



WERE THE CURRENCY CRISES IN EASTERN EUROPE (1995-2008) PREDICTABLE? AN EMPIRICAL APPROACH

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Abstract

This paper is based on finding the characteristics that could have made crises in Central and Eastern Europe occurred in the past forecastable based on lagged time series analysed as a set of binary models estimated with the extreme value approach which is suitable for irregular non stationary data on rare events. This method has been used in order to predict the possibility of rare events such as earthquakes, floods or other unpredictable by trend disasters. I use this method for the very first time in macroeconomics and especially in currency crisis events. The sample consists of five countries of central and Eastern Europe (Belarus, Bulgaria, Moldova, Romania, and Ukraine respectively) for a thirteen year period (1995-2008). The results show that explanatory variables can work as a predictor in the case of Bulgaria, Belarus and Moldova but not in the cases of Romania and Ukraine.

Keywords: currency crisis, developing economies, structural reforms.

JEL classification: F41, P33

1. INTRODUCTION

Based on previous empirical works, nobody can be sure on making a forecast can be accurate and useful on studying and expecting economic variables. Especially when these forecasts are based on previous economic time series data sets. The Early Warning Models (EWS), developed earlier didn't give any positive signs, or even worst they have given false signals predicting an inexistent crisis. Kenneth Galbraith said that there are two kinds of forecasters: Those who that their forecast is wrong, and those who don't know that their forecast is wrong. Although, the arguments on forecasting practices, my work has to do with countries from the same sample developed by an earlier work on Central and Eastern European crises (Liargovas and Dapontas, 2008) and its ability and significance as an early warning system. My dataset consists of five countries of central and Eastern Europe (Belarus, Bulgaria, Moldova, Romania, and Ukraine) for a thirteen year period (1995-2008). There were 38 incidents, I cut the sample one month before the second incident in each country and I expect from a binary model of extreme value to forecast the forthcoming crisis. I have chosen the extreme value model because of the nature of the variable. Incidents of currency crises are very rare, and they meet the purposes of the model. Previous trend models excluded these periods from their analysis and their samples. For example if someone tries to analyse the trends on the labour market within 20th century, he should exclude

the two world wars periods, the great recession and the oil crisis. But for this kind of studies these are the periods of interest and their characteristics are analysed intensively. The paper is structured as following: The next section describes selected previous empirical research. The third part provides a discussion of the main macroeconomic problems and policy outcomes in the countries concerned. A description of the data and the variables used is provided in section 4. Section 5 presents the set of models and the results of the empirical model. Finally, in the last section I offer some concluding remarks.

2. EMPIRICAL RESEARCH

The empirical research started and inspired on the same time that pioneers (Salant and Henderson, 1978), had developed the first Theoretical model on currency crises. Almost simultaneously (Bilson, 1979) inspired of the idea of shadow rate¹ using a probit model, found that it really had a forecasting ability but it wasn't important. In their later work (Blanco and Garber, 1986) and (Cumby and Van Weinberger 1989) on the light of the theoretical models of first generation and the payment stop of Mexico in 1982 and Argentina in 1981, show that the domestic credit growth didn't have forecasting significance for the next period. In a more comprehensive work (Klein and Marion, 1994) the official settlements with abroad had shown forecasting significance but within a period of 24 months.

Based on second generation theoretical models and the central banks' ability to face the speculators and resist (Eichengreen, Rose and Wypolysz, 1995) and added to their probit model unsuccessful speculators attacks. Later (Frankel and Rose, 1996), using high inflation as an assumption for currency crises, but only 5 out of 117 incidents had a positive signal.

Models based on third generation variables didn't really succeed to make confident forecasts. Later, referring to practice (Krznar, 2004) had developed an EWS (Early Warning System) for Croatia using a set of 40 variables had succeed to forecast and warn the central bank of the country using a logit model and successfully forecasting the forthcoming speculative attack 6 months before its break. With an insignificant cost for the size of the attack Croatia overlapped this incident.

