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The International Integration of the Eastern Europe and two Middle East Stock Markets

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Abstract

This article studies the international integration of twelve Eastern Europe Stock Markets and two Middle East Stock Markets. It is commonly accepted that the returns in these markets have a low correlation with the other markets, which means that they are still weakly integrated in the world financial market. This assumption is the object of the empirical analysis in the present article, in which the co-integration of each of these national stock markets with the international market is estimated. Co-integration is a well adapted methodology to study the international integration of stock markets, since it puts in evidence, simultaneously, the long-term relation between the stock prices of a domestic market and those representing the international market and the short-term relation between the changes in those prices. The results obtained show that, in general, these stock markets are co-integrated with one or more international indexes.

Keywords: *Financial Integration, stock markets, structure breaks*

JEL: F36, F37, G15

Introduction

In this article, co-integration is used to evaluate the integration in the world financial market of Eastern Europe stock markets and two Middle East stock markets. The Eastern Europe group is composed by the emerging markets of Czech Republic, Hungary, Poland, Russia, and by the frontier markets of Bulgaria, Croatia, Slovenia, Estonia, Lithuania, Romania, Serbia and Ukraine. The two Middle East stock markets included in the present research are those of Turkey (emerging market) and of , Kazakhstan (frontier market).The classification of these stock markets, as emerging markets or as frontier markets, is made by Morgan Stanley Capital International, based on the criteria proposed by the International Financial Corporation, which takes in consideration the fact that they are relatively recent and present low levels of activity, liquidity and market capitalization, comparatively with the developed markets. The frontier markets are, in general, younger than the emerging markets, and with less liquidity and lower market capitalization. It is commonly accepted that these two groups of stock markets are weakly correlated with the Word financial market, and that they do not receive significant capital flows from outside. The evaluation of the international integration of these of stock markets is the object of this article. The co-integration methods used are those of Engle and Granger (1987) and of Gregory and Hansen (1996). The first of these methods corresponds to the more general case of co-integration, without changes in the long-term relation between the

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variables, while the second is adapted to put in evidence breaks in that long-term relation. The integration of each of these individual stock markets is evaluated both at the regional level, and at the World level. In order to evaluate the integration of each of these markets with the others of the same region, two international indexes were used: the European Frontier Markets Index (EFI), and the European and Middle East Emerging Markets Index (EMI). The All Countries Word Index (ACWI), composed by the national indexes of 45 countries, was used to evaluate the integration of these markets in the World market.

1. Co-integration as a method to evaluate the integration of financial markets

The co-integration methodology offers the advantage of distinguishing the long-term and short-term dependence of a domestic market relatively to the international financial market. When a stationary long-term relation exists between a domestic stock market and the international indexes, the stock prices of that domestic market follow a common path with those of the international market. This is a first symptom of the international integration of that domestic market. Additionally, if the changes on the domestic market prices are dominated by their long-term relation with international stock prices, and by the short-term past changes of these prices, the presence of regular capital flows between the international market and the domestic market is quite probable. Co-integration has been used as a method to evaluate financial market integration in several studies, most of them directed to the developed markets. This methodology was firstly used by Kasa (1992) who applied it to estimate the number of common stochastic trends between five highly developed stock markets: Canada, Germany, Japan, United Kingdom and USA. That study was followed by the one of Arshanapalli and Doukas (1993), who used co-integration to estimate the dependence of the stock indexes of four developed countries: France, Germany, Japan and United Kingdom, relatively to a USA stock index, before and after the 1987 crash. These authors concluded that the Japanese stock market was integrated with the US stock market both before and after the crash, while, by the contrary, the integration of stock markets of France, Germany and UK with the US stock only occurred afterwards. Richards (1995) enlarged the number of stock indexes to which the study of Kasa was applied, and estimated the co-integration of 16 domestic stock indexes of developed markets. One of the aims of Richards' article was to explain the apparently anomalous results reported by Kasa, when this author identified a single common stochastic trend between the stock indexes included in his tests. The use of co-integration to study the integration between European stock markets was firstly used by Rangvid (2001) who applied this methodology to evaluate the integration between the stock indexes of France, Germany and the United Kingdom before the introduction of the euro. This methodology was also used by Miloudi (2003) to analyse the integration between sixteen European stock indexes, before and after the launch of the euro, conducting separated tests for the members and non-members of the EMU. In his tests, Miloudi observed that the number of long-term relations between the stock indexes of EMU countries was augmented when the indexes of Austria, Finland and Greece were withdrawn from the tests. This result is interpreted by Miloudi as meaning that a strong degree of integration exists between the stock markets of the countries which founded the European Union. Soares da Fonseca (2008) applied co-integration methods to analyse the integration between 16 European stock markets, and concluded that the international integration of those markets is the result of European and non European factors. He also concluded that there is no

difference of patterns in the international integration between EMU and non EMU members. More recently, Calvi (2010) also used co-integration analysis to compare European and Asian financial markets. This author concludes that integration is significantly more advanced in the former than in the second of these two groups of markets.

2. *Empirical analysis of the present research*

The period under analysis in this article is of four years, going from 2 January 2007 to 31 December 2010. The database is composed by daily data and comprises 1045 observations of the international indexes EFI, EMI and ACWI, and of each domestic index, in the cases of Bulgaria, Croatia, Czech Republic, Slovenia, Estonia, Hungary, Kazakhstan, Poland, Romania, Russia, Turkey and Ukraine. In the cases of Lithuania and Serbia, data is available since 30 may 2008, and comprises 676 observations of each index.

