Intro

Data
○○○

Predictive model
○○
○

Results
○○
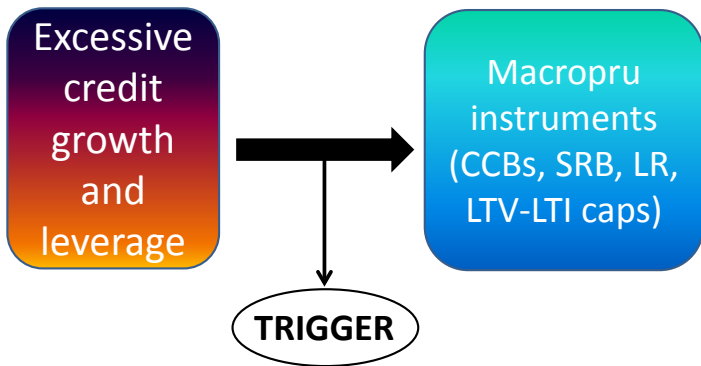○○

Out-of-sample
○

Conclusion
○

Identifying excessive credit growth and leverage

Lucia Alessi and Carsten Detken

European Central Bank

Aim of the paper

Early warning indicators for macropru instruments targeting credit

| Intro | Data | Predictive model | Results | Out-of-sample | Conclusion |
| o | ●oo | oo | oo | o | o |
| | | o | oo | | |

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
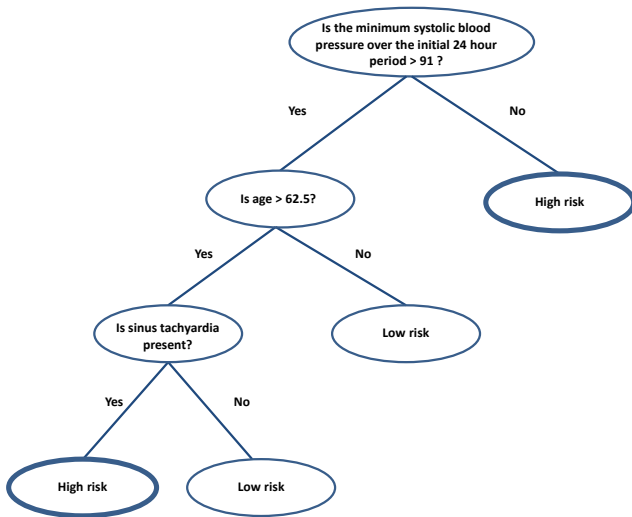
Intro

Data
○●○

Predictive model
○○
○

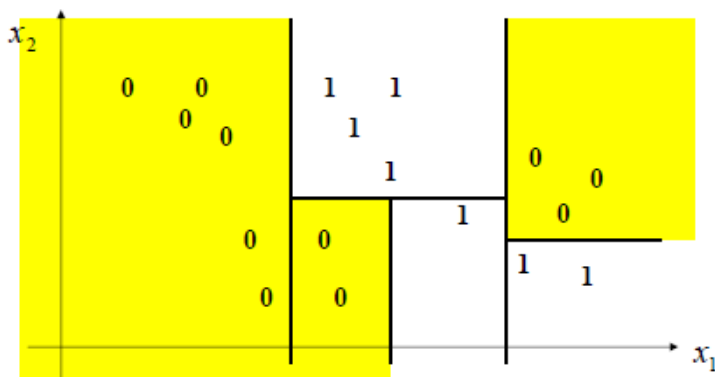Results
○○
○○

Out-of-sample
○

Conclusion
○

Target variable
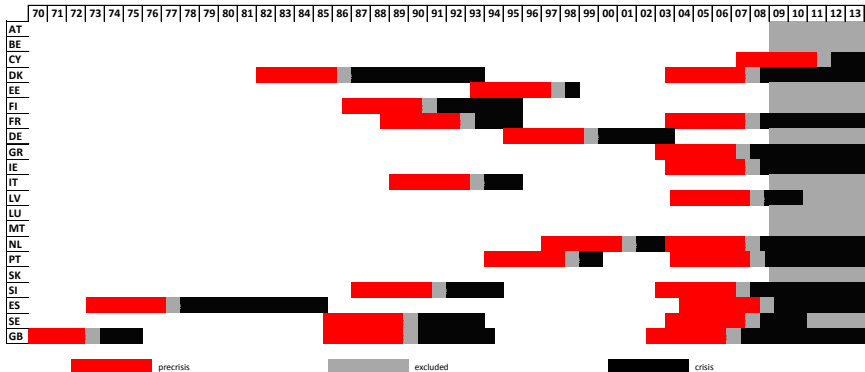
Early warning indicators

