



VOLATILITY SPILLOVERS BETWEEN STOCK MARKETS AND BOND MARKETS IN SOME SELECTED EUROPEAN COUNTRIES

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OUTLINE

- Aim and Scope
- Data
- Empirical Methodology
- Results
- Conclusion

AIM AND SCOPE

The bursting of the U.S. housing bubble caused the values of subprime mortgage based securities to plummet, which in turn triggered the 2008 global financial crisis due to liquidity problems in the financial system. The crisis reached its peak when Lehman Brothers declared its bankruptcy on 15th of September, 2008. To avoid the risk of a financial collapse, the U.S. Federal Reserve (Fed) has taken steps to launch its quantitative easing programme (i.e., creating money and buying bonds and other financial assets from banks), On 22 of May 2013 Chairman Bernanke signaled the first tapering (The FED would reduce its purchases beginning in January 2014)and than the FED announced its second tapering on 18th of December, 2013

Aim and Scope

- I. Investigate the effects this historical shocks on the volatility of stocks market and interest rates.
- II. Measure the size and persistence of the shocks.
- III. Analyze volatility spillovers across stock markets and interest rates of European Countries
- IV. Estimate dynamic correlations between stock markets and interest rates
- V. We focus on PIIGS (**P**ortugal, **I**taly, **I**reland, **G**reece, **S**pain) countries.

DATA AND VARIABLES

Stocks: Stock Markets Returns

Interest Rates: Ten Years Bond Rates (%)

Period: 2008 Jan. -2014 April (Daily Data)

Data Source: Bloomberg

DESCRIPTIVE STATISTICS

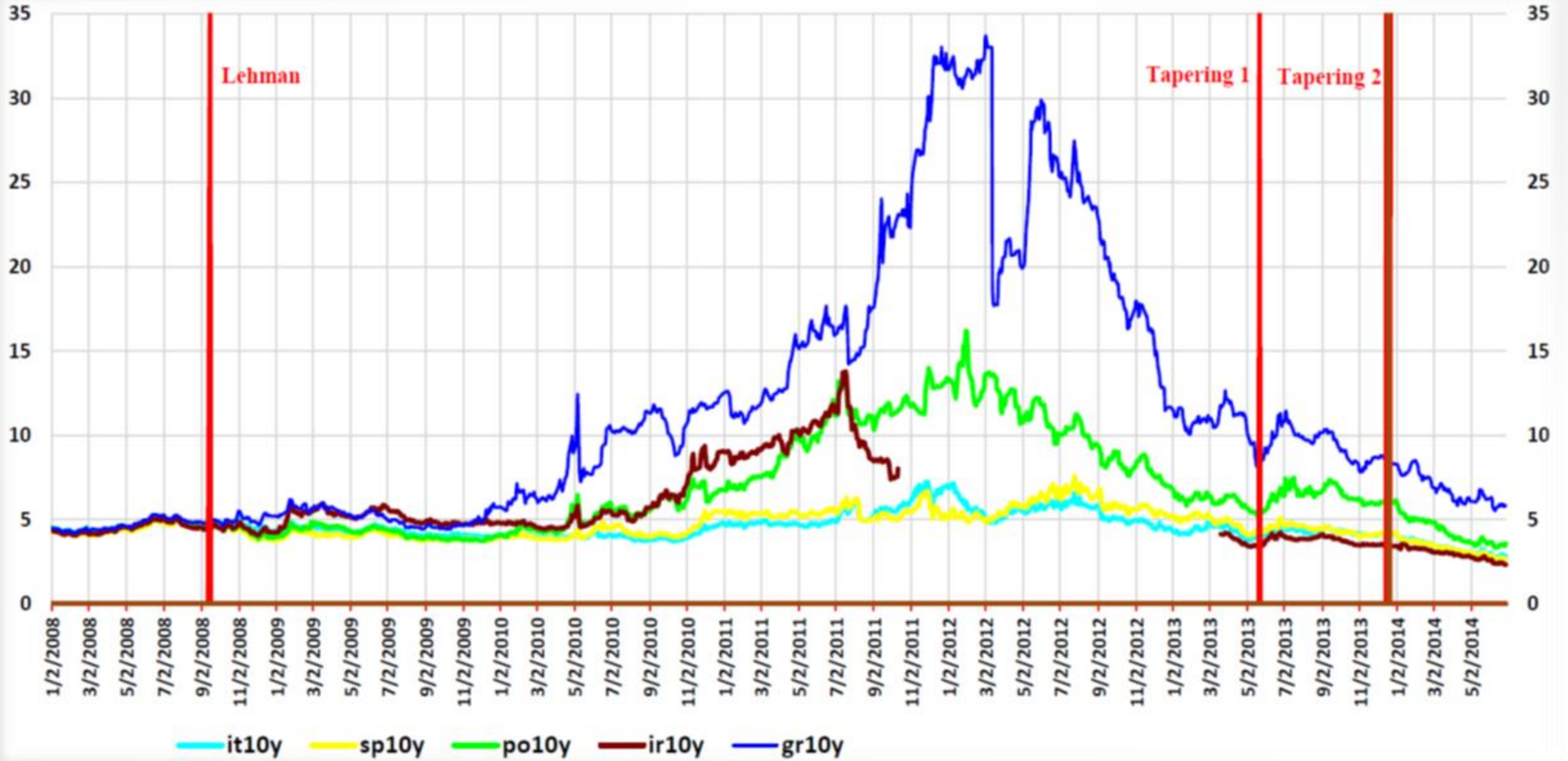
(1/2/2008-6/27/2014)

Bonds

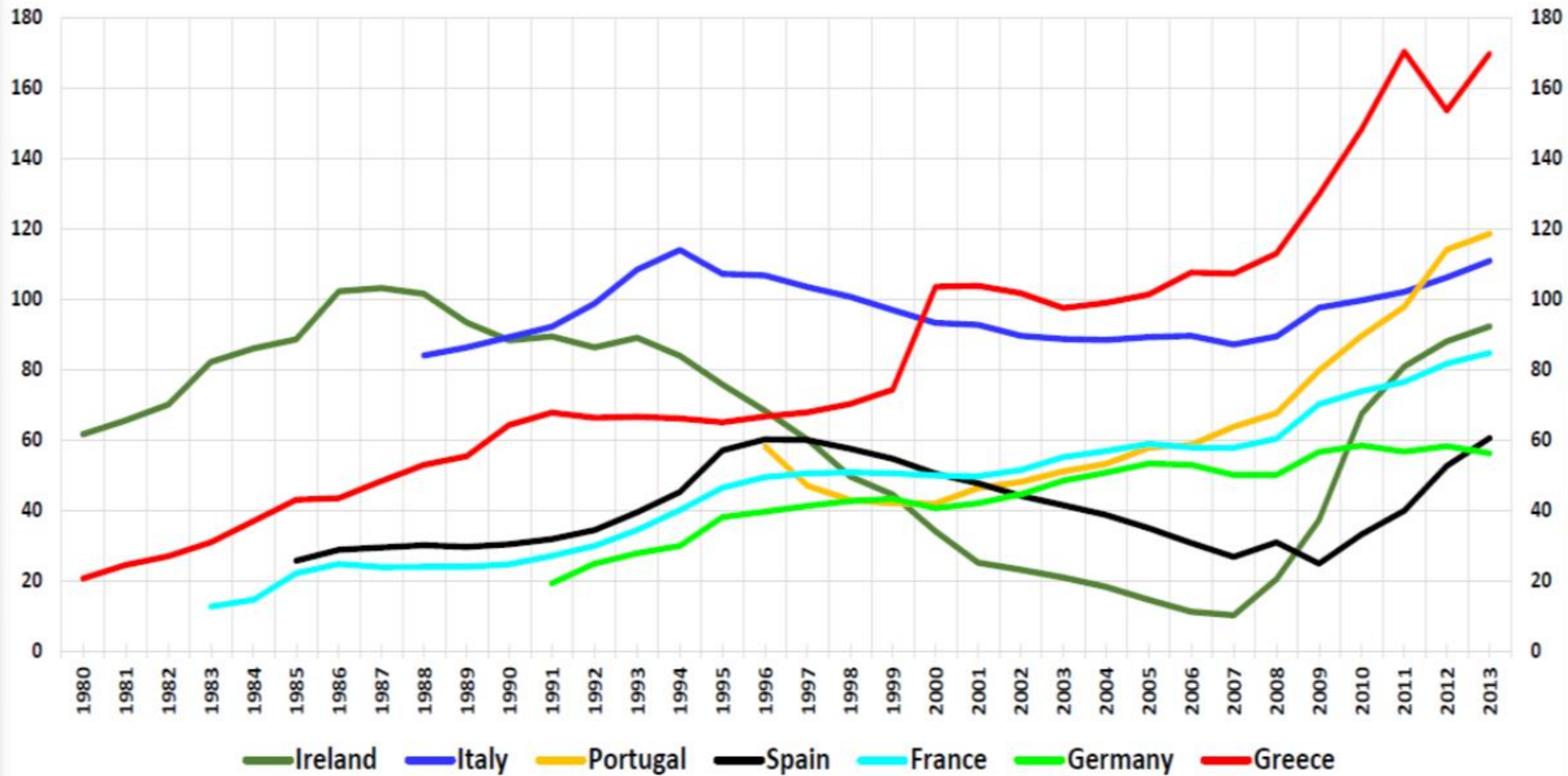
Stocks

	GR10Y	IR10Y	IT10Y	PO10Y	SP10Y		GRSTOCK	IRSTOCK	ITSTOCK	POSTOCK	SPSTOCK
Mean	11.45864	5.425819	4.585756	6.715802	4.649180	Mean	1663.125	3542.499	20208.36	7053.825	9747.640
Median	9.341000	4.774000	4.460000	5.785000	4.475000	Median	1431.300	3135.320	19783.21	7011.620	9732.800
Maximum	33.70200	13.78600	7.244000	16.21000	7.566000	Maximum	5207.400	6981.760	38063.00	12892.70	15002.50
Minimum	4.215000	2.323000	2.756000	3.330000	2.571000	Minimum	476.4000	1916.380	12362.51	4408.730	5956.300
Std. Dev.	7.598842	2.198541	0.760923	2.890111	0.849088	Std. Dev.	979.1500	1071.475	5066.416	1535.118	1720.960
Skewness	1.303943	1.415810	0.788743	1.033010	0.502101	Skewness	1.364907	1.310253	1.268265	1.010014	0.416500
Kurtosis	3.767702	4.394876	4.162398	2.889987	3.155691	Kurtosis	4.335233	4.080642	4.514713	4.196638	2.841495
Jarque-Bera	472.3719	492.7903	245.4166	273.5978	66.00422	Jarque-Bera	628.3466	546.7040	593.8905	375.0764	48.92275
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	1534	1187	1534	1534	1534	Observations	1633	1633	1633	1633	1633

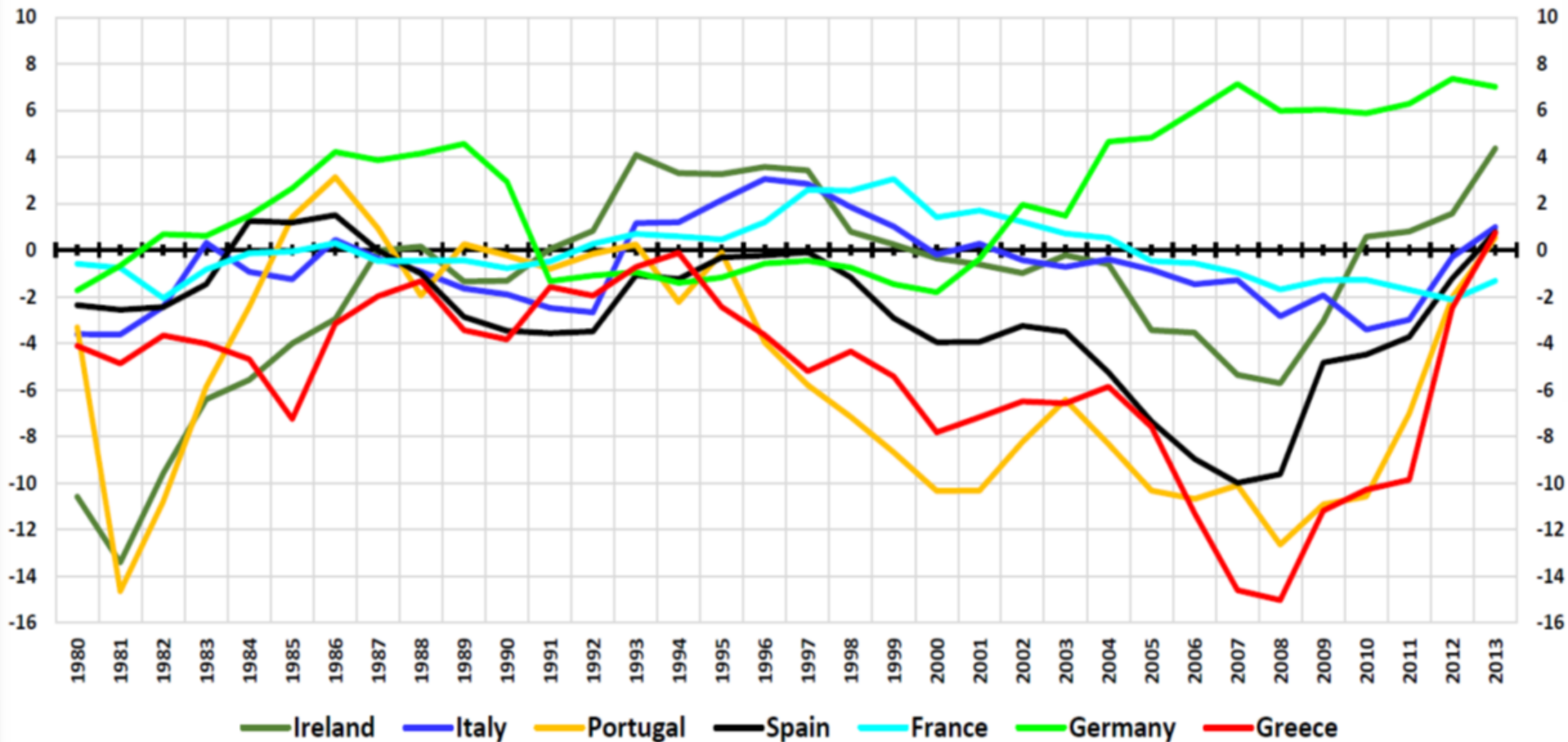
TEN YEARS BOND GRAPHICS FOR PIIGS COUNTRIES



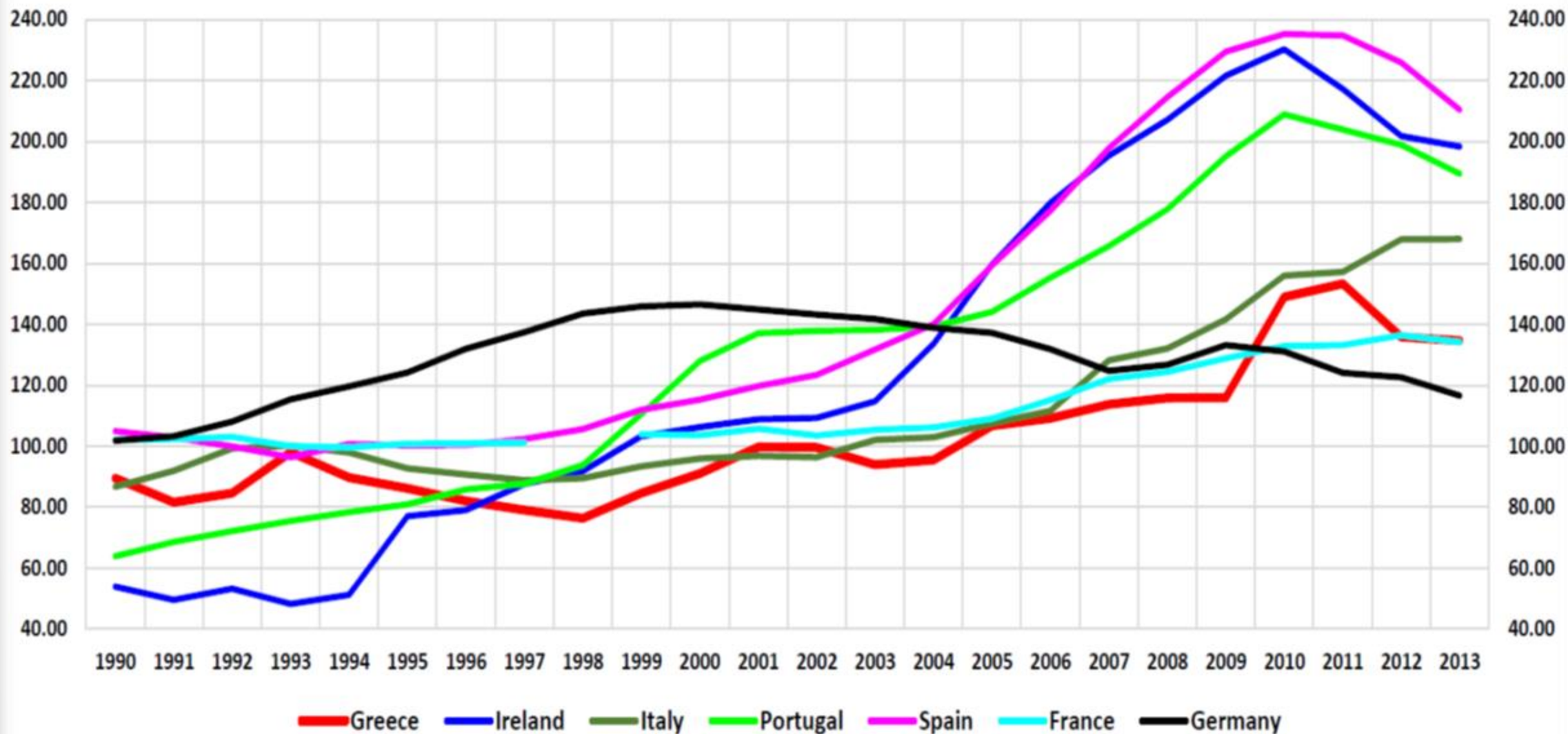
General government net debt (Percent of GDP)



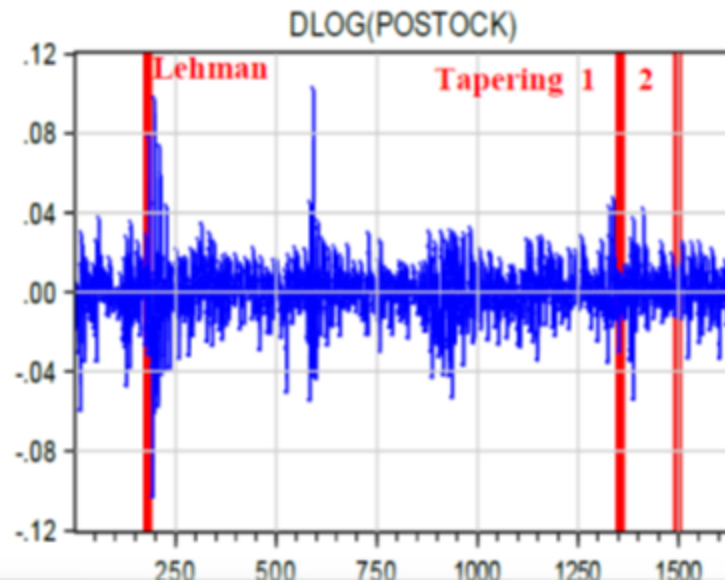
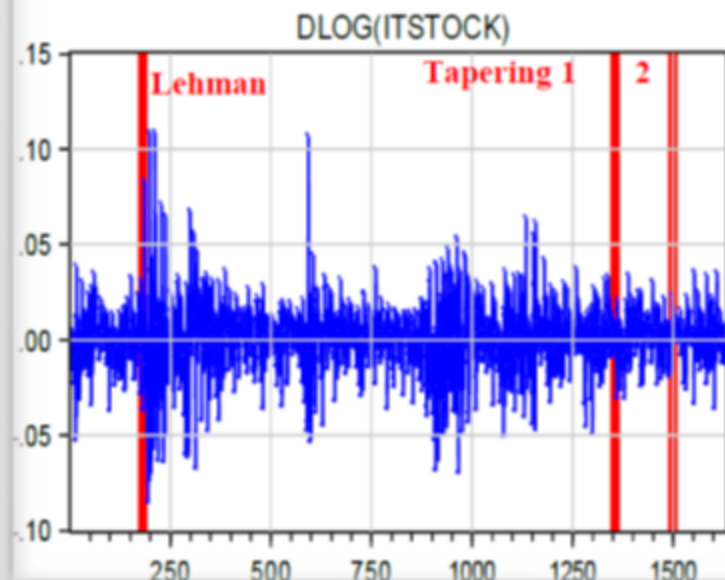
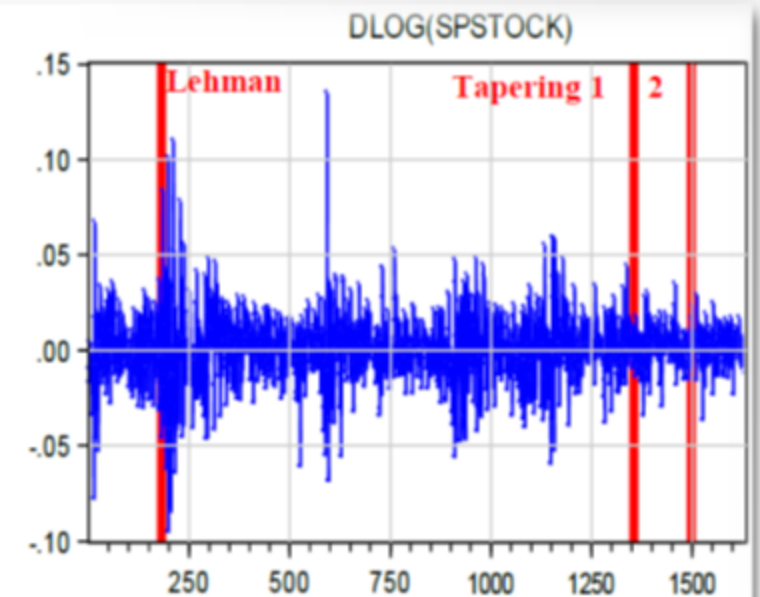
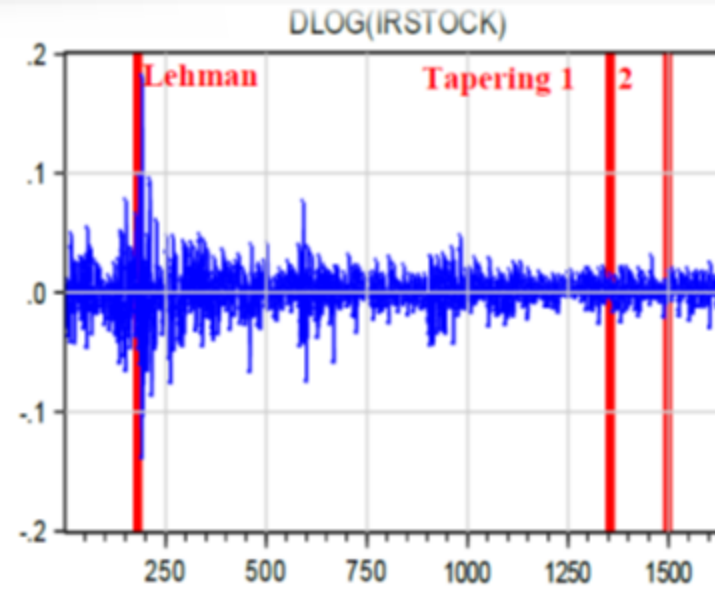
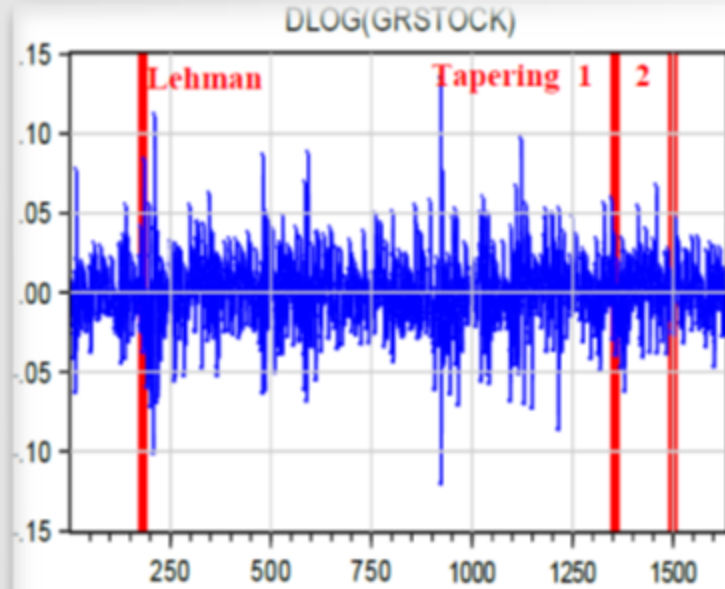
Current account balance (Percent of GDP)



