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WHY EWSs FOR FINANCIAL CRISES FAILED DURING THE COVID-19 PANDEMIC: THE EXAMPLE OF SERBIA

Zašto su tokom pandemije kovida 19 zakazali modeli ranog upozorenja – primer Srbije

Abstract

Early warning systems (EWSs) are designed to anticipate future crises, giving policymakers optimism that they would be able to make proactive management decisions. The demonstration of EWSs effectiveness in the economy was clear throughout the Asian financial crisis at the end of the 1990s, the financial crisis of 2007-2008, the Great Recession, and the European sovereign debt crisis of 2008-2012. However, EWSs failed during the COVID-19 pandemic. Using Eichengreen et al. [13], Kaminsky et al. [23], and Sachs et al. [33] methodology, the paper explains this phenomenon by analyzing the determinants of currency crises episodes in the Republic of Serbia from January 2001 to December 2021. The complexity of the current crisis required a change of approach. As reflected by the Statistical Office of the Republic of Serbia, one of the solutions is to develop a Decision-Making Support System (DMSS). EWSs presented here could serve as one of the many inputs in the assessment and identification of financial crises. However, these models are not accurate enough to be used as the sole method to anticipate crises. Like other crisis models, they bring benefits but obviously have their drawbacks. That is why it would be good to put them under the auspices of a more complex DMSS. Again, for now DMSS should be seen just as a better alternative to earlier practice. This is neither a final nor an almighty option, but it must be further worked on in the future.

Keywords: *early warning system, financial crisis, COVID-19 pandemic, Serbia's economic recovery, DMSS*

Sažetak

Modeli ranog upozorenja (EWSs) dizajnirani su u cilju predviđanja budućih kriza, a kreatorima politika pružaju optimizam u pogledu ishoda proaktivnih upravljačkih odluka. Demonstracija efikasnosti EWS u ekonomiji je nedvosmisleno potvrđena za vreme finansijske krize u Aziji krajem devedesetih, finansijske krize od 2007. do 2008, Velike recesije i evropske krize državnog duga od 2008. do 2012. Međutim, EWS je zakazao tokom pandemije kovida 19. Koristeći metodologiju autora Eichengreen et al. [13], Kaminski et al. [23] i Sachs et al. [33], rad objašnjava pomenuti fenomen analizirajući determinante epizoda valutne krize u Republici Srbiji od januara 2001. do decembra 2021. godine. Kompleksnost aktuelne krize zahtevala je promenu pristupa. Prema oceni Republičkog zavoda za statistiku, jedno od rešenja je razvoj sistema za podršku donošenju odluka (DMSS). EWS mogu poslužiti kao dopunski input u proceni i identifikaciji finansijskih kriza. Međutim, ovi modeli nisu dovoljno precizni da bi se koristili kao isključivi alat za predviđanje. Poput nekih drugih kriznih modela, oni imaju prednosti, ali i nedostatke. Stoga je bolje da budu pod okriljem robusnijeg DMSS. Opet, DMSS bi za sada trebalo posmatrati samo kao bolju alternativu ranijoj praksi. To nije ni konačna ni svemoguća opcija, ali se na tome mora dalje raditi u budućnosti.

Ključne reči: *sistem ranog upozorenja, finansijska kriza, pandemija kovida 19, ekonomski oporavak Srbije, DMSS*

Introduction

Predictions are affected by uncertainty. Therefore, some kind of explicit disclaimer is always necessary to discuss serious risks. But we must also consider the economic system in all its complexity. The intertwined feedback loop produces expansions that can hardly be approximated by economists' typical forecasting models. Perhaps they cannot be approximated at all [34].

COVID-19 has affected the overall economic system in many ways [22], [16], [38], [30]. We like to say it is an unprecedented shock to the world economy since WWII. It is essentially a systemic crisis like the previous global financial crisis. Since the Asian financial crisis at the end of the 1990s, early warning systems (EWSs) have been designed to anticipate future fractures, giving policymakers optimism that they would be able to make proactive management decisions [6], [37], [35]. As the leading indicators of financial crisis, financial variables usually offer strong predictive power [15], [11]. Analytical efforts have generated a wide-ranging debate and uncovered numerous insights into their effectiveness [12], [7], [5], [24], [32]. However, the paper's findings suggest that pandemics may cause economic damages that differ from the past global crises. After the initial fears in the financial markets, this part of the economy remained spared until the end of 2021. EWS did not offer the clearest signals. Or rather, it failed.