The domestic indexes, the EFI, the EMI and the ACWI, used in our tests, were obtained from MSCI[1]. Three supplementary variables were constructed to be used in our tests, designed by EMXFM, ACXFM, and ACXEM, which are, respectively, the differences between the accumulated returns of EMI and EFI, ACWI and EFI, and of ACWI and EMI, since 2 January 2007.

Two different approaches to international integration were taken in consideration on the tests. In the first approach is tested the co-integration of each domestic index with a single international index. In the case of the emerging markets, the co-integration of each domestic emerging market with the index representing all the European Emerging Markets (EMI) and with the world index (ACWI), were tested alternatively. In the case of the frontier markets three cases of co-integration were tested alternatively: 1) with the European Frontier Markets Index, EFI; 2) with the emerging markets of the same region, EMI; 3) with the world market index, ACWI. The objective of the second approach is to test the co-integration of each domestic market with two international indexes. One of the international variables is the international index representing the markets of the same category and region of the one whose integration is being estimated, and the other is one of the supplementary variables defined above (EMXFM, ACXFM, or ACXEM), which is used in the tests as the proxy of one of the other international indexes, in order to prevent the possibility of co-linearity. In the tests about the integration of the emerging markets, the international variables used were the EMI and the ACXEM. In the case of the frontier markets, two pairs of international variables were used alternatively: EFI and EMXFM, and EFI and ACXFM.

2.1. *The unit root tests*

Co-integration only can exist between non-stationary variables. Thus, prior to the co-integration estimations, it was verified if the variables involved are integrated of order 1, I(1), which means that the indexes are not stationary, but stationarity is observed in their first

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[1] Morgan Stanley Capital International

differences. The values calculated for the Dickey-Fuller τ statistic, presented in Table I, for all the domestic indexes, and for the regional and world indexes confirm that all these variables are I(1). Thus, all these indices can be the object of analysis by co-integration methods.

Insert Table I

2.2. The estimation of the long-term relation between each domestic index and one international index

Two alternative models were applied to estimate the long-term relation between the variables. The first is the Engle and Granger (1987) co-integration model (E&G), which excludes changes in the long-term relation between the variables. The other is the Gregory and Hansen (1996) model (G&H), which takes in consideration three alternative cases of changes in the long-term relation between the variables: 1) intercept break, 2) intercept break and trend, 3) full break (intercept and slope breaks). According with the Engle and Granger model, the estimation of the long-term relation between the domestic index of each country, P_D, and the international index, P_I, is represented by the following regression:

$$P_{D,t} = \alpha + \beta P_{I,t} + e_t \qquad (1)$$

This regression is followed by the calculation of the McKinnon (1991) τ statistics related to the Engle-Granger test.

The first type of change, in the G&H method, the *intercept break*, is represented by the following long-term regression:

$$P_{D,t} = \alpha_0 + \alpha_1 \varphi_{t\tau} + \beta P_{I,t} + e_t \qquad (2)$$

The difference between this model and the standard model of Engle and Granger consists in the inclusion of a dummy variable, $\varphi_{t\tau}$, which represents the level break occurring at date τ. The second type of change, which is the possibility of an *intercept break and a trend* in long-term relation, has the following representation:

$$P_{D,t} = \alpha_0 + \alpha_1 \varphi_{t\tau} + \beta P_{I,t} + \mu t + e_t \qquad (3)$$

Finally, the hypothesis of a full break, both in the intercept and in the slope, takes the following representation:

$$P_{D,t} = \alpha_0 + \alpha_1 \varphi_{t\tau} + \beta_1 P_{I,t} + \beta_2 \varphi_{t\tau} P_{I,t} + e_t \qquad (4)$$

The values calculated for the MacKinnon (1991) statistics related to the Engle-Granger test, and for the Gregory and Hansen statistics are presented in Table II for the frontier markets, in the tests where the EFI plays the role of the international variable. In the Table III are represented the results of these statistics related both for the emerging and the frontier markets, in the tests in which the international variable is the EMI. The break dates are indicated when

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the value calculated for the Gregory & Hansen statistics is significant at 5% According with the results presented in the Table II, a long-term stationary relation with the EFI exists in three cases of frontier markets: Romania (in the E&G model), Croatia (in the G&H model with an intercept break at 01-08-2008) and Serbia (in the G&H model with a full break at 02-04- 2009).

Insert Table II

The values presented in the Table III show that there is no case of a stationary long-term relation between a domestic emerging market index, and the corresponding regional index, EMI. By the contrary, two frontier markets, Bulgaria and Serbia, have a long-term stationary relation with the Emerging Markets Index, with intercept breaks and trend, the breaks occurring, respectively at 27-03-2008 and at 24-03-2010.

Insert Table III

In the tests in which the ACWI was the international variable, the values calculated for the MacKinnon (1991) statistics, related to the Engle-Granger test, and for the Gregory and Hansen statistics, are represented in the Table IV. These results show that four national indexes have a stationary long-term relation with the ACWI: Bulgaria in the G&H model with a full break occurring at 25-09-2008, Hungary in the E&G model, Poland in all the models (all the three types of G&H breaks occurring at 06-01-2009), and Lithuania in the E&G model. In summary, the tests in which a single international index was used, put in evidence a long-term stationary relation, in the case of seven countries within a total of fourteen domestic markets. These results also show that the world index ACWI dominates the two regional indexes, in the number of cases of stationary long-term relations.