Domestic credit provided by financial sector (% of GDP)

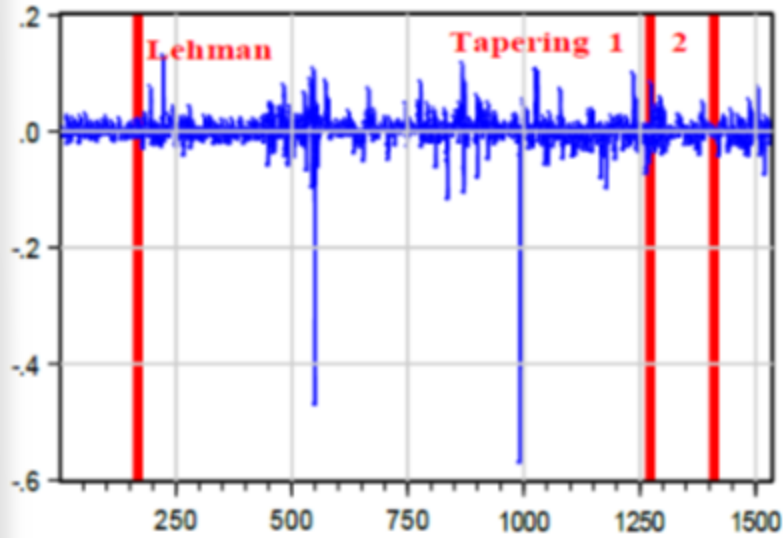


STOCK MARKETS RETURNS (Log-difference)

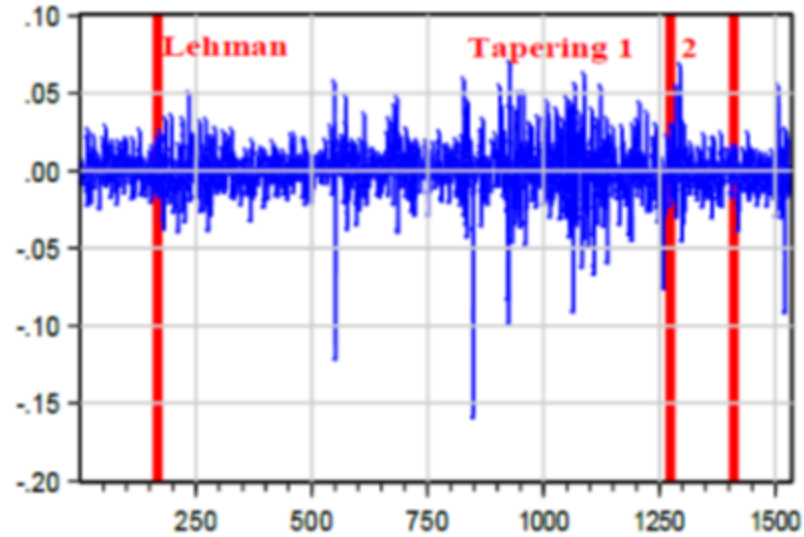


BOND MARKETS RETURNS (Log-difference)

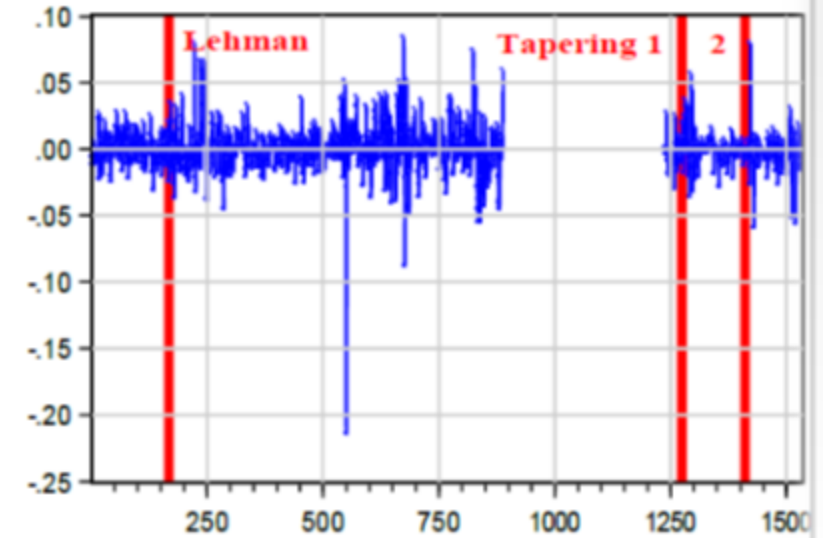
DLOG(GR10Y)



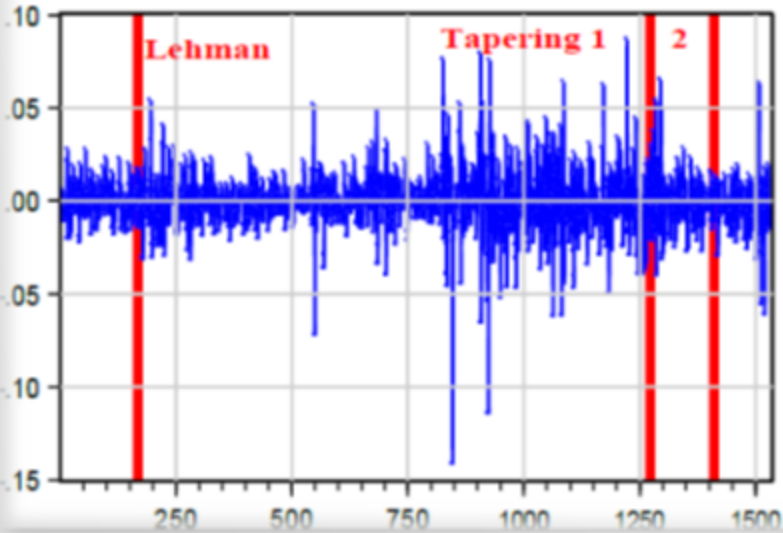
DLOG(SP10Y)



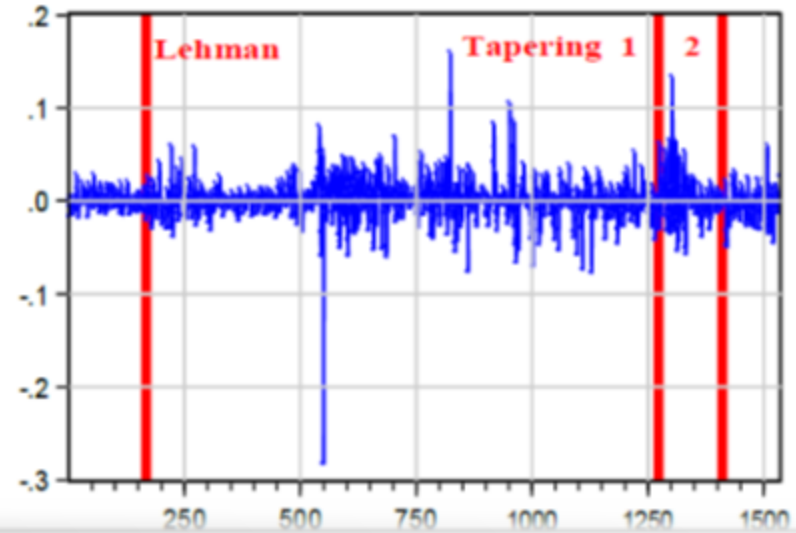
DLOG(IR10Y)



DLOG(IT10Y)



DLOG(PO10Y)



LITERATU

Authors	Aim and Scope	Method
Henry et al.(2007)	Stock Markets returns and volatility spillovers for eight Southern Asian countries	Tests for Causality in variance
Hassan and Malik (2007)	Volatility spillovers accross daily stock returns of different sectors in US	MGARCH
Panopouloua and Pantelidis (2009)	The international information transmission between the US and the rest of the G-7 countries using daily stock market return data covering the last 20 years.	Volatility impulse response
Koulakiotis et. Al. (2009)	The interdependencies among the stock markets in the Eurozone´s southern periphery, before and after the outbreak of the European debt crisis.	DCC-GARCH
Singh et. (2010)	The price and volatility spillovers among North American, European and Asian Stock Markets	ARCH and VAR

LITERATURE

Authors	Aim and Scope	Method
El Hedi Arour vd.(2011)	Volatility transmission Mechanism of oil and stock returns in Europe and US sectors	VAR-GARCH
Toyoshimaa and Hamorib (2012)	Volatility transmission mechanism among the swap markets of UK, US and Japan	Causality in variance tests
Zheng and Zuo (2013)	Volatility spillovers among US, Japan, Hong-Kong , UK, Germany stock markets	Markow Switching causality test
Jung and Maderitsch (2014)	Volatility spillovers among US, Europe and Hong-Kong stock markets	Heterogeneous ARDL

EMPIRICAL METHODOLOGY

VAR-BEKK (Engle and Kroner (1995))

$$H_t = CC' + Au_{t-1}u'_{t-1}A' + GH_{t-1}G' \quad (1)$$

H: variances-covariances matrix
C: Lower triangular matrix of constants
A: shock spillovers
G: volatility spillovers

WHY BEKK?

- I. Variances from BEKK are always positive
- II. Provides dynamic (conditional) correlations
- III. Optimal model for the modelling of conditional variances and covariances (Caporin ve McAleer (2009))

VIRF (Hafner ve Herwartz (2006))

$$H_t^{1/2} = \Gamma_t \Lambda_t^{1/2} \Gamma_t' \quad (2)$$

$$\Gamma_t = (\gamma_{t1}, \gamma_{t2}, \dots, \gamma_{tK}) \quad \Lambda_t = \text{diag}(\lambda_{1t}, \lambda_{2t}, \dots, \lambda_{Kt})$$

$$\varepsilon_t = H_t^{-1/2} u_t \quad (3)$$

Why VIRF?

- ✓ The VIRF is a symmetric function of the shock as opposed to odd function in the traditional analysis
- ✓ The VIRF is not a homogeneous function of any degree, in contrast to traditional linear analysis
- ✓ The VIRF depends on the history through the volatility state H_0 at the time when the initial shock occurs
- ✓ No ordering problem in variables since identification of shocks is done through Jordan decomposition rather than Cholesky decomp as in linear analysis

$$\text{Vech}(H_t) = \text{vech}(C) + F\text{vech}(u_{t-1}u_{t-1}') + B\text{vech}(H_{t-1}) \quad (4)$$

$$V_t(\varepsilon_0) = E[\text{vech}(H_t) | \varepsilon_0, \Omega_{-1}] - E[\text{vech}(H_t) | \Omega_{-1}] \quad (5)$$

First term: expectation of volatility conditional on an initial shock and history

Second term: baseline expectation conditional on history only

Exp: VAR-BEKK(1,1), it is a 3 dim. Vector where 1st and 3rd elements represent the reaction of conditional variances of variables and 2nd element represent Conditional covariances of vars to the shock

$$V_1(\varepsilon_0) = F \left\{ \text{vech}(H_0^{1/2} \varepsilon_0 \varepsilon_0' H_0^{1/2}) - \text{vech}(H_0) \right\} = FD_K^+ (H_0^{1/2} \otimes H_0^{1/2}) D_K \text{vech}(\varepsilon_0 \varepsilon_0' - I_K) \quad \text{for } t=1 \quad (6)$$

$$\begin{aligned} V_t(\varepsilon_0) &= (F + G)^{t-1} FD_K^+ (H_0^{1/2} \otimes H_0^{1/2}) D_K \text{vech}(\varepsilon_0 \varepsilon_0' - I_K) \\ &= (F + G)V_{t-1}(\varepsilon_0) \quad \text{for } t \geq 2 \end{aligned} \quad (7)$$

D: duplication matrix ($\text{vech}(Z) = D\text{vec}(Z)$)

D+: the Moore-Penrose inverse matrix



EMPIRICAL RESULTS



Results - GREECE

Estimation results for VAR-BEKK-t model - GREECE

C0	A11		G11		λ_i
-0.000544125***	0.197990713***	0.017821632	0.971817351***	-0.009389107	0.99520082
-0.000944928***	0.174092617***	0.314361379***	-0.043062478***	0.944811326	0.98194364
0.000000007					0.98194364
					0.97691774

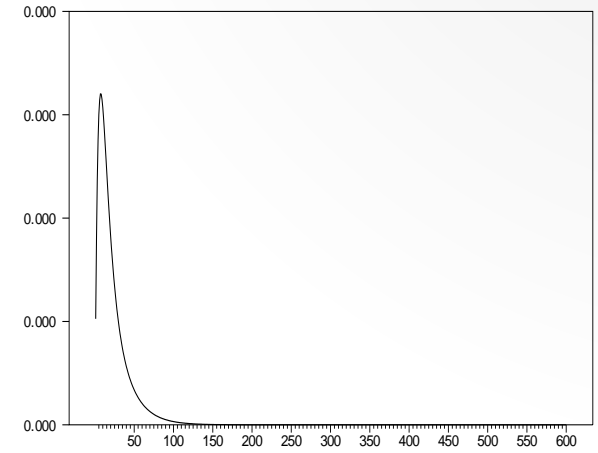
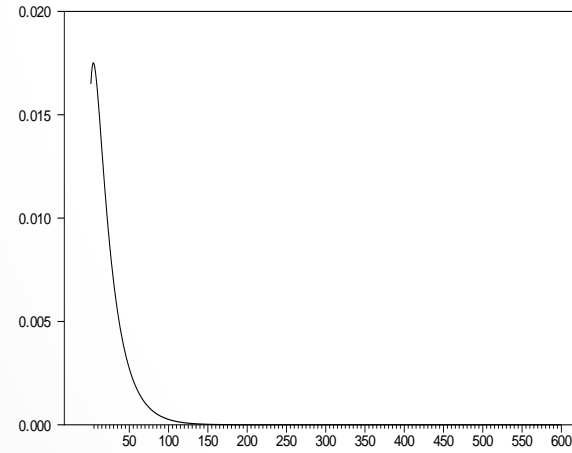
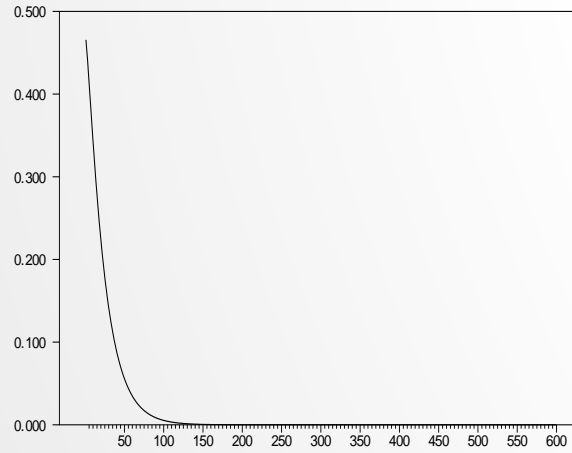
VIRF FOR GREECE

15 Sept 2008

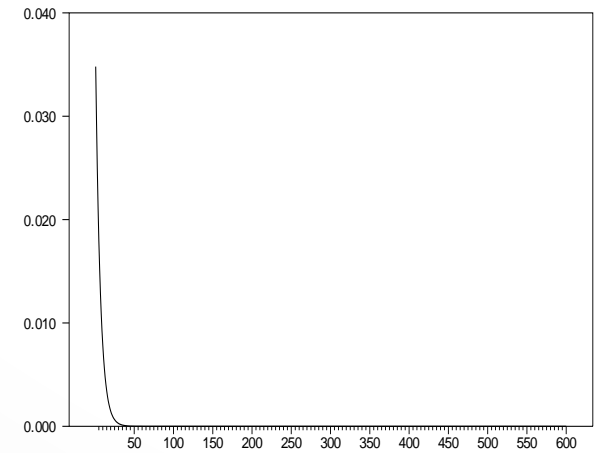
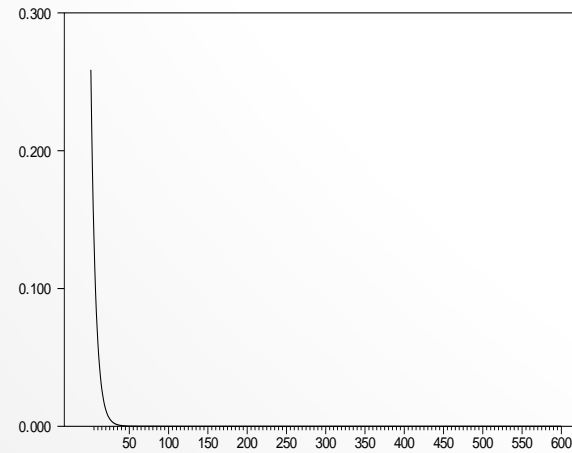
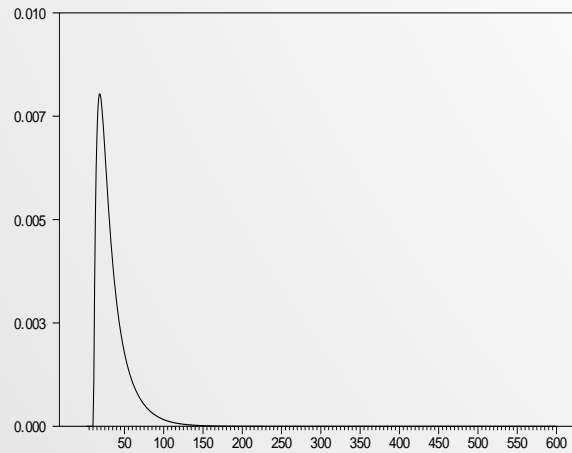
22 May 2013