3. MACROECONOMIC POLICIES AND OUTCOMES IN TRANSITION ECONOMIES

I focus my attention on five transition economies two of South-East Europe (Bulgaria, and Romania) and three are former Soviet Union states (Belarus, Moldova and Ukraine). The countries under examination have made progress since 1989, but they didn't reach the results of the countries that accessed European Union in 2003. The macroeconomic environment at the early stages of transition was not favorable in any of these countries. High inflation, increased fiscal deficits, large accumulation of bad debts, lack of developed financial and fiscal institutions and low confidence in economic policy were some of the common characteristics of their macroeconomic environment. Market reforms were delayed. The inflow of FDI has in general been less than that directed to Central Europe (e.g. Poland) and it is quite volatile. The development of local capital market has been slow, decreasing the possibility of importing portfolio capital. Most important, the incomplete and highly regulated markets had as a result the volatility of prices and real exchange rates, which used to give wrong signals. Central banks were not independent of the fiscal authorities. Often they were

used to finance large budget deficits. Credit policies were highly accommodating and repeatedly subject to direct intervention by the government and the parliament.

One of the most prominent characteristic of the Belarusian economy is its close dependency on the Russian economy. The Russian crisis, which erupted in August 1998, was easily transmitted to Belarus around the same period. But the contagion effect in Belarus was not the only factor responsible for the financial crisis. Since the election of President Alexander Lukashenko in 1995, the Belarusian authorities implemented expansionist macroeconomic policies. They supported the priority sectors of the economy such as agriculture, construction, and export to Russia by vast direct financial resources, indirect form of tax and trade subsidies, and depreciation of the official exchange rate. Increasing domestic credit growth resulted in exchange rate instability or loss of reserves and accelerating underlying rate of inflation with tightening price control. Other effects of the expansionary macroeconomic policies were the deterioration of the balance of payments with a growth of debts for import of energy resources, the low efficiency of domestic investments and the financial deterioration of commercial banks. The energy crisis with its major trading partner Russia (October 2006) has also effected the national currency and fastened the process of a monetary union between the two countries.

Bulgaria represents a country with a sequence of episodes in the 1996-97 period. The crisis was complex, involving drops in output and a financial crash, including a banking crisis and a currency crisis. The indicators preceding the crises included unsustainable fiscal deficits, low savings and investment, accumulation of bad debts and accommodating monetary policy. The failure of monetary policy to prevent accelerating inflation till 1997 led to the adoption of a currency board in mid 1997, which legally constrained monetary policy and helped restore confidence. Two distinctive sources of scepticism triggered crisis. First, inability of the government to meet its obligations, especially its debt service, and second, public awareness of insolvency of the banking system. These two factors developed fears that the Bulgarian National Bank (BNB) will continue to be a source of money expansion and that the BNB will block foreign exchange deposits.

Moldova faced a severe financial crisis after August 1998. It implied the rapid depreciation of the domestic currency and dramatic changes in the structure of balance of payments. According to previous studies, fundamental macroeconomic imbalances, such as the rapid deterioration of the balance of payments after the outbreak of the Russian crisis in August 1998, increased budget deficits and rapid accumulation of external and internal debt, were the main cause of the financial crisis in Moldova. The fiscal problems of Moldova reflected the weakness of state structures, the political climate favourable for populism and rent-seeking, the slow pace of privatization and restructuring and delayed reform in the social sphere. Inefficiencies in the state-controlled energy sector also had profound negative implications for the economic situation before the crisis. While the real sector suffered severely, the banking sector survived the crisis relatively intact.

The increase in Central Bank direct credit was the main responsible for the deterioration of the Romanian economy since the late 1993. Over the past nine years the Romanian authorities have implemented a number of regulatory and institutional reforms which brought about a significant liberalization of the country's foreign exchange system. After a series of privatisations and reforms in the late 1990s and early 2000s, government intervention in the Romanian economy is somewhat lower than in other European economies. In 2005, the liberal-democrat Tăriceanu government replaced Romania's progressive tax system with a flat tax of 16% for both personal income and corporate profit.