The aim of the paper is to underline the experiences with EWSs in Serbia during the first two years of the pandemic and to suggest alternatives. It seems that the complexity of the current crisis required a change of approach.

The paper consists of two compatible parts. First, it underscores the specifics of the COVID-19 pandemic, which disavows (or even completely erases) the expected signals of early warning indicators. If this is a fact, in the second part of the paper it is suggested that it is more expedient to include these indices of crises in a more complex framework of crisis response. In Serbia, we call it a Decision-Making Support System (DMSS).

This paper contributes to the large literature on the early warning indicators of financial crisis, possible alternative responses to the crisis as well and is structured as follows: Section 2 presents different measurement approaches as well as the literature on EWSs; Section 3 outlines the data and methodology used to identify the financial crisis in Serbia since 2000 and during the first two years of the pandemic; Section 4 shows the results; Section 5 presents a DMSS. Finally, Section 6 concludes the paper with policy implications.

Literature review

EWSs are designed to anticipate future crises, giving policymakers optimism that they would be able to make proactive management decisions. Given the lagged impact of policy, timely crisis detection can provide room for regulatory and supervisory adjustment and preparation for potential fallout. Good EWSs require an ongoing examination and revision combined with actual economic and financial operations.

Early warning systems for financial crises have improved over the course of ongoing regional financial crises, providing a wealth of empirical data at the end of the last century. However, predicting the timing of a crisis has widely been considered to be challenging, and crisis models have a weak record in this regard. For example, none of the crisis early-warning models correctly predicted the global financial crisis in 2008 [36]. Against the uncertainty of still-evolving research, a cautious approach would be to look at a range of indicators, look for early signs of a reversal and widen gaps in financial variables.

Vast empirical studies on the identification and measurement of financial crises have been published. The studies vary in the following aspects: countries that are investigated, modeling approach, variables used, methodology, and estimation techniques.

It is evident that the importance of EWS has been acknowledged in the available literature, but there is a lack of consistency [17]. In general, EWS models can be divided into three categories:

1. *The signals (nonparametric) models* are created to track the number of variables that tend to behave abnormally before a currency crisis. When a variable exceeds a predefined threshold, an alert is sent. A crisis is

defined as the period in which a crisis index is significantly different from its mean [23], [13], [33]. Each variable is considered in isolation, and thresholds can be country and variable-specific, based on a standard reference percentile. Variations of this EWS approach are widely used in the IMF work on crisis vulnerabilities, whose staff was tracking several EWS models by 2003 [7].

2. *Probit/Logit approach*: These are limited dependent variable regression models, where the probability of a crisis is estimated as a function of several variables [14], [19]. The chance of crisis incidence takes the value of one if a crisis occurs or zero if it does not happen. The benefit of the technique is that it allows one to assess the relative importance of variables jointly, but this also makes it challenging to examine several signs at once.

3. *More recent new techniques:* (a) multinomial models [9]; (b) non-parametric clustering methods, such as the binary recursive tree approach [3], [20], [18]; (c) machine learning based on decision trees, like the artificial neural networks [3], [21], [28], [4], [8]; (d) Markov switching model - focuses on finding transitions from "tranquil periods" to "speculative times", allows the transition probability between states as a function of fundamentals and expectations [1], [27], etc.

This balance between accuracy and interpretability determines whether to use machine learning alternatives or traditional linear approaches. In scenarios and applications where predicted accuracy is valued, machine learning may be more advantageous than classical regression. The decision is based more on practical than on quantitative factors. Machine learning can play a small role in environments where the scale and sign of regression coefficients emphasize clarity of interpretation. Machine learning may produce outstanding results if prediction accuracy is crucial or when heteroscedasticity or high dimensionality might impair the clarity of linear approaches [10].

