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February 2012

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Abstract

This paper examines long and short-run relationships among three emerging Balkan stock markets (Romania, Bulgaria and Croatia), two developed European stock markets (Germany and Greece) and United States (U.S.), during the period 2000 - 2005. We apply Johansen's (1988) cointegration methodology to test the long-run relationships between these markets and Granger's (1969) causality methodology in order to capture short-run cointegration. Our findings are mixed. We provide evidence on long-run relationships between the Bulgarian and Croatian stock markets and the developed markets. On the other hand, there is no any cointegration among the developed markets and the Romanian market. Moreover, there is no cointegrating relationship among the three regional emerging markets, while short-run relationships exist only among the region. These results have crucial implications for investors regarding the benefits of international portfolio diversification.

Keywords: Balkan equity markets, Johansen cointegration, Granger causality

JEL codes: F36, C52, G15

1. Introduction

Portfolio diversification theory applied by investors from the early 1960. However, in recent years the liberalized financial markets, new developments in technology and telecommunications, deregulation and the creation of monetary union of Europe provide evidence on convergence of international markets. Many researchers developed theories in reducing portfolio risk. For instance, Markowitz (1952) supported that the portfolio risk is reduced, as long as there is low correlation between the portfolio's shares.

However, an integrated regional stock market will be more appealing to investors from outside the region who would find investment in the region easier and or more justifiable. As shares become more liquid and transaction costs fall, fund managers become increasingly willing to take positions in the stock markets. As a part of economic integration, financial integration may help to reduce political risk, promote economic stability and increase the size of local markets, contributing therefore, to investment activity.

Over the last decade, impressive changes have occurred in Balkans; from the conflicts and economic collapse to the break up of traditional trade within the region. Since 2000, the Balkan economies are through a transitory phase of structural adjustment towards a market oriented economic system. Nevertheless, during all these years, the Balkan region displays robust growth rates, expanding more rapidly than the E.U. average and trying to import the euro as common currency (Kenourgios and Samitas, 2009). The countries of the Balkan region, which are closer to adopt euro, are Romania, Croatia and Bulgaria.

Cointegration analysis proposed by Johansen (1988) has been adapted to this study in order to empirically investigate the long- run comovements between international stock markets. Of course, priority to proceed to Johansen's cointegration methodology is to determine the order of cointegration of the market indices and ensure that it is equal for all series. Augmented Dickey-Fuller (1979) and Phillips-Perron (1998) unit root tests are used to test for the nonstationarity of the series. Finally, we empirically investigate short-run interdependence and bidirectional causality between the Balkan region and developed markets using Granger causality methodology (1969).

Our empirical analysis provides two main findings: (i) there are cointegrated relationships in the long run only between Bulgaria and Croatian equity markets and developed equity markets, limiting international portfolio diversification benefits; (ii)

there is a Granger causality relationship among the emerging Balkan markets, indicating short-term relationships.

The structure of the paper is organized as follows: Section 2 provides the literature review. Section 3 analyzes data and methodological issues. Section 4 presents the empirical results. The final section contains the concluding remarks.

2. Literature Review

The benefits of international portfolio diversification due to low correlations between developed and emerging financial markets have been investigated by several authors, i.e. Eun and Resnick (1984), Errynza and Padmanabhan (1988), Wheatly (1988), Meric and Meric (1989), Bailey and Stulz (1990), Divecha et al. (1992) and Michaud et al. (1996). Their results can be explained by several factors such as restrictions on world trade, barriers and high costs transactions, inadequate information on foreign markets and home bias puzzle. However, several studies, including Roll (1998), Hamao et al. (1990), Lau and McInish (1993), Rahman and Yung (1994) and Meric and Meric (1989), found a significant increase in correlation and volatility between stock markets before and after 1987, which occurred in international stock market crisis. The common feature of these studies is that correlations between stock markets were estimated using relatively short term periods (weekly, monthly or quarterly sample).

Considering the long term relationships between the U.S. market and European stock markets, Kasa (1992) and Arshanapali and Doukas (1993), found evidence of bivariate integration between U.S. and these markets. However, the results of Byers and Peel (1993) and Kanas (1998) showed that there are no such links. Differences in periods conducted these studies may explain the discrepancy of their results.