Insert Table IV

2.3. The estimation of the long-term relation between each domestic index and two international variables

The second approach to financial integration used in this article consists in including two international variables in the tests, as referred above. In the case of the emerging markets, the international variables were the indexes EMI and the ACEXEM. These estimations test the hypothesis that the international integration of each emerging market is governed,

simultaneously, by the regional index representing the emerging markets, and by the index representing the world market. In the case of the frontier markets, two different solutions were used in this approach. The first solution consisted in estimating the co-integration of each frontier with the EFI index and the variable EMEXEF, testing the hypothesis that the international integration of each frontier market is influenced both by the other frontier markets and by the emerging markets of the same region. The second solution consisted in estimating the co-integration of each frontier market with the EFI index and the variable ACEXEF. This solution tests the hypothesis that the international integration of the frontier markets is governed, simultaneously, by the other markets of the same category and region, and by the all world financial market.

The representation of these long-term relations between the variables in this approach, for the Engle-Granger normal case, is:

$$P_{D,t} = \alpha_0 + \beta_1 P_{I,t} + \beta_2 P_{IX,t} + e_t \qquad\qquad (5)$$

where P_D is the domestic index, P_I the first international index, and P_{IX} is the proxy of the second international index. The estimations of the G&H hypothesis of breaks are represented, respectively, by:

$$P_{D,t} = \alpha_0 + \alpha_1 \varphi_{t\tau} + \beta_1 P_{I,t} + \beta_2 P_{IX,t} + e_t \qquad\qquad (6)$$

for the case an intercept break,

$$P_{D,t} = \alpha_0 + \alpha_1 \varphi_{t\tau} + \beta_1 P_{I,t} + \beta_2 P_{IX,t} + \mu t + e_t \qquad (7)$$

for the case an intercept break and a trend, and

$$P_{D,t} = \alpha_0 + \alpha_1 \varphi_{t\tau} + \beta_1 P_{I,t} + \beta_2 \varphi_{t\tau} P_{I,t} + \beta_3 P_{IX,t} + \beta_2 \varphi_{t\tau} P_{IX,t} + e_t \qquad\qquad (8).$$

for the full-break case. The values calculated for the MacKinnon τ statistics related to the Engle-Granger test, and for the Gregory and Hansen statistics, are represented in the Table V for the Emerging Markets.

Insert Table V

The results presented in the Table V show that only the indexes of Poland and Russia have long-term stationary relations with the international variables EMI and ACXEM. In the case of Poland, the stationary relation is observed in all the models estimated, and, all the three G&H models have their breaking dates at 06-01-2009. In the case of Russia the stationary relation is observed only in the G&H model with intercept break occurring at 06-08-2009. The results of the equivalent tests concerning the frontier markets are presented, respectively, in the Tables VI and VII. The results presented in the Table VI show that long-term stationary relations with the variables EFI and EMEXEF were observed in the cases of the national indexes of Bulgaria (both on the E&G model and on the G&H model with an intercept break at 31-03-2008 and trend), Romania (on the E&G model), Serbia (both on the G&H model with intercept break and trend, the break occurring at 12-03-2009, and with a full break occurring at

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13-03-2009) and Ukraine (on the G&H model with a full break occurring at 09-09-2008). The results presented in the Table VII show that long-term stationary relations with the EFI and ACEXEF variables were observed in the cases of the national indexes of Bulgaria (on the E&G model), Croatia (both on the E&G model and on the G&H model with an intercept break at 16-07-2008 and trend), Slovenia, Lithuania and Romania (all of them on the E&G model), and Serbia (on the G&H model with a full break occurring at 27-3-2009). In summary, the results presented in the Tables V, VI and VII show that ten of the fourteen stock markets under analysis have one or more stationary relations with two international indexes: Bulgaria, Croatia, Slovenia, Hungary, Lithuania, Poland, Romania, Russia, Serbia and Ukraine. This number corresponds to an increase of three markets, comparatively with the tests in which a single international index was included. Only in the cases of the stock indexes of the Czech Republic, Estonia, Kazakhstan and Turkey no stationary long-term relations with the international indexes.

Insert Table VI
Insert Table VII

2.3. Estimation of the error-correction model

The second part of the empirical analysis consisted in estimating the *error-correction* model (ECM) in the cases in which a long-term stationary relation of the domestic index with the international variables was observed. The *error-correction* model has the following representations, respectively, for the model including one international variable:

$$\Delta P_{D,t} = a_1 + a_e e_{t-1} + \sum_{j=1}^{L} a_{D,j} \Delta P_{D,t-j} + \sum_{j=1}^{L} a_{I,j} \Delta P_{I,t-j} + \varepsilon_t \qquad (9)$$

and for the model including two international variables:

$$\Delta P_{D,t} = a_1 + a_e e_{t-1} + \sum_{j=1}^{L} a_{D,j} \Delta P_{D,t-j} + \sum_{j=1}^{L} a_{I,j} \Delta P_{I,t-j} + \sum_{j=1}^{L} a_{IX,j} \Delta P_{IX,t-j} + \varepsilon_t \quad (10)$$

According with the error-correction model, the current change of the national index, $\Delta P_{D,t,}$ must be explained by the lagged error term of the long-term relation with the international variables, e_{t-1}, by the lagged changes of the national index, itself, ΔP_{Dt-j} (j=1,…, L), by the lagged changes of the main international index used in the estimations, $\Delta P_{I,t-j}$ (j=1,…, L) , and, in the second model, also by the lagged changes of the supplementary international variable, $\Delta P_{IX,t-j}$ (j=1,…, L). The optimal number of lags, L, was calculated using the Schwarz Bayesian criteria. The value of the estimator of a_e, is the measure of *elasticity of reversion* of the value of the domestic stock index to its long term relation with the international variables. A causality test was applied to the estimators of a_e and to the coefficients of the lagged changes of the international variables, through the calculation of an F statistic. Complementarily, a Ljung-Box test on the autocorrelation and an ARCH test on the heteroskedasticity were also applied to the residuals series. The corresponding statistics (the chi-square statistic in the Ljung-Box test, and

the F statistic in the ARCH tests) were calculated over the results of the estimation of four lags autoregressive models, related respectively to the residuals and to the squared residuals of the ECM.

