

Integration, contagion and risk contagion in financial crises: Evidence from international stock markets

Dimitrios I. Vortelinos*Konstantinos Gkillas [†]and Athanasios Tsagkanos [‡]

January 15, 2017

Abstract

This paper examines the size of contagion (integration and co-movement) of weighted portfolios based on stock market capitalization rather than firm characteristics. We investigate a large sample from 3,906 trading days from sixty-seven international stock markets taking into consideration both regional and global level. Our findings point to distinct shifts in co-movement that are detected either in regional or global level. The robustness analysis provides more evidence of contagion effect at regional level from US crisis.

Keywords: Contagion; Crises; Regime switching; Stylized portfolios.

JEL Classification Codes: F21, G01, G11, G15

*Corresponding author. Lincoln International Business School, University of Lincoln, UK. Contact at dvortelinos@lincoln.ac.uk, 0044-1522-835634 (tel.).

[†]Department of Business Administration, University of Patras, Greece. Contact at gillask@upatras.gr.

[‡]Department of Business Administration, University of Patras, Greece. Contact at atsagkanos@upatras.gr.

1 Introduction

The international impact of the recent financial crises raises issues concerning the contagion (integration and co-movements) of the international equity portfolios. Apparently, the amplification of transmission channels among financial markets (Iacoviello and Minetti, 2006) except benefits for investors may lead to adverse effects. For instance, Gupta and Guidi (2012) find that time-varying conditional correlations among developed Asian markets rose dramatically during period of crisis. There is transmission of crisis effects from one market to another (see Baele and Inghelbrecht, 2010; among others) that were enhanced by financial deregulation and integration. However, each crisis brings a different set of causes and consequences to financial markets. Therefore, any portfolio proofing policy may fail. Thus, many researchers are interested in investigating the effects of spillover and contagion in structure of international portfolios. Firstly, Bekaert et al. (2005) developed an asset pricing framework to disentangle the effect of interdependence and contagion on asset co-movements. In continuous, Bekaert, et al. (2014) researched the existence of contagion in the most recent financial crisis. The authors focus on the recent global crisis employing a small sample of firms of each market. On the same wavelength is moving the study of Dungey and Gajurel (2014) that inferred increased co-movement of global financial markets with strong contagion effects from the US to other markets. Similarly, Baur (2012) records evidence of strong contagion effects in 10 industry sectors across 25 countries during the global financial crisis, finding that no country or industry was immune.

Although a significant body of literature (e.g. Boyer 2011, Campbell et al. 2010, Wahal and Yavuz, 2013) point out the higher co-movement between stocks belonging to the same style with respect to stocks belonging to different styles, there is little evidence on how crises affect such style portfolios. A novel research of Cho et al. (2015) examines the impact of different crises based on consequences in predictability of portfolio diversification and asset allocation. The Mexican and Asian crises, originated in emerging markets, were considered to have mostly a regional impact; whereas, the recent US and EU debt crises had a global impact. Such regional and global impacts affect portfolio diversification and asset allocation.

The present paper makes a number of contributions to the literature. At first, it extends the empirical findings provided by Cho et al. (2015) to the international stock markets. This topic becomes more important taking into account the growing demand for style investments. In addition, we shall obtain a better view about the volatility of gains from international portfolio diversification and the possible reduction of systematic market risk. The augmented structural factor model of Cho et al. (2015) is employed to model shifts in integration and incorporate crisis dummies. It examines sixty-seven international stock indices from sixty-seven respective national stock exchanges, instead of firm level data. Moreover, the paper determines whether stock indices, either emerging or developed, and with different values of country characteristics (macroeconomic variables); in a regional and global level.

The employed methodology concerns a regime-switching GARCH model in accordance with a world regional-local CAPM, similar to Cho et al. (2015), and Baele and Inghelbrecht (2010). It is a joint hypothesis problem of an appropriate factor specification of co-movements. Moreover, Baele and Inghelbrecht

(2010) and Bekaert et al. (2014) contagion tests are utilized to whether international equity portfolios experienced contagion effects through increased co-movements during periods of financial crises. Bekaert et al. (2014) examined the additional impact on co-movement represented by a multi-factor model with global, regional and country factors. The US and EU financial crises are expected to have a high global impact in international equity portfolios. Cho et al. (2015) found signs of contagion with a global impact for the US crisis (also evident on Bekiros, 2013). Cho et al. (2015) also found a regional impact for the Mexican and Asian crises (also evident on Baele and Inghelbrecht, 2010), and a limited impact for the EU debt crisis. Similar evidence is expected for the international equity portfolios in the present paper.

The rest of the paper is organized as follows. Section 2 provides a detailed description of the data sources. Section 3 discusses the employed methodology. Section 4 illustrates the empirical findings together with a discussion of the results. The concluding remarks are noted in section 5.

2 Data

Dataset begins on January 3, 2000 and ends on December 31, 2014, for a total of 3,906 training days. Data were obtained from Datastream. All of the stock market data are in US dollars. Table 1 reveals the sixty-seven countries (split in regions/continents), their respective stock exchanges and indices. The symbols as well as the regional and global weights based on stock market capitalization.¹ Europe is ranking at first place as regards the stock market capitalization. This is justified on the grounds of Europe is the area with the greater number of developed markets.

[Insert Table 1 About here]

The countries selected are the countries with the most significant economies and stock markets in them regions/continents. The three financial crisis periods, following Cho et al. (2015), are: Argentine debt crisis (01/12/2001-29/11/2002), US financial crisis (18/07/2007-27/08/2009), and EU debt crisis (08/12/2010-31/12/2011). Table 1 also reveals the regional (local) and the international significance of each country's stock market capitalization. Quarterly or monthly macro data series is retrieved by the Economic Outlook Database of the International Monetary Fund in October 2014.²

Relatively to market capitalization the Americas' portfolio exhibits the highest value both in average and cumulative return. However, these values are accompanied by respective higher values both in standard deviation and Sharpe ratio (show higher risk). The results are not reported for the sake of brevity.