Methodology

This section presents several approaches to testing the signals models and highlights their unique features. Indices abbreviations refer to the author's acronym - [13], [23], and [33]. The financial crises studied in this paper include currency, debt, banking, and systemic crisis. Thereby, the signaling procedure takes the following stages: dating the currency crises; determining the leading variables as indicators of crises; applying a statistical method to test and measure the effectiveness of those variables; and selecting an optimal cut-off threshold to receive a clear signal on crises.

The empirical analysis is based on monthly data for the Republic of Serbia, collected from January 2001 to December 2021.

The first ERW index assumes that speculative attacks are manifested in an extreme pressure on the FX market resulting in a weakening currency. Monetary authorities respond to this by raising interest rates and/or interventions from FX reserves. Accordingly, the index by which such disturbances would be expressed contains the weighted average of standard changes in the exchange rate, the ratio of FX reserves and the monetary aggregate M1 and the interest rate. All variables in the observed country are placed in a relative relationship with the country whose currency serves as the anchor currency (in this case it is the EU, i.e. the euro). The ERW index for Serbia would take the form:

$$ERW_{RS,t} = \frac{1}{\sigma_e}\frac{\Delta e_{RS,t}}{e_{RS,t}} - \frac{1}{\sigma_r}\left(\left(\frac{\Delta rm_{RS,t}}{rm_{RS,t}} - \frac{\Delta rm_{EU,t}}{rm_{EU,t}}\right) - \frac{\Delta rm_{EU,t}}{rm_{EU,t}}\right) + \frac{1}{\sigma_i}\Delta\left(i_{RS,t} - i_{EU,t}\right)$$

where: $e_{RS,t}$ is RSD/EUR exchange rate; $rm_{RS,t}$ coverage of money supply by FX reserves; $i_{RS,t}$ weighted average interest rate on securities used in open market operations by the National Bank of Serbia (NBS); $i_{EU,t}$ interest rate in the EU; while σ_e, σ_r, σ_i are the standard deviation of the relative change in the exchange rate, the standard deviation of the difference between the relative change in the ratio of FX reserves and the money supply M1 in Serbia and the EU, and the standard deviation of the interest rate differential, respectively.

The second KLR index probably belongs to the most prominent tools for predicting currency crises. The KLR index omits the calculation's reference country and the interest rate differential. The initial assumption is that interest rates are under the direct control of monetary

authorities and that they only multiply the right side of the equation by the standard deviation of the relative change in the exchange rate. The currency crisis here is a period of pronounced domestic currency depreciation and/or reduction of FX reserves in euros. Therefore, the KLR index is given as a weighted average of the growth rate of the exchange rate and the growth rate of FX reserves expressed in euros, in monthly dynamics:

$$KLR_t = \frac{\Delta e_t}{e_{RS,t-1}} - \frac{\Delta R_t}{R_{t-1}}$$

where: $e_{RS,t}$ is RSD/EUR exchange rate; R_t is FX reserves expressed in euros; and $w = \sigma e/\sigma R$, i.e. the ratio of the standard deviation of the rate of change of the exchange rate and the standard deviation of the rate of change of FX reserves, respectively.

Finally, the so-called *STV* index, can be expressed in the following form:

$$STV_{RS,t} = \left(\frac{1/\sigma_e}{\left(\left(\frac{1}{\sigma_e}\right) + \left(\frac{1}{\sigma_r}\right) + \left(\frac{1}{\sigma_i}\right)\right)} \right) \frac{\Delta e_{RS,t}}{e_{RS,t}} - \left(\frac{1/\sigma_r}{\left(\left(\frac{1}{\sigma_e}\right) + \left(\frac{1}{\sigma_r}\right) + \left(\frac{1}{\sigma_i}\right)\right)} \right) \frac{\Delta r_{RS,t}}{r_{RS,t}} + \left(\frac{1/\sigma_i}{\left(\left(\frac{1}{\sigma_e}\right) + \left(\frac{1}{\sigma_r}\right) + \left(\frac{1}{\sigma_i}\right)\right)} \right) \Delta r_{RS,t}$$

where $r_{RS,t}$ is FX reserves of Serbia, while the description of the other symbols is the same as before.

