

# Identifying excessive credit growth and leverage

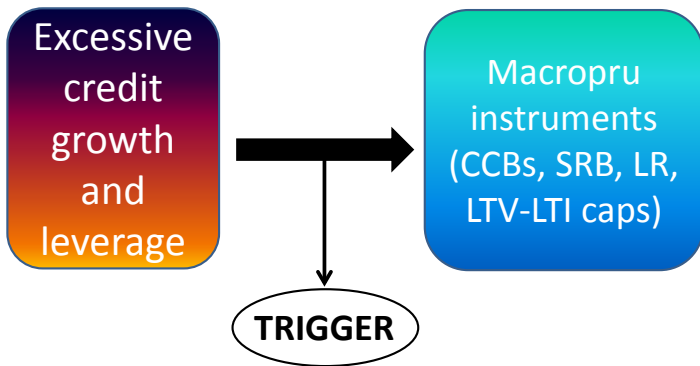
Lucia Alessi and Carsten Detken

European Central Bank

MaRs conference  
Frankfurt am Main, 23-24 June 2014

## Aim of the paper

Early warning indicators for macropru instruments targeting credit



# Target variable

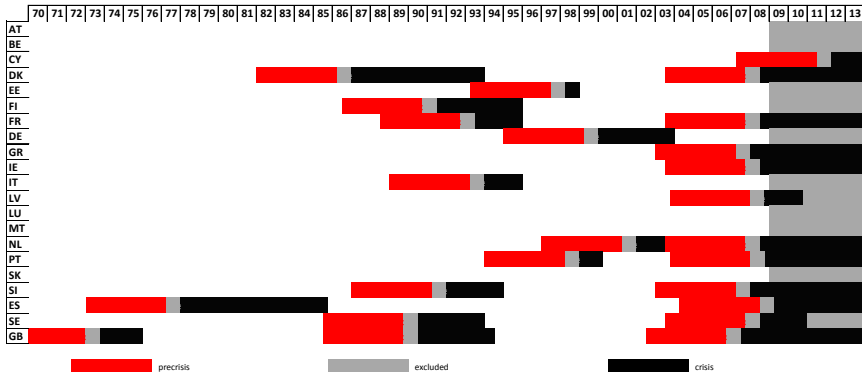
## Systemic banking crises and 'near misses'

### Banking crises dataset by Expert Group:

- based on the HoR database compiled by the MaRs
- amended in order to include:
  1. *only* systemic banking crises associated with a domestic credit/financial cycle
  2. periods in which in the absence of policy action or of an external event that dampened the credit cycle a crisis as in 1. would likely have occurred



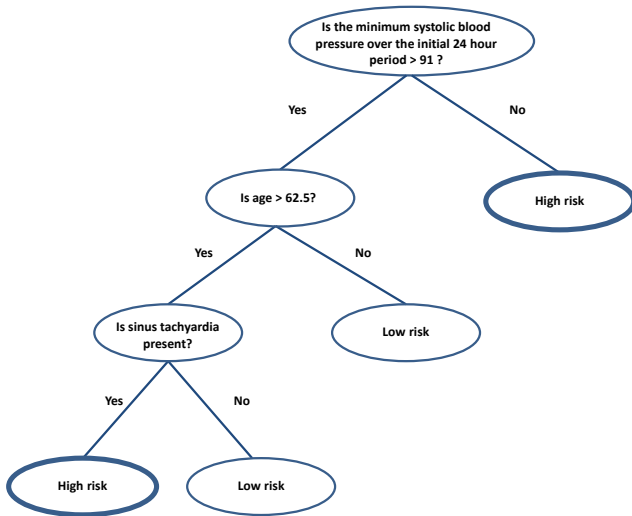
# Target variable



## Early warning indicators

- **Credit related** indicators, based on total credit and bank credit, credit to households and non-financial corporations, the debt service ratio and public debt
- **Real estate** indicators based on residential property prices, incl. valuation measures
- **Market-based** indicators such as the short and long term interest rates and equity prices
- **Macroeconomic** variables such as real GDP growth, M3, real effective exchange rate, current account

# Classification trees



## Recursive partitioning



$$GINI(f) = \sum_{i=1}^n f_i(1 - f_i) = 1 - \sum_{i=1}^n f_i^2$$

# The Random Forest

**Bootstrap** and **aggregation** of a multitude of trees, each grown on a randomly selected set of indicators and observations.

