

1. FINANCIAL RISK METER FOR THE ROMANIAN STOCK MARKET

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Abstract

This article aims to estimate the systemic risk of the Romanian stock market, using the FRM (Financial Risk Meter) methodology. This research contribution is about applying a novel systemic risk index to the Romanian financial system (FRM@RO), to identify potential sources of systemic risk, and to understand network interconnections, thus increasing risk awareness of both managers and regulators. By using data for companies listed at the Bucharest Stock Exchange (BSE), our article highlights several aspects of the systemic risk of the Romanian stock market. First, our study reveals that the main driver of systemic risk, especially during financial crises, is the volatility index, VIX. However, local factors, such as ROBOR interest rate and sectorial indices for financial investment companies, in general, and energy sector companies, in particular, are extremely important in triggering systemic risk. Second, the system risk indicator for the Romanian stock market, FRM@RO, may capture both investor sentiment, measured via the Google Trends Search Volume Index, and stock market volatility. Third, FRM@RO can act as an early warning indicator for economic turmoil, being able to predict periods of technical recession one quarter in advance. Fourth, by using network analysis, we can identify, daily, the level of market interconnectedness and highlight the main companies triggering tail co-movements. Fifth, we emphasize the need for an integrated early warning system for financial crises.

Keywords: systemic risk; spillover effect; Romania; FRM@RO; financial risk meter

JEL Classification Codes: E44, C11, C32

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Appendix A

Table A1. Bucharest Stock Exchange companies used in the study

Nr.	Refinitiv ticker	BSE symbol	Company	Industry
1	ALR.BX	ALR	ALRO S.A.	Industry
2	ATB.BX	ATB	ANTIBIOTICE S.A.	Pharma
3	ROAQ.BX	AQ	AQUILA PART PROD COM	Trade
4	ROTLV.BX	TLV	BANCA TRANSILVANIA S.A.	Banking
5	ROBIO.BX	BIO	BIOFARM S.A.	Pharma
6	ROBRD.BX	BRD	BRD - GROUPE SOCIETE GENERALE S.A.	Banking
7	ROBVB.BX	BVB	BURSA DE VALORI BUCURESTI SA	Securities
8	ROTEL.BX	TEL	C.N.T.E.E. TRANSELECTRICA	Energy
9	COTE.BX	COTE	CONPET SA	Energy
10	IMP.BX	IMP	IMPACT DEVELOPER & CONTRACTOR S.A.	Real Estate
11	ROM.BX	M	MEDLIFE S.A.	Medical
12	ROSNP.BX	SNP	OMV PETROM S.A.	Energy
13	ROONE.BX	ONE	ONE UNITED PROPERTIES	Real Estate
14	PBK.BX	PBK	PATRIA BANK S.A.	Banking
15	ROSNB.BX	EL	SOCIETATEA ENERGETICA ELECTRICA S.A.	Energy
16	SNG.BX	SNG	S.N.G.N. ROMGAZ S.A.	Energy
17	TGN.BX	TGN	S.N.T.G.N. TRANSGAZ S.A.	Energy
18	ROEL.BX	SNN	S.N. NUCLEARELECTRICA S.A.	Energy
19	ROSGF.BX	SFG	SPHERA FRANCHISE GROUP	Food
20	ROBRK.BX	BRK	SSIF BRK FINANCIAL GROUP SA	Securities
21	TTS.BX	TTS	TTS (TRANSPORT TRADE SERVICES)	Transport
22	SIF2.BX	EVER	EVERGENT INVESTMENTS S.A.	Securities
23	FP.BX	FP	FONDUL PROPRIETATEA	Securities
24	SIF1.BX	SIF1	SIF BANAT CRISANA S.A.	Securities
25	SIF4.BX	SIF4	SIF MUNTENIA S.A.	Securities
26	SIF5.BX	SIF5	SIF OLTENIA S.A.	Securities
27	SIF3.BX	SIF3	SIF TRANSILVANIA S.A.	Securities
28	AAG.BX	AAG	AAGES S.A.	Industry
29	ROALT.BX	ALT	ALTUR S.A.	Industry
30	ALU.BX	ALU	ALUMIL ROM INDUSTRY S.A.	Industry
31	ROARTE.BX	ARTE	ARTEGO SA	Industry
32	BNET.BX	BNET	BITTNET SYSTEMS SA BUCURESTI	Education
33	CBC.BX	CBC	CARBOCHIM S.A.	Industry

