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Information System for Macroprudential Policies

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Abstract: A macroprudential system is crucial for national security as it ensures financial stability and prevents crises that could negatively impact both the economy and state security. By identifying and managing systemic risks, it protects critical institutions from economic shocks and prevents the spread of financial instability. Strengthening resilience against external threats, including cyberattacks and geopolitical fluctuations, ensures the continuity of financial infrastructures essential for economic stability. Macroprudential policies, implemented through regulatory frameworks, help limit speculative behavior, reduce contagion effects, and support sustainable growth. In Romania, the National Bank and the National Committee for Macroprudential Supervision play a key role in monitoring risks and maintaining financial stability. A stable financial system protects national resources, prevents recessions, and guarantees access to funding for both the government and the private sector. Economic risks such as cyber threats, financial market manipulation, and excessive sovereign debt pose significant challenges to national security. The 2008 crisis demonstrated the global consequences of financial instability. Effective macroprudential policies, including capital regulations and financial stress tests, help prevent crises and reduce their economic and security impact. In an era of economic volatility, implementing robust macroprudential policies is essential to safeguarding financial sovereignty and national security.

Keywords: Financial Stability; Macroprudential Policies; National Security; Information System

JEL Classification: E58, G01, G18, H12, H56.

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1. Introduction

A macroprudential system is essential for national security as it ensures financial stability and prevents economic crises that could negatively impact both the economy and national security. It identifies and manages systemic financial risks, protecting critical institutions from internal and external economic shocks and preventing contagion effects in the event of major financial entity failures (Alqaralleh & Abuhommous, 2024).

By reducing economic vulnerabilities (Tache, 2010), such a system strengthens national resilience against external threats, including cyberattacks targeting financial infrastructure (Zhang & Kutan, 2020). It also helps maintain stability amid geopolitical fluctuations and economic sanctions (Tache, 2009), ensuring the continuity of critical financial infrastructures that are vital for the optimal functioning of the economy.

Another major benefit of the macroprudential system is its capacity to enhance financial resilience in the face of global crises (Bouri & Gupta, 2021). It helps prevent economic recessions caused by political instability or international financial turmoil, providing the state with tools to respond quickly and effectively (Dragomir, 2016a). Additionally, it supports confidence in the banking system and financial institutions, a crucial factor for long-term economic stability (Tache & Postolache, 2010).

By promoting financial autonomy and reducing economic dependence, the macroprudential system supports the development of national financial infrastructure and decreases exposure to external markets (Dragomir, 2016b). This translates into effective economic security policies, diversification of funding sources, and improved management of public debt and currency fluctuations.

Furthermore, a macroprudential system plays a significant role in combating the financing of illegal activities and economic terrorism. Through careful monitoring of financial flows, it helps prevent money laundering and other illicit activities (Dragomir, 2021) increases transparency in financial markets, and mitigates the risks of economic fraud. Collaboration with international institutions is also essential in preventing economic attacks on the state and maintaining a secure and stable economic environment.

2. Connectivity Between Macroprudential Policies and National Security

National security can no longer be viewed exclusively through the lens of territorial defense or the prevention of military threats, but must include the economic dimension. An economically stable state is a secure state, capable of protecting its

citizens and managing the financial risks that may affect national security. Macroprudential policies, designed to ensure the stability of the financial system, play a fundamental role in protecting the economy from crises that can have devastating consequences for national security.

2.1. Macroprudential Policies and Economic Stability

Macroprudential policies are a set of regulations and measures adopted to reduce systemic risks in the economy and prevent financial instability. These policies aim to limit speculative behavior, reduce contagion effects in the event of a crisis and ensure sustainable economic growth. The National Bank of Romania (BNR), through the National Committee for Macroprudential Supervision (CNSM), monitors systemic risks and proposes measures to maintain financial stability. A stable financial system contributes to national security by protecting economic resources, avoiding severe recessions and maintaining access to financing for the government and the private sector. For example, if a financial crisis were to lead to the failure of large banks, the social and economic consequences could fuel internal instability, generating social tensions, protests and an increase in the level of insecurity.

2.2. Economic Risks That Threaten National Security

A vulnerable financial system exposes a nation to multiple risks, from cyberattacks and external manipulation of financial markets to economic collapses that can generate social instability. Globalization has made national economies interconnected, and financial crises in one part of the world have direct effects on other states. For example, the 2008 financial crisis demonstrated how quickly the negative effects of a fragile banking system can spread. Another major risk is that of excessive sovereign debt, which can limit the state's ability to invest in infrastructure, education and defense. If the state becomes too dependent on external financing, its economic sovereignty can be compromised and its ability to react to external threats can be reduced. Through effective macroprudential policies, states can prevent the accumulation of financial imbalances and ensure a sustainable level of public debt.