Insert Table VIII
Insert Table IX

The results of the estimations of the error correction model are presented in the Tables VIII and IX, respectively, for the cases in which one and two international indexes were, included in the tests. The results concerning the elasticity of return to the long-term relation are, in general, significantly different from zero. The only exception is one of the five models estimated for Bulgaria: the one in which EFI and ACXFM are the international variables. Complementarily, the causality test F statistic is significantly different from zero in all the cases. In a few cases the null hypothesis of residual autocorrelation and of GARCH effects cannot be rejected, because the corresponding statistics are significant at the 5% level. The cases are those of Croatia, in all the four ECM estimated for this country, Slovenia, in the single ECM estimated for this country, and Serbia in one of the five models estimated. In another of the models estimated for Serbia residual autocorrelation is observed, but not GARCH effects. However, the presence of residual autocorrelation and of GARCH effects in the residuals is of minor importance, since it does not preclude the existence of co-integration. According with the results presented in the Table VIII, twelve cases of co-integration between a domestic index and a single international index are confirmed, which are referred to seven countries: Bulgaria, Croatia, Hungary, Lithuania, Poland, Romania and Serbia. The domestic indexes of Bulgaria and Serbia are co-integration with the EMI. The domestic indexes of Croatia, Romania and Serbia are co-integrated with EFI. Finally, the co-integration with the ACWI was put in evidence relatively to the domestic indexes of Bulgaria, Hungary, Lithuania, and Poland. The co-integration of these seven domestic indexes with the international indexes was confirmed in the tests which included two international variables. These tests produced eighteen cases of co-integration, referred to a total of ten countries. The ACWI index, represented by its proxies ACXEM and ACXEF, is present in twelve of those eighteen cases of co-integration, which are referred to nine countries. The only exception was Ukraine whose co-integration was observed in a single test in which the international variables were the EFI and the proxy of the EMI index. The domestic markets whose co-integration only could be observed using two international variables are those of Slovenia, Russia and Ukraine. No co-integration was detected in the cases of Estonia, Kazakhstan, and Turkey. In summary, the results confirm that the domestic stock markets of Bulgaria, Croatia, Slovenia, Hungary, Lithuania, Poland, Romania, Russia, Serbia and Ukraine are co-integrated with international indexes.

Conclusion

The results of the co-integration tests conducted in the present article show that ten of the fourteen Emerging and Frontier Markets of the Eastern Europe and the Middle East under analysis are integrated in the international financial market. These tests also show that the co-integration is mainly governed by the world financial market, rather than by the other markets of the same region or classification. In fact, the All Countries World Index is dominant over the regional indexes. The results obtained, in favour of the international integration of this group of markets, can be explained by the increase in international portfolio diversification that has been

occurring during the last decades. This process of international diversification has been observed firstly between developed stock markets. It is now being extended to the emerging and frontier stock markets, which after a certain number of years of activity, are revealing to be capable of offering to the international investors new opportunities of investment.

References

Arshanapalli, B. and Doukas, J. (1993), "International stock market linkages: Evidence from the pre- and post-October 1987 period", *Journal of Banking and Finance*, 17, 193-208.

Calvi, R. (2010) "Assessing financial integration: a comparison between Europe and East Asia," European Economy - Economic Papers 423, Directorate General Economic and Monetary Affairs, European Commission.

Engle, R. and Granger, C. (1987), "Co-integration and Error-Correction: Representation, Estimation and Testing", *Econometrica*, Nº 55, 251-276.

Gregory, A. M and Hansen, B. (1996), "Residual-based tests for co-integration in models with regime shifts", *Journal of Econometrics*, Nº 70, 99-126.

Kasa, K. (1992) "Common stochastic trends in international stocks markets", Journal of Monetary Economics, 29, 95-124.

MacKinnon, J.(1991), "Critical Values for Co-integration Tests, in *Long-Run Economic Relationships,* R.F. Engle and C.W.J. Granger, eds., London, Oxford, 267-276.

Miloudi, A. (2003), "Interdépendances entre Places Financières Européennes: une Analyse en terme de Cointégration et de Causalité", *document de recherche*, ATER en Finance, Université de Rennes.

Rangvid, J. (2001), "Increasing convergence among European stock markets? A recursive common stochastic trends analysis", *Economic Letters*, 7, 383-389.

Richards, A. (1995), "Co movements in national stock markets returns: Evidence of predictability, but not co-integration", *Journal of Monetary Economics*, 36, 631-654.

Soares da Fonseca, J. (2008), "The Co-integration of European Stock Markets after the Launch of the Euro", Panoeconomicus, Vol. LV, Nº3, 309-324.

Table I- Dickey-Fuller Tests on the stationarity of the stock indexes and their first differences
(Dickey-Fuller τ statistic)

Country	Index	First Diff. of the index	Country	Index	First Diff. of the index
Czech Rep.	-1.345	-31.530	Bulgaria	-0.585	-34.382
Hungary	-1.306	-30.307	Croatia	-0.861	-28.079
Poland	-1.201	-31.257	Slovenia	-0.385	-26.282
Russia	-1.232	-30.218	Estonia	-1.349	-29.745
Turkey	-1.426	-31.117	Kazakhstan	-1.416	-31.381
EMI	-1.133	-30.168	Lithuania	-1.214	-25.150
ACWI	-1.130	-28.278	Romania	-0.818	-32.523
ACEXEM	-1.887	35.901	Serbia	-2.240	-20.370
			Ukraine	-0.927	-29.856
			EFMI	-0.795	-27.727
			EMEXFM	-1.387	-36.480
			ACEXFM	-0.901	-36.898
Stat. value at the crit. level of 5%	-2.865	-2.865	Stat. value at the crit. level of 5%	-2.865	-2.865

