Global Finance Journal 49 (2021) 100491

Contents lists available at ScienceDirect

Global Finance Journal

journal homepage: www.elsevier.com/locate/gfj

On the stability of stock-bond comovements across market conditions in the Eurozone periphery

Thomas J. Flavin [a,*], Dolores Lagoa-Varela [b]

[a] Department of Economics, Finance and Accounting, Maynooth University, Maynooth, Co. Kildare, Ireland
[b] Departamento de Empresa, Campus de Elviña, 15071 A Coruña, Universidade da Coruña, Spain

ARTICLE INFO

JEL classification:
G01
G11
C32

Keywords:
Stock-bond relationship
Eurozone peripheral countries
Financial crisis
Safe haven

ABSTRACT

We analyze the relationship between returns on equity and long-term government bonds in the crisis-hit Eurozone peripheral economies. In particular, we are interested in the stability of the relationship across differing market conditions and if long-term bonds act as a safe haven for equity investors during periods of financial distress. Employing a Markov-switching vector autoregression model with three regimes, we find that the stock-bond relationship varies across market conditions and across countries. Overall we observe increased comovement during the crisis regimes at the market level, with the relationship between the financial sectors and the domestic sovereign bond being its most important driver across countries.

1. Introduction

The recent financial turbulence in the Eurozone was a prolonged period of crisis, with the Eurozone sovereign debt crisis following quickly on from the international banking crisis. Throughout this period, equity investors sought to protect their wealth by shedding risky assets and diversifying their portfolio into safer alternatives, particularly those who exhibit either permanently low correlation with their equity portfolio or whose return is negatively correlated with the equity return during stock market downturns. The latter is often referred to as a 'safe-haven' asset and usually has the feature that the relationship between the two asset classes under consideration varies over time. A safe-haven asset need not permanently exhibit a negative (or zero) correlation with equity but must have this characteristic during equity market declines. Much of the extant literature on safe-haven assets investigates the relationship between equity and long-term sovereign bonds as the latter are expected to deliver a stable return and be less sensitive to corporate shocks.

The relationship between stock and sovereign bond returns has been studied extensively for the U.S. The early literature suggests that long-term bonds provide a good hedge and act as a 'safe haven' for equity investors. For example, Fleming, Kirby, and Ostdiek (1998) and Scruggs and Glabadanidis (2003) both find that stock market shocks elicit little response in measures of bond market risk. More recently, studies such as Baele, Bekaert, and Inghelbrecht (2010) document substantial time-variation in the co-movements of stocks and sovereign bonds. One popular explanation is that the time-varying relationship depends on market conditions and that during episodes of stock market turbulence, there is a 'flight-to-safety' reaction whereby investors flee equity markets and take refuge in relatively safe assets, such as government bonds. Evidence consistent with this is provided by Connolly, Stivers, and Sun (2005), Guidolin and Timmermann (2006), Andersson, Krylova, and Vähämaa (2008), Yang, Zhou, and Wang (2009) and Flavin, Morley, and

* Corresponding author.
E-mail addresses: thomas.flavin@mu.ie (T.J. Flavin), dlagoa@udc.es (D. Lagoa-Varela).

https://doi.org/10.1016/j.gfj.2019.100491
Received 31 December 2018; Received in revised form 17 August 2019; Accepted 27 August 2019
Available online 31 August 2019

Panopoulou (2014) among others, who all report a negative stock-bond relationship during equity market declines. This supports the view that government bonds provide an effective hedge against equity risk during stock market downturns.

This relationship also seems to hold for stocks and domestic sovereign bonds, during periods of financial market turbulence, in non-U.S. markets. For example, Baur and Lucey (2009) find negative stock-bond correlations during equity market downturns for eight developed markets, while Chang and Hsueh (2013) confirm this finding for a group of Asia-Pacific countries. However, during the most recent financial crisis, a different pattern has begun to emerge for some of the Eurozone periphery countries, casting doubts on the diversification potential of sovereign bonds for equity investors. Jammazi, Tiwari, Ferrer, and Moya (2015) find a positive stock-bond relationship in Spain, Greece, Ireland, Portugal and Belgium since the beginning of the European sovereign debt crisis in late 2009. They attribute this to investors moving away from stock and government bond markets of peripheral countries to invest in economies with more solid fundamentals. Similarly, Acosta-González, Andrada-Félix, and Fernández-Rodríguez (2016) report that, during the recent crisis, the correlation between bond and stock returns inverted from negative to positive in countries like Italy and Spain, while Flavin (2019), using a similar methodology to that employed here, finds positive co-movement between stock (at the broadest market level) and bond returns in the crisis-hit peripheral Eurozone states during the most recent crisis. These studies imply that domestic sovereign bonds may not always act as a safe haven for equity investors, particularly during periods of high volatility in sovereign bond markets.

We re-visit this issue and focus on the Eurozone countries worst affected by the crisis; namely Greece, Ireland, Italy, Portugal and Spain, the so called GIIPS countries. We choose this set of countries in an effort to explain the recent evidence of a positive relationship between domestic stocks and sovereign bonds during the crisis. We delve deeper into the driving forces behind this change in stock-bond co-movement, using a relatively new methodology, by undertaking a sectoral analysis of the GIIPS financial markets.

Our main innovation is to look at the relationship between equity and sovereign bond returns at a sectoral level. The aforementioned literature has predominantly focused on this relationship at the stock market index level, but this may conceal important cross-sectoral differences. An analysis at this finer level of disaggregation has the potential to uncover these differences, which may be important for both investors and policy makers. In particular, it allows us to ascertain if the documented changes at the country level are pervasive across all sectors or result from particular industries. This information is relevant to investors who hold equity portfolios diversified across industries and it can be used to distinguish between sectors whose risk can and cannot be effective hedged by domestic sovereign bonds during a financial crisis. Similarly, government policy makers bidding to curb the contagious spread of a crisis and/or persuade bond investors as to the creditworthiness of their sovereign bonds may need to identify the sectors that cause most spillovers during a crisis. This disaggregated information will allow them to focus on particular sectors as they strive to build a strong, resilient economy.

Specifically, we analyze the relationship between sectoral equity indices and a 10-year sovereign bond using a Markov-switching vector autoregression (MS-VAR) model which allows us to assess the time-variation in the conditional correlation across market conditions. The MS-VAR approach is ideally suited to address this question. Firstly, the regime-switching framework is designed to deal with non-contiguous data, i.e. it accommodates samples of calm interspersed with crisis events (that is the dates do not have to be contiguous). This is particularly useful over our sample period when financial markets were hit with a series of shocks over a relatively long time period and, as we show later, we identify three regimes over our sample – a period of calm (normal) markets and two distinct phases of the crisis. Secondly, the VAR framework allows us to model the interactions of the variables in the system and identify the asset-specific shocks. Thirdly, we can generate regime-specific generalized impulse response functions (GIRFs) to assess the cross-market reactions to a shock. The GIRFs allow us to assess the relative importance of stock and bond market shocks in generating cross-market comovement and enable us to easily detect changes in the shock transmission between regimes.