18 Dec 2013

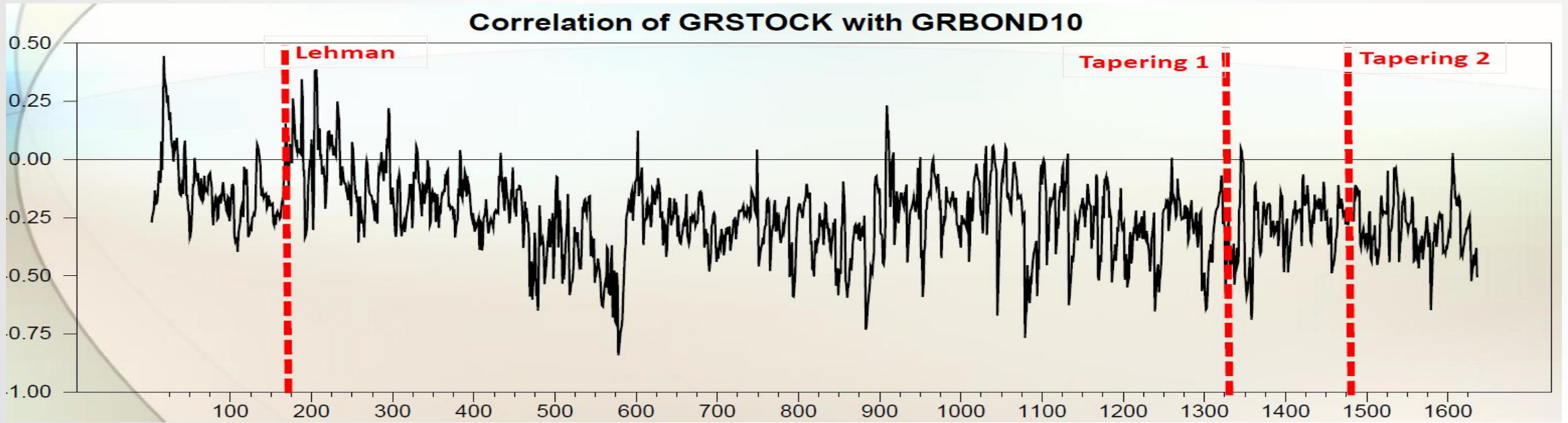
GRSTOCK Variance



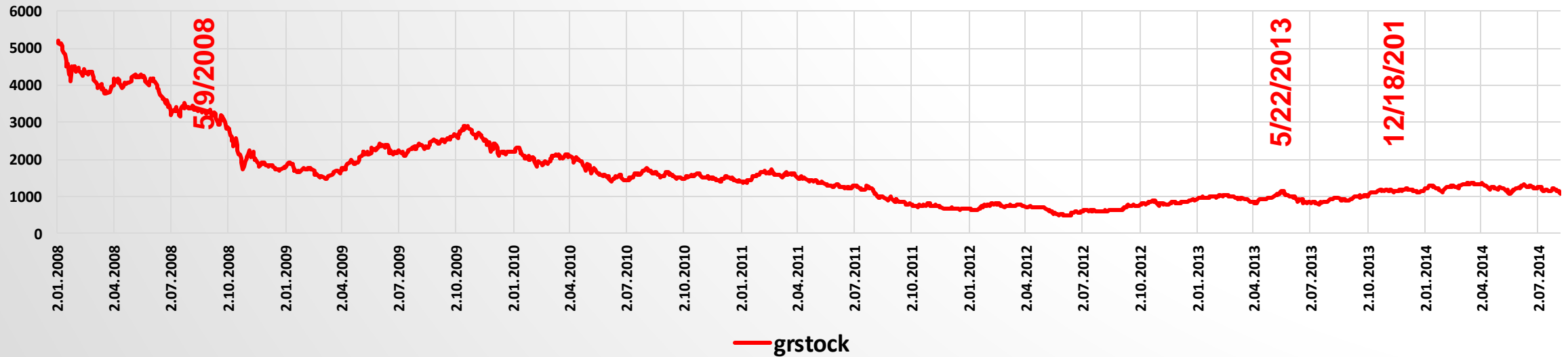
GRBOND10 Variance



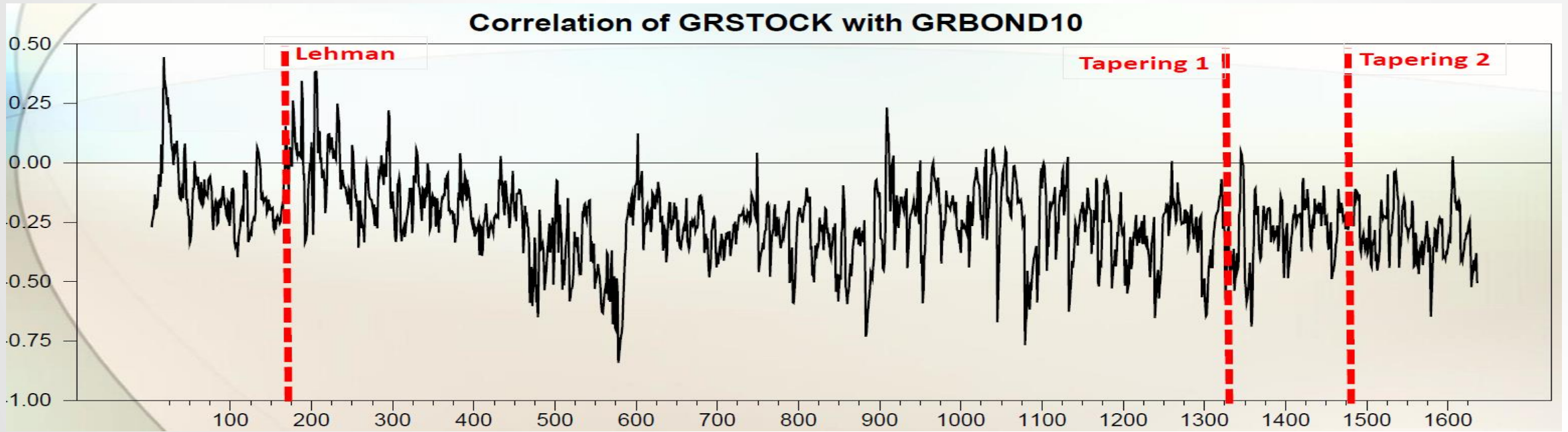
DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR GREECE



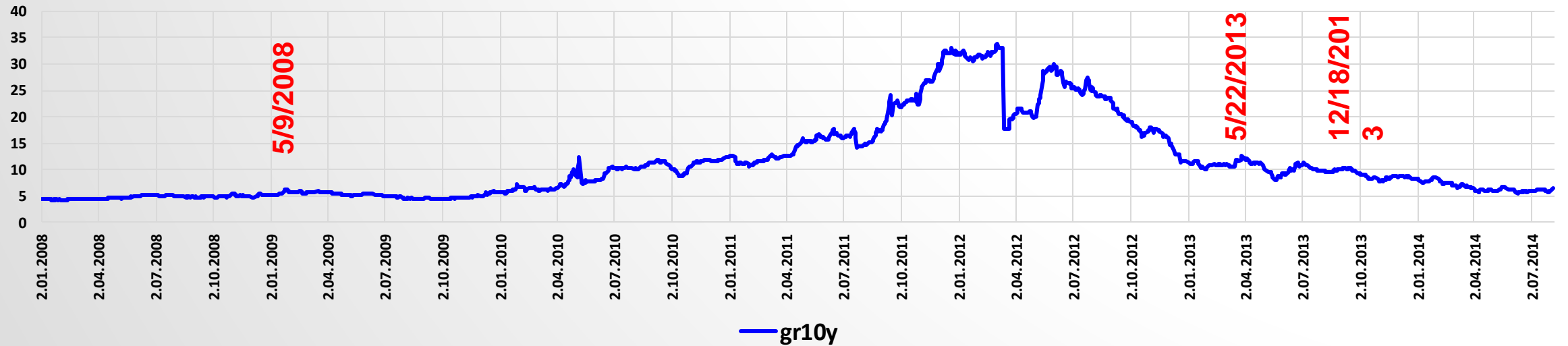
Greece - Bond and Stock



DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR GREECE



Greece - Bond and Stock





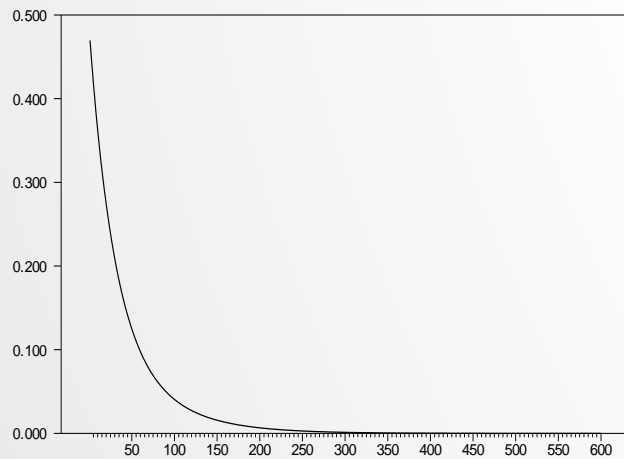
Results - PORTUGAL

Estimation results for VAR-BEKK-t model - PORTUGAL

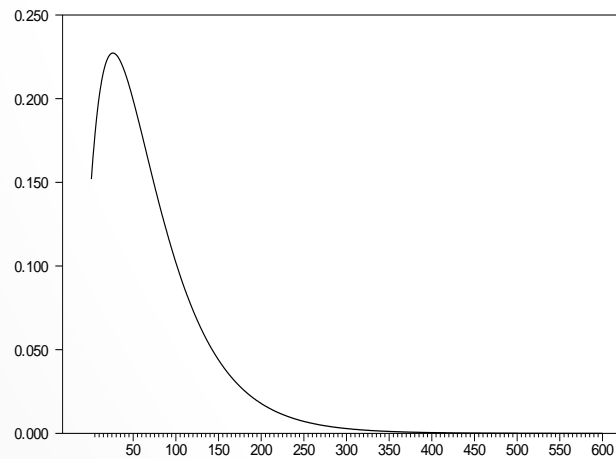
C0	A11		G11		λ_i
-0.000544125***	0.197990713***	0.017821632	0.971817351***	-0.009389107	0.99520082
-0.000944928***	0.174092617***	0.314361379***	-0.043062478***	0.944811326	0.98194364
0.000000007					0.98194364
					0.97691774

VIRF FOR PORTUGAL

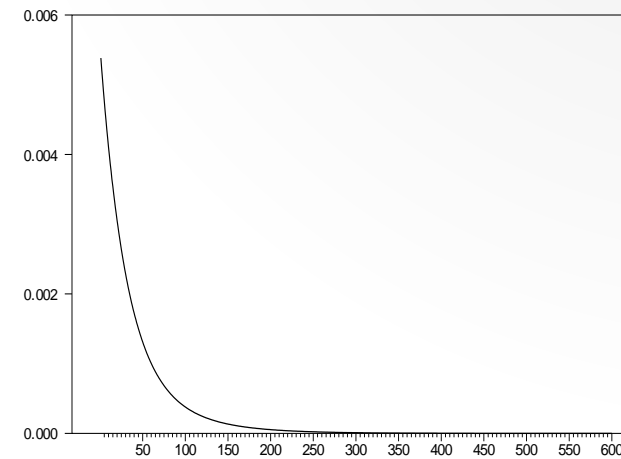
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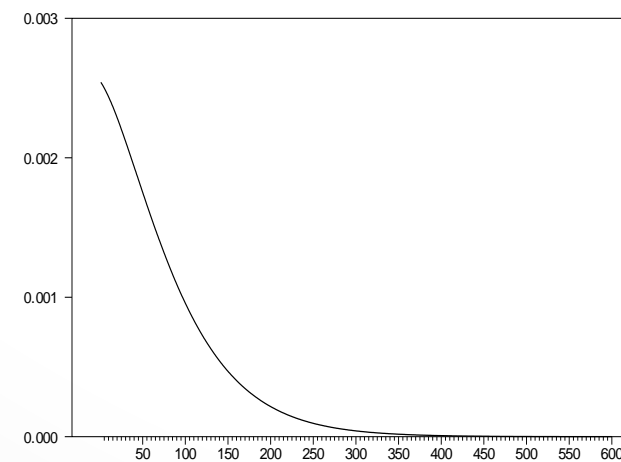
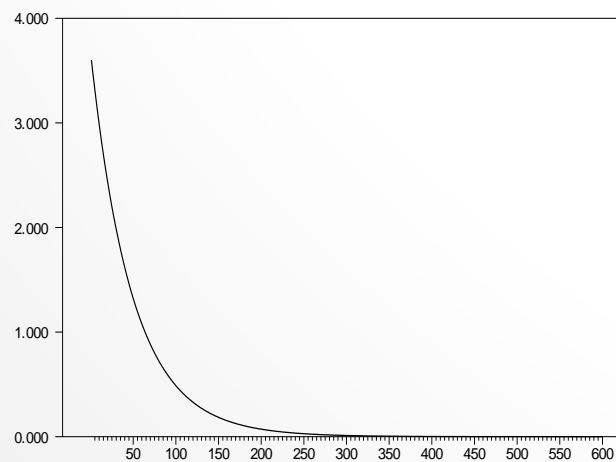
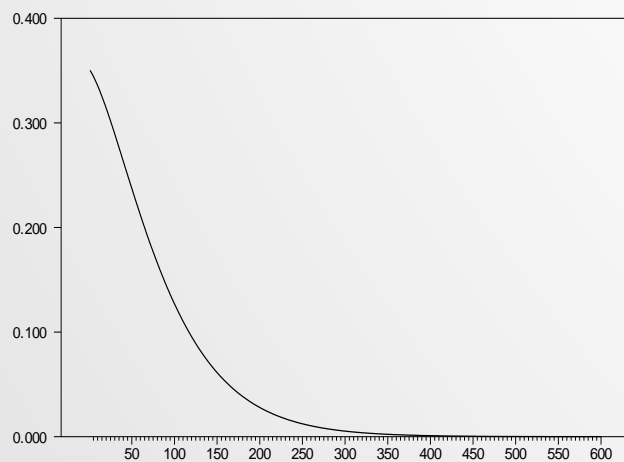
22 May 2013



18 Dec 2013

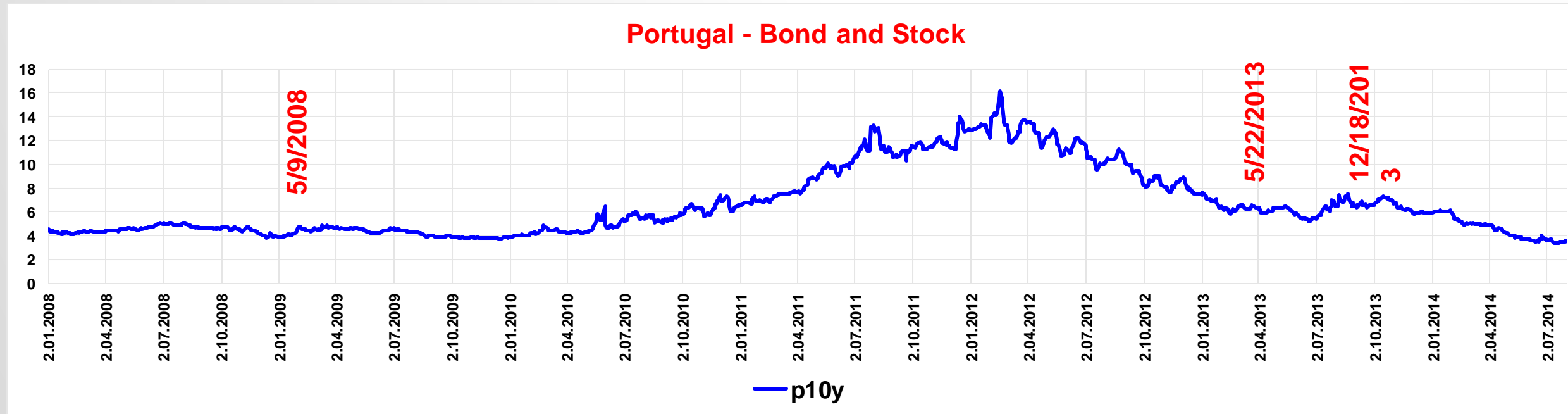
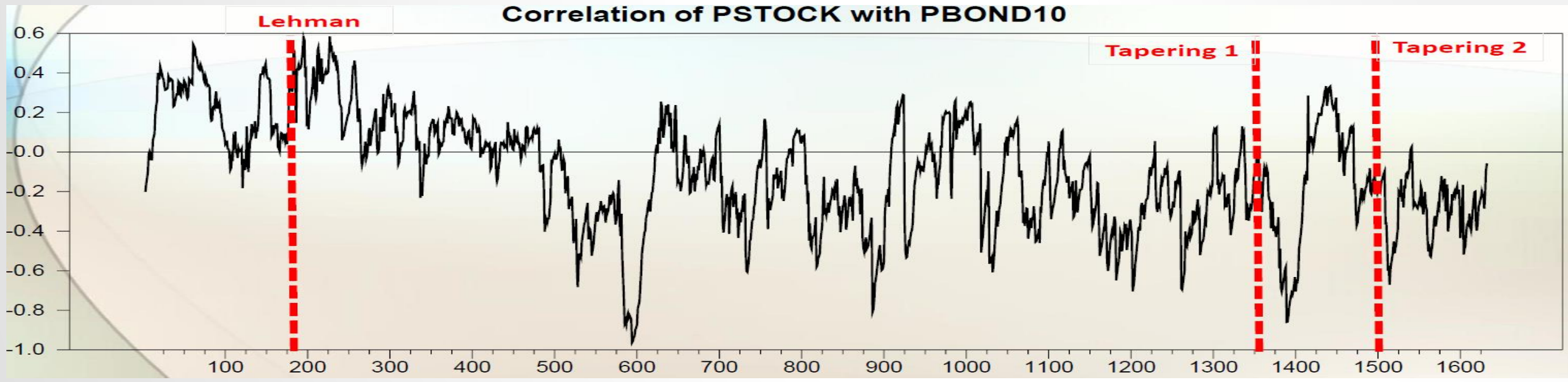


PSTOCK Variance

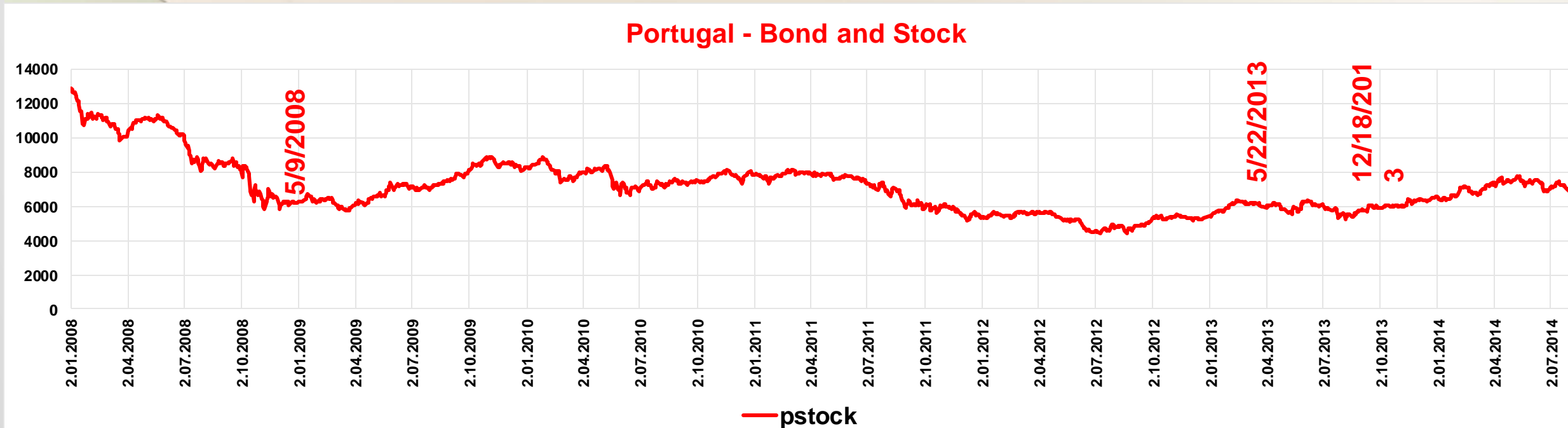
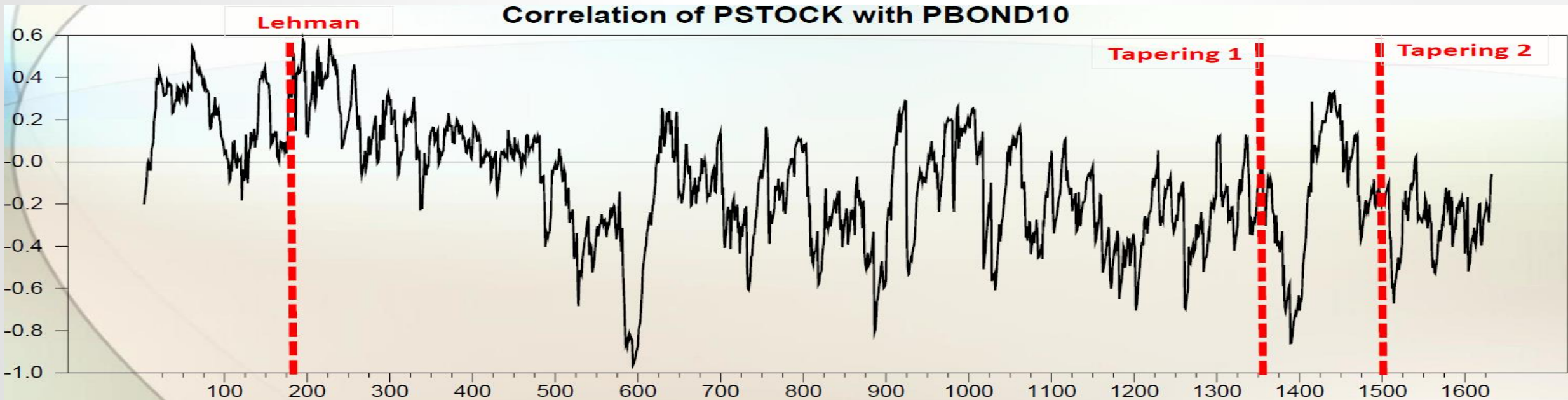


PBOND10 Variance

DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR PORTUGAL



DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR PORTUGAL





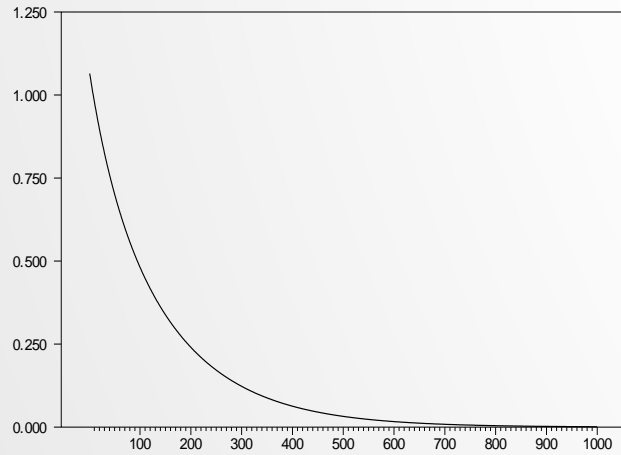
Results - SPAIN

Estimation results for VAR-BEKK-t model - SPAIN

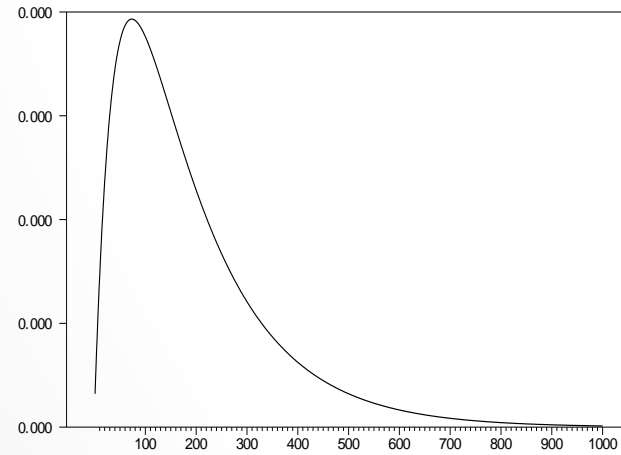
C0	A11		G11		λ_i
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VIRF FOR SPAIN