Table II: McKinnon and Gregory & Hansen statistics of the error terms of the long term relation between each national frontier market index and the **EFI**

	McKinnon Stat.	Intercept Break		Intercept Break & Trend		Intercept and Slope Breaks	
		GH Stat.	Break date	GH Stat.	Break date	GH Stat.	Break date
Bulgaria	-2.792	-3.938	*	-3.779	*	-4.122	*
Croatia	-3.264	-4.790	01-08-2008	-4.873	*	-4.790	*
Slovenia	-2.506	-3.225	*	-2.768	*	-3.222	*
Estonia	-1.592	-2.045	*	-2.497	*	-2.492	*
Kazakhstan	-2.548	-3.267	*	-3.600	*	-3.507	*
Lithuania	-1.223	-2.697	*	-3.273	*	-2.771	*
Romania	-3.473	-3.485	*	-3.467	*	-3.460	*
Serbia	-1.525	-3.930	*	-3.957	*	-5.449	02-04-2009
Ukraine	-2.587	-3.823	*	-3.721	*	-4.239	*
Stat value at the critical level of 5%	-3.34	-4.61		-4.99		-4.95	

Table III: McKinnon and Gregory & Hansen statistics of the error terms of the long term relation between the domestic indexes and the **EMI**

	McKinnon Stat.	*Intercept Break*		*Intercept Break & Trend*		*Intercept and Slope Breaks*	
		GH Stat.	**Break date**	**GH Stat.**	**Break date**	**GH Stat.**	**Break date**
Emerging Markets							
Czech Rep	-1.894	-2.367	*	-3.326	*	-2.853	*
Hungary	-2.195	-2.567	*	-3.661	*	-3.031	*
Poland	-2.344	-3.943	*	-4.033	*	-4.327	*
Russia	-2.056	-4.188	*	-3.542	*	-4.754	*
Turkey	-1.745	-3.004	*	-4.103	*	-3.014	*
Frontier Markets							
Bulgaria	-1.294	-4.214	*	-6.767	27-03-2008	-4.121	*
Croatia	-1.982	-3.652	*	-4.133	*	-3.867	*
Slovenia	-1.025	-2.911	*	-3.249	*	-3.150	*
Estonia	-1.918	-2.846	*	-2.663	*	-4.309	*
Kazakhstan	-3.095	-3.151	*	-3.825	*	-3.355	*
Lithuania	-2.897	-2.792	*	-3.269	*	-3.791	*
Romania	-1.361	-3.601	*	-3.686	*	-3.690	*
Serbia	-1.189	-3.312	*	-5.838	24-03-2010	-4.895	*
Ukraine	-1.447	-3.864	*	-4.582	*	-4.678	*
Stat value at the critical level of 5%	-3.34	-4.61		-4.99		-4.95	

Table IV: McKinnon and Gregory & Hansen statistics of the error terms of the long term relation between the domestic indexes and the **ACWI**

	McKinnon Stat.	*Intercept Break*		*Intercept Break & Trend*		*Intercept and Slope Breaks*	
		GH Stat.	**Break date**	**GH Stat.**	**Break date**	**GH Stat.**	**Break date**
Emerging Markets							
Czech Rep.	-1.830	-2.427	*	-3.510	*	-3.008	*
Hungary	-3.449	-3.654	*	4.256	*	-4.047	*
Poland	-3.981	-5.052	06-01-2009	-5.637	06-01-2009	-5.081	06-01-2009
Russia	-2.474	-2.781	*	-4.403	*	-3.405	*
Turkey	-2.024	-3.849	*	-4.092	*	-3.791	*
Frontier Markets							
Bulgaria	-1.489	-4.186	*	-4.897	*	-5.565	25-09-2008
Croatia	-2.819	-4.429	*	-4.773	*	-4.293	*
Slovenia	-1.025	-2.911	*	-3.249	*	-3.150	*
Estonia	-2.648	-3.324	*	-3.420	*	-3.356	*
Kazakhstan	-3.015	-3.200	*	-3.440	*	-3.778	*
Lithuania	-3.431	-3.552	*	-3.909	*	-4.754	*
Romania	-1.976	-3.690	*	-4.197	*	-4.127	*
Serbia	-1.410	-2.996	*	-4.522	*	-4.394	*
Ukraine	-1.841	-4.110	*	-4.592	*	-4.203	*
Stat value at the critical level of 5%	-3.34	-4.61		-4.99		-4.95	

Table V: McKinnon and Gregory & Hansen statistics of the error terms of the long term relation between the emerging domestic indexes, the EMI and ACXEM

	McKinnon Stat.	Intercept Break		Intercept Break & Trend		Intercept and Slope Breaks	
		GH Stat.	Break date	GH Stat.	Break date	GH Stat.	Break date
Czech Rep.	-2.391	-3.597	*	-4.522	*	-4.244	*
Hungary	-3.248	-3.467	*	-4.264	*	-4.263	*
Poland	-3.719	-5.658	06-01-2009	-5.811	06-01-2009	-5.690	06-01-2009
Russia	-2.052	-5.285	06-08-2008	-5.017	*	-5.335	*
Turkey	-1.794	-3.858	*	-4.198	*	-4.416	*
Stat value at the critical level of 5%	-3.34	-4.92		-5.29		-5.50	

Table VI: McKinnon and Gregory & Hansen statistics of the error terms of the long term relation between each frontier market index, the **EFI** and **EMXFM**

