Early warning indicators of banking crises: expanding the family - ONLINE APPENDIX

Variables: sources and definitions

Credit-to-GDP gaps

For credit to both the non-financial private sector and the household sector, the credit-to-GDP gaps are defined as the difference between the credit-to-GDP ratio and its long-run trend, based on a one-sided HP filter with the smoothing parameter equal to 400,000. The aggregate credit-to-GDP ratio as published in the BIS database of total credit to the private non-financial sector, capturing total borrowing from all domestic and foreign sources, is used as input data. The subcategory corresponding to the household sector is used for our measure of the household credit-to-GDP gap.

Debt service ratios

The debt service ratio (DSR) is defined as the ratio of interest payments plus amortisations to income. As such, the DSR provides a flow-to-flow comparison – the flow of debt service payments divided by the flow of income.

The BIS constructs and publishes quarterly data on DSRs for the private non-financial sector (what we refer to as “total DSR” in the special feature), as well as sectoral DSRs for households and private non-financial corporations. We use the series for the total DSR, as well as the subcategory for the household sector. The published data start in 1999. We use non-published data to extend the series as far back as possible (for details on the sample used in the analysis, see Table A1).

As there are country-specific differences in the level of DSRs, it is important to remove the long-run trend. We do so by computing the difference of the respective DSR from its country-specific 20-year rolling average. For the first 20 years of data the average is constant.

Property price gaps

Property price gaps build on residential property price data collected at the BIS. The residential property price gap is the deviation of inflation-adjusted residential property prices from their long-run trend, based on a one-sided Hodrick-Prescott filter with the smoothing parameter equal to 400,000.

Cross-border claims

Cross-border claims are taken from the BIS locational banking statistics. For each counterparty country, we use the stock of cross-border claims in all currencies against both banks and non-banks. We adjust the series for breaks due to methodological or
sample changes. Given major breaks prior to 1984, we only use data from the first quarter of 1984 onwards. We then divide this by nominal GDP and compute the 12-quarter growth rates.

**Foreign currency debt**

Foreign currency debt combines information from the BIS locational banking statistics and the debt securities statistics, applying the methodology used to construct the BIS global liquidity indicators' total credit to non-residents. We add cross-border foreign currency claims on non-banks, international debt securities issued in foreign currency by non-banks, and local claims in foreign currency on non-banks. Foreign currency includes loans and debt securities denominated in US dollars, euros, Japanese yen, Swiss francs and sterling. The published data disaggregated at the currency level used to construct the series starts in 1999. We extend it backwards until the fourth quarter of 1995 using non-published data. As for the cross-border claims, we adjust for breaks in series. Before 1995, we approximate the change in foreign currency debt by the change in cross-border claims on non-banks in all currencies. The results are robust to alternatively using the changes in total cross-border claims or cross-border claims on banks. We opt for cross-border claims on non-banks since these are the largest component of foreign currency credit for the majority of countries, and therefore show a similar time series behaviour. We then divide this by nominal GDP and compute the 12-quarter growth rates.
## The sample

<table>
<thead>
<tr>
<th>Credit-to-GDP gap</th>
<th>Total DSR</th>
<th>Property price gap</th>
<th>Household credit-to-GDP gap</th>
<th>Household DSR</th>
<th>Cross-border claims to GDP</th>
<th>Foreign currency debt to GDP</th>
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Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, debt securities, locational banking and property price statistics; authors’ calculations.
The sample (cont)  

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<th>Property price gap Start</th>
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<th>Household credit-to-GDP gap Start</th>
<th>Household credit-to-GDP gap End</th>
<th>Household DSR Start</th>
<th>Household DSR End</th>
<th>Cross-border claims to GDP Start</th>
<th>Cross-border claims to GDP End</th>
<th>Foreign currency debt to GDP Start</th>
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Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, debt securities, locational banking and property price statistics; authors' calculations.
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Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, debt securities, locational banking and property price statistics; authors’ calculations.
## Credit-to-GDP gap performance for different threshold values

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1 Optimal EWI threshold that minimises the noise-to-signal ratio while capturing at least 66% of historical crises; in percentage points.  
2 Results are based on the broadest data coverage.  
3 Results are based on a common sample, when all four indicators used in Table 2 of the main text are available.  
4 Percentage of correctly predicted crises. A crisis is judged to be correctly predicted if the indicator variable breached the critical threshold (column 1) anytime within a three-year horizon before a crisis.  
5 NTS: noise-to-signal ratio; fraction of type II errors (the threshold is breached but no crisis occurs within the next three years) divided by the fraction of correctly predicted crises (column 2 or 5).  
6 Number of crises included in the analysis.

Sources: National data; BIS credit to the non-financial sector statistics; BIS calculations.
## Total DSR performance for different threshold values

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Sources: National data; BIS credit to the non-financial sector statistics; BIS calculations.
### Household DSR performance for different threshold values

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Sources: BIS property price statistics; BIS calculations.
## Cross-border claims to GDP performance for different threshold values

Table A6

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1. Optimal EWI threshold that minimises the noise-to-signal ratio while capturing at least 66% of crises; in percentage points.
2. Results are based on the broadest data coverage.
3. Results are based on a common sample, when all four indicators used in Table 2 of the main text are available.
4. Percentage of correctly predicted crises. A crisis is judged to be correctly predicted if the indicator variable breaches the critical threshold (column 1) anytime within a three-year horizon before a crisis.
5. NTS: noise-to-signal ratio; fraction of type II errors (the threshold is breached but no crisis occurs within the next three years) divided by the fraction of correctly predicted crises (column 2 or 5).
6. Number of crises included in the analysis.

Sources: BIS locational banking statistics; BIS calculations.