First, the analysis is conducted for each country's equity market index and a domestic 10-year sovereign bond and we confirm the aforementioned pattern at the overall market level, i.e. returns on domestic long-term sovereign bonds and equity have exhibited positive comovement during the recent crisis, for all countries except Ireland. Ireland is different in a number of respects. Firstly, it is the only one of the GIIPS to suffer higher asset return volatility during the global banking crisis (2007–09) than during the period of the Eurozone sovereign debt crisis and secondly, the two domestic asset classes tended to move in opposite directions during the latter crisis period. We then proceed to analyze the stock-bond relationship at a finer level of disaggregation using ten equity-market sectoral indices. It reveals important differences in the stock-bond relationship across sectors. A feature of our results is that the positive comovement of the Financial sector and sovereign bonds is pervasive across the GIIPS countries, with shocks to both assets reinforcing the positive relationship and thereby reducing the diversification potential of these assets. Results are less uniform across other sectors. In Greece, all equity sectors become positively correlated with the domestic sovereign bond during the crisis regimes but this is the extreme case. At the other extreme, none of the non-financial sectors in Ireland exhibit positive comovement with the government bond during the high-volatility regime. This suggests that Irish investors in domestic non-financial stocks and bonds continued to enjoy diversification benefits during this regime.

The remainder of the paper is structured as follows. Section 2 describes the econometric methodology and our data. Section 3 presents our empirical results and discusses their implications, while section 4 contains our concluding remarks.

2. Econometric methodology and data

2.1. Econometric model: specification and estimation

We estimate bivariate MS-VAR models to study the time-varying relationship between equity market sectors and long-term government bonds across the GIIPS countries. We specify the vector of dependent variables as $y_t = \{\text{equity return, bond return}\}_t$. The bond

return is always the return on a 10-year sovereign bond but we employ different measures of the equity return in each model specification. Initially we focus on the total equity market index for each country and then repeat the analysis at the sectoral level to provide a more disaggregated assessment of the relationship between equity and bond returns. We study the stability of shock transmission across regimes by analyzing regime-dependent GIRFs.[1] The GIRFs allow us to study both the contemporaneous cross-market responses to asset return shocks and assess the stability of the dynamics of shocks across regimes.

In our models, we allow for up to three distinct regimes, which we identify as low-, intermediate-, and high-volatility market conditions. The low-volatility regime can be thought of as the pre-crisis, with the other regimes corresponding to different phases of the crisis. As in Guidolin and Timmermann (2005), we find that two regimes are not sufficient to capture the market dynamics and hence opt for the higher dimension specification.[2]

We estimate the following MS-VAR model:

$$\begin{aligned} &y_t = \lambda(s_t) + \sum\nolimits_1^p \theta_p(s_t) y_{t-p} + \varepsilon_t^{st} \\ &S_t \in \{1,2,3\} \\ &\varepsilon_t^{st} \sim i.i.d.\left(0, \sigma_s^2\right) \end{aligned} \tag{1}$$

where y_t is a 2×1 vector as defined above. The regression constant (λ), the matrix of autoregressive coefficients (θ) and the covariance matrix of residuals (σ) are all regime-dependent. S_t is an unobservable latent variable, which takes a value of unity in the non-crisis, low-volatility period, a value of 2 in the first phase of the crisis, when markets exhibited intermediate levels of volatility, a value of 3 in the more intense, high-volatility crisis regime. The evolution of the unobserved regime path is specified to be Markov switching and is endogenously determined by the data. The conditional matrix of transition probabilities has the following typical element:

$$Pr[S_t = i | S_{t-1} = j] = p_{ij} \tag{2}$$

The model is estimated using a Bayesian Markov-chain Monte Carlo (MCMC) approach. We follow Dungey, Flavin and Lagoa-Varela (2018) in specifying the prior distributions for the parameters as follows. For the variances, we employ a Wishart distribution, the VAR coefficients have a flat prior and we use a weak Dirichlet prior for the transitions, with a preference towards remaining in the same state. Using Gibbs sampling, we estimate the parameters and regimes in the following sequence;

Step 1: We draw the sigmas, given the mean coefficients and regimes.
Step 2: We draw the mean coefficients ($\boldsymbol{\lambda}$ and $\boldsymbol{\theta}$) given sigmas and regimes.
Step 3: We draw the regimes, given the sigmas and mean coefficients.
Step 4: We draw the transition parameters.

This sequence of steps is repeated 10,000 times after discarding an initial 'burn-in' set of 2000 replications. From the estimated parameters, we generate the regime-dependent GIRFs and their associated confidence bands. The GIRFs are the Choleski factors standardized to unit variances. This allows us to compare differences in dynamics rather than differences in variances, since what we are interested in is the stability of the shock transmission across regimes.

2.2. Data

Our data set consists of daily returns on equities and long-term government bonds for each of the GIIPS countries. We employ Datastream-constructed total return (including dividends) indices for both the equity market (TOTMKCC) and constant-maturity 10-year government bonds (BMCC10Y).[3] Later, we disaggregate the equity index into ten sectors. These are based on the FTSE's Industry Classification Benchmark and the sectors are Financials, Oil & Gas, Basic Materials, Industrials, Consumer Goods, Consumer Services, Telecoms, Technology, Utilities and Healthcare. Our sample covers the period from January 1st, 2004 to December 31st, 2015. The starting point is chosen so as to avoid contamination from other international financial crisis such as the bursting of the dot.com bubble in 2000 and the Latin-American bond crises of 2001–2. Table 1 shows the relative importance of sectors to each of the domestic indices by reporting the average proportion of market capitalization attributable to each sector. The financial sector is the largest in each country, while the technology and healthcare sectors tend to be relatively small across the GIIPS. We omit sectors that do not have data for the entire sample and sectors that, on average, represent less than 1% of the total domestic market capitalization. Applying these restrictions means that the Technology sector is excluded in each country and yields a final sample coverage of 9 sectors in Spain and

[1] Ehrmann, Ellison, and Valla (2003) show how to generate regime-dependent IRFs in a Markov-switching VAR and Dungey, Flavin, and Lagoa-Varela (2018) exploit the methodology to test for cross-market contagion and decoupling using regime-dependent GIRFS.

[2] In a two-regime specification, the high-volatility regime tends to become an absorbing state and thus fails to pick up the different phases of the crisis. A number of studies of Eurozone bond markets also find that three regimes are required to capture this tumultuous period, e.g. Cronin, Flavin, and Sheenan (2016).

[3] Datastream-constructed total market indices are computed as market-capitalization weighted indices of the largest 50 companies on the domestic index. The 10-year benchmark government bond index is computed as a constant-maturity total-return index of the most liquid government bonds in accordance with the European Federation of Financial Analysts Society (EFFAS) methodology. In the mnemonics, CC represents a country-specific country code.

Italy, 8 in Greece, and 6 each in Ireland and Portugal.

Table 2 presents descriptive statistics for all return series. Panel A reports the average return for each asset/index. It reveals that, over the sample period, the sovereign bond return slightly outperformed the total domestic equity market across all countries. The financial and telecom sectors did poorly in all countries, with the former recording negative average returns in Greece, Ireland and Portugal and the latter in all countries for which the index exists.

Panel B reports the asset/index volatilities over the period. Stock market indices display far greater volatility than the bond return and, furthermore, sectoral returns are more volatile than the total equity market. Greek assets are usually riskier than their counterparts in other countries and the Greek sovereign bond return is strikingly so, with a standard deviation of more than double the next highest (Portugal).

Panels C and D report skewness and kurtosis statistics respectively, for each asset/index. All sectoral returns exhibit skewness and strong evidence of kurtosis. Equity returns are predominantly negatively skewed, while bond returns tend to be positively skewed. Bond returns display considerable evidence of kurtosis, along with equity returns in Greece and Ireland. The prevalence of fat tails suggests that modeling these returns in a Markov-switching framework may be a better approach than in a single state setting.