	McKinnon Stat.	Intercept Break		Intercept Break & Trend		Intercept and Slope Breaks	
		GH Stat	Break date	GH Stat	Break date	GH Stat	Break date
Bulgaria	-3.713	-3.924	*	-5.665	31-03-2008	-4.556	*
Croatia	-3.311	-4.867	*	-4.818	*	-5.284	*
Slovenia	-2.888	-3.272	*	-3.061	*	-4.451	*
Estonia	-1.454	-2.512	*	-2.511	*	-4.811	*
Kazakhstan	-3.311	-3.261	*	-3.757	*	-4.028	*
Lithuania	-2.989	-3.136	*	-3.661	*	-4.746	*
Romania	-3.806	-3.504	*	-3.643	*	-4.273	*
Serbia	-2.318	-4.098	*	-5.481	12-03-2009	-5.906	13-03-2009
Ukraine	-3.207	-3.898	*	-4.081	*	-5.697	09-09-2008
Stat value at the critical level of 5%	-3.34	-4.92		-5.29		-5.50	

Table VII: McKinnon and Gregory & Hansen statistics of the error terms of the long term relation between each frontier market index, the **EFI** and **ACXFM**

	McKinnon Stat.	Intercept Break		Intercept Break & Trend		Intercept and Slope Breaks	
		GH Stat	Break date	GH Stat	Break date	GH Stat	Break date
Bulgaria	-3.511	-4.07	*	-4.293	*	-4.458	*
Croatia	-3.650	-4.800	*	-5.458	16-07-2008	-5.097	*
Slovenia	-3.558	-3.414	*	-3.587	*	-4.082	*
Estonia	-2.335	-3.562	*	-4.410	*	-4.133	*
Kazakhstan	-2.864	-3.478	*	-3.684	*	-3.935	*
Lithuania	-3.524	-3.972	*	-4.449	*	-4.943	*
Romania	-3.465	-3.627	*	-3.788	*	-3.933	*
Serbia	-2.496	-4.067	*	-4.451	*	-5.878	27-03-2009
Ukraine	-2.685	-3.820	*	-4.498	*	-4.490	*
Stat value at the critical level of 5%	-3.34	-4.92		-5.29		-5.50	

Table VIII: Estimations of the stationary long-term relations between the domestic markets indexes and a single international index and of the respective error-correction models (standard error within brackets)

Country	Long –term relation				Error-correction model				
	Independent Variables	Coefficients	Adjusted R^2	Elasticity of reversion to the long –term relation	Lags of past changes of the variables		Causality F test	Ljung-Box chi-squared statistic on the residuals	F statistic of the no ARCH effect test on the squared residuals
					Variables	Coefficients			
Bulgaria	Constant EMI Int. Break Trend	29.584 (0.795)*** 0.882 (0.006)*** -13.422 (0.530)*** -0.069 (0.001)***	0.989	-0.045 (0.009)***	Dep. Variable (lag 1) Dep. Variable (lag 2) EMI (lag 1) EMI (lag 2)	-0.129 (0.031)*** 0.000 (0.031) 0.152 (0.025)*** 0.086 (0.025)***	28.917 ***	6.575	1.668
Bulgaria	Constant ACWI Int. Break Slope Break	-95.542 (4.255)*** 1.971 (0.041)*** 97.789 (4.585)*** -1.658 (0.047)***	0.980	-0.036 (0.006)***	Dep. Variable (lag 1) ACWI (lag 1)	-0.138 (0.029)*** 0.3830 (0.040)***	49.805 ***	6.691	1.863
Croatia	Constant EFI Int. Break	-12.352 (1.390)*** 1.190 (0.012)*** 14.064 (0.721)***	0.977	-0.0308 (0.010)***	Dep. Variable (lag 1) EFI (lag 1)	0.195 (0.044)*** -0.097 (0.055)	5.601 ***	19.198 ***	4.506 ***
Hungary	Constant ACWI	-47.326 (0.917)*** 1.469 (0.010)***	0.950	-0.040 (0.010)***	Dep. Variable (lag 1) Dep. Variable (lag 2) ACWI (lag 1) ACWI (lag 2)	-0.067 (0.042) 0.012 (0.042) 0.414 (0.079)*** -0.199 (0.080)***	17.509 ***	9.194	2.302
Lithuania	Constant ACWI	-32.995 (1.734)*** 1.485 (0.023)***	0.852	-0.026 (0.007)***	Dep. Variable (lag 1) Dep. Variable (lag 2) ACWI (lag 1) ACWI (lag 2	-0.082 (0.042)** 0.023 (0.041) 0.396 (0.058) *** -0.064 (0.060)	21.479 ***	5.663	1.412
Poland	Constant ACWI	-47.310 (0.912)*** 1.536 (0.010)***	0.954	-0.041 (0.010)***	Dep. Variable (lag 1) Dep. Variable (lag 2) ACWI (lag 1) ACWI (lag 2)	-0.118 (0.042)*** 0.078 (0.041)* 0.457 (0.076)*** -0.237 (0.077)***	22.962 ***	1.198	0.307
Poland	Constant ACWI Int. Break	-25.578 (1.022)*** 1.343 (0.010)*** -10.205 (0.357)***	0.974	-0.055 (0.013)***	Dep. Variable (lag 1) ACWI (lag 1)	-0.132 (0.041)*** 0.463 (0.076)***	31.519 ***	2.103	0.491

*   Significant at 10%
**   Significant at 5%
*** Significant at 1%

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Table VIII (cont.): Estimations of the stationary long-term relations between the domestic markets indexes and a single international index and of the respective error-correction models (standard error within brackets)