¹The abbreviations of stock indices are the same as country abbreviations.

²For quarterly data, a linear interpolation based on the monthly ones, is implemented.

3 Methodology

3.1 Structural regime-switching factor model

The present paper employs the Cho et al. (2015) structural regime-switching factor model in an asset (non-portfolio) CAPM model. The present paper's model, as employed in Cho et al. (2015), concerns regional and international results and targets to encapture key stylized facts like time varying betas, volatility clustering, volatility regimes, financial crises and structural economics variables.

$$r_{i,t} = \mu_{i,t-1} + \beta_{i,t}^w e_{w,t} + \beta_{i,t}^{reg} e_{reg,t} + e_{j,t} \quad (1)$$

where $r_{i,t}$ is the excess return on country i with $\mu_{i,t}$ its time-varying mean (expected return); $r_{reg,t}$ is the regional market return; $e_{w,t}$ is the global market shock ($r_{w,t} = \mu_{w,t-1} + e_{w,t}$); $e_{i,t}$ is the country specific idiosyncratic shock; $e_{reg,t}$ is the regional market shock (obtained from the regression $r_{reg,t} = \mu_{reg,t-1} + \beta_{reg,t}^w e_{w,t} + e_{reg,t}$);

Time varying betas are explained from both structural economics variables, a regime variable and crisis dummies.

$$\beta_{i,t}^w = \beta_{0,i}^w (S_{i,t}) + \beta_{1,t}^w X_{reg,t-1}^w + \sum_{j=1}^5 \gamma_{j,i}^w D_{j,t} \quad (2)$$

$$\beta_{i,t}^{reg} = \beta_{0,i}^{reg} (S_{i,t}) + \sum_{j=1}^5 \gamma_{j,i}^{reg} D_{j,t} \quad (3)$$

where $\beta_{i,t}^w$ and $\beta_{i,t}^{reg}$ are the time-varying exposures of country i to the world and regional shocks; $S_{i,t}$ is a latent regime variable different for each country; $X_{reg,t-1}^w$ are structural variables like trade integration (TI), gross domestic product (GDP), stock market capitalization (MC) that are regionally or internationally aggregated; $D_{j,t}$ is a crisis dummy variable.

Following the specifications of Cho et al. (2015), the regional shocks ($e_{reg,t}$) are estimated by an asymmetric GARCH(1,1) t-student model, and the world (global) shocks ($e_{w,t}$) by a regime switching asymmetric GARCH(1,1) Normal model, respectively. The model is estimated in three steps: Firstly, the world shock is estimated; second, the regional shock is computed using the first step's world shock; and finally, the full model is estimated for each country.

3.2 Contagion tests

Bekaert et al. (2014) consider contagion as the excess comovement beyond fundamental linkages and suggested the following test for contagion:

$$\hat{e}_{i,t} = v_0 + \sum_{j=1}^3 v_j D_{j,t} + u_{i,t} \quad (4)$$

where $\hat{e}_{i,t}$ is the estimated idiosyncratic return shocks of portfolio i , $D_{j,t}$ is a crisis dummy variable, and v_j encaptures the contagion crisis effect.

Baele and Inghelbrecht (2010) suggested two contagion tests. The first is to regress portfolio residuals on the world and their own regional shocks to retrieve any contagion signals from world and regional shocks, respectively:

$$\hat{e}_{i,t} = w_i + v_{i,t}^w e_{w,t} + v_{i,t}^{reg} e_{reg,t} + u_{i,t} \quad (5)$$

$$v_{i,t}^{w(reg)} = v_0^{w(reg)} + \sum_{j=1}^3 v_{j,i}^{w(reg)} D_{j,t} \quad (6)$$

where $\hat{e}_{i,t}$ is the idiosyncratic return shocks of portfolio i ; $v_{i,t}^{w(reg)}$ is the additional contagion from a specific crisis period j at global and regional level, respectively; $D_{j,t}$ is a crisis dummy variable. If the crisis generates abnormal higher comovement, these comovements should be depicted in the $v_{j,i}^{w(reg)}$ coefficients.

The second test follows:

$$\hat{e}_{i,t} = c_i + v_{i,t}^k e_{k,t} + \varepsilon_{i,t} \quad (7)$$

$$v_{i,t}^k = v_0^k + \sum_{j=1}^3 v_{j,i}^k D_{j,t} \quad (8)$$

where $\hat{e}_{k,t}$ is the sum of all the idiosyncratic shocks of all the other k portfolios in the same region as portfolio i except for portfolio i . This test concerns whether a crisis generates excess comovement via a two-tailed hypothesis test ($H_0 : v_{j,i}^k \neq 0$).

4 Empirical Findings

The differences are signified via their differences in the magnitude and statistical significance of the coefficients in the structural regime switching factor models. In order to obtain more reliable results and incorporating crisis dummies we move our analysis based on time-varying betas for global and regional level. Table 2 report the estimated coefficients for all international equity portfolios.

[Insert Table 2 About here]

Results from such a model are retrieved regionally and internationally and concern the stylified facts of volatility regimes, financial crises and structural economic variables. The results seem to highlight contrasting patterns. Overall there are clear differences on the level of co-movement between global and regional level. As regards the market capitalization weighted portfolios the level of co-movement and integration is shifted mainly to regional level almost for all areas. The US crisis plays important role in this direction detecting as well respective impacts both from Argentine crisis and EU crisis (except the area of Africa).

In general, the extension of research to international stock markets broadens the empirical findings provided by Cho et al. (2015). In addition, both different country characteristics (macroeconomic variables) and crises periods have significant impact in international equity portfolios affecting the size of integration and co-movement. Therefore, the investors should be careful when choose style investments in international stock markets based on national macroeconomic variables. The reduction of systematic market risk is a laborious process and any potential diversification may be unsuccessful if they do not take into consideration the distinct shifts in co-movement as causes of country characteristics and crises periods.

Evidence of contagion effects from periods of financial crises are presented in table 3 following the approach of Bekaert et al. (2014).