3. Discussion of results

3.1. Results of the MS-VAR model

Country-specific bivariate MS-VAR models are estimated for the long-term sovereign bond return and the returns on each of the stock market indices described above. In all applications, we identify three regimes from the estimated volatilities.

Fig. 1 presents the smoothed probabilities of the regimes for the total market-level analysis.[4] It shows the prevailing financial market conditions over the sample period. For all countries except Ireland, a similar pattern emerges. The initial period is a clear 'Bull' market regime, associated with strong stock market and economic growth. For Greece, Italy, Portugal and Spain, the global banking crisis causes a transition to a crisis regime with intermediate levels of volatility. This is interspersed with short, intense periods of high volatility around the time of the collapse of Lehman Brothers, which triggered turmoil and liquidity runs in international markets.[5] Markets reverted to the intermediate volatility regime before the most prolonged high-volatility period in 2011 when all countries became embroiled in the developing Eurozone sovereign debt crisis. High-volatility regimes tend to be the least persistent than but are also the most destructive with strongly negative returns and increasing uncertainty. The sample ends in a mainly intermediate-volatility regime with some sporadic spurts of growth.

Ireland is different. After the initial period of bull markets, Ireland suffered the most intense period of crisis in its financial markets during the global banking crisis. During this period, the Irish banking sector suffered massive losses and the indigenous banking sector was all but wiped out.[6] This led to a period of high-volatility, which is larger than that recorded in the domestic financial system during the Eurozone sovereign debt crisis. Interestingly, the Irish recovery starts relatively early and by mid-2012, markets revert to a regime of positive returns and low volatility. This state gives way to sporadic crisis episodes, corresponding to periods of distress for the common currency zone and fears for its viability due to negotiations on how to deal with the Greek financial and economic collapse.

Tables 3 and 4 contain regime-specific estimates of expected returns and volatilities respectively, for both equities (all indices) and the 10-year government bond. The three regimes have distinct characteristics. The low-volatility (non-crisis) regime has positive expected equity returns, consistent with a bull stock market. The first phase of the crisis is characterized by expected equity returns that oscillate around zero and an intermediate level of volatility, as the turmoil developed. While the more intense crisis regime exhibits strongly negative equity returns and high volatility, the typical characteristics of a bear market. The long-term bonds of Italy and Spain generate positive expected returns (Table 3) across all three regimes, while the expected bond returns in Greece, Ireland and Portugal all become negative in the regime that encompasses the Eurozone sovereign debt crisis. In general, the magnitude of returns in the intense, high-volatility regime is the largest but they are often imprecisely estimated due to increased volatility in the system. Focusing on results at the total stock market level during this regime, we find that the expected returns in both stock and long-term sovereign bond markets are negative, indicating that both markets were simultaneously suffering financial distress. Common factors such as liquidity shortages are likely to have played a role in both markets.

The asset volatilities (Table 4) confirm some stylized facts. Across all sectors, stock market returns are more volatile than returns in the sovereign bond market except in Greece during the high-volatility regime. Furthermore, the volatility increases are far more pronounced for equity returns than bond returns as we move from the tranquil, non-crisis period to the crisis regimes.

3.2. Regime-specific correlations

Table 5 presents the regime-specific correlations generated by the MS-VAR model. Though not a statistical test for the stability of

[4] Similar figures are available for each specification of the model and are available upon request. However, to conserve space, we do not include the graphs for the sectors.

[5] Aït-Sahalia, Andritzky, Jobst, Nowak, and Tamirisa (2009) attribute (in part) the 'internationalization' of the U.S. crisis to liquidity shortages following the fall of Lehman Brothers in September 2010.

[6] Connor, Flavin, and O'Kelly (2012) provide an overview of the Irish financial crisis, detailing the collapse of the banking system and the government's response to it.

Table 1
Average proportion of total market capitalization by sector.

	Greece	Ireland	Italy	Portugal	Spain
Financials	39.1	27.1	34.8	20.5	33.4
Basic materials	4.1	4.4	3.6	7.8	2.0
Industrials	7.8	19.8	9.3	12.3	11.7
Cons. services	14.0	23.2	4.1	24.2	12.2
Cons. goods	11.2	20.6	10.0	0.7	1.6
Telecoms	10.7	0.02	5.4	12.1	13.8
Technology	0.3	0.3	0.6	0.4	0.6
Utilities	6.3	NA	14.8	21.9	16.4
Healthcare	0.4	NA	1.3	0.2	2.1
Oil & gas	6.1	4.6	16.2	NA	6.2

Notes: These are the average proportions (expressed in percentages) of market capitalization attributable to each sector over the whole sample. NA signifies that this sector does not exist in the indicated country.

relationships, they provide an overview of the changes in comovement across the three regimes.

A number of interesting features of the relationship emerge from this analysis. Firstly, the low-volatility, pre-crisis regime is predominantly associated with negative comovement between the two asset classes. For most stock market sectors across all countries, equity and bond returns tend to move in opposite directions during periods of positive stock market news as investors re-balance portfolios in favor of the high-yielding asset. Secondly, during the intermediate-volatility regime, the correlations all turn positive, implying that returns to both assets move in the same direction in response to shocks during this relatively stagnant period. Thirdly, and most importantly in assessing the diversification benefits of sovereign bonds during financial downturns, the sign of the correlation is not uniform across stock market sectors during the periods of intense high volatility. Returns for the total market and the long-term bond are positively correlated for Greece, Portugal and Spain but not for Ireland and Italy. As high-volatility regimes are characterized by negative shocks, this suggests that for some countries, domestic sovereign bonds may not act as 'safe-havens' for investors who track the domestic equity market index. However, our sectoral analysis reveals some crucial differences in the comovements, with only Financials exhibiting this tendency for positive comovement during periods of high volatility across all countries. For the other sectors, the pattern of correlations varies across countries. This implies that the reported positive relationship in the extant literature may not be prevalent across all sectors and thus that sovereign bonds may continue to provide a safe haven for some equity investors.

3.3. Generalized impulse response functions – transmission of cross-market shocks

Thus far, the analysis suggests that bonds have some diversification benefits for equity investors, but their effectiveness varies across sectors of the equity market. We require a more thorough statistical investigation of the stock-bond relationship across different market conditions. Regime-dependent IRFs, as proposed by Ehrmann, Ellison and Valla (2003), are ideally suited to show the changes (and their statistical significance) in the transmission of structural shocks across different market conditions. As in Dungey, Flavin and Lagoa-Varela (2018), GIRFs are used here since they are invariant to the ordering of the variables in the specification of the VAR model. We present these here to analyze the transmission of shocks and their cross-market effects. The GIRFs allow us to analyze the sign of the responses in each regime and changes in the dynamics of the relationship across regimes. Furthermore, it allows us to determine if the pattern of comovements suggested by the regime-specific correlations is statistically supported by the data.

3.3.1. Market-level analysis

Firstly, we focus on the total equity market and the long-term sovereign bond relationship. Fig. 2 presents the GIRFs, with 95% confidence bands. The top row shows the bond market reaction to a stock market shock, while the bottom row displays the stock market reaction to a bond market shock. Each column presents a market regime.