Country	Long –term relation			Error-correction model					
	Independent Variables	Coefficients	Adjusted R^2	Elasticity of reversion to the long – term relation	Lags of past changes of the variables		Causality F test	Ljung-Box chi-squared statistic on the residuals	F statistic of the no ARCH effect test on the squared residuals
					Variables	Coefficients			
Poland	Constant ACWI Int. Break Trend	-29.820 (0.990)*** 1.356 (0.009)*** -15.845 (0.526)*** 0.011 (0.001)***	0.978	-0.060 (0.014)***	Dep. Variable (lag 1) ACWI (lag 1)	-0.129 (0.041)*** 0.461 (0.076)***	31.344 ***	2.167	0.509
Poland	Constant ACWI Int. Break Slope Break	-24.367 (1.214)*** 1.331 (0.012)*** -13.585 (1.867)*** 0.041 (0.022)	0.974	-0.055 (0.013)***	Dep. Variable (lag 1) ACWI (lag 1)	-0.132 (0.041)*** 0.466 (0.076)***	20.929 ***	2.115	0.494
Romania	Constant EFI	-28.483 (0.611)*** 1.333 (0.007)***	0.967	-0.020 (0.008) **	Dep. Variable (lag 1) EFI (lag 1)	-0.046 (0.039) 0.117 (0.068)*	4.803 ***	4.683	1.232
Serbia	Constant EFI Int. Break Slope Break	-30.558 (0.518)*** 1.397 (0.008)*** 26.904 (1.304)*** -0.814 (0.024)***	0.982	-0.054 (0.013) ***	Dep. Variable (lag 1) EFI (lag 1)	0.172 (0.045)*** 0.136 (0.053)***	8.621 ***	8.043	2.011
Serbia	Constant EMI Int. Break Trend	-3.852 (0.639)*** 1.145 (0.009)*** 7.427 (0.523)*** -0.089 (0.001)***	0.982	-0.045 (0.010) ***	Dep. Variable (lag 1) EMI (lag 1)	0.158 (0.040)*** 0.124 (0.033)***	19.321 ***	8.092	2.018

*   Significant at 10%
**   Significant at 5%
*** Significant at 1%

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Table IX: Estimations of the stationary long-term relations between the domestic markets indexes and two international variables and of the respective error-correction models (standard error within brackets)

Country	Long –term relation			Error-correction model					
	Independent Variables	Coefficients	Adjusted R^2	Elasticity of reversion to the long – term relation	Lags of past changes of the variables		Causality F test	Ljung-Box chi-squared statistic on the residuals	F statistic of the no ARCH effect test on the squared residuals
					Variables	Coefficients			
Bulgaria	Constant EFI EMXFM	-39.091 (0.864)*** 1.421 (0.009)*** -0.525 (0.022)***	0.971	-0.012 (0.005)**	Dep. Variable (lag 1) EFI (lag 1) EMXFM (lag 1)	-0.135 (0.033)*** 0.216 (0.043)*** 0.149 (0.032)***	18.036 ***	6.434	1.828
Bulgaria	Constant EFI EMXFM Int. Break Trend	25.066 (1.581)*** 0.918 (0.012)*** 0.771 (0.032)*** -12.628 (0.602)*** -0.064 (0.001)***	0.989	-0.047 (0.009)***	Dep. Variable (lag 1) EFI (lag 1) EMXFM (lag 1)	-0.121(0.033)*** 0.187 (0.043)*** 0.133 (0.032)***	24.735 ***	8.185	2.279 *
Bulgaria	Constant EFI ACXFM	-21.851 (2.040)*** 1.216 (0.020)*** -0.750 (0.046)***	0.964	-0.003 (0.005)	Dep. Variable (lag 1) EFI (lag 1) EMXFM (lag 1)	-0.136 (0.032)*** 0.392 (0.046)*** 0.379 (0.046)***	32.934 ***	5.910	1.682
Croatia	Constant EFI ACXFM	1.037 (1.124) 1.078 (0.011)*** 0.311 (0.025)***	0.972	-0.044 (0.008)***	Dep. Variable (lag 1) EFI (lag 1) ACXFM (lag 1)	0.130 (0.041)*** 0.156 (0.057)*** 0.491 (0.043)***	53.442 ***	19.051 ***	4.518 ***
Croatia	Constant EFI ACXFM Int. Break Trend	-19.680 (1.317)*** 1.283 (0.013)*** 0.399 (0.030)*** 15.710 (0.703)*** -0.010 (0.001)***	0.981	-0.045 (0.010)***	Dep. Variable (lag 1) EFI (lag 1) ACXFM (lag 1)	0.129 (0.042)*** 0.161 (0.057)*** 0.491 (0.044)***	50.176 ***	18.739 ***	4.444 ***
Slovenia	Constant EFI ACXFM	43.460 (2.490)*** 0.875 (0.025)*** -1.083 (0.056)***	0.932	-0.011 (0.004)**	Dep. Variable (lag 1) EFI (lag 1) ACXFM (lag 1)	0.140 (0.040)*** 0.399 (0.067)*** 0.570 (0.055)***	38.727***	21.993 ***	5.212***
Lithuania	Constant EFI ACXFM	-36.697 (1.960)*** 1.500 (0.023)*** 1.645 (0.047)***	0.855	-0.027 (0.007)***	Dep. Variable (lag 1) EFI (lag 1) ACXFM (lag 1)	-0.020 (0.045) 0.213 (0.078) *** 0.504 (0.066)***	25.604 ***	6.761	1.753

* Significant at 10%
** Significant at 5%
*** Significant at 1%

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Table IX (cont. 1): Estimations of the stationary long-term relations between the domestic markets indexes and two international variables and of the respective error-correction models (standard error within brackets)

