THE ANALYSIS OF THE FINANCIAL CRISIS INDICATORS IN ROMANIA USING *ARCH* MODELS

CORNELIA TOMESCU DUMITRESCU[1], ANIELA BĂLĂCESCU[1], CRISTIAN TOMESCU DUMITRESCU[2]
[1]UNIVERSITY "CONSTANTIN BRÂNCUȘI" FROM TG-JIU, ROMANIA, FACULTY OF ECONOMICS
[2]D.G.F.P. FROM GORJ, ROMANIA

Abstract:
The vast majority of the models define the financial crises as situations in which unexpected speculative attacks determine the sudden devaluation of the national currency in a fix course regime (peg) or the abrupt depreciation registered by this one in a floating course regime.
The methods, that only try to anticipate the successful attacks upon the currency, define the crisis as being indicated by a big enough nominal or real variation of the exchange rate in a short period of time. For example, Frankel and Rose (1996) catalogued as crisis the situation in which the nominal depreciation of the national currency exceeds 25 per cent in only a year, being situated, at the same time, with at least 10 percentual points above the precedent year's level. The deficiency of this approach consists in the fact that it doesn't consider the rate of inflation when it comes to defining the financial crisis.

Key words: ARCH models, financial crisis, exchange rate, interest rate.

JEL classification: C5

Kaminsky, Lizodo and Reinhart (1998) broaden the definition of the crisis in the sense that the authors consider the financial crisis and the situations in which the speculative attack doesn't succeed, but the costs necessary to avoid the devaluation and, respectively, the depreciation of the national currency are high (the increase of the interest rate, the loss of the financial reserves). Under these conditions, the crisis can be highlighted from the aggregation of the information referring to the macroeconomic variables regarding the exchange rate, the financial reserves, the rate of inflation and the interest rate. Thus, Eichengreen, Rose and Wyplosz (1994), Kaminsky, Lizodo and Reinhart (1998) and Herrera and Garcia (1999) build up composite crisis indices and define the crisis as that certain period in which the speculative pressures' index reaches extreme values (exceeds the apron value). The deficiency of these indices resides in the fact that they identify the ex-post period of crisis, the extreme values being highlighted by comparing them to the values registered in the analyzed period of time. At the same time, these crisis indices can have conflicting results depending on the period of time analyzed.

Eichengreen, Rose and Wyplosz (1994) define the speculative pressure index (SPI_{ERW}) as the ponderous mean of the variations registered by the exchange rate, the interest rate and the financial reserves (reported to the monetary base). The hefts are established such as the conditioned variances of the components are equal.

$$SPI_{ERW} = \Delta\%\overset{\alpha}{CS} + \Delta\%\overset{\alpha}{RD} - \Delta\%\frac{\overset{\alpha}{res}}{BM}$$

where:
$\Delta\%CS$ - the variation of the exchange rate;
$\Delta\%RD$ - the variation of the interest rate;

$\Delta\% \dfrac{res}{BM}$ - the variation of the financial reserves calculated as percent of the monetary base.

The apron, calculated based on the historical data, is $\mu + 2\sigma$, where μ is the mean of the interval and σ is the mean squared error.

Keeping the conceptual cadre developed by Eichengreen, Rose and Wyplosz in 1994, **Kaminsky, Lizodo and Reinhart (1998)** constructed a similar index. The difference consists in the fact that the formula SPI_{KLR} excludes the interest rate and the fiduciary value, depending on which the crises are identified, is $\mu + 3\sigma$.

$$SPI_{KLR} = \Delta\%\overset{\alpha}{CS} - \Delta\%\dfrac{\overset{\alpha}{res}}{BM}$$

The method of aggregation of the different early warning indicators of **Herera and Garcia (1999)** distinguishes itself from the two anterior approaches. The premise taken as a starting point, when it comes to calculating SPI_{HG}, consists in the fact that the signal of the crisis must be generated when a set of indicators from the SPI_{HG}'s composition evolve, in a certain period, in the same direction (condition ensured through the standardization of the series). Thus, the SPI_{HG} methodology differs from the one used in the cases of SPI_{ERW} and SPI_{KLR}, whose modality of calculation makes the crisis signal to be present even if a significant deterioration intercedes only in the case of one of the indicators, on whose basis the indices are determined.

$$SPI_{HG} = \Delta\%CS + \Delta\%RD - \Delta\%RI$$

where:
$\Delta\%CS$ - the variation of the exchange rate;
$\Delta\%RD$ - the variation of the interest rate;

$\Delta\%\dfrac{res}{BM}$ - the variation of the financial reserves.

In order to calculate the SPI_{ERW} for Romania, the conditioned variances, necessary when it comes to establishing the individual hefts, were calculated through an exchange rate model, *EGARCH(1,1)* and based on some *GARCH(1,1)* interest rate and financial reserves models for the period January 2001 – March 2007. The *ARCH* models, used in order to estimate the conditioned variance, are:

For the rate of exchange *EUR/RON*

Dependent Variable: D_EXRATE
Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)
Sample (adjusted): 2001M02 2007M04
Included observations: 99 after adjustments
Convergence achieved after 20 iterations
Variance backcast: ON
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) +
      C(5)*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.006275	0.001610	3.897866	0.0001
D_EXRATE(-1)	0.454454	0.061353	7.407207	0.0000
Variance Equation				
C(3) -0.598666	0.164906	-3.630359	0.0003
C(4) -0.418436	0.118587	-3.528508	0.0004
C(5) 0.301386	0.111936	2.692500	0.0071
C(6) 0.888282	0.023449	37.88184	0.0000
GED PARAMETER	1.422305	0.335999	4.233058	0.0000
R-squared	0.362595	Mean dependent var		0.019069
Adjusted R-squared	0.321025	S.D. dependent var		0.041058
S.E. of regression	0.033832	Akaike info criterion		-4.573963
Sum squared resid	0.105303	Schwarz criterion		-4.390470
Log likelihood	233.4112	F-statistic		8.722530
Durbin-Watson stat	1.986612	Prob(F-statistic		0.000000

