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Using a Threshold Approach to Flag Vulnerabilities in CESEE

Isabella Moder
Foreign Research Division
Oesterreichische Nationalbank

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Outline

1. Introduction into early warning models
2. OeNB’s early warning model
3. Evaluation
4. Application

Early Warning Models: Introduction

- Motivation: Predicting the likelihood of a crisis
- Started in the 1950s with qualitative discussion or country comparisons
- Intensified in the 1990s as response to emerging market crises, focusing mostly on developing countries
- Two main approaches: Probit/logit regressions and threshold models
- Models widely used in practice (e.g. Scoreboard of the EU‘s MIP, IMF exercises for emerging and advanced economies)

Early Warning Models: Introduction

1. Probit/logit regressions

- Developed by Frankel and Rose (1996) to predict currency crises
- Crisis dummy variable (endogeneous) regressed on a set of exogeneous variables
- Aim to test the statistical significance of various indicators in determining the incidence or probability of a crisis
- Cross-country sample

Early Warning Models: Introduction

2. Threshold approach:

- Developed by Kaminsky et al. (1998)
- Some variables alter their behaviour in the run-up to a crisis
- Calculate thresholds for useful variables
- When a certain value exceeds the threshold, a warning signal is issued
- Advantages over the probit/logit approach:
  - Suited for data with large missing data points
  - Interactions between variables are not excluded as in the *ceteris paribus* assumption of regressions
  - No multicollinearity issues
  - Robust to “over-fitting”

Other Approaches

- Binary classification trees (e.g. Ghosh and Ghosh, 2003)
- Markov switching models (e.g. Abiad, 2003)
- Beyesian model averaging (e.g. Crespo Cuaresma and Slacik, 2009)
- Metastudies
  - Most recent: Frankel and Saravelos (2012)
  - Top indicators for predicting the 2008/2009 crisis: level of international reserves, real exchange rate overvaluation

Limitations of early warning models

- Data availability: annual vs. higher-frequency indicators; data may come too late
- Easier to explain (in-sample) than to predict (out-of-sample)
- Institutional and political issues cannot be incorporated in the models
- Danger of self-fulfilling prophecy

Model

	Crisis	Noncrisis
Signal issued	A	B
No signal issued	C	D
Number of crises	A + C	–
Number of noncrises	–	B + D

- Two correct predictions: A, D
- Two types of errors: false alarm (B), crisis missed (C)

→ Our goal is error minimization

Model

- Threshold is chosen by:

$$\min_{\delta}\left(\theta\frac{\mathrm{C}(\delta)}{\mathrm{A}(\delta)+\mathrm{C}(\delta)}+(1-\theta)\frac{\mathrm{B}(\delta)}{\mathrm{B}(\delta)+\mathrm{D}(\delta)}\right)$$

- δ individual threshold value for each indicator k
- θ error trade-off parameter
  - Defines loss function for policy maker (trade-off between errors)
  - Either fixed or varying across sample
  - Our model: fixed at ½ → missing crises is more costly than false alarms

