

# Identifying excessive credit growth and leverage

Lucia Alessi\* Carsten Detken  
European Central Bank, Germany

**ABSTRACT**

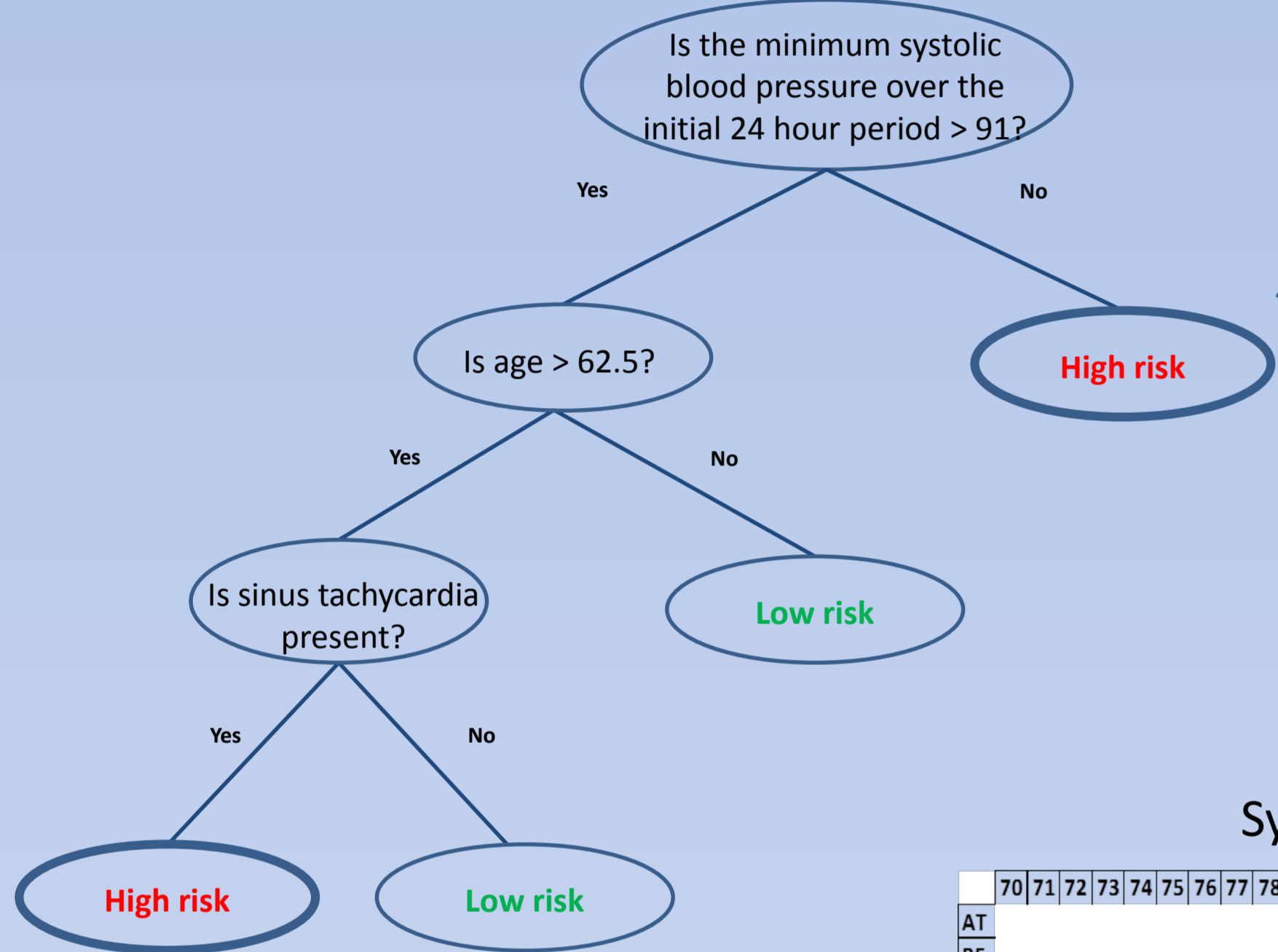
Unsustainable credit developments lead to the build-up of systemic risks to financial stability. While this is an accepted truth, how to assess whether risks are getting out of hand remains a challenge. To identify excessive credit growth and aggregate leverage we propose an **early warning system**, which aims at predicting banking crises and gives an indication on the nature of specific vulnerabilities. The key indicators are selected by applying the **“Random Forest”** method, based on decision trees, and include (global) credit as well as real estate variables. The benchmark early warning tree identifies the associated warning thresholds.