Moreover, studies in emerging markets of the Pacific region have also concluded to mixed results. Campell and Hamao (1992) supported that the U.S. market and Japan have long-run relationships, while Harvey (1991) and Chan et al. (1992) demonstrated that there is a lack of integration between U.S. and Asian markets. Phylaktis and Ravazollo (2004) demonstrated that there are different degrees of integration between the Pacific basin area and U.S. Syriopoulos (2005) supported that there is strong integration among

emerging markets of Central Europe, U.S. and Germany, as well as Voronkova (2004) for the emerging markets of Central Europe, developed European markets and U.S.

In contrast, DeFusco et al. (1996) concluded that the U.S. market has not any cointegrated vector using thirteen emerging capital markets among three regions (the Pacific basin region, Latin America region and the Mediterranean region). Also, Felix et al. (1998) demonstrated that there is no long-run relationship between U.S. and a number of emerging markets.

3. Data and methodology

The data consists of daily prices of six stock markets indices. The indices considered are: the S&P 500 in U.S., the Xetra DAX in Germany, the ASE General of Greece, the Vanguard of Romania, the Bulgarian Sofix and the Croatian Grobex, during the period from 2 November 2000 to 30 December 2005 (1187 observations). Following the common practice, all indices are expressed in respective local currency to evade problems associated with transformation due to fluctuations in cross-country exchange rates and also to avoid the restrictive assumption the relative purchasing power parity holds.

Prior to testing for co-integration, we determine the order of cointegration of the market indices and ensure that it is equal for all series. Augmented Dickey-Fuller and Phillips-Perron (PP) unit root tests are used to test for the nonstationarity of the series. ADF test procedure is most popular technique while PP test is less restrictive and provides an alternative way for checking the stationarity feature of a time series. To determine the appropriate number of lag length the Akaike Information Criterion (AIC) is employed.

Cointegration may exist for variables despite variables are individually nonstationary. This means a linear combination of two or more time series can be stationary and there is a long-run equilibrium between them. Thus the regression on the levels of the variables is meaningful and not spurious. Defining a vector z_t of n endogenous variables, it is possible to specify the following data generating process and model z_t as an unrestricted vector autoregression (VAR) involving up to k– lags of z_t:

$$Z_t = A_1 z_{t-1} + A_2 z_{t-2} + \ldots + A_\lambda z_{t-k} + u_t \qquad u_t \sim IN(0, \Sigma) \qquad (1)$$

where z_t is a (n x 1) matrix, and each of A_i is a (n x n) matrix of parameters. Then equation (1) can be reformulated into a VECM form:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \ldots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + u_t \quad \text{or}$$

$$\Delta z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-k} + u_t \qquad (2)$$

where $\Gamma_i = -(I - A_1 - \ldots - A_i)$, (i= 1,…., k-1), Γ_i are interim multipliers, and $\Pi = -(I - A_1 - \ldots - A_k)$. Testing for cointegration is related to the consideration of the rank of Π, that is finding the number of r linearly independent in Π. The number of significant co-integrating vectors is tested by using the maximum likelihood based λ-max and λ-trace statistics introduced by Johansen (1991) and Johansen and Juselius (1990).

The Granger causality is employed to examine the existence of short-term causal relationhips between emerging and developed markets. The Granger causality test takes the form:

$$y_t = a_0 + \Sigma a_i y_{t-i} + \Sigma \beta_j x_{t-j} + \varepsilon_t \qquad (3)$$

$$x_t = a_0 + \Sigma a_i x_{t-i} + \Sigma \beta_j y_{t-j} + \mu_t \qquad (4)$$

The methodology of Granger determines whether a present variable Y can be explained by past values of Y and whether adding lags of another variable X improves the explanation.

4. Empirical results

Table 1 presents stationarity tests results from both the Dickey-Fuller and the Philips-Perron tests. The unit root test statistics reveal that each series is nonstationary in log levels, but stationary in log first differences. Thus, we note that all regional index series are integrated of order one, I(1), in the sample period.

The Johansen (1988) procedure was then applied to determine whether any of the three Balkan equity markets are pairwise or multivariate cointegrated with the developed equity markets. Two versions of the Johansen procedure were used: one with intercept in the cointegrating equation and the other without it. Lag structures were chosen according to the Akaike Information Criterion (AIC). From Tables 2 and 3, according to the two tests, the Bulgarian equity market has signs of cointegration with the three developed

markets, but no cointegration is existed among the Bulgarian and other two regional markets. From Tables 4 and 5, the Croatian market has signs of cointegration with Germany and Greece, but this is not the case with U.S. Also, no sign of cointergration exists among Croatian and the other two emerging Balkan markets. Results from Tables 6 and 7 show that the Romanian market has no sign of pairwise cointegration with the three developed markets. However, the Romanian market is cointegrated with the group of the developed markets. Finally, from Tables 8 and 9, we observe that there are cointegrated relationships when grouping together the emerging and developed markets.

