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THE NATURE OF CURRENCY CRISES:
GLOBAL LESSONS AND FORECASTING SYSTEMS

Abstract

This paper seeks to present the essence and models for predicting currency crises based on the theoretical background and evidence of currency crises in the world. Extensive literature has been used to delve deeper into the mechanisms of action of currency crises on representative examples of countries. The findings suggest that there are different causes of currency crises, but that there are certain typical patterns of movement of certain macroeconomic indicators that are predictors of currency crises. The study, based on a systematic review of empirical experiences, emphasizes that the root causes lie in the poor economic fundamentals on which the economy rests: high inflation, unfavourable economic structure, fiscal deficit, speculative attacks on the currency and political instability. Such findings can contribute to monetary authorities and researchers in building models for the early detection of currency crises based on these variables. In addition, it was concluded that without international aid, countries were not able to quickly cope with the currency crisis.

Key words: *currency crises, financial crises, exchange rates, early warning systems for crisis, monetary policy*

JEL classification: *F30, F47, G01, G17, G28*

ПРИРОДА ВАЛУТНИХ КРИЗА:
ГЛОБАЛНЕ ПОУКЕ И СИСТЕМИ ЗА ПРЕДВИЂАЊЕ

Апстракт

Овај рад настоји да прикаже суштину и моделе за предвиђање валутних криза на основу теоријске позадине и евиденције валутних криза у свету. Опсежна литература је коришћена како би се дубље зашло у механизме деловања валутних криза на репрезентативним примерима земаља. Налази говоре да постоје различити узроци валутних криза, али да ипак постоје одређени типични обрасци кретања одређених макроекономских показатеља који представљају предикторе валутних криза. Студија, на

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основу систематског прегледа емпиријских искустава, наглашава да основни узроци леже у лошим економским фундаментима на којима привреда почива: висока инфлација, неповољна привредна структура, фискални дефицит, шпекулативни напади на валуту и политичка нестабилност. Оваква сазнања могу допринети монетарним властима и истраживачима у изградњи модела за рано откривање валутних криза заснованих на овим варијаблама. Додатно, закључено је да без међународне помоћи земље нису успевале брзо да се изборе против валутне кризе.

Кључне речи: *валутне кризе, финансијске кризе, девизни курсеви, системи раног упозоравања на кризу, монетарна политика*

Introduction

Financial crises have plagued the world, especially since the last century. Sometimes the causative agents are from the real sector, and sometimes it can be banking crises. Moreover, in some cases, it is impossible to find a clear cause of a crisis, because it is a set of circumstances that influence the occurrence and development of financial crises. Panic in the market without a clear cause (spread of rumours, for example) can also be a trigger for the emergence of a banking crisis and then a financial crisis. Financial crises are often facilitated by factors from the country, and in a globalized world there is a growing insight into the effect of external factors that do not leave any country protected: whether it is a small, medium, large country, or even regardless of the level of financial and economic development. That is why this research is useful to a wide audience that includes economic and public policy makers, states, researchers, and the entire academic community. All countries can draw lessons, because all of them, we emphasize again, are a possible "target" of crisis strikes. Over the past 100 years, the world has faced several devastating crises that have shaken the global economy and financial markets. The Great Depression (1929-1933), the oil shock (1973 oil crisis) and the global financial crisis (2007-2009) left a significant mark on all of humanity. These major crises seem to have occurred, as a rule, about 40 years apart. The COVID-19 crisis has also left its mark on the conduct of international business and has threatened the functioning of the global economy, finance, and trade (Stojadinović-Jovanović, Krstić, Marković, 2020). We do not want to be pessimistic, but following previous patterns of manifestation, we can say that in the future the question is not whether the crisis will occur, but only when it will manifest its (often devastating) effect.