**MOTIVATION**  
In 2006 credit was growing in the US at more than 10 p.p. above trend...  
↓  
...having learnt the lesson, we should not miss another credit-fuelled asset price bubble

**OBJECTIVE**  
An **early warning model** which:  
1. Identifies those periods in which the build-up of leverage can be defined as excessive and may warrant policy action.  
2. Provides policymakers with concrete advice on which macroprudential instrument would be best suited to address a specific credit-related vulnerability.

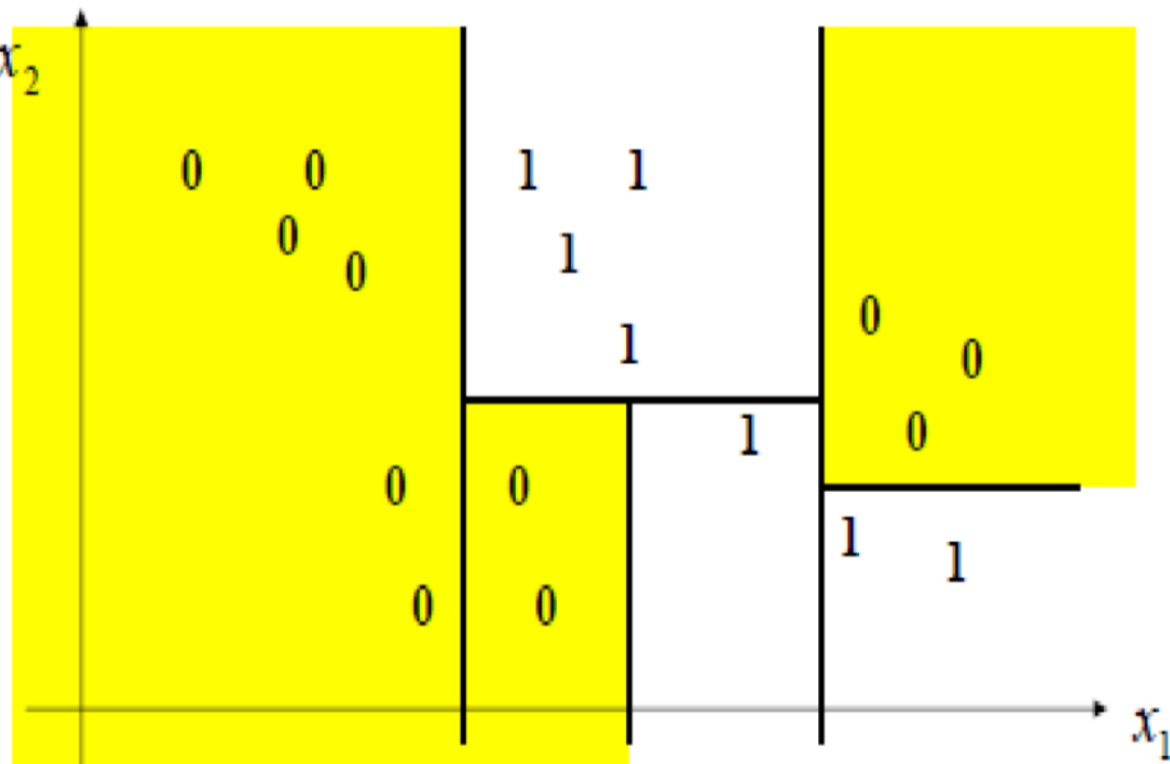


**METHODOLOGY (1)**  
Classification trees (Breiman et al., 1984)

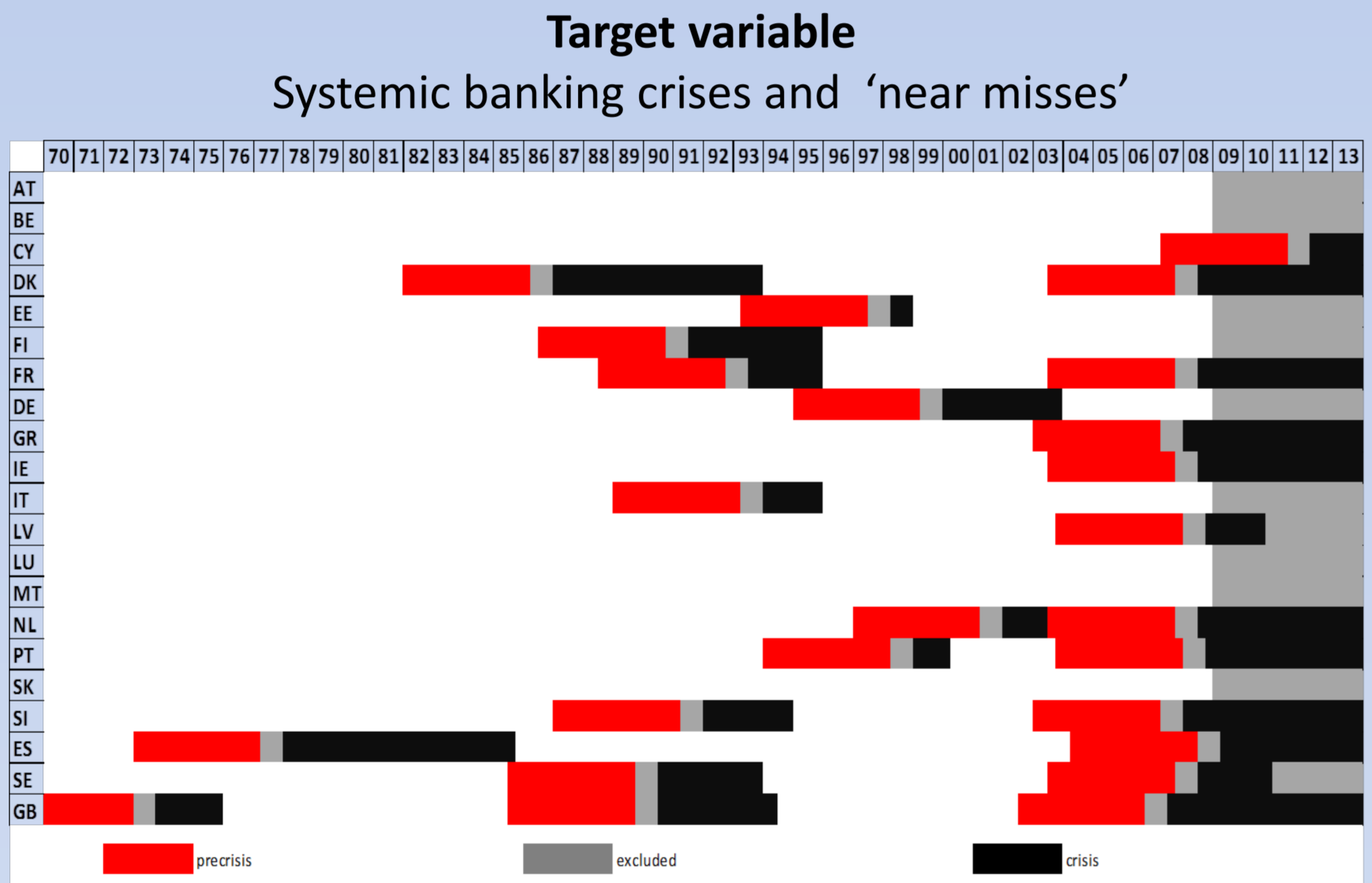


A doctor in an emergency room needs to decide on the spot whether a patient might have a heart attack  
  
A policymaker in a board room needs to decide whether to raise capital requirements in a certain jurisdiction