Across all GIIPS, the bond market either tends to not react or react negatively (opposite in sign) to an equity market shock during the low-volatility regime. While the contemporaneous impact is negative and statistically significant, the shock quickly dies out and the dynamics are not statistically different from zero. Unexpected good news in the stock market causes stock and bond markets to move in opposite directions and effect occurs within the day of the event. This is consistent with investors liquidating bond portfolios to increase their exposure to the equity market in pursuit of increased returns. This negative relationship is further reinforced by the stock market response to a bond market shock. Again, markets exhibit negative or zero comovement with the effect of the shock dying out quickly.

Both asset markets respond differently during the intermediate-volatility regime. Now the contemporaneous reaction to a shock in the other market is positive (of the same sign) and always statistically significant. Furthermore, the effects of the shock remain in the system for about two days. This suggests that the diversification potential is limited during this phase of increased market volatility due to the higher comovement. Furthermore, the fact that the stock market response to a bond shock is also positive and statistically significant shows the increasing impact of bond market volatility during this period.

Turning to the high-volatility regime, we observe less uniformity across countries. For Greece, Portugal and Spain, the relationship is unambiguously positive. Both stock market and bond market shocks illicit a positive cross-market response in their domestic market. In both Greece and Spain, the reaction to the shock is more persistent than in the other regimes and although it turns negative (while

Table 2
Summary statistics.

	Greece	Ireland	Italy	Portugal	Spain
Panel A: mean					
Total market	−0.0554	0.0234	0.0155	0.0084	0.0255
10-year bond	0.0064	0.0260	0.0272	0.0278	0.0259
Financials	−0.1776	−0.0733	0.0010	−0.0669	0.0094
Basic materials	0.0014	−0.1029	0.0324	0.0450	0.0193
Industrials	0.0043	0.0814	0.0190	0.0039	0.0315
Consumer services	0.0083	0.0474	−0.0010	0.0296	0.0565
Consumer goods	0.0551	0.0063	0.0456	NA	0.0404
Telecoms	−0.0394	NA	−0.0125	−0.0446	−0.0123
Utilities	−0.0283	NA	0.0261	0.0357	0.0420
Healthcare	NA	NA	0.0514	NA	0.0518
Oil & gas	0.0098	0.0438	0.0188	NA	0.0097
Panel B: volatility					
Total market	2.0310	1.4032	1.3609	1.1849	1.3332
10-year bond	1.8564	0.5541	0.4794	0.7909	0.4833
Financials	3.4349	3.5621	1.8199	2.1815	1.7869
Industrials	2.2302	4.5243	2.1798	1.3596	1.4335
Basic materials	2.0056	2.1206	1.3226	1.3957	1.3331
Consumer services	1.8030	1.5871	1.3043	1.4004	1.4619
Consumer goods	1.9923	1.7808	1.4440	NA	0.8848
Telecoms	4.9722	NA	2.2135	1.7851	1.6872
Utilities	2.5479	NA	1.2759	1.5088	1.3401
Healthcare	NA	NA	1.1845	NA	1.3511
Oil & gas	2.0910	2.8608	1.6428	NA	1.5794
Panel C: skewness					
Total market	−0.5060	−0.6216	−0.1304	−0.2623	0.0345
10-year bond	1.2165	0.5192	0.6877	−0.5242	0.9671
Financials	−0.5372	−1.6206	−0.1163	0.0387	0.3593
Industrials	−0.2346	−0.2311	−0.4312	−0.0901	−0.1820
Basic materials	−0.4334	0.8909	−0.3539	−0.4946	−0.3150
Consumer services	−0.2644	−0.8460	−0.1684	−0.3295	0.1580
Consumer goods	−0.2037	−1.0244	−0.0714	NA	−0.0641
Telecoms	−0.3851	NA	4.1392	−0.3644	−1.4511
Utilities	−0.4959	NA	−0.2569	−0.2557	−0.0761
Healthcare	NA	NA	−0.2696	NA	−0.6001
Oil & gas	−0.0810	−0.2953	0.2067	NA	−0.3471
Panel D: kurtosis					
Total market	9.3912	7.8573	5.3461	7.4861	5.9083
10-year bond	90.9572	30.2781	18.0319	42.8956	15.3000
Financials	10.0147	36.5509	4.4157	5.5839	8.7324
Industrials	5.4177	7.4404	8.1366	4.3539	3.4578
Basic materials	5.4287	17.2291	2.7633	14.1964	3.6935
Consumer services	4.5935	11.5175	2.4402	5.5132	4.0571
Consumer goods	4.3353	37.2454	3.5675	NA	8.5577
Telecoms	6.3034	NA	150.7328	18.5729	28.3445
Utilities	7.4901	NA	6.6666	10.5101	7.3695
Healthcare	NA	NA	2.1111	NA	7.6829
Oil & gas	3.6263	14.7633	10.0970	NA	6.1392

Notes: This table presents summary statistics for the daily percentage returns on the total stock market index, the 10-year government bond, and the sectoral equity indices used in the study. The means are geometric means and volatility is measured as the standard deviation of return. NA signifies that there was no (or partial) data available for that sector and it has been omitted.

remaining statistically different from zero) on days 2–4 after the shock, the sum of the reactions is positive, suggesting that overall the diversification benefits of sovereign bonds are limited following an equity market shock. Italian bond market shocks similarly give rise to a positive stock market response though, the bond market is largely unresponsive to a stock market shock during this period. Again, the role of the bond market as a source of volatility is noteworthy and is picked up by our methodology. Ireland is different with negative cross-market responses to a shock, but this is partially due to the difference in the timing of the regime. For Ireland, the high-volatility regime largely corresponds to the period of the U.S. banking and credit crisis and not the Eurozone sovereign bond crisis as in the other GIIPS. Diversification benefits continue to be delivered by the relatively tranquil bond market in this period before the Irish sovereign became distressed in the aftermath of the government's blanket guarantee of the liabilities of its indigenous banks. However, for all countries, the crisis period in Eurozone debt markets in characterized by positive cross-market comovement. It appears that while sovereign bonds may diversify equity market risk during tranquil periods, this does not persist when sovereign bond markets suffer episodes of distress. This is consistent with the regime-dependent correlations and confirms the aforementioned results of Jammazi, Tiwari, Ferrer, and Moya (2015), Acosta-González, Andrada-Félix, Fernández-Rodríguez (2016) and Flavin (2019) for this