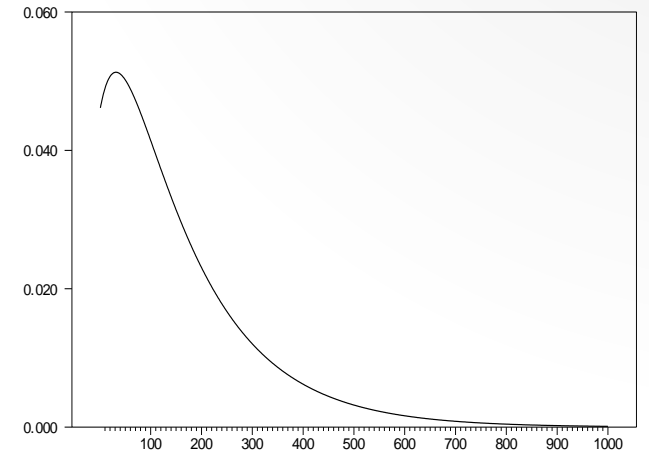
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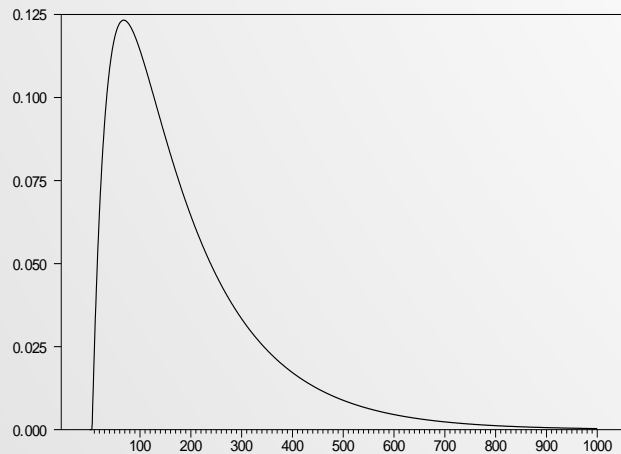
22 May 2013



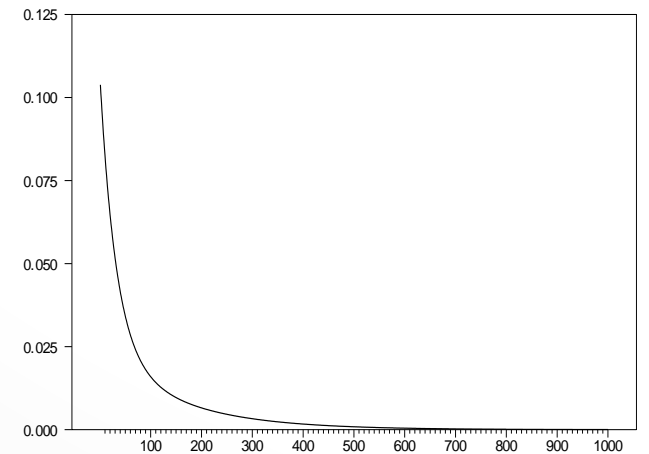
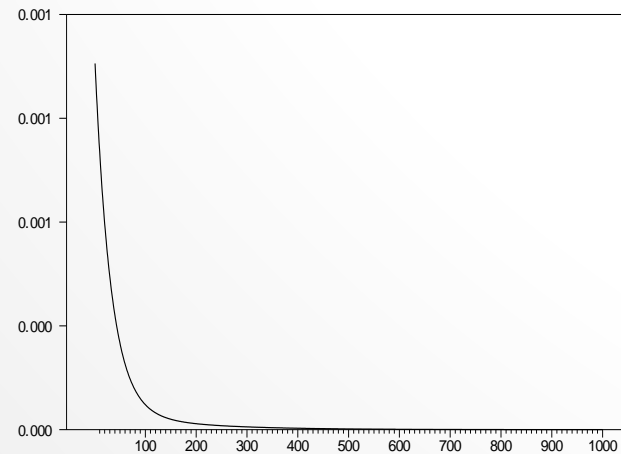
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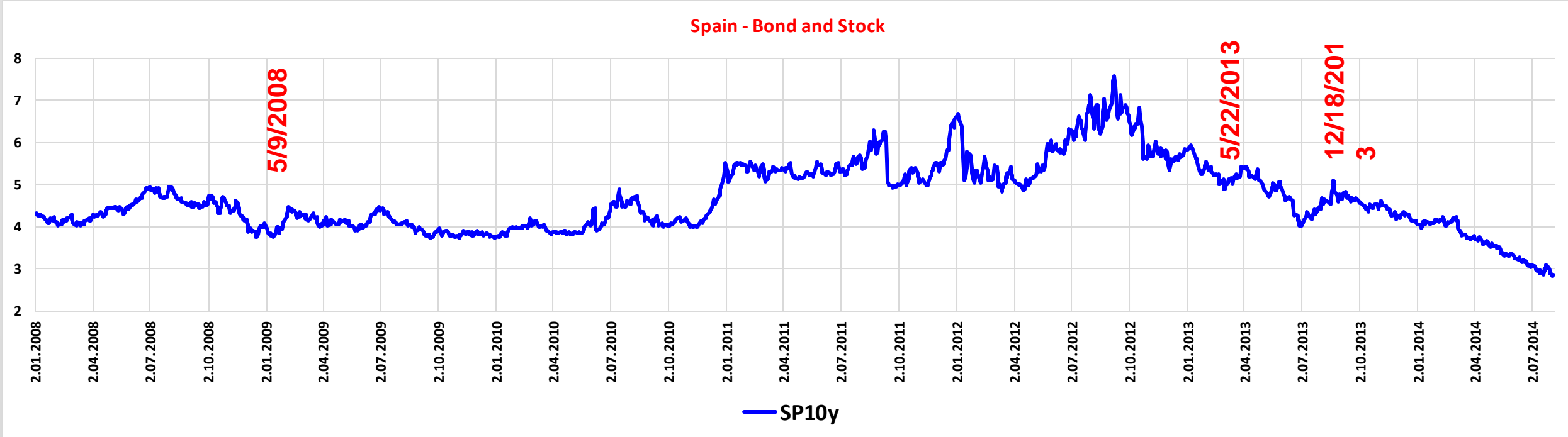
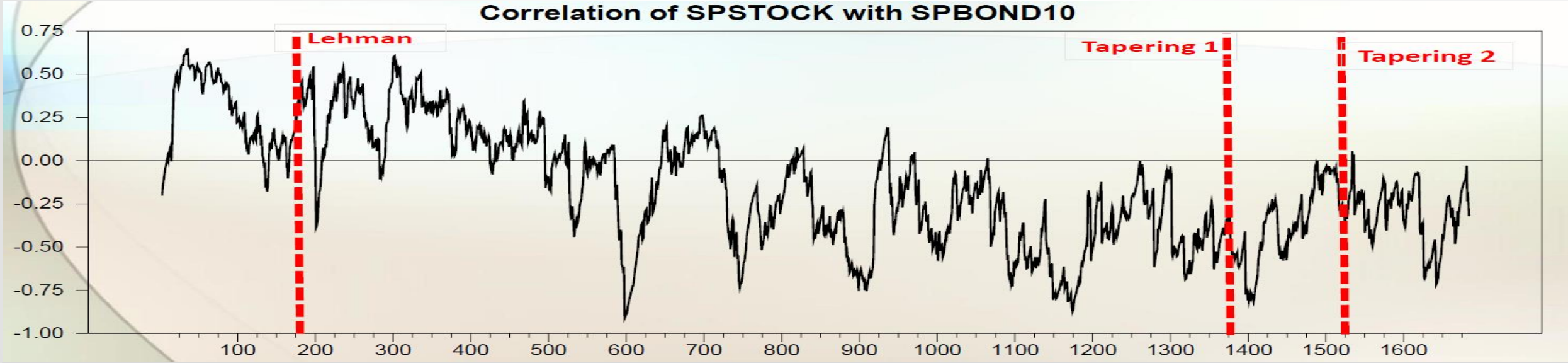
SPSTOCK Variance



SPBOND10 Variance

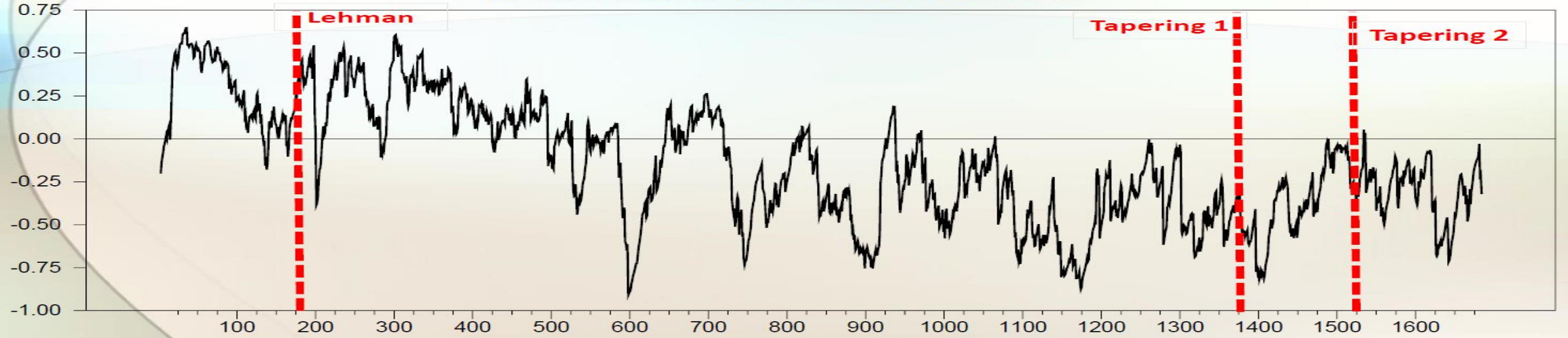


DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR SPAIN

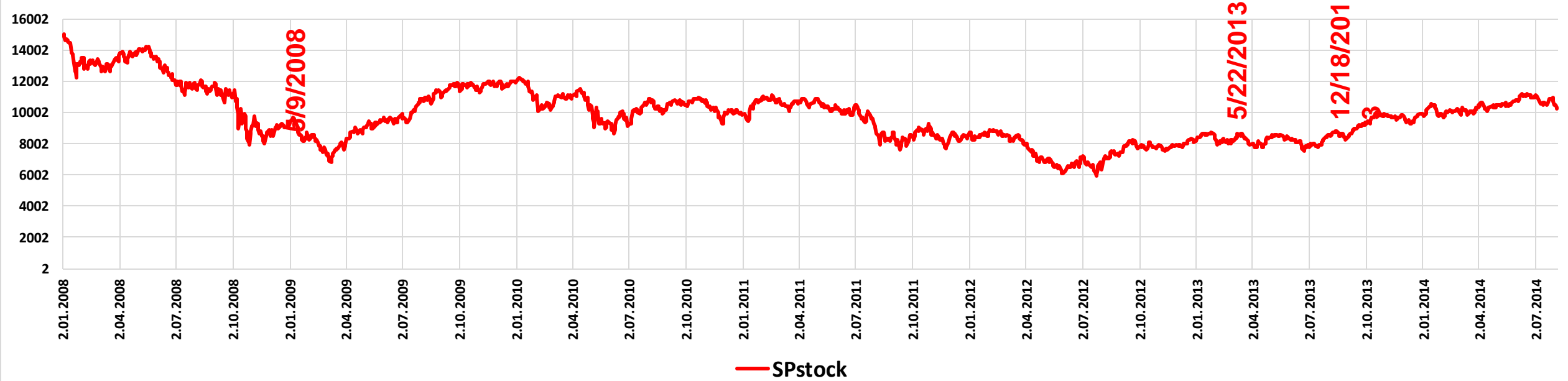


DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR SPAIN

Correlation of SPSTOCK with SPBOND10



Spain - Bond and Stock





Results - ITALY

Estimation results for VAR-BEKK-t model - ITALY

C0	A11		G11		λ_i
-0.000544125***	0.197990713***	0.017821632	0.971817351***	-0.009389107	0.99520082
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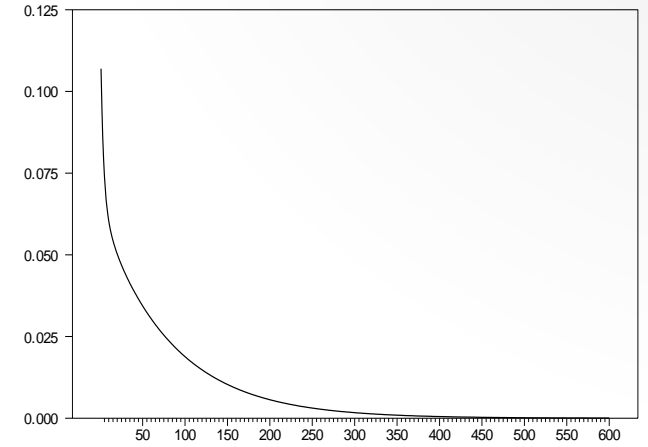
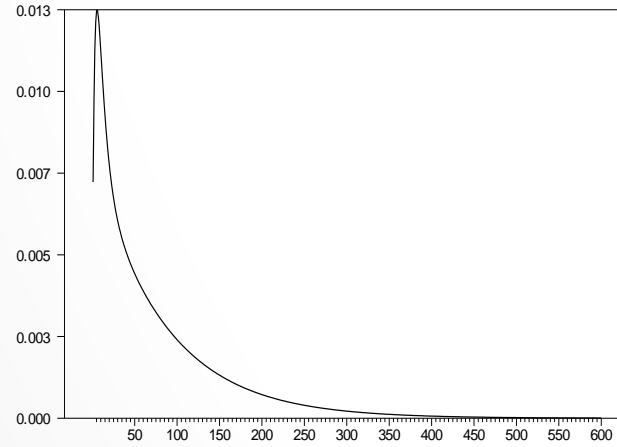
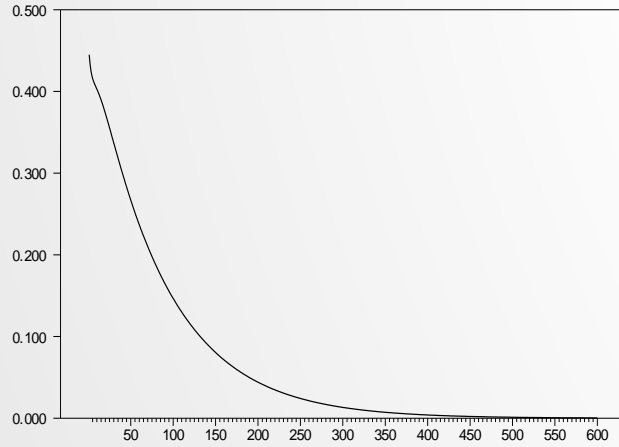
VIRF FOR ITALY

15 Sept 2008

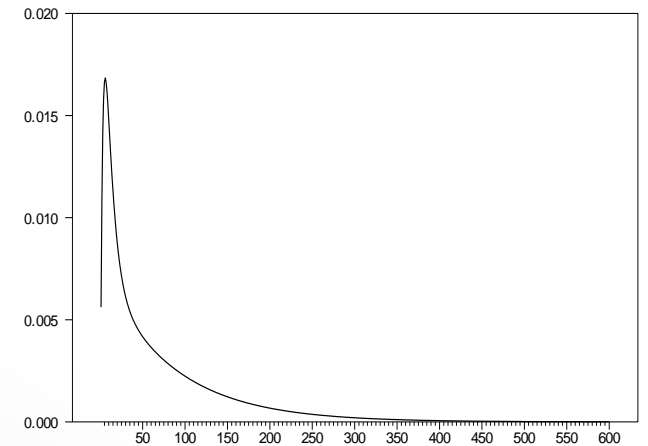
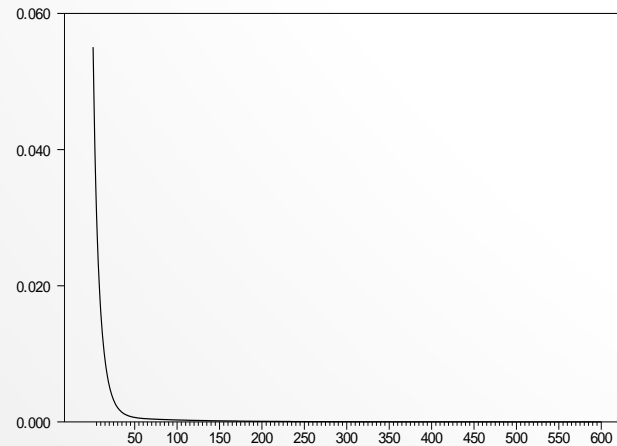
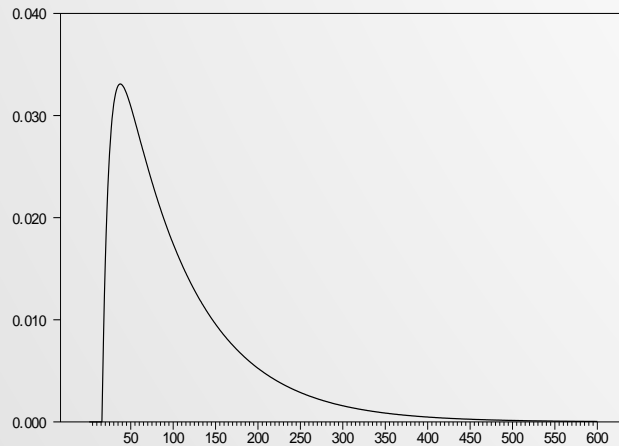
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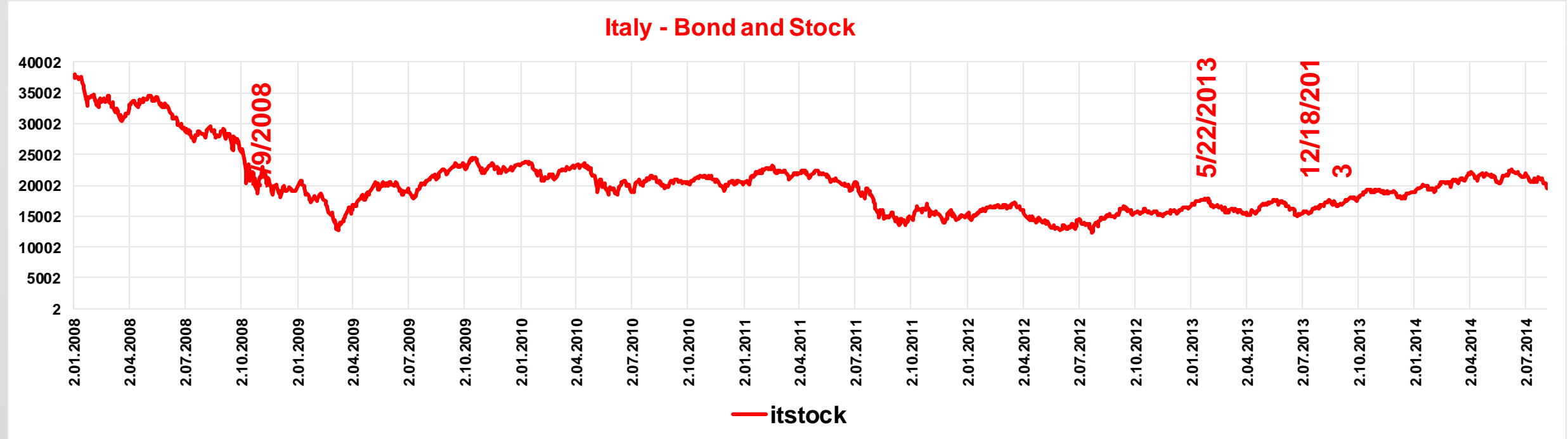
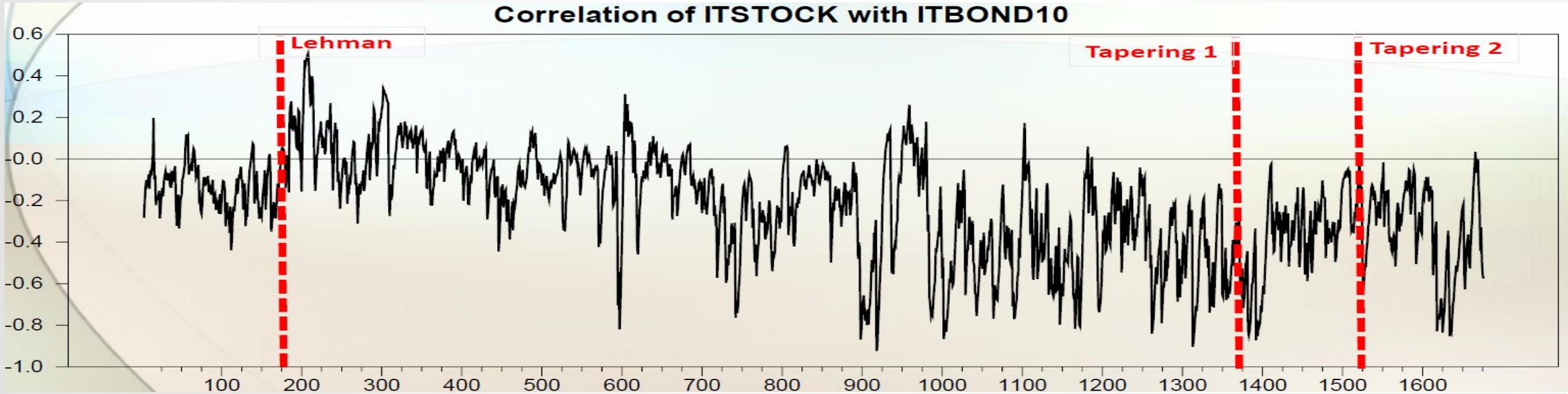
ITSTOCK Variance



