EUROPEAN CENTRAL BANK

EUROSYSTEM

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# Directions for Developing Economics After the Crisis

Panel intervention at the International Conference in Honour of Niels Thygesen on "Financing the Future – Analytical and Policy Challenges in Europe, China and in an Interdependent World"
University of Copenhagen, 5 December 2014

*Disclaimer: The views expressed are those of the speaker and do not necessarily reflect those of the ECB or the Eurosystem*

# Short overview of the Macro-prudential Research Network (MaRs)

## ESCB network established in 2010 by the General Council

- Mandate: develop core conceptual frameworks, models and tools that provide research support to improve macro-prudential supervision in EU
- Three work streams
  1. Macro-financial models linking financial stability and the performance of the economy (WS1)
  2. Early warning systems and systemic risk indicators (WS2)
  3. Assessing contagion risks (WS3)

## Output

- 161 individual research papers (WS1 – 65, WS2 – 51, WS3 – 45)
- 72 ECB Working Papers by this summer (WS1 – 32, WS2 – 27, WS3 – 13)
- 50 published in journals (WS1 – 21, WS2 – 18, WS3 – 11), including *Journal of Political Economy, Journal of Financial Economics*, *Economic Journal*, *Journal of Monetary Economics*
- 3 large joint cross-country projects
- 3 large public conferences: October 2011, October 2012 and June 2014
- Comprehensive report: http://www.ecb.europa.eu/press/pr/date/2014/html/pr140623.en.html

# Some quick reactions to Borio and Frydman

## ➢ Introducing financial instability into macroeconomics (MaRs WS1)

- "Finance-less" pre-crisis macroeconomic paradigm (main challenge of economics today!)
- MaRs made major effort in contributing to rectifying this (several models published!)
- But systemic financial instability more than introducing financial cycles in macro models
  - Regular versus crisis cycles (see also structural change below)
  - Contagion (MaRs WS3) versus unravelling of bubbles
- Longer financial than business cycle also in euro area but diverse (Schüler et al. 2014)
- MaRs WS2 confirmed BIS-type credit gaps as early warning indicators and developed their use further
- But early-warning system needs to include many variables in conjunction with them

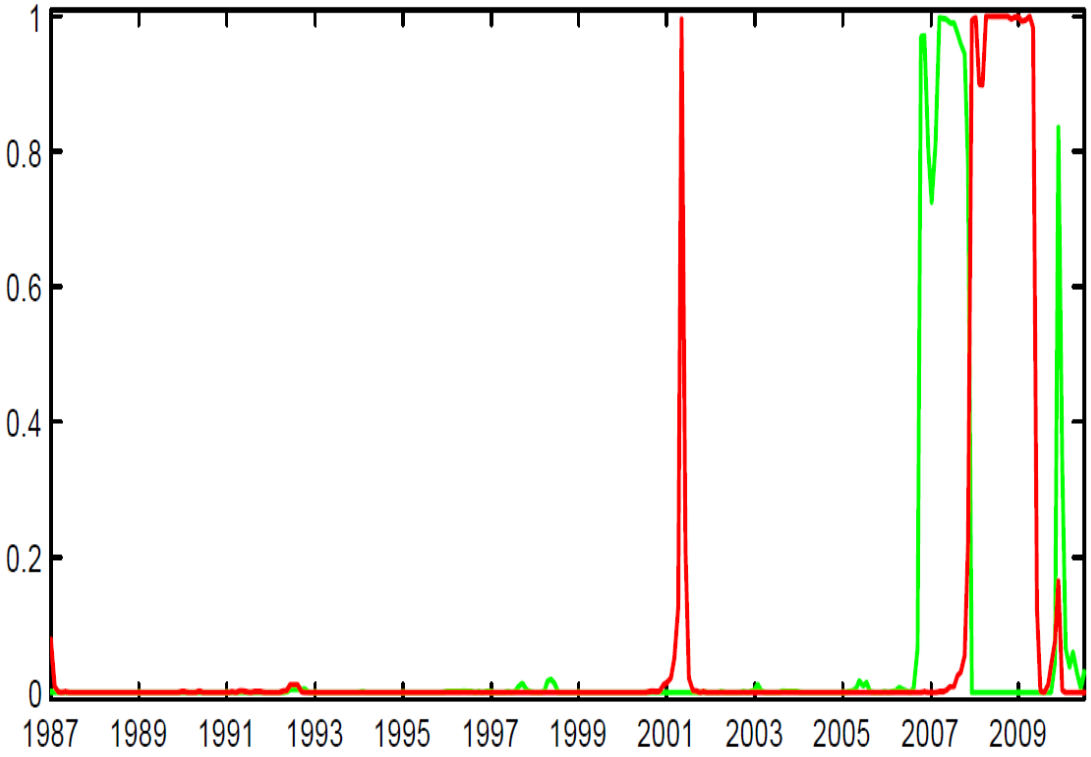
## ➢ Uncertain structural change associated with financial crises

- Crises tend to be associated with drastic, non-linear adjustments (historical experience and finance theory)
- Can be associated with fundamental structural change that is uncertain
- Next slides: Empirical model from MaRs WS1 how to analyse this, which can also be used as an analytical tool for supporting policy (Hartmann et al. 2012)

# Empirical macro model with systemic financial instability 1

## ➢ Uncertain structural change associated with financial crises

- Take Bayesian vectorautoregression model with output growth, inflation, interest rate and credit growth allowing feedback effects between all variables (monthly data, 1987-2010)
- Incorporate our Composite Indicator of Systemic Stress (CISS; see slide 26) in it
- Add Markov-Switching/regime changes in parameters and error variances

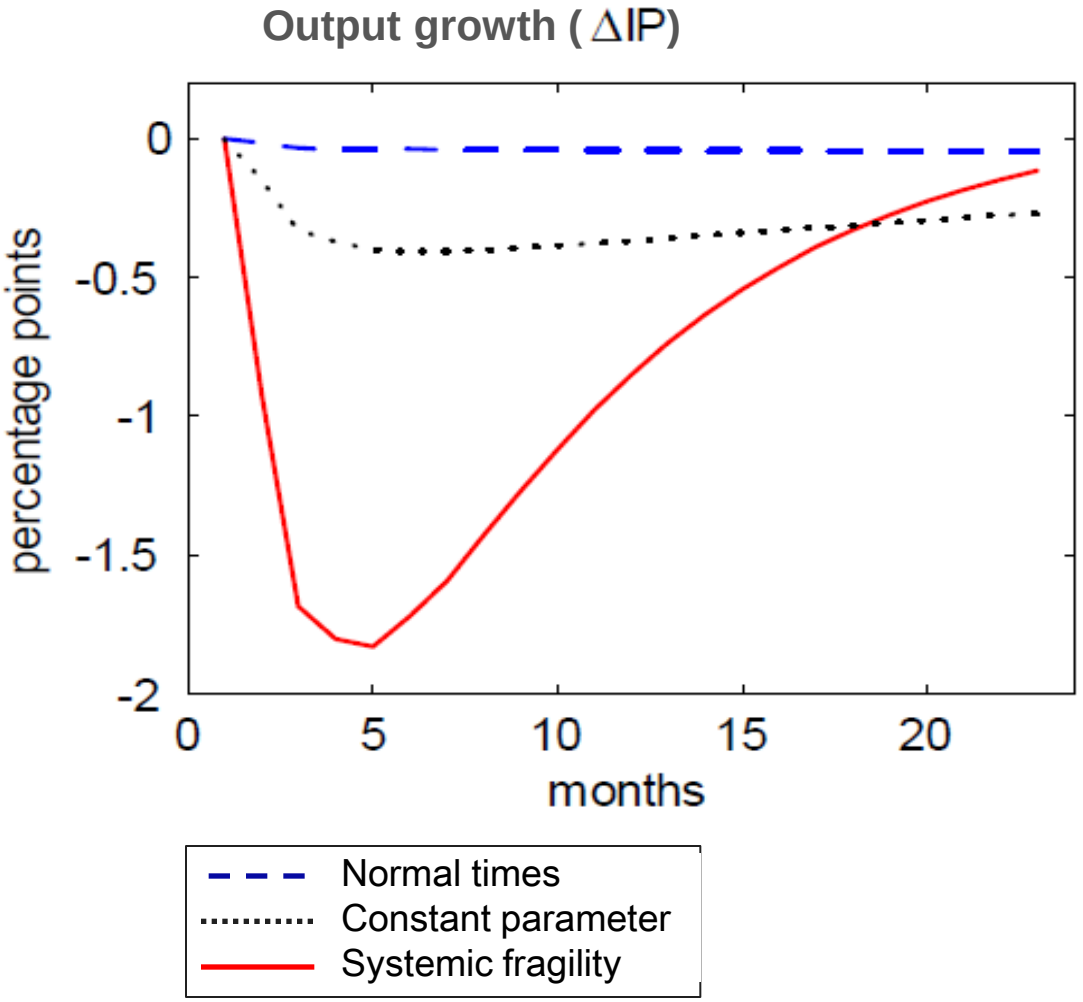



*Source: Hartmann, Hubrich, Kremer and Tetlow (2012).*

- Red: Probability of extreme regime in which parameters and variances have switched
  - Parameters: Strong transmission of financial shocks to the real economy
  - Variances: High uncertainty/large shocks
- Happens in September 2001 (short-lived) and May 2008 (protracted)
- Nowcasting states of "systemic fragility" (e.g. mandate of European Systemic Risk Board to identify states of emergency)

