SKEWNESS IN STOCK RETURNS: EVIDENCE FROM THE BUCHAREST STOCK EXCHANGE DURING 2000 – 2011

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Abstract
Our paper investigates the symmetry in stock returns of the 30 most liquid companies traded on Bucharest Stock Exchange during 2000 – 2011 and also the most representative 5 market indices. Our daily data shows that skewness estimates are slightly negative for most indices and individual stocks, but only a few present values significantly different from the characteristics of a normal distribution. We compare our results with skewness estimates for 21 major and emerging stock market indices around the world and find that such results are similar to other low capitalization and trading volume markets. For all the Romanian and international assets studied, the Studentized-Range (St-R) and Jarque-Bera (J-B) tests reject the hypothesis of normal distribution of daily returns.

Keywords: *Skewness, stock returns, asymmetric returns, frontier and emerging markets.*
JEL Classification: G01, G12, G14, G15

Introduction

This paper is dedicated to the study of the normality of distributions and especially the symmetry (or asymmetry) of the financial assets returns. Our focus is on the Romanian capital market and especially on the indices and individual stocks traded on the Bucharest Stock Exchange but for comparison reasons we also include in our analysis a good number of international developed and emerging stock market indices.

Maximization of utility is the principle behind investment choice. The conventionalmean-variance equilibrium method (a two-parametermodel) requires either that return distributions are normal (Gaussian) or quadraticutility functions. Although over time esearchers have proposed different statistical distributionsfor pricing financial assets, the pertinence of symmetry analysisexceeds the pure determination of the statistical distributions.

The well known Capital Asset Pricing Model(CAPM) assumes that investors are only interested about the mean andvariance of returns, and thus implying that upside and downside risks are viewedwith equal dislike.

Some other authors have found that CAPM-based valuationmeasures are not so appropriate when market timing strategies and their subsequentnon-normal returns are taken into account. Also, investors typically take into consideration the difference between upside and downside risk. As a result, the basic hypothesis of the CAPM are disputed, and its emblematic risk measure beta is equally doubted.

There are models that allow for some asymmetry of the returns (two or three-parametermodels) and require logarithmic or cubic utility functions.Alternatively, some financial models were created to allow skewness to affect the requiredreturn of financial assets. Kraus and Litzenberger (1976),(1983) constructed a three-moment capital asset pricing model that includesthe effect of skewness on valuation.

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If we take into consideration arguments that higher moments of returndistributions are not negligible, at least not in major international financialmarkets like USA, UK and Japan, it is not reasonable to assume thatinvestors will ignore them.

Consequently, the objective of ourinvestigation is to extend the previous work and to find whether such results are true for the Romanian capital market. In order to achive this, we will compute skewness according to its most widely used defition and will employ statistical tests for the significance of mean, skewness and for the normaly of the distributions of the sample daily log-returns.

A number of authors have proposed analysing portfolioson the basis of the first three moments of return distributions, rather thanthe traditional two moments (mean and variance introduced by Markowitz in 1952). The positive sign of the third derivative ofthe utility function ((Arrow, 1964), (Pratt, 1964)) gives tells us that investors' risk aversion decreases as wealth increasesand, therefore, has cubic utility functions.

Arrow (1971) suggests that the most desirable properties for an investor'sutility function are (a) positive marginal utility for wealth, (b) decreasingmarginal utility for wealth and (c) decreasing absolute risk aversion.The first two conditions are consistent with mean-variance preference.Arditti(1967) has argued that condition (c) implies preference for positive skewness.

Important work about the type of empirical returns wasperformed byFama and Roll (1968) and Fama (1971). Also, a theoretical refference on thirdmoments was developed by Jean (1971), by addressing the question of skewnesspreference in a portfolio context.

Recently, Kearney and Lynch (2007) used daily returns on 6 international stock market indices from 1978 to 2002 in order to search for skewness in the tails, in different intervals and in the entire distribution and found very limited evidence of statistically significant skewness.

Tudor (2008) explored the power of the skewness coefficient in explaining stock returns on the Romanian equity market employing weekly observations for 31 common stocks traded on Bucharest Stock Exchange during 2000-2006 and found positive results.

Lucey et all (2006) showed that the incorporation of skewness as an objective in portfolio selection causes the optimal portfolio to change significantly from one formed only under conditions of meanvarianceanalysis.