2.3. The Role of Macroprudential Policies in Preventing Financial Crises

Preventing financial crises is an essential element of macroprudential policies and directly contributes to national security. Among the measures used by macroprudential authorities are stricter capital requirements for banks, limiting excessive lending, and implementing financial stress tests to assess the resilience of

the banking system to economic shocks. For example, the European Union has adopted the Basel III regulatory framework, which requires banks to maintain higher capital reserves to withstand possible losses. This type of regulation helps prevent financial crises, reducing their impact on the economy and, implicitly, on national security.

Macroprudential policies are an essential tool for protecting the economy and ensuring financial stability, with a direct impact on national security. By closely monitoring systemic risks, adopting prudent regulations, and developing a resilient financial sector, states can prevent economic crises and ensure a stable environment for economic development. In a global context marked by economic volatility and multiple risks, the implementation of sound macroprudential policies becomes a strategic necessity for any state that wishes to protect its economic sovereignty and national security.

3. Vulnerabilities of the Risk Analysis and Modelling Module in Early Warning Systems

In the current context of the global economy, early warning systems play a key role in identifying and preventing economic and financial crises. One of the most important components of these systems is the risk analysis and modelling module, which uses statistical, econometric methods and advanced technologies to detect emerging threats. However, this module is not without vulnerabilities, and errors in risk analysis and modelling can lead to ineffective decisions, generating unexpected crises or delayed reactions.

3.1. Data Quality and Availability

One of the biggest obstacles to risk analysis is access to complete, accurate and up-to-date data. Early warning systems depend on economic and financial information collected from various sources, but this data can be:

- Inaccurate or manipulated – governments or financial institutions may underreport or overestimate economic indicators to create a more favorable picture of the economy.
    - Incomplete – the lack of relevant historical data series can affect the accuracy of econometric models.
    - Inconsistencies – multiple data sources may use different methodologies, generating discrepancies.

- If the data used in models is erroneous or insufficient, the resulting predictions may be wrong, leading to decisions based on incorrect information.

3.2. Limitations of Econometric Models and AI Algorithms in Risk Analysis

Econometric models and artificial intelligence algorithms are essential tools for analyzing economic and financial risks. They allow the identification of patterns in historical data and the estimation of the probability of economic crises. However, although these models offer undeniable advantages in the decision-making process, they also have significant limitations that can reduce their efficiency in dynamic and unpredictable economic conditions. The first major limitation of econometric models is the dependence on rigid assumptions. The most widely used econometric models, such as multiple linear regressions, autoregressive models (ARIMA), or VAR (Vector Autoregression) models, often assume that the relationships between economic variables are stable over time. For example, linear regression models are based on the assumption that the effects of an independent variable on a dependent variable remain constant. However, the real economy is much more dynamic, and external shocks, regulatory changes, or behavioral changes can alter the relationships between variables. For example, during the 2008 financial crisis, models that relied on the assumption that markets were efficient seriously underestimated the risks associated with financial derivatives. As for AI algorithms, they bring a new dimension to risk modeling, using techniques such as artificial neural networks (ANN), classification learning algorithms (Random Forest, XGBoost) and deep learning models. These methods can analyze large volumes of data and identify complex relationships that would be difficult to detect through traditional econometrics. However, these models suffer from the "Black Box" problem, which means that the decisions made by the algorithm are difficult to explain and interpret by economists and policymakers. For example, a deep neural network can detect a pattern in the volatility of financial markets, but without providing a clear explanation of the causal factors.

Another significant limitation is the inability of models to capture extreme uncertainty, also known as the "Black Swan" phenomenon. Econometric models are built on historical data and use probability distributions to estimate future risks. However, these distributions cannot predict rare but high-impact events, such as the COVID-19 pandemic, the 2008 crisis, or the collapse of financial markets due to cyberattacks. Traditional models, such as ARIMA or GARCH (used to model volatility), assume that extreme events are very unlikely, which makes them ineffective in the face of such shocks. In contrast, more recent models, such as Bayesian Networks, attempt to incorporate uncertainty and subjective probabilities, but these remain difficult to calibrate and require a large amount of reliable data. AI algorithms are also not immune to this problem, as they learn from historical