[Insert Table 3 About here]

We result in little evidence of contagion of the crises periods. The US and EU financial crises have a higher global impact while Argentine crisis demonstrate higher regional impact. However, overall the magnitudes of the detected contagion effects are very small. The results come in accordance with previous studies as these of Baele and Inghelbrecht (2010), Bekiros (2013), Bekaert et al. (2014) and Cho et al. (2015). Therefore, the nature of crisis itself produces different impacts. For instance, a crisis that originates from developed nations is not sufficient to cause significant contagion effects. For this reason, we observe little evidence of contagion during US and EU crisis.

Our key findings are checked performing two robustness tests as Baele and Inghelbrecht (2010). In order to conserve space, we do not present the results bur are available upon request. The results seem to confirm and support the previous inferences. Primarily we are based on first test. For global contagion the Argentine crisis show infinitesimal effect. On the other hand, the US and EU financial crises produce widespread global effects although global contagion signals are not detected. At regional level there is a reverse relationship where the Argentine crisis exhibit greater contagion signals than the other crises. The results of second test are almost similar. The contagiousness of crises remains at the same level. However, there is also evidence of contagion effect at regional level from US crisis that is quite clear. Apparently, a crisis that originates from the most important economy of the world is a crucial parameter that cannot discarded neither from global nor from regional level.

5 Concluding remarks

In this paper, we make an effort to respond in question whether the amplification of transmission channels among financial markets was the cause of increased contagion during crisis periods. Obviously, the consequences cause change in classical portfolio management. We therefore contribute to this issue of research examining the degree of integration, co-movement and prone to contagion of weighted portfolios based on stock market capitalization variable rather than firm characteristics. The research is extended to international stock markets concerning both regional and global level.

Our results exhibit distinct shifts in co-movement that are detected either in regional or global level (this is depends on the stylized portfolio) while significant effects originate from country characteristics and crises periods. The implications for investors are highlighted by means of these findings. Understanding the nature of time variation in integration is the first part of investors to adopt a valuable risk management strategy. The other part concerns the understanding of the effects from country characteristics and crises periods.

In continuous, following the approach of Bekaert et al. (2014) we detect little evidence of contagion effect because their magnitudes are very small. More specifically, the US and EU financial crises have a higher global impact while Argentine crisis demonstrate higher regional impact. The robustness analysis confirms our main findings suggesting as well more evidence of contagion effect at regional level from US crisis. Clearly, our analysis provides new directions for portfolio managers in order to achieve better returns with lower risk.

References

- [1] Baele, L., and Inghelbrecht, K. (2010). Time-varying integration, interdependence and contagion. *Journal of International Money and Finance*, 29, 791-818.
- [2] Baur, D. (2012). Financial contagion and the real economy. *Journal of Banking and Finance*, 36, 2680-2692.
- [3] Bekaert, G., Ehrmann, M., Fratzscher, M., and Mehl, A. (2014). The global crisis and equity market contagion. *Journal of Finance*, 69 (6), 2597-2649.
- [4] Bekaert, G., Harvey, C. R., and Ng, A. (2005). Market integration and contagion. *Journal of Business*, 78, 39-69.
- [5] Bekiros, S.D. (2013). Contagion, decoupling and the spillover effects of the US financial crisis: Evidence from the BRIC markets. *International Review of Financial Analysis*, 33, 58-69.
- [6] Boyer, H. B. (2011). Style related comovement: Fundamentals or labels? *Journal of Finance*, 66, 307-332.
- [7] Campbell, J. Y., Polk, C., and Vuolteenaho, T. (2010). Growth or glamour? Fundamentals and systemic risk in stock returns. *Review of Financial Studies*, 23, 305-344.
- [8] Cho, S., Hyde, S., and Nguyen, N. (2015). Time-varying regional and global integration and contagion: Evidence from style portfolios. *International Review of Financial Analysis*, 42, 109-131.
- [9] Dungey, M., and Gajurel, D. (2014). Equity market contagion during the global financial crisis: Evidence from the world's eight largest economies. *Economic Systems*, 38(2), 161-177.
- [10] Gupta, R., and Guidi, F. (2012). Cointegration relationship and time varying co-movements among Indian and Asian developed stock markets. *International Review of Financial Analysis*, 21,10-22.
- [11] Iacoviello, M., and Minetti, R. (2006). International business cycles with domestic and foreign lenders. *Journal of Monetary Economics*, 53, 2267-2282.
- [12] Wahal, S., and Yavuz, M. D. (2013). Style investing, comovement and return predictability. *Journal of Financial Economics*, 107, 136-154.