When the value of the index exceeds a certain threshold value, it means that the country has a currency crisis. The threshold value, in this study, is determined as the mean of the index plus 1.5 standard deviations. The selected cut-off point rests on an ad hoc decision as to which type of error is preferred. In this case, it is certainly a conservative approach.

Results and discussion

The result of all the above is directly reflected in the value of the three crisis indices. Their values in the two years of the COVID-19 pandemic (2020-2021) are far below the calculated threshold. So, unequivocally, there was no need for further calculation of the composite probability of a crisis outbreak.

In contrast, as we can see, early warning indices have worked well during previous crises. Although this is not explicitly the subject of this research, Serbia did not differ from other European countries, except for Turkey, which recorded a strong currency crisis in early autumn 2021.

All three indices indicate that Serbia was successively going through crisis periods until the first quarter of 2013 [29]. Since then full currency stability has been established and later successfully maintained. The amplitude and frequency of oscillations of the observed indices indicate huge problems, particularly in the period 2008-2012 when the critical threshold was repeatedly breached, which is represented on the graphs by a dashed line (see Figure 1).

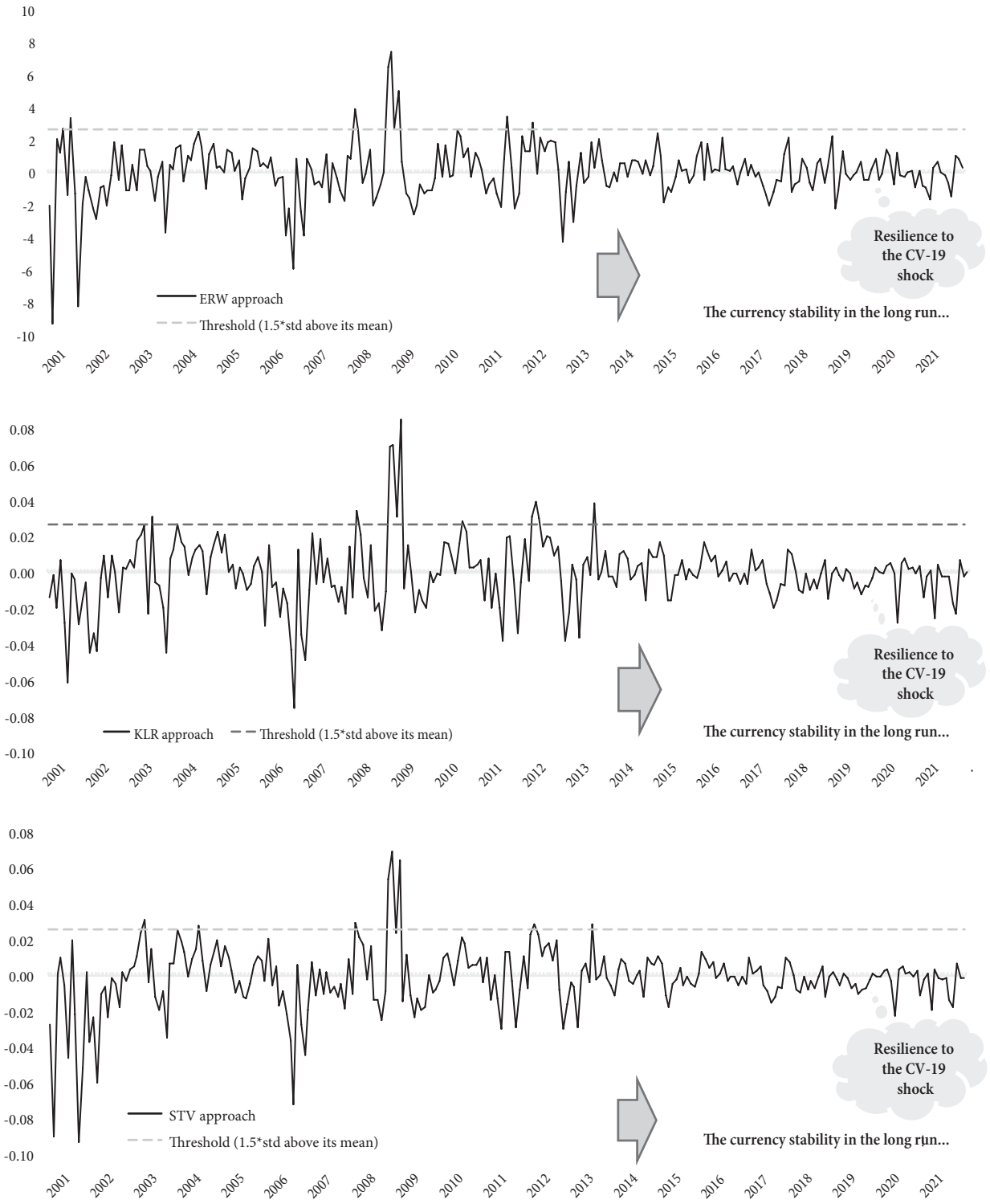
For example, from January 2008 to August 2012, the FX reserves of the NBS stagnated, and the value of the dinar against the euro fell from 81.8 to 117.9, with an increase in monetary policy restrictions. From that moment until December 2021, the NBS's FX reserves increased from EUR 9.9 billion to EUR 16.4 billion, the exchange rate stagnated, while the interest rates from the double-digit zone dropped to a level close to zero. In this period, the NBS appears as a net buyer of foreign exchange in the amount of EUR 3.1 billion, thus compensating for the excess supply of foreign exchange.