Although the results of the cointegration tests indicate that there are signs of long-run relationship between the developed and emerging Balkan stock markets, the possibility of short-run relationships remains. To empirically investigate short-run relationships, we apply the pairwise Granger-causality test and the results are shown in Table 10. Since this test is highly sensitive to the lag orders of the right-hand-side variables, the Akaike criterion was used to determine the optimal lag length; this was nine in each case. The results suggest a Granger causality running from the Bulgarian market to the Croatian market (bi-directional causality). Also, there is a uni-directional causality between the Romanian and the Bulgarian markets, while and the Romanian market does Granger cause the Croatian market. For any other case of under examination markets, there is no causality relationship in either direction.

5. Conclusions

Most of the empirical studies on financial market integration in Europe have focused on either European markets or transition economies. This paper aims to fill this gap by investigating the relationship among three Balkans stock market (Bulgaria, Croatia, and Romania), two developed European stock markets (Germany and Greece) and United States (U.S.), during the period 2000 - 2005. The methodology used is Johansen cointegration approach and Granger causality.

The results of unit-root tests reveal that each stock index has nonstationary feature over time, but becomes stationary in its first difference. Johansen's cointegration results are mixed. There is a long-run relationship between the Bulgarian and Croatian stock markets and the developed markets. On the other hand, there is no any cointegration

among the developed markets and the Romanian market. Moreover, there is no cointegrating relationship among the three regional emerging markets. In the short-term, there is a uni-directional causality between the Romanian and the Bulgarian markets, while a bi-directional causality exists between the Bulgarian market and the Croatian market and between the Romanian and Croatian markets.

Our results support the conclusion that investors from developed markets can benefit from diversifying into the Romanian equity market. Since the Romanian market is not cointegrated with the developed markets, the relatively low correlations of returns between them are not dependent on the investment horizon and do indicate diversification benefits for both short- and long-term investors.

Our study presents several additional points that need to be considered. First, from the results of the Johansen cointegration test it may be preferable to consider the Bulgarian and Croatian markets as a single market due to high correlation between them. Furthermore, as is typical with emerging markets, the correlations of the three emerging Balkan markets with developed countries are increasing over time. Also, it is likely that as the economies of this region become more fully integrated with Western Europe and other developed areas, the degree of long-run comovement will increase and also become a factor in asset allocation decisions. Consequently, the changing nature of diversification benefits will need to be taken into account over time.

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TABLE 1: Stationarity Tests Results

Market Index	First Level		First Differences	
t- statistic	ADF	PP	ADF	PP
Bulgaria	2.540361	2.784468	-20.36902	-28.46858
Croatia	1.921913	1.921913	-23.09444	-35.77267
Romania	1.776573	1.274234	-21.16259	-53.89027
Greece	-0.319546	-0.420910	-30.64788	-30.64788
Germany	-2.394157	-2.394157	-34.22546	-34.22546
U.S.A.	-2.514286	-2.514286	-34.67324	-34.67324

Note: The critical values are based on McKinnon (1991).

TABLE 2: **Johansen cointegration test results for the Bulgarian market**

(A model with no constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
BULGARIA-GERMANY	6.250876	3.84	2 C.E.
BURGARIA-GREECE	6.284691	3.84	2 C.E.
BURGARIA-U.S.A.	11.70315	12.53	0 C.E.
BULGARIA - GERMANY, GREECE, U.S.A.	25.32180	24.31	2 C.E.
BULGARIA – CROATIA, ROMANIA	21.62346	24.31	0 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 3: **Johansen cointegration test results for the Bulgarian market**

(A model with constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
BULGARIA-GERMANY	21.34282	19.96	1 C.E.
BURGARIA-GREECE	21.97279	19.96	1 C.E.
BURGARIA-U.S.A.	20.04192	19.96	1 C.E.
BULGARIA - GERMANY, GREECE, U.S.A.	20.66332	19.96	3 C.E.
BULGARIA – CROATIA, ROMANIA	29.37620	34.91	0 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 4: **Johansen cointegration test results for the Croatian market**