While some researchers deal with the origins and determinants of currency crises in a theoretical sense, others aim to predict future crises using various techniques and tools. This study aims to find the most common empirical factors that can be a threat to currency resilience, as well as to propose systems for evaluating and monitoring currency crises. The factors are complex because it is a multidimensional crisis. Moreover, it is often not possible to say what the root cause of the crisis is, because it can be caused by an entire range of factors that can be from the interior, but also from abroad. This study looks at the determinants of the crisis based on numerous examples of currency crises

in earlier decades: the crisis of the European Currency Mechanism, the currency crises in Mexico, Asia, Russia, Brazil, Argentina, Türkiye, Venezuela. Some countries are still dealing with the consequences of the same, while in Russia and Argentina, for example, currency crises had multiple episodes. The experience of the analysed countries shows that the following triggers of currency vulnerability were the most present: inflationary disturbances, speculative attacks on the currency, ineffective macroeconomic policy, poor choice of exchange rate regime, high private and public debt, the spread of crises (contagion) from abroad, budget problems, political turmoil, poor structure of the economy. These are the common causes of most of the currency crises that are evaluated in the paper. Although there is no precise classification of factors, in the literature it is possible to show factors that are classified according to currency crisis models, which will be further presented in the study. Also, the generations (models) of currency crises differ according to the dominant factors, although the fact is that a significant number of identical factors are present in each of the generations of currency crises.

On the other hand, the study offers a methodological framework that can be used for quick and early identification of currency crises. The authors offer a comprehensive insight into fractal analysis, a signal approach in identifying currency crises, as well as discrete choice models in their assessment. The paper also highlights the importance of certain modern techniques for considering the probability of currency crises, such as Markov models, artificial neural networks, and decision trees. The development of prediction systems based on machine learning will be the backbone of some scientists in the future to be prompt and better assessing the potential risks of financial crises of any type.

Insight into the causes of currency crises

Currency crises are a type of financial crisis. Financial crises arise as a disturbance resulting from the interactions of the financial and real sectors in an economy. They are most often explained as a sharp and rapid decline in the nominal value of a financial asset. If a crisis is caused in one of the major economies of the world, it leads to spread to other countries, which requires global coordination of the economic policies of the countries (Dabrowski, 2010). There is an entire range of factors that describe a financial crisis: rising interest rates, a strong depreciation of the national currency, mass panic and withdrawal of deposits, and a crisis of public debt and money circulation (Radelet, & Sachs, 2007). Hardy & Sever (2020) classify the determinants of currency crises into supply-side (decline in labour productivity, poor allocation of capital, and reduced investment in intangible capital), and demand-side (decline in consumption, demographic changes). Other authors point out the distinction between the factors of currency crises (as the key causes of financial crises) depending on whether the triggers are from home or abroad (Marjanović, & Marković, 2019a). Hindmoor & McConnell (2013) emphasize the signs of financial crises viewed more through the prism of banking crises: an unexpected rise in interest rates, an enormous increase in the number of non-performing loans, bankruptcies of large banks, a decrease in the amount of borrowed funds.

In many cases, financial crises are manifested by currency crises. The causes of currency crises can be different. The hasty liberalization of capital movements (credit

and financial sector), in the conditions of an inadequate regulatory framework (a system of supervision and control over banks as leading financial institutions) and the well-known effect of short-term speculative capital, has been identified in most studies as a trigger or reinforcing factor of currency crises (Marković, 2015). Throughout the scientific literature, a long list of factors of currency crises has been observed that are more likely to cause a real currency crisis if the central bank does not have optimal levels of foreign exchange reserves (Marjanović, & Marković, 2019). Among them are the drastic depreciation of the exchange rate, as well as the effect of hot money, which depletes the foreign exchange reserves managed by the central monetary institution. That is why the following terms are mentioned as synonyms for currency crisis in the literature: devaluation crisis, speculative crisis and foreign exchange crisis (Helísek, 2019).

A country with a currency crisis usually has a high depreciation of the national currency (over 25% annually) or the rate of currency depreciation (again on an annual basis) is 10 percentage points higher in the current year compared to the rate of depreciation in the previous year (Frankel, & Rose, 1996). In this case, monetary authorities usually sell foreign exchange reserves or raise interest rates to avoid speculative attacks. Therefore, Ari & Cergibozan (2016) emphasize that a currency crisis cannot be judged solely based on exchange rate movements; an indicator of a currency crisis can also be a drastic depletion of foreign exchange reserves. If a country chooses a bad (unsustainable) exchange rate regime, it is certain that at some point it will encounter the devastating effects of the currency crisis (Đolić, Marković, & Stojadinović-Jovanović, 2024). That is why monetary policy is a segment of economic policy that is crucial in preventing financial and currency crises (Anđelković, Kostić, & Milačić, 2025).

