CURRENCY CRISES: MODELS AND THEIR POSSIBILITY IN LITHUANIA

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Abstract

Increased integration of the financial markets brought new forms and more global character of the crises episodes. A currency crisis, according to many economists, is a situation in which a currency experiences heavy exchange market pressure. Recent currency crises drawn attention, not only because of their increased frequency but because they have been experienced by a diverse group of countries, including several with large, well-developed economies. A currency crisis can be forestalled if it is detected in its early stage and appropriate measures are undertaken. Following an initial overview of theoretical three generations currency crises models, this paper presents an early warning system of a currency crisis based on a signal approach and assesses currency crisis probability in Lithuania. The system monitors several economic indicators: the values of these indicators are usually different before, during and after a crisis, so their movements can be used to forecast the probability of the onset of a crisis. Keywords: currency crisis, exchange rate, early warning system, speculative attack.

Introduction

Currency crisis is not just a phenomenon of the recent decades. The decade of the 1990s was marked by an unusual number of currency crises such as the attack on the European Monetary System in 1992-1993, the Mexican peso crisis in 1994-1995, the Asian crisis in 1997, the Russian default in 1998 and its spillover to Latin America.

All currency crises can be very costly. These costs include fiscal and quasi-fiscal costs, misallocation and an underutilization of resources, losses in real output and changes in distribution of wealth. M. Bordo et al. (2001) estimate that the downturns following financial crises have lasted on average 2-3 years and cost 5-10 % of GDP. This motivates the study and it is important to investigate the causes of the past currency crises and ways of detecting countries vulnerable to crises. Knowing the main vulnerabilities from the past might help to take prompt corrective action to avoid new crises.

The main aim of this paper is to develop an operational early warning system that can detect the potential currency crisis and evaluate a suitability of an early warning system for predicting the potential currency crisis in Lithuania. To achieve this goal the paper analyzes and extends the early warning system developed by G. Kaminsky, S. Lizondo, and C. Reinhart (1998; 1999) that is based on the signal approach. The system should provide a satisfactory way of selecting indicators preceding a currency crisis and thus anticipate the actual crisis.

The object of the research is currency crises and their prediction. To achieve the aim the following tasks were exercised:
• To review and compare theoretical currency crisis models;
• To determine leading indicators as predictors of crisis episodes;
• To design an early warning system of a currency crisis;
• To evaluate a currency crisis probability in Lithuania.

Currency crises models: review and comparison

There is no exact quantitative definition of the currency crisis, but it generally involves a sudden and rapid fall in the value of one or more currencies (Kaminsky & Reinhart, 1999). The increase in the number of these crises and the importance of their impact of the economy has generated a large amount of research into their causes. At the theoretical level, the literature distinguishes between three main types of models of currency crises.

The classic approach to currency crises was laid out by P. Krugman (1979), R. Flood and P. M. Garber (1984). It was created in an attempt to explain the currency crises in Mexico (1973-1982) and Argentina (1978-1981). These models indicate that an inadequate macroeconomic policy was the main cause of the currency crises. Currency crises occur because international reserves are gradually depleted. The model fixes the timing of a currency attack such that the remaining reserves before the attack are just enough to satisfy the foreign currency demands of market participants during the attack.
Second generation models claim self-fulfilling speculation is the main source of a currency crisis (Brakman, 2006). The ERM crisis in 1992 and the Mexican crisis of 1994–1995 acted as stimulus for working out the second generation models. Here currency attacks can take place even though current policy is not inconsistent with the exchange rate commitment. The attacks can nevertheless be successful because the costs of maintaining a currency peg, in the form of high domestic interest rates, rise in response to the attack. Therefore, second generation models reveal an interesting fact – even if the country is fundamentally able to maintain a fixed exchange rate, change in speculators expectations can dramatically change the situation. However, this generation models could not explain why the currency crisis spread to other countries (Kaminsky, 2003).

P. Krugman (1979), who created the first generation model, took the view that the currency crisis is inevitable if the currency depreciation is expected. Third generation currency crises models, whose main authors are A. K. Rose, B. Eichengreen (1996a; 1996b), M. Obstfeld (1995; 1996), already allow to establish how monetary policy can impact the currency crises and to explain the causes why crises spread across the countries. There are various explanations of crisis transmission from one country to another. One of the explanations is based on the negative impact of an identical exogenous shock experienced in a number of countries. A crisis can also be transferred by means of trade relationships when the depreciation of a currency in one country results in the reduced competitiveness of another country. Financial interdependence can contribute to the expansion of a crisis when the inability of a country to repay its external debt forces its foreign creditors to recall loans to other countries. Finally, a currency crisis in a particular country can contribute to the deteriorated perception of the condition of economic systems in other countries with similar system characteristics. Table 1 below introduces the comparison of all theoretical models of currency crises.