(A model with no constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
CROATIA-GERMANY	14.40423	12.53	1 C.E.
CROATIA-GREECE	3.870097	3.84	2 C.E.
CROATIA-U.S.A.	9.691233	12.53	0 C.E.
CROATIA - GERMANY, GREECE, U.S.A.	33.02941	39.89	0 C.E.
CROATIA – BULGARIA, ROMANIA	21.62346	24.31	0 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 5: **Johansen cointegration test results for the Croatian market**

(A model with constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
CROATIA-GERMANY	14.93328	19.96	0 C.E.
CROATIA-GREECE	18.66235	19.96	0 C.E.
CROATIA-U.S.A.	16.16794	19.96	0 C.E.
CROATIA - GERMANY, GREECE, U.S.A.	52.88785	53.12	0 C.E.
CROATIA – BULGARIA, ROMANIA	29.37620	34.91	0 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 6: **Johansen cointegration test results for the Romanian market**

(A model with no constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
ROMANIA-GERMANY	10.59345	12.53	0 C.E.
ROMANIA-GREECE	10.05480	12.53	0 C.E.
ROMANIA-U.S.A.	5.251089	12.53	0 C.E.
ROMANIA-GERMANY-GREECE-U.S.A.	43.92825	39.89	1 C.E.
ROMANIA – BULGARIA, CROATIA	21.62346	24.31	0 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 7: **Johansen cointegration test results for the Romanian market**

(A model with constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
ROMANIA-GERMANY	12.80594	19.96	0 C.E.
ROMANIA-GREECE	13.76527	19.96	0 C.E.
ROMANIA-U.S.A.	12.25164	19.96	0 C.E.
ROMANIA-GERMANY-GREECE-U.S.A.	59.09048	53.12	1 C.E.
ROMANIA – BULGARIA, CROATIA	29.37620	34.91	0 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 8: **Johansen cointegration test results for all markets**

(A model with no constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
BULGARIA, CROATIA, ROMANIA-GERMANY, GREECE, U.S.A.	85.19853	82.49	1 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 9: **Johansen cointegration test results for all markets**

(A model with constant term, without trend)

Groups of emerging and developed markets	likelihood ratio	5% critical value	Number of cointegration Equations (CE)
BULGARIA, CROATIA, ROMANIA-GERMANY, GREECE, U.S.A.	78.44647	76.07	2 C.E.

Note: If the value of the likelihood ratio is less than the critical value at 5 % significance level, then we accept that there are no cointegration vectors.

TABLE 10: Pairwise Granger causality tests results

Null hypothesis:	Obs	F Stat.	Probability
CROATIA does not Granger cause BULGARIA	1178	0.67607	0.73118
BULGARIA does not Granger cause CROATIA		3.50453	0.00027
ROMANIA does not Granger cause BULGARIA	1178	2.49079	0.00806
BULGARIA does not Granger cause ROMANIA		2.47180	0.00856
GERMANY does not Granger cause BULGARIA	1178	0.73806	0.67417
BULGARIA does not Granger cause GERMANY		0.92501	0.50221
GREECE does not Granger cause BULGARIA	1178	0.56211	0.82877
BULGARIA does not Granger cause GREECE		1.88693	0.05014
USA does not Granger cause BULGARIA	1178	0.90056	0.52399
BULGARIA does not Granger cause USA		0.87177	0.55004
ROMANIA does not Granger cause CROATIA	1178	4.29811	1.6E-05
CROATIA does not Granger cause ROMANIA		1.45358	0.16044
GERMANY does not Granger cause	1178	1.29328	0.23581

CROATIA			
CROATIA does not Granger cause GERMANY		0.83959	0.57959
GREECE does not Granger cause CROATIA	1178	1.40002	0.18305
CROATIA does not Granger cause GREECE		1.45871	0.15840
USA does not Granger cause CROATIA	1178	1.34033	0.21124
CROATIA does not Granger cause USA		0.81906	0.59862
GERMANY does not Granger cause ROMANIA	1178	0.85110	0.56897
ROMANIA does not Granger cause GERMANY		0.59260	0.80398
GREECE does not Granger cause ROMANIA	1178	1.44662	0.16324
ROMANIA does not Granger cause GREECE		1.28517	0.24026
USA does not Granger cause ROMANIA	1178	1.05845	0.39109
ROMANIA does not Granger cause USA		0.86913	0.55245