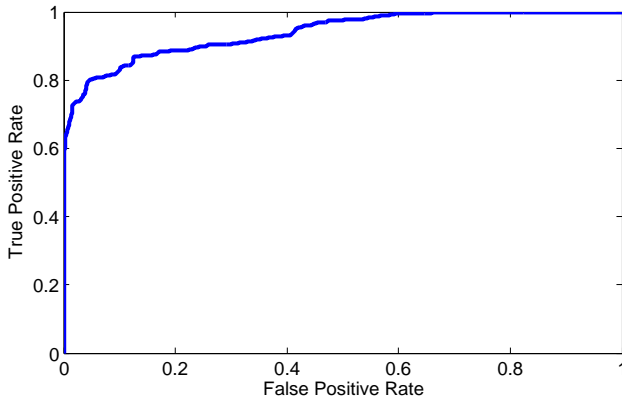


Robust technique



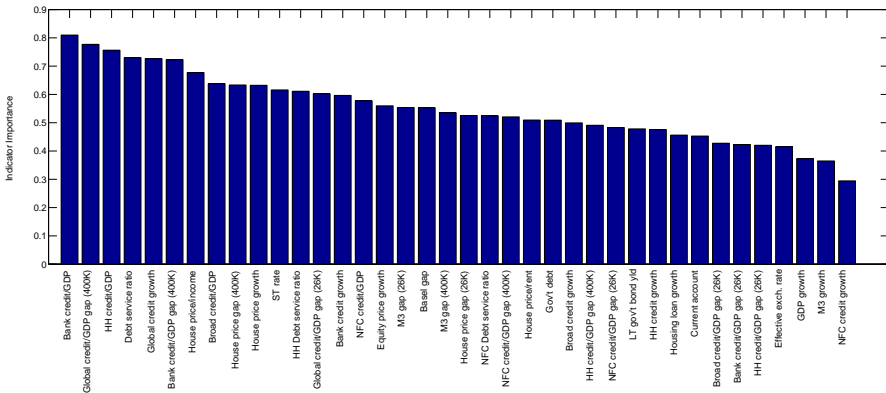
# Random forest performance

AUROC=0.94, out-of-sample missclassification=7%

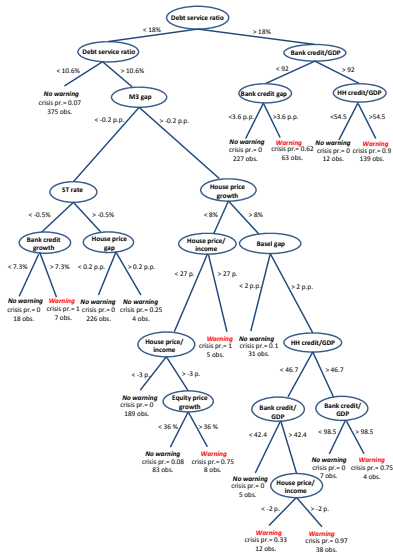


# Random Forest ranking

## Key indicators



# Early warning tree



## Evaluation metrics

	Crisis	No Crisis
Signal	<i>A</i>	<i>B</i>
No signal	<i>C</i>	<i>D</i>

		$\theta = 2/3$
TPR	$\frac{A}{A+C}$	85%
FPR (Type II error)	$\frac{B}{B+D}$	4%
Type I error	$\frac{C}{A+C}$	15%
N2S	$\frac{B}{B+D} / \frac{A}{A+C}$	5%
Loss	$\theta \frac{C}{A+C} + (1 - \theta) \frac{B}{B+D}$	0.12
Usefulness	$\min[\theta; 1 - \theta] - Loss$	0.22
Rel. Usefulness	$\frac{Usefulness}{\min[\theta; 1 - \theta]}$	0.65



# 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*

\*Crisis started beyond prediction horizon



# Conclusion

- The Random Forest/Early Warning methodology can become a useful quantitative tool to:
  - spur discussion on country risks
  - provide information on the most appropriate policy instrument to address identified vulnerabilities
- Additional relevant (potentially country specific) information can be included