# Empirical macro model with systemic financial instability 2

## ➢ Non-linear impact of widespread financial instability on growth




*Source: Hartmann, Hubrich, Kremer and Tetlow (2012).*

- Tremendous difference in the effect of 1 standard deviation shock in the CISS on output growth between the regime of "systemic fragility" and tranquil/normal times
- CISS increase of 0.1 under "systemic fragility" leads to an output contraction of 2 pp. over 5 months (in August 2007 and September 2008 systemic instability increases were 3-4 times larger)
- No effect in normal times
- Severe underestimation of output effects with traditional models
- Model can also be used for scenario analysis and, may be, forecasting

# Concluding remarks

- There is still a long way to go in solving all the problems in our usual economic models and tools that the crisis has unearthed
- A key area for central banks is the development of macro models with realistic characterisations of widespread financial instability (one key focus of MaRs)
  - To support macro-prudential policies
  - To support unconventional monetary policies
- One, may be the main challenge for economics today
- Such models, ultimately, need to find their way in the standard economics curriculum taught at universities
- The change needed has, indeed, paradigmatic dimensions
- We also need to be open to non-standard techniques (e.g. from other sciences, such as agent-based models stepping away from too extreme rationality assumptions and exclusive equilibrium thinking)

# Annex

# MaRs and internal references in the presentation 1


- Alessi, L., & Detken, C., 2014, Identifying excessive credit growth and leverage, ECB, *Working Paper Series*, 1723.
- Aoki, K., & Nikolov, K., 2012, Bubbles, banks and financial stability, ECB, *Working Paper Series*, 1495.
- Babecký, J., Havránek, T., Matějů, J., Rusnák, M., Šmídková, K., & Vašíček, B., 2012. Banking, debt and currency crises: Early warning indicators for developed countries, ECB, *Working Paper Series*, 1485.
- Boissay, F., Collard, F., & Smets, F., 2013, Booms and systemic banking crises, ECB, *Working Paper Series*, 1514.
- Boissay, F., Hartmann, P., & Nikolov, K., forthcoming, Financial instability in macroeconomics: A set of new models, ECB, *Research Bulletin*.
- Clerc, L., Derviz, A., Mendicino, C., Moyen, S., Nikolov, K., Stracca, L., Suarez, J., & Vardoulakis, A., 2014, Capital regulation in a macroeconomic model with three layers of default, ECB, *Mimeo*.
- de Bandt, O., Hartmann, P., & Peydró, J. L., 2010, Systemic risk: An update, in A. Berger et al. (eds.), *The Oxford Handbook of Banking*, Oxford University Press, 633-672.
- European Central Bank, 2009, The concept of systemic risk, *Financial Stability Review*, December, 134-142.
- European Central Bank, 2010, Analytical models and tools for the identification and assessment of systemic risks, *Financial Stability Review*, June, 138-146.
- European Central Bank, 2014, Results of the Macro-Prudential Research Network (MaRs), Frankfurt am Main, June.

# MaRs and internal references in the presentation 1


- Hartmann, P., 2011, Macro-financial models linking financial stability and the performance of the economy – a call for a new finance-macro synthesis, panel intervention at the Deutsche Bundesbank/Institute for Monetary and Financial Stability/SUERF conference “The ESRB at 1”, Berlin, 8 November.
- Hartmann, P., Hubrich, K., & Kremer, M., 2013, Introducing systemic financial instability into macroeconomics: How to meet the challenge?, ECB, *Research Bulletin*, 19, 2-9.
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- Trichet, J.C., 2011, Intellectual challenges to financial stability analysis in the era of macroprudential oversight, Banque de France, *Financial Stability Review*, 15, February, 139-149.

# External references in the presentation


- Blanchard, O., 2008, The state of macro, *NBER Working Paper*, 14259, August.
- Brooks, D., 2010, The return of history, *The New York Times*, 25 March.
- Buiter, W., 2009, The unfortunate uselessness of most 'state of the art' academic monetary economics, Financial Times Blog, 3 March.
- Eichengreen, B., 2010, The last temptation of risk, *The National Interest*, May-June.
- Engle, R., 2014, Rethinking economics after the crisis, panel intervention at the concluding conference of the Macro-prudential Research Network, ECB, Frankfurt, 24 June.
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- Krugman, P., 2009, How did economists get it so wrong?, *The New York Times*, 2 September.
- Lucas, R., 2009, In defence of the dismal science, *The Economist*, 6 August.
- Stiglitz, J., 2011, Rethinking macroeconomics: what failed, and how to repair it, *Journal of the European Economic Association*, 9(4), 591-645.
- The Economist, 2009, What went wrong with economics – and how the discipline should change to avoid the mistakes of the past, 16 July.

# On the state of economics 1

- Blanchard (2008): "…a largely shared vision both of fluctuations and of methodology has emerged…Like all revolutions, this one has come with the destruction of some knowledge, and suffers from extremism and herding. None of this is deadly however. The state of macro is good."

- Buiter (2009): "The Monetary Policy Committee of the Bank of England…contained…quite a strong representation of academic economists and other professional economists with serious technical training and backgrounds. This turned out to be a severe handicap when the central bank had to switch gears and changed from being an inflation-targeting central bank to a financial-stability oriented central bank…Indeed, the typical graduate macroeconomics and monetary economics training received at Anglo-American universities during the past 30 years or so, may have set back by decades serious investigations of aggregate economic behaviour and economic policy-relevant understanding. It was a privately and socially costly waste of time and other resources."

- Krugman (2009): "…the economics profession went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth."

# On the state of economics 2

- Stiglitz (2011): "The standard macroeconomic models have failed, by all the most important tests of scientific theory. They did not predict that the financial crisis would happen; and when it did, they understated its effects. Monetary authorities allowed bubbles to grow and focused on keeping inflation low, partly because the standard models suggested that low inflation was necessary and almost sufficient for efficiency and growth. After the crisis broke, policymakers relying on the models floundered…the sum of these failures points to the need for a fundamental re-examination of the models…"

# Limitations identified in (macro)economics

- Mainly criticism of macroeconomics (less financial economics)
- Motivated a lot by the complexities of financial instability

1. Dominance of theory (structural models) over empirics and history
2. One-sided picture of human behaviour
3. Too strong believe in equilibrium and convergence towards general equilibrium (extreme benchmark gets most attention)
4. Negligence of non-linearities, structural instability or amplification/ feedback effects (even practical stress testing)
5. Negligence of information problems and too strong believe in rational expectations
6. Overwhelming use of complete markets (e.g. insolvency and illiquidity excluded)
7. Widespread use of efficient-market hypothesis (e.g. no asset bubbles)

# The key field of macro-finance 1

- Pre-crisis standard macroeconomic models had no financial sector (let alone banks) or it did not play any meaningful role (notwithstanding Bernanke and Gertler's financial accelerator paper)
- Nevertheless, "finance-less" dynamic stochastic general equilibrium (DSGE) models heavily used in central banks (e.g. inflation targeting)
- But historical experience and evolution of central banks' roles suggest that their most important roles are in monetary macro management (price stability) and financial stability (e.g. "lender of last resort")
- Moreover, the two roles interact
  - Financial instability can impair the monetary transmission mechanism
  - Low interest rates can inadvertently stimulate "search for yield" and therefore contribute to future financial stability risks
- Hence, central banks need aggregate models with realistic characterisations of financial instability at the core of their analytical toolkit
- MaRs: Perhaps greatest challenge for economics in present times

# The key field of macro-finance 2

- But this need is more general than just for central banks
- Conclusion of The Economist's (2009) overview article "What went wrong with economics?": "But broader change in mindset is still needed. Economists need to reach out from their specialised silos: macroeconomists must understand finance, and finance professors need to think harder about the context within which markets work."
- Hartmann (Berlin 2011): Call for a new "finance-macro synthesis"

# On the state of economics – Some defences

- Lucas (2009): “Macroeconomists in particular were caricatured as a lost generation educated in the use of valueless, even harmful, mathematical models, an education that made them incapable of conducting sensible economic policy. I think this caricature is nonsense and of no value in thinking about the larger questions…”

- Mankiw (2010): “…relatively few academic economists devote their time to forecasting. The economists you see on TV are often trying to predict the future, but that is hardly a random sample of top economists.” “…I doubt there will be a fundamental change in the field of economics. The old textbooks don’t need to be thrown away. I admit, however, that on this point, I may not be the most objective judge.”