ITBOND10 Variance

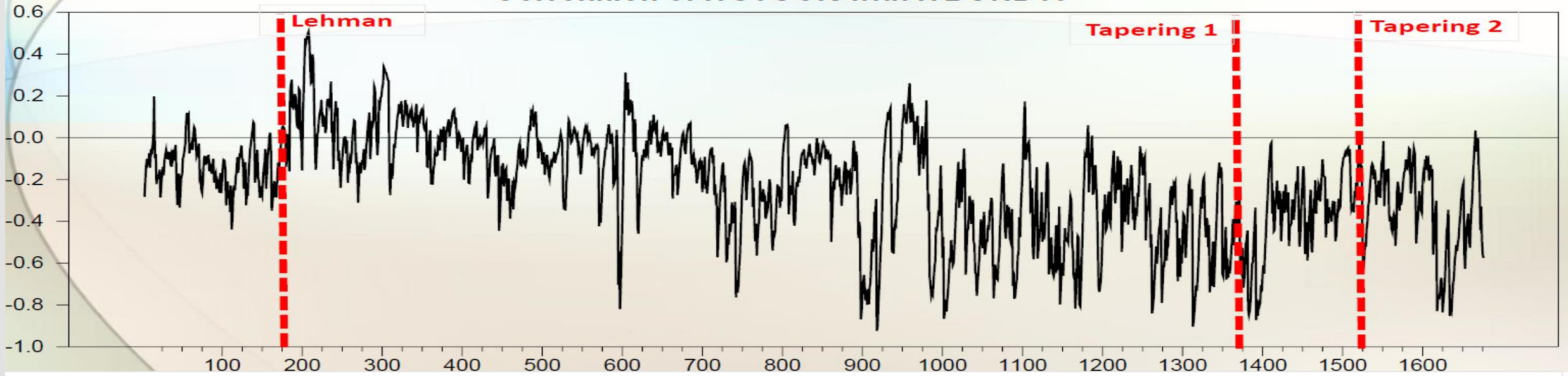


DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR ITALY



DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR ITALY

Correlation of ITSTOCK with ITBOND10



Italy - Bond and Stock



VOLATILITY SPILLOVERS BETWEEN COUNTRIES

STOCK MARKETS VOLATILITY SPILLOVERS BETWEEN COUNTRIES

Estimation results for VAR-BEKK-t model - PIIGS

Shock Spillovers (A)					Volatility Spillovers (B)				
-0.166***	-0.045***	-0.018	-0.023**	-0.003	0.985***	-0.009***	-0.005	-0.002	0.003
0.043	0.201***	0.006	0.031	-0.035	0.032**	0.987***	0.024	-0.008	0.035**
0.033	-0.077*	0.142***	-0.054*	-0.036	-0.002	0.026*	0.988***	0.022**	0.026
-0.020	-0.025	-0.070***	0.143***	-0.043*	0.020***	0.015***	0.023***	0.991***	0.010*
0.263***	0.171***	0.168***	0.103***	0.317***	-0.085***	-0.069***	-0.090***	-0.032**	0.871***

λ_i				
0.896	0.995	0.946	0.954	0.948
0.896	0.930	0.946	0.979	0.948
0.906	0.930	0.981	0.939	0.934
0.997	0.919	0.981	0.981	0.934
0.882	0.919	0.966	0.981	0.972

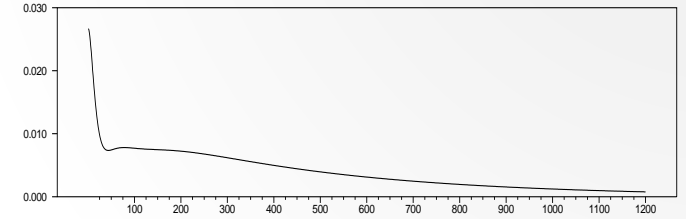
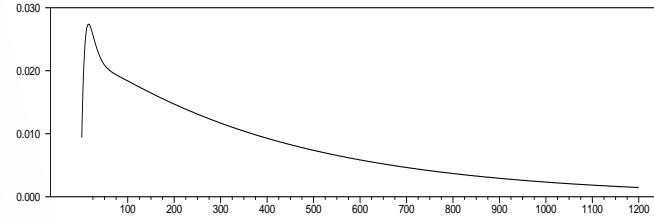
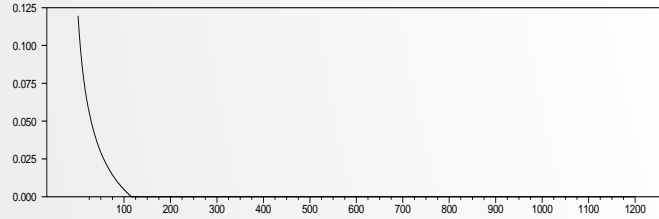
VIRF - STOCK MARKETS

15 Sept 2008

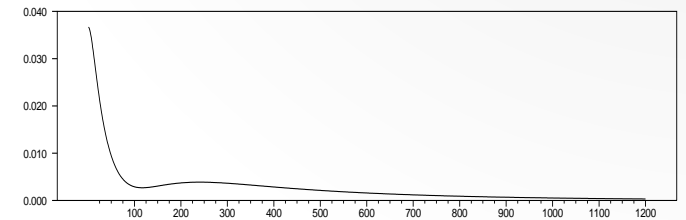
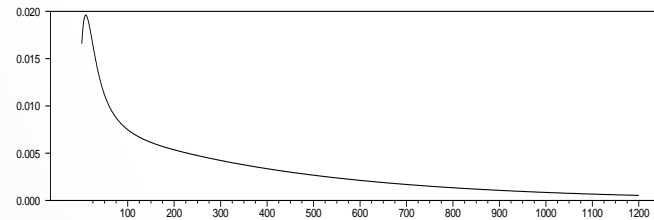
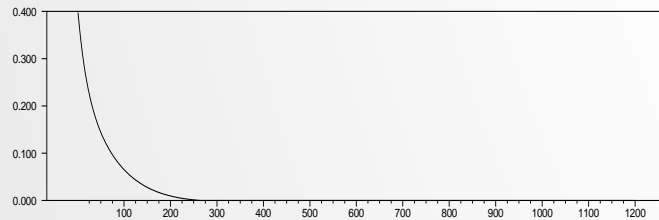
22 May 2013

18 Dec 2013

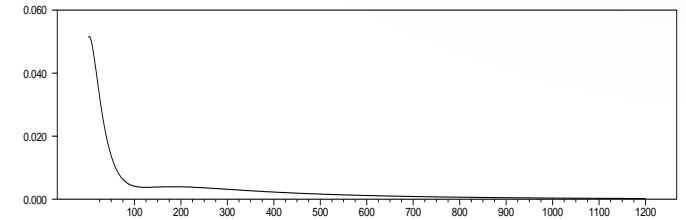
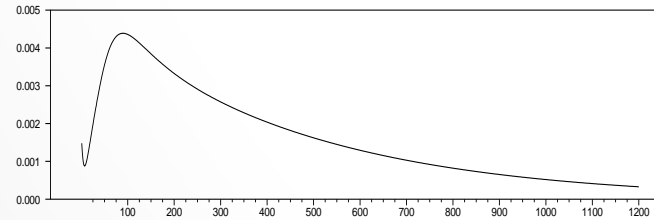
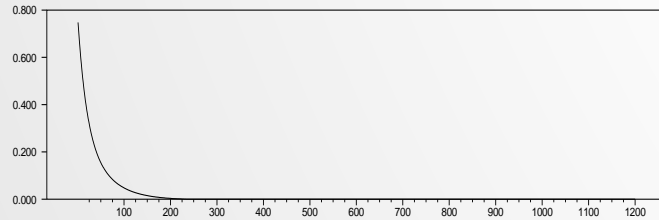
GREEK Variance



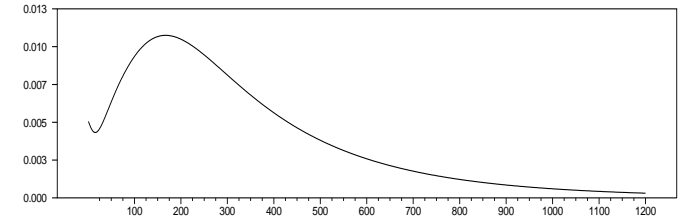
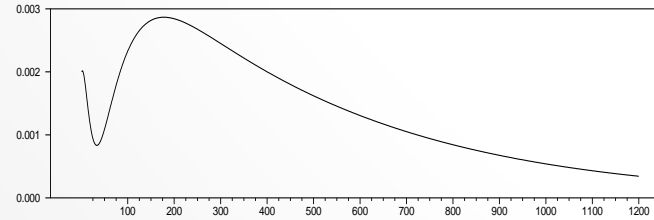
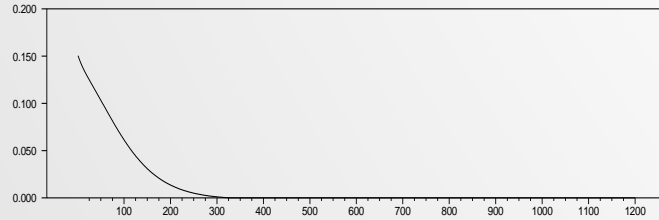
ITALY Variance



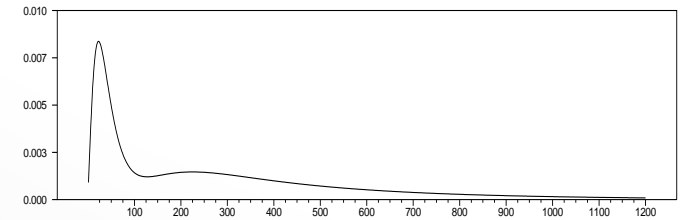
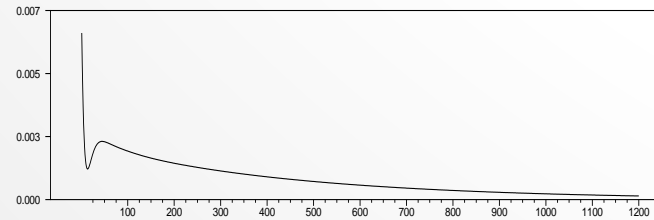
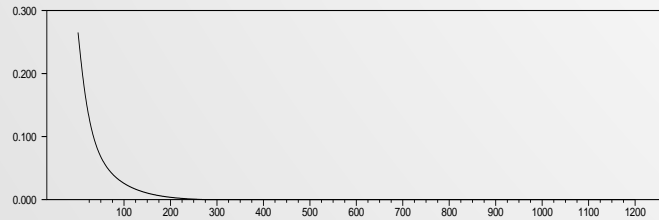
SPAIN Variance



