Identifying Banking Crises Using Money Market Pressure: New Evidence For A Large Set of Countries

Jing Zhongbo Jakob de Haan[1] Jan Jacobs Haizhen Yang

CIRANO, Montréal, 31 October 2013

[1]The views expressed do not necessarily reflect those of De Nederlandsche Bank.

Abstract

We construct a money market pressure index based on central bank reserves and the short-term nominal interest rate to identify banking crises, thereby extending the index proposed by Von Hagen and Ho (2007). We compare the crises identified by both indices with banking crises according to the benchmarks of Laeven and Valencia (2010) and Reinhart and Rogoff (2009). Both indices identify more crises than these benchmarks. The crises identified by our index are more in line with the benchmarks than the crises identified by the Von Hagen and Ho index, while our index also gives fewer false signals.

Background

Since the collapse of the Bretton Woods system, the frequency of financial crises has doubled (Bordo et al., 2001). Notably after the financial liberalization during the 1990s, the intensity of financial crises has increased. Recent research suggests that financial crises may have a permanent effect on potential output (Furceria et al., 2012).

In general, three types of financial crises may be distinguished:

- currency crises,
- banking crises,
- debt crises.

Compared to other types, banking crises have a more serious impact on the economy (Hutchison et al., 2005).

Identification of banking crises

Events methodology

Identify a systemic banking crisis based on exceptional *events* or policy interventions, such as bank closures, deposit freezes and government rescues (cf. Laeven and Valencia, 2010; Reinhart and Rogoff, 2009).

The events methodology may be biased for several reasons

- Interventions may refer to individual bank failures
- Hard to determine a particular policy intervention
- Banking crises may be identified too late
- Central banks sometimes solve financial problems successfully

Identification of banking crises

Money Market Pressure Index

Von Hagen and Ho (2007; vHH) propose an index to identify banking crises based on money market pressure (MPI).

MPI cannot offset all drawbacks of the events methodology, but

- Less subjective
- Available at a higher frequency
- More timely

This Paper

- Proposes a modified monetary pressure crises index and compares it to MPI of vHH
- Nominal instead of real short-term interest rates
- Different weights
- Comparison to Laeven-Valencia (2010) and Reinhart-Rogoff (2009) banking crises benchmarks

Structure

1. Introduction
2. Identifying banking crises
3. Modification of the money market pressure index
4. Sample and criteria for identifying banking crises
5. Empirical results
6. Conclusion

The events method

Caprio and Klingebiel (1996)
Adopt information from supervisors and country experts to identify banking crises.

IMF (1998, p.76)
Identifies a banking crisis as a situation in which actual or potential bank runs and failures lead banks to suspend the internal convertibility of their liabilities or compel the government to provide large-scale interventions in the banking sector.

The events method, continued

Demirgüç-Kunt and Detragiache (1998, 2002, 2005)

1. the ratio of non-performing assets to the banking system's total assets exceeds 10%;
2. the cost of the government's rescue operation is at least 2% of GDP;
3. banking sector problems result in a large-scale nationalization of banks;
4. extensive bank runs take place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees are enacted by the government in response to the crisis.

The events method, continued

Laeven and Valencia (2008, 2010)

Define a systemic banking crisis as an event where "corporate and financial sectors of a country experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time."

Money market pressure index

Basic idea

In a crisis the banking sector will face difficulties, leading to a sharp increase in banks' demand for central bank liquidity.

The central bank responds to this increased demand in two ways.

- The supply of reserves will be constant and the short-term interest rate will rise.
- Inject additional reserves into the banking sector.

Thus, a banking crisis is generally characterized by a sharp increase of short-term interest rates, the stock of central bank reserves, or both.

Money market pressure index (MPI)

$$MPI_t = \frac{\Delta\gamma_t}{\sigma_{\Delta\gamma}} + \frac{\Delta r_t}{\sigma_{\Delta r}} \tag{1}$$

Δ is the difference operator, γ is the ratio of central bank reserves to total bank deposits, r is the short-term real interest rate, while $\sigma_{\Delta\gamma}$ and $\sigma_{\Delta r}$ are the standard deviations of $\Delta\gamma$ and Δr_t, respectively.

Money market pressure index (MPI), continued

To identify a banking crisis, vHH apply two criteria:

- The MPI needs to exceed the 98.5 percentile of the sample distribution for the country under consideration.
- The increase of the MPI from the previous period should at least be 5%.