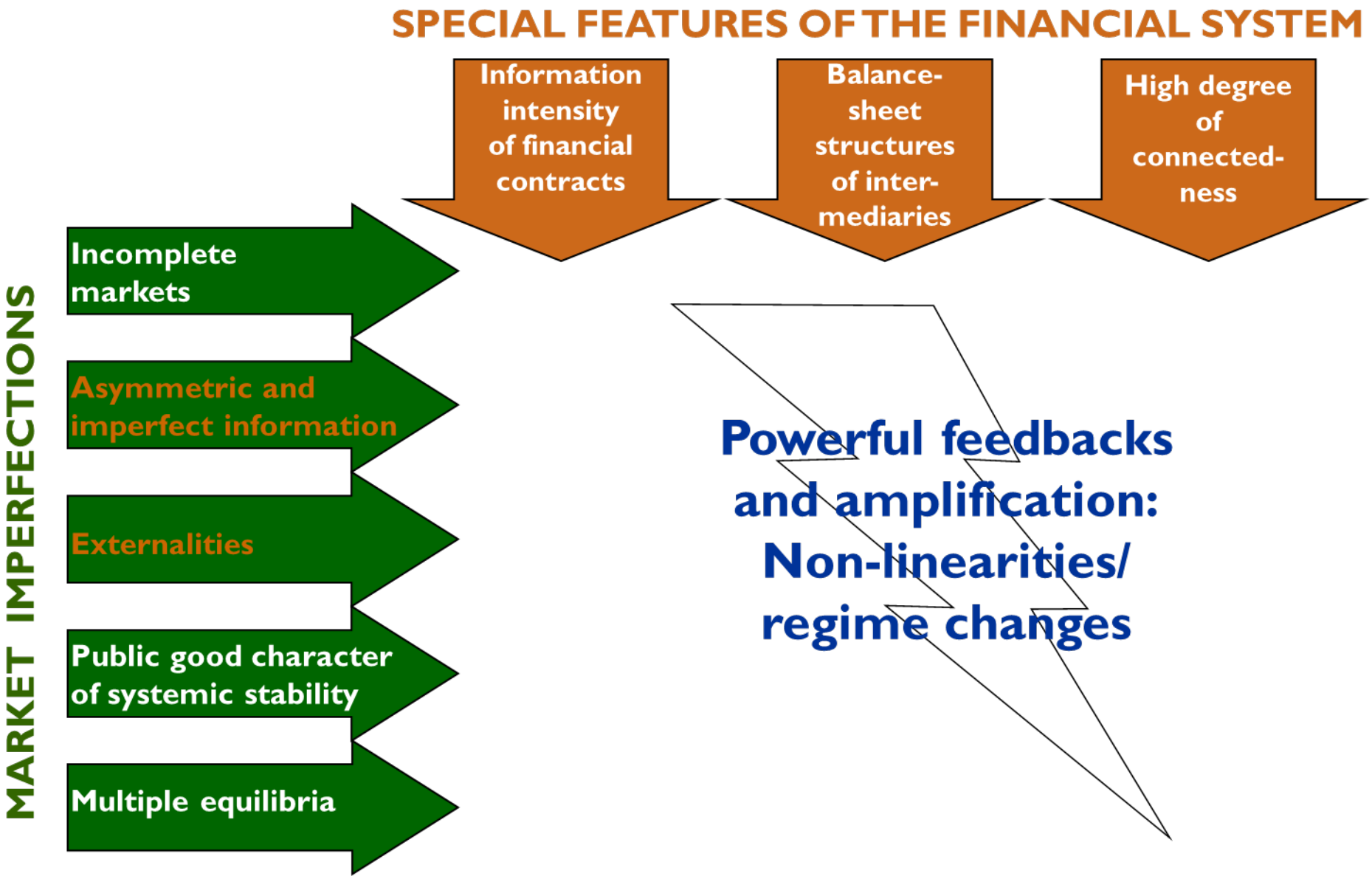
- Eichengreen (2010): “…the problem lay not so much with the poverty of the underlying theory but with the selective reading of it – a selective reading shaped by the social milieu.”

# Introduction: Systemic risk and macro-prudential policy

- 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")…
  - Intermediaries (including so-called shadow banks),
  - Markets and
  - Market infrastructures

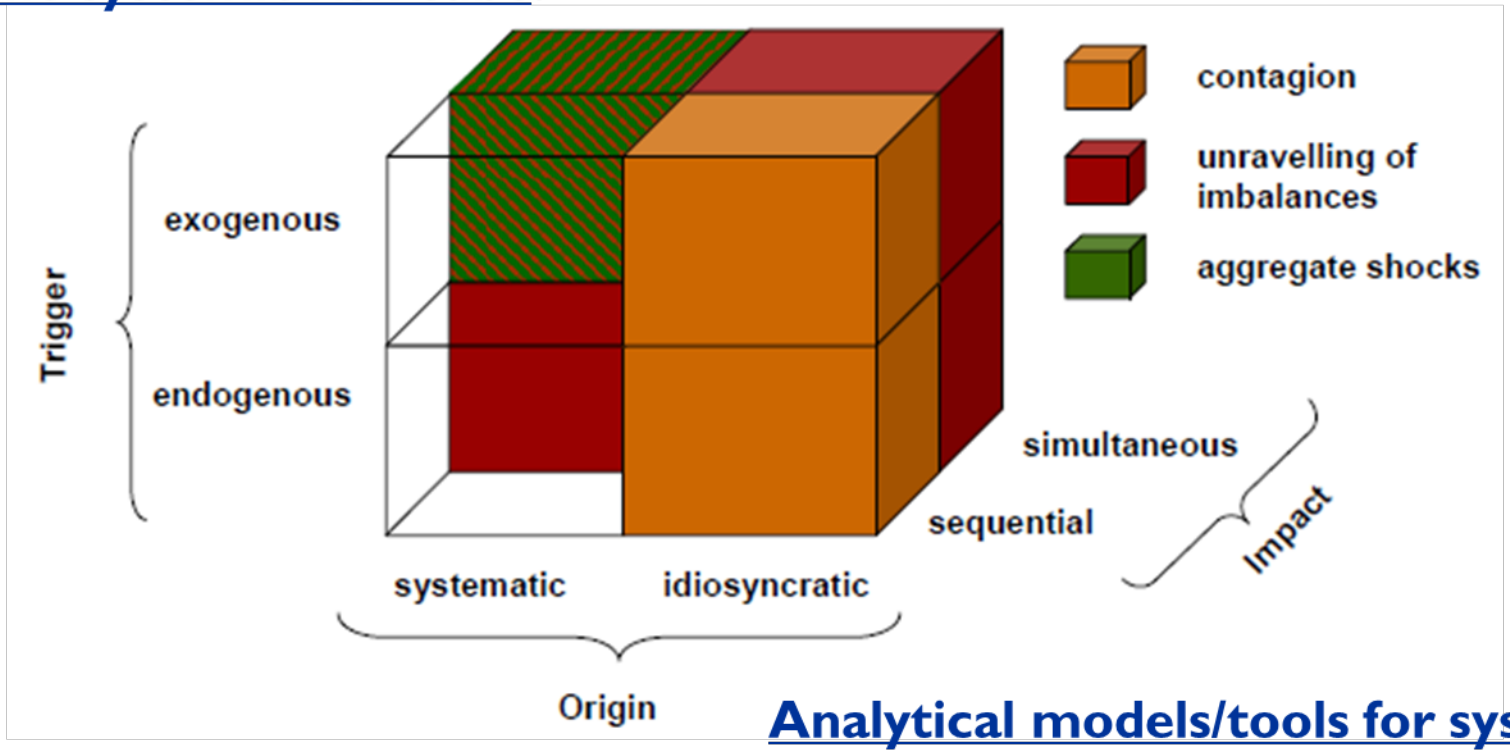
  …and two-way relationship with the economy at large ("vertical")
- Macro-prudential policy
  - Oversight/supervision: Public oversight that aims at identifying and containing systemic risks (rather than risks of individual intermediaries or markets)
  - Regulation: Public regulations that aim at maintaining systemic stability

# Ultimate sources of systemic risk



# 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: Based on de Bandt, Hartmann and Peydró (2010) and ECB (2009 and 2010).*

# MaRs management structure

**Chair**: Philipp Hartmann, ECB

**Work Stream 1 Coordinators**:

Laurent Clerc, BdF
Philipp Hartmann, ECB

**Work Stream 2 Coordinators**:

Carsten Detken, ECB
Kateřina Šmídková, CNB

**Work Stream 3 Coordinators**:

Paolo Angelini, BdI
Simone Manganelli, ECB

**Consultants**:

Professor Xavier Freixas,
Universitat Pompeu Fabra
(2010-2012)

Professor Javier Suarez,
CEMFI, Madrid
(2012-2014)

**Consultant** :

Professor Hans Degryse,
Katholieke Universiteit Leuven
(2012-2014)

**Secretaries**:

Angela Maddaloni, ECB, 2010-2011
Kalin Nikolov, ECB, 2011-2012
Fiorella De Fiore, ECB, 2012-2013
Gerhard Rünstler, ECB, 2013

# MaRs research questions

| | |
|---|---|
| **Work Stream 1** | 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 nonlinearities, 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 macro-prudential policies to maintain systemic stability? |
| **Work Stream 2** | What are the key macro-prudential 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? |
| | What are the best indicators of current systemic stress or instability? |
| **Work Stream 3** | 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? |

# WS1: Selected research highlights…

## ➢ Research progress

- Several approaches incorporating financial instability in macroeconomic models
  - Perhaps main challenge in economics today (brief survey Hartmann et al. 2013)
  - Imbalances for bank assets and liabilities (liquidity!, see next slides)
  - Economy behaves fundamentally differently at systemic instability (incl. non-linearities, see example on slide 4 and in background slides)
  - Recessions more severe in crises where bank credit plays important role
  - Modelling financial instability rather than frictions makes material difference for macroeconomy
- Shadow banking/securitisation, expectations about real-estate prices (e.g. no rational expectations) and foreign currency loans amplify credit and leverage cycles
- Cross-country spillovers from regulator policies may be material

## ➢ Analytical tools

- Macroeconomic model for assessing macro-prudential regulatory policies
  - Developed by staff from 4 NCBs, ECB and MaRs consultant — Shared across the ESCB
- Non-linear empirical model for assessing macro impact of financial crises (slides 4f. and annex slides)
  - Nowcasting states of systemic fragility, scenario analyses and, may be, forecasting