Data

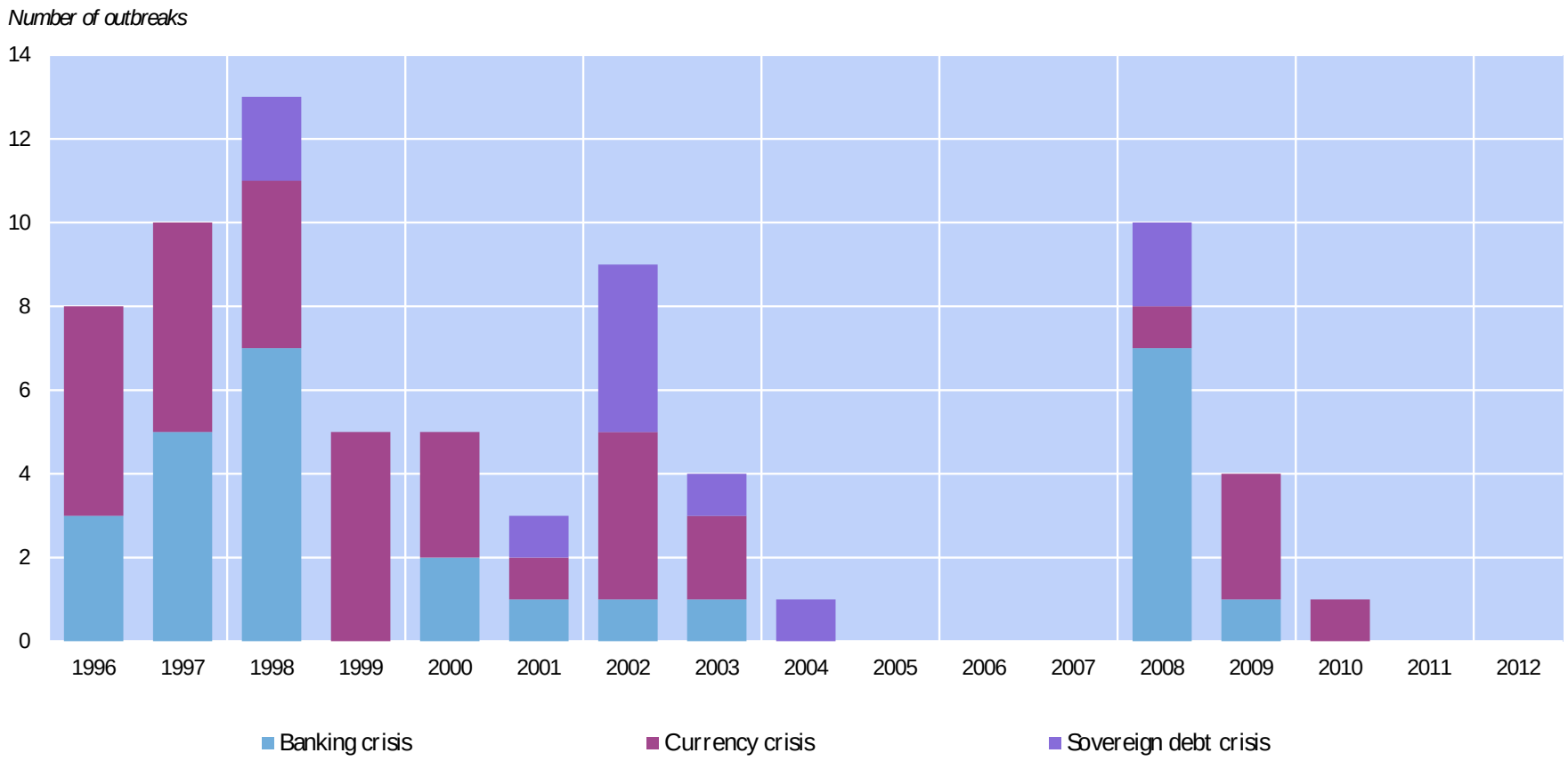
- Global dataset on 93 emerging market economies, incl. 23 CESEE countries
- Annual data from 1995 to 2012
- 48 variables as potential indicators from the following categories:
  - External sector (18)
  - Macroeconomic and fiscal performance (21)
  - Banking / financial sector (9)
- Exclude observations of ongoing crisis years and of immediate post-crisis period
- Crises periods lagged by one year

Types of Crises

- Traditional focus of early warning models on currency crises
- Since 2008 enhanced interest in financial and debt crises
- Both discrete (binary) and continuous crisis measures used
- We use the crisis definition and dataset of Laeven and Valencia (2008, 2012):
  - Currency crises: depreciation vis-à-vis US$ ≥ 30% and depreciation *t* vs. *t-1* ≥ 10%
  - Sovereign debt crises: based on qualitative and quantitative information by IMF, World Bank, other sources
  - Banking crises: only systemic banking crises (significant distress in banking system and at least three significant banking policy intervention measures)
- Crisis events make 3.8% of observations (1,581) in the sample
- No special treatment for twin and triple crises due to lack of data

Types of Crises

Crises outbreaks since 1996



Source: Own illustration, based on Laeven and Valencia (2012).

Selection of Indicators

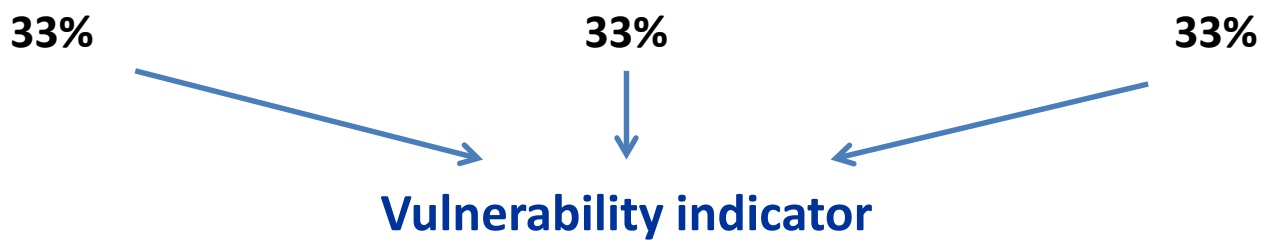
- How to evaluate the quality of the thresholds δ ?
- Goodness-of-fit:

$$g = 1 - \frac{1}{2} * \left(\frac{C}{A+C} + \frac{B}{B+D}\right); g \in [0,1]$$

- Criterion: Goodness-of-fit ≥ 40%; ≥ 3 indicators from each category
- From 48 indicators 16 indicators are used to build composite indicator
- The best indicators: Total reserves in months of imports, 3-years-average of credit growth, money growth
- The worst indicators: Gross public debt in % of GDP, NPLs in % of total loans, contribution of exports to GDP growth

