

# Banking Sector Vulnerability Models and Indicators

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# Outline

**1. Introduction**

2. Financial and Banking Sector Vulnerabilities and Crises

3. Indicators, Assessment, Analysis, and Prediction

4. Concluding Remarks

# Role of the Financial Sector

*"Finance is, as it were, the stomach of the country, from which all the other organs take their tone."*

William Gladstone , former British Prime Minister, 1858



# Role of the Financial Sector

A well-developed financial system should improve economic growth:

- Improve the efficiency of investors' decisions through a better allocation of resources
- Information dissemination facilitating efficient investment decisions
- Foster risk sharing
- Facilitate cross-border transactions
- Provision of required financial market infrastructure



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# Financial Sector Vulnerability

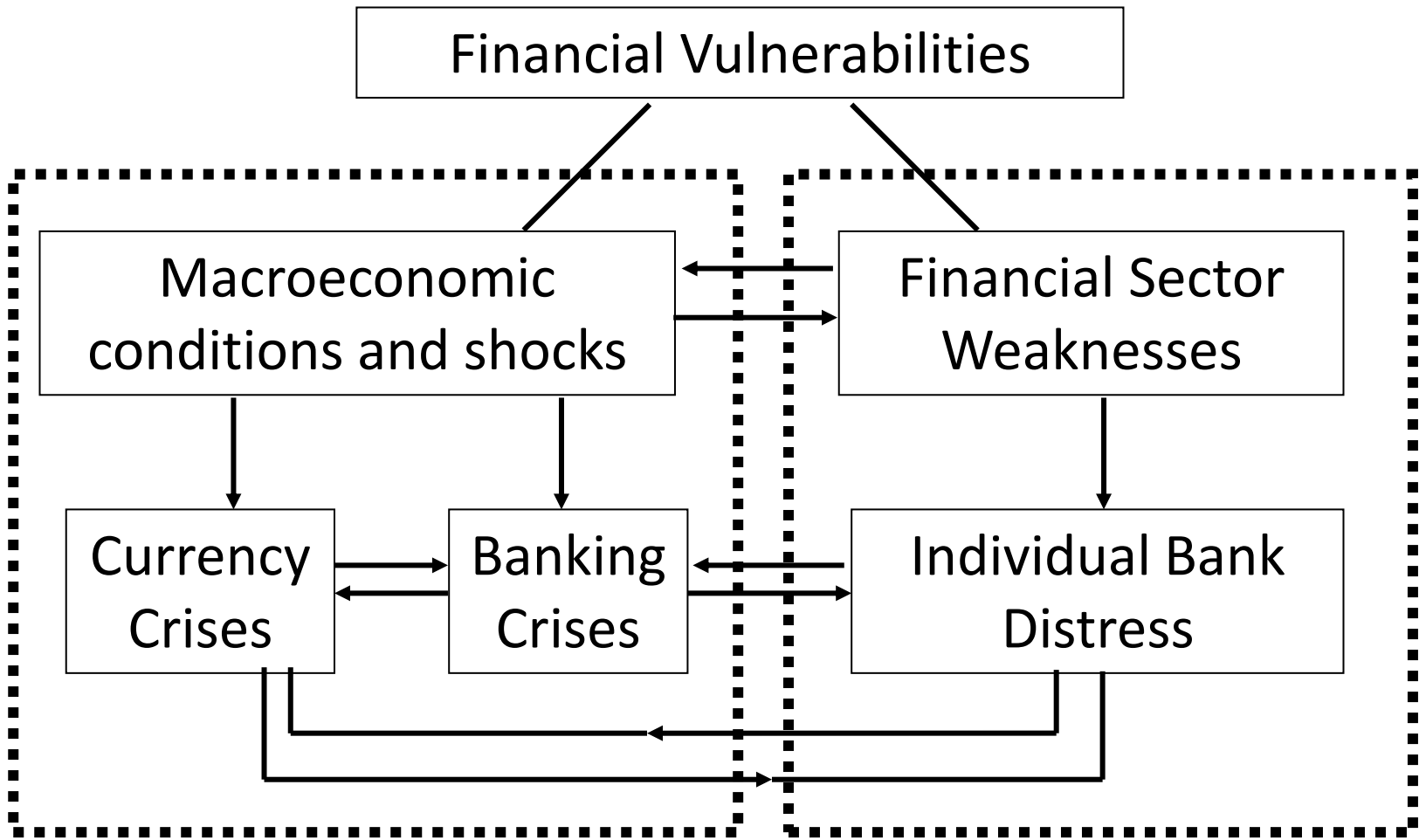
- Definition: the state of being exposed or being open to attack or damage (*Webster Dictionary*)
- Causes: “*Excessively rapid financial and capital market liberalization was probably the single most important cause of the crisis...*” (J.E. Stiglitz, 2003, *Globalization and its Discontents*, p. 89)

