Signalling fiscal stress in the euro area
A country-specific early warning system

A discussion

Alessandro Turrini
DG ECFIN
European Commission

"Fiscal policy in an uncertain environment",
Brussels 29 January 2019
Aim of the paper

- Signalling approach (e.g., Kaminski and Reinhart, 1999): at the ground of many early warning systems

- Main idea: identify thresholds of key variables permitting a swift identification of increased risk. Broad criterion: adequate balance between missed crises and false alarms

- Needed: sufficiently many crisis data \( \rightarrow \) signalling approach generally implemented in pooled data, putting together information for different countries

- The paper makes a step forward in estimating country specific thresholds using the signalling approach
Main achievements and results

- Important objective. Well-known that debt tolerance is largely country-specific, depending inter-alia on:
  - Debt characteristics (net debt, duration, foreign exposure, FX exposure...)
  - Economic and public finance prospects (growth potential, tax burden,...)
  - Fiscal governance (fiscal and non-fiscal institutions)
  - Macro imbalances (private debt, external debt, current account balances and prospects, real estate boom-bust)
  - Financial sector conditions (capitalisation, profitability,... ...)

- Country-specific thresholds
  - permit to take into account such heterogeneity
  - As thresholds are built to fit each countries' data, country-specific thresholds permit to achieve a higher signal power across the whole panel as compared to single one-size-fits-all thresholds
  - Complements "standard S0"
Main limitations

- Few episodes of crisis starts across the EA11, 1970-2010 sample (27 crisis episodes in total, 15 crisis starts: 1.36 per country on avg.):

- Implications
  - For 3 countries where no crisis have occurred signal power is not defined (Prob missed crisis=No. crises not called/No. crises) $T=\text{MaxV}$ (e.g., govt. debt in BE=134%)

  - For 2 countries with 1 crisis start, $T=V$ in crisis year;
  Prob missed crisis=0 $\rightarrow$ signal power =1 (e.g., govt. debt in DE=18%)

- Questions
  - Signal power is mechanically high: but are thresholds representative?
  - Can future crisis probability be inferred from past on the basis of few observations?
Main limitations

More fundamentally, is crisis probability fully country-specific and time invariant?

- For instance, govt. debt $>18\%$ should still imply high risk for DE now because of a crisis taking place in 1974? Or have country characteristics changed?

- In a nutshell, is the identity of the country that matters or a combination of its key characteristics?

- Similar problem as predicting on the basis of fixed effects from probit/logit models/
Are there alternatives?

Sample split by main characteristics

- How to go beyond one-size-fits-all thresholds while addressing above limitations?
- A first approach could be to apply the signalling approach to sub-samples where countries are grouped according to structural characteristics that contribute to the riskiness of a particular variables
  
  - E.g.,

<table>
<thead>
<tr>
<th>Govt. debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>High. share of short-term debt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Govt. debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>High. share of short-term debt</td>
</tr>
<tr>
<td>High current account balance</td>
</tr>
</tbody>
</table>
Are there alternatives?

Variable interactions

A second approach could be to apply the signalling approach to variables interacted with measures of structural characteristics that contribute to the riskiness of a particular variables (Commission NIIP benchmarks, Turrini and Zeugner forthcoming)

- E.g., Govt. debt * share of short-term debt
  Govt. debt * share of govt. debt / potential growth

Defining a threshold for interacted variables permit to take into account additional information and get higher signal power
Interacting NIIP with income allows for better separating crisis vs. non-crisis episodes

Large red: crisis start in t+1, small red: crisis within 5 years, grey: no crisis
1980-2015, relative income is GDP in PPP per working-age person as % of G3 level
Advantages of alternatives that allow availability of numerous crisis years

Availability of numerous crisis years allow additional metrics to assess thresholds:
- Robustness wrt. sample perturbations
- Robustness with respect to alternative criteria for computing thresholds AUROC (are under ROC curve, reporting the ratio correct signals/false alarm for each value of the variable)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Threshold</th>
<th>Signal power of (1)</th>
<th>Missed crises (%)</th>
<th>False alerts (%)</th>
<th>Std. dev of (1) wrt. sample perturbations</th>
<th>AUROC</th>
<th>Median c.s. threshol d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIIP</td>
<td>-25</td>
<td>0.34</td>
<td>0.22</td>
<td>0.45</td>
<td>8</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>NIIP / relative per capita income</td>
<td>-83</td>
<td>0.48</td>
<td>0.18</td>
<td>0.35</td>
<td>9</td>
<td>0.77</td>
<td>-44</td>
</tr>
<tr>
<td>NIIP * Non-FDI liabilities / total liab.</td>
<td>-65</td>
<td>0.38</td>
<td>0.38</td>
<td>0.24</td>
<td>10</td>
<td>0.74</td>
<td>-46</td>
</tr>
<tr>
<td>NIIP / imports</td>
<td>-131</td>
<td>0.41</td>
<td>0.33</td>
<td>0.26</td>
<td>26</td>
<td>0.77</td>
<td>-40</td>
</tr>
<tr>
<td>NIIP / Fraser economic freedom index</td>
<td>-7</td>
<td>0.45</td>
<td>0.33</td>
<td>0.22</td>
<td>1</td>
<td>0.77</td>
<td>-46</td>
</tr>
</tbody>
</table>
Advantages of alternatives that allow availability of numerous crisis years

Area under Receiver Operating Characteristic, selected indicators signalling external crises

AUROC: area under ROC=share correct/false signals

Measures signal power of a variable irrespective of specific criterion to choose the threshold
Aggregating thresholds

Should thresholds be aggregated into a synthetic indicator?
- Allow synthesis, combine information and leads to higher signal power.
- But contribution of single variables to level and changes of the synthetic indicator is also key: this info should not be lost.

Which weights for the aggregation?
- Fiscal variables do not add much to $S_0$ (their inclusion even reduce out-of-sample signal power!)
- Current criterion: variables weighted according to the signal power of the associated threshold. This is NOT a measure of the signal power of the variables itself, but a measure of the extent of which the signal power of the variable is non-linear (raises significantly when values are above a given threshold).
- Alternatives?
  - $AUROC_i / \sum_i AUROC_i$
  - $\sum_j \beta_j X_j / \sum_i \sum_j \beta_j X_j$
    i.e., prediction from probit/logit multivariate empirical model for crises