Leading Indicators for Crisis Prediction

External sector	Macroeconomic and fiscal performance	Banking / financial sector
• Current account balance • Basic balance • Short-term external debt in % of total external debt • REER change in % • Total reserves in months of imports • Exchange market pressure (Δ in ER and reserves) • Total debt service in % of exports • External debt in exports	• Risk premium on lending in %points • Money growth (M2) in % • Inflation, 3-years-average • Deviation from real GDP trend growth in %points • Structural balance in % of GDP	• Lending interest rate in % • Excess credit growth (domestic credit times 3-years-av. credit growth) • Capital-to-assets ratio



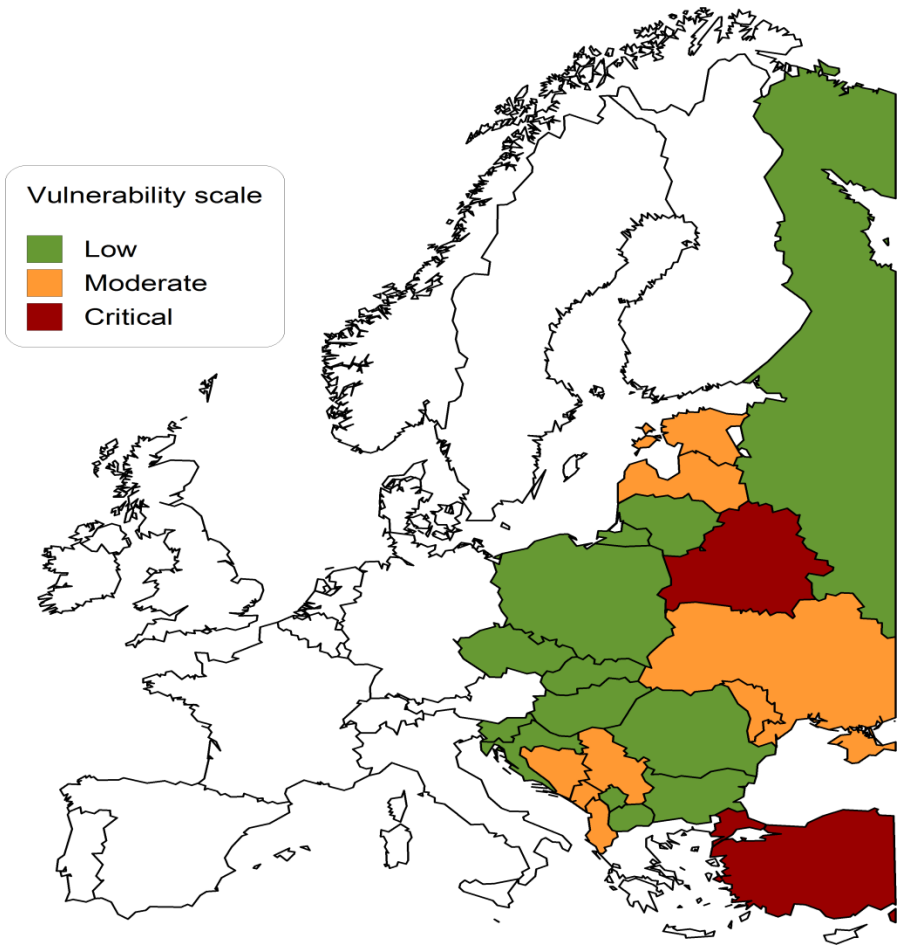
3. Evaluation – Insample Performance

Uniform weighting	Crisis	Noncrisis
Signal issued	72.83	30.63
No signal issued	27.16	69.37

More weight to external risk subcategory	Crisis	Noncrisis
Signal issued	77.78	33.27
No signal issued	22.22	66.73

Less weight to banking subcategory	Crisis	Noncrisis
Signal issued	70.37	32.33
No signal issued	29.63	67.67

Current Vulnerabilities in CESEE



Source: Own calculation, based on 2013/2014 data

Current Vulnerabilities in CESEE

Belarus

- Vulnerable in all sectors
- Experienced currency crises in 2009 and 2011
- But: slight improvement compared to March 2014

Turkey

- Vulnerable in all sectors
- Strong credit growth and inflation
- Additionally pronounced current account deficit, high short term external debt compared to total external debt and large debt service

- No major vulnerabilities in other CESEE countries

What about…

… Countries that have been in recession for some time? (e.g. Croatia)

- Recessions often triggered by crises → early warning comes too late
- Also, structural indicators are not incorporated in the model, since they do not alter their behavior much in the run-up to a crisis

… Ukraine and Russia?

- Early warning system cannot predict political crises
- Ukraine‘s vulnerability deteriorating fast
- Russia: Oil-exporting economy, thus many shock-absorbing factors → oil price developments should be monitored closely

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For further information see:

Feldkircher, M., T. Gruber and I. Moder. 2014. Using a Threshold Approach to Flag Vulnerabilities in CESEE. Focus on European Economic Integration Q3/2014

isabella.moder@oenb.at