# Financial Stress and Crisis

- Financial stress:
  - The financial sector is under strain and its ability to intermediate may be impaired
  - May impact real economic activity
- Financial crises:
  - Significant disruption of the financial sector: currency crises, banking crises, sovereign debt crises, speculative bubbles and crashes
  - Substantial loss in real economic activity

# Financial Stress and Crisis

- Financial stress → (severe ones) financial crisis → economic slowdown
  - Rapid expansion in credit
  - Run-up in house prices
  - Heavy borrowing by firms and households
- Banking stress amplifies effects on economic activity
- There are many different types crisis and they can originate from different sources



Origin of Vulnerabilities	Macroeconomic conditions and shocks	Financial Sector Weaknesses
<div data-bbox="40 426 382 615" style="border: 1px solid black; padding: 10px; text-align: center;"> <p>Type of Indicators</p> </div>	<ul style="list-style-type: none"> <li>• <b>Current account:</b> external trade and balance, REER</li> <li>• <b>Capital account:</b> foreign reserves, total/ST external debt, maturities, interest rate differential</li> <li>• <b>Monetary sector:</b> monetary conditions, interest rates, inflation rates</li> <li>• <b>Fiscal sector:</b> fiscal deficit &amp; financing, public sector debt</li> <li>• <b>Real sector:</b> economic activity</li> <li>• <b>External conditions:</b> commodity prices, global interest rates, global growth</li> </ul>	<ul style="list-style-type: none"> <li>• Capital adequacy</li> <li>• Asset quality</li> <li>• Management soundness</li> <li>• Earnings &amp; profitability</li> <li>• Liquidity</li> <li>• NPLs</li> <li>• Sensitivity to market risks</li> <li>• Market indicators</li> <li>• Other indicators of NBFIs</li> </ul>

# Defining Banking Crisis

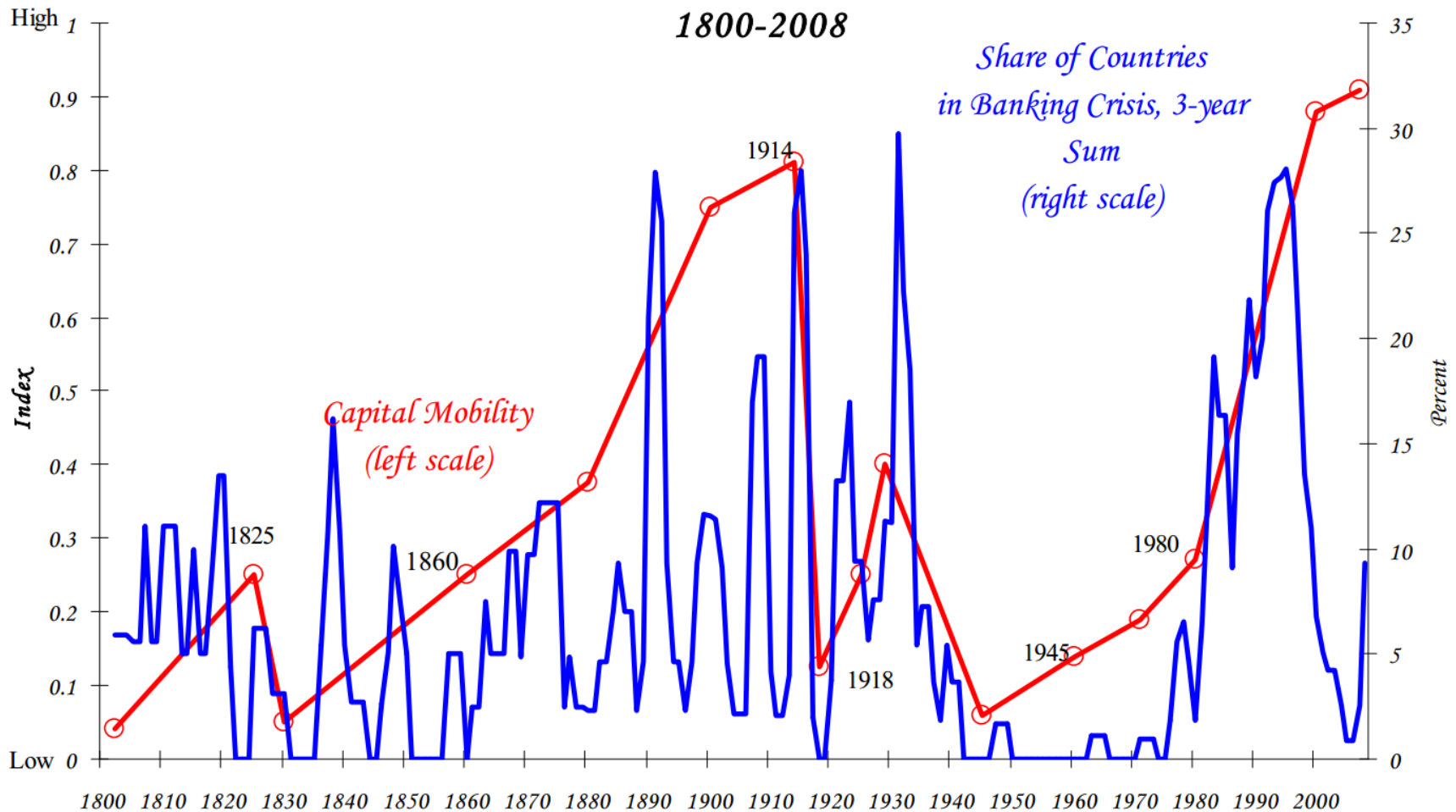
- Indicator-based:
  - Nonperforming loan (NPL) ratios
  - Costs of bank rescue operations
  - Losses of bank capital
- Events-based
  - Bank runs
  - Bank closures
  - Mergers and/or takeovers of major financial institutions
  - Public sector interventions