# WS1: …and selected insights for policy

## ➢ Macro-prudential policy

- Multitude of market imperfections that contribute to systemic risk require multiple regulatory instruments:
  - Key to diminish fire-sale risk
  - Regulatory arbitrage may require capital requirements to be combined with margin requirements on repos
- But indiscriminate combinations of regulations can also be counterproductive
- Countercyclical loan-to-value ratios (LTVs) more effective than static ones (politically complex, but perhaps generalised collateral limit could help)
- Advisable to consider LTVs and debt-to-income limits (DTIs) together
- Regulatory policies may need to be coordinated across financially integrated countries (roles of Single Supervisory Mechanism, ESRB), also for instruments outside EU legislation (LTVs, DTIs!)
- Interaction with monetary policy

- Descriptive work by the CGFS, ESRB and IMF on macro-prudential policy instruments

# Macro models with financial instability developed by MaRs 1

## ➢ Structural/theoretical

- Aoki and Nikolov, 2012, Bubbles, banks and financial stability, *ECB Working Paper*, No 1495 – non-linear dynamic general equilibrium model with banks holding asset bubbles and multiple equilibria
- Boissay, 2011, Financial imbalances and financial fragility, *ECB Working Paper*, No 1317 – non-linear static general equilibrium model with excessive wholesale funding of financial intermediaries and multiple equilibria
- Boissay, Collard and Smets, 2013, Booms and systemic banking crises, *ECB Working Paper*, No 1514 – non-linear calibrated dynamic general equilibrium model with banks' wholesale funding leading to boom-bust cycles
- Clerc, Derviz, Mendicino, Moyen, Nikolov, Stracca, Suarez and Vardoulakis, 2014, Capital regulation in a macroeconomic model with three layers of default, ECB, *Mimeo*. – calibrated dynamic general equilibrium model with bank, firm and household default and multiple financial frictions
- Dewachter and Wouters, 2013, Endogenous risk in a DSGE model with capital constrained financial intermediaries, *National Bank of Belgium Working Paper*, No 235 – integrating the He and Krishnamurthy approach in non-linear calibrated DSGE model
- De Walque, Pierrard and Rouabah, 2010, Financial (in)stability, supervision and liquidity injections: A dynamic general equilibrium approach, *Economic Journal*, 120(549) – dynamic general equilibrium model with an interbank market and a bank default

# Macro models with financial instability developed by MaRs 2

## ➢ Structural/theoretical (cont.)

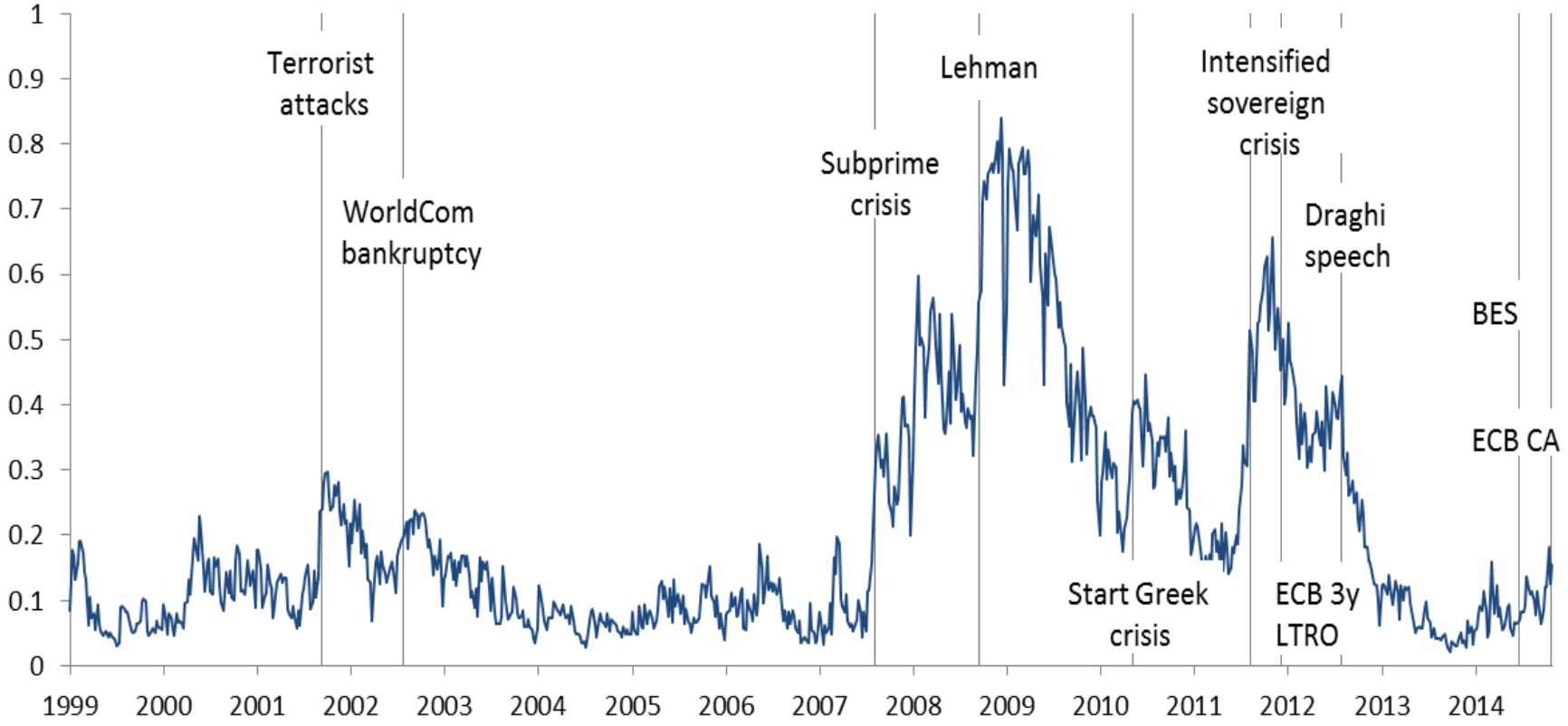
- Goodhart, Kashyap, Tsomocos and Vardoulakis, 2012, Financial regulation in general equilibrium, *Banque de France Document de Travail*, No 372 – non-linear static general equilibrium model with bank default and shadow banking

## ➢ Empirical

- Hartmann, Hubrich, Kremer and Tetlow, 2012, Melting down: Systemic financial instability and the macroeconomy, ECB, *Mimeo.* – non-linear vectorautoregression model incorporating systemic financial instability

# Measuring systemic financial instability (MaRs WS2)

## ➢ Composite Indicator of Systemic Stress ("CISS")



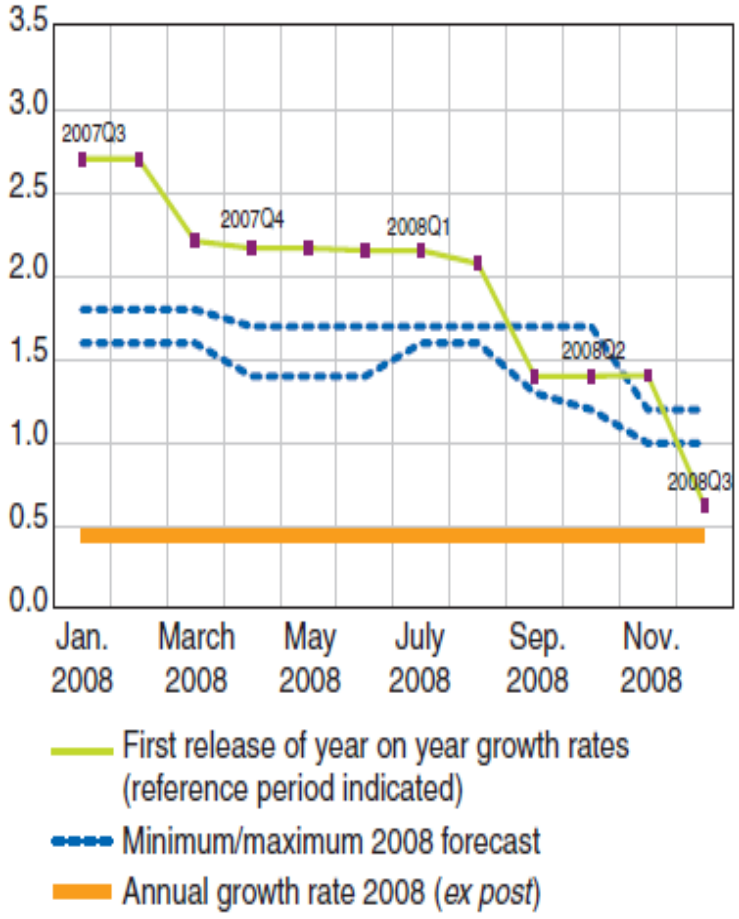

- Scope: Equity, bond, money and FX markets plus banks/financial institutions - real time
- Basic sub-measures include volatilities, trends, spreads, recourse to marginal lending (weekly data)
- Normalisation between 0 and 1 and aggregation weighted with correlations ("systemic")

