Can leading indicators assess country vulnerability?

Evidence from the 2008-09 global financial crisis

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1. Introduction

Objective

Attempt to identify variables that could have helped predict which countries were badly impacted by the global financial crisis of 2008-09, such that we could be *provided with early warnings of macroeconomic and financial risks, and the actions needed to address them*.

1. Introduction

Why this crisis?

➔ Its large magnitude makes it good against which the variables' predictive power can be tested

➔ The synchronized timing of the crisis incidence throughout the global economy, and the spillover effects across the countries

This paper is about the victims of contagion, and **not** the originators!

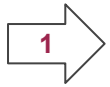
2. Literature

Did any variables have consistently proven successful as leading indicators of crisis incidence in the past?

1. Extensive review of more than 80 papers from the pre-2008 early warning indicators.

2. Selection of variables for the empirical analysis of the effects of the 2008-09 crisis.

Limitations

1. The definitions of crisis and crisis incidence 

2. The variables examined as indicators are selected with the benefit of hindsight, though usually based on some underlying economic reasoning

Solution: identify the causes and symptoms of financial crisis that have been most consistent over time, country and crisis.

Definitions

- ➔ *Discrete measures,* (binary variables) define crisis as occurring, once a particular threshold value of some economic or financial variable has been breached (*e.g.*, changes in the exchange rate)
- ➔ *Continuous measures,* overcome the problem of defining particular thresholds, by measuring crisis intensity on a continuous scale (*e.g.*, nominal and real exchange rates; speculative pressure indices; drop in GDP; drop in equity market)
- ➔ *Both,* defining a crisis endogenously by identifying speculative attacks and the determinants of switching to speculative regimes

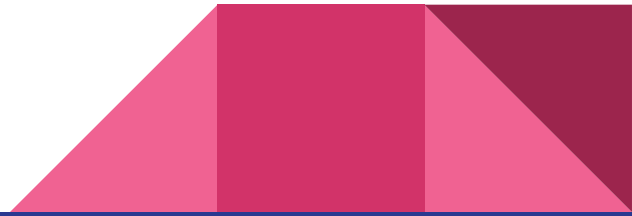
Model specifications

The different modelling approaches employed can be grouped into 4 categories:

1. Linear regression or limited dependent variable probit/logit techniques
2. Non-parametric/Signals approach
3. Qualitative/quantitative analysis of the behaviour of various variables around crisis occurrence
4. Use of binary recursive trees to determine leading indicator crisis thresholds

Literature

It has converged to a number of independent variables most frequently examined as leading indicators of crisis incidence, despite the wide range of estimation techniques.



Meta-analysis

Summarizes the number of times a particular indicator was found to be statistically significant across the reviews and additional studies cited above:

- KLR (1998) for studies up to 1997
- Hawkins and Klau (2000) for studies up to 2000
- Abiad (2003) for studies up to 2001

Table 1
Summary of pre-2008 early warning indicators.

Leading indicator[1]	KLR (1998)[2]	Hawkins and Klau (2000)[3]	Abiad (2003)[4,6]	Others[5,6]	Total
Reserves[a]	14	18	13	5	50
Real exchange rate[b]	12	22	11	3	48
GDP[c]	6	15	1	3	25
Credit[d]	5	8	6	3	22
Current account[e]	4	10	6	2	22
Money supply[f]	2	16	1	0	19
Exports or imports[1a, g]	2	9	4	2	17
Inflation	5	7	1	2	15
Equity returns	1	8	3	1	13
Real interest rate[h]	2	8	2	1	13
Debt composition[1b, i]	4	4	2	0	10
Budget balance	3	5	1	0	9
Terms of trade	2	6	1	0	9
Contagion[j]	1	5	0	0	6
Political/legal	3	2	1	0	6
Capital flows[1c, k]	3	0	0	0	3
External debt[l]	0	1	1	1	3
Number of studies	28	28	20	7	83

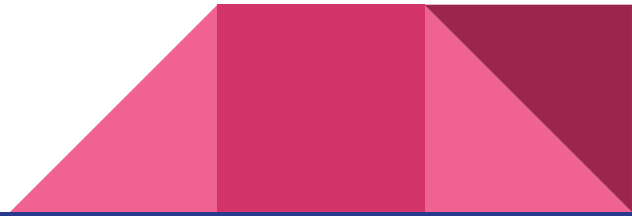
Limitations

1. Some indicators have been tested more frequently than others
2. The criteria used to determine which indicators are significant differ among KLR (1998), Hawkins and Klau (2000) and our last two columns.