In total, the background of all episodes of the currency crisis in Serbia until 2013 can be grouped from the previous one into two groups.

The first group concerns political instability, and inadequate and uncoordinated macroeconomic policies. The closest approach to this group is to predict currency crises based on rational expectations and the credibility of economic policymakers, which are crucial for currency stability.

Consequently, the second group consists of the unsustainability of fundamental variables. Above all, external positions - the exceptional balance of payments deficit against GDP and investments (CA deficit amounted to 17.3% of GDP in 2007 and 20% of GDP in 2008); critically endangered external liquidity (debt-service ratio in that period reached as much as 37% of goods and services

Figure 1: Results of three signals models of the financial crisis in Serbia, 2001-2021



Source: Authors' calculation

exports, while external debt exceeded the total value of exports by 2.2 times); low export competitiveness and import dependence (coverage of imports by exports of goods and services in this period was only 52%), etc.

Fiscal policy relied on the erroneous assessment that privatization proceeds will flow forever [31] and that a scenario of interruption of capital inflows from abroad, even its sudden withdrawal from the country, is

not possible; in addition, fiscal irresponsibility culminates in late 2011 when public sector wages and social benefits increased well above economic opportunities.

The country also had a problem with its financial positions – as a result of a loose control of the banking sector, reduced and incomplete financial stability was created, etc. The global financial crisis, which manifested itself in September 2008, only exposed and deepened all the mentioned weaknesses of the Serbian economy. It can never be an excuse or an excuse for the problems Serbia had, but only their trigger. This analysis again showed that Serbia was falling into a serious currency crisis a few months before its outbreak.

Moreover, a better confirmation of this thesis is the testimony and legacy of the current COVID-19 pandemic. If the economy had experienced the crisis in the state we found ourselves in 2008, it could not have avoided or minimized its negative effects.

It should be emphasized that the negative effects of the pandemic have been avoided by the huge pumping of liquidity by states. When the Covid shock occurred, several central banks significantly increased the quantity of assets on their already massive balance sheets. They were accompanied by a comprehensive variety of macroprudential and fiscal short-term initiatives [30].

The monetary authorities in the majority of the EU-27 nations, as well as in Serbia, took quick and extraordinary action, both in terms of standard and non-standard monetary policy instruments. The European Central Bank approved non-regular open market operations: pandemic emergency purchase program, pandemic emergency longer-term refinancing operations, targeted longer-term refinancing operations, and asset purchase program [26]. New swap and repo lines were established with central banks worldwide. This entails reducing all base interest rates, giving banks access to more liquidity resources, enhancing credit conditions under the Guarantee Program, and enabling borrowers to postpone paying their debts, etc. The interventions gave an immediate result, calming the market and displacing negative expectations. Banks profited from government credit guarantees, temporary easing of some capital restrictions, and flexible financial funding. Corporate lending expanded very rapidly across the EU. Even though the majority of lending was directed towards working capital and liquidity, investment lending declined. Similar trends are also observed in Serbia.