# Deeper Causes of Banking Crises

- Macroeconomic Shocks
  - E.g: interest rates, exchange rates, commodity prices, output growth, productivity, external demand, capital flows, etc.
  - Worsening banking sector health and bank failures
- Structural problems in Financial Sector
  - E.g.: Poor market discipline, weak governance, moral hazard, poor regulation & supervision, limited competition
- Legacies
  - System-wide problems often materialize during periods of financial liberalization
- Contagion: spillovers to the whole system

# Capital flows and banking crises

*Capital Mobility and the Incidence of Banking Crisis: All Countries, 1800-2008*



Source: Bordo et al. (2001), Caprio et al. (2005), Kaminsky and Reinhart (1999), Obstfeld and Taylor (2004), and Reinhart and Rogoff (2008).

# Liberalization and Banking Crises

- In the 1980s and 1990s most liberalization episodes were associated with financial crises of varying severity, and preceded banking crises.
- Robust finding: financial liberalization negatively affects banking sector stability
- Inadequate regulation and lack of supervision at the time of the liberalization may play a key role

# Asset Prices and Banking Crises

- Banking crises tend to occur either at the peak of the boom in real housing prices, or right after the bust (Bordo and Jeanne, 2003)
- A boom in real housing prices in the run-up to the crisis is followed by a considerable and long lasting decline the year of the crisis and in subsequent years (Reinhart and Rogoff, 2008)

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# Assessing Financial Vulnerabilities

- Macroprudential analysis:
  - Macro environment and the financial system as a whole
  - Enhance financial stability and, in particular, limiting the likelihood of financial crises
- Microprudential analysis:
  - Individual financial institutions
  - Limit the risk of episodes of financial stress arising from individual institutions

## The macro- and microprudential perspectives compared

	<b>Macroprudential</b>	<b>Microprudential</b>
Proximate objective	limit financial system-wide distress	limit distress of individual institutions
Ultimate objective	avoid output (GDP) costs	consumer (investor/depositor) protection
Model of risk	(in part) endogenous	exogenous
Correlations and common exposures across institutions	important	irrelevant
Calibration of prudential controls	in terms of system-wide distress; top-down	in terms of risks of individual institutions; bottom-up

# Early Warning System (EWS)

- Definition:
  - Any system of biological or technical nature deployed by an individual or group to inform of a future danger
  - Purpose: to enable the deployer of the warning system to prepare for the danger and act accordingly to mitigate against or avoid it
- EWS for financial crisis
  - Monitor and assess financial vulnerabilities originating from macro shocks and policy inconsistencies
  - Apply statistical methods to predict the likelihood that an economy will face a financial crisis over a given time horizon