The factors of currency crises are often viewed in the literature through the study of the generation of currency crises. Based on practical experience, there are three generation models of currency crises that are presented with their root causes in Table 1.

Table 1. Models (generations) of currency crises and their determinants

The first generation of currency crises	The second generation of currency crises	The third generation of currency crises
- Mismanagement of monetary policy - A huge trade balance deficit - A high budget deficit - Excessive growth of domestic credit supply	- Speculative attacks on currency (hot money) - Bank panic and massive withdrawal of deposits - Pessimistic forecasts of investors	- Banking crisis - Over-indebtedness of the country - The high level of private sector debt - Moral hazard and negative selection - Accelerated liberalization of capital movements - Contagion from other countries

Source: Marković, & Marjanović, 2021

In contemporary professional and scientific circles, the need to develop a fourth-generation model of currency crises is discussed, bearing in mind some anomalies of existing models (Padhan, & Prabheesh, 2019). New comprehensive models can help to better understand and diagnose currency crises, better predict the vulnerability of

countries, but also offer more adequate argumentation of previous models to successfully implement anti-crisis policies.

Contemporary currency crises: records from the analysed countries

For many years, from 1979 to 1992, the global monetary system was extremely stable. However, starting in 1992, the unstable monetary situation in many countries has awakened the attention of theorists and practitioners in the field of economics to a phenomenon of a multidimensional nature, such as the currency crisis. The eroded stability of the European Monetary Mechanism was the initial source of growing concerns at the regional and global levels. This crisis was the result of post-German political conflicts that surfaced after reunification (Gordon, 2000), as well as misguided economic policy measures that caused high inflation and budget deficits in Italy and the United Kingdom (Higgins, 1993). Of course, speculative attacks were also an indispensable part of the process due to the pessimistic expectations of market participants, which was expressed especially after the referendum in Denmark (Rose, & Svensson, 1994). Further, the crisis spread to the Scandinavian countries and many currencies were devalued despite interventions through foreign exchange reserves. Finally, there was an adjustment of key interest rates, as well as the abandonment of currency pegs to the Deutsche Mark.

The devaluation of the peso at the end of 1994 triggered one of the biggest currency crises in recent history. It is about the currency crisis in Mexico, which is a mirror of the crisis of the first generation. Excessive budget spending and the consequent foreign debts have put the country in a difficult position. This was followed by political instability, a decrease in capital inflows, as well as a drastic decline in the amount of foreign exchange reserves. The failure of the devaluation has undermined the credibility of economic policymakers (Babić, & Žigman, 2000). This crisis threatened to take on global proportions, and in the end, the International Monetary Fund intervened with a sum of money that was intended to help vulnerable economies.

Asian countries (Singapore, Malaysia, Hong Kong, South Korea, Thailand, Taiwan) faced serious problems at the end of the last decade of the twentieth century, after a period of intense economic growth and development and overall socio-economic success (1965-1996). For many economists, the crisis was unexpected, while the monetary authorities were unprepared for the coming crisis. A huge amount of loans with low interest rates have become non-performing due to the depreciation of national currencies (Hughes, 2000). The inadequate debt structure in favour of the short-term one, as well as the too rapid removal of restrictions on the capital movement, has made many countries vulnerable. The high amounts of savings that were easily placed on the private sector were one of the reasons for the banking crisis. These are the classic consequences of the overheating of these economies, with loose regulation and supervision of financial institutions. The recovery of Asian countries did not come until 1999, after a serious restructuring of the banking sector, the establishment of better financial controls, and the reduction of foreign borrowing (Kawai, 1998).