**Recursive partitioning**



$$GINI(f) = \sum_{i,j} C_{ij} f_{ij}$$



**DISCUSSION**

- The heroic task of **identifying credit bubbles in real time** requires assessing whether conjunctural credit developments might be disconnected from fundamentals or reflect excessive risk taking and overly optimistic expectations.
- Together with the Basel gap, one should take into account other conditioning variables because **not all credit expansions are bad** for financial stability.
- Our EWM helps to overcome the possible **inaction bias** on the part of policy makers. In case risks are emerging which have in the past led to systemic banking crises, the onus is on those who aim to use judgement alone to justify why macro-prudential policy tools are not activated.
- Increased transparency** on the side of authorities competent for macroprudential policy also helps to increase acceptance policy decisions which appear unpopular at first sight.
- By emphasizing the importance of **global liquidity** as an early warning indicator, our work provides support for policy actions even in jurisdictions where domestic developments still appear to be under control.
- A prompt policy reaction, assuming the current macroprudential legislation were already in place, based on the indications from our EWM, would have allowed to have **countercyclical capital buffers in place already for one year before the Lehman collapse**, in all of the large EU economies that underwent a systemic banking crisis.

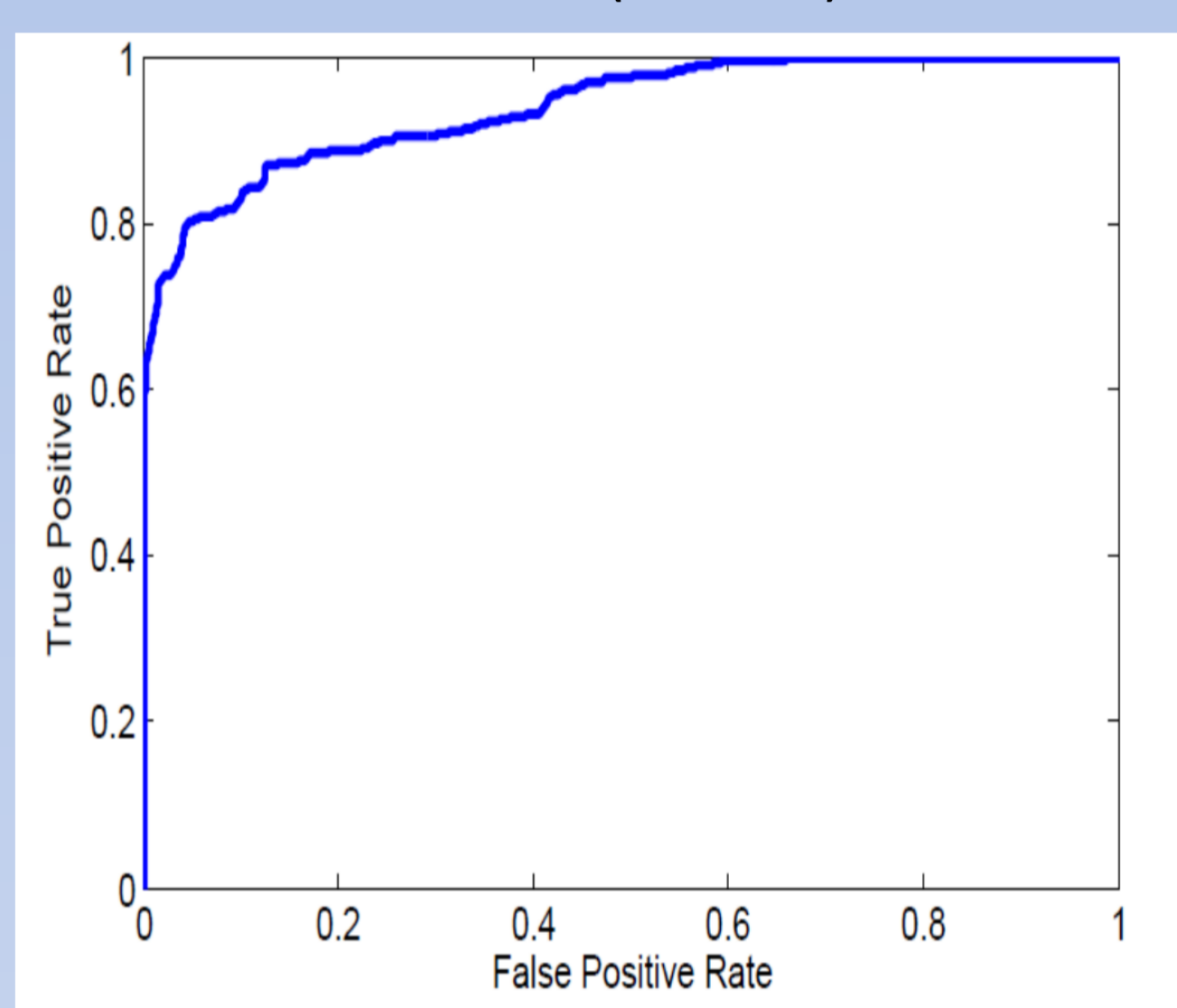
**METHODOLOGY (2)**  
Random Forest (Breiman et al., 2001)