Ukraine faced a financial crisis in August 1998. It implied a sharp devaluation of the hryvna and brought a new wave of inflation. The credibility of the exchange rate was destroyed and since Sept. 1998 the NBU stopped selling foreign exchange to the market, introduced a number of administrative measures to control the foreign exchange market and removed the exchange rate band. Budgetary policy was mainly responsible for the vulnerability of the economy to changes in portfolio investor's sentiments. Excessive government borrowing led to debt accumulation which resulted in a debt pyramid. When investors decided to leave the Ukrainian T-bill market, the NBU started to spend foreign exchange reserves to defend the exchange rate. The crisis in Russia merely accelerated some processes, but did not cause them. There was no banking crisis, because Ukrainian banks had not been involved in foreign borrowing and off-balance sheet transactions on derivatives. Then there was no political crisis. Therefore most of the stylized facts point to the weak fundamentals and macroeconomic policies (first generation models).

4. THE DATA SET AND THE MAIN VARIABLES USED

The variables used in the analysis are chosen in light of theoretical considerations and empirical determinants of crises. I apply a set of variables that have been proved useful by a large number of empirical studies as well as the circumstances specific to the transition economies. In order to enhance the possibility of identifying the crisis factors, the process of evaluating the model applies ten variables, grouped into five groups: variables related to monetary policy, to real sector, to the external sector, to contagion and specific institutional variables related to transition economies. The data source is the International Financial Statistics the United Nations and the Heritage foundation. Data frequency is monthly with the exception of Economic Freedom index which is annual. The variables cover all three known and applied generations along with their modified ones and the introducing fourth generation. There is a major debate on the existence and presence of a possible fourth generation. In an early approach (Chionis and Liargovas, 2002) suggested the introduction of a possible fourth generation based on political risk and black market premiums. A latter work (Breuer 2004) argues that poor institutional variables are an underlying cause for unsustainable policies. In their two years later work (Simpalee and Breuer, 2006), they term institutional factors as "social capital" or "social infrastructure". Weak institutional fundamentals are still present. Their analysis is based on second generation modified models (Li and Inlan, 2001, Johnson et. al. 2000) using variables such as central bank independence, financial liberation, coordinated wage and corruption. The conflict and overlap between generations is obvious and in a determinants of currency crises analysis (Cuaresma and Slacik, 2007). In later works following the global credit crunch (Dapontas 2008) suggested a set of variables such as home price index (HPI) as long as economic freedom. In a PhD thesis Dapontas (2010) suggested a double dimension on fourth generation crises analysis using the social variables and economic freedom and UN HDI variables in contrast to the second real economy dimension explaining crisis through contagion and banking crises existence. Finally they are past works that seem to reject the existence of possible fourth generation arguing that the past three generations can explain possible crises (Castillo, 2006). The variables included in my model and their economic justification of the choice of the variables to be applied to five transition economies is as following:

A. Variables related to monetary policy

1. *Real exchange rate (REER)*: The Real Effective Exchange Rate of the national currency given by IMF or by calculation of the real exchange rates of major trading partners, against national currency, weighted by their participation. REER is a measure of competitiveness. A decline of REER (overvaluation) has negative effect on competitiveness and vice versa. The choice of this variable was established by a previous work (Kaminsky, Lizondo and Reinhart, 1998). According to them, the real exchange rate is overvalued relative to its equilibrium level or its average level during tranquil times, in periods preceding the currency crash. Therefore, I establish a negative relation between this variable and the incidence of a crisis.
2. *International reserves (Reserves)*: Foreign exchange reserves expressed in USD. All the past theoretical or empirical models used this fundamental as the main (and before first generation models the only) measure of crisis likelihood. It is clear that the lower reserves are, the higher the probability of speculative attacks and currency crisis (negative effect). I should note, however, that the central bank can also keep other reserves beyond foreign exchange (gold, SDR etc.). Therefore, the variable is expected to have negative effect if the reserves are used as a measure of remedy or savings and positive if not.
3. *Money (Money)*: The money offer including quasi money. Previous studies have used the measure of money offer by central bank (M2) excluding other means of money. According to the first generation models, the months preceding the crisis should be characterized by highly expansionary monetary policy (positive effect). However the effect can be negative if the bank policy aims to preserve the money supply level and continuously finances the foreign exchange demand (Copeland, 2008). Also the use of broad money (M4+ quasi money) is broader than M2 used in the past empirical framework.
4. *Inflation (AP)*: The change of CPI over the last month. It is a proxy of macroeconomic mismanagement that is having an adverse effect on a country's economy. It is related positively with the occurrence of a crisis. The inflation rate played a central role in the examined economies and sometimes met definition of hyperinflation. (Cagan, 1956)
5. *Lending rate (LR)*: Official annual lending rate given by the national bank of the country. Interest rates can play a crucial role if there is a collapse in the confidence in the macroeconomic policy stance. In the case of an expansionary monetary policy for example, a collapse of the confidence of forward looking participants in the foreign exchange market pressures monetary authorities to steeply increase interest rates and devalue the official rate. Therefore, the variable is expected to have positive effect.