IRELAND Variance

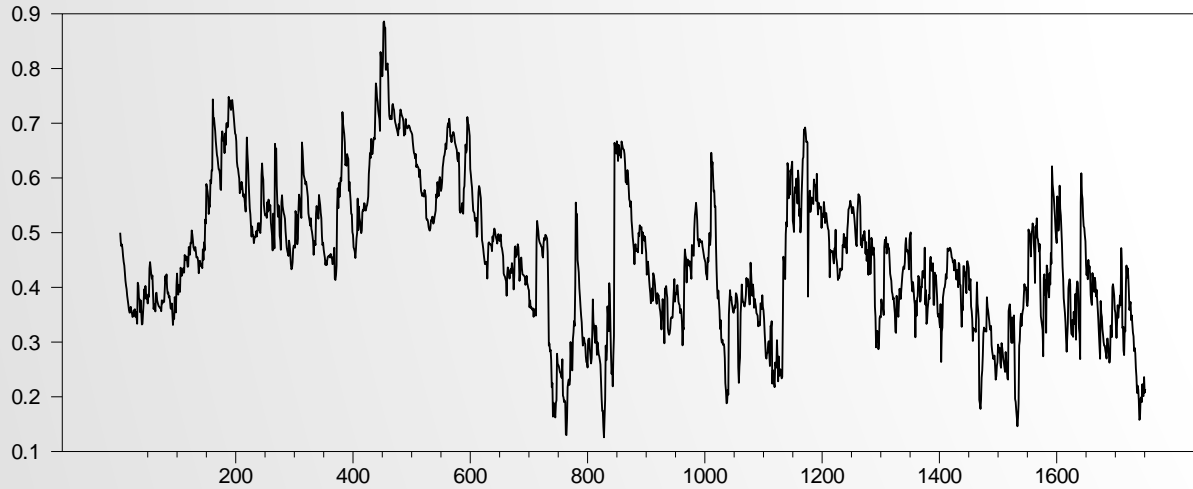


PORTUGAL Variance

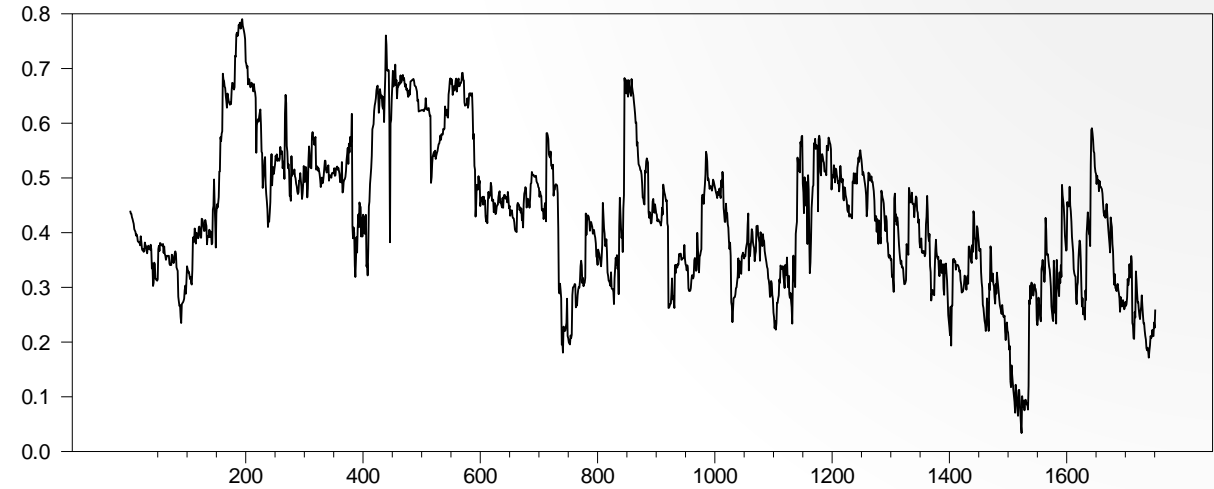


DYNAMIC CONDITIONAL CORRELATION (DCC) – STOCKS - I

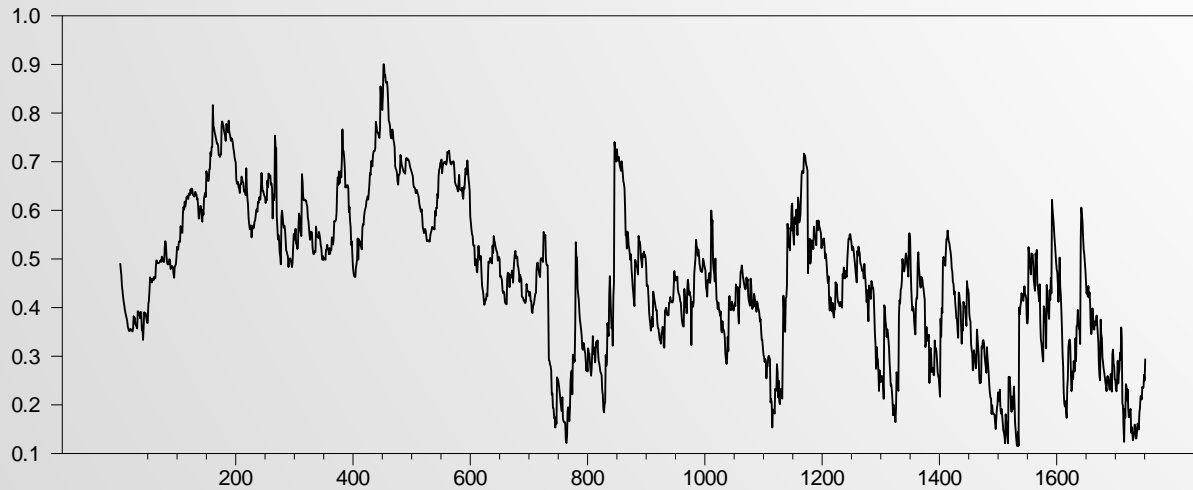
Correlation of GR with PO



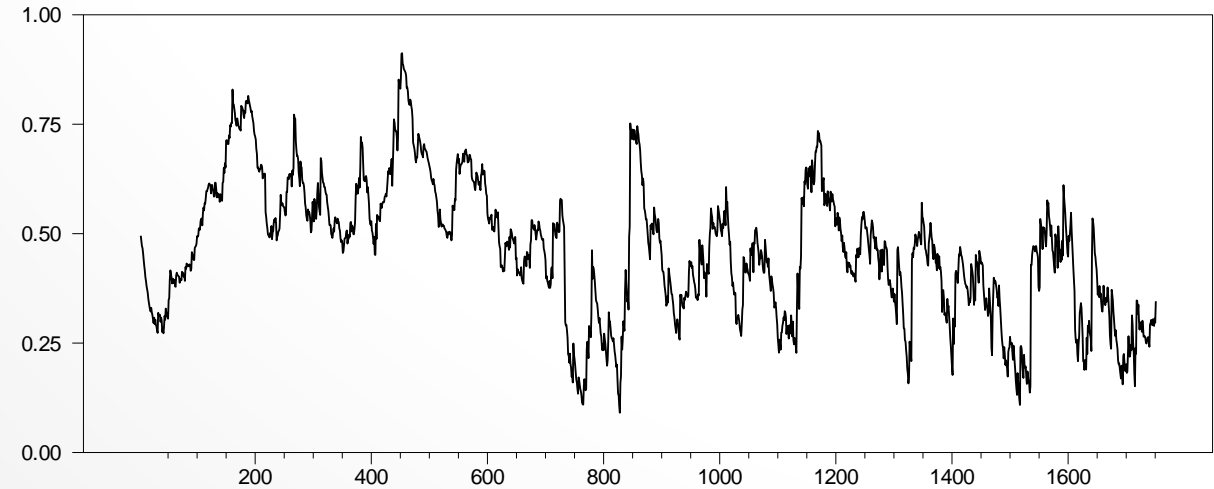
Correlation of GR with IR



Correlation of GR with SP

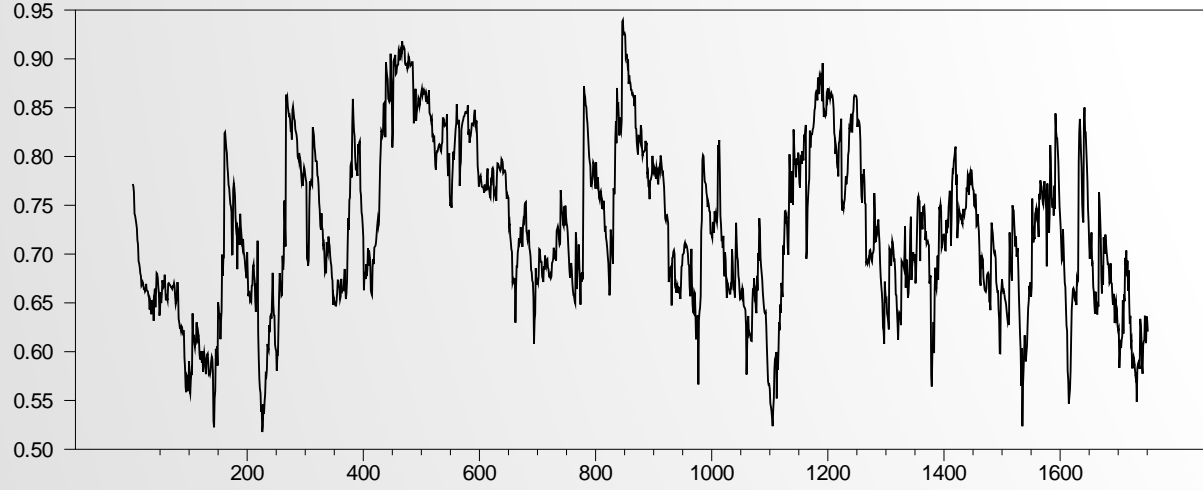


Correlation of GR with IT

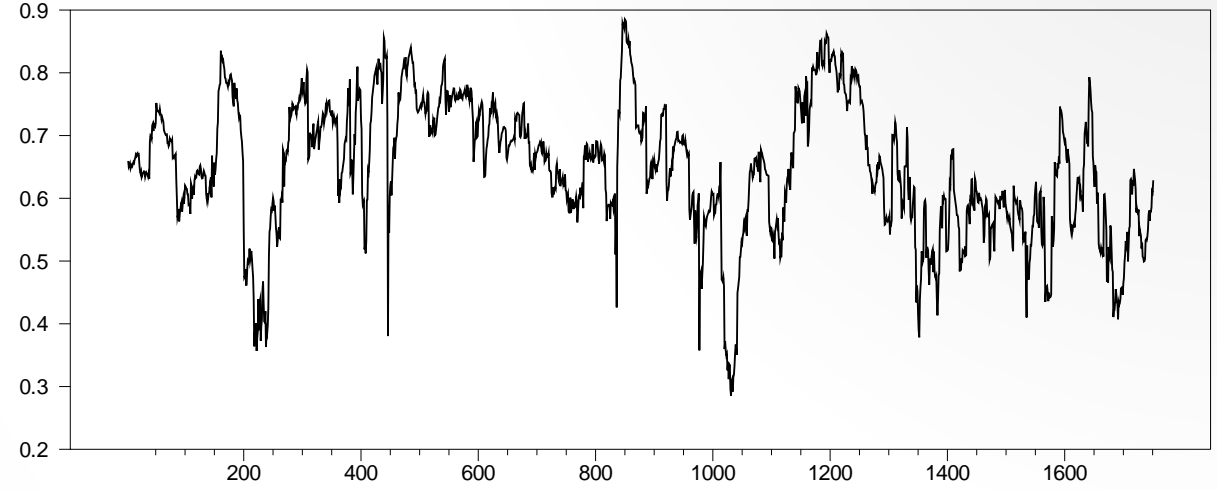


DYNAMIC CONDITIONAL CORRELATION (DCC) – STOCKS - II

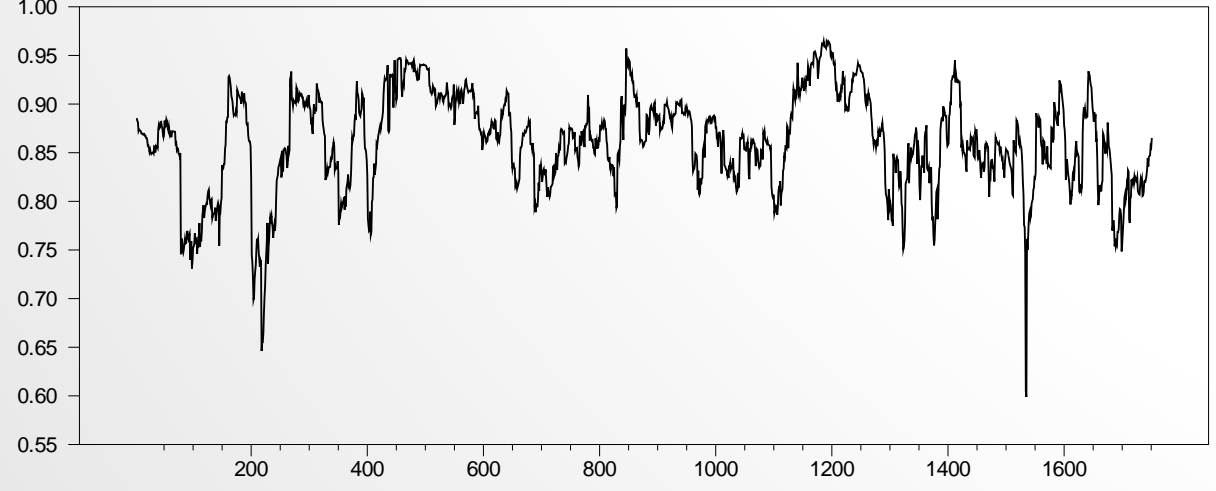
Correlation of SP with PO



Correlation of SP with IR

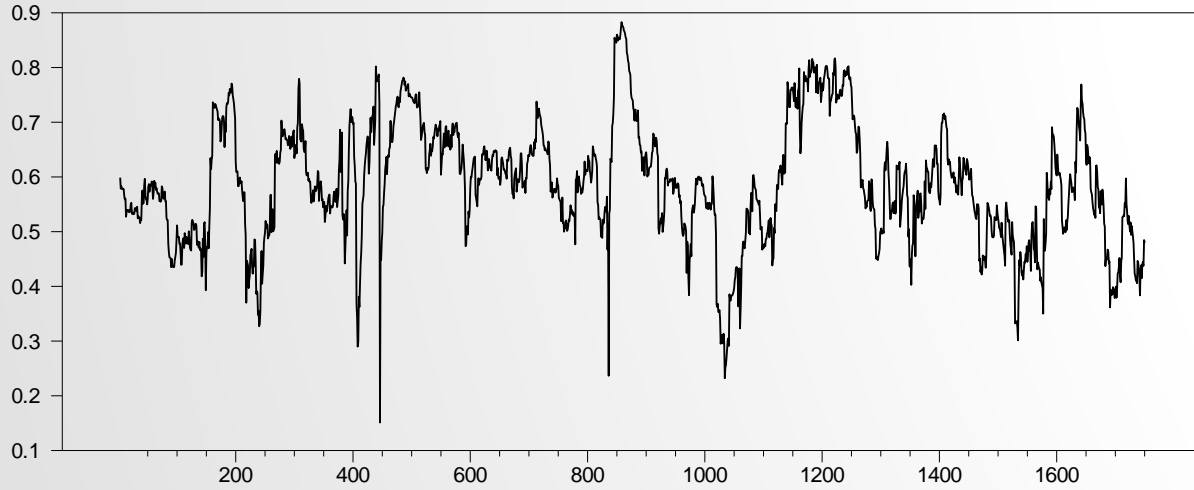


Correlation of IT with SP

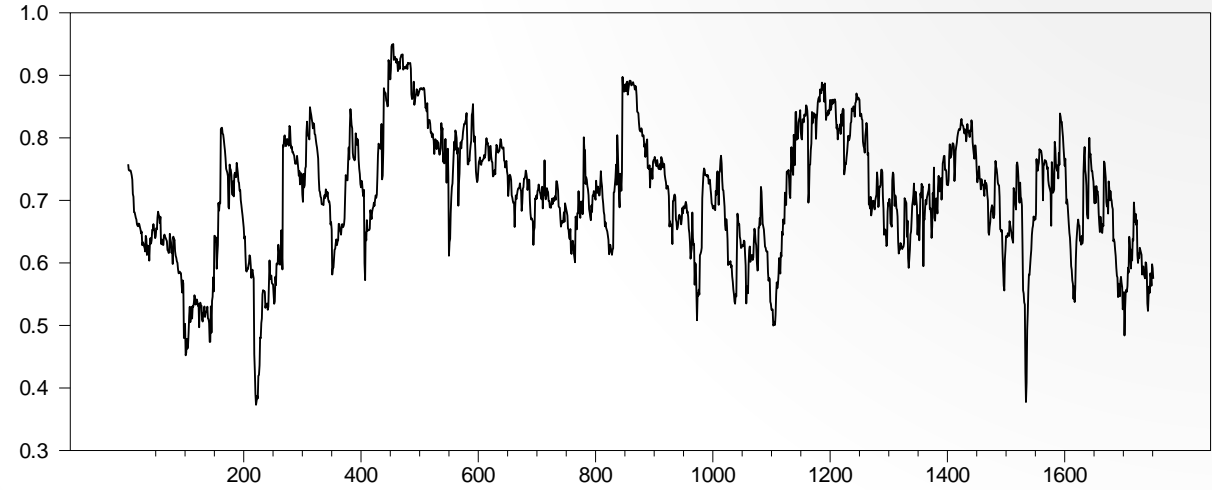


DYNAMIC CONDITIONAL CORRELATION (DCC) – STOCKS - III

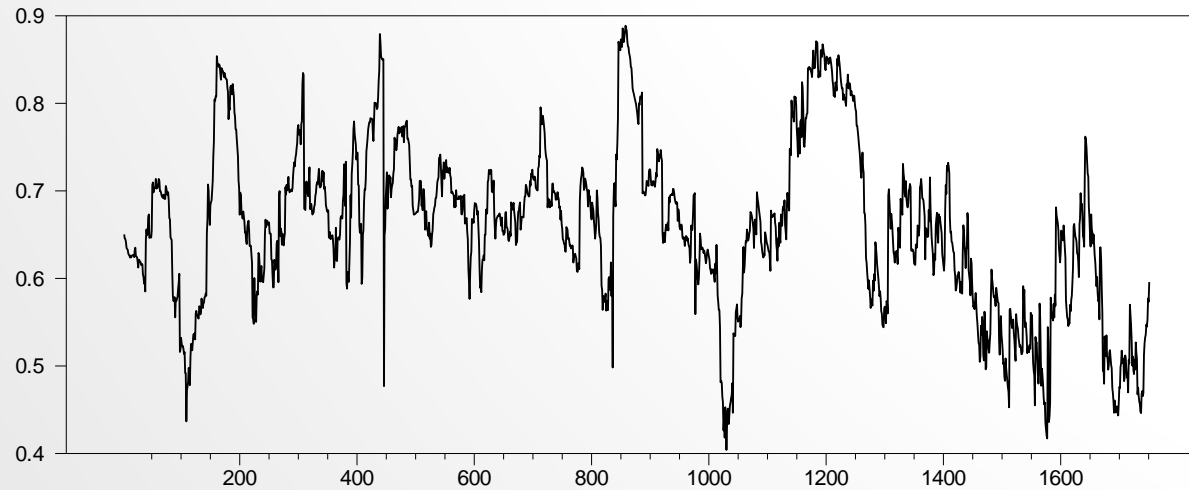
Correlation of IR with PO



Correlation of IT with PO



Correlation of IT with IR



BOND MARKETS VOLATILITY SPILLOVERS BETWEEN COUNTRIES

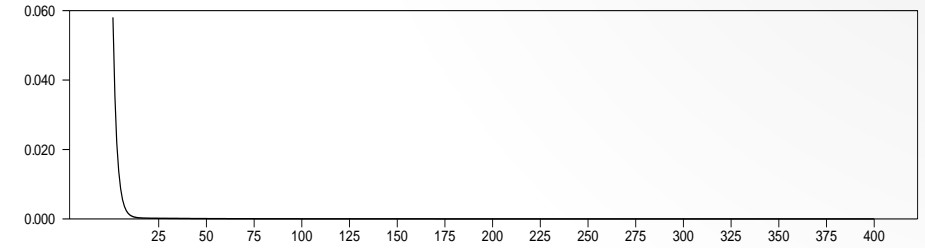
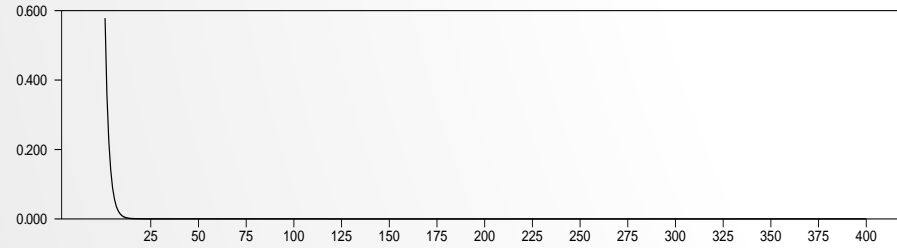
VIRF - BOND MARKETS

Excluding Lehman shock.....

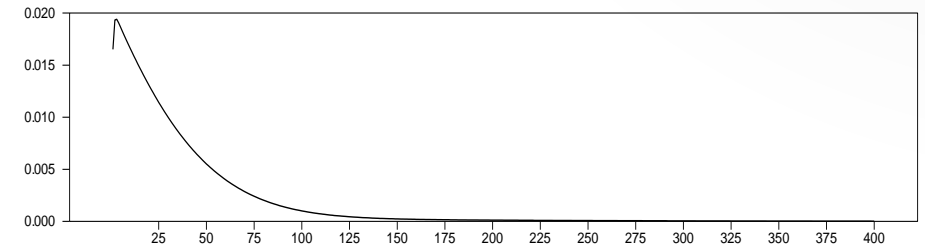
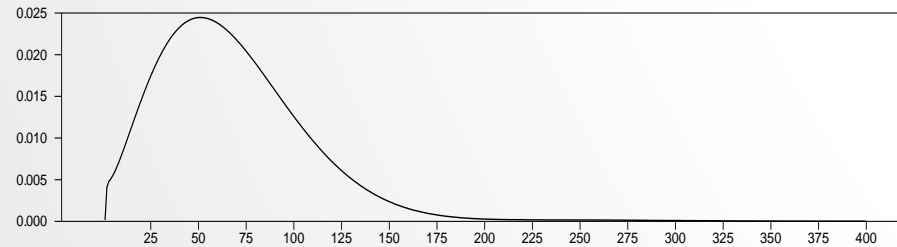
22 May 2013

18 Dec 2013

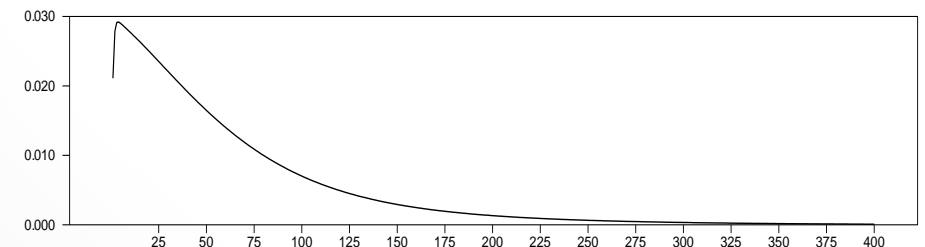
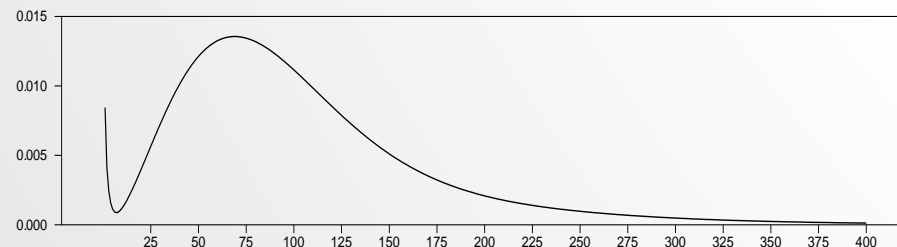
GREEK Variance



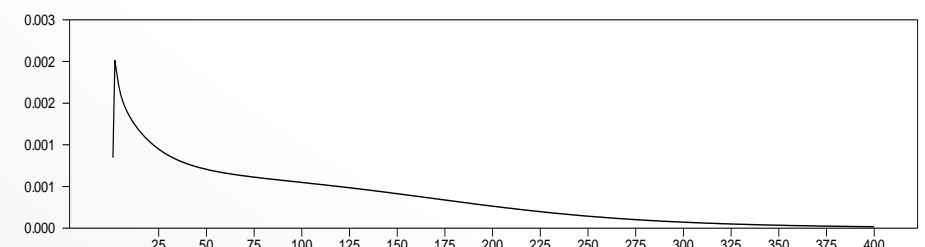
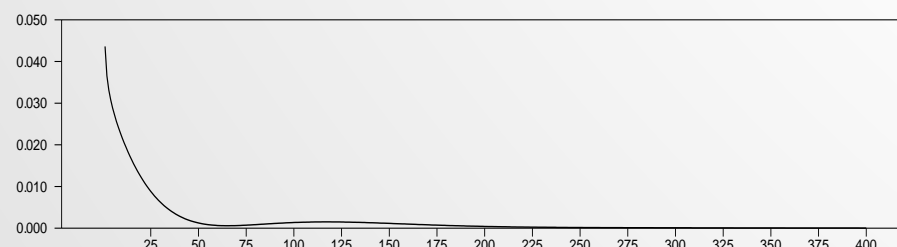
ITALY Variance



