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Asset Prices as an Early Warning Indicator of Banking Crises: A Critical Evidence from India

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Abstract
Banking crises caused such great chaos to economies in the past that economists always tried to make an early warning system which could signal crises in advance. This paper attempted to check the predictability of asset prices as an early warning indicator for banking crises. Signal Extraction Approach was used to check the predictive power and noise signal of the variable. A time span of 1980 to 2019 was taken to load the data values and three threshold limits were selected to analyse the results. Three threshold limits were decided to check the predictive ability of the indicator. It was found that the indicator performed well on the 0.5 threshold limit.
Keywords: Banking Crises, Early Warning Indicators, Asset Prices, Signal Extraction Approach, Threshold limit

Introduction

Banking crises represents bank runs or a loss of faith of customers in the bank. Banks play an important role in each economy. Loss of faith or their run can create a big issue on the macro level of economies. So, it was always tried by policymakers that such loss could be avoided by forewarning crises. Early warning indicators are the variables which show heat in the system if crises are going to happen in the near future. Previous literature showed that asset prices proved good early warning indicators in forewarning banking crises. Asset prices (Return on Investment) are the prices on which stocks and bonds are valued. Just like property prices if the prices of assets are more than their intrinsic value it also can create a situation of bubbles in the financial system and ultimately could be a reason for a burst.

Review of literature: Drehmann et. al revealed that enormous asset prices could act as an early warning indicator for crises period. Glick and Hutchinson (1999) found that there is a strong relationship between bank runs and asset prices in emerging and less developed countries. But Vila (2000) found the converse holds true in case of developed economies as her study claimed that there is a weak relationship between asset prices and banking crises.

Research Methodology: Primary objective of the paper is to check the predictive ability of asset prices in forewarning banking crises. A data series of 1980 to 2019 was taken to perform the results of the signal extraction approach on a 12 month window. Results of signal extraction approach can be compiled in a contingency matrix:

	Signal issued	No signal issued
Financial stress event	A	B
No financial stress event	C	D

A and D are the situations good for the system as these are the true calls while B and C are the situations of error 1 and error 2. Moreover, to check the responsiveness of the indicator, lead time was also calculated. Lead time is the time when the indicator gives signal for the first time and is persistent about the signal during the whole time till the crisis occurs. Utility of lead time lies in the fact that if signal is issued timely then policy can be modified but if signal issued just before the crisis then it is not possible to amend policies.Persistence of signal is also a desirable feature to become a good leading indicator. It shows the perseverance of the signal just prior to the crisis period (12 months for the study). To measure this behavior, the persistence table was framed by inverting the noise to signal values.

Model Formulation

As the first step, for India i, we define a banking stress as the banking stress index rises above an extreme value,

$$hbs\_(i,t) = \begin{cases} 1, \text{if } bsi\_t > \text{mean} + \mu.\text{standard deviation} \\ 0 \text{ otherwise,} \end{cases}$$

Here bs stands for banking stress and t denotes time. μis the threshold value which is 0.5, 1.0 and 1.5 for the study and chosen according to previous literature. For these thresholds model would become:

$$hbs\_(i,t) = \begin{cases} 1, \text{if } bsi\_t > \text{mean} + 0.5.\text{standard deviation} \\ 0 \text{ otherwise,} \end{cases}$$

hbs_(i,t) = 1,if bsi_t> mean + 1.0.standard deviation
0 otherwise,

hbs_(i,t) = 1,if bsi_t> mean + 1.5.standard deviation
0 otherwise,

Data Analysis: Results summarised in this section are0.5 threshold limit as the indicator was not responded to 1.0 and 1.5 value.

Noise signal ratio	((B)/(B+D)) / ((A)/(A+C)	0.43
Conditional probability	A/(A+B)	0.70
Unconditional probability	(A+C)/(A+B+C+D)	0.50

Signal Matrix:

[A=0.83B=0.36C=0.17D=0.64]

Here A represents the correct signal, whereas false signals, missing crisis and correct silence are represented by B, C and D respectively.

Table: Result Analysis

Noise signal ratio of the indicator was found 0.43 which is a very good value and indicating strongly that it could have information about crises.

Conditional probability of the indicator is greater than unconditional probability and hence the second necessary condition is also fulfilled. High value of conditional probability indicates that other parameters of the indicators might be good.