Bootstrapping and aggregating (*bagging*) a multitude of trees, each grown on a randomly selected set of indicators and observations.

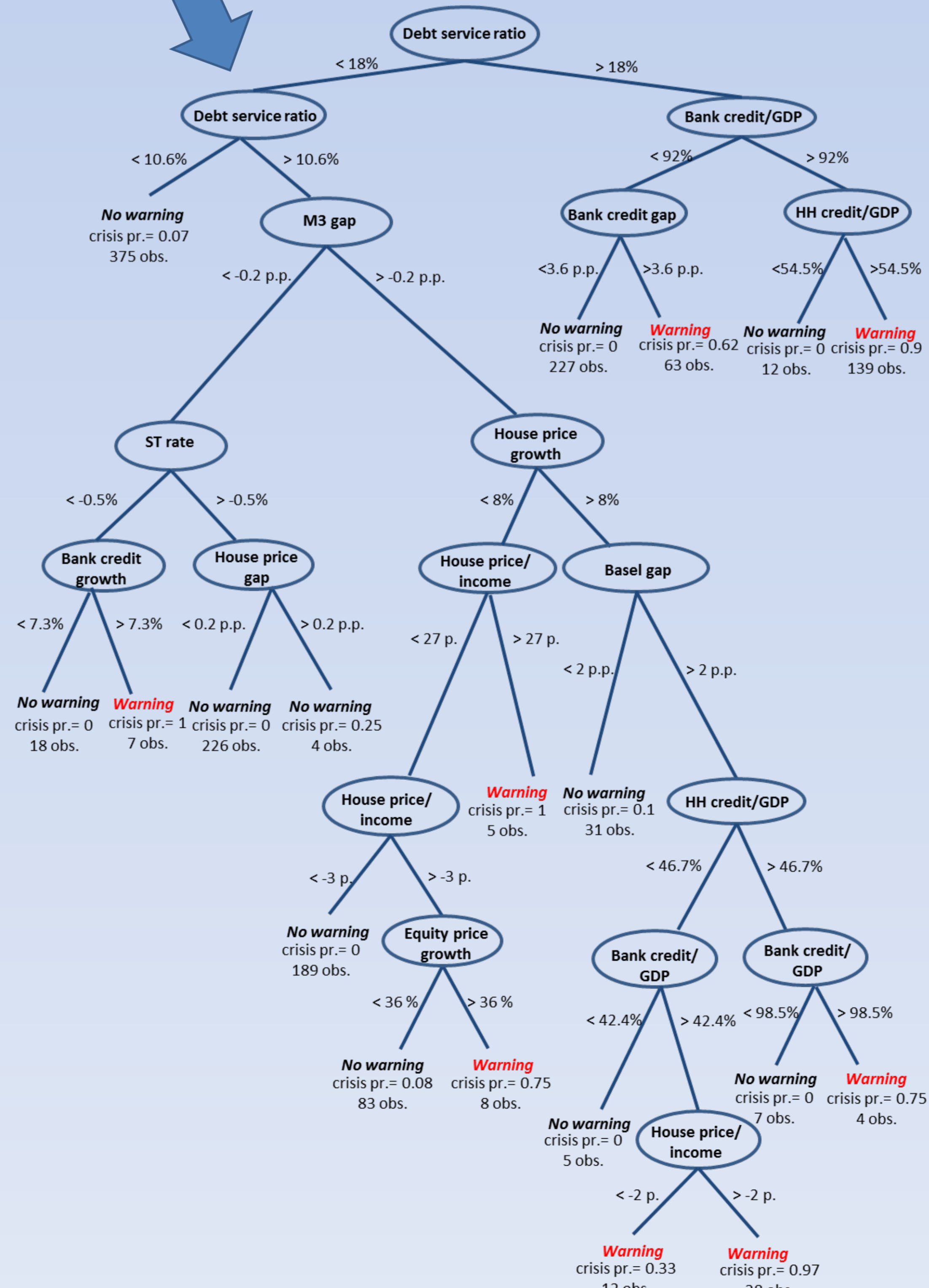
**RESULTS**

- Excellent predictive performance
- Tree in-sample performance:  
True Positive Rate = 85%  
Type 1 error = 15%  
Type 2 error = 4%
- Random Forest out-of-sample performance:  
