Systemic event prediction by an aggregate early warning system: An application to the Czech Republic

Diana Zigraiova [a,b,*], Petr Jakubik [b,c,*]

[a] *Czech National Bank (CNB), Czech Republic*
[b] *Institute of Economic Studies, Charles University, Prague, Czech Republic*
[c] *European Insurance and Occupational Pensions Authority (EIOPA), Germany*

ABSTRACT

This work develops an early warning framework for assessing systemic risks and predicting systemic events over a short horizon of six quarters and a long horizon of 12 quarters on a panel of 14 countries, both advanced and developing. First, we build a financial stress index to identify the starting dates of systemic financial crises for each country in the panel. Second, early warning indicators for the assessment and prediction of systemic risk are selected in a two-step approach; we find relevant prediction horizons for each indicator by a univariate logit model followed by the application of Bayesian model averaging to identify the most useful indicators. Finally, we observe the performance of the constructed EWS over both horizons on the Czech data and find that the model over the long horizon outperforms the EWS over the short horizon. For both horizons, out-of-sample probability estimates do not deviate substantially from their in-sample estimates, indicating a good out-of-sample performance for the Czech Republic.

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* Corresponding authors.
E-mail addresses: diana.zigraiova@cnb.cz, diana.zigraiova@fsv.cuni.cz (D. Zigraiova), petr.jakubik@eiopa.europa.eu, jakubik@fsv.cuni.cz (P. Jakubik).

1. Introduction

In the wake of the recent global crisis, research in the area of financial stability including early warning systems (EWS) has attracted renewed attention. EWS can be characterized as functional, data-driven approaches that draw attention to variables associated with past crises with the main objective of alerting policymakers of the potential for future crises (Gramlich et al., 2010). Essentially, EWS are based on the existence of causality between crises and crisis-driving factors and the possibility of identifying crisis-driving factors ex ante. In the financial context, EWS can be used for risk prediction both for a single financial institution, from a microeconomic point of view, as well as for an entire financial system, i.e. macroeconomic risk. In this study, we focus on the latter.

In general, systemic risk can be defined as ''the possibility that an event will trigger a negative feedback loop that significantly affects financial markets' ability to allocate capital and serve intermediary functions, which, in turn, will create spillover effects on the real economy that have no clear self-healing mechanism'' (Hendricks et al., 2007). As such, the functioning of the financial system is impaired to the extent that economic growth and welfare suffer materially (Lo Duca and Peltonen, 2013).

This paper contributes to the early warning literature in two ways. First, we explore a combination of advanced estimation techniques in developing our multivariate EWS framework on a panel of 14 countries over two horizons of differing length. Our EWS allows for different relevant prediction horizons for potential leading indicators, determined by univariate logit models, and employs a relatively novel systematic approach to selecting the most useful leading indicators of crises: Bayesian model averaging. Second, the paper extends the scope of the early warning literature by investigating the performance of our aggregate EWS framework for a single country, the Czech Republic.

The paper is organized as follows. Section 2 explains the methodology, develops a financial stress index and identifies systemic event episodes from the calculated FSI. Section 3 deals with the identification of leading indicators for systemic events detection. Section 4 evaluates the performance of our systemic events probability framework on the panel of countries over a short and a long horizon. Section 5 applies and evaluates the performance of the developed EWS on the Czech Republic. Section 6 checks the validity and investigates the performance of an alternative regional panel EWS on the Czech Republic. The last section concludes.

2. Financial stress indicators

Despite the fact that the root causes of financial crises throughout history are often diverse, along with their propagating channels and the market segments which are consequently affected, it is still interesting to compare these events in terms of the systemic stress levels that are reached. For this reason, the general objective of constructing a financial stress index (FSI) is to measure, in an analytical way, the level of instability (frictions, stresses) within a financial system and to present the findings in a single statistic.

Formerly, the literature on financial crises depended substantially on historical narratives of crisis episodes, mostly for banking crises connected with bank capital erosion and disruption of lending, which typically demanded public intervention (Caprio and Klingebiel, 2006). Other such documented episodes further link banking crisis episodes with those of currency crises that exhibit reserves depletion and/or major changes in the exchange rate mechanism (e.g. Kaminsky and Reinhart, 1999). Despite the fact that these historical narratives provide a wide database of crisis episodes, there has been an outbreak of more analytically based research that aspires to quantify financial stress within the economy by means of a single comprehensive statistic, the FSI. The underlying reason for this branch of research is the existence of several drawbacks linked to the above-mentioned historical approaches to crisis identification. First, these crisis episodes are known ex post to have large output effects and often require strong public intervention, while high stress episodes of little macroeconomic impact are often disregarded. Second, the episodes identified by historical approaches are usually spread over considerable time periods and thus incorporate stresses of varying magnitudes, making it challenging to identify stress peak dates. Third, as databases tend to focus on banking and currency crises, security market stress or liquidity squeezes are easily overlooked, e.g. the Long-Term Capital Management collapse of 1998. To avoid these problems, extreme values of a composite indicator, the FSI, are used for financial crisis identification.