Peiro (1999) addressed the symmetry of daily returns in eight international stockmarkets and three spot exchange rates. He showed that for his data the tests of symmetry with the sample skewnessseem of little value, due to the non-normality of the returns, butunder alternative nonnormaldistributions, the symmetry of the returns cannot be rejected for most markets.

Again Peiro (2001) examined the symmetry of twenty-four individual stock returns at different frequencies: daily, weekly and monthly. He found that while some asymmetries are observed indaily returns, they disappear almost completely at lower frequencies.

Machado-Santos and Fernandes (2005) used binomial and distribution free tests and found significant evidence of negative skewness in the Portuguese market during 1997-2002 period.

Brunner et all (2009) experimentally tested skewness preferences at the individual level. And found that the skewness of a distribution has a significant impact on the investment decisions.

Data and methodology

In our study we used daily prices from 21 international indices, 5 indices of the Bucharest Stock Exchange and 30 individual stocks traded on the Bucharest Stock Exchange. For the international indices the source of data was Yahoo Finance (www.finance.yahoo.com), while the date for the Romanian stocks and indices were obtained directly from the Bucharest Stock Exchange, courtesy of the Data Dissemination Department.

Our objective was to investigate the symmetry of the distribution of the daily returns during 2000 – 2011. However, a few of the indices and individual stocks used in our study were traded for only a part of this period, or data was unavailable for the first part of the period that we investigated.

These exceptions are mentioned in the Table 1 presented below. We consider that this compromise is not significant and didn't influence our conclusions.

Table 1: The financial time series used

Series symbol	Description	Period of daily observations
_AEX	Amsterdam Stock Exchange Index (Netherlands)	2000 - 2011
_ATX	Wien Stock Exchange Index (Austria)	2000 - 2011
_BET	Bucharest Stock Exchange BET Index	2000 - 2011
_BET_C	Bucharest Stock Exchange BET-C Index	2000 - 2011
_BET_FI	Bucharest Stock Exchange BET-FI Index	2001 - 2011
_BET_XT	Bucharest Stock Exchange BET-XT Index	Jun 2008 - 2011
_BFX	Euronext BEL-20 index (Belgium)	2005 - 2011
_BSESN	BSE SENSEX Index (India)	2000 - 2011
_BVSP	IBOVESPA Index (Brasil)	2000 - 2011
_FCHI	CAC 40 Index (France)	2000 - 2011
_FTSE	FTSE 100 Index (UK)	2000 - 2011
_GDAXI	DAX 30 Index (Germany)	2000 - 2011
_GSPC	SP500 Index (USA)	2000 - 2011
_HSI	Hang Seng Index (Hong Kong)	2000 - 2011
_JKSE	Jakarta Composite Index (Indonesia)	2000 - 2011
_KLSE	FTSE Bursa Malaysia (Malaysia)	2000 - 2011
_KS11	KOSPI Composite Index (South Korea)	2000 - 2011
_MERV	MERVAL Buenos Aires (Argentina)	2000 - 2011
_N225	NIKKEI 225 (Japan)	2000 - 2011
_NZ50	NZX 50 Index (New Zeeland)	May 2004 - 2011
_OMXSPI	OMXS All Share Index (Sweden)	2000 - 2011
_OSEAX	Oslo Exchange All Share Index (Norway)	2001 - 2011
_ROTX	Bucharest Stock Exchange ROTX Index	Oct 2008 - 2011
_SSEC	Shanghai Composite Index (China)	2000 - 2011
_SSMI	SMI Index (Switzerland)	2000 - 2011
_TWII	TSEC Index (Taiwan)	2000 - 2011
ALT	Altur Slatina SA	2004 - 2011
ALU	Alumil RomIndustry SA	2007 - 2011
AMO	Amonil Slobozia SA	2000 - 2011
ATB	Antibiotice Iasi SA	2000 - 2011
AZO	Azomures Tg-Mures SA	2000 - 2011