Country	Long –term relation				Error-correction model				
	Independent Variables	Coefficients	Adjusted R^2	Elasticity of reversion to the long – term relation	Lags of past changes of the variables		Causality F test	Ljung-Box chi-squared statistic on the residuals	F statistic of the no ARCH effect test on the squared residuals
					Variables	Coefficients			
Poland	Constant EMI ACXEM	-38.803 (1.094)*** 1.433 (0.012)*** 1.147 (0.032)***	0.960	-0.036 (0.010)***	Dep. Variable (lag 1) EMI (lag 1) ACXEM (lag 1)	0.001 (0.050) 0.350 (0.079)*** 0.679 (0.084)***	27.996 ***	1.381	0.327
Poland	Constant EMI ACXEM Int. Break	-13.999 (0.988)*** 1.208 (0.010)*** 0.865 (0.023)*** -10.863 (0.295)***	0.982	-0.061 (0.016)***	Dep. Variable (lag 1) EMI (lag 1) ACXEM (lag 1)	0.010 (0.050) 0.353 (0.078)*** 0.674 (0.084)***	28.855 ***	1.799	0.416
Poland	Constant EMI ACXEM Int. Break Trend	-16.827 (1.165)*** 1.228 (0.011)*** 0.927 (0.026)*** -12.687 (0.501)*** 0.003 (0.001)***	0.983	-0.062 (0.016)***	Dep. Variable (lag 1) EMI (lag 1) ACXEM (lag 1)	0.010 (0.050) 0.352 (0.078)*** 0.671 (0.084)***	28.848 ***	1.860	0.431
Poland	Constant EMI ACXEM Int. Break Slope Break	-13.729 (1.105)*** 1.204 (0.011)*** 0.850 (0.023)*** -17.755 (2.878)*** 0.086 (0.035)**	0.982	-0.060 (0.016)***	Dep. Variable (lag 1) EMI (lag 1) ACXEM (lag 1)	0.010 (0.050) 0.352 (0.078)*** 0.673 (0.084)***	28.628 ***	1.830	0.424
Romania	Constant EFI EMXFM	-23.552 (0.782)*** 1.299 (0.008)*** -0.192 (0.020)***	0.969	-0.024 (0.008)***	Dep..Variable (lag 1) EFI (lag 1) EMXEM (lag 1)	-0.076 (0.040) 0.139 (0.068)** 0.193 (0.045)***	9.656 ***	4.444	1.133
Romania	Constant EFI ACXFM	-29.159 (1.736)*** 1.339 (0.017)*** 0.016 (0.039)	0.966	-0.019 (0.007)**	Dep..Variable (lag 1) EFI (lag 1) ACXFM (lag 1)	-0.095 (0.038)** 0.445(0.075)*** 0.611(0.062)***	22.048 ***	2.307	0.568

 *   Significant at 10%
 **   Significant at 5%
 *** Significant at 1%

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Table IX (cont. 2): Estimations of the stationary long-term relations between the domestic markets indexes and two international variables and of the respective error-correction models (standard error within brackets)

Country	Long –term relation				Error-correction model				
	Independent Variables	Coefficients	Adjusted R^2	Elasticity of reversion to the long – term relation	Lags of past changes of the variables		Causality F test	Ljung-Box chi-squared statistic on the residuals	F statistic of the no ARCH effect test on the squared residuals
					Variables	Coefficients			
Russia	Constant EMI ACXFM Int. Break	20.064 0.943)*** 0.737 (0.009)*** -0.351 (0.016)***-- 16.342 (0.298)***	0.992	-0.053 (0.022)**	Dep.Variable (lag 1) EMI (lag 1) ACXEM (lag 1)	0.328 (0.117)*** 0.039 (0.120) 0.592 (0.083)***	18.392***	1.521	0.377
Serbia	Constant EFI EMXFM Int. Break Trend	-8.7905 (0.888)*** 1.180 (0.010) *** 1.029 (0.054) *** -7.348 (0.542) *** -0.057 (0.002) ***	0.972	-0.033 (0.010)***	Dep. Variable (lag 1) EFI (lag 1) EMXEM (lag 1)	0.158 (0.045)*** 0.141 (0.052)*** 0.128 (0.041) ***	10.371 ***	8.507	2.091
Serbia	Constant EFI EMXFM Int. Break Slope Break	-29.148 (0.681)*** 1.384 (0.008)*** 0.171 (0.099)* 24.583 (1.246)*** -0.778 (0.021)***	0.982	-0.057 (0.013)***	Dep. Variable (lag 1) EFI (lag 1) EMXEM (lag 1)	0.154 (0.045)*** 0.158 (0.053)*** 0.181 (0.054)***	8.111 ***	9.636 **	2.401
Serbia	Constant EFI ACXFM Int. Break Slope Break	-31.050 (2.373)*** 1.401 (0.025)*** 0.028 (0.080) 27.450 (2.749)*** -0.811(0.033)***	0.982	-0.058 (0.013)***	Dep.Variable (lag 1) EFI (lag 1) EMXEM (lag 1)	0.168 (0.043)*** 0.254 (0.054)*** 0.364 (0.050)***	18.643 ***	13.322 **	3.226**
Ukraine	Constant EFI EMXFM Int. Break Slope Break	-3.236 (3.673) 1.052 (0.034)*** -1.061(0.030)*** 0.883 (3.922) -0.602 (0.044)****	0.979	-0.021 (0.007)***	Dep. Variable (lag 1) EFI (lag 1) EMXEM (lag 1)	0.052 (0.033) 0.090 (0.042)** 0.053 (0.049)	3.847**	3.183	0.805

*   Significant at 10%
**   Significant at 5%
*** Significant at 1%

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