B. Variables related to the real sector

6. *Human Development Index (HDI)*: The UN Human Development Index indicator, which consists of three equally, weighted indicators: The life expectancy index, the education index and the GDP index. I introduce this indicator because I want to develop a new and more accurate measure of development (economic and social activity) in the countries concerned than the GDP growth rate. The UN index is broader and it represents an initial effort to capture social phenomena as well. I expect that HDI will be lower before the crisis. Therefore it is expected to have negative effect.

Variables related to the external sector

7. *Balance of Payments (BoP)*: The balance of payments expressed in USD. The conventional view is that this variable is expected to have positive effect if the balance is positive and negative if there is deficit. However, the theoretical discussion regarding the effect of current account deficit on the occurrence of currency crises is not so clear. According to (Edwards, 2001) deficits “may matter”. In a similar work (Sasin, 2001) provided an overview of the empirical studies which have tried to provide links between current account deficits and currency crises. Most of the studies reviewed do not provide strong and significant correlation between high current account deficit and currency crises.
8. *Gold price (GoldP)*: The price of fine troy ounce in London exchange market in USD. The variable has to do with the significance that gold has on global market. Even after the gold standard there are central banks keeping gold reserves which can be sold in the international markets for foreign exchange (usually USD). Thus, the gold price has an effect on currency crises and it is connected to the money reserves. The effect depends on central bank policy. If the bank tends to keep gold reserves the effect is positive, if not it is negative.

Variables related to contagion

9. *Crisis elsewhere (CE)*: It is a categorical binary variable which denotes the presence of a crisis in other country (1) or not (0). The so called crisis elsewhere or, in chaos theory, “butterfly effect”, has a significant role in an external currency crisis development. If a country has economic relations with a country hit by an incident it is possible to be infected. The main reasons have to do with the economic contagion between the two countries but also with the speculators’ behavior. If a major trading partner of a regional economy collapses then the other partners will collapse with a time lag of one or two months. In the ruble crisis of 1998 the ruble collapse was followed by a delayed collapse in other countries of the former Soviet Union. When a speculator decides to attack he will hit multiple markets in the same region on the same time as it happened in the Asian crisis of 1997.

Variables specific to transition economies (institutional)

10. *Economic Freed (EF)*: The Heritage rate of economic freedom, is a total score consisting of indicators on trade, fiscal burden, government intervention, monetary policy, foreign investment, banking, wages and prices, property rights, regulation and informal market. It represents the progress that countries might have achieved regarding the implementation of structural reforms. Market and institutional reforms (e.g. the establishment of a sound financial and banking system, the well functioning of fiscal institutions etc) offer great assistance to the countries in their effort to prevent a crisis. Unfortunately, almost all the countries in my sample (with the exemption of Albania) are characterized as laagers as far as the implementation of structural reforms is concerned. The effect of this variable is expected to be negative.

Based on an earlier work, (Esquivel and Larrin 1998), I try to combine variables which represent the main predictions of the first, the second and the third generation models. Variables 1-5 and 7 are closely associated with first-generation models. Variable 6 is associated with second generation models. Variables 8-9 and 10 are associated with the third genera-

tion models. Fourth generation models in this analysis are present with their both variations in 6, 9 and 10 respectively.