Russia has been hit by a currency crisis since 1997. Pinto & Ulatov (2010) cite the reasons for the outbreak: (i) non-compliance with the agreed objectives of the fiscal

deficit reduction program, (ii) high political risk, and (iii) the monopsony power of certain banks. The fall in the prices of natural resources on which Russian exports are based, the low inflow of investments, as well as speculative attacks directly affected the occurrence of the currency crisis. The economy has not yet fully recovered, and the next crisis broke out shortly after, in 2014. Hidden problems gradually accumulated. It was obvious that at the same time Russia had certain unresolved problems in the structure of the economy, a sharp drop in the prices of oil and non-ferrous metals as the main export product, but this country also experienced economic sanctions from the United States and European countries, which were reflected to some extent in the weakening of macroeconomic parameters (Eberhardt, & Menkiszak, 2015).

Brazil was also a victim of the currency crisis in 1999. High inflation rates, as well as increased imports due to the overvaluation of the domestic currency, were the internal initiators of the crisis. Of the external factors, there was the effect of financial contagion from Russia and Asian countries (Marković, & Marjanović, 2021).

Argentina's economy, unlike before the crisis when it experienced an economic boom thanks to successful economic policies, has been very unstable since the beginning of the 21st century. The strengthening of the national currency, the illiquidity of companies and the "bank run" have accelerated the currency crisis (James, & Kulkarni, 2009). The crisis was contained thanks to international financial intervention. However, in 2018, Argentina experienced a new currency crisis, which again went through the consequences of this type of financial crisis. Of the obvious determinants, the huge budget deficit, natural disasters, but also the beginning of the pandemic in 2020 were in the lead. All this has led to the manifestation of high inflation, the depreciation of the currency, as well as the depletion of foreign exchange reserves.

Egypt's currency crisis began in 2007 when the economy was hit by falling food and energy prices, which are crucial for this country (Boshkov, 2019). This crisis occurred at an inopportune time, just before the onset of the great global economic and financial crisis (2007-2008), which was particularly worrying and put the country's monetary and economic authorities in an uncomfortable position. International financial assistance was crucial for the country to recover by 2017 and to compensate for capital outflows due to a decline in foreign direct investment and foreign exchange inflows from tourism.

Similar common determinants of currency crises have been manifested in Türkiye. The currency crisis had the characteristics of a debt crisis. The balance of payments deficit, delays in measures and reforms of economic policies and high inflation rates have led the country to face one of the biggest crises in modern history (Öniş, & Kutlay, 2021). While the Turkish lira has stabilized with interest rate cuts and an adequate repayment plan, the pandemic has once again exposed the hidden weakness of the Turkish economy and the instability of the national currency (Orhangazi, & Yeldan, 2021).

Poor macroeconomic performance since 2012 has been the main cause of the crisis in Venezuela. More specifically, highly concentrated exports, growth in public spending, and rising borrowing costs, coupled with a decline in gross domestic product, have set the stage for a flare-up of the currency and economic crisis. The crisis was also contributed to by the so-called Dutch disease, a phenomenon related to over-reliance and favouritism on one product – oil in this case. A rather undiversified export, as well as the so-called rentier economy, makes a country very vulnerable if there is a fall in the price of the product in question on the global market (Buxton, 2021), which was the case in

Venezuela. Based on the previous evidence on the factors of currency crises, Figure 1 is constructed.

Figure 1. Common factors of the world's leading currency crises
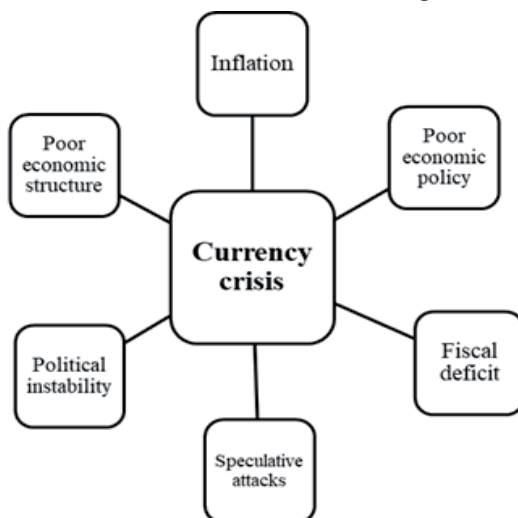
Source: Authors' overview

Overview of early warning systems for currency crises

Currency crises are undesirable because they have a negative impact on all segments of the economy. They lead to a decline in economic activity, financial instability, and undermining the credibility of monetary and public authorities, causing the outflow of capital from the country and reducing investment. That is why systems and models are being developed to predict potential currency crises. Although they are imperfect, in fact, they are not able to completely stop the occurrence of crises with their predictive properties, the study and upgrade of these models is necessary to better assess future currency crises. Furthermore, failure to detect currency crises can be justified by a country's unstable macroeconomic fundamentals (Yépez, Flood, & Marion, 2010).