Tables

Table 1. Description of the dataset

Country	Stock exchange	Index	Symbol	Weights Stock market capitalization	
				Regional	International
AFRICA				AFR	7.19%
Botswana	Botswana stock exchange	Botswana Gaborone Index (BGSMDC)	BWA	29.32%	2.11%
Egypt	Egyptian exchange	Egypt Stock Market (EGX30)	EGY	16.32%	1.17%
Kenya	Nairobi stock exchange	Nairobi Securities Exchange 20 share index (N20I)	KEN	15.70%	1.13%
Mauritius	Mauritius stock exchange	Mauritius Stock Exchange Semdex Index (SEMDEX)	MUS	21.85%	1.57%
South Africa	Johannesburg stock exchange	FTSE/JSE Africa All Shares Index (JALSH)	ZAF	16.80%	1.21%
AMERICAS				AME	15.47%
Argentina	Argentina stock exchange	Argentina Merval Index (MERVAL)	ARG	7.46%	1.15%
Brazil	Brazil Stock Market (BOVESPA)	Ibovespa Brasil Sao Paulo Stock Exchange Index (IBOV)	BRA	7.51%	1.16%
Canada	Toronto stock exchange (TMX)	S&P/Toronto Stock Exchange Composite Index (SPTSX)	CAN	9.50%	1.47%
Chile	Santiago stock exchange	Santiago Stock Exchange Ipsi Index (IPSA)	CHL	9.40%	1.45%
Colombia	Bolsa de Valores de Colombia (BVC)	IGBC index	COL	8.90%	1.38%
Jamaica	Jamaica stock exchange	Jamaica Stock Exchange Market Index (JMSMX)	JAM	10.04%	1.55%
Mexico	Mexico Stock Market (IPC)	Mexican Stock Exchange Mexican Bolsa Ipc Index (MEXBOL)	MEX	9.40%	1.45%
Panama	Panama Stock Market (BVPSI)	Bolsa de Valores de Panama General Index (BVPSBVPS)	PAN	9.85%	1.52%
Peru	Bolsa de Valores de Lima (BVL)	Bolsa de Valores de Lima General Sector Index (IGBVL)	PER	9.20%	1.42%
United States	NASDAQ Stock Market	Nasdaq Composite Index (CCMP)	USA	8.80%	1.36%
Venezuela	Venezuela Stock Market (IBVC)	Caracas Stock Exchange Stock Market Index (IBVC)	VEN	9.95%	1.54%
ASIA				ASI	32.90%
Australia	Australian Securities Exchange (ASE)	Australian Stock Exchange All Ordinaries Index (AS30)	AUS	5.37%	1.77%
Bangladesh	Dhaka stock exchange (DSE)	Dhaka Stock Exchange Index (DHAKA)	BGD	5.12%	1.68%
China	Shanghai stock exchange (SSE)	Shanghai Stock Exchange Composite Index (SHCOMP)	CHN	8.55%	2.81%
Hong Kong SAR	Hong Kong Stock Exchange (HKEx)	Hang Seng CSI Shanghai-Hong Kong AH Smart Index (HSI)	HKG	4.61%	1.52%
India	National Stock Exchange of India Limited (NSE)	S&P Bse Sensex Index (SENSEX)	IND	6.36%	2.09%
Indonesia	Indonesia Stock Exchange (IDX)	Jakarta composite index (JCI)	IDN	5.50%	1.81%
Israel	Tel Aviv Stock Exchange (TASE)	Tel Aviv 25 Index (TA-25)	ISR	3.90%	1.28%
Japan	Japan Exchange Group (JPX)	Nikkei 225 (NKY)	JPN	4.37%	1.44%
Jordan	Amman Stock Exchange (ASE)	Amman Stock Exchange General Index (JOSMGNFF)	JOR	4.87%	1.60%
Malaysia	Bursa Malaysia (KLSE)	ftse Bursa Malaysia KLCi Index Kuala Lumpur Composite Index (FBMKLCI)	MYS	4.68%	1.54%
New Zealand	New Zealand Stock Market (NZX)	New Zealand Exchange 50 Gross Index (NZSE50FG)	NZL	4.31%	1.42%
Oman	Muscat Securities Market (MSM)	Muscat Securities Msm 30 Index (MSM30)	OMN	5.08%	1.67%
Pakistan	Islamabad Stock Exchange (ISE)	Karachi Stock Exchange Kse100 Index (KSE100)	PAK	3.14%	1.03%
Philippines	Philippine Stock Exchange (PSE)	Philippines Stock Exchange Ps Ei Index (PCOMP)	PHL	3.96%	1.30%
Saudi Arabia	Saudi Stock Exchange (Tadawul)	Tadawul All Share Index (TASI)	SAU	4.93%	1.62%
Singapore	Singapore Exchange (SGX)	Singapore exchange market index (SGX)	SGP	5.24%	1.72%