*Source: Update from Holló, Kremer and Lo Duca (2012).*

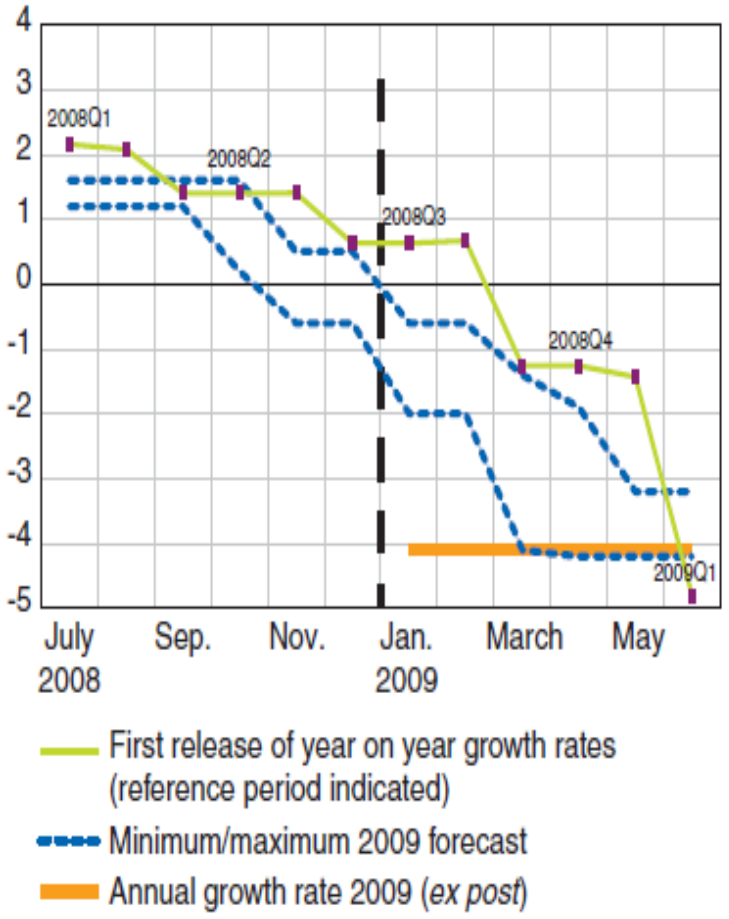
## Real time euro area GDP growth forecast errors and coincident growth releases

(%)

a) For 2008




b) For 2009




*Source: Trichet (2011).*

# WS1: Markov-switching vectorautoregression model 1

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

$y_t$: vector of endogenous variables [nx1] ;

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

$\varepsilon_t$: error terms, vector of random shocks [nx1];

$\Xi$: 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:

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

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:

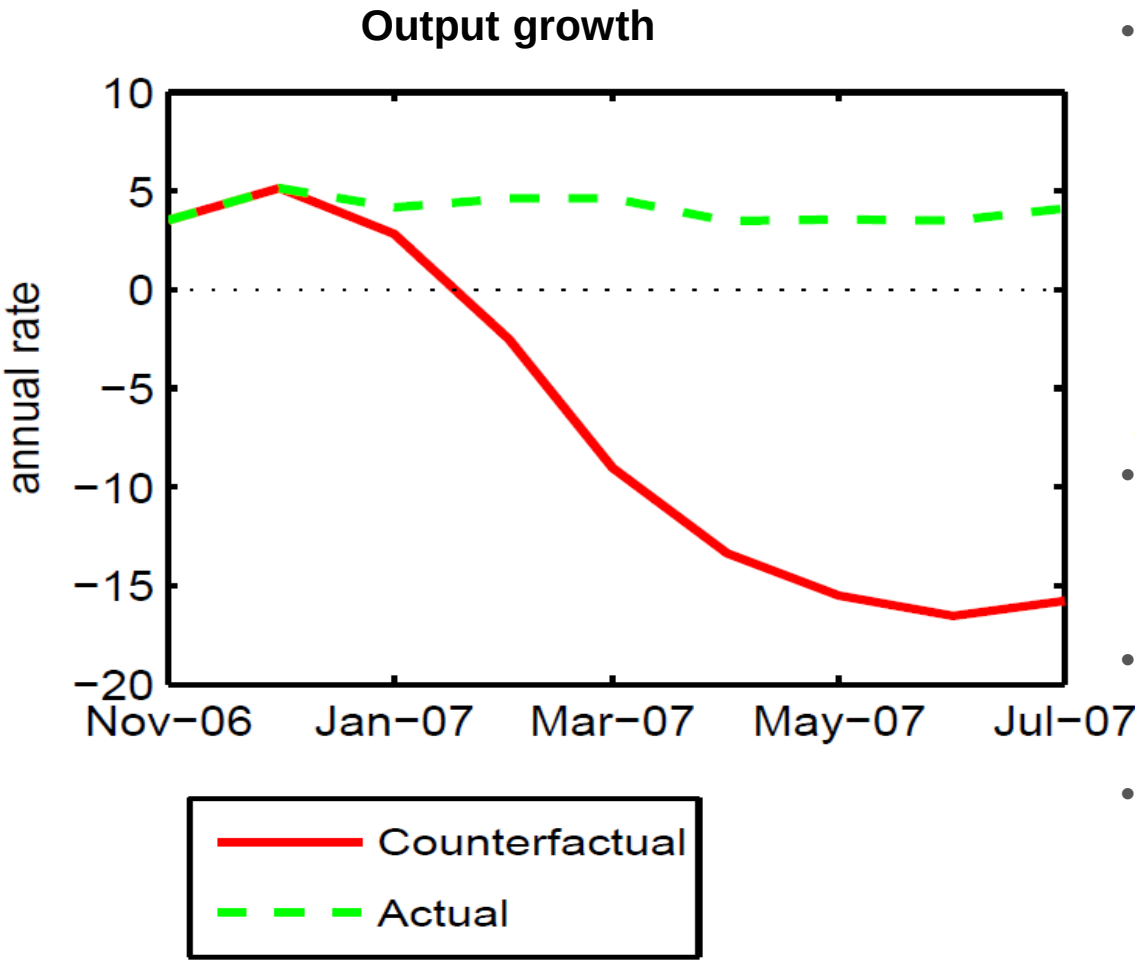
$$\varepsilon'_t(s_t^v) | Y^{t-1} \sim N(0_{n\,x1}, I_n) \qquad \textbf{(3)}$$

# WS1: Markov-switching vectorautoregression model 2

- **Endogenous variables:** $y_t = [\Delta IP_t, \Delta P_t, R_t, \Delta Ln_t, S_t]$
  - $\Delta IP_t$: growth rate of industrial production
  - $\Delta P_t$: inflation rate (HICP)
  - $R_t$: money market rate (3-month Euribor)
  - $\Delta Ln_t$: 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