data, and if such extreme events have not occurred in the past, AI systems cannot predict them. Machine learning models, such as LSTM (Long Short-Term Memory) or GANs (Generative Adversarial Networks), are more flexible than traditional econometric models, but they still cannot predict events for which there is no relevant data. Another problematic aspect is algorithmic bias, which affects both econometric models and AI algorithms. Machine learning systems are trained on historical data sets, and if this data contains errors, biases, or anomalies, the algorithms will learn these trends and perpetuate them. For example, an AI-based credit scoring model, if trained on historical data in which certain demographic groups had limited access to financing, may continue to discriminate against those groups, even if the system's intention is not to discriminate. When comparing econometric models with AI algorithms, each category presents distinct advantages and disadvantages. Traditional econometric models, such as regressions and autoregressive models, are relatively transparent, easy to interpret, and allow testing of causal relationships between variables. However, they are limited in the face of modern economic complexity, where interactions between variables are not always linear and where dependencies can change abruptly. On the other hand, AI algorithms, such as Random Forest and Gradient Boosting Machines (XGBoost, LightGBM), offer a greater ability to identify complex patterns and adapt to large data sets and multiple variables. For example, XGBoost is frequently used in financial risk analysis to detect bank fraud or abnormal trading behaviors. However, these algorithms are less transparent and require careful interpretation of the results. Artificial neural networks and deep learning models are the most powerful in identifying hidden patterns, but they have major interpretability issues and require considerable computational resources. For example, LSTM models are used for economic time series analysis because they can consider long-term dependencies between economic variables. However, they are difficult to calibrate and can become overfitted to historical data, which reduces their generalizability. In conclusion, while econometric models and AI algorithms are essential tools in risk analysis, each has its own specific limitations. Econometric models are more transparent and easier to interpret, but they are often based on rigid assumptions and do not capture extreme events well. AI algorithms are more flexible and capable of analyzing large volumes of data, but they are vulnerable to biases and interpretation difficulties. In an increasingly complex economic environment, an optimal approach would be to integrate both types of models, combining the interpretive power of econometrics with the pattern-finding ability of artificial intelligence.

3.3. Difficulty in Interpreting and Implementing Alerts

Early warning systems are essential for preventing economic and financial crises, but their effectiveness depends not only on technological capacity, but also on the correct interpretation and adequate implementation of the necessary measures. Even if prediction models identify imminent risks, decision-makers face multiple difficulties in analysing the signals and taking prompt action.

One of the main challenges is related to the generation of false positives and negatives. Econometric models and artificial intelligence algorithms can issue alerts that are not confirmed in reality, thus inducing an unjustified sense of alarm. For example, if a system erroneously warns of a possible recession that does not materialize, governments or central banks could overreact by taking measures that unnecessarily affect the economy. On the other hand, there is also the risk that the models will not detect real dangers, which happened before the 2008 financial crisis, when many analysis tools underestimated the vulnerabilities in the subprime lending sector. Another major problem is the difficulty in communicating risks. Even when economic models provide clear predictions, decision-makers need to correctly understand their implications and convey them in an accessible way to the public and other relevant institutions. The complexity of economic data and statistical forecasts can make this process difficult, especially when there are uncertainties in interpretation. In addition, the technical terminology specific to financial analyses can become an obstacle for those unfamiliar with advanced econometric models, leading to delays in applying the necessary measures.

Another key issue is related to delayed political and economic reactions. Often, even if an alert system identifies a real threat, decision-makers may hesitate to act for various reasons, either to avoid inducing panic in financial markets or to protect certain political or economic interests. This phenomenon is frequently encountered in pre-election periods, when governments are reluctant to implement unpopular policies, even if they are necessary to prevent imminent crises. International bodies, such as the International Monetary Fund or the European Central Bank, must also carefully manage sensitive information to avoid destabilizing effects on the global economy. Thus, although early warning systems are valuable tools for detecting emerging risks, their effectiveness largely depends on the capacity of institutions to correctly interpret the data and quickly implement appropriate measures. In the absence of clear reaction mechanisms, alerts generated by econometric models and AI algorithms risk remaining simple warnings without a real impact on crisis prevention. To improve this process, closer collaboration between economists, policymakers, and technology experts is needed so that the interpretation and application of risk signals are more accurate and effective.