Reserves and the real exchange rate are the two most significant indicators in each of the review groupings considered, while credit, GDP and the current account also rank highly.

3. Recent research

- ➔ Obstfeld et al. (2009, 2010)
- ➔ Rose and Spiegel (2009a, 2009b, 2010)
- ➔ Rose and Spiegel (2011)
- ➔ Berkmen et al. (2009)
- ➔ Blanchard et al. (2009)
- ➔ Lane and Milesi-Ferretti (2011)
- ➔ Llaudes et al. (2011)
- ➔ Dominguez et el. (2011)



Predicting the incidence of the financial crisis

2009 research on the global financial crisis finds that the leading indicators that most frequently appeared in earlier reviews were not statistically significant indicators this time.

This paper offers 3 innovations:

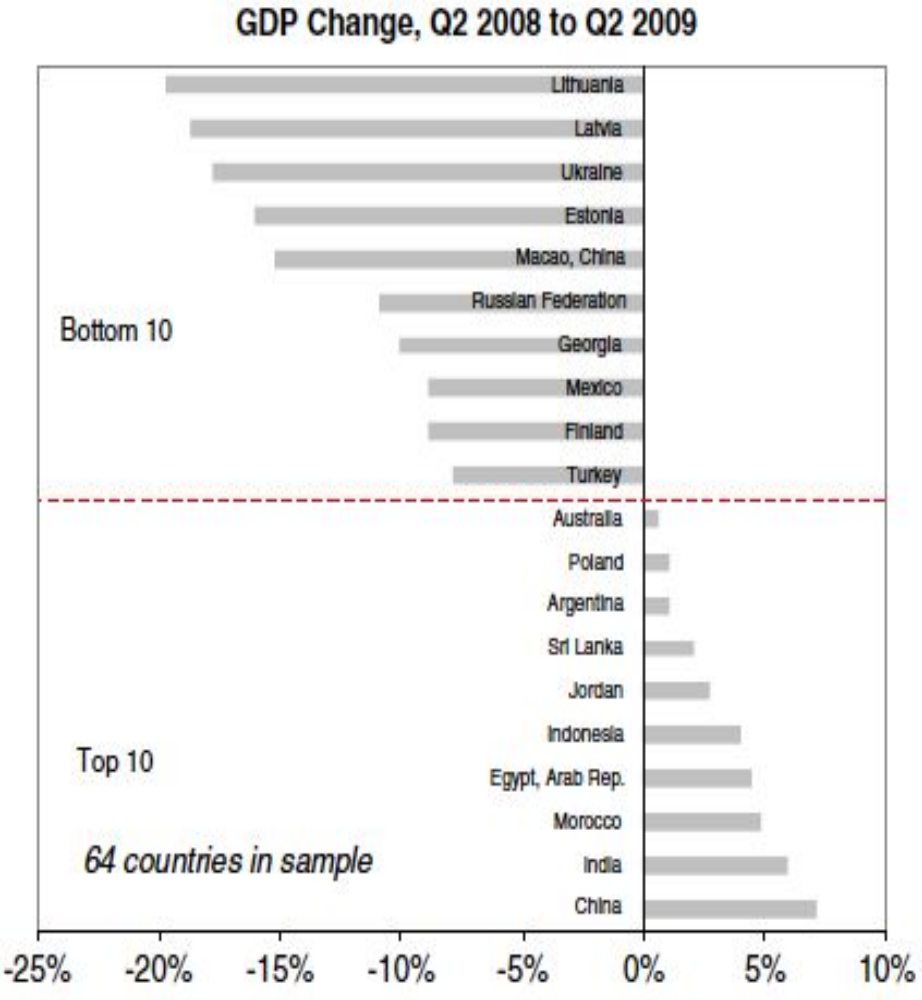
1. Crisis incidence is measured using five different variables
2. Greater attention given to the leading indicators that have been identified as useful by the literature prior to 2008
3. Inclusion of the second quarter of 2009 in the analysis