# WS1: Counterfactual/scenario analysis

## ➢ What would be the growth outlook when financial instability struck at a particular point in time?

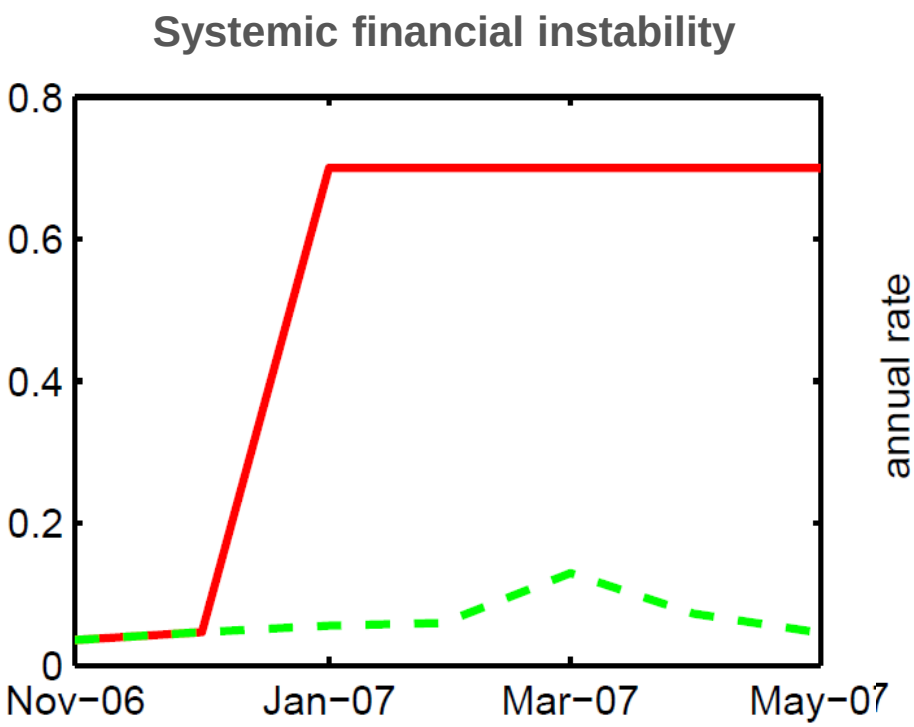


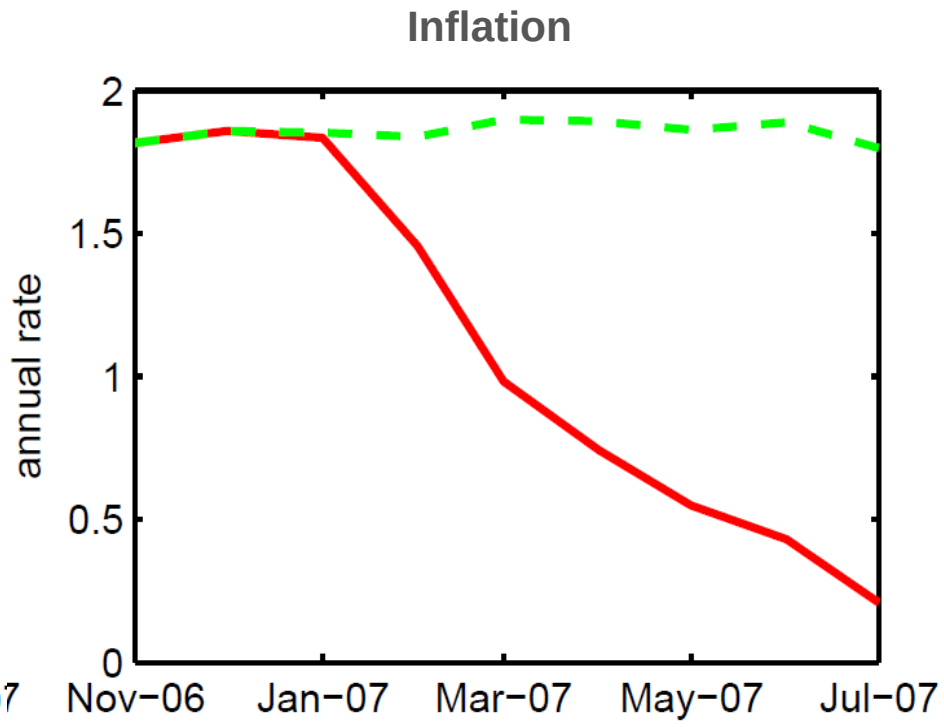

- Scenario in 01/07 (until 06/07)
  - Time of Trichet speech in New York about potential major repricing of risk in financial markets
  - Fundamental switch from tranquil regime to "systemic fragility"
  - Large increase of CISS to 0.7
- Dramatic recession, comparable to late 08/early 09, would have been the consequence
- Also drastic disinflationary effect (see background slides)
- One caveat: This scenario not "out of sample", but possible in the future

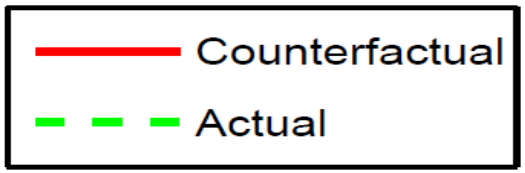
*Source: Hartmann, Hubrich, Kremer and Tetlow (2012).*

## ➢ Non-linear impact of widespread financial instability on inflation

- Markov-switching Bayesian vectorautoregression model with CISS from slides 4f. and 28ff.
- January 2007 scenario: Large increase of CISS and fundamental regime change to a state of “systemic fragility” (until June 2007)



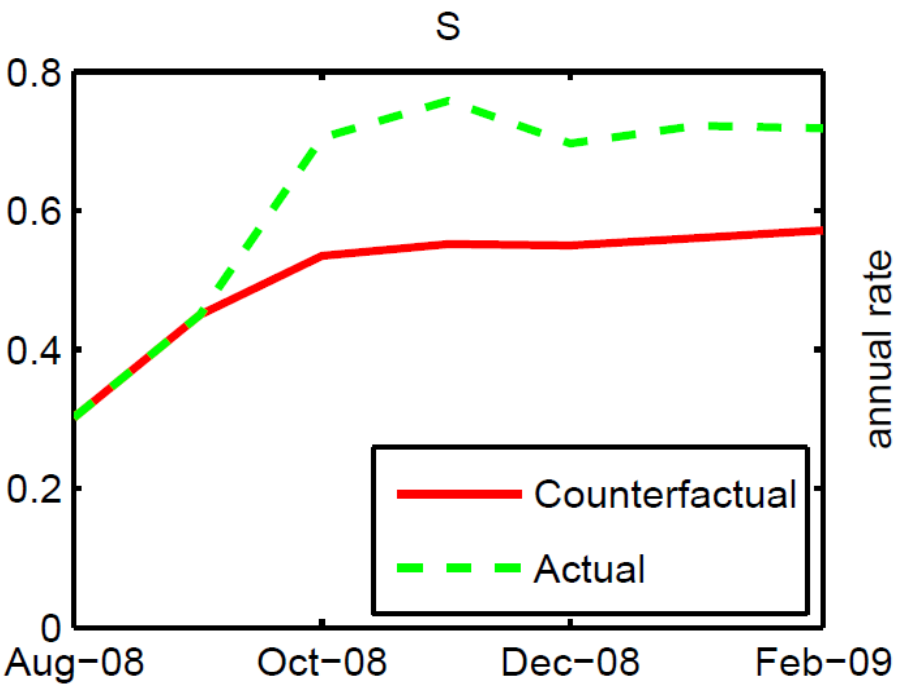




*Source: Hartmann, Hubrich, Kremer and Tetlow (2012).*

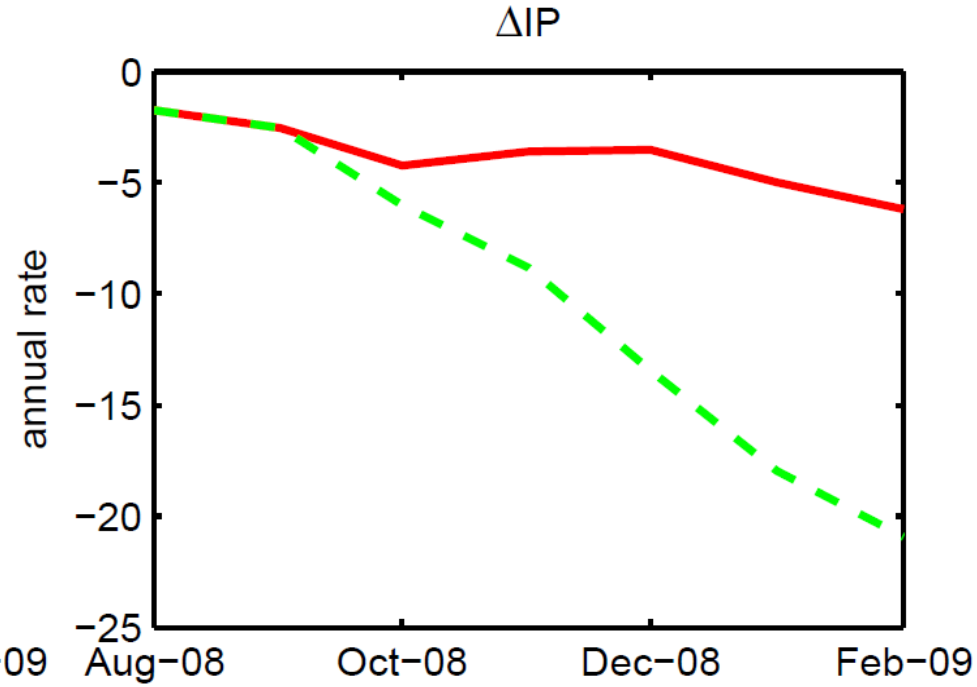
## ➢ Non-linear impact of widespread financial instability on growth

- Markov-switching Bayesian vectorautoregression model with CISS from slides 4f. and 28ff.
- October 2008 scenario: Fundamental regime change from state of “systemic fragility” to tranquil times (until February 2009)