3.4. Cybersecurity Risks

Early warning systems play a crucial role in identifying and preventing economic crises, but their effectiveness can be seriously compromised by cybersecurity vulnerabilities. These systems, which collect and analyse huge volumes of economic data, become attractive targets for attackers who want to manipulate information or sabotage decision-making processes. Among the greatest threats to these systems are the manipulation of economic data, attacks on IT infrastructure and the interception of confidential information. One of the most dangerous risks is the manipulation of economic data. Cyber attackers, whether they are independent hacking groups or acting on behalf of states, can introduce false data or alter economic indicators to mislead predictive models. For example, a change in inflation indicators or the level of national debt could lead to wrong conclusions about financial stability, leading governments to adopt inappropriate measures. Such manipulation could generate panic in financial markets or, conversely, mask real economic problems until it is too late to react effectively. Attacks on IT infrastructure represent another major threat. Risk modelling systems depend on complex networks of computers and databases that must operate continuously to provide accurate forecasts. A Distributed Denial of Service (DDoS) attack could overload the servers of these systems, making them inaccessible at a critical moment. In such situations, authorities would no longer have access to the information needed to respond to a potential crisis, which could worsen economic instability. Cyber-attacks on national financial infrastructures could also paralyse the functioning of central banks or regulatory institutions, affecting the entire economy. The interception of confidential information is another significant vulnerability. Risk analysis systems handle highly sensitive economic data, such as economic growth estimates, inflation projections, or monetary policy decisions before they are publicly announced. If such information falls into the hands of malicious entities, it can be used to manipulate financial markets. For example, speculators could use stolen information about upcoming central bank measures to gain significant financial advantages, thereby destabilizing markets and affecting economic equilibrium. Without robust cybersecurity measures, risk analysis systems are vulnerable to harmful external influences. Implementing advanced security protocols, such as end-to-end data encryption, using artificial intelligence to detect anomalies, and hardening network infrastructure, is essential to protect these systems. In addition, cooperation between governments, financial institutions, and cybersecurity companies is crucial to develop effective mechanisms for protecting against attacks. In a world where cyber warfare is becoming an increasingly present reality, securing early warning systems must be a strategic priority for any state that wishes to protect its economic stability.

3.5. Reduced Adaptability to Economic Changes

The global economy is constantly evolving, and risk analysis models must be flexible enough to adapt to new economic realities. However, many of these models are built on historical data, which makes them vulnerable to major structural changes. For example, the digitalization of the economy and the transition to green energy have fundamentally transformed economic mechanisms, but traditional risk models have not always been able to capture these mutations in a timely manner. Reliance on historical data can lead to an inability to correctly anticipate emerging trends, which reduces the effectiveness of crisis prevention measures. Another major obstacle is that risk analysis systems do not always update quickly to incorporate new risk factors. For example, climate change has become a central element in assessing economic stability, having a significant impact on industrial sectors, agriculture and financial markets. However, many econometric models and AI algorithms continue to under-estimate the risks associated with natural disasters or increasingly stringent environmental regulations. Rapid changes in international financial regulations can also affect capital flows and liquidity risks, but traditional systems are not always equipped to integrate these variables in real time. A related problem is the over-reliance on past scenarios, which can lead to an underestimation of emerging risks. Economic models work on the basis of correlations identified in the past, but these are not always relevant for the future. Recent economic crises have shown that unforeseen shocks – such as the COVID-19 pandemic or the war in Ukraine – can have devastating effects on global economies, and risk models have not been able to anticipate them properly. In such contexts, the rigidity of existing models can lead to a delayed reaction by the authorities, amplifying the negative consequences on the economy. To improve the adaptability of risk analysis models, a more dynamic integration of new economic and social variables is necessary.

4. Conclusion

The risk analysis and modelling module is an essential element of early warning systems, providing critical information for the prevention of economic crises. However, vulnerabilities related to data quality, limitations of econometric models, interpretation difficulties, cyber risks and low adaptability can compromise the efficiency of this system. In order to improve the performance and reliability of these models, continuous investment in advanced technologies, cybersecurity, updating of algorithms and transparency in the collection and analysis of economic data is essential. Only through a multidimensional and flexible approach can an early warning system capable of preventing financial crises and contributing to national economic security be ensured the use of advanced technologies, such as artificial intelligence and big data analysis, could allow for a faster update of

models and a better adaptation to changing economic realities. Also, collaboration between financial institutions, regulators and public policy experts could contribute to the development of more flexible analytical frameworks capable of managing emerging risks. In an increasingly complex economic landscape, the ability to understand and anticipate changes is essential for maintaining financial stability and long-term economic security. If risk analysis mechanisms are not constantly updated and adapted to the current economic context, their efficiency decreases significantly.

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