South Korea	Korea stock exchange (KRX)	Korea Stock Exchange Kospi Index (KOSPI)	KOR	6.23%	2.05%
Taiwan Province of China	Taiwan Stock Exchange (TWSE)	Taiwan Stock Exchange Weighted Index (TWSE)	TWN	4.19%	1.38%
Thailand	Thailand Stock Market (SET)	Stock Exchange Of Thailand Set Index (SET)	THA	5.24%	1.72%
United Arab Emirates	United Arab Emirates Stock Market (ADX)	Dubai Financial Market General Index (DFMGI)	ARE	4.37%	1.44%
EUROPE				EUR	44.43%
Austria	Austria Stock Market (WBI)	Vienna Stock Exchange Austrian Traded Index (ATX)	AUT	3.29%	1.46%
Belgium	Brussels Stock Exchange (BSE)	Bel 20 Index (BEL20)	BEA	3.11%	1.38%
Bulgaria	Bulgaria Stock Market (SOFIX)	Bulgaria Stock Exchange Sofix Index (SOFIX)	BGR	3.65%	1.62%
Croatia	Zagreb Stock Exchange (ZSE)	Croatia Zagreb Stock Exchange Crobex Index (CRO)	CRO	3.64%	1.62%
Cyprus	Cyprus Stock Exchange (CSE)	Cyprus Stock Exchange General Index (CYSMMAPA)	CYP	2.60%	1.15%
Czech Republic	Prague Stock Exchange (PSE)	Prague Stock Exchange Index (PX)	CZE	3.87%	1.72%
Denmark	Copenhagen Stock Exchange (CSE)	OMX Copenhagen 20 index (KFX)	DNK	2.88%	1.28%
Estonia	Tallinn Stock Exchange (TSE)	Om x Tallin Index (TALSE)	EST	4.49%	2.00%
Finland	OMX Helsinki (OMXH)	Om x Helsinki Index (HEX)	FIN	3.36%	1.49%
France	Euronext Paris	Cac 40 Index (CAC)	FRA	3.28%	1.46%
Germany	Frankfurt Stock Exchange (FWB)	Deutsche Boerse Ag German Stock Index Dax (DAX)	DEU	2.68%	1.19%
Greece	Greece Stock Market (ASE)	Athens Stock Exchange General Index (ASE)	GRE	2.98%	1.32%
Hungary	Budapest Stock Exchange (BUX)	Budapest Stock Exchange Budapest Stock Index (BUX)	HUN	3.24%	1.44%
Ireland	Irish Stock Exchange (ISE)	Irish Stock Exchange Overall Index (ISEQ)	IRL	3.26%	1.45%
Italy	Italian stock exchange (MIB)	ftse Mib Index (FTSEMIB)	ITA	2.95%	1.31%
Latvia	Riga Stock Exchange (RSE)	OMX Riga (OMXR)	LVA	4.05%	1.80%
Lithuania	Vilnius Stock Exchange (VSE)	OMX Vilnius (OMXV)	LTU	3.08%	1.37%
Luxembourg	Luxembourg Stock Exchange (LUX)	Luxembourg Stock Exchange Lux X Index (LUXXX)	LUX	3.07%	1.37%
Malta	Malta Stock Exchange (MALTEX)	Malta Stock Exchange (MALTEX)	MLT	2.80%	1.24%
Netherlands	Amsterdam Stock Exchange (AMX)	Amsterdam Stock Exchange Amsterdam Midkap Index (AMX)	NLD	3.05%	1.36%
Norway	Norway Stock Market (OBX)	Oslo Stock Exchange All Share Index (OSEAX)	NOR	3.31%	1.47%
Portugal	Lisbon Stock Exchange (LSE)	Portugal PSI 20 Index (PSI20)	PRT	3.21%	1.42%
Romania	Bucharest Stock Exchange (BSE)	Bucharest Stock Exchange Trading Index (BET)	ROU	3.62%	1.61%
Russia	Moscow Interbank Currency Exchange (MICEX)	Micex Index (INDEXCF)	RUS	3.13%	1.39%
Slovak Republic	Bratislava Stock Exchange (BSE)	Slovak Share Index (SKSM)	SVK	3.61%	1.61%
Spain	Madrid Stock Exchange (MSE)	Madrid Stock Exchange IBEX 35 Index (IBEX)	ESP	3.70%	1.65%
Sweden	Stockholm Stock Exchange (SSE)	OMX Stockholm 30 Index (OMX)	SWE	2.70%	1.20%
Switzerland	Swiss Exchange (SIX)	Swiss Exchange (SIX)	CHE	3.15%	1.40%
Turkey	Istanbul Stock Exchange (ISE)	Borsa Istanbul 100 Index (XU100)	TUR	2.87%	1.27%
Ukraine	Ukrainian Stock Exchange (PFTS)	Ukrainian Equities Index (UX)	UKR	3.00%	1.33%
United Kingdom	London stock exchange (LSE)	FTSE 100 Index (UKX)	GBR	2.40%	1.07%
ALL				ALL	100.00%