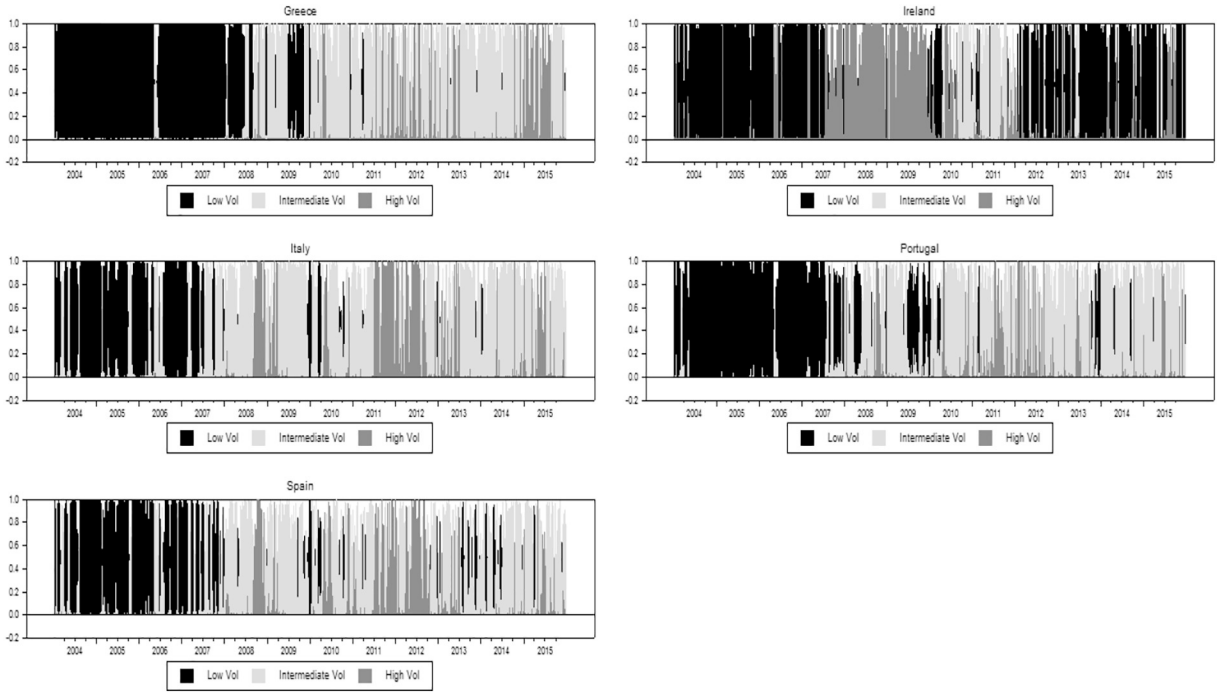

Fig. 1. Regime probabilities across countries.

Table 3
Estimates of expected returns across regimes.

		TOTMK	FINAN	BMATR	INDUS	CNSMG	CNSMS	TELCM	UTILS	HLTHC	OILGS
Low-volatility	Greece	0.060	0.062	0.091	0.075	0.135	0.043	0.094	−0.007	NA	0.058
		0.013	0.013	0.016	0.012	0.014	0.015	0.018	0.017		0.016
		0.129	0.087	0.052	0.093	0.094	0.108				0.086
	Ireland	0.035	0.015	0.021	0.035	0.035	−0.023	NA	NA	NA	0.035
		0.148	0.112	0.126	0.184	0.146	0.094	0.010	0.111	0.141	0.103
	Italy	0.019	0.014	0.041	0.025	0.031	0.010	0.020	0.019	0.044	0.029
		0.102	0.080	0.088	0.129	NA	0.092	0.047	0.101	NA	NA
	Portugal	0.013	0.020	0.019	0.014		0.017	0.018	0.018		
		0.158	0.124	0.155	0.158	0.071	0.153	0.071	0.112	0.109	0.104
	Spain	0.015	0.013	0.023	0.029	0.024	0.021	0.020	0.027	0.023	0.023
		−0.109	−0.228	−0.070	−0.039	0.037	0.010	−0.006	−0.071	NA	−0.075
Intermediate-volatility	Greece	0.035	0.047	0.028	0.022	0.020	0.023	0.024	0.028		0.024
		0.002	−0.160	−0.186	0.121	−0.063	−0.009				−0.026
	Ireland	−0.017	0.055	0.051	−0.024	−0.028	−0.023	NA	NA	NA	−0.018
		−0.032	0.017	0.017	−0.240	0.023	−0.048	−0.179	0.021	0.074	−0.067
	Italy	0.014	0.044	0.023	0.036	0.010	0.049	−0.014	0.047	0.029	0.002
		−0.025	−0.122	−0.027	−0.070	NA	0.031	−0.020	0.035	NA	
	Portugal	0.020	0.024	0.024	0.026		0.015	0.032	0.092		NA
		−0.031	−0.013	−0.079	−0.046	−0.018	0.062	0.009	−0.014	0.067	−0.021
	Spain	0.029	0.036	0.005	0.014	0.007	0.018	0.023	0.010	0.025	0.021
		−0.464	−0.697	−0.154	−0.358	−0.421	−0.271	−0.211	−0.004	NA	−0.037
High-volatility	Greece	−0.284	−0.176	−0.160	−0.389	−0.368	−0.252	−0.168	−0.256		−0.308
		−0.216	−0.018	−0.283	0.025	−0.253	−0.095				0.062
	Ireland	0.026	−0.073	−0.036	0.027	0.032	0.039	NA	NA	NA	0.023
		−0.211	−0.255	−0.180	−0.014	−0.175	−0.066	0.009	−0.432	−0.330	−0.355
	Italy	0.040	−0.005	−0.008	0.005	0.025	−0.015	0.046	−0.027	−0.036	0.027
		−0.257	−0.094	−0.008	−0.276	NA	−0.234	−0.146	−0.062	NA	
	Portugal	0.098	0.063	0.026	0.055		0.070	0.028	0.011		NA
		−0.216	−0.131	−0.218	−0.235	0.021	−0.030	−0.339	−0.271	−0.297	−0.349
	Spain	0.011	0.013	0.032	0.029	0.042	0.031	0.017	0.032	0.037	0.018

Notes: This Table presents the regime-specific expected returns, generated by the estimated model, for equities (μ_E – top number in each cell) and the 10-year government bond (μ_B – bottom number in each cell). NA signifies that there was no (or partial) data available for that sector and it has been omitted.

Table 4
Estimates of volatilities across regimes.

		TOTMK	FINAN	BMATR	INDUS	CNSMG	CNSMS	TELCM	UTILS	HLTHC	OILGS
Low-volatility	Greece	1.049	1.792	1.564	2.695	2.081	1.476	1.703	2.214	NA	2.310
		0.068	0.066	0.064	0.080	0.078	0.072	0.065	0.068		0.077
	Ireland	0.568	0.754	0.855	1.520	0.802	1.198	NA	NA	NA	3.212
		0.060	0.054	0.060	0.062	0.075	0.059				0.066
	Italy	0.467	0.403	0.961	0.534	0.823	0.421	1.093	0.496	1.021	1.195
		0.066	0.059	0.088	0.070	0.075	0.056	0.061	0.058	0.176	0.076
	Portugal	0.339	0.354	0.281	0.698	NA	0.387	0.910	0.894	NA	NA
		0.061	0.058	0.060	0.061		0.057	0.069	0.071		
	Spain	0.369	0.513	0.769	0.646	0.336	0.464	1.125	0.628	0.503	0.820
		0.054	0.058	0.069	0.072	0.076	0.060	0.085	0.078	0.057	0.067
		3.944	9.098	5.881	3.497	3.862	3.507	7.147	5.733	NA	4.425
Intermediate-volatility	Greece	0.888	0.722	0.601	1.310	1.240	1.006	0.696	0.846		1.206
		2.181	5.984	13.969	4.265	1.672	1.809				5.324
	Ireland	1.496	0.098	0.097	1.553	1.352	1.459	NA	NA	NA	1.443
		3.048	2.491	5.713	2.875	2.652	1.956	5.253	1.606	1.133	3.105
	Italy	0.787	0.101	0.082	0.177	0.893	0.116	0.985	0.159	0.089	0.930
		1.447	3.819	2.628	1.931	NA	2.226	3.604	2.599	NA	
	Portugal	0.294	0.201	1.964	0.362		0.277	3.200	4.376		NA
		1.568	2.353	1.865	1.978	0.711	2.727	1.357	2.647	1.689	2.782
	Spain	0.160	0.141	0.695	0.652	0.643	0.710	0.205	0.700	0.154	0.207
		16.026	48.433	10.890	13.435	12.908	9.560	21.706	24.003	NA	13.979
High-volatility	Greece	24.832	20.276	20.001	29.995	26.685	25.687	21.136	22.709		27.152
		5.168	51.781	76.117	12.589	10.792	7.038				35.284
	Ireland	0.154	1.217	1.324	0.177	0.084	0.185	NA	NA	NA	0.226
		3.712	10.453	12.178	3.378	4.924	3.742	6.347	6.076	4.296	11.241
	Italy	0.158	0.850	0.877	0.832	0.116	0.982	0.229	1.183	1.310	0.188
		5.982	17.875	2.851	10.339	NA	6.744	6.704	4.453	NA	
	Portugal	4.762	3.305	1.372	6.026		4.358	0.299	0.375		NA
		6.267	10.944	4.702	4.289	2.510	3.526	8.519	6.085	6.259	10.223
	Spain	0.876	0.775	0.183	0.144	0.156	0.148	0.908	0.195	1.055	1.082