5. THE SET OF MODELS AND EMPIRICAL RESULTS

I use as dependent variable the volatility that has been occurred between two successive months on the official rate against national currency rate. The empirical literature provides little guidance as regards a generally accepted definition of “currency crisis”. The majority of the studies refer to devaluation as large, unique and infrequent or a set of small and repeated incidents. Others use the weighted average of monthly depreciation compared to depreciation of the previous year. A couple of Greek authors (Chionis and Liargovas, 2002) define as a “currency crash” the nominal depreciation of the monthly average exchange rate of national currency against USD of at least 10%, no matter if this comes as result of a speculative attack or not.

I choose for this study to use the binary extreme value model as given by the EviewsTM statistics package. The extreme value model is developed in order to explain irregular and non stationary situations such as earthquakes frequency, floods, crises and other turbulences. In fact when I use binary models it refers to incidents that 1 - the existences of the situation - is less than half per cent of the population. Especially, crises are unique facts and should be handled so.

The two situations are:

$$\Pr(y_i = 1 | x_i, \beta) = 1 - F(-x_i' \beta)$$

$$\Pr(y_i = 0 | x_i, \beta) = F(-x_i' \beta)$$

The possibility of crisis is given by:

$$\begin{aligned} E(y_i | x_i, \beta) &= 1 \cdot \Pr(y_i = 1 | x_i, \beta) + 0 \cdot \Pr(y_i = 0 | x_i, \beta) \\ &= \Pr(y_i = 1 | x_i, \beta). \end{aligned}$$

This can be written as a regression process:

$$y_i = (1 - F(-x_i' \beta)) + \epsilon_i$$

Where extreme value estimator can make:

$$\begin{aligned} \Pr(y_i = 1 | x_i, \beta) &= 1 - (1 - \exp(-e^{-x_i' \beta})) \\ &= \exp(-e^{-x_i' \beta}) \end{aligned}$$

I'm estimating a model with dependent binary variable the existence of crisis (1) or not in a month period, and a set of one month lagged independent variables. I selected one month lag through a preliminary on AIC and SBC criterion data analysis. The dataset consists of five countries as described with monthly frequency, in the 1995-2008 period. I choose to cut the sample two months before the crisis incident and the model should forecast the next month's crisis and its following end. Possibility over 50% is a positive sign of existence of crisis. I have chosen the variables that seem to be important for each country under the Z-statistic confidence interval along with the framework developed by the study that analyzed the same countries in the same period as referred (Liargovas and Dapontas, 2008). I have chosen the latest incidents in order to achieve the best possible results.

In the case of Belarus Important independent variables were the balance of payments, the economic freedom, the real effective exchange rate, the international reserves, the crisis elsewhere, the gold price and the money supply. The estimation period ends on May of 2000 and the forecast start on June and ends in September. The results are shown on table 1.

Table no. 1 Results for Belarus on 5% significance

Variable	Coefficient	Std. Error
C	-296.4693	402.258
BALANCE	0.046011	0.042512
CRISIS E	3.474364	2.263988
ECO_FREE	54.44265	47.84521
EFF_RATE	-3.281522	4.910165
FOR_EX	0.058277	0.054482
GOLD_PRI	0.154696	0.141635
HDI	-219.5710	162.1165
LENDING	0.150547	0.146177
MONEY	-0.000294	0.003125
PRICE_LE	0.380920	0.208793
R ²	0.74	0.024851