Appendix. Financial Risk Meter For The Romanian Stock Market

Nr.	Refinitiv ticker	BSE symbol	Company	Industry
34	CEON.BX	CEON	CEMACON SA	Industry
35	ROCMP.BX	CMP	COMPA S. A.	Industry
36	COMI.BX	COMI	CONDMAG S.A.	Industry
37	DAFR.BX	DAFR	DAFORA SA	Industry
38	ELGS.BX	ELGS	ELECTROARGES SA	Industry
39	RMAH.BX	RMAH	FARMACEUTICA REMEDIA SA	Pharma
40	IARV.BX	IARV	IAR SA BRASOV	Industry
41	MECE.BX	MECE	MECANICA FINA SA	Industry
42	OIL.BX	OIL	OIL TERMINAL S.A.	Energy
43	PREB.BX	PREB	PREBET SA AIUD	Industry
44	ROPPL.BX	PPL	PROMATERIS S.A.	Industry
45	MCAB.BX	MCAB	ROMCAB SA	Industry
46	ROCE.BX	ROCE	ROMCARBON SA	Industry
47	RORRC.BX	RRC	ROMPETROL RAFINARE S.A.	Energy
48	ROPTR.BX	PTR	ROMPETROL WELL SERVICES S.A.	Energy
49	RPH.BX	RPH	ROPHARMA SA	Pharma
50	SNO.BX	SNO	SANTIERUL NAVAL ORSOVA S.A.	Industry
51	ROSTZ.BX	STZ	SINTEZA S.A.	Industry
52	TRP.BX	TRP	TERAPLAST SA	Industry
53	ROTBK.BX	TBK	TRANSILVANIA BROKER DE ASIGURARE	Insurance
54	ROTBM.BX	TBM	TURBOMECANICA S.A.	Industry
55	EFO.BX	EFO	TURISM, HOTELURI, RESTAURANTE MAREA NEAGRA S.A.	HORECA
56	VESY.BX	VESY	VES SA	Industry
57	VNC.BX	VNC	VRANCART SA	Industry
58	ROSCD.BX	SCD	ZENTIVA S.A.	Pharma
59	DIGI.BX	DIGI	DIGI COMMUNICATIONS N.V.	Communication
60	EBS.BX	EBS	ERSTE GROUP BANK AG	Banking
61	ROWINE.BX	WINE	PURCARI WINERIES PUBLIC COMPANY LIMITED	HORECA

Table A2. Macroeconomic factors

Nr.	Refinitiv Ticker	Description
1	.BETI	BUCHAREST EXCHANGE TRADING INDEX
2	.BETFI	BUCHAREST EXCHANGE TRADING – INVESTMENT FUNDS INDEX
3	.BETNG	BUCHAREST EXCHANGE TRADING ENERGY & RELATED UTILITIES INDEX
4	.CACT	CAC 40 EURONEXT PARIS
5	.GDAXI	GERMAN STOCK INDEX DAX 30
6	EURRON=	EUR/RON EXCHANGE RATE
7	EURIBOR3MD=	EURO AREA 3 MONTH EURIBOR
8	.STOXX50	EURO STOXX 50 INDEX
9	RON=	RON/USD EXCHANGE RATE
10	.ROTX	ROMANIAN TRADED INDEX
11	.SPX	S&P 500 INDEX
12	.SPBDUB3T	THE S&P U.S. TREASURY BILL INDEX
13	.VIX	VIX VOLATILITY INDEX
14	.RORON3MD=	ROBOR 3M

