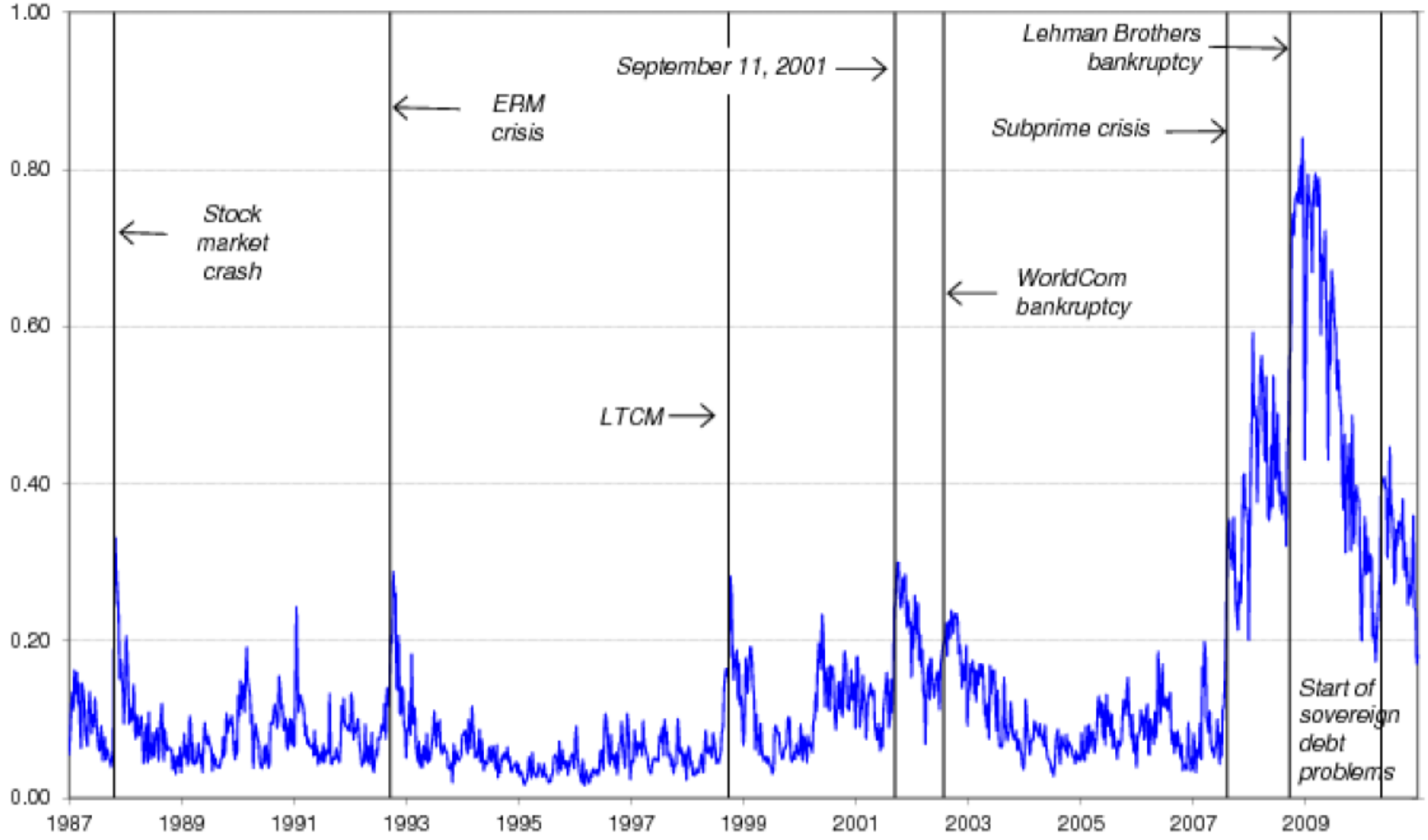


b) For 2009



Source: Trichet (2011)

CISS and stress events between 1987 and 2010



The Markov-Switching Vector Autoregression model

$$y'_t A_0(s_t^c) = \sum_{l=1}^{p} y'_{t-l} A_l(s_t^c) + z'_t C(s_t^c) + \varepsilon'_t \Xi^{-1}(s_t^v) \qquad \textbf{(1)}$$

y_t: vector of endogenous variables [nx1] ;

z_t: vector of exogenous variables and intercept terms; later assumed to be only intercepts [nx1];

ε_t: error terms, vector of random shocks [nx1];

Ξ: diagonal matrix containing the standard deviations of the shocks [nxn];

A_0 [nxn], A_l [nxn], C[1xn]: coefficient matrices;

s_t^c, s_t^v: unobserved state variables evolve according to two independent first-order Markov processes:

$$\Pr(s_t^m = i | s_{t-1}^m = k) = p_{ik}^m, \quad i,k = 1,2,..h^m \quad \text{, m=c,v} \qquad \textbf{(2)}$$

Let $Y^t = \{y_0, y_1, ... y_t\}$ as the vector y stacked in the time dimension, then the structural disturbances are conditionally normal:

$$\varepsilon'_t(s_t^v) | Y^{t-1} \sim N(0_{n\,x1}, I_n) \qquad \textbf{(3)}$$

Data and identification

- **Endogenous variables:** $y_t = [\Delta IP_t, \Delta P_t, R_t, \Delta Ln_t, S_t]$
  - ΔIP_t: growth rate of industrial production
  - ΔP_t: inflation rate (HICP)
  - R_t: money market rate (3-month Euribor)
  - ΔLn_t: growth rate of bank lending
  - S_t: CISS
- **Identification**
  - Choleski decomposition, ordering of variables as above
  - Systemic financial stress responds instantaneously to innovations in all other variables (but not vice versa)
  - Results robust to other orderings
- **Data sample: Euro area**
  - monthly frequency, at annual rates
  - January 1987 to December 2010
  - seasonally adjusted

Source: Hartmann et al. (2013)