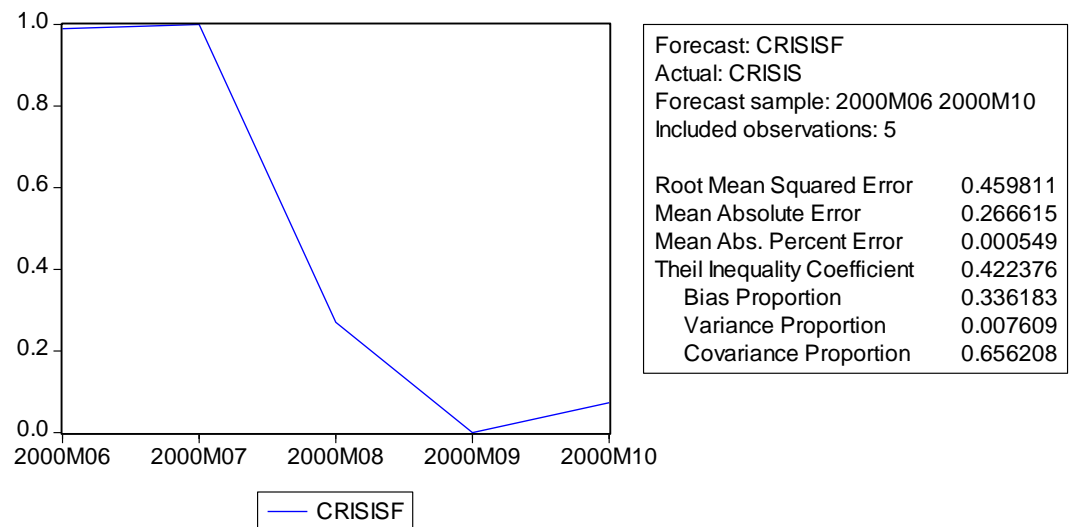


Figure no. 1 Belarus forecast

As we can see on Figure 1, the model forecasted the start of the crisis; the duration of the crisis was one month less than the model forecasted. It also succeeded on forecast of the crisis end in August (0.2) and September (0.0).

In the case of Bulgaria important were the following independent variables: Balance of payments, economic freedom, real effective rate and international reserves. The explanation period ends in April of 1997.

Table no. 2 The results of Bulgaria on 5% significance

Variable	Coefficient	Std. Error
C	-476.1425	402.3129
BALANCE	-0.023274	0.052180
CRISIS E	20.59160	3.94174
ECO_FREE	148.3093	122.3185
EFF_RATE	-0.436615	0.325771
FOR_EX	-0.002798	0.012143
GOLD_PRI	-0.192678	0.300226
HDI	0.909011	0.333491
LENDING	-0.022478	0.019211
MONEY	-0.002971	0.002739
R²	0.86	0.058767

We notice that none of the independent variables was statistical important I made a forecast for the May - July period.