Notes. Table 1 describes the dataset. It includes the countries examined, their respective stock exchanges, main stock indices, symbols, and regional and international significance (regional and international weights) in terms of stock market capitalization.

		Table 2. Structural regime-switching factor model on Market Capitalization-based portfolios																									
		Global betas											Regional betas														
		β_0^G	β_1^G	ARG crisis	US crisis	EU crisis	MC	TI	GDP	INF	INT	adj. R^2	F - stat	β_0^R	β_1^R	ARG crisis	US crisis	EU crisis	MC	TI	GDP	INF	INT	adj. R^2	F - stat		
AFRICA																											
Botswana		-27.634	-34.292	-34.292	23.372	-47.175**	-14.236	-0.878	1.476**	-1.266	-0.550	0.068	1.135	-0.499**	-0.389**	0.671	1.067*	0.129**	-0.256**	-0.065**	-0.055**	0.087**	0.019**	0.112	1.961**		
Egypt		0.4865**	-0.374**	1.027**	0.973	-0.740	-2.632	-0.375**	0.027**	0.960*	0.040	0.055	0.915	0.031	1.184	1.379	-1.854**	-1.959	0.608	-0.338*	0.094**	0.094**	0.242**	0.058	0.957		
Kenya		18.900	15.396	33.046**	-16.909	-27.446	-5.818	93.566**	2.253*	-26.874**	12.245*	0.180	0.179**	0.809**	1.069**	-0.094	1.077	-0.026	0.772*	-0.867	-0.011**	0.320**	-0.170**	0.098	1.700**		
Mauritius		3.413	0.949	-9.760*	-3.297	5.806	-4.812	4.311	-1.299*	-0.435	2.676	0.065	1.084	-0.184*	0.133	-0.028	-0.228**	-0.669**	-0.105	-0.329**	0.065**	0.016**	0.028**	0.050	0.815*		
South Africa		-1.706*	-2.130	0.129	2.807**	-1.196	-3.528	5.402	0.094**	-1.200	0.070	0.049	0.820	1.474**	1.932**	1.136**	-0.976**	-0.562	3.306**	-1.488	-0.023**	-0.675	-0.320**	0.137	2.478**		
AMERICAS																											
Argentina		0.820	2.516	-2.504	-2.165	-1.723	-6.689	0.022	10.878	-1.341*	1.629**	0.039	0.632	-0.655	-1.588**	-2.046**	-1.537**	1.097	0.657	-0.035	-2.340	-0.132	-0.058*	0.067	1.125		
Brazil		-0.977**	-0.977**	1.075**	0.748**	0.769*	-0.546	-0.117**	0.080**	-0.157*	0.028**	0.115	2.028**	-0.280	-0.713**	-1.012	-0.905**	0.644	-0.381	-0.026	-0.104**	-0.367**	-0.050**	0.063	1.049		
Canada		7.615	2.131	-1.123	-1.123*	3.765	2.214	2.482	-1.355	3.669*	-0.911	0.039	0.039	-0.501**	-0.667**	-0.848**	-1.248**	0.091	0.054	0.173**	-0.113**	0.311**	0.154**	0.072	1.201		
Chile		-3.104	-10.182	3.070	-16.019	-7.192	-15.022	13.432	0.186	-18.776*	6.780	0.024	0.392	-0.024**	-0.092**	-0.086**	-0.153**	0.171**	0.116**	-0.076**	-0.019**	0.375**	-0.046**	0.050	0.824		
Colombia		-5.982**	-3.139*	0.298	0.298	-6.174*	-4.005	-0.865**	0.475	-0.056*	0.421	0.065	1.090	-0.236**	-0.204**	-0.199**	-0.297**	0.085	-0.019**	0.020**	-0.011**	-0.714**	0.025**	0.060	0.989		
Jamaica		46.184	4.877	-19.652	20.257	-6.063	4.735	19.386	19.386	-0.108	30.973	0.025	0.395	-0.059**	0.201**	-0.406**	-0.028	1.641**	-0.759**	0.016**	0.008*	0.081	-0.090**	0.249	5.162**		
Mexico		-1.423	-1.423	-0.909	-2.069	1.019	-4.791	-0.251	0.077**	-4.809**	1.121**	0.062	1.037	-0.186	-0.332**	-0.762**	-1.542**	0.223	0.299	-0.063**	-0.080**	1.263**	0.188**	0.161	2.985**		
Panama		-9.605	0.772	-13.944	-11.056	-13.053	0.311	4.225	3.650	0.645	2.752	0.024	0.379	0.443**	0.173**	-0.711**	-0.142**	0.152	-0.263	0.202	-0.104**	0.302**	0.094**	0.092	1.582		
Peru		-0.083	-0.778	0.712	-1.540	-0.332	-4.935**	0.695	3.763**	-0.045	0.362**	0.106	1.886**	-0.333**	-0.220**	-0.191**	-0.296**	-0.123**	0.084**	0.062**	-0.020**	0.076**	-0.017**	0.065	1.093		
United States		-3.083	-1.261*	2.010	0.145	-0.920	0.166	3.043*	0.109**	-0.661**	0.015	0.075	1.268	0.510**	-0.117**	-1.420	-0.779	0.234	0.780	-1.419	-0.075**	-0.244**	0.165**	0.125	2.227**		
Venezuela		-0.425**	-0.093	-0.185	-0.185*	0.242	0.713**	-0.111	-0.044**	-0.278**	-0.035**	0.039	0.039	-0.087**	-0.309**	-0.144**	-0.571**	-0.134**	0.030	-0.498**	0.006**	0.454**	0.090**	0.067	1.126		
ASIA																											
Australia		-1.452	-4.301	-1.233	-6.066	-13.007**	12.267*	-2.383	0.749**	0.749	-0.391	0.065	1.086	0.024	-0.087*	-0.131**	-0.180**	0.129**	-0.455**	0.110**	-0.071**	-0.075**	0.088**	0.095	1.630*		
Bangladesh		0.817	1.284	1.007	-1.734	-1.708	1.811	-1.704	-1.228	1.479	-0.777*	0.120	0.313	1.780**	1.796**	-0.122**	-0.389**	-0.168**	-0.036**	-0.101**	0.049**	-0.454**	0.002	0.159	2.952**		
China		-1.142	-3.168	-0.758	1.726	-1.992	1.290	-5.952*	0.158	-4.896**	-1.786**	0.106	0.106**	3.656**	3.406**	-0.789**	-0.996*	-0.090	0.356	-0.171	-0.014*	0.051	0.267**	0.130	2.839**		