Appendix B

Figure B1. Adjacency matrix estimated at $\tau = 0.05$ on 9 March 2022

	EBS.BX	ROSNP.BX	ROTLV.BX	SNG.BX	ROBRD.BX	FP.BX	ROSNN.BX	DIGL.BX	ROONE.BX	ROEL.BX	ROM.BX	TGN.BX	RORRC.BX	TRP.BX	ROTEL.BX	ROSCD.BX	SIF1.BX	SIF2.BX	ALR.BX	IMP.BX	
EBS.BX							0.24		0.20	0.24					0.92		0.30	0.30	0.09	0.00	
ROSNP.BX				0.23		0.04				0.20	0.12	0.10					0.06				
ROTLV.BX	0.05				0.33								0.01	0.19		-0.09				0.04	
SNG.BX					0.06		0.58		0.02	0.14			0.14	-0.11			0.06			-0.04	
ROBRD.BX							0.28		0.09				-0.10	0.17		0.04			0.04	0.05	
FP.BX		0.06							0.12			0.17			0.09	0.40	0.01			0.01	
ROSNN.BX	0.05		0.16						0.05	0.01	0.13				0.20				0.07	-0.02	
DIGL.BX									0.14		0.25	0.24	0.02	0.06		0.05				-0.01	0.01
ROONE.BX						0.13		0.36		0.17	-0.06		-0.04	0.24							0.24
ROEL.BX			-0.07	0.45		0.00		0.00	0.00						0.00	0.10	0.04		0.06	0.27	
ROM.BX					0.31	0.02			0.14						0.32	0.06	-0.14				0.02
TGN.BX	0.18					0.10	0.14	0.14	0.01			-0.12			-0.04						
RORRC.BX	-0.21			0.24		0.75	-0.06	0.18									-0.60		0.46	-0.14	0.14
TRP.BX		0.42								0.78	-0.28	0.09			-0.15		0.11		0.01	0.25	
ROTEL.BX		0.04			0.18		-0.18	0.04		0.02	0.20	-0.03	0.03						0.10	0.17	
ROSCD.BX	-0.19					0.10		0.29					-0.03	0.00	0.15		0.08	-0.07	0.18	0.27	
SIF1.BX	0.01	0.25						0.02		-0.36						0.07			0.21	0.24	
SIF2.BX	0.22								0.42				0.05							0.07	
ALR.BX	0.38	0.18					-0.39	0.34	0.29				-0.20	0.36	-1.00	0.87					-0.56
IMP.BX	0.38	0.18		0.33			0.39	-0.11		0.11	-0.30			0.24		0.29			0.24		

Figure B2. Spillover effect on 9 March 2022, from IMP.BX to ALR.BX

IMP.BX	ALR.BX
0.00 EBS.BX	0.09 EBS.BX
0.04 ROTLV.BX	0.04 ROBRD.BX
-0.04 SNG.BX	0.01 FP.BX
0.05 ROBRD.BX	0.07 ROSNN.BX
-0.02 ROSNN.BX	-0.01 DIGL.BX
0.01 DIGL.BX	0.27 ROEL.BX
0.24 ROONE.BX	-0.14 RORRC.BX
0.02 ROM.BX	0.01 TRP.BX
0.14 RORRC.BX	0.10 ROTEL.BX
0.25 TRP.BX	0.18 ROSCD.BX
0.17 ROTEL.BX	0.21 SIF1.BX
0.27 ROSCD.BX	
0.24 SIF1.BX	
0.07 SIF2.BX	
-0.56 ALR.BX	



Figure B3. The smoothed (rolling seven-day mean) influence indicator for the top 5 macroeconomic risk variables