Type 1 error	C / (A+C)	0.17
Type 2 error	B / (B+D)	0.36
Predicted/forecast crisis	A / (A+C)	0.83
Probability of banking stress event gives no alarm	C / (C+D)	0.21
Probability of false alarms in total alarms	B / (A+B)	0.30

Conditional probability (0.70) > Unconditional probability (0.50)

As both required conditions are fulfilled, a predictive ability table can be framed for the indicator to discuss the other variables.

Table: Predictive Ability of Asset Prices/ ROA

Type 1 error of the indicator is 0.17 which is a commendable value. It shows that only 17% of crises were missed by the indicator. Predictive ability of the indicator is 83% which is too good and best in selected indicators. It states that it predicted 83% of crises accurately. Type 2 error of the indicator is 36% which is decent and acceptable with such a high predictive ability. Only 21% times the indicator did not give any alarm even when crises occurred which is in favor of being a good indicator. False signals in relation to total signals were observed 30% times.

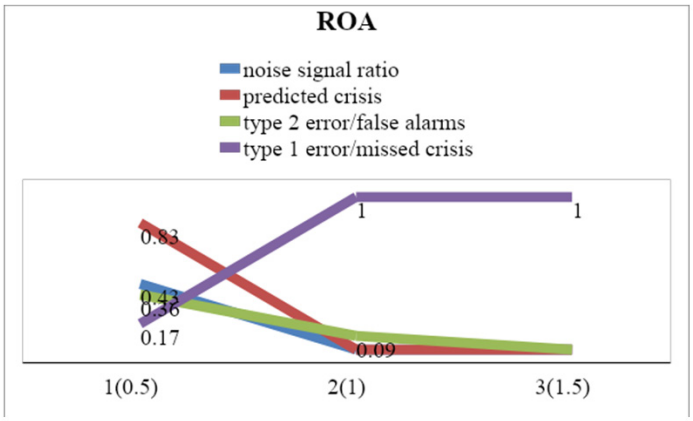
So, in conclusion it can be said that it is the best among all the selected indicators on this threshold value. It can be used for forecasting crises in Indian Banking background and can be used for composite indices with highest weight among all chosen indicators on this critical limit.

Discussion:

At both of the upper critical limits the indicator does not give any result because even the necessary conditions are not fulfilled. Consequently, further reduction in threshold has to be introduced to see the predictive power of the variable.

When threshold limit is mean+0.5(SD)

After revising the limit predictive ability would become 83%. The signal to noise ratio is not too low(0.43) but it may be admissible by researchers on such a high value of forecasting power. Chances of missing a crisis event are also reduced very much and became 0.17 and type 2 error enhanced and became 0.36%.



So, the results state that the indicator tends to have better predictive power on low threshold limits. Further, a proper threshold value is necessary to see the results otherwise the results could be misleading or the variable would not indicate a crisis event.

Comparative Analysis of ROA

In the given figure, comparative analysis of the indicator

ROA/ asset prices has shown at various threshold limits. The graph depicts all four critical indicators for more realistic comparison in a single chart.

Noise to signal Ratio: Blue line shows that noise to signal ratio is least on 1.0 and 1.5 threshold limits.

Predictive Ability: Red line shows predictive ability of the indicator is highest on 0.5 with 0.83 value which is highest among all selected indicators while it showed nil predictive ability on other threshold limits.

False Alarms: The results of this metric are the same as usual, with the lowest values found on 1.5, 1.0, and 0.5, respectively.

Missing Crisis: Missing crises are indicated by a purple line and it was found that these occurred least on 0.5. It can be seen from the graph that all crises are missed by the indicator at 1.0 and 1.5 threshold level.

The graph shows that the indicator performed excellent predictive ability on the 0.5 threshold value while it did not show any results on remaining thresholds.

Average lead time of the indicator on 0.5 threshold level is 3 years and persistence of signal was found 2.33.

Conclusion: It can be concluded from above discussion that asset prices proved very efficient in forewarning the crises in Indian banking Space. But it showed the results only on 0.5 threshold value. As the value of threshold was increased to 1.0 and 1.5, predictive ability reduced almost nil. Average lead time and persistence of signal is also good on this threshold limit. So, it is worth mentioning that the value of threshold limit and its proper selection is necessary.

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