Drawbacks

- Nominal interest rate may be better than real interest rate
- Standard deviations are calculated over the whole sample period thereby ignoring possible changes in monetary regimes
- The index of vHH is driven by the most stable component

Modified money market pressure index (MMPI)

$$MMPI_t = \omega_1 \Delta\gamma_t + \omega_2 \Delta r_t, \tag{2}$$

where

$$\omega_1 = \frac{\frac{1}{\sigma(\Delta\gamma)}}{\frac{1}{\sigma(\Delta\gamma)} + \frac{1}{\sigma(\Delta r)}}, \qquad \omega_2 = \frac{\frac{1}{\sigma(\Delta r)}}{\frac{1}{\sigma(\Delta\gamma)} + \frac{1}{\sigma(\Delta r)}}.$$

Our index

We extend vHH in two more ways:

- We apply a quantitative method in assessing false alarms and missed crises of the indices.
- We include more countries in our sample with and without banking crises to investigate whether our index can identify banking crises in both types of countries.

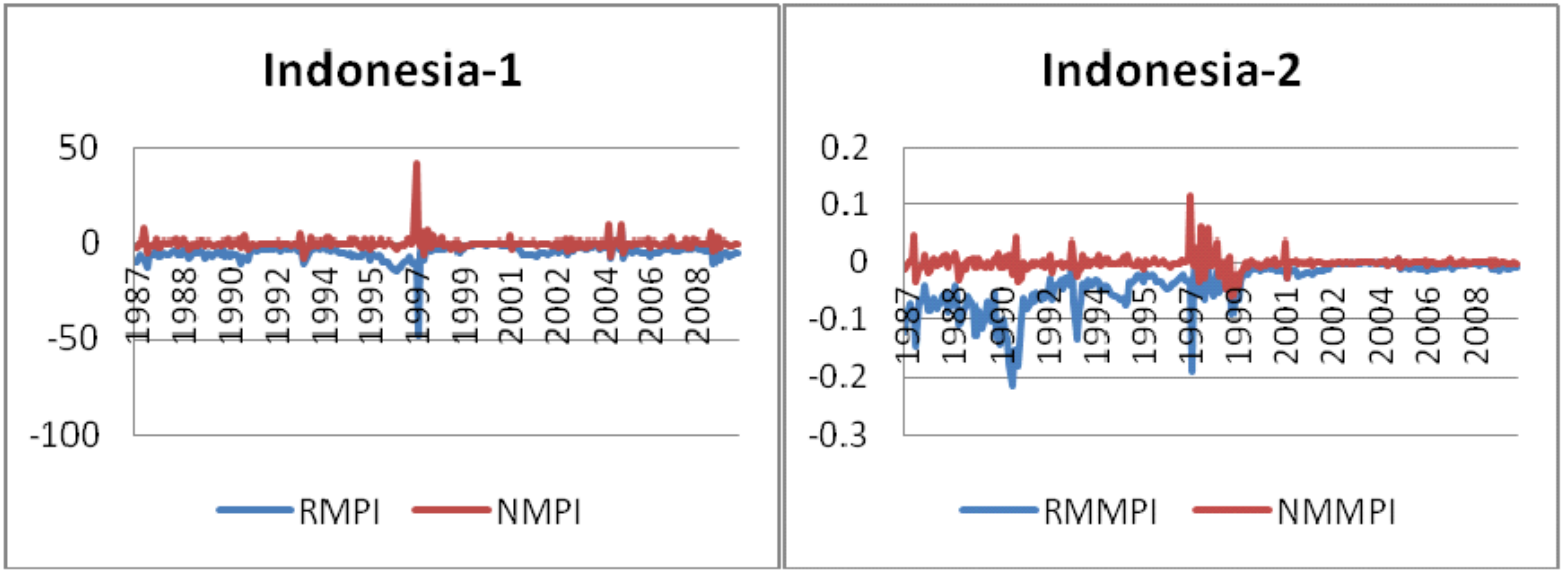
Sample

- 21 industrial economies and 115 developing economies having 11 and 64 banking crises, respectively
- Monthly data from the *International Financial Statistics*, spanning the period 1975 to 2009
- Total deposits consist of demand deposits, time and saving deposits and foreign liabilities of deposit money banks
- Central bank reserves are defined as loans from monetary authorities
- Nominal short-term interest rate: money market rate
- Inflation: changes in consumer price index