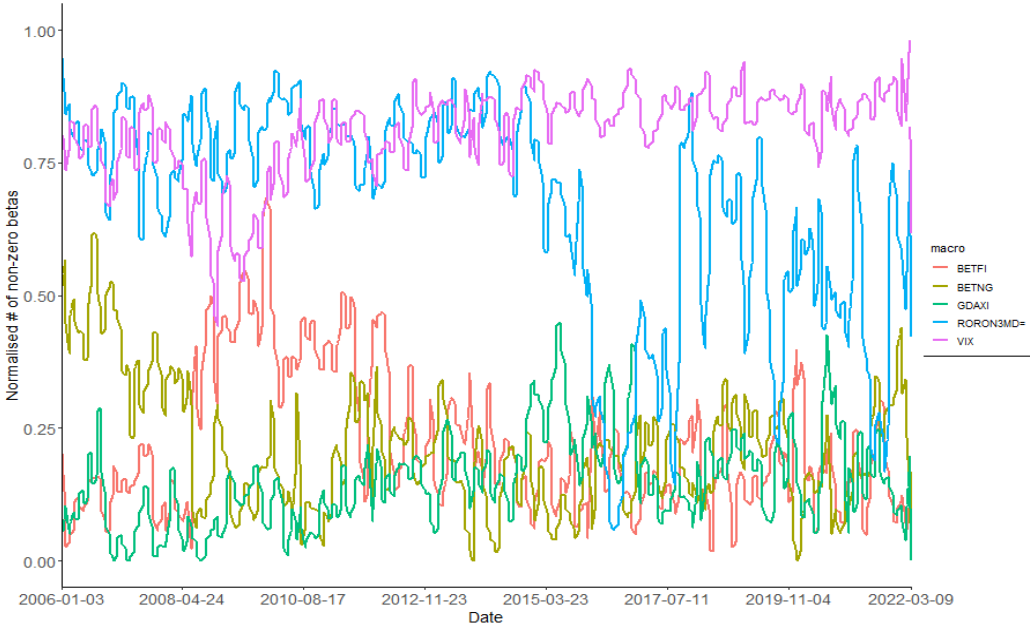




Figure B4: Network example on 2008/10/08 with BIOFARM S.A. (ROBIO.BX) as the central node and its in-degree and out-degree edges.

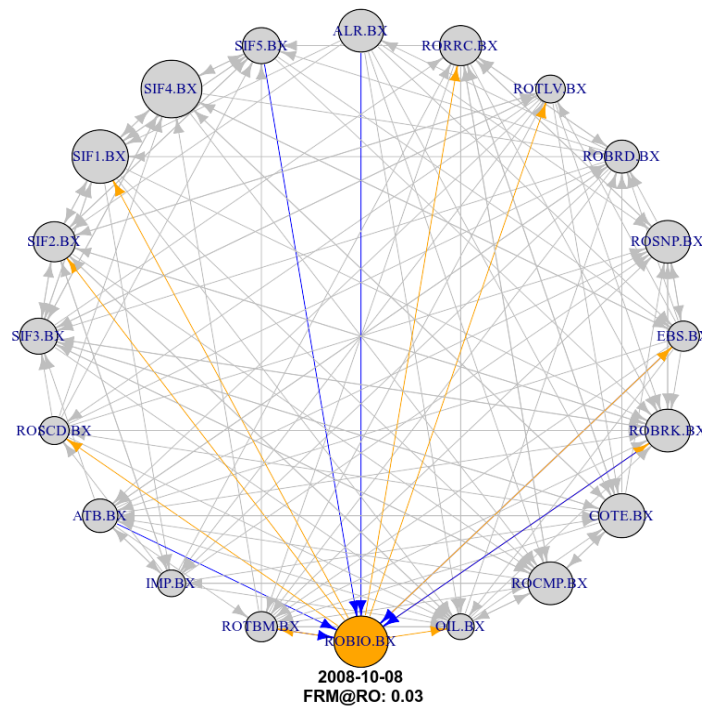


Figure B4 shows the network on October 8, 2008, when one of the most critical events of the financial crisis hit the Bucharest Stock Exchange: the main market index, BET, dropped by 10%, BETFI (the index of financial investment companies) dropped by almost 15%, and the trading session was suspended two hours after opening.