# Early Warning System Models

- Objective of EWS models
  - To predict whether a crisis occurs within a specific time horizon
- Two types
  - Parametric: regressions with limited dependent variables
  - Non-parametric: Signal approach
- Two applications:
  - Currency Crises
  - Banking Crises

# Parametric EWS Models

- Using a regression to estimate the probability of a financial crisis by using discrete choice econometric methods
- Probit and Logit models:
  - Dependent variable: take on the value of one or zero, corresponding respectively to crisis or no-crisis observations
  - To be estimated to find out which indicators are significant, and the estimated value of the dependent variable would be used to infer crisis probability
- Assumption: the occurrence of financial crises follows a given probability distribution

# Non-parametric EWS Models

- Signal approach developed by Kaminsky and Reinhart (1999)
- No distributional assumptions
- A signal occurs if the indicator exceeds a pre-defined threshold
- Threshold found for each individual indicator by a grid search minimizing noise to signal ratio
- Possibility of constructing composite indices from a set of indicators

# Leading Indicators for Currency Crises

	<u>Conditional crisis probability</u>
Real exchange rate against US\$, deviation from trend - HP filter	0.681
Short-term external debt to reserves	0.509
Real effective exchange rate, deviation from trend - HP Filter	0.498
Foreign liabilities to foreign assets	0.483
M2 to reserves	0.434
M2 to reserves, 12 m change	0.413
Current account balance to GDP	0.402
Domestic real interest rate differential from US rate, 12 m change	0.387
US real interest rate	0.377
M2 multiplier, 12 m % change	0.363
Short-term external debt to reserves, 12 m change	0.363
Oil price, 12 m % change	0.362
M2 multiplier	0.359
Domestic real interest rate	0.355
Domestic credit to GDP, 12 m change	0.354
Domestic consumer price index, 12 m % change	0.351
Loans to deposits	0.346
Foreign reserves in months of imports	0.346
Central bank credit to the public sector to GDP, 12 m change	0.341
Deposits in BIS banks to reserves	0.340

Unconditional crisis probability: 22%



# Leading Indicators for Banking Crises

	<u>Conditional crisis probability</u>
Current account balance to GDP, 12 m change	0.887
Imports, 12 m % change	0.869
Short-term capital flows to GDP, 12 m change	0.834
Government consumption to GDP	0.826
Domestic real interest rate differential from US rate	0.824
Central bank credit to the public sector to GDP	0.728
Stock price index in local currency, 12 m % change	0.715
Domestic real interest rate differential from US rate, 12 m change	0.714
M2 multiplier	0.712
Domestic credit to GDP	0.701
Fiscal balance to GDP, 12 m change	0.687
Lending-deposit rate spread, 12 m change	0.676
M2 to reserves, 12 m change	0.630
Domestic real interest rate, 12 m change	0.538
US real interest rate	0.463
M2 multiplier, 12 m % change	0.443
Deposits in BIS banks to reserves, 12 m change	0.432
Deposits in BIS banks to reserves	0.413
M2 to reserves	0.394
Foreign reserves in months of imports	0.393