Hong Kong SAR		1.903	1.401	-1.866**	1.397**	0.948	4.703**	-2.633	0.392**	-2.084**	-0.441**	0.062	1.023	6.972*	6.922*	-0.195	-1.961	-0.619	-1.574	1.192	0.014**	0.078	0.542**	0.154	2.344**		
India		-43.779	-52.495	-2.343	-20.970	-12.942	-56.845*	50.272	0.255	-5.771	2.768	0.040	0.649	1.282**	0.813**	-0.390*	-1.608	-0.903	-1.611	-0.385	0.068**	-0.054	0.531	0.077	1.308		
Indonesia		1.435	2.740	4.379	-1.167	-6.984*	-4.394	-3.319	0.372**	0.135*	0.522	0.042	0.676	1.912**	1.525**	-0.100*	-0.586**	0.004	0.814**	-0.057	-0.012**	0.095**	-0.157**	0.124	2.215**		
Israel		-3.248	-1.490	-3.394*	-0.325	0.210	-0.117	-7.674	-0.088	-1.096*	-0.307	0.037	0.599	2.561**	2.310**	0.033	-0.844**	0.089*	-0.372	2.950	0.066**	-0.014**	0.175**	0.180	3.416**		
Japan		5.177	2.906	4.802	2.611	-5.324**	-5.088	-8.796	0.556**	4.395*	0.810**	0.073	1.227	8.437**	8.055**	-0.092	-0.745**	-0.281**	0.764*	-1.817**	-0.035**	-0.218**	-0.104**	0.240	4.919**		
Jordan		28.346	18.577	-4.986	-34.331**	0.718	37.840**	9.022*	-0.333**	8.443**	3.022	0.152	2.813**	-0.032**	-0.043**	0.065**	-0.067**	-0.206**	-0.156**	0.076**	0.023**	-0.058**	0.031**	0.120	2.127**		
Malaysia		-2.037	-3.726	-7.148	-3.180*	-5.377	-19.308*	-2.289	0.300*	0.288	0.915	0.032	0.514	0.066**	0.541**	0.066*	-0.327**	-0.052**	-0.602**	0.018**	0.015**	-0.055**	0.120**	0.080	1.364		
New Zealand		13.148	11.159	1.283	-1.466	-14.293*	12.327**	-33.315**	0.577	-13.415**	-2.451	0.205	4.024**	0.943**	0.763**	-0.054	0.127**	0.549**	0.583**	0.575**	-0.047**	0.042**	-0.104**	0.148	2.708**		
Onan		38.748**	38.937**	-4.425	1.257	-2.595	5.243	2.038	-0.311	3.139	-0.763	0.084	1.427	3.956**	3.812**	-0.080**	-0.155**	-0.031**	0.341**	-0.038**	-0.017**	0.035**	-0.034**	0.315	7.164**		
Pakistan		-2.453	-3.324	-3.074	-1.877	-0.421	1.712	2.763	-0.081	-5.863	-0.137	0.021	0.339	1.783**	1.637**	0.344**	-0.319**	-0.162**	0.064	-0.174**	-0.002**	0.1834**	0.030	0.151	2.782**		
Philippines		-0.399	-0.400	-29.569**	-29.569	-9.525	-6.610	19.407**	15.843	-0.423	3.019	0.074	0.074	1.111**	0.769**	1.033**	-0.516**	-0.469**	0.345**	0.389**	-0.431**	0.019**	-0.032**	0.126	2.254**		
Saudi Arabia		13.927	15.432	-7.392*	1.027	3.800	-0.465	-2.696*	0.016**	0.773	3.746	0.033	0.528	-0.352**	-0.313**	0.092**	-0.106**	0.125**	0.091**	0.001**	-0.004**	-0.032**	-0.035**	0.082	1.402		
Singapore		-3.920	-3.719	-2.273	-3.019*	2.508	-4.741*	1.973	0.463	-0.087	1.518**	0.050	0.819	3.538**	3.324**	-0.398**	-0.984**	-0.402**	1.001**	-0.196**	-0.160**	-0.017**	0.087**	0.159	2.948**		
South Korea		-6.866	-7.869	-1.929	-1.545	-6.082*	-3.300	0.012	1.428*	-0.194	-0.455*	0.045	0.727	9.806**	9.462*	-0.375	-0.965**	0.237	0.941*	-0.312**	-0.273**	0.051**	0.044**	0.186	3.574**		
Taiwan Province of China		-0.279	0.223	1.704*	5.135**	-2.464	0.803*	1.815**	-0.083	1.855**	-1.163**	0.107	1.894**	4.926**	4.700**	-0.011	-1.426**	-0.196	0.102	-0.195	0.198*	-0.183**	0.254**	0.151	2.764**		
Thailand		-3.796	1.115	-6.950	-2.116	4.590	28.333**	-7.722*	-9.261**	-4.396	-4.935**	0.090	1.547	1.662**	1.356**	-0.352**	-0.848**	-0.466**	-0.308	0.176*	0.226**	-0.058	0.199*	0.117	2.059**		
United Arab Emirates		-13.047	-12.159	1.278	10.542**	-4.110	-8.980*	17.659*	0.355	0.507	-2.382*	0.123	2.190**	0.222**	0.168**	0.082**	-0.088**	-0.058**	0.076**	-0.123**	0.038**	0.033**	-0.019**	0.102	1.766*		
EUROPE																											
Austria		-7.253	-8.223	0.298	5.069*	-3.733	1.992	-2.165	0.201	1.319	2.765	0.040	0.643	0.479**	0.532**	-0.239**	-0.413**	-0.390**	-0.652**	-0.123**	0.034**	-0.045**	0.512**	0.137	2.485**		
Belgium		-1.429	-1.052	-0.709*	0.303	-1.018	-0.320	-0.741	0.701	-0.291**	-0.188**	0.018	0.282	0.479**	0.234**	-0.146*	-0.542**	-0.690**	0.514**	0.751**	0.829	-0.028	0.273**	0.127	2.272**		
Bulgaria		-1.873	-3.518	-0.402	-0.389	-5.728**	1.410	2.245	4.516	0.328*	-0.144	0.030	0.474	-0.146	0.287	-0.533	-1.795**	-1.169	5.325	2.024	-2.409	-0.050	-0.370	0.074	1.216		
Croatia		-4.797	3.990	53.029**	0.990	1.673	-5.405	3.361	0.034**	-7.348	0.539	0.082	1.402	-0.353**	-0.656**	-0.704**	-0.825**	-0.825	0.971	1.585	-0.082**	-0.027	0.071**	0.114	2.066**		
Cyprus		-3.995	-2.229	0.447	-7.248**	-6.017*	-12.041**	-1.114	0.255	-0.823	2.950**																