Notes: This Table presents the regime-specific variances, generated by the estimated model, for equities (σ_E^2 – top number in each cell) and the 10-year government bond (σ_B^2 – bottom number in each cell). NA signifies that there was no (or partial) data available for that sector and it has been omitted.

group of markets.

3.3.2. Sectoral-level analysis

Our results for the market-level analysis (and those in the recent literature) paint a dismal picture for equity investors who rely on domestic sovereign bonds to diversify their portfolios. To shed more light on the stock-bond relationship for the GIIPS markets, we conduct our analysis at a finer level of disaggregation using stock market sectoral indices. We investigate if the market-level results prevail across all sectors or if there are sectoral differences that might be exploited by investors. Fig. 3 shows the GIRFs for the financial sector and Tables 6–8 summarize our results.[7]. Tables 6, 7, and 8 show the sign of the contemporaneous reaction to the bond market to an equity market shock (Panel A) and the stock market response to a bond market shock (Panel B) in the low-volatility, intermediate-volatility and high-volatility regime respectively.

The sectoral analysis produces a number of striking results. Firstly, the relationship between returns on the financial sector and the domestic sovereign bond is the most consistent across countries. During the non-crisis periods, the bond appears to be a good hedging instrument against risk in the financial sector. The relationship is negative (or zero in the case of Ireland) and the sign of cross-market responses to an asset market shock do not depend on the source of the shock. However, as market conditions change, so does the sign of this relationship and becomes positive in all countries except Ireland during the intermediate-volatility regime. Even in Ireland, even though the contemporaneous reaction to the shock is negative, it oscillates about zero and the initial effect is cancelled out within a couple of days. Regardless of whether the shock originates in the stock or sovereign bond market, the cross-market response is in the same direction, thus increasing market comovement and reducing diversification potential. This relationship also prevails during the short, intense periods of high volatility. Therefore, it appears that domestic government bonds are poor diversifiers of financial-sector risk during crisis periods, especially when the financial distress is not contained within one particular market. Our findings are consistent with the extant literature documenting the links between the banking sector and the sovereign during the crisis and that generally, financial crashes lead to debt crises (Reinhart and Rogoff, 2011). Terms such as the 'deadly embrace' of Fahri and Tirole (2018) and the 'diabolical loop' of Brunnermeier, Garciano, Lane, Pagano, Reis, Santos, Thesmar, Van Nieuwerburgh, Vayanos (2016) are commonly used to describe the severe financial consequences of the simultaneous decline in both markets. During the most recent crisis, difficulties in the domestic banking sector caused price declines and increased uncertainty for domestic sovereign bonds (see

[7] Similar figures are available for all sectors and are presented in the working paper version of this paper (available at https://ideas.repec.org/p/may/mayecw/n295-19.pdf.html). However to conserve space here, we summarize results in Tables 6–8.

Table 5
Regime-specific correlations.

	Greece	Ireland	Italy	Portugal	Spain
Panel A: low-volatility regime					
Total market	−0.0768	−0.0316	−0.0153	−0.0473	−0.1196
Financials	−0.1657	−0.0519	−0.1141	−0.0586	−0.1568
Basic materials	−0.0973	0.0245	0.0782	0.0160	−0.0658
Industrials	−0.0799	0.0242	0.0352	−0.1222	0.0309
Consumer services	−0.0947	−0.0119	−0.0973	0.0028	−0.0606
Consumer goods	−0.0967	−0.0301	0.0152	NA	−0.0178
Telecoms	−0.0762	NA	−0.0540	−0.0306	−0.1808
Utilities	−0.1102	NA	−0.0941	−0.0408	−0.0615
Healthcare	NA	NA	0.1712	NA	−0.0306
Oil & gas	−0.051	−0.0309	−0.0435	NA	−0.0860
Panel B: intermediate-volatility regime					
Total market	0.2415	0.2851	0.6223	0.0238	0.0914
Financials	0.2683	0.0323	0.1147	0.0917	0.1341
Industrials	0.2453	0.2431	−0.1638	0.0332	0.3954
Basic materials	0.1691	−0.0203	−0.2382	0.2760	0.3994
Consumer services	0.1397	0.1160	0.0001	0.0212	0.3846
Consumer goods	0.0747	0.0761	0.4245	NA	0.3148
Telecoms	0.1987	NA	0.6207	0.5022	0.3812
Utilities	0.2221	NA	0.2419	0.2728	0.4888
Healthcare	NA	NA	−0.1003	NA	0.0142
Oil & gas	0.2494	0.0782	0.5003	NA	0.1027
Panel C: high-volatility regime					
Total market	0.2751	−0.2806	−0.0690	0.3384	0.3506
Financials	0.2099	0.1135	0.5135	0.3004	0.1902
Industrials	0.2863	−0.1837	0.5762	0.2830	−0.3205
Basic materials	0.3264	−0.0634	0.1415	−0.0295	−0.2492
Consumer services	0.2541	−0.1836	0.5241	0.3701	−0.1100
Consumer goods	0.1339	−0.0360	−0.2000	NA	−0.1408
Telecoms	0.2738	NA	−0.0064	−0.0036	0.2461
Utilities	0.2446	NA	0.3060	0.0344	−0.2420
Healthcare	NA	NA	0.2651	NA	0.1142
Oil & gas	0.1900	−0.1658	−0.1115	NA	0.1941

Notes: This presents the regime-dependent pairwise correlations between long-term bonds and equities market generated by our *MS-VAR* model. NA signifies that there was no (or partial) data available for that sector and it has been omitted. NA signifies that there was no (or partial) data available for that sector and it has been omitted.

Acharya, Drechsler, and Schnabl, 2014; Mody and Sandri, 2012). Merton, Billio, Getmansky, Gray, Lo and Pelizzon (2013) describe the dynamics that lead to such a connection between sovereign bonds and the financial sector. The contingent liability created by government guarantees, either implicit or explicit, to the domestic banking sector may be valued as a put option on the value of the banking sector's assets. The value of the put option increases as the asset values decline and/or the volatility of the asset values increase. Furthermore, the sensitivity of the option value increases in a non-linear fashion implying that consecutive declines in the value of banks' assets will have increasingly large negative repercussions for the government (option writer) and this impairs the valuation of its sovereign debt and its ability to issue new bonds. The 'doom loop' of banks and sovereign debt is exacerbated by banks holding large amounts of sovereign debt which again can be valued as a put option, this time written by banks on the value of government debt. Declines in the value of sovereign debt lead to losses for banks, which reinforces the adverse loop between the two entities. This explanation fits very well with the GIIPS situation, where many banks were bailed out by governments or nationalized, and the falling value of government debt further weakened the balance sheets of already distressed banks. Given the relatively large size of the banking sectors in the domestic stock markets of the GIIPS countries (see Table 1),[8] it is likely that this sector was the main driving force behind the observed positive relationship during the crisis regimes at the total market level.