BCC	Banca Comerciala Carpatica SA	2004 - 2011
BIO	Biofarm SA	2000 - 2011
BRD	BRD - GSG	2001 - 2011
BRK	SSIF Broker Cluj SA	2004 - 2011
CMP	Compa Sibiu SA	2000 - 2011
COMI	Condmag SA	2000 - 2011
DAFR	Dafora SA	2000 - 2011
IMP	Impact SA	2000 - 2011
ELMA	Electromagnetica SA	2000 - 2011
OLT	Oltchim Rm-Valcea SA	2000 - 2011
PTR	Rompetrol Well Services SA	2000 - 2011
RRC	Rompetrol Rafinare Constanta SA	2004 - 2011
SCD	Sicomed SA	2000 - 2011
SIF1	SIF1 Banat-Crisana SA	2000 - 2011
SIF2	SIF2 Moldova SA	2000 - 2011
SIF3	SIF3 Transilvania SA	2000 - 2011
SIF4	SIF4 Muntenia SA	2000 - 2011
SIF5	SIF5 Oltenia SA	2000 - 2011
SNO	Santierul Naval Orsova SA	2000 - 2011
TBM	Turbomecanica SA	2000 - 2011
TEL	Transelectrica SA	2006 - 2011
TGN	Transgaz SA	2008 - 2011
VNC	Vrancart SA	2004 - 2011
TLV	Banca Transilvania SA	2000 - 2011
SNP	OMV - Petrom SA	2001 - 2011

Regarding the returns estimation, as Strong (1992, p.353) pointed out "there are both theoretical and empirical reasons for preferring logarithmic returns. Theoretically, logarithmic returns are analytically more tractable when linking together sub-period returns to form returns over long intervals. Empirically, logarithmic returns are more likely to be normally distributed and so conform to the assumptions of the standard statistical techniques." Precisely for this reason we decided to use logarithmic returns in our study since our objective is to test of whether the returns of the Romanian stock and indices during 2000 – 2011 were normally distributed or, instead, showed signs of asymmetry (skewness). The computation formula of the daily returns is as follows:

$$R_{i,t} = Ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$$

where $R_{i,t}$ is the return of asset *i* in period *t*; $P_{i,t}$ is the price of asset *i* in period *t* and $P_{i,t-1}$ is the price of asset *i* in period *t-1*. According to this methodology of computing the returns, the prices of

the assets must be adjusted for corporate events such as dividends, splits, consolidations and share capital increases (mainly in case of individual stocks because indices are already adjusted).

As a result of this initial data gathering we obtained 56 time series of log-returns, each with approx. 3000 daily observations.

Concerning the estimation of skewness, according to most authors a time series of financial asset returns is symmetric around it's mean (noted here with μ) if:

$$\forall k, f(\mu + k) = f(\mu - k)$$

where f is the density function of the returns. If this property is valid then the mean of the returns series coincides with its median.

The skewness of a data population is defined as the third central moment. To be more precise, skewness is computed as the average cubic deviation of the individual observations from the sample mean, divided by the standard deviation raised to the third power. As a consequence of these considerations, we have calculated the sample skewness as follows:

$$\hat{S} = \frac{\frac{1}{N}\sum_{t=1}^{N}(R_t - \bar{R})}{\hat{\sigma}^3}$$

where $\hat{S}$ is the sample skewness; N is the total number of individual observations within the sample, R_t is the return of period t, $\bar{R}$ is the sample arithmetic mean and $\hat{\sigma}$ is an estimator for the standard deviation that is based on the biased estimator for variance ($\hat{\sigma} = \sigma\sqrt{(N-1)/N}$), where the standard deviation is given by:

$$\sigma = \sqrt{\frac{\sum_{t=1}^{N}(R_t - \bar{R})^2}{N-1}}$$

The skewness of a symmetric distribution, such as the normal distribution, is zero. Positive skewness means that thedistribution has a long right tail and negative skewness implies that the distributionhas a long left tail.

According to Peiro (1999), under normality hypothesis, the asymptotic distribution of $\hat{S}$ is given by $\hat{S} \to N(0, \frac{6}{T})$.

Results and interpretations

The first thing that we observe analyzing the data is that for 45 out of 56 of assets investigated we cannot reject the null hypothesis of zero mean of the sample daily returns over the 2000-2011 period. Still, it is very interesting that from the 5 Romanian indices investigated, three present mean sample returns that are significantly positive (at the 5% level). Also, 2 out of the 30 individual Romanian stocks studied present significant negative daily mean returns and 4 out of 30 present significant positive daily returns. From 21 the international indices studied for the period 2000-2011 only 2 present significant positive daily returns, while for all the other 19 indices we were not able to reject the hypothesis of zero mean returns.