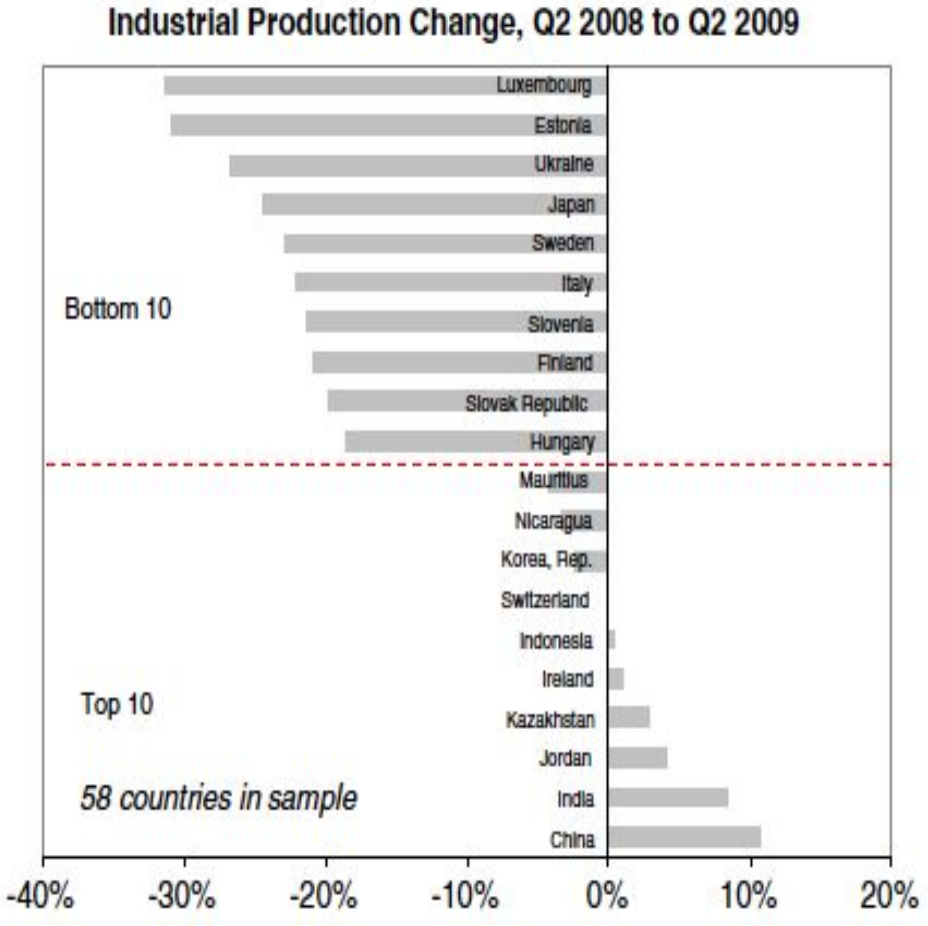
Defining the crisis

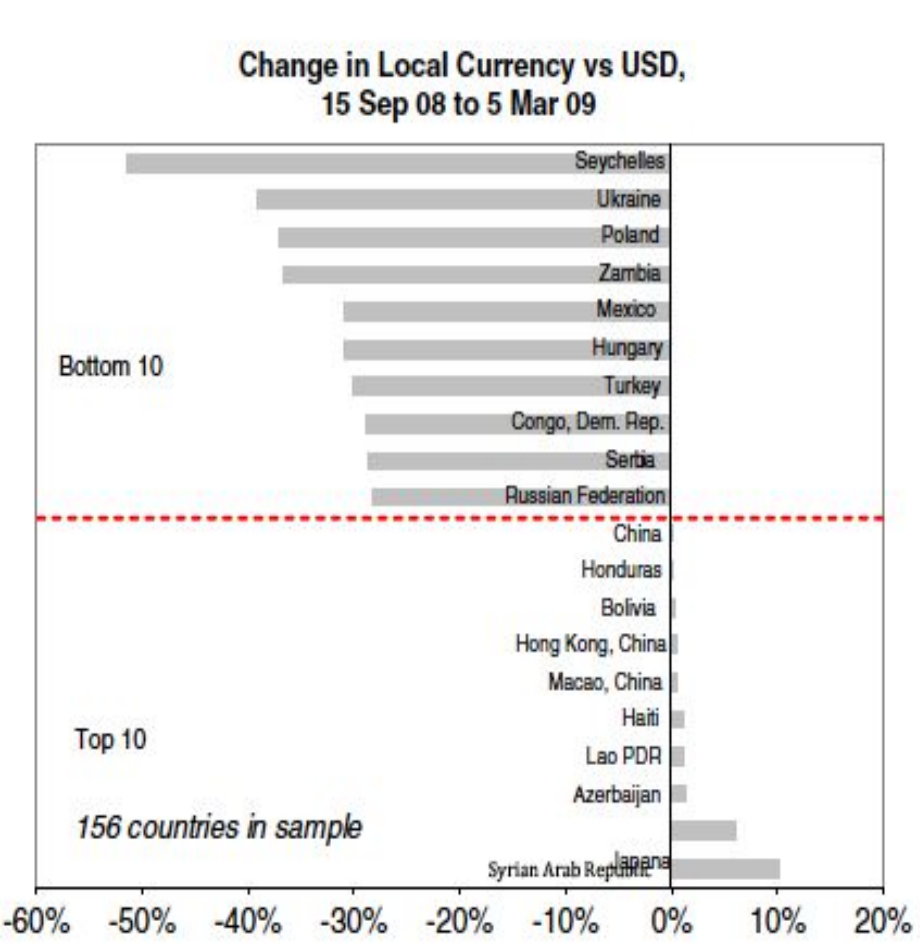
This paper defines crisis in terms of both financial and real symptoms. It considers the crisis period to have continued into 2009, rather than having ended in 2008. The **crisis measures** are as follows:

1. Nominal local currency percentage change versus the US dollar
2. Equity market returns in domestic stock market benchmark indices
3. Percentage change in the level of real GDP
4. Percentage change in industrial production
5. Recourse to IMF financing

4. Empirical Results


GDP Change, Q2 2008 to Q2 2009
Lithuania
Latvia
Ukraine
Estonia
Macao, China
Russian Federation
Georgia
Mexico
Finland
Turkey
Bottom 10
Australia
Poland
Argentina
Sri Lanka
Jordan
Indonesia
Egypt, Arab Rep.
Morocco
India
China
Top 10
64 countries in sample
-25%
-20%
-15%
-10%
-5%
0%
5%
10%


Industrial Production Change, Q2 2008 to Q2 2009
Luxembourg
Estonia
Ukraine
Japan
Sweden
Italy
Slovenia
Finland
Slovak Republic
Hungary
Bottom 10
Mauritius
Nicaragua
Korea, Rep.
Switzerland
Indonesia
Ireland
Kazakhstan
Jordan
India
China
Top 10
58 countries in sample
-40%
-30%
-20%
-10%
0%
10%
20%