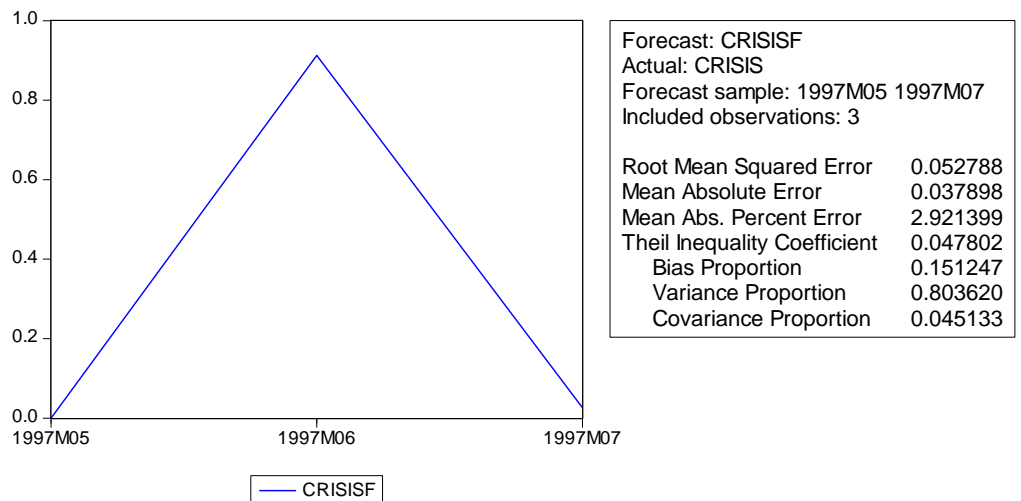


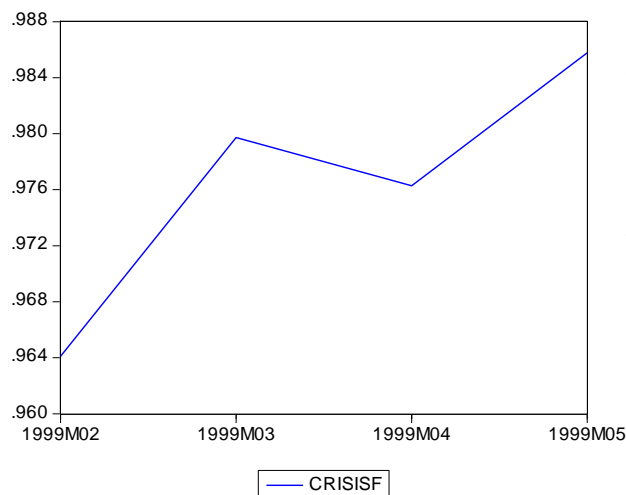
Figure no. 2 The forecast for Bulgaria

We can see that the possibility for crisis in June was 95 percent and the model successfully forecasted the crisis end in July.

In the case of Moldova the incidents of crises were very close the period of estimation ends on January of 1999, (crisis held on March - May 1999) The model seem to rate as important balance of payments, real effective rate, gold price and price level as independent variables.

Table no. 3 The results of Moldova on 5% significance

Variable	Coefficient	Std. Error
C	50.67641	105.697
BALANCE	-0.137462	0.36546
CRISIS E	-0.341837	1.166097
ECO_FREE	-2.160101	0.28158
EFF_RATE	-0.245084	0.58815
FOR_EX	-0.047062	0.10471
GOLD_PRI	-0.059554	0.09871
HDI	-101.4547	82.37474
LENDING	0.179887	0.097217
MONEY	-0.019444	0.011104
PRICE_LE	-0.398961	1.21756
R²	0.242226	0.06345



Forecast: CRISISF
 Actual: CRISIS
 Forecast sample: 1999M02 1999M05
 Included observations: 4

Root Mean Squared Error 0.686159
 Mean Absolute Error 0.493725
 Mean Abs. Percent Error 0.862565
 Theil Inequality Coefficient 0.407552
 Bias Proportion 0.482201
 Variance Proportion 0.514337
 Covariance Proportion 0.003462

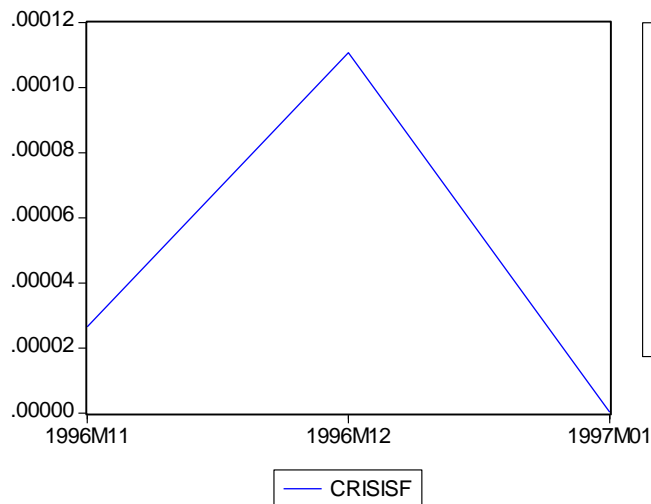
Figure no. 3 The forecast for Moldova

The model managed to forecast effectively and on time the March - May crisis, and an increased possibility the month before.

In the case of Romania, I have the estimation period until November of 1996 and the crisis period (January - February 1997) significant were balance of payments, the real effective rate and the international reserves.

Table no. 4 The results of Romania in 5% significance

Variable	Coefficient	Std. Error
C	0.447828	8.649200
BALANCE	-0.004391	0.009010
CRISIS_E	1.205676	1.166265
ECO_FREE	-0.758328	0.590880
EFF_RATE	0.059132	0.153567
FOR_EX	-0.004577	0.005303
HDI	-124.1230	214.7409
GOLD_PRI	-0.054283	0.038887
LENDING	-0.050417	0.222097
MONEY	0.369199	0.437045
PRICE_LE	0.028197	0.105631
R²	0.258692	0.001241