The arsenal of fiscal measures consisted of the so-called automatic stabilizers (direct government subsidy payments to businesses or households, tax cuts, or refunds, and extraordinary expenditures, where a significant portion had incentives to access to healthcare) and discretionary measures of fiscal policy (above all, it is about measures of expansive fiscal policy, such as, for example, spending on public works construction that increase employment).

The policy pursued in the first two years of the pandemic, as well as the policy of quantitative easing that has been in force since the middle of the last decade and the interventionism in a market economy, apart from its benefits also generates systemic risk. Such measures have built up vulnerabilities and accumulated risks of uncertainty, which, together with geopolitical troubles, are reflected in record inflation at the global level as early as 2022.

DMSS

Official statistics are in charge of creating and disseminating official statistical data. This 'raw' data material, however, cannot be used directly for policy making. Statistical systems must filter critical statistical knowledge from raw data streams, refine it, and transform it into politically usable information. Therefore, the purpose of statistical systems is to discover relevant but often hidden or overlooked relationships between various indicators, to extract important information from large amounts of data, and to improve the effectiveness and efficiency of decision-making. It is also about defining key metrics to improve reliability.

To offer users enough accurate information so they can determine the state of the economy, including potential imbalances, a forward-looking vulnerability assessment with statistically significant predictors of crises, the Statistical Office of the Republic of Serbia (SORS) formed a section devoted to catalyzing data and changing it into easy, trustworthy, and broadly applicable indicators. The

institutional transformation started in early 2017. The Council for Coordination of Activities and Measures for GDP Growth was formed with the aim of monthly monitoring of the entire economy in Serbia. In the work of the Council, it quickly became clear that SORS is an extremely important part of its work, acting not only as a data provider but also as an active member of the analytics crew. The Council's primary responsibility is to create an analytical framework for tracking GDP growth and analyzing changes in the trends of individual growth factors. As a result, prospective growth support measures are also taken into account. Each month, the updating of a specifically chosen collection of indicators and data on recent events marks the beginning of the monitoring of predictions and suitable feedback on specific activities and macroeconomic domains. Thus, an image is created of the direction (wrong, neutral or right) of the movement during certain activities.

The DMSS is meant to serve as a toolkit. Some were always included in the official statistics system, while others were later accepted and created to more effectively illustrate and explain a specific occurrence. These tools are intended to describe the nation's economic situation, mathematically illustrate the relationship between key economic indicators and encourage effective decision-making [25].

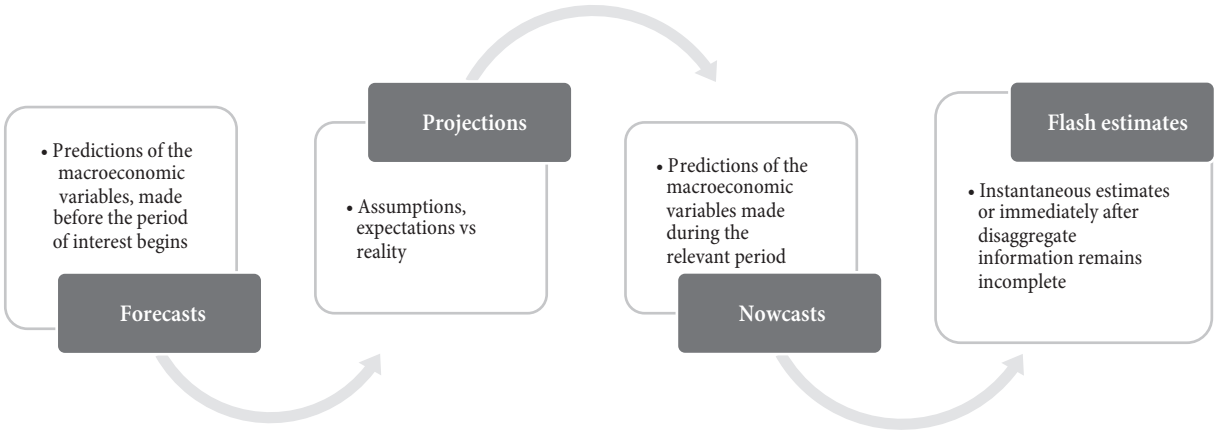
The toolbox also includes new risk assessment models and aids in the generation of a relevant summary of main unresolved hazards. It includes, for example, a monthly projection update system, a system of leading indicators, a system for quarterly GDP nowcasting, predictions, and an Economic Sentiment Indicators (ESI) system, among other things.