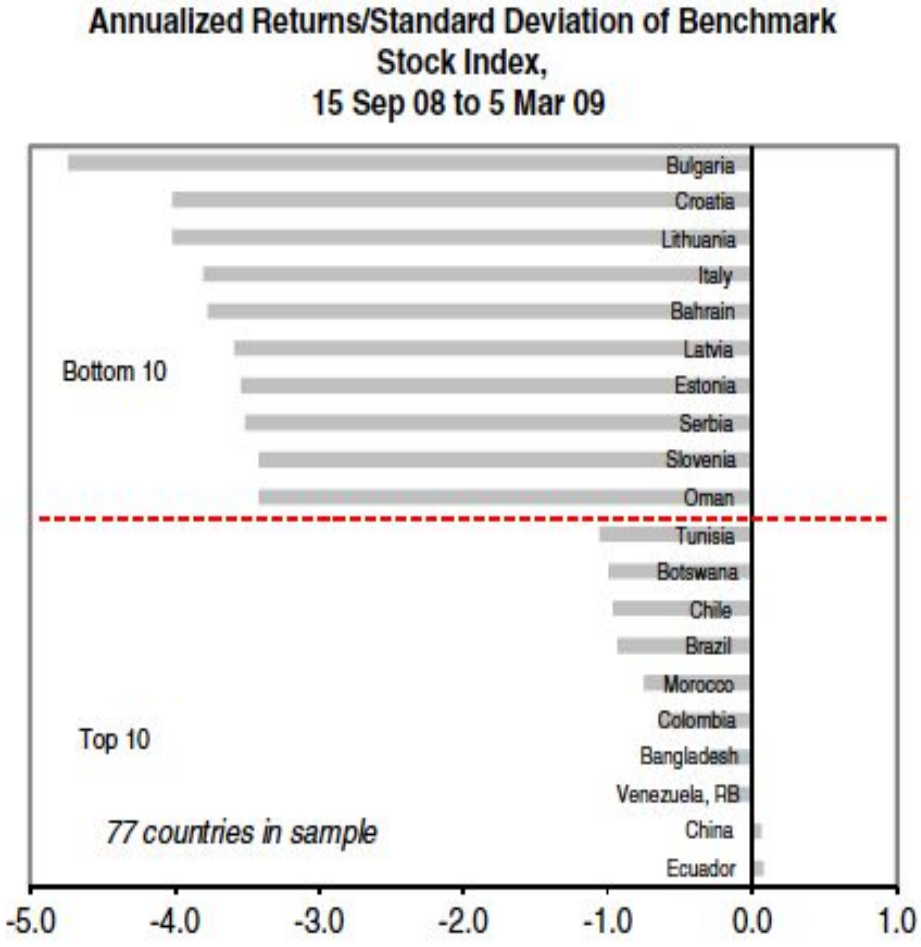


Fig. 3. Best and worst performing countries by crisis incidence indicator.

Multivariate regression for an exchange market pressure index

Table 5
Multivariate specifications.

Coefficient estimates of regressions of exchange market pressure index[1] on leading indicators *t-stat in parentheses*

	Regression specification			
	1	2	3	4
Independent variables, as of 2007				
Real GDP per capita	0.0014	0.0043		0.0083
	(0.17)	*(0.33)*		*(0.58)*
Reserves (% GDP)	0.1642	0.1310	0.1247	0.0950
	*(3.63)***	*(2.03)***	*(2.00)***	*(1.56)*
Rise in REER[2]		−0.3647	−0.3574	−0.4387
(%, 2003–07)		*(−3.57)***	*(−3.45)***	*(−4.61)***
Peg Dummy		0.1013	0.1009	0.0547
(1 = peg; else 0)		*(2.95)***	*(2.95)***	*(1.59)**
Net FDI (% GDP)				0.0020
				*(1.65)**
Number of observations	151	65	66	54
R-squared	4%	31%	30%	37%

Heteroscedasticity robust standard errors calculated; OLS for all specifications.
**if significant at 10% level; ** if significant at 5% level.*
[1]A higher index is associated with lower crisis incidence.
[2]A higher REER is associated with local currency appreciation.

Robustness analysis

- In order for testing the robustness of the earlier analysis the authors modified some alternative crisis incidence measures and tested if the results still hold.
  - Reserves remained also highly statistically significant.
  - REER turned out to be important in explaining currency market weakness and recourse to the IMF.
  - The coefficients on current account/national savings, credit growth, GDP and external debt appear to have the same patterns of significance.

5. Economic significance and policy implications

- The econometric analysis above confirmed that the top two indicators identified in the literature review were also leading indicators in the 2008-09 crisis.
- A level of reserves equivalent to 100% of GDP is associated with a one standard deviation fall in crisis intensity as measured through the exchange market pressure index.