<table>
<thead>
<tr>
<th>Main creators</th>
<th>First generation models</th>
<th>Second generation models</th>
<th>Third generation models</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P. Krugman; P. Garber; R. Flood.</td>
<td>M. Obstfeld; A. Calvo; A. Rose; A. Velasco; S. Morris.</td>
<td>A. Rose; B. Eichengreen; M. Obstfeld.</td>
</tr>
<tr>
<td>Main economic indicators</td>
<td>Fiscal deficit/GDP; Real money quantity; M1 balance surplus.</td>
<td>Export; Import; Real exchange rate; Trade terms; Production; Real interest rate.</td>
<td>Domestic credit/nominal GDP M2/international reserves; M2 multiplier; Share prices; Deposits; Banking crises.</td>
</tr>
<tr>
<td>Main properties</td>
<td>Focus on long run; Unique equilibrium; Government deficit monetarization is the cause of speculative attack against the national currency.</td>
<td>Focus on short run; Multiple equilibrium; Currency crisis largely depends on speculators expectations.</td>
<td>These models already allow to establish how monetary policy can impact the currency crises and to explain the causes why crises spread across the countries.</td>
</tr>
<tr>
<td>Main disadvantages</td>
<td>Government and central bank passively monitor the speculative attack.</td>
<td>Unexplained currency crisis spread.</td>
<td>All disadvantages we will see in the future.</td>
</tr>
</tbody>
</table>

An early warning system of currency crises: methodology

A currency crisis can be forestalled if it is detected in its early stage and appropriate measures are undertaken. Early detection of a crisis is vital and in this respect early warning indicators, that are being developed more and more, can be of great help. The signaling approach for constructing an early warning system (EWS) models involves the following steps: identifying historical crisis episodes, selecting leading indicators as predictors of crisis episodes, setting threshold values of the selected leading indicators, constructing composite leading indices, and predicting crises. The basic idea is that, if we can find relevant factors that invite crises, we will be able to predict currency crises.

The authors define a crisis as a situation in which an attack on the currency leads to a sharp depreciation of the currency, a large decline in international reserves, or a combination of both. The signaling method provides the best results when the behavior of variables in the pre-crisis period is clearly different from their behavior in a tranquil period (Vlaar, 2000).

As we can see in figure 1, an indicator $I_j$ is said to signal an upcoming crisis in period $t$ if the indicator crosses some threshold value $T'_j$. In this case it constitutes a good signal (case A). A signal issued before that date correspondingly a bad signal (case B). When an indicator remains silent we can not streakly speak of a signal, but call a realisation instead (case C and D).

In order to assess the economic vulnerability of the individual economics sectors $z'_j$ is calculated. When $n$ economic indicators vector is $I$, the first composite variable calculated by the following formula (1):

$$z'_j = \sum_{j=1}^{n} S'_j$$  

$$S'_j = \begin{cases} 1, & |I_j'| > |T'_j| \\ 0, & |I_j'| < |T'_j| \end{cases}$$

$z'_j$ - economic vulnerability indexes (acquires values from 0 to n) ;

$|T'_j|$ - the critical value of economic indicator;

$|I_j'|$ - the value of economic indicator.

In order to distinguish extreme signals from normal signals a second threshold is introduced $T'_2$ (see figure 1) Then:

$$z''_j = \sum_{j=1}^{n} S''_j$$

$$S''_j = \begin{cases} 1, & |I_j'| \leq |T'_1| \leq |I_j'| < |T'_2| \\ 2, & |I_j'| \geq |T'_2| \end{cases}$$

Not all the economic indicators at the same time signals about a critical situation, so we need to assess the previous periods of economic indicators variability. For this reason $z''_j$ is calculated (5):

$$z'''_j = \sum_{j=1}^{n} S'''_j_{j-1,j-1}$$

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where \( S_{t-s,t-1}^{j} = \begin{cases} 1 & |I_{t-1}^{j}| > |I_{t}^{j}| \text{ or } |I_{t-s}^{j}| > |I_{t}^{j}| \\ 0 & \end{cases} \)  \hspace{1cm} (6)

In order to capture the dangerous signals coming from the selected economic indicators, and assess the probability of currency crisis - exchange market pressure index (EMP) is calculated. In this case, \( z_{t}^{j} \) provided information is specified by \( z_{t}^{2} \), so finally EMP index will be calculated by the formula (7):

\[
EMP = \frac{z_{t}^{2} + z_{t}^{3}}{3n} \hspace{1cm} (7)
\]

**Currency crisis possibility in Lithuania**

According to the early warning system of currency crises, we tried to evaluate an exchange market condition in Lithuania (in the period from January 1997 to December 2001). The period was selected for the reason that in this time general economic situation was negatively affected by the Russian currency crisis. Thus, a currency crisis contagion will be checked too.

Based on theoretical priors and on the availability of data on a monthly basis, six economic indicators were selected: foreign exchange reserves, current account balance, interest rates, real effective exchange rate, public foreign debt, M2 and foreign exchange reserves ratio (see table 2). As mentioned before, the signaling method assumes a difference in the behavior of variables prior to the crisis and in the tranquil period.

The main data source is the Bank of Lithuania. General database ensures their compatibility. The data on variables published quarterly have been interpolated on a monthly level.