Scenario analysis, policy implementation risk, and a variety of different crisis risk models are some new indications. For example, a helpful technique for outlining specific coordinated threats is scenario analysis, which simulates the materialization of significant global dangers. It also provides a forward-looking element to the review. The risk associated with the effective execution of policies assesses this capacity while taking into consideration potential obstacles including political impasse and a lack of technical expertise (see Figure 2).

Many government agencies have recognized the importance of the complex link between the producer of official statistics, the needs of users, and many current challenges, which ultimately leads to a holistic approach suitable for decision making and management, and policy formulation. Consistent with this, SORS works closely with each of them.

The Chamber of Commerce and Industry of Serbia (CCIS) in particular plays an important role in DMSS. Through industry associations and readily available data sources, it collects information and data of general and specialized interest. CCIS's Department for Strategic Planning, Development and Analysis primarily focuses on analysis to identify and limit problems at the micro and macro levels of a homogenous group of producers and exporters. The specialized skills of this department are complemented by outside experts.

Figure 2: The key outputs of DMSS



Source: Authors' illustration

Incorporating CCIS into the system of planning, predictions, recognizing constraints, and deriving remedies completes the shown system of forecasting and monitoring GDP growth and economic activity. It also makes it possible to establish policies that support growth and remove impediments to growth.

At lower levels of business entity groupings, such as areas or categorization categories, all the way up to an individual business entity, CCIS has developed its own DMSS. The system is one of many analytic databases structured around different levels of aggregation of data from a variety of sources.

Conclusion

The results in this paper endorse the general conclusion that the pandemic has caused different economic damages from the past global crises - the Asian financial crisis at the end of the 1990s, the financial crises of 2007-2008, the Great Recession, and the European sovereign debt crisis of 2008-2012. According to historical evidence, crises are the result of single triggering events colliding with economic or financial weakness. Fundamental weaknesses are thus a necessary but insufficient condition for a catastrophe [2].

Although it is impossible to predict when a crisis will emerge, the extent of underlying vulnerabilities can be used to predict worst-case scenarios and assess the likelihood of a crisis occurring. Furthermore, the variety of potential hazards in the complex global economy is virtually limitless.

Due to the COVID-19 pandemic's impact on worldwide commerce and consumption, the expansion of the world economy has been severely hampered. But after the initial fears in the financial markets, this part of the economy remained spared until the end of 2021. In contrast to market and political instability, the COVID-19 pandemic is a true external economic disturbance. Accordingly, EWS does not offer the clearest signals. Or rather, it failed.

The complexity of the current crisis required a change of approach. Creating a DMSS that can accommodate an EWS is one of the alternatives, as suggested by the Statistical Office of the Republic of Serbia. The DMSS's operation has strengthened government surveillance efforts by focusing attention on hazards and distributing novel assessment techniques. Equally important, it ensures efficiency of action and timely response to challenges.

EWSs presented here can serve as one of the many inputs in the assessment and identification of financial crises. However, these models are not precise enough to be the only tool used to predict catastrophes. Like other crisis models, it brings benefits but obviously has its drawbacks. That is why it would be good to put it under the auspices of a more complex DMSS.

Again, for now DMSS should be seen just as a better alternative to earlier practice. This is neither a final nor an almighty option, but it must be further developed in the future. This fact is an additional contribution to the paper that emphasizes the importance of a better understanding of its toolkit and accelerating the process of improving the methodology. At the same time, such an approach could be a motive for spreading a fruitful discussion on this topic among the academic community and individuals.

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