Figure B5. FRM@RO risk levels

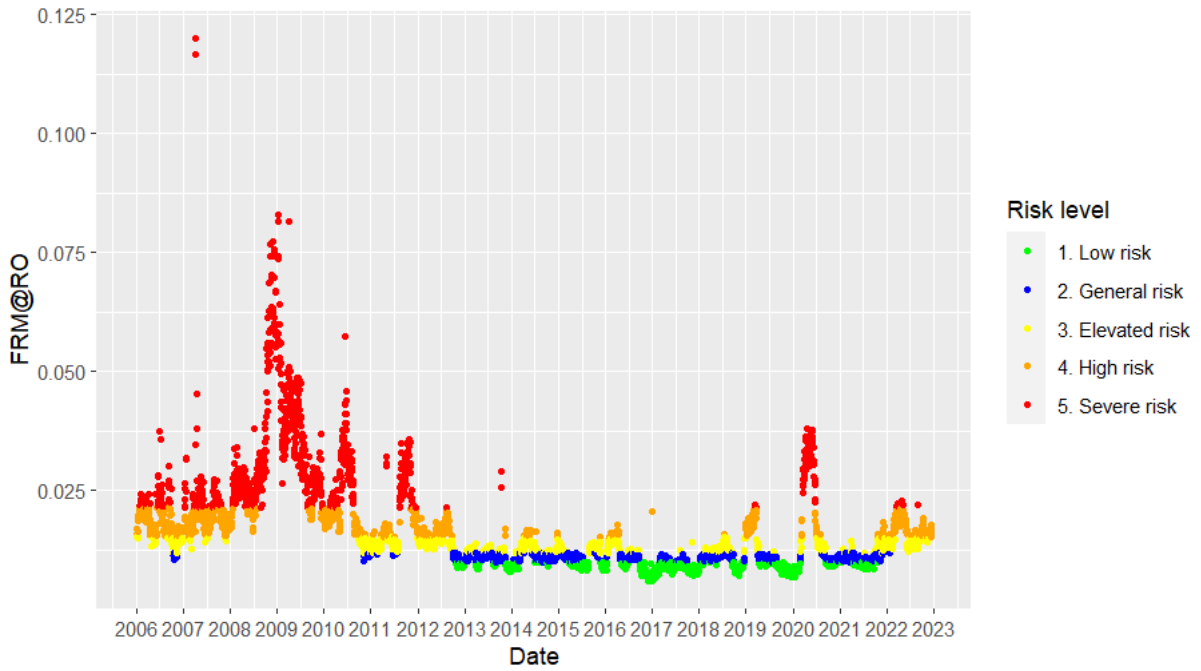


Figure B6. FRM@RO ($\tau=0.01$) and BET Index volatility

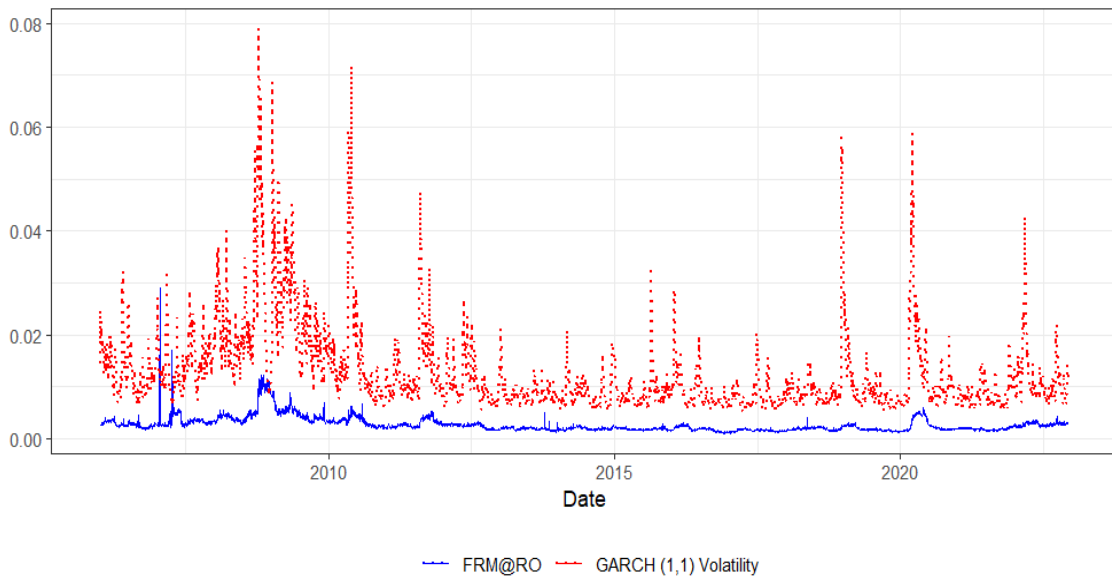




Figure B7. Normalized time series of $FRM@RO$ ($\tau=0.01$) and SVI