**Table 2. The critical values of economic indicators**

<table>
<thead>
<tr>
<th>Economic indicator</th>
<th>Comments</th>
<th>( T_{1}^{j} )</th>
<th>( T_{2}^{j} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public foreign debt change pokytis (mln. Lt.)</td>
<td>The growth of government debt increases the probability of currency crisis.</td>
<td>400,55</td>
<td>800,02</td>
</tr>
<tr>
<td>Real effective exchange rate</td>
<td>Real effective exchange rate, around one year before the currency crisis, is significantly overvaluated.</td>
<td>3,90</td>
<td>5,40</td>
</tr>
<tr>
<td>M2 and foreign exchange reserves ratio change</td>
<td>M2 and foreign exchange reserves ratio tends to increase before a currency crisis.</td>
<td>0,14</td>
<td>0,21</td>
</tr>
<tr>
<td>Foreign exchange reserves change (mln.Lt)</td>
<td>Foreign exchange reserves of the central bank tends to fall before a crisis</td>
<td>-528,36</td>
<td>-764,64</td>
</tr>
<tr>
<td>Interest rates change (%)</td>
<td>Prior to a crisis interest rates are 1 to 2 percentage points higher than in tranquil times</td>
<td>2,29</td>
<td>3,21</td>
</tr>
<tr>
<td>Current account balance change (mln. Lt.)</td>
<td>The growing current account deficit increases the probability of a crisis.</td>
<td>-529,51</td>
<td>-1060,01</td>
</tr>
</tbody>
</table>

Table 2 shows the critical values: \( \min T_{1}^{j} \) and \( \max T_{2}^{j} \). They are freely chosen according to the mean, standard deviation and median of each economic indicator. The transformation of the indicator variable into a dummy variable (1; 0), based on the criterion whether its value is above or below the threshold.
Figure 2 shows the development of the EMP index and the possibility of the currency crisis in Lithuania. A higher index indicates, therefore, higher pressure on foreign exchange markets. As we can see, this index was highest in December 1999. G. Kaminsky, S. Lizondo, C. Reinhart (1998) argue, that if the index exceeds a certain bound, the event have a big possibility of a currency crisis.

\[
\text{Currency crisis} = 1, \text{ if } EMP_t > 3\sigma_{EMP} + \mu_{EMP} \quad (8)
\]

where \( \mu_{EMP} \) - mean; \( \sigma_{EMP} \) – standard deviation

Lithuanian case: \( \mu_{EMP} = 0.23796, \sigma_{EMP} = 0.110209 \).

\[
R=0.23796+3*0.110209=0.56859 \approx 0.569
\]

During the period (January, 1997 – December, 2001) only in December, 1999 EMP index is equal to 0.667 and was beyond the critical value (0.667 > 0.569). As a result, measuring the index of exchange market pressure indicated, that only situation in December 1999 can be described as a pre-crisis when the general economic situation was negatively affected by the Russian crisis. All economic indicators showed bad situation in the country: public foreign debt increased up to 10043.41 mln. Lt.; commercial banks increased their interest rates; official foreign reserves in December 1999 decreased to 4,968.40 mln. Lt, M2 and foreign exchange reserves ratio increased up to 1.832, current account deficit increased more. All six economic indicators showed only negative signs. Therefore the results show that an early warning system should be thought of as a useful diagnostic tool. Our findings suggest that six economic indicators - foreign exchange reserves, current account balance, interest rates, real effective exchange rate, public foreign debt, M2 and foreign exchange reserves ratio – are appropriate for currency crisis prediction in Lithuania.

Crisis will continue to occur again in the future, perhaps even at an increasing rate following the globalization of capital markets. While some crises may occur when countries have immaculate fundamentals, the risk of crises increases sharply as market fundamentals deteriorate. Thus, for policy makers to be able to adopt pre-emptive actions, they need to identify weaknesses and imbalances early enough before crises erupt. In this regard, the development of an early warning system of vulnerability proves to be useful.

Conclusions

- There is no exact quantitative definition of the currency crisis, but it generally involves a sudden and rapid fall in the value of one or more currencies.
- Currency crisis literature describes three generations of models explaining the causes of currency crises: first generation models view speculative attacks as being caused by economic fundamentals which are inconsistent with a given parity; second generation models claim self-fulfilling speculation are the main source of a currency crisis; third generation models consider
international illiquidity as necessary and sufficient condition for balance of payments crisis and/or banking sector collapse.

- A currency crisis can be forestalled if it is detected in its early stage and appropriate measures are undertaken. Early detection of crisis is vital and in this respect early warning indicators that are being developed more and more can be of great help.
- According to the early warning system of currency crises, we tried to evaluate an exchange market condition in Lithuania in the period from January 1997 to December 2001. As a result, measuring the index of exchange market pressure indicated, that only situation in December 1999 in Lithuania can be described as a pre-crisis when the general economic situation was negatively affected by the Russian currency crisis. The results suggest that an early warning system should be thought of as a useful diagnostic tool for the basic diagnosis of a currency crisis.

References