Secondly, across the non-financial sectors there is little uniformity except in the non-crisis (low-volatility) period. In this regime (Table 6), cross-market responses to a shock are generally negative or not statistically different from zero and this is consistent across countries. Interestingly, in Greece, the sovereign bond market is less responsive to equity market shocks than the equity market sectors are to bond shocks. However, the consistent story is that markets appear decoupled during the low-volatility regime. Positive news in the stock market appears to lead to portfolio rebalancing with investors holding more equity and smaller proportions of government bonds. However, once bond markets become distressed, the diversification potential of domestic sovereign bonds begins to wane. This is evidenced by the fact that bond shocks illicit a positive response in the stock market sectors just as often as the other way around. In most cases, the responses to shocks are reinforcing and generate a downward spiral between the two asset classes. This finding is

[8] At the start of the crisis (end of Q2, 2006), the relative importance of the Financial sector in the domestic indices was even greater; Greece, 45%; Ireland, 55%; Italy, 42%; Portugal, 29%; and Spain 33%.

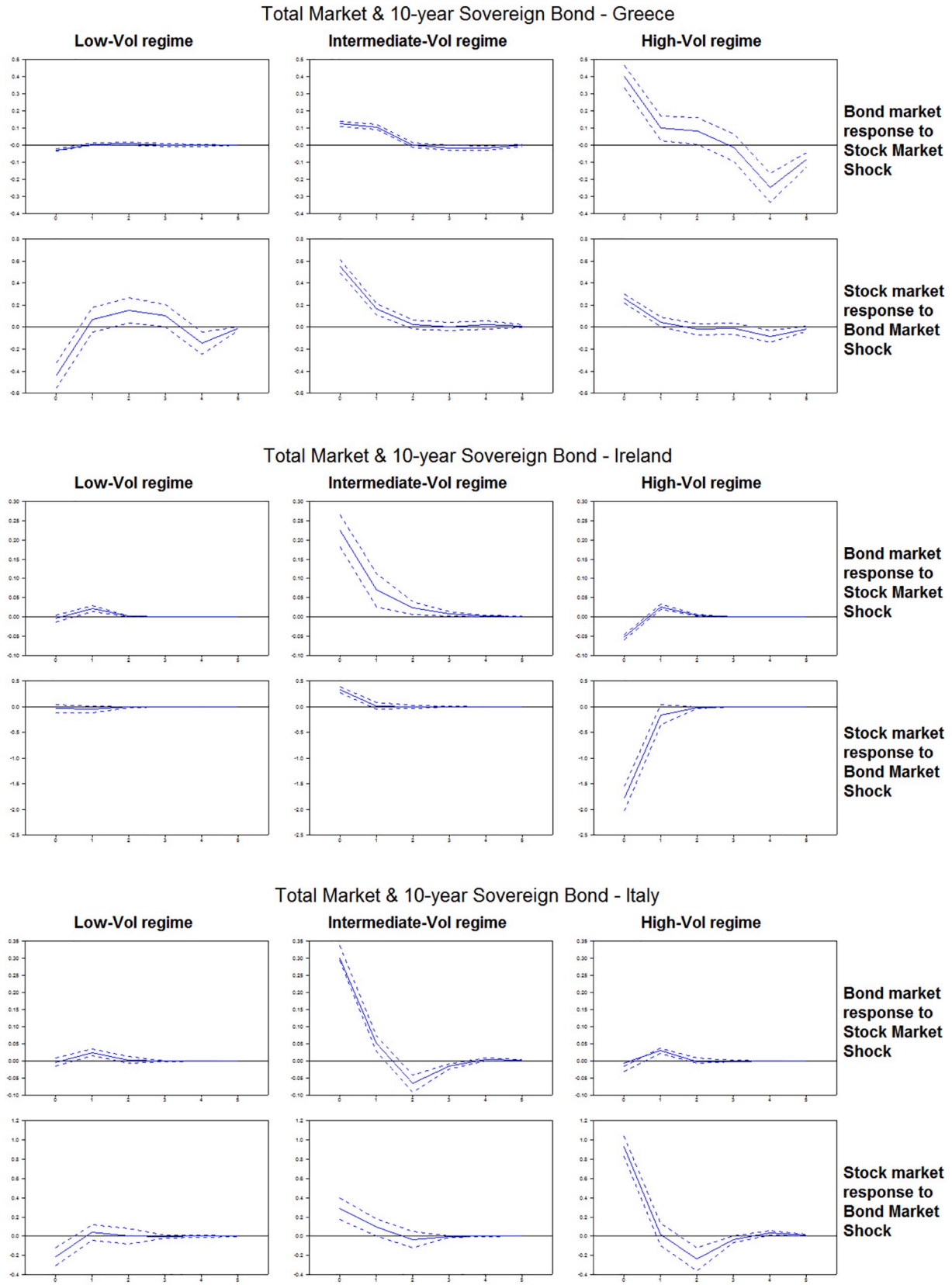

Fig. 2. Total market and 10-year sovereign bond.