AUROC = 0.94  
Misclassified periods: 6%
- Key indicators
  - Bank credit
  - Broad credit
  - Global liquidity
  - Debt service ratios
  - Asset prices
- Transformations (credit aggregates)
  - Ratios to GDP, gaps, growth rates

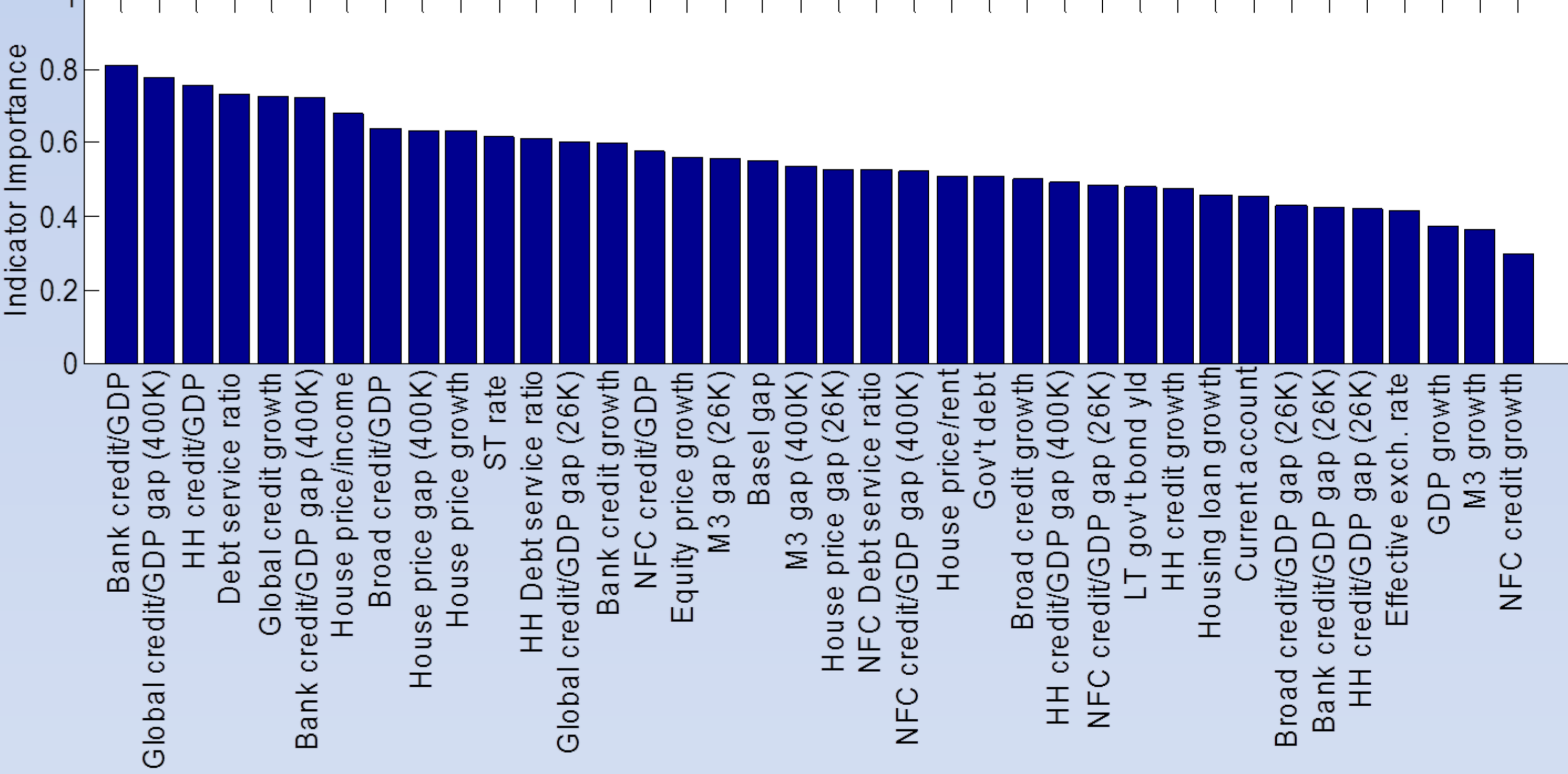
Area Under the Receiver Operating Characteristic (AUROC) curve