**Systemic financial instability**



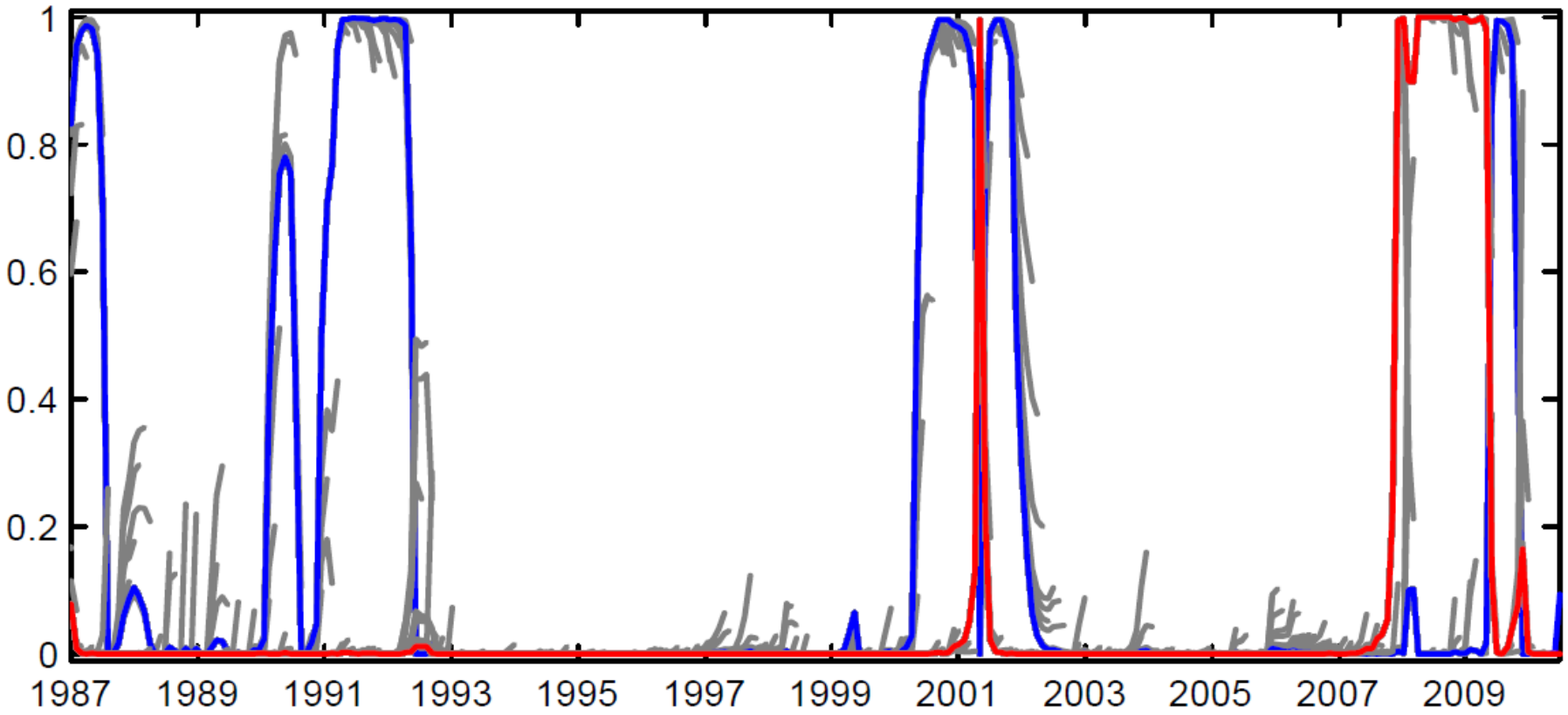

**Output growth**




*Source: Hartmann, Hubrich, Kremer and Tetlow (2012).*

# WS1: What can we gain from macro-prudential research?

## ➢ Real-time state probabilities

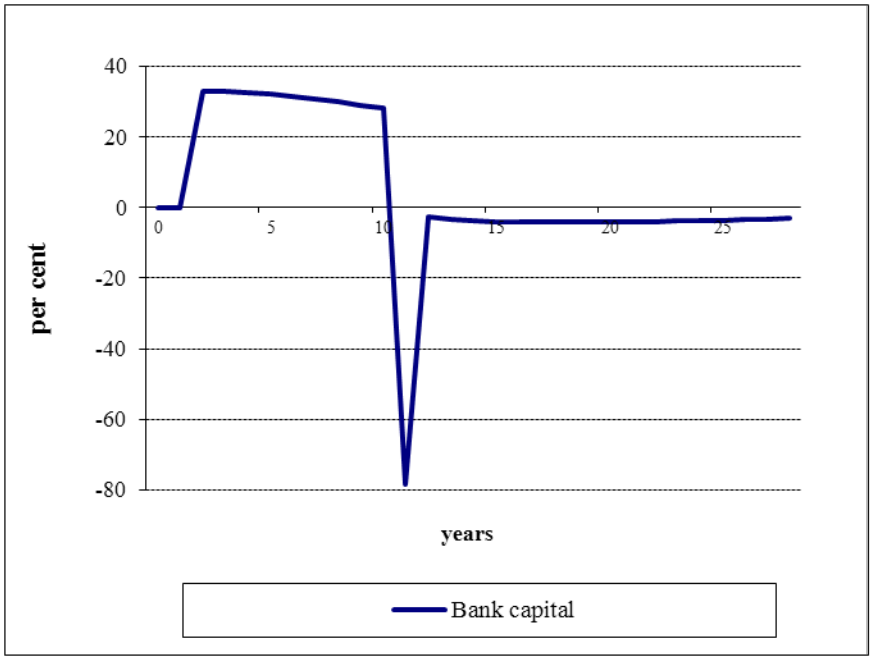


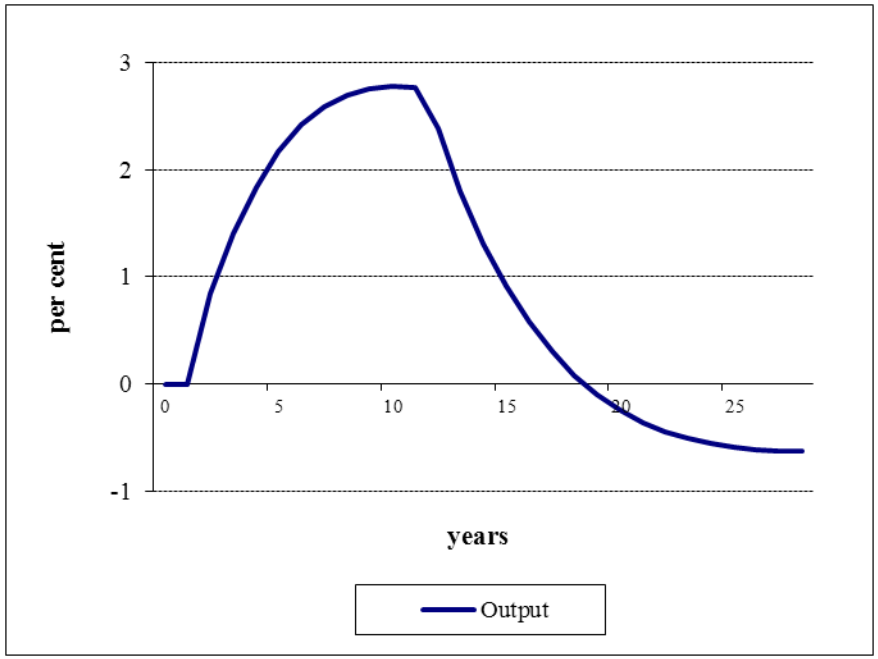

- State probabilities: Red – v3, c2 (regime 6); Blue – v2, c2 (regime 4)
- Grey: Real-time state probabilities (for each point on red or blue line sub-sample estimation from start of sample to one month after initial point in time is conducted)
- Comparing grey probabilities with red and blue ones gives an idea of type 1 and type 2 errors (e.g. nowcasting systemic fragility)

*Source: Hartmann, Hubrich, Kremer and Tetlow (2012).*

## ➢ Build-up and unravelling of imbalances via banks' asset side

- Calibrated dynamic stochastic general equilibrium model with banks that can hold a bubble asset like in the rational bubbles literature and face occasionally binding capital constraints
- Credit constraints of firms and banks decrease interest rates and lead to "search for yield"
- Banks start to hold "zero-dividend" asset in pure expectation that its value will appreciate



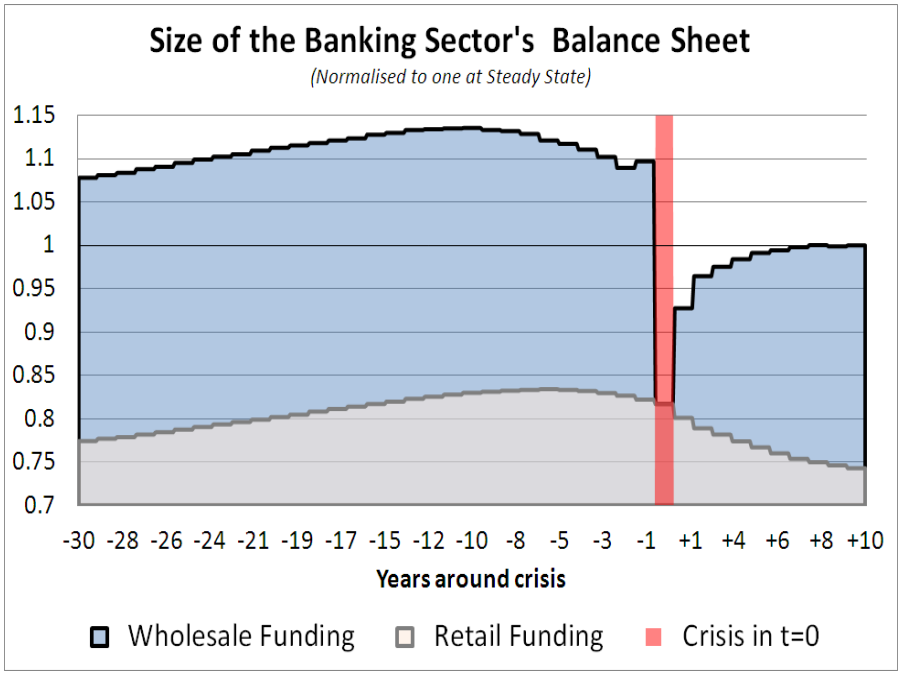

- Crisis driven by (exogenous) switch between multiple equilibria (non-linearity), one where the zero-dividend asset has value and one where it has not

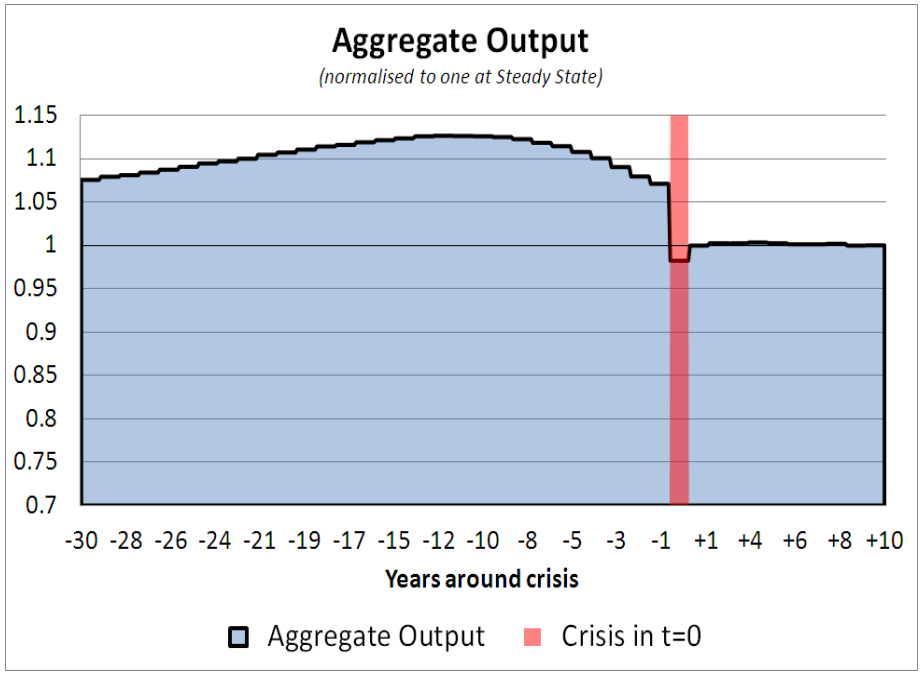
*Source: Aoki and Nikolov (2012).*

# WS1: Macroeconomic model with boom-bust cycles 2

## ➢ Build-up and unravelling of imbalances via banks' liability side

- Calibrated real business cycle model with banks of different ability to choose borrowers (asymmetric information)
- Positive productivity shock creates demand for loans, banks take wholesale funding and grow
- Less proficient banks enter until trust breaks down and the interbank market freezes