Notes. Table 2 reports the estimated coefficients for all types of international equity Market Capitalization-based portfolios from the structural regime-switching factor model. Coefficients are retrieved regionally and internationally and concern the stylized facts of volatility regimes, financial crises and structural economics variables. β_0^w and β_1^w are the estimates of the latent regime variables. The three crises concern the coefficients of the three respective dummy variables. MC, IT ... are the structural macroeconomic variables. Then, the adjusted R^2 (adj. R^2) and the joint significance hypothesis F test ($F - stat$) are reported. * and ** indicate statistical significance at 10% and 5% respectively.

Table 3. Bekaert et al. (2011) contagion test on Market Capitalization-based portfolios								
	Implied global betas				Implied regional betas			
	v_0	Arg cr.	US cr.	EU cr.	v_0	Arg cr.	US cr.	EU cr.
AFRICA								
Botswana	-1.387*	-1.390	0.517	1.524	0.054	-0.706**	0.312*	-0.083
Egypt	-0.011	0.253	-0.022	0.050	-0.076	0.997	0.220	0.047
Kenya	-0.010	-0.481**	-0.003	0.404**	-0.063*	0.156	0.043	0.055
Mauritius	-0.205	-0.465	-0.099	0.687	0.009	0.099	0.018	0.012
South Africa	0.120*	0.172	-0.463**	-0.351*	-0.019	0.372**	-0.055	0.023
AMERICAS								
Argentina	0.541*	-0.508	-0.533	-2.091*	0.042	0.175	0.074	-0.623
Brazil	-0.089	-0.019	0.066	-0.015	0.178	0.025	-0.048	-0.307
Canada	1.592*	-1.330	-0.912	-1.311	-0.092	0.260	0.153	0.029
Chile	3.287**	-3.507	-3.482	-3.980	-0.014	0.121**	0.038	-0.054*
Colombia	0.244**	-0.069	-0.087	0.097	-0.043**	0.098*	0.067*	0.020
Jamaica	2.928**	-5.013	-3.803*	-2.384	-0.009	0.030	0.020	0.282**
Mexico	0.539**	-0.754	-0.839*	-0.234	0.178	0.068	-0.098	-0.334
Panama	0.110*	-0.010	0.002	0.356*	0.085	-0.095	-0.085	-0.193
Peru	-0.040	-0.262*	-0.056	-0.111	-0.001	0.071	0.035	-0.026
United States	0.009	-0.002	0.032	0.125	0.020	0.044	0.055	-0.002
Venezuela	0.709**	-1.208	-0.933	-0.449	0.005	0.061	0.070	-0.012
ASIA								
Australia	1.109**	-1.045	-1.507**	-1.066	0.004	0.035	0.004	-0.007
Bangladesh	0.210*	-0.944*	0.024	0.131	-0.027*	0.027	0.024	0.025
China	0.046	-0.183	-0.749*	0.562	0.035	0.038	-0.020	0.011
Hong Kong SAR	-0.221**	0.475**	0.323**	0.280	0.094	0.075	-0.079	-0.032
India	-2.228**	2.442	1.658	5.270*	-0.021	0.181	0.054	0.003
Indonesia	-0.414*	0.238	0.174	0.746	-0.054*	0.176*	0.063	0.092
Israel	0.182	-0.471	-0.239	0.229	-0.054	0.222*	0.075	0.072
Japan	0.169	-0.619*	0.003	-0.245	-0.099	0.123	0.109	0.053
Jordan	-0.662	0.650	0.555	0.884	0.002	0.035**	0.004	0.019
Malaysia	-0.816*	1.001	0.677	1.381	0.011	0.144*	0.003	0.036
New Zealand	0.004	0.262	-0.039	0.052	-0.050*	0.160	0.064	0.058
Oman	-0.324*	0.079	-0.159	0.806	-0.047**	0.048	0.052	0.053
Pakistan	0.441**	-0.583	-0.542	-0.683	-0.013	0.098*	0.010	0.049
Philippines	0.280	0.069	-0.353	-0.341	0.004	0.476**	0.004	-0.014
Saudi Arabia	0.665**	-0.846	-1.318**	0.869*	0.001	0.045	0.004	0.028
Singapore	-0.192**	0.228	-0.022	0.623**	0.044	0.008	-0.030	0.012
South Korea	0.743**	-0.929*	-0.632*	-1.083**	-1.083*	0.039	-0.141	-0.237
Taiwan Province of China	-0.225*	-0.027	0.248	-0.975**	0.002	0.200	-0.001	-0.094
Thailand	-0.094	0.154	-0.305	-0.872	0.052	0.039	-0.049	-0.041
United Arab Emirates	0.719**	-0.810	-1.700**	-0.173	2.21e-4	0.020	1.29e-4	-0.001
EUROPE								
Austria	0.741**	-0.802	-0.849*	-0.717	-0.057**	0.065	0.061	0.067
Belgium	0.114**	-0.119	-0.316**	0.124	-0.111	0.113	0.136	0.097
Bulgaria	-0.087	0.183	-0.448	1.949**	-1.174**	1.169	1.156	1.085
Croatia	0.394	-1.477**	-0.480	-0.480	0.213**	0.166	0.198	0.157
Cyprus	-0.481**	-0.152	0.238	-0.339	-0.104*	0.103	0.159	0.051
Czech Republic	-0.120*	-0.806**	-0.027	-0.066	-0.194**	0.205	0.224	0.130
Denmark	0.410*	-0.318	-0.356	-0.506	-0.084*	0.106	0.097	0.017
Estonia	0.122	-0.671*	0.083	0.380	-0.150**	0.159	0.176*	0.151
Finland	-0.285**	-0.303	0.316	-0.384	-0.498**	0.499	0.638**	0.393
France	-0.171**	0.201	0.090	0.054	-0.159	0.166	0.209	0.099
Germany	-0.085*	0.198	-0.007	0.088	-0.125	0.131	0.155	0.082
Greece	-0.063	0.208	-0.611**	0.152	-0.129**	0.153	0.157	0.004
Hungary	0.127	-0.157	-0.190	-0.247	-0.198**	0.208	0.231	0.179
Ireland	0.103*	-0.339*	0.145	-0.046	-0.187	0.199	0.221	0.191
Italy	0.123**	-0.137	-0.295**	0.075	-0.111	0.113	0.136	0.097
Latvia	0.951**	-2.051**	-1.143*	-0.500	-0.314**	0.323	0.340	0.299
Lithuania	0.250**	-0.046	-0.948**	-0.276	-0.031*	0.037	0.035	0.034
Luxembourg	-0.157*	0.009	0.001	0.328	-0.088**	0.095	0.098*	0.089
Malta	1.015**	-1.187	-2.382**	-0.886	-0.044	0.049	0.050	0.022
Netherlands	-0.225**	-0.498*	0.211	0.365	-0.168	0.184	0.223	0.142
Norway	0.149**	-0.088	-0.175	0.473**	-0.191**	0.208	0.220*	0.143
Portugal	-0.071	-0.014	-0.161	-0.276*	-0.242**	0.251	0.270*	0.222
Romania	0.503**	0.503*	-0.497	-0.717	-0.149*	0.162	0.178	0.136
Russia	-0.033	-0.111	0.437**	0.168	-0.275**	0.299	0.337*	0.276
Slovak Republic	0.145**	-0.769**	-0.098	0.350	-0.030	0.028	0.038	0.008
Spain	-0.083	-0.093	-0.533**	0.352	-0.162**	0.171	0.185	0.157
Sweden	-0.178**	0.294	0.071	0.416*	-0.462**	0.502	0.506	0.440
Switzerland	-0.249**	0.082	0.227	0.134	-0.201**	0.214	0.226	0.156
Turkey	0.114**	0.160	-0.056	-0.239	-0.181*	0.201	0.227	-0.015
Ukraine	0.085	-0.362	-0.487	0.114	-0.296	0.299	0.340	0.274
United Kingdom	0.015	-0.275*	-0.096	-0.079	-0.221**	0.240	0.230*	0.133

Notes. Table 3 presents the results of the Bekaert et al. (2011) contagion test depending on Market Capitalization-based portfolios. The v_0 and v_j coefficients (j concerns the crises) are reported with an indication of statistical significance as well. * and ** indicate statistical significance at 10% and 5% respectively. Results came from either internationally or regionally constructed portfolios. Portfolios are Market Capitalization weighted portfolios.