**The Early Warning Tree**



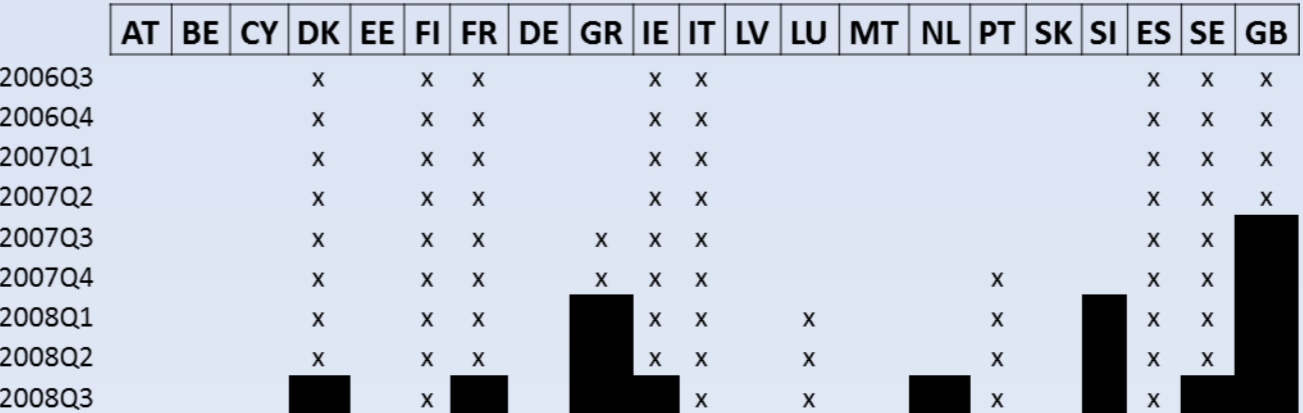
**The Random Forest ranking of early warning indicators**



**Out-of-sample exercise**  
Imagine you were in mid-2006...

	Crisis	No crisis
Warning	FR, IE, ES, SE, DK, UK	FI, IT
No warning	GR, PT, LV, SI, NL	AU, BE, LU, DE, EE, SK, MT, CY*

...and in 2007, 2008.



**CONCLUSIONS**

- Our approach takes into account the **conditional relations** between various indicators when setting early warning thresholds.
- By doing so, it sheds light on the **(nonlinear) relationship** between credit, asset prices and the occurrence of systemic banking crises.
- The model is able to give an indication on the **nature of specific vulnerabilities** and has a **remarkable predictive performance**.
- Global liquidity** stands out as one of the best early warning indicators in our framework.