- Crisis driven by breakdown of wholesale funding (non-linearity)

*Source: Boissay, Collard and Smets (2013).*

# WS2: Selected highlights

## ➢ Research progress Early Warning Models (EWMs)

- Evaluation methodologies: taking into account policymaker's relative aversion against missing crises and false alarms and checking robustness across range of thresholds (AUROC=Area under the receiver operating characteristic)
- Variable selection methodologies: Bayesian model averaging; bootstrapping (random forests, see slide 38); principal components; should all improve out-of-sample performance of models
- Visualisation of EWM results for policy purposes: Decision trees; self-organising maps

## ➢ Analytical tools

**Early warning models:**

- Univariate signalling approach
- Multivariate logit/probit (also including random coefficient models)
- Decision trees (binary classification trees, see slide 38)
- Bayesian model averaging

**Systemic instability indicator:**

- CISS: aggregates stress indicators for the main financial markets and institutions (broad coverage of financial system) taking into account their dependence and relation to real economy (slide 26); useful e.g. in guiding the release phase of the countercyclical capital buffer

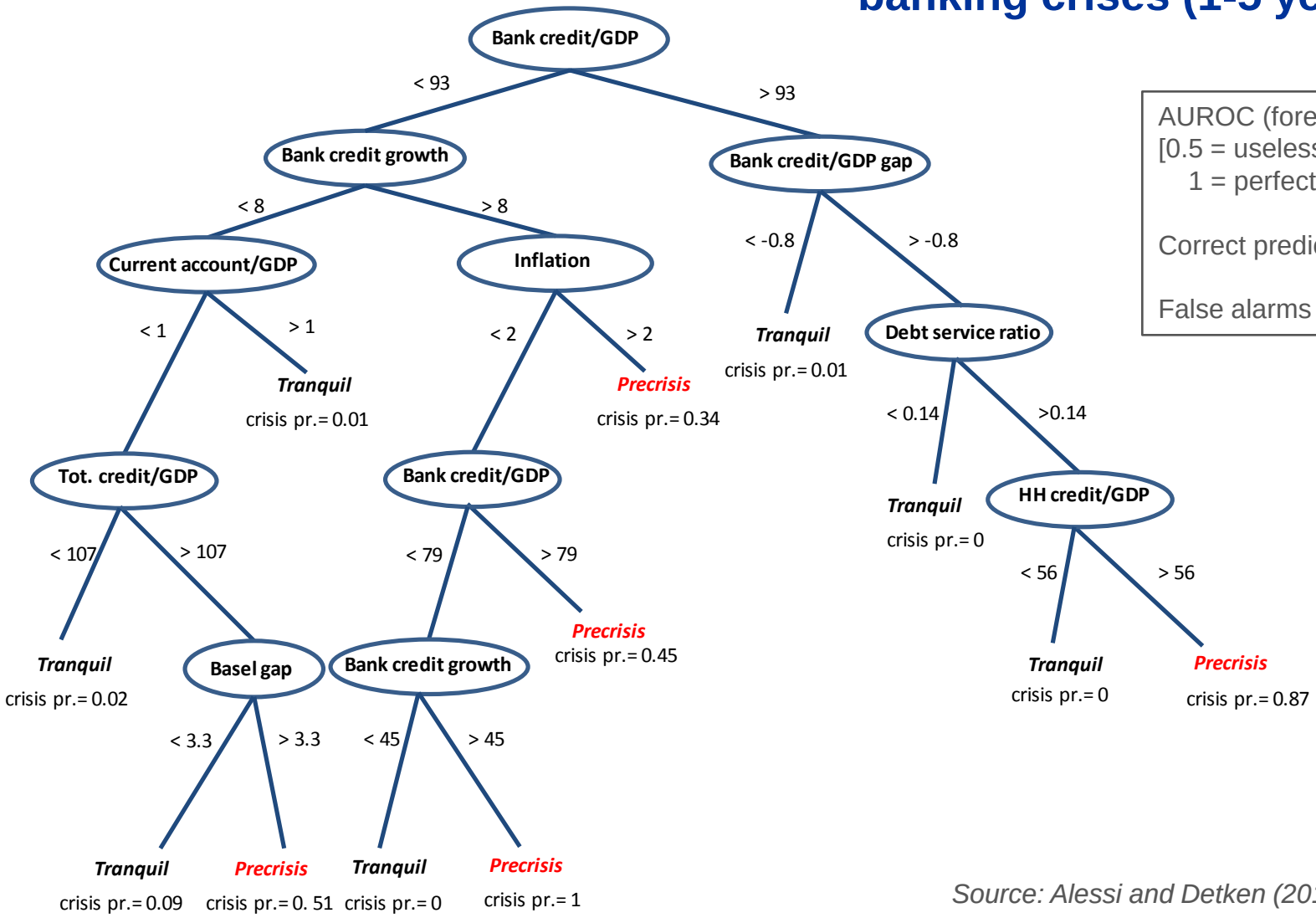
# WS2: Joint cross-country project comparing early warning models

## ➢ "Horse race": Exercise set up to compare in a systematic way alternative EWMs for systemic banking crises in the EU

- Common dataset of systemic banking crises in EU countries collected by MaRs researchers and other ESCB staff with the help of Heads of Research (Babecký et al. 2012)
- Harmonised explanatory data (as much as possible)
- Common rules of the game (e.g. prediction horizon 1-5 years ahead, recursive de-trending, pseudo-real time data)
- Common evaluation method
- Nine teams from seven NCBs and the ECB participated (next slide one example: decision tree based on random forest)

# WS2: Example of an early warning tool (MaRs WS2)

- **A decision tree (as part of a random forest) for signalling systemic banking crises (1-5 years ahead)**




| | |
|---|---|
| AUROC (forest): [0.5 = useless; 1 = perfect] | 0.93 |
| Correct predictions (tree): | 84% |
| False alarms (tree): | 18% |

*Source: Alessi and Detken (2014).*

# WS2: “Horse race” cross-country project results

## ➢ Policy advice (for building a robust early warning system)

- No single model dominating across all evaluation criteria and policy makers’ preferences. A suite of models recommended; best models, indicators and especially (optimal) triggers strongly dependent on policy makers’ preferences
- Credit is key indicator (credit/GDP gaps, credit growth) but other indicators also useful: proxies for asset (housing) price misalignments, CA/GDP, debt-service-to-income ratios; global indicators and interaction terms, bank leverage (see also Detken et al. 2014)
- Multivariate models outperform single credit and housing indicators by conditioning credit developments and adding time dependency and contagion/herding information [best AUROCs 0.9 (univariate 0.8), false alarms 10-30% (univariate 35%); correct predictions for univariate and multivariate 80-86%]

→ Support for overcoming “this-time-is-different syndrome”

# WS2: Research questions and main findings

1. What are the key macro-prudential early warning indicators for groups of countries (with relatively similar financial structures in the European Union)?
   - Important to make a distinction between indicators of the **potential sources and transmission of vulnerabilities.**
   - Key **domestic variables**: credit-to-GDP gaps are the best single leading indicators for systemic banking crises associated with excessive credit growth and leverage. Other important indicators measuring asset price misalignments are e.g. house price to income ratio, the growth rate of commercial real estate prices, and the debt service ratio.
   - In addition, WS 2 research also emphasises the importance of **global variables** in early warning models, in particular those related to global credit growth, leverage and asset price misalignments.
2. How can the different indicators be aggregated at the EU level?
   - The WS 2 analysis shows that it is desirable to apply **a suite of early warning models** rather than to try identifying the single best performing model and use it alone. This applies in particular in situations where policy makers' preferences towards type I and II errors are not the same across jurisdictions, stable over time or entirely clear.
3. What are the best early indicators of widespread imbalances, asset price bubbles, credit booms and over-indebtedness?
   - The empirical evidence of WS 2 warns **against relying too much on simple statistical de-trending or filtering methods** to detect imbalances.
   - New developments to detect excessive credit and leverage include e.g. construction of structural or regime switching models. In the area of equity bubbles, factors contributing to mispricing, highlighted by WS2 researchers, include market sentiment and the intensity of herding behaviour.
4. What are the best indicators of current systemic stress or instability?
   - A **composite indicator (CISS)** captures the systemic dimension by being broad in covering stress in the main financial markets and intermediaries and by aggregating these components taking their dependence into account, with their weights linked to their relation to the real economy.
   - This indicator proves to be useful e.g. in guiding the release phase of the countercyclical capital buffer.