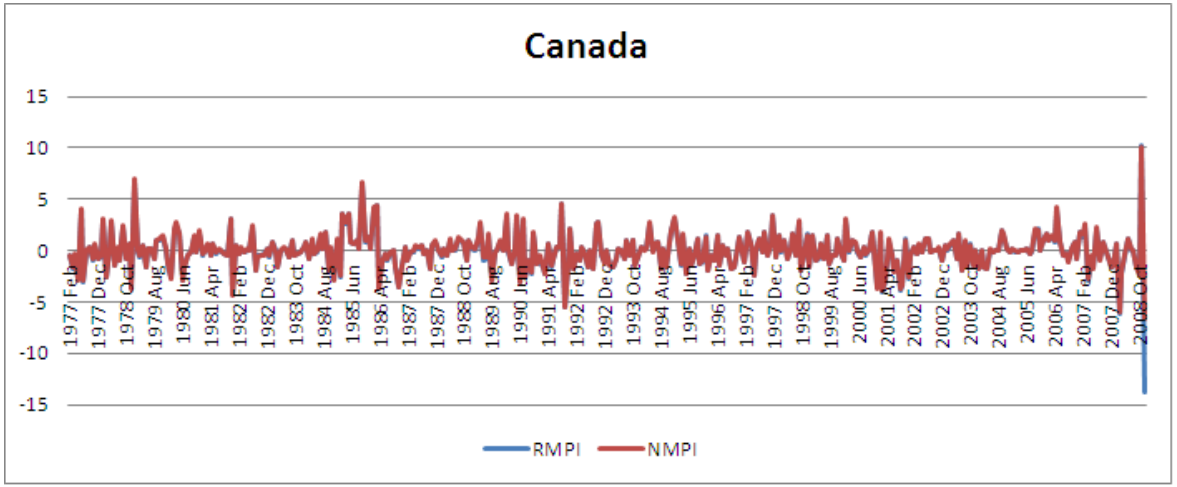
Indices used in this paper

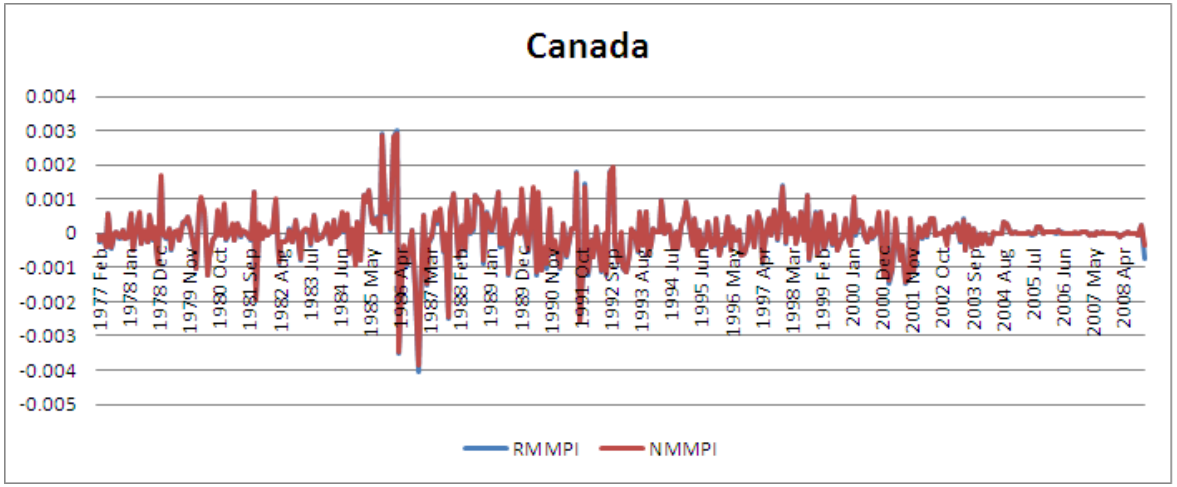
Index	Definition
vHH	MPI proposed by Von Hagen and Ho (2007)
RMPI	MPI constructed using real interest rates and 24-months moving window for standard deviation
NMPI	MPI constructed using nominal interest rates and 24-months moving window for standard deviation
RMMPI	MMPI (Equation (2)) constructed using real interest rates and 24-months moving window for standard deviation
NMMPI	MMPI (Equation (2)) constructed using nominal interest rates and 24-months moving window for standard deviation

Money market pressure indices of Indonesia



Money market pressure indices of Canada





Assessing crisis signals

A crisis is signaled if

1. the index exceeds the 98.5 percentile of the sample distribution for the country under consideration, and
2. the index increases by at least 5% compared to the previous period.