Early warning systems for currency crises combine economic and financial indicators to identify a country's vulnerability and/or the sustainability of the current exchange rate regime (Rădoi, & Gurau, 2019). Their power is to prevent economic losses associated with the outbreak of a crisis at an early stage, by allowing policymakers to assess the chances of its occurrence and respond on time. To begin with, it is necessary to distinguish between external and internal predictors of currency crises. The most important external indicators are exchange rate, foreign exchange reserves, current account of the balance of payments, and external debt, while the most common internal indicators are interest rate and non-performing loans (Abubakar, Utari, & Azwar, 2020). Irrational expectations of investors must also be considered, which can lead to the appearance of the so-called herd behaviour.

One of the techniques in the development of a system for assessing and predicting currency crises is a fractal analysis. It is based on the theory of fractals, which according to this system represent time series. In fact, it is a mathematical technique for studying the complex nature of financial indicators (Evertsz, 1995). Financial markets are non-linear, complex systems that are determined by a range of unknown parameters that are often beyond the control of market participants. There are many papers that prove the possible use of this analysis in forecasting financial crises (Sornette, & Zhou, 2004; Czarnecki, Grech, & Pamuła, 2008; Budinski-Petković et al., 2014).

Non-parametric models for assessing currency crises are most often related to the signal approach. This crisis detection system uses indicators that do not have a characteristic movement in the pre-crisis period. A signal for a potential currency crisis exists when the movement of a particular indicator deviates from a threshold value (Marković, & Marjanović, 2021). This signal warns that a currency crisis could occur in the next 24 months. Different authors use different indicators to predict future currency crises. One of the most cited papers that applies a signal approach to warn of possible episodes of currency crises uses the following parameters (Kaminsky, Lizondo, & Reinhart, 1998): banking crisis, international reserves, exports, imports, terms of trade, real exchange rate, the ratio of real interest rates on deposits in the country to real interest rates abroad (real interest differential), surplus money supply M1, M2 multiplier, value of domestic credits to the gross domestic product of the country, real interest rate on deposits, the relationship between lending rate and deposit rate, the value of deposits of commercial banks, the money supply of M3 relative to international reserves, the industrial output index and the stock price index. After defining the variables, this approach involves the following steps:

Step 1. Evaluation of indicators using the following matrix form (Berg, & Pattillo, 1999):

Table 2. Signal approach - matrix

	Crisis within 24 months	No crisis within 24 months
Signal was issued	A	B
No signal was issued	C	D

Source: Berg, & Pattillo, 1999.

where:

A – the number of months in which the indicator gave a good signal,

B – the number of months in which the indicator gave a bad signal,

C – the number of months in which the indicator did not issue a signal that should be a good signal,

D – the number of months in which the indicator did not issue a signal, which would be a bad signal.

Step 2. Defining the optimal threshold that minimizes the ratio of noise to signal (noise-to-signal ratio):

$$\frac{\frac{B}{B+D}}{\frac{A}{A+C}}$$

This step is very important because it selects a threshold value to achieve a balance between the risk of bad signals, on the one hand, and the risk that the signal does not occur, and that a currency crisis occurs, on the other.

Step 3. Calculation of the composite crisis indicator (Kaminsky, 1998):

$$k_t = \sum S_t^i * w^i$$

where:

k_t - composite indicator of the currency crisis.

S_t^i - this indicator is equal to one (1) if the indicator i exceeds the limit value, otherwise it is equal to zero (0),

w^i - the inverse ratio of the noise and signal of the indicator i.

Step 4. Calculating the conditional probability of a crisis by looking at how often a given index value is followed by a crisis over a 24-month period (Berg, & Pattillo, 1999):

$$\Pr(C_{t,t+24}^n | k_t = j) = \frac{months\ with\ k = j\ and\ a\ crisis\ within\ 24\ months}{months\ with\ k = j}$$

Here we obtain the value of the conditional probability of a currency crisis for the country i in the time interval [t, t+24].