More important for our study, from all the 56 assets investigated, during the period 2000-2011 only 11 presented skewness values that appear far from zero (the value of the standardized normal

distribution). All these 11 assets are Romanian assets: one index (ROTX) and 10 individual stocks. None of the 21 international indices appear to present significant skewness although most values are slightly negative.

As shown below in Table 2, both tests of the normality of the distribution of sample returns during 2000-2011 that we have conducted (the Studentized-Range test and the Jarque-Bera test) indicate that none of the 56 assets studied present a normal (Gaussian) distribution. In such a context, where the sample returns don't seem to conform to a normal distribution, a more complex analysis is needed in order to verify whether there is asymmetry in the data.

Table 2: Return statistics

Series	N	Mean (in %)	t-stat	Std. Dev. (in %)	Skewness	Sk S.E.	St-R	Jarque-Bera
_AEX	2989	-0.0092%	-0.7246	0.0069	0.0245	0.0448	12.30	3802.74
_ATX	2892	0.0089%	0.7122	0.0067	-0.2902	0.0455	14.44	6601.98
_BET	2898	0.0360%	2.4616	0.0079	-0.5053	0.0455	13.06	6110.21
_BET_C	2891	0.0256%	1.8644	0.0074	-0.5350	0.0456	20.40	24260.21
_BET_FI	2684	0.0501%	2.2116	0.0117	-0.1251	0.0473	11.07	2977.05
_BET_XT	855	-0.0257%	-0.6991	0.0107	-0.5089	0.0838	9.58	857.99
_BFX	1552	-0.0098%	-0.6048	0.0064	0.1600	0.0622	12.92	3456.70
_BSESN	2891	0.0164%	1.1878	0.0074	-0.1155	0.0456	16.26	4315.93
_BVSP	2891	0.0213%	1.3544	0.0085	-0.0643	0.0456	13.24	1522.98
_FCHI	2988	-0.0066%	-0.5255	0.0069	0.1190	0.0448	12.66	2490.25
_FTSE	2963	-0.0019%	-0.1790	0.0057	-0.0806	0.0450	14.09	3848.92
_GDAXI	2983	-0.0009%	-0.0703	0.0071	0.1243	0.0448	11.03	1766.27
_GSPC	3019	-0.0022%	-0.2044	0.0060	-0.1525	0.0446	14.73	6242.37
_HSI	2915	0.0016%	0.1162	0.0072	0.0110	0.0454	16.27	6286.14
_JKSE	2828	0.0240%	1.9207	0.0066	-0.6811	0.0461	12.14	4277.19
_KLSE	2874	0.0086%	0.8998	0.0051	-0.2201	0.0457	33.03	869185.20
_KS11	2868	0.0091%	0.6299	0.0078	-0.4093	0.0457	13.23	2055.04
_MERV	2880	0.0182%	1.0348	0.0094	-0.1602	0.0456	13.37	2682.09
_N225	2847	-0.0116%	-0.8870	0.0070	-0.3707	0.0459	15.77	5200.25
_NZ50	1863	0.0042%	0.5384	0.0033	-0.3789	0.0568	14.00	1983.22
_OMXSPI	2733	0.0002%	0.0123	0.0065	0.0684	0.0469	10.70	1331.09
_OSEAX	2661	0.0141%	1.0654	0.0068	-0.5903	0.0475	12.02	3430.63
_ROTX	789	-0.0093%	-0.2526	0.0103	-1.1287	0.0872	12.68	3087.56
_SSEC	2958	0.0067%	0.5190	0.0071	-0.0933	0.0450	11.49	2488.70
_SSMI	2961	-0.0013%	-0.1243	0.0056	0.0911	0.0450	14.76	4119.56
_TWII	2867	-0.0026%	-0.1999	0.0069	-0.2359	0.0457	10.42	714.01
ALT	1503	-0.0619%	-1.3276	0.0181	0.1104	0.0632	11.27	797.87
ALU	1094	-0.0733%	-1.5720	0.0154	-0.5380	0.0741	8.37	875.59