Forecast: CRISISF	
Actual: CRISIS	
Forecast sample: 1996M11 1997M01	
Included observations: 3	
Root Mean Squared Error	0.577350
Mean Absolute Error	0.333379
Mean Abs. Percent Error	33.33332
Theil Inequality Coefficient	0.999886
Bias Proportion	0.333242
Variance Proportion	0.666534
Covariance Proportion	0.000224

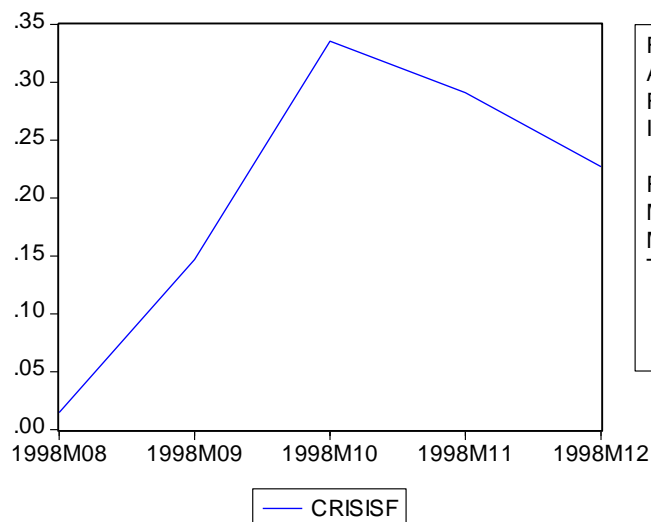
Figure no. 4 The forecast for Romania

We can note that the model didn't forecast at all the forthcoming crisis.

Finally, I modelled the case of Ukraine. The country one month after the Russian crisis had crisis by contagion in September 1998. I end the estimation period on July 1998. Important variables are balance of payments, crisis elsewhere, the real effective rate and gold price.

Table no. 5 The results of Ukraine on 5% significance

Variable	Coefficient	Std. Error
C	2.042998	15.25428
BALANCE	-0.000254	0.002174
CRISIS_E	0.973752	1.199716
ECO_FREE	-0.132122	0.008332
EFF_RATE	-0.041181	0.039413
FOR_EX	-0.001129	0.001003
GOLD_PRI	0.003366	0.032672
HDI	-25.72032	59.60576
LENDING	-0.017441	0.017557
MONEY	-8.60E-05	7.63E-05
PRICE_LE	0.123145	0.130356
R²	0.345655	0.021423



Forecast: CRISISF	
Actual: CRISIS	
Forecast sample: 1998M08 1998M12	
Included observations: 5	
Root Mean Squared Error	0.511055
Mean Absolute Error	0.410121
Mean Abs. Percent Error	30.35273
Theil Inequality Coefficient	0.590748
Bias Proportion	0.148492
Variance Proportion	0.542393
Covariance Proportion	0.309115

Figure no. 5 The forecast for Ukraine

I noticed that the raised possibility of September cannot be taken as a positive sign of crisis.

6. CONCLUSIONS

The analysis of these extreme situations cannot fulfil my expectations for a long term forecast model or an early warning system. The countries with more incidents tend to have better results than the others and countries without history in crises are not suitable for forecasting analysis. I choose models based on the forecast ability rather than explaining the crises eliminating possible false signals by giving possibility percentage results and not only a crisis or not prediction. In the most cases the variables which can explain the causes of a crisis where insignificant and their sign positive or negative is generally unimportant. But also the general rule shows that these forecasts and signs liability was low. In the three cases though the results cannot be rated as random. The known and expected variables seem to work but their long term forecasting ability is still questionable as every early prediction. The time of spread on every incident has been decreased dramatically in our days and the lag on variables should be the minimum accepted. Long term forecast and real signal system is needed. Every country has the ability to create its own EWS, which it could help in speculative attacks. As a pessimist could say, no one can be sure if the model works if it doesn't succeed. Every forecast has its odds and I believe that this set of models based on extreme value analysis can be a base for a reliable prediction. Maybe in the future another more accurate model can be developed by us or the future researchers. The conversation for the forecast model developing can be profitable and creative, and it could become a lesson for forecasting economic phenomena newly formed and examined.

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Note

- ¹ Shadow rate: The rate that speculators are willing to sell national currency for international one