SPAIN Variance

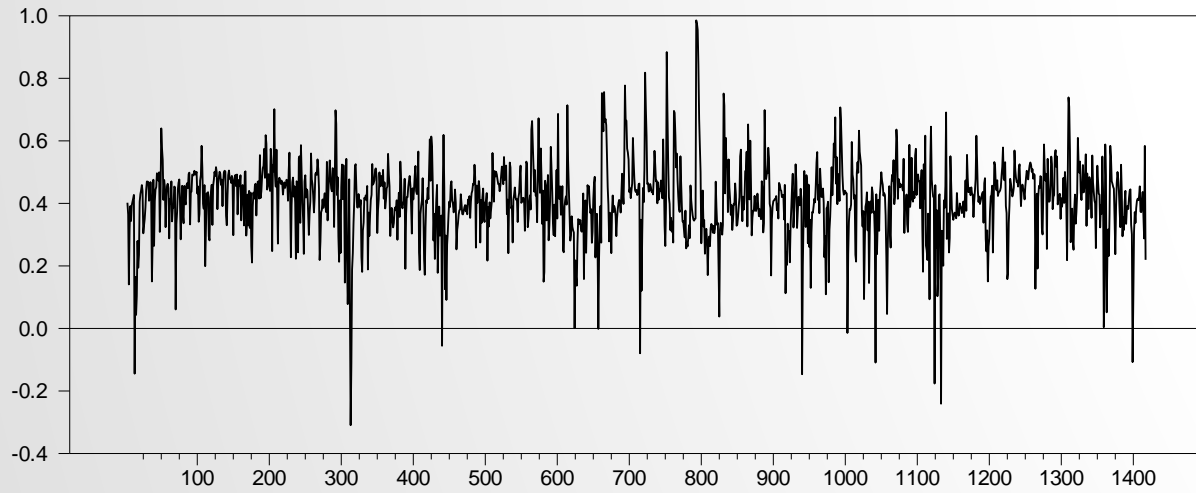


PORTUGAL Variance

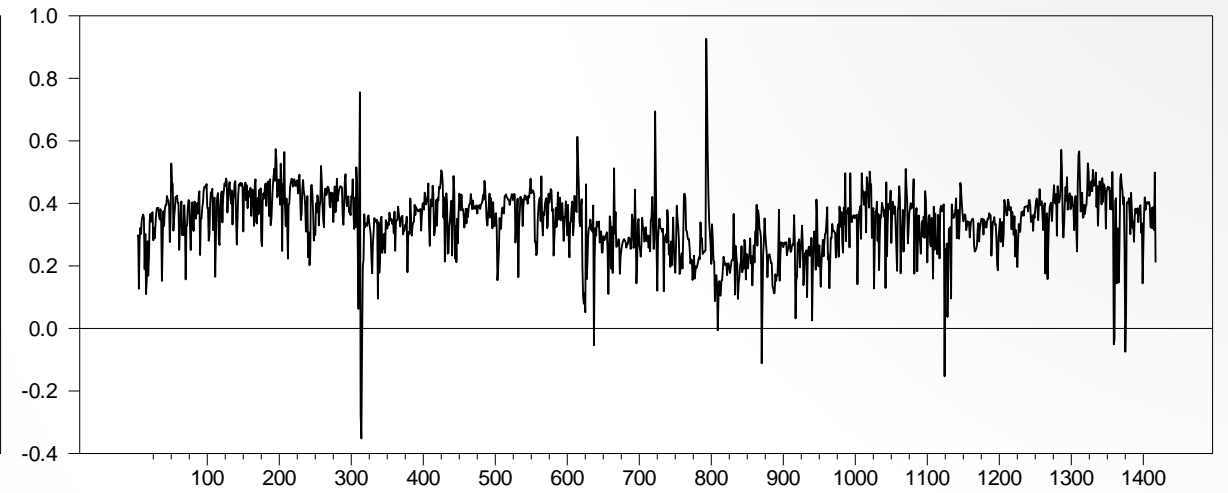


DYNAMIC CONDITIONAL CORRELATION (DCC) – BONDS - I

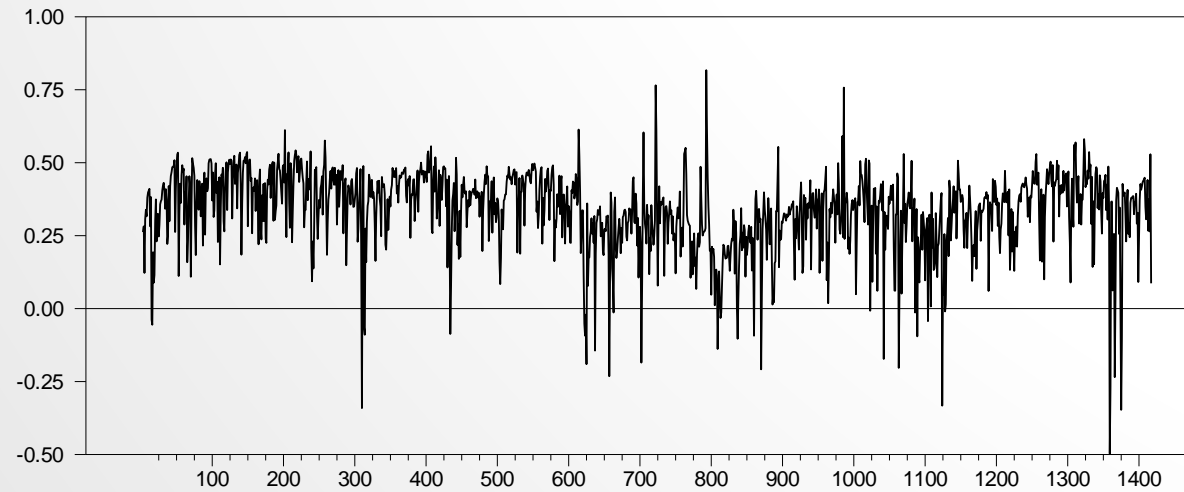
Correlation of GR with PO



Correlation of GR with SP

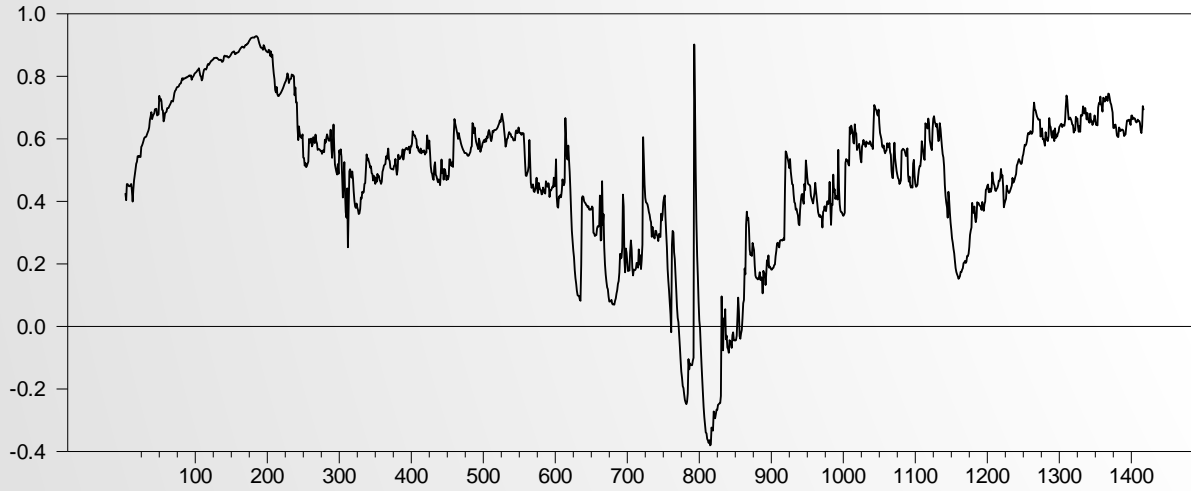


Correlation of GR with IT

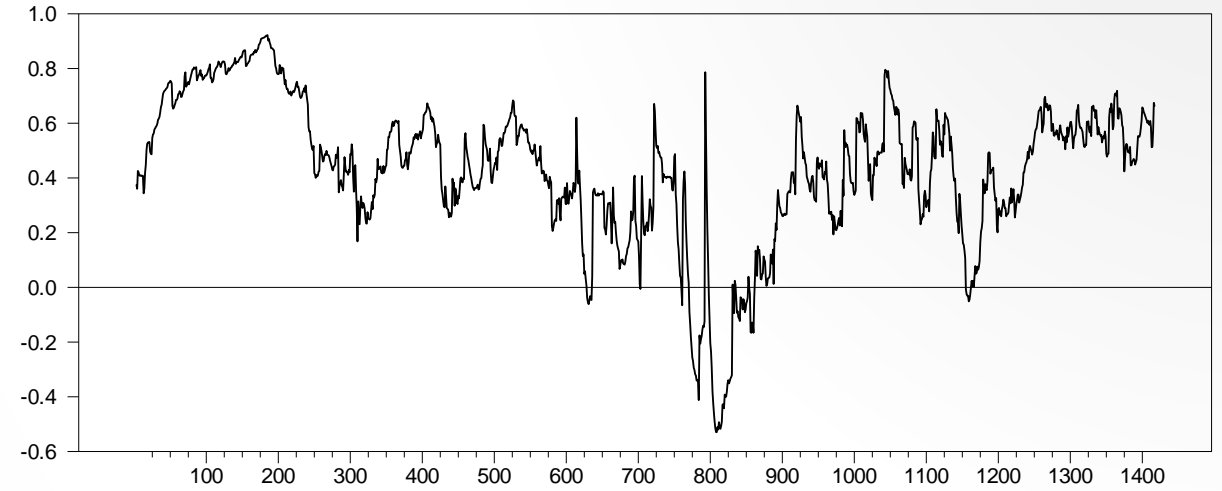


DYNAMIC CONDITIONAL CORRELATION (DCC) – BONDS - II

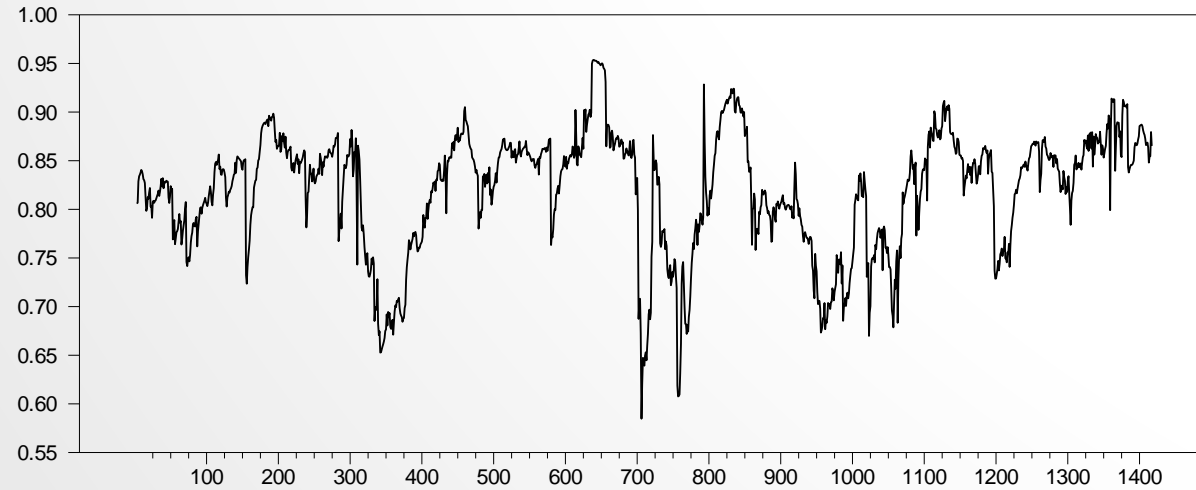
Correlation of SP with PO



Correlation of IT with PO



Correlation of IT with SP





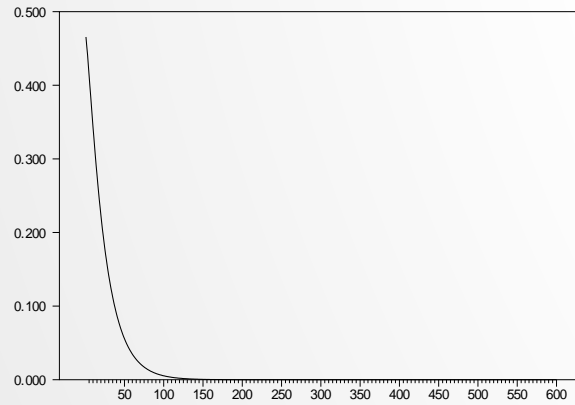
**VOLATILITY SPILLOVERS BETWEEN STOCK
AND BOND MARKETS WITHIN COUNTRIES**



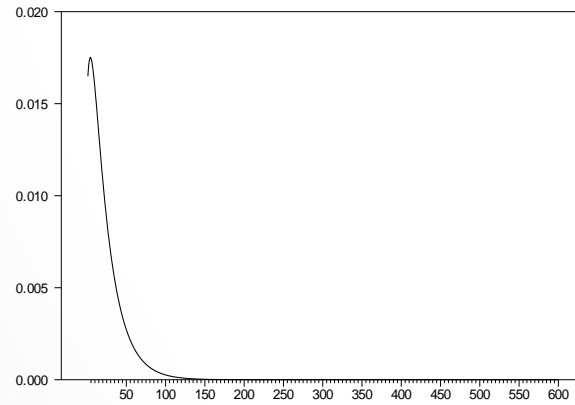
Results - GREECE

VIRF FOR GREECE

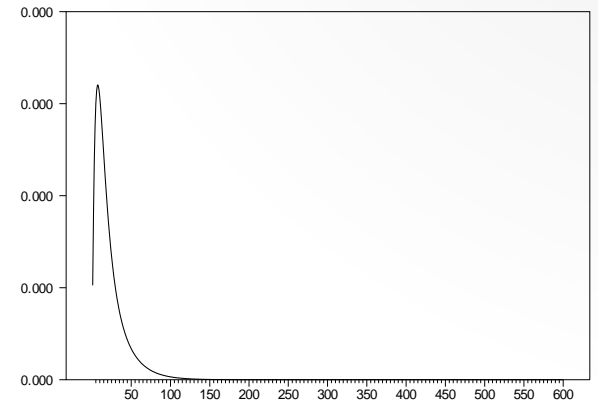
15 Sept 2008



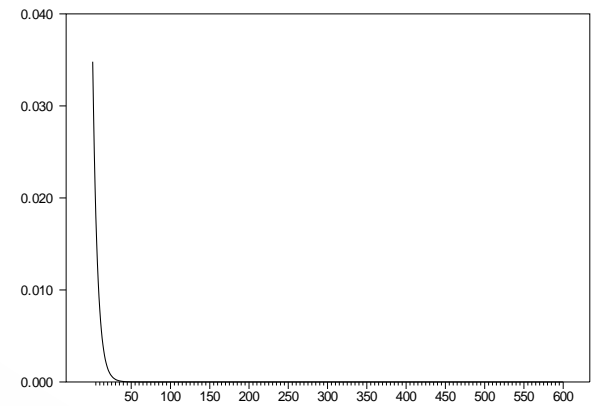
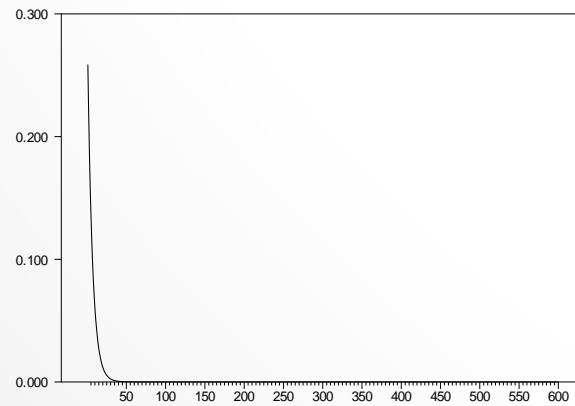
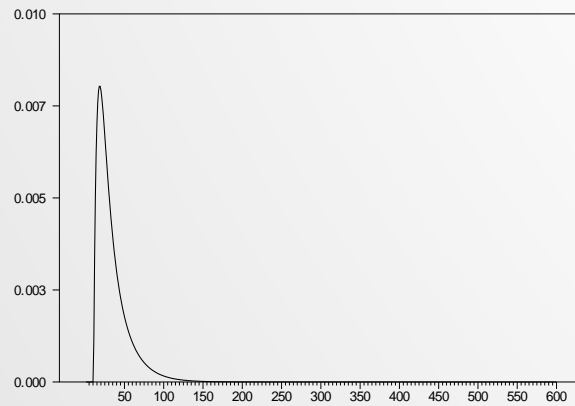
22 May 2013



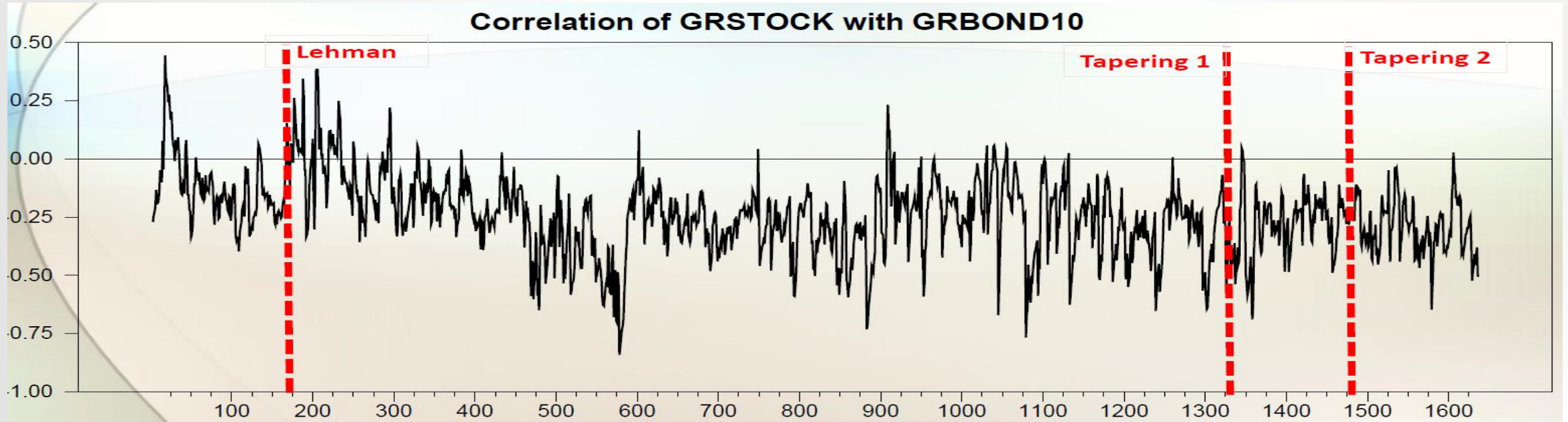
18 Dec 2013



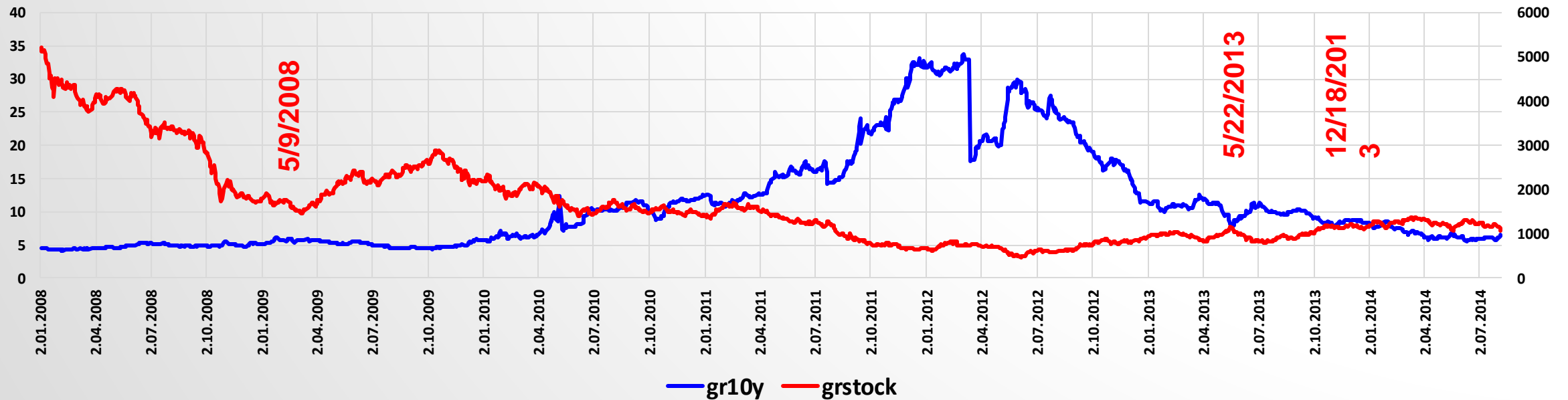
GRBOND10 Variance



DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR GREECE



Greece - Bond and Stock

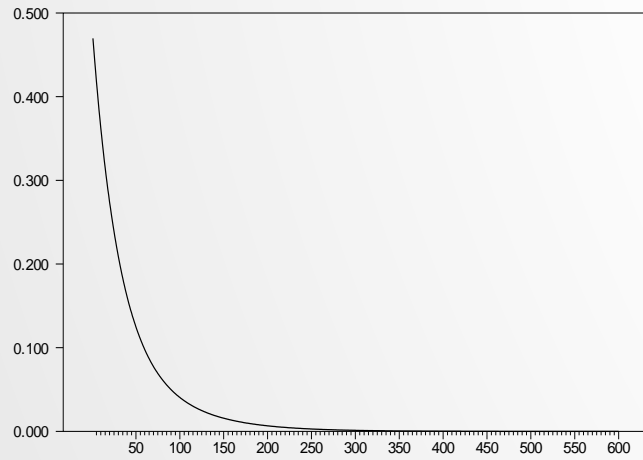




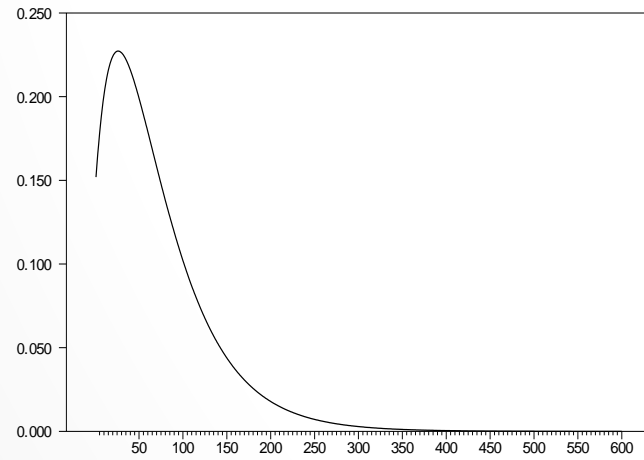
Results - PORTUGAL

VIRF FOR PORTUGAL

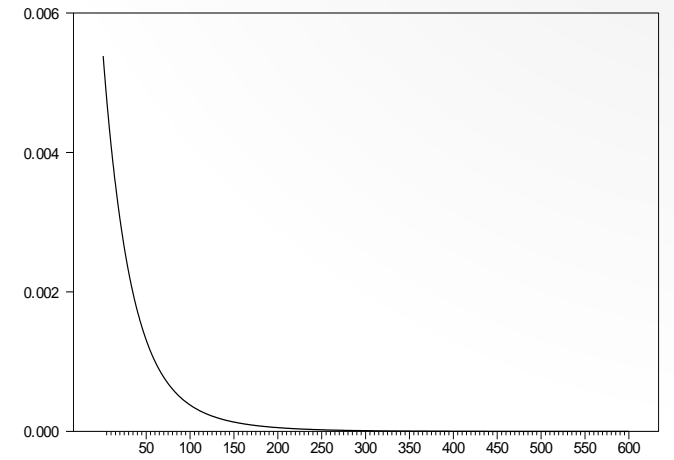
15 Sept 2008



22 May 2013

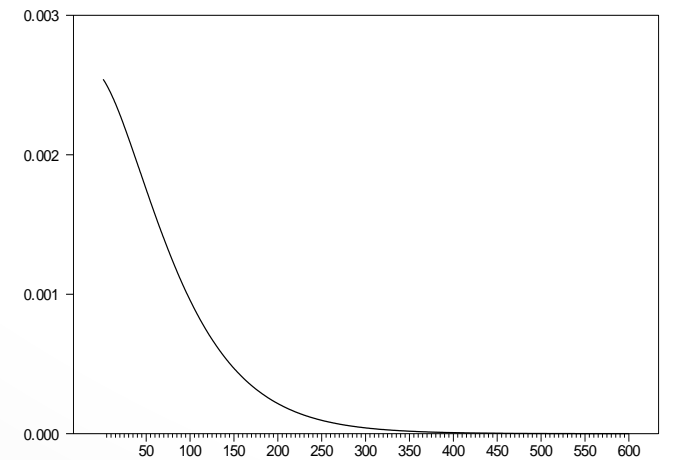
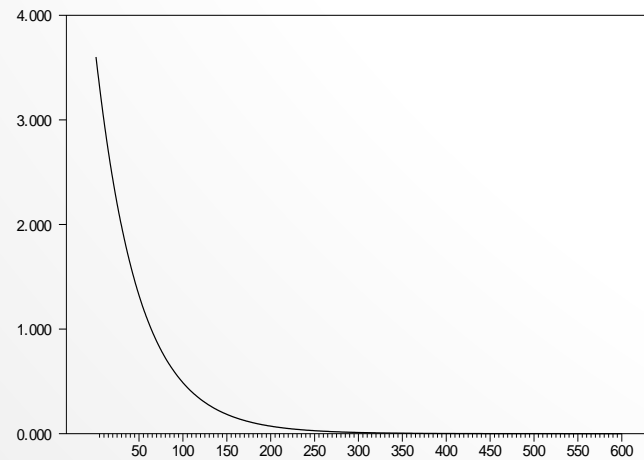
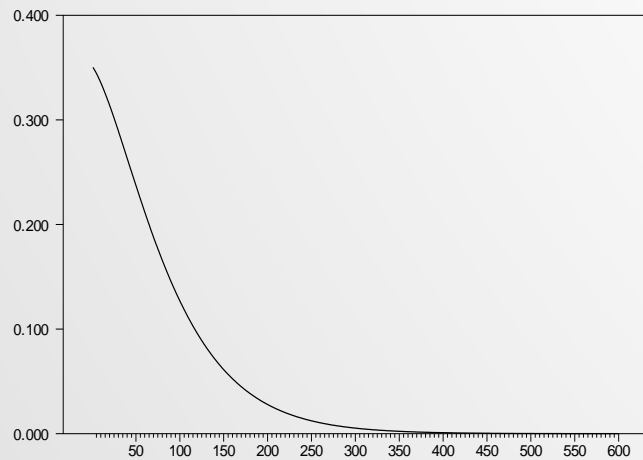


18 Dec 2013

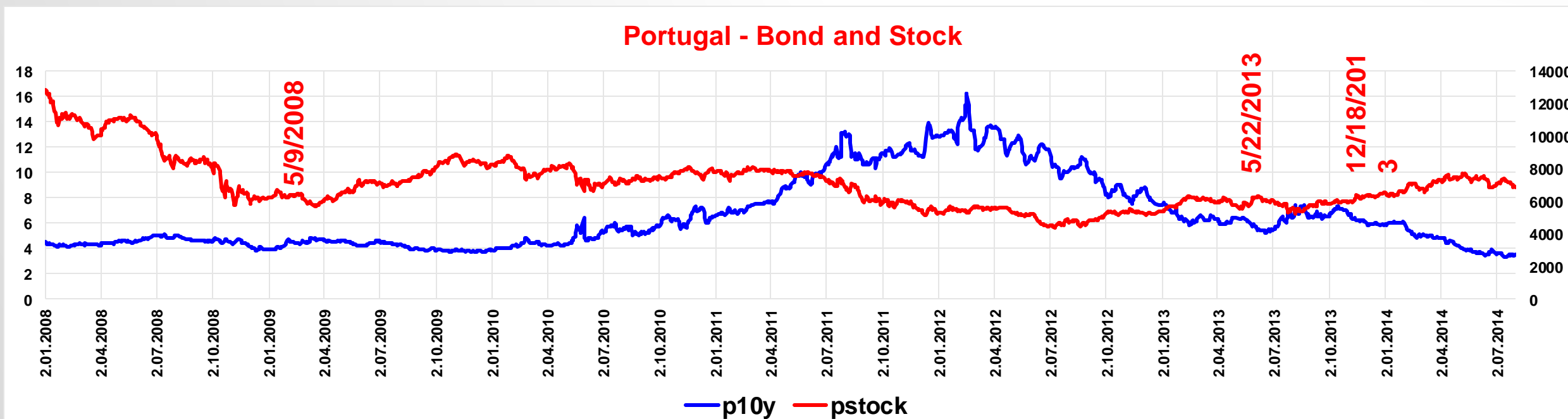
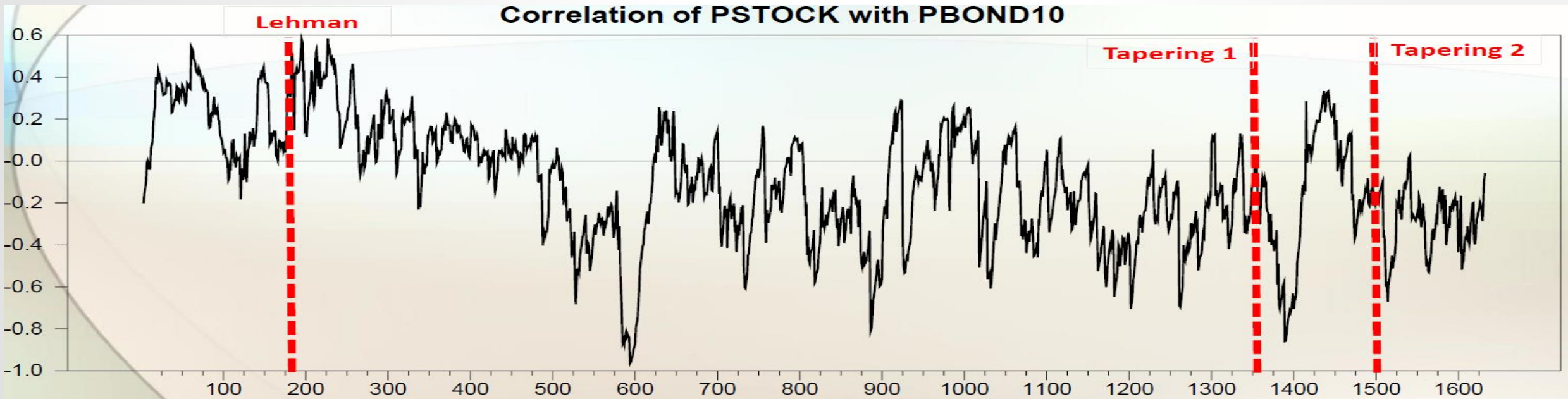