ATB	2795	0.0196%	0.7499	0.0138	-0.3673	0.0463	9.92	6411.76
AMO	2594	-0.0159%	-0.4027	0.0201	0.1103	0.0481	6.53	763.88
AZO	2748	0.0481%	1.4460	0.0174	-1.3681	0.0467	25.04	131989.50
BCC	1758	-0.0515%	-1.8918	0.0114	-0.3367	0.0584	11.50	4912.83
BIO	2363	0.0084%	0.1009	0.0406	0.2151	0.0504	45.76	8278150.00
BRD	2533	0.0209%	0.6903	0.0152	6.3559	0.0487	42.04	7089361.00
BRK	1591	-0.0906%	-1.9790	0.0183	-2.1014	0.0614	15.50	33666.87
CMP	2730	0.0272%	0.8999	0.0158	-0.4526	0.0469	14.22	6607.11
COMI	1248	0.1208%	0.7553	0.0565	0.0381	0.0693	18.81	46759.67
DAFR	1780	0.0255%	0.1466	0.0734	0.4441	0.0581	32.43	1905812.00
ELMA	2296	0.0167%	0.3408	0.0235	-6.5459	0.0511	25.30	1340663.00
IMP	2554	-0.0470%	-1.2981	0.0183	-2.4815	0.0485	18.33	94268.74
OLT	2658	0.0492%	1.2440	0.0204	1.3308	0.0475	18.45	48503.15
PTR	2492	0.0168%	0.2578	0.0325	-30.3469	0.0491	44.16	171000000.00
RRC	1773	0.0066%	0.1945	0.0142	0.4581	0.0582	9.91	1265.69
SCD	2780	0.0288%	1.1098	0.0137	-8.0406	0.0465	32.88	6646394.00
SIF1	2848	0.0516%	2.0217	0.0136	-0.2789	0.0459	9.64	2873.11
SIF3	2836	0.0439%	1.6136	0.0145	-3.2254	0.0460	24.88	546528.10
SIF2	2849	0.0564%	2.1254	0.0142	-0.2634	0.0459	9.26	2639.46
SIF4	2832	0.0351%	1.4139	0.0132	-0.2075	0.0460	9.94	2965.16
SIF5	2836	0.0503%	1.9384	0.0138	-0.1601	0.0460	9.50	2547.85
SNO	1976	0.0384%	0.9071	0.0188	0.0594	0.0551	6.98	543.21
SNP	2374	0.0239%	0.9764	0.0119	-0.2607	0.0503	11.01	3512.21
TBM	2461	-0.0030%	-0.0959	0.0155	-0.0934	0.0494	8.46	3096.99
TEL	1270	-0.0132%	-0.4068	0.0116	0.0440	0.0687	11.00	1302.75
TGN	956	-0.0084%	-0.2436	0.0106	-0.2264	0.0792	12.15	3620.56
TLV	2718	-0.0159%	-0.5301	0.0156	-9.1025	0.0470	27.78	3489067.00
VNC	1473	-0.0159%	-0.4251	0.0144	0.0599	0.0638	9.07	875.80

Conclusions

This study was dedicated to the issue of symmetry in financial assets returns on the Romanian capital market during the period 2000-2011.

In early financial studies, many authors and traditional methodologies used only the first two moments of the distributions (mean and variance) for pricing of the financial assets, assuming implicitly the normality of those distributions. Latter,a vast literature appeared suggesting that the inclusion of skewness and kurtosis in such valuation methods is useful since the third and fourth moments of the distribution are not negligible and therefore they are not ignored by investors and speculators.

We used daily data from Bucharest Stock Exchange for the mentioned period to prove that the distributions of the log-returns are not normally distributed although for most of the series we could not reject the null hypothesis of zero mean. This result is consistent with what we find for 21

international indices (both from developed and emerging markets) during the same period and confirm the recent studies of other authors for other markets, periods and asset groups.

Calculating the skewness of the distributions of the daily log-normal returns we found very few evidence of significant asymmetry, with only 10 individual Romanian stocks and 1 Romanian index presenting clearly negative skewness out of the 56 total assets studied. None of the 21 international indices presented clear evidence of skewness significantly different from zero. Still, we think that further analysis is required to clarify the issue of asymmetry because according to literature, the rejection of normality does not necessary imply the rejection of symmetry (Machado-Santosand FERNANDES, 2005). In this context a binomial distribution test and a distribution-free test such as Kruskal-Wallis test could be more suited.

Also, it would be interesting, as a piece of further research, to extend this study of skewness to a low frequency sample data such as the weekly and monthly returns for the same period.

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