Unconditional crisis probability: 8%



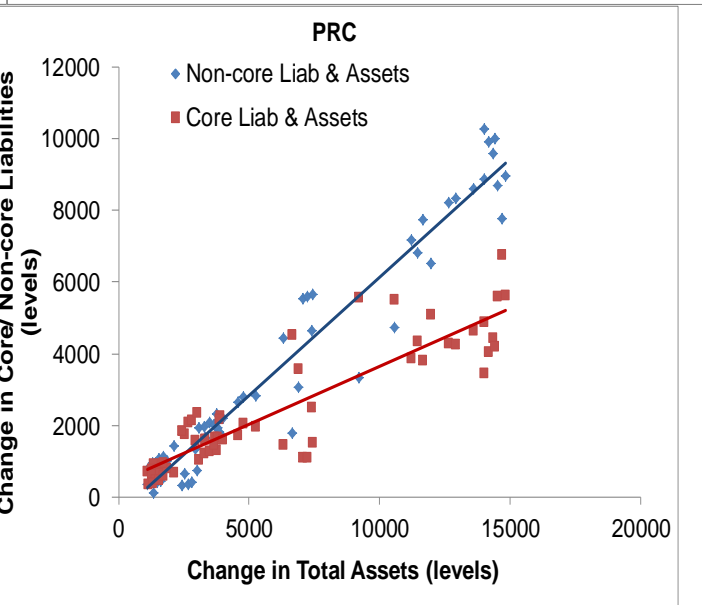
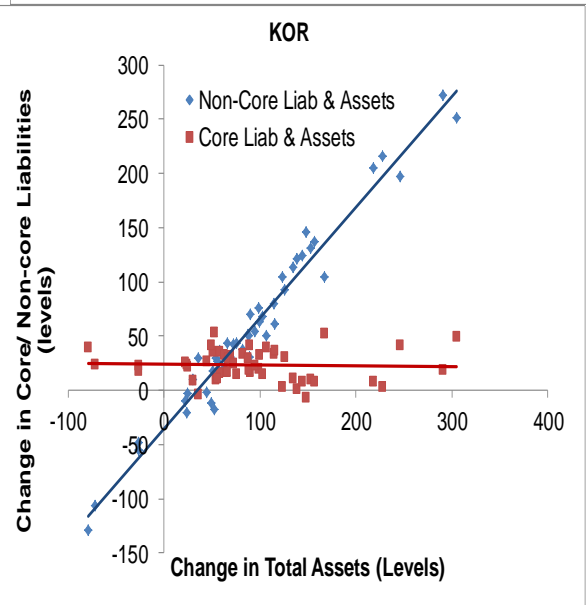
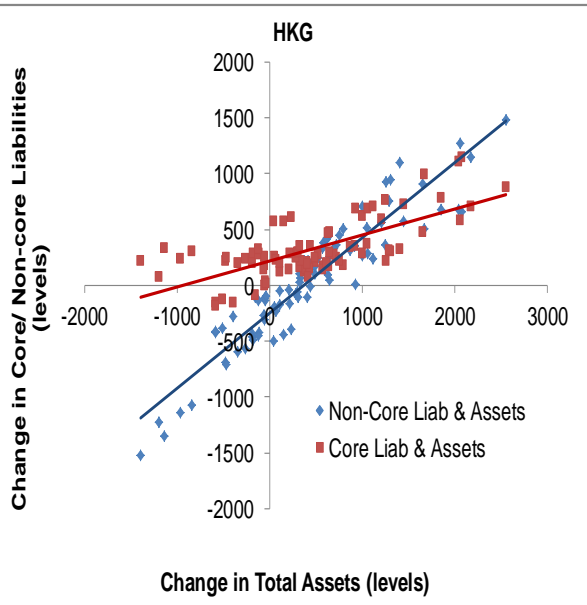
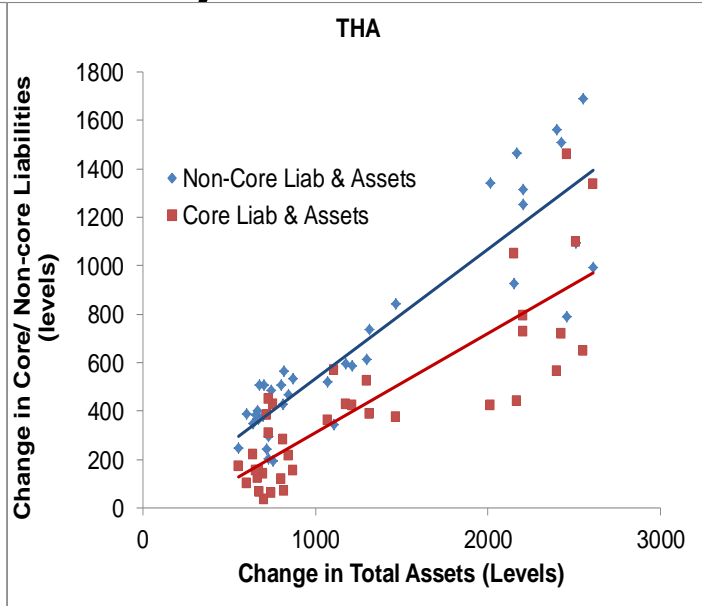
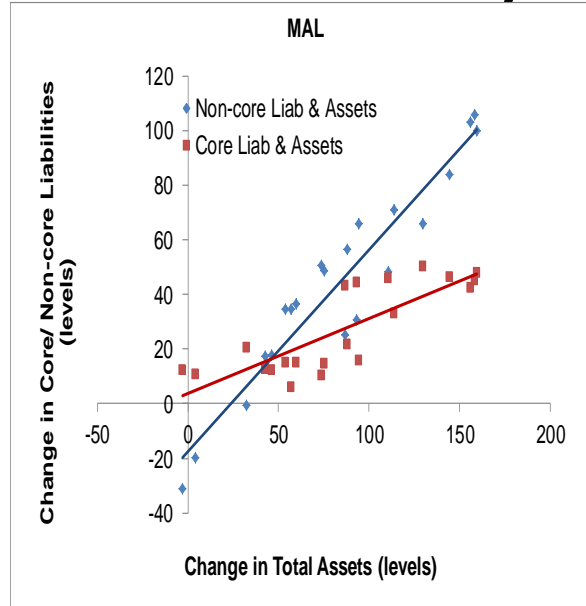
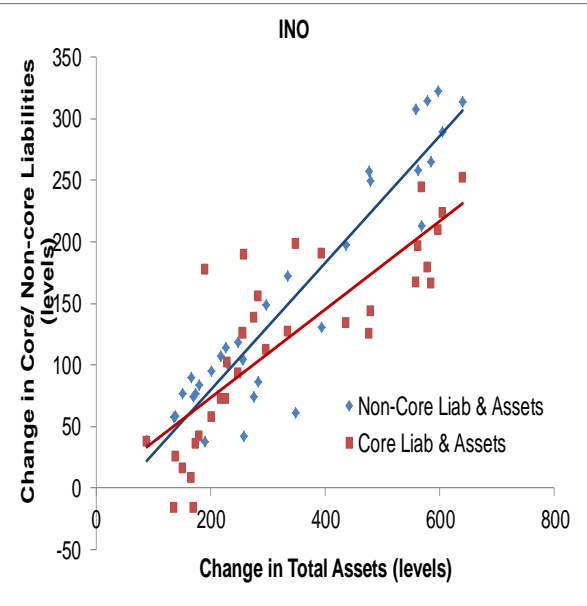
# EWS models: which one is better?