PSTOCK Variance

PBOND10 Variance



DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR PORTUGAL

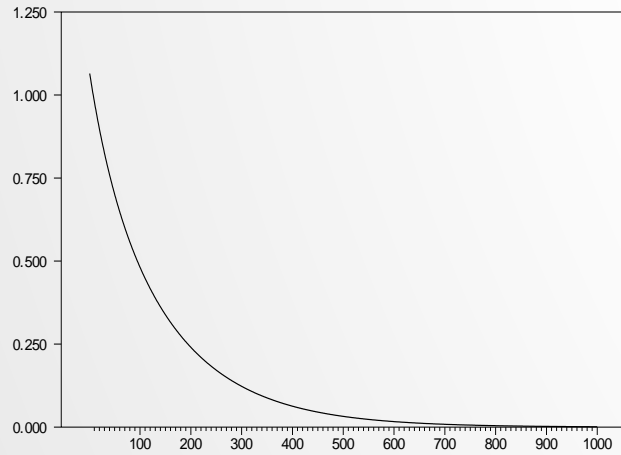




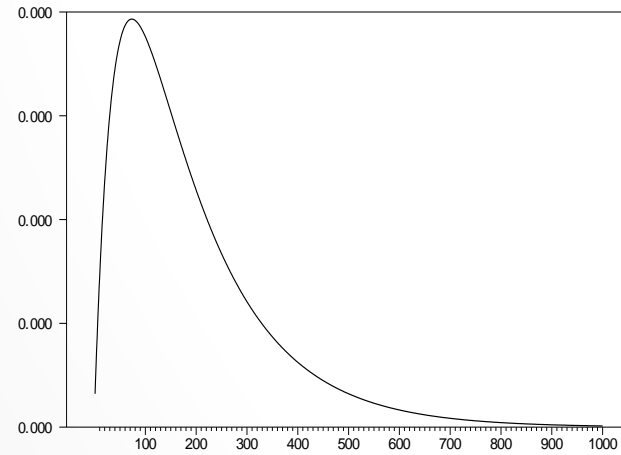
Results - SPAIN

VIRF FOR SPAIN

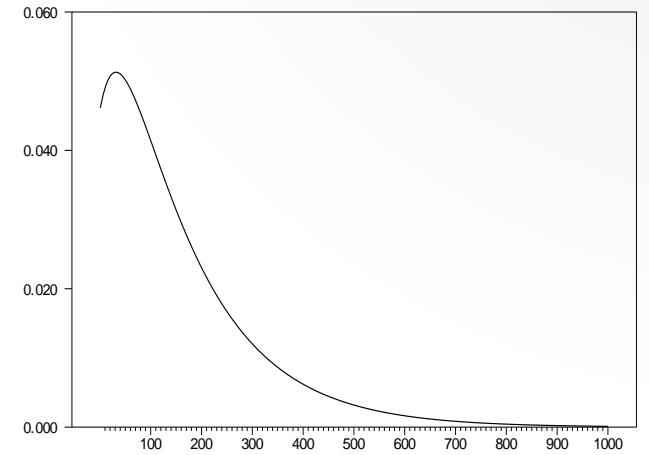
15 Sept 2008



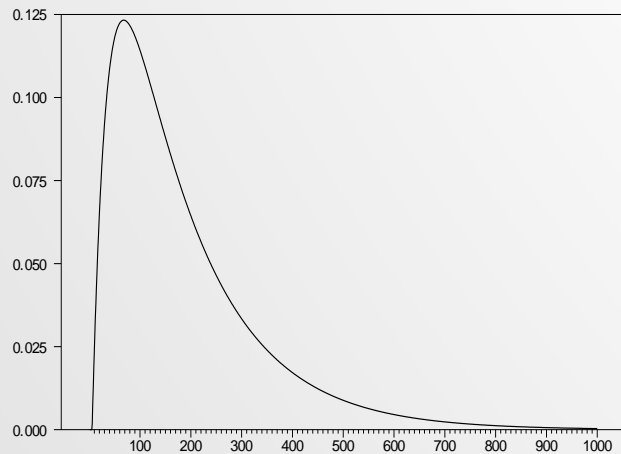
22 May 2013



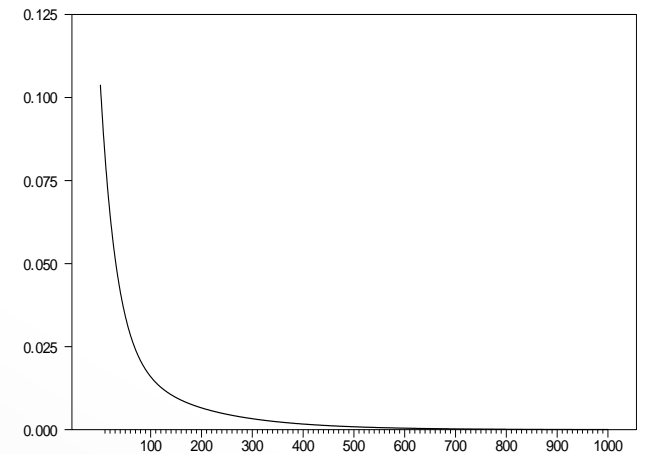
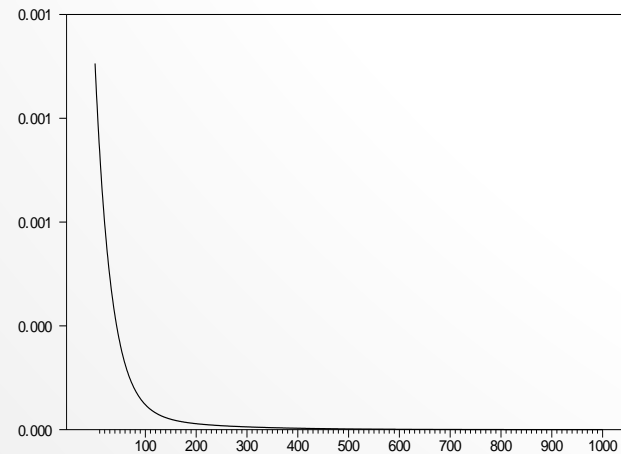
18 Dec 2013



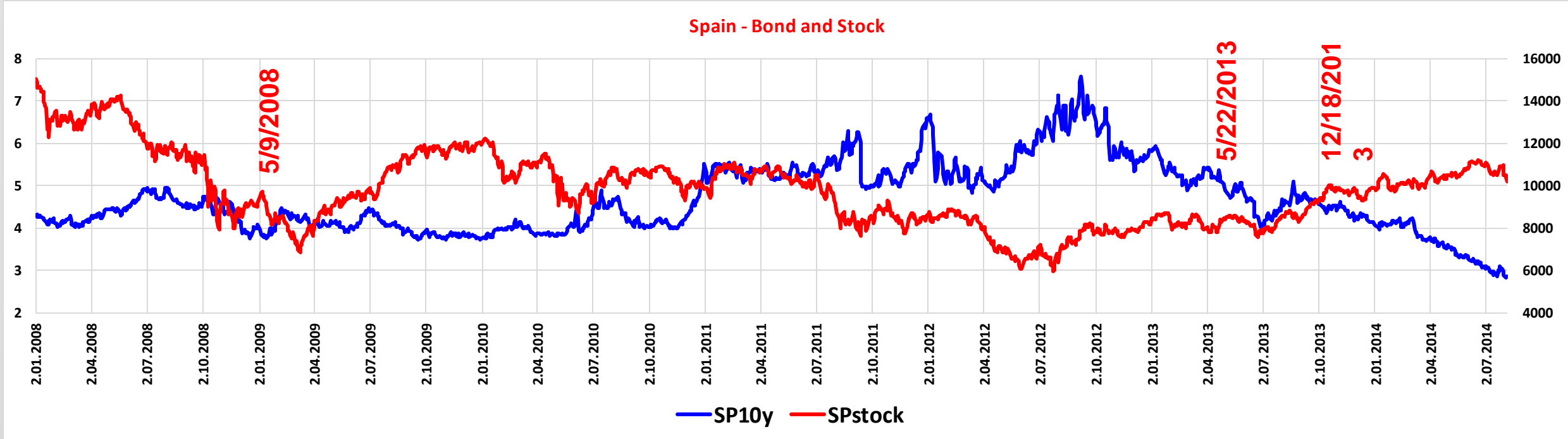
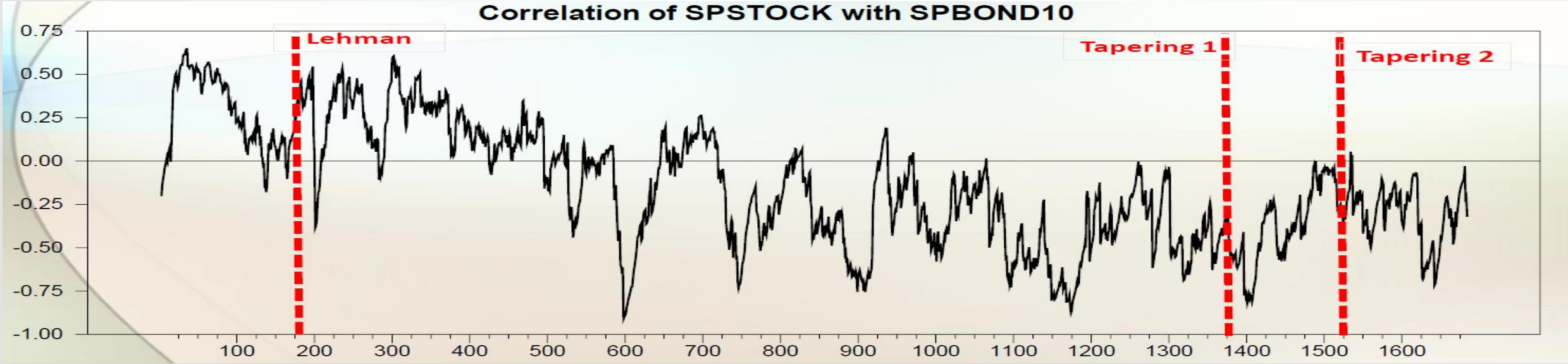
SPSTOCK Variance



SPBOND10 Variance



DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR SPAIN





Results - ITALY

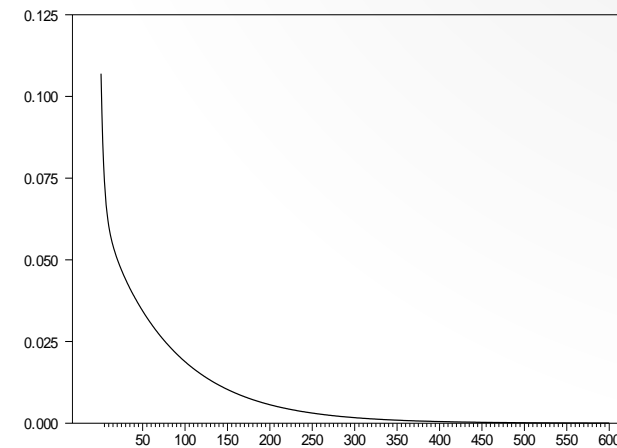
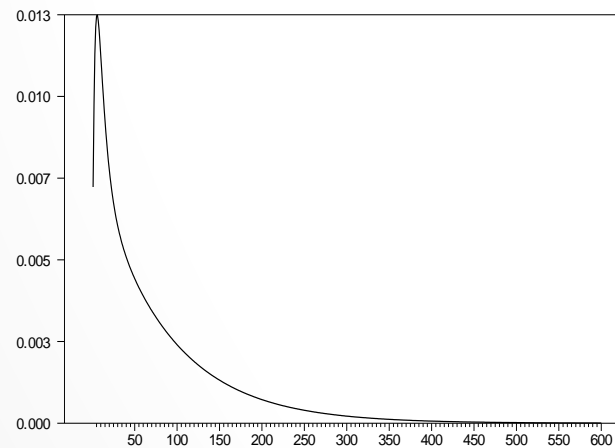
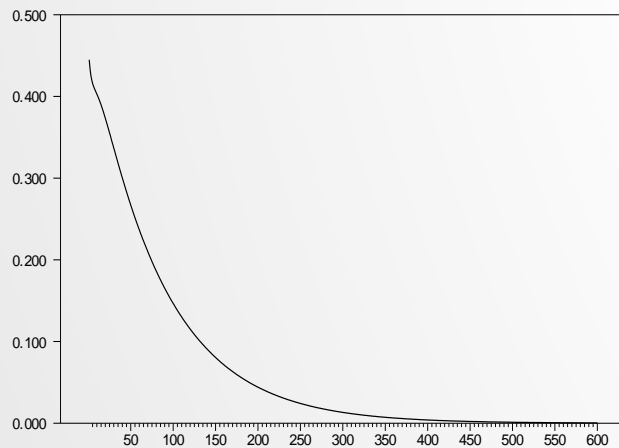
VIRF FOR ITALY

15 Sept 2008

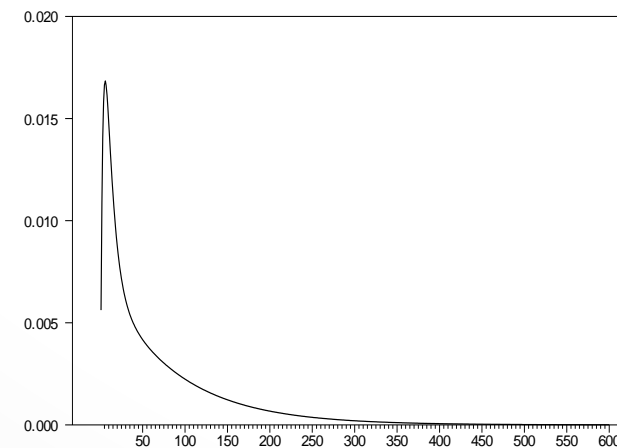
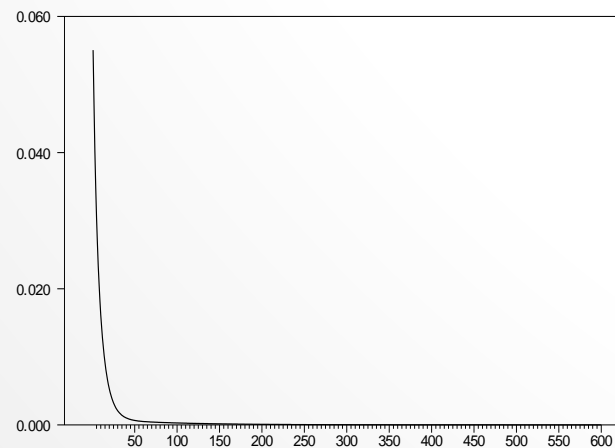
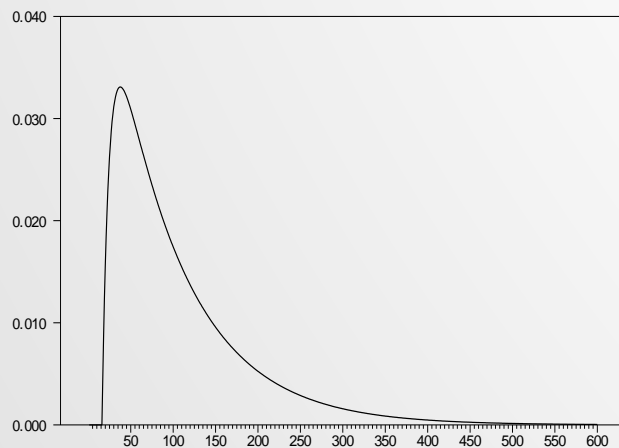
22 May 2013

18 Dec 2013

ITSTOCK Variance

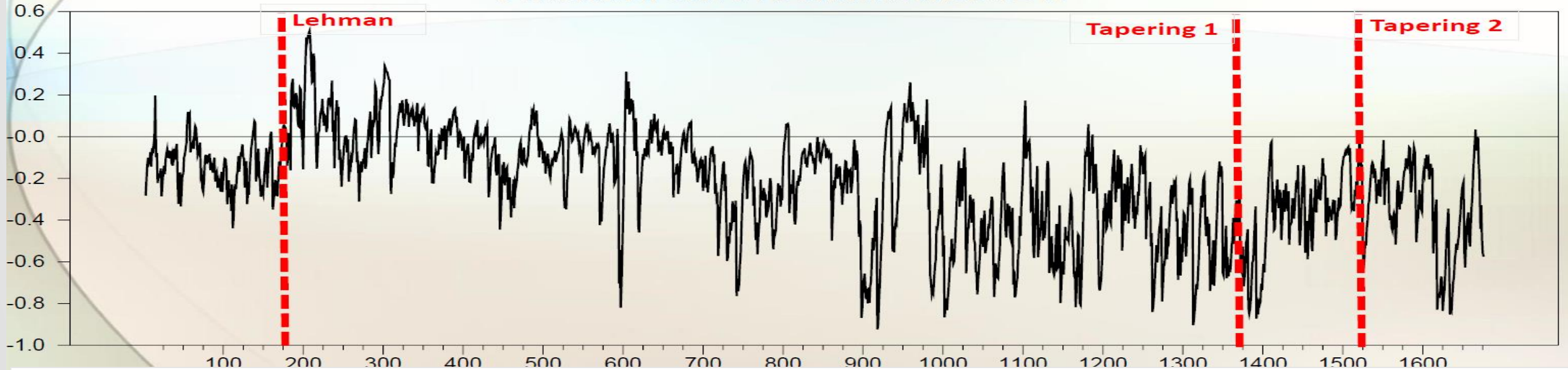


ITBOND10 Variance

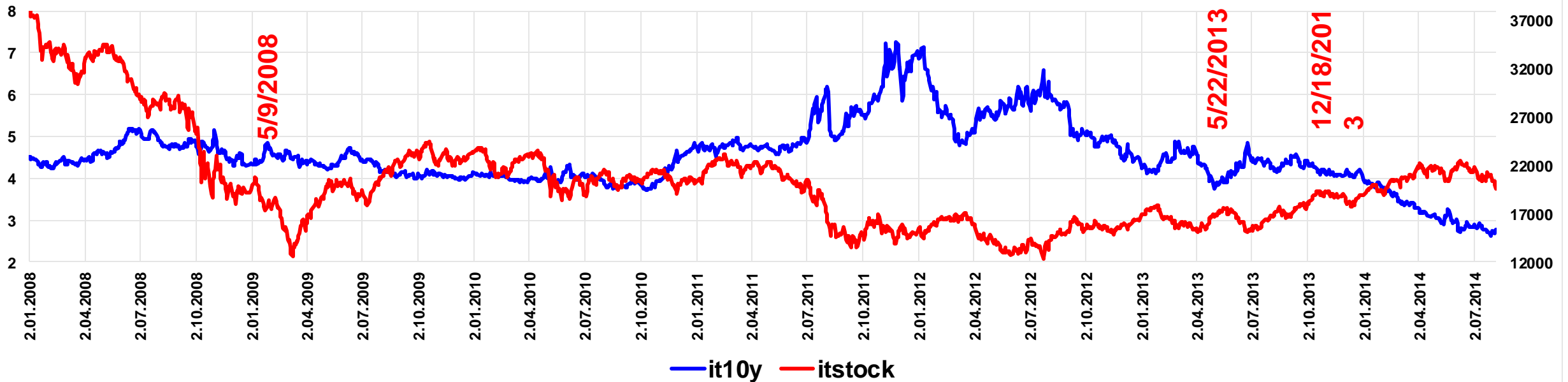


DYNAMIC CONDITIONAL CORRELATION (DCC) BETWEEN STOCK AND BOND10Y FOR ITALY

Correlation of ITSTOCK with ITBOND10



Italy - Bond and Stock





SUMMARY OF FINDINGS

Effects of the shocks on volatility (Size)

All PIIGS (STOCK)

		Stock		
	Lehman	Tapering 1	Tapering 2	
Greece	0.119	0.027	0.0266	
Italy	0.397	0.0196	0.0366	
Spain	0.748	0.00147	0.0516	
Ireland	0.15	0.0020	0.0050	
Portugal	0.265	0.0066	0.00837	

Effects of the shocks on volatility (Persistence)

All PIIGS (STOCK)

Stocks			
	Lehman	Tapering 1	Tapering 2
Greece	113	1366	1089
Italy	253	930	762
Spain	221	714	650
Ireland	303	723	856
Portugal	245	356	399

Effects of the shocks on volatility (Size)

PIIGS/Ireland (BOND)

Bonds 10y

	Tapering 1	Tapering 2
Greece	0.578	0.058
Italy	0.0237	0.0194
Spain	0.0084	0.0291
Portugal	0.0436	0.0020

Effects of the shocks on volatility (Persistence)

PIIGS/Ireland (STOCK)

Stocks			
	Lehman	Tapering 1	Tapering 2
Greece	113	1366	1089
Italy	253	930	762
Spain	221	714	650
Ireland	303	723	856
Portugal	245	356	399



Conclusion

- There is a significant volatility spillovers between financial markets in all PIIGS countries
- Lehman bankruptcy seems to have a more significant impact than tapering on financial markets in PIIGS, both in terms of size and persistence.

Thank you