Parametric models for predicting currency crises include discrete choice models and modern approaches that are still under development. First, discrete choice models (probit and logit models) are based on a binary variable: 1 – when a crisis is present, 0 – when there is no period with a crisis (Marjanović, & Marković, 2019a), with the aim of accurately detecting the occurrence of a currency crisis. Unlike the signal approach, this model determines the contribution of each of the indicators to the outbreak of the crisis. Demirgüç-Kunt & Detragiache (2005) support discrete choice models and criticize the signal approach because such an approach does not properly assess the potential for a crisis outbreak because it does not consider how far the value of a particular indicator is from a predefined threshold.

On the other hand, modern techniques for assessing currency crises are being developed to compensate for the perceived shortcomings of earlier models. They are primarily based on machine learning techniques but also include Markov models. A Markov model seeks to address some of the shortcomings of applying the discrete choice model in the construction of an early warning system for a crisis. A particular advantage lies in the fact that these models also incorporate some immeasurable factors, such as investor expectations, which are often subject to change (Fratzscher, 2002). Machine learning techniques usually involve the use of neural networks and decision trees. Artificial neural networks have emerged as a normal consequence of the following circumstances: (i) the development of modern science and technology, including the Big data, (ii) the need to reduce costs and, at the same time, increase the power of prediction (Nag, & Mitra, 1999), (iii) the need for more flexible models for forecasting currency crises (Fioramanti, 2008). The last technique within the framework of the currency crisis early warning system is the decision tree. It is an instrument that is based on the principles of classification and forecasting. It presents a kind of map of possible outcomes

of a series of choices that are interconnected. In crisis early warning systems, each node within the decision tree (binary trees) has two branches that symbolize outcomes. Then, the probability for each of the outcomes is determined, while the end node depicts the outcome of the decision trajectory.

Conclusion

Currency crises are one of the basic forms of financial crises that are unavoidable when there are economic and financial disturbances in domestic and global markets. Currency crises, sovereign debt crises, and banking crises are the most common examples of financial crises. In addition, scientists are also considering a twofold crisis. It is a combination of the currency crisis and banking crisis. The depreciation of the exchange rate and the drastic drop in foreign exchange reserves reflect the emergence and presence of a currency crisis in the country. The liberalization of capital flows, speculative attacks on the currency, as well as the so-called hot money (short-term capital that often moves from country to country) can be emphasized as the most common complementary factors of currency collapses. Additionally, currency vulnerability is more often manifested in small open countries that: poorly conduct economic policy, have a shallow financial market and are politically unstable.

Therefore, currency crises are obviously a negative phenomenon and have a harmful impact on the socio-economic development of the country, as well as on sustainable development. To build resilient societies, the potential problems that currency crises bring with them must be looked at in detail to construct an adequate regulatory framework. This research aims to attract attention to all stakeholders involved in the implementation of monetary, fiscal, and economic policy. Currency crisis detection systems must provide a timely alarm so that monetary authorities can react appropriately to prevent a possible currency crisis. The central bank has a dominant place in identifying, analysing, and taking preventive measures to counteract currency crises. However, the government institutions that manage fiscal policy are also making efforts to ensure coordination with monetary policy. The central bank has several instruments and measures whose prompt and effective use can help the country avoid the severe consequences of such crises. Since the trigger of currency crises can be the real or private sector, it is necessary to cooperate with the holders of all public policies and segments of economic policy. At the international level, the International Monetary Fund plays an important preventive role, both through financial resources and advisory services. Although there are divided opinions about the effectiveness of these measures, in the last resort, the role of this global institution in tackling currency crises can be crucial because modern financial systems are highly interconnected and often exposed to global events (shocks) at the same time. It is noted that the largest number of currency crises occurred in the last decade of the last century. After several years of stagnation, the 2007 crisis restarted the debate on the prevention of currency crises in many countries. Hence, there is a constant interest in scientific and academic circles in the study of nature, essence, and systems for assessing currency crises based on experience from the world.

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