- The signal (non-parametric) approach is simpler
- But it imposes certain nonlinearity restrictions on the way that indicators affect crisis probabilities
  - An indicator yields a warning only once it crosses the threshold
- One consideration could be a combination of the two approaches:
  - Use the signal approach to identify best leading indicators
  - Use the regression approach to calculate crisis probabilities

# Key Lessons from EWS Literature

- Predicting a crisis is cumbersome
- Identifying vulnerabilities and triggering propagation mechanisms are more important
- Practitioners prefer a signal approach: it is simple and easy to communicate
- Generally, we have a good idea about indicators associated with a crisis
- But there are new sources of vulnerabilities

# Rising Non-core Liabilities by Banks Elevate the Risk of Pro-cyclicality



# Non-performing Ratios in Emerging Asia, 2015

Country	NPL Ratio (%)	Year	Country	NPL Ratio (%)	Year
Below 5%			5% to below 10%		
Turkmenistan	0.01	2014	Samoa	5.3	2015
Brunei Darussalam	0.4	2015	India	5.9	2015
Uzbekistan	0.4	2015	Kyrgyz Republic	7.1	2015
Korea, Republic of	0.6	2014	Armenia	7.9	2015
New Zealand	0.6	2015	Kazakhstan	8.0	2015
Hong Kong	0.7	2015	Bangladesh	9.3	2015
Singapore	0.9	2015	Above 10%		
Australia	1.0	2015	Pakistan	11.4	2015
PRC	1.5	2015	Bhutan	11.9	2015
Cambodia	1.6	2015	Afghanistan	12.3	2015
Japan	1.6	2015	Maldives	14.1	2015
Malaysia	1.6	2015	Tajikistan	19.1	2015
Fiji	1.8	2015			
Philippines	1.9	2015			
Georgia	2.7	2015			
Thailand	2.7	2015			
Vietnam	2.9	2014			
Sri Lanka	3.2	2015			
Solomon Islands	4.1	2015			
Azerbaijan	4.9	2015			

Source: World Development Indicators



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# Concluding Remarks

- Need to carefully monitor the real economy, financial markets and the banking sector
- Make financial markets and the banking sector more resilient
  - Role for macro- and microprudential policies
  - Financial crisis is bound to occur from time to time
  - Analyze past crises
- Analyze new sources of vulnerabilities



Thank you very much