- 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

```
        Is the minimum systolic blood
        pressure over the initial 24 hour
                period > 91 ?

         Yes                    No

    Is age > 62.5?          High risk

   Yes          No

 Is sinus tachyardia      Low risk
    present?

Yes          No

High risk    Low risk
```

Recursive partitioning

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

The Random Forest

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

$$\Downarrow$$

Robust technique

Random forest performance
AUROC=0.94, out-of-sample missclassification=7%
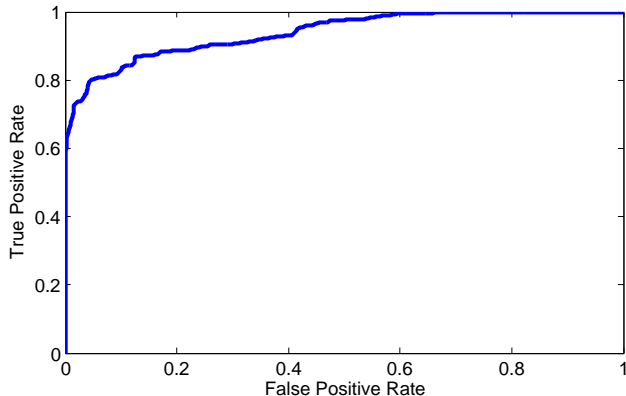
Random Forest ranking
Key indicators
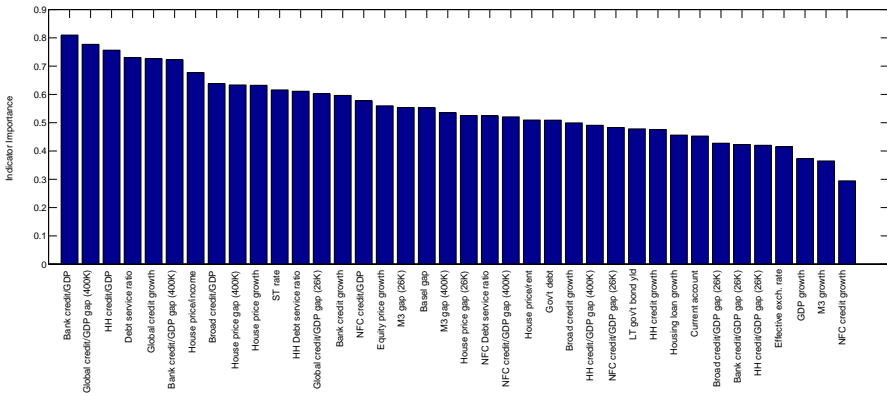
Early warning tree
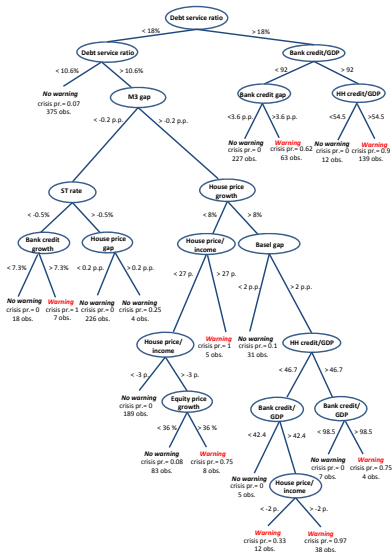
Evaluation metrics

	Crisis	No Crisis
Signal	*A*	*B*
No signal	*C*	*D*

		$\theta = 2/3$
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

Intro
○

Data
○○○

Predictive model
○○
○

Results
○○
○○

Out-of-sample
●

Conclusion
○

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.

Not classified in terminal nodes owing to lack of data.

	AT	BE	CY	DK	EE	FI	FR	DE	GR	IE	IT	LV	LU	MT	NL	PT	SK	SI	ES	SE	GB
2006Q3				x		x	x			x	x								x	x	x
2006Q4				x		x	x			x	x								x	x	x
2007Q1				x		x	x			x	x								x	x	x
2007Q2				x		x	x			x	x								x	x	x
2007Q3				x		x	x		x	x	x								x	x	■
2007Q4				x		x	x		x	x	x				x				x	x	■
2008Q1				x		x	x		■	x	x	x			x			■	x	x	■
2008Q2				x		x	x		■	x	x	x			x			■	x	x	■
2008Q3			■			x	■		■		x		x		■	x			x	■	■

Intro
○

Data
○○○

Predictive model
○○
○

Results
○○
○○

Out-of-sample
○

Conclusion
●

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