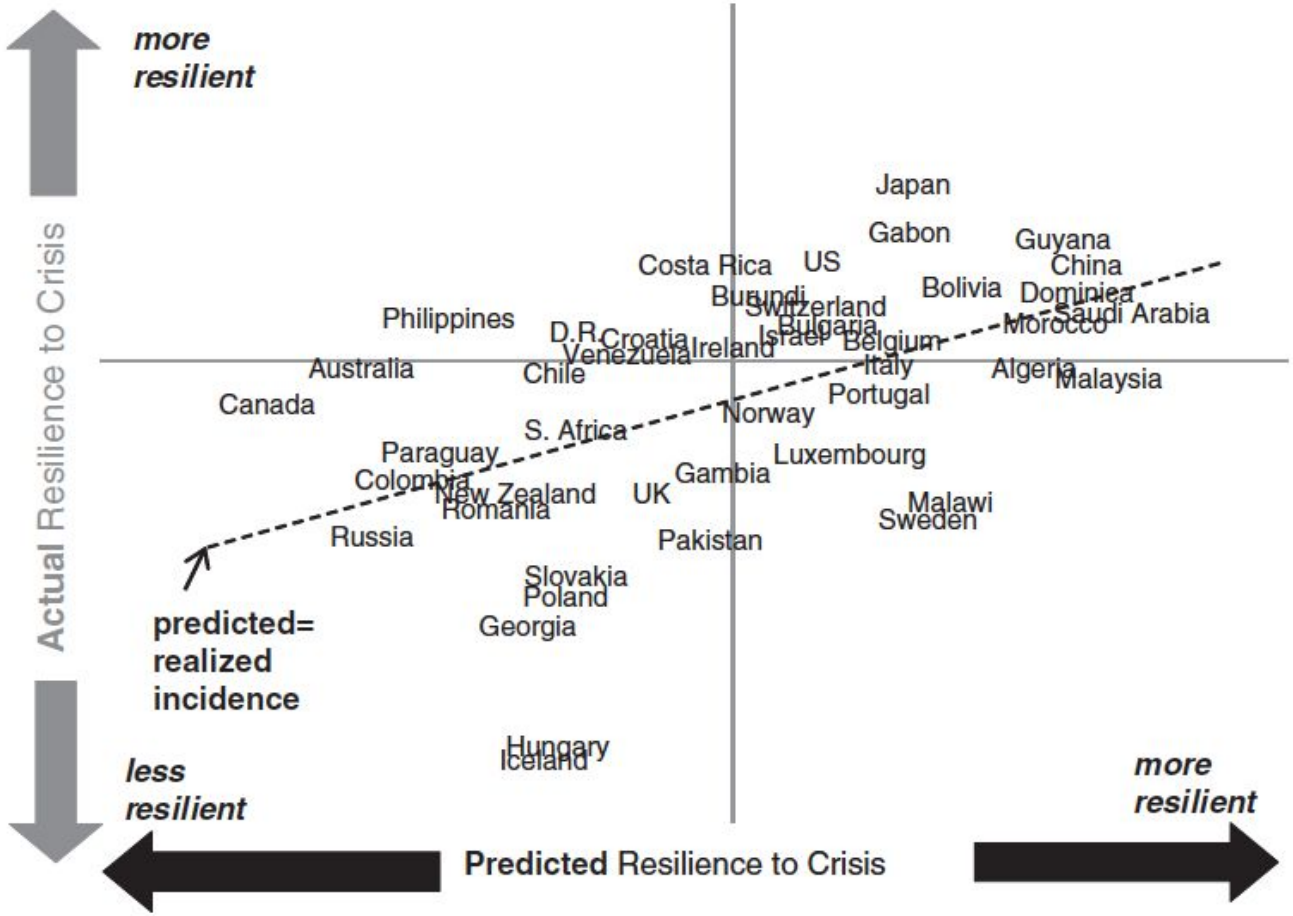


Fig. 4. Success at predicting the impact of the 2008–09 crisis.

6. Conclusions

From the variables selected from the literature review, international reserves and the REER were the most useful in the empiric analysis of the 2008-09 crisis.

Reserves turned out to be robust to a number of crisis definitions.

Past exchange rate overvaluation proved useful for measures that defined crisis in terms of currency.

A number of other variables also appear as useful leading indicators, although their robustness across the different measures was not strong.

Questions

1. How does the signals' modelling approach work?
2. What are the limitations of the meta-analysis used by the authors?
3. Which of the early warning indicators turned out to be the most important in predicting vulnerability?
4. REER was useful in explaining which measure of crisis incidence?