Correct signal:

- a banking crisis is signalled at most two years prior to the start of the crisis according to the benchmark, and
- the signal indicates a banking crisis at most one year later than the benchmark.

Assessing crisis signals, continued

Index	Benchmark	
	Crisis	No crises
Crisis	Correct crises	False alarms
No crisis	Missed crises	Correct non-crises

Benchmarks

- Laeven and Valencia (2010)
- Alternative: Reinhart and Rogoff (2009)

Comparison of five indices

Index	vHH	RMPI	RMMPI	NMPI	NMMPI
# crises in the benchmark	75	75	75	75	75
Correct crises	40	49	47	53	54
Missed crises	35	26	28	22	21
False alarms	181	181	158	218	166

Comparison of five indices

All indices produce many false alarms.

- The benchmark of Laeven and Valencia (2010) may not identify all banking crises; 24 and 20 'false alarms' are crises identified by Reinhart and Rogoff (2009) and Caprio and Klingebiel (1996), respectively.
- Many 'false alarms' identified by NMMPI may indicate events which are not severe enough to be identified as banking crisis by our benchmark or other banking crises databases.

Country	Signaled crises:	Events
Albania	1997–1998	In 1997, the Rural Commercial Bank, a state-owned bank, was closed down.
Algeria	1998; 2005	Financial restructuring of banks occurred in 1991–1994, 1995–1998, and 2001.
Armenia	1999	In 2000, RNPL reached a peak of 17.5%.
Bangladesh	1996	All banks had high levels of non-performing loans. In 1998, the RNPL reached 40%.
Bolivia	2002–2003	The average RNPL for 2001-03 is about 17%.
Cambodia	2003	The average RNPL to total assets in 2002–2003 is about 14%.
Canada	1991–1992	In 1991–1992, 9 financial companies collapsed.
...		

Comparison of RMMPI and NMMPI

RMMPI performs slightly better than vHH and RMPI, and NMMPI performs better than NMPI.

Crises	NMMPI	RMMPI
coincide with benchmark	45	39
2-year lead	5	3
1-year lead	2	1
1-year lag	5	4

Weighting missed crises and false alarms

Loss function of Demirgüç-Kunt and Detragiache (2000)

$$L(H,w) = \underbrace{p(H,w)}_{\text{false warning}}\ c_1 + \underbrace{a(H,w)}_{\text{missed crisis}}\ c_2$$

- The value of H ranges between 90% to 99% (with steps of 0.2%)
- Likewise, we set c_1 equal to 1 and let $(c_2 - c_1)$ vary from 5 to 50 in steps of 5

Weighting missed crises and false alarms: loss

$c_2 - c_1$	NMMPI	RMMPI	Difference
5	2.2463	2.2895	−0.0432
10	2.2840	2.3406	−0.0566
15	2.2992	2.3822	−0.0830
20	2.3106	2.4201	−0.1095
25	2.3204	2.4586	−0.1381
30	2.3303	2.4977	−0.1674
35	2.3402	2.5374	−0.1972
40	2.3502	2.5778	−0.2276
45	2.3602	2.6188	−0.2586
50	2.3702	2.6604	−0.2902

Sensitivity analysis: industrial vs developing countries

	NMMPI	RMMPI
Industrial countries		
Total crises in the benchmark	11	11
Correct crises	8	8
Missed crises	3	3
False alarms	30	24
Developing countries		
Total crises in the benchmark	64	64
Correct crises	46	39
Missed crises	18	25
False alarms	136	134

Sensitivity analysis: periods

Period	1970–1989	1990–1999	2000–2009
Total crises in the benchmark	15	46	14
	NMMPI		
Correct crises	9	34	11
Missed crises	6	12	3
False alarms	42	54	70
	RMMPI		
Correct crises	4	33	10
Missed crises	11	13	4
False alarms	20	48	90

Sensitivity analysis: NMMPI for different crisis windows

Window	Missed crises	False alarms
[T-2, T+1]	21	166
[T-2, T+2]	17	161

Conclusion

1. We construct a MMP index using nominal interest rates instead of real interest rates.
2. Our index is more in line with the benchmark of Laeven and Valencia (2010) than vHH and issue less false alarms.
3. This conclusion is robust for different groups of countries, periods, crisis windows and benchmarks.
4. Most of the 'false alarms' indicate crises that are not severe enough to be considered as systemic by our benchmark, or reflects stress in the banking sector.