For financial reserves /*M0*

Dependent Variable: D_REZM0
Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 2001M01 2007M03
Included observations: 99 after adjustments
Convergence achieved after 22 iterations
Variance backcast: ON
$GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)$

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.020369	0.006889	2.957001	0.0031
Variance Equation				
C	0.000394	0.000296	1.331048	0.1832
RESID(-1)^2	0.214318	0.073825	2.903050	0.0037
GARCH(-1)	0.711094	0.052593	13.52063	0.0000
R-squared	-0.007324	Mean dependent var		0.031173
Adjusted R-squared	-0.039134	S.D. dependent var		0.126881
S.E. of regression	0.129340	Akaike info criterion		-1.949025
Sum squared resid	1.589230	Schwarz criterion		-1.844172
Log likelihood	100.4768	F-statistic		1.514661
Durbin-Watson stat		Prob(F-statistic		

For interest rate (*BOBOR 3M*)

Dependent Variable: D_INTRATE
Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 2001M02 2007M04
Included observations: 99 after adjustments
Convergence achieved after 23 iterations
Variance backcast: ON
$GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)$

	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.009765	0.005625	-1.735912	0.0826
D_INTRATE(-1)	0.610444	0.085233	7.162102	0.0000
Variance Equation				
C	0.000137	5.11E-05	2.679272	0.0074
RESID(-1)^2	0.182821	0.074530	2.452992	0.0142
GARCH(-1)	0.738023	0.048816	15.11851	0.0000
R-squared	0.214171	Mean dependent var		-0.004462
Adjusted R-squared	0.180731	S.D. dependent var		0.178309
S.E. of regression	0.161393	Akaike info criterion		-2.333370
Sum squared resid	2.448493	Schwarz criterion		-2.202303
Log likelihood	120.5018	F-statistic		6.404714
Durbin-Watson stat	1.698369	Prob(F-statistic		0.000133

The series of the index was standardized such as to have the mean 0 and the mean squared error 1. Under these conditions, the apron value is 2.

At the same time, the series of the SPI_{KLR} index was standardized too, and, consequently, its apron value is 3.

In order to calculate the SPI_{HG} for Romania, the variables are expressed in monthly modifications and are standardized as to have the mean 0 and the mean squared error 1. The period in which $SPI > \mu + 1,5\sigma$ (where μ is the mean and σ is the standard deviation of the SPI_{HG}) is considered crisis. The values of the index are standardized as well and, under these conditions, the apron value is 1,5.

According to the results obtained, the three crisis indices altogether signaled a period of economical vulnerability. The main factors that determined it are the liberalization of the currency market, in the first trimester of 2001, which leaded to a sudden depreciation of the high exchange rate and the interest rate, determined by the sudden increase of the rate of inflation in the context of the liberalization of the prices.

The HG index signals in addition, another period of vulnerability, during 2002 and the first half of 2003. This episode was, mainly, due to the existence of the entrance in payment incapacity risk of Romania, that leaded to an accentuated depreciation of the exchange rate due to the necessary currency purchases for the payment of the outstanding external debt (in the absence of other financing sources) and to the increase of the interest rates (due to the increase of the risk bounty).

REFERENCES

[1]   Banerjee, Abhijit, 1992, „*A Simple Model of Herd Behavior*", Quaterly Journal of Economics, CVII, pp 797-817

[2]   Calvo, Guillermo A., 1998, „*Balance of Payments Crises in Emerging Markets. Large Capital Inflows and Sovereign Governments*", NBER Conference on Currency Crises

[3]   Calvo, Guillermo A., 1997, „*Rațional Herd Behavior and the Globalization of Securities Markets*", University of Maryland

[4]   Frankel, Jeffrey A. și Andrew K. Rose, 1996, „*Currency Crashes in Emerging Markets: Empirical Indicators*", NBER WP 5437

[5]   Gandolfo, Giancarlo, 2001, „*International Finance and Open-Economy Macroeconomics*", Springer

[6]   Krugman, Paul şi Marcus Miller, 1993, „*Why Have a Target Zone?”,* Carnegie-Rochester Conference Series on Public Policy, 38:279-314

[7]   Krugman, Paul şi J. Rotemberg, 1991, „*Speculative Attacs on Target Zones”*, în: P. Krugman   şi   M.   Miller,   editori, „*Echange Rate Targets and Currency Bands*”, Cambridge University Press, Bambridge, 117-132

[8]   Morris, Stephen şi Hyun Song Shin, 1995, „*Informational Events that Trgger Currency Attacks*”, Working Paper No. 95-24, Federal Reserve Bank of Philadelphia

[9]   Obstfeld, Maurice, 1986, „*Rational and Self-fulfilling Balance of Payments Crises*”, American Economic Review, 76:72-81

[10]   Obstfeld, Maurice, 1995, „*Models of Currency Crises with Self-Fulfilling Features*”, NBER Working Paper 5285

[11] Sarno, Lucio şi Mark Taylor., 2002, „*The Economics of Exchange Rates*”, Cambridge University Press

[12]   ***, 1998, „*World Economic Outlook*”, IMF