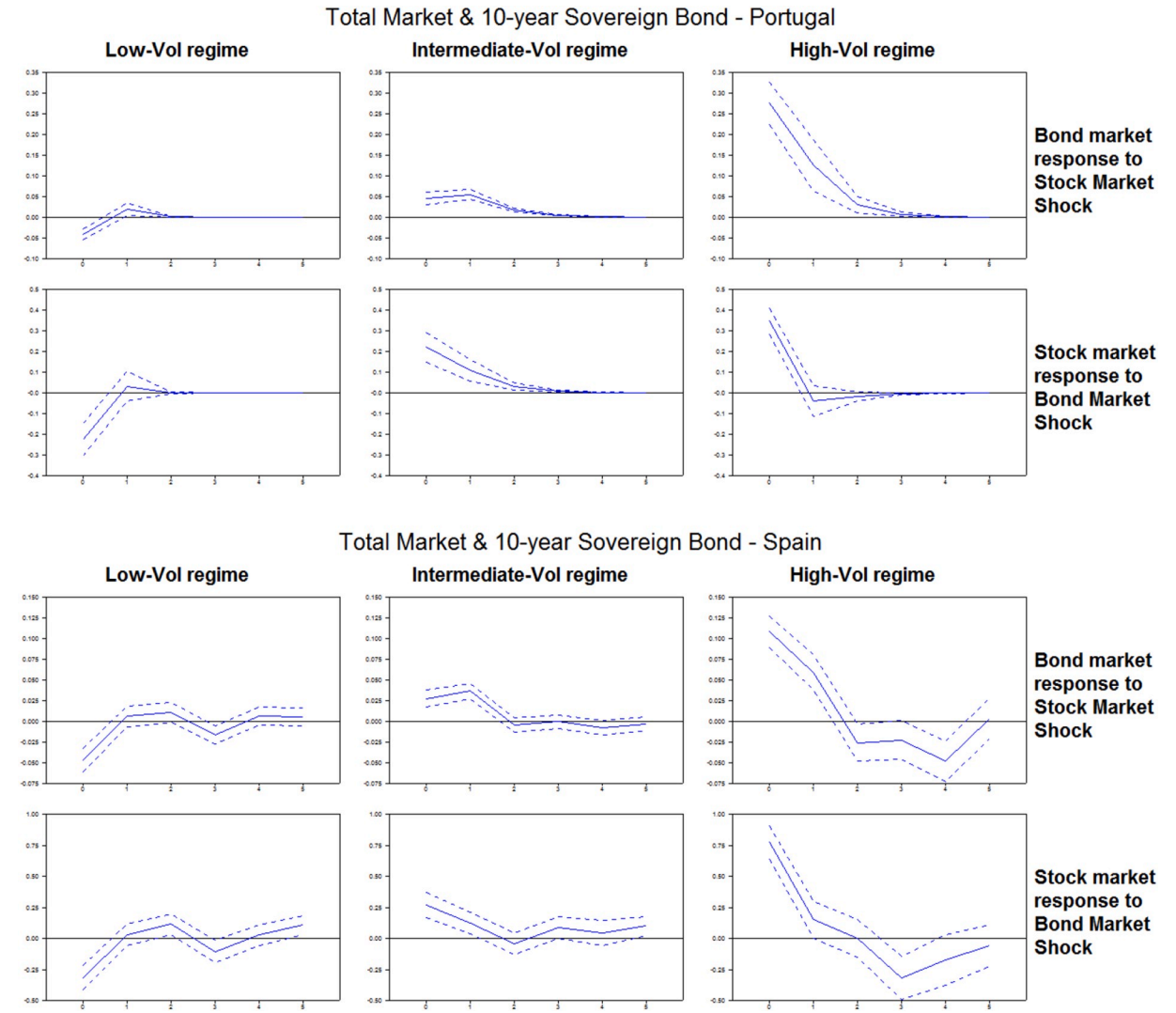

Fig. 2. (*continued*).

consistent with evidence presented by Campbell, Sunderam, and Viceira (2017) who show that in the U.S. high stock-bond comovement is associated with high bond return volatility.

Thirdly, there is substantial differences across countries. The country worst affected by the crisis was Greece and here, it appears that there is no hiding place for investors. Once the domestic financial markets enter the crisis period, the stock-bond relationship turns positive across all equity market sectors and regardless of the source of the shock (Tables 7 and 8). This result is not surprising as Dungey, Milunovich, and Thorp (2010) document the 'heightened sensitivity' of markets in crisis and hence the tendency to overreact to any negative news. On the other hand, Ireland and Spain are interesting in that during the high-volatility regime (Table 8), there were many sectors who continued to be decoupled from the sovereign bond market (i.e. exhibit a negative or zero response to a cross-market shock). In Ireland, the bond market continued to react negatively to non-financial sector equity shocks and this was also true for the majority of sectors in Spain. For these sectors, the domestic sovereign bond fulfilled the requirements of a safe-haven asset. In Italy and Portugal, some sectors remain decoupled from the sovereign bond, e.g. Telecoms in Italy and Basic Materials in Portugal. However, there is little pattern to reassure investors in identifying these sectors.

In summary, our results show that domestic sovereign bonds are not a suitable risk diversifier for investors in financial equities due to their tendency to fall together during a crisis. In general, bond market volatility limits the effectiveness of sovereign bonds as a hedging instrument for any equity sectors but there are some exceptions. The problem facing investors is to identify these a priori. Our evidence suggests that equities and sovereign bonds remained largely decoupled during the high-volatility regime in Ireland, and to a lesser extent, Spain but there is little other pattern to guide investors.

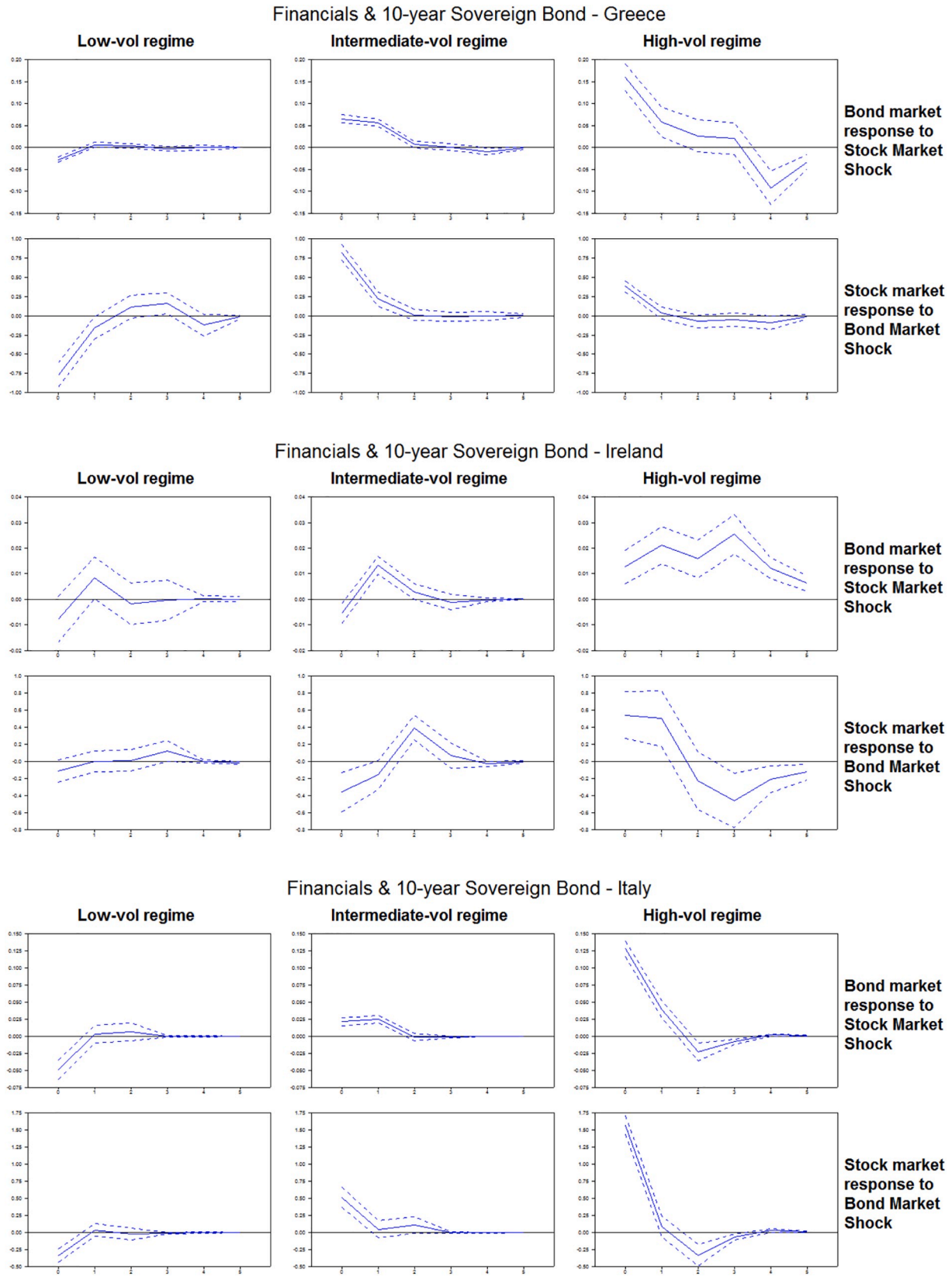

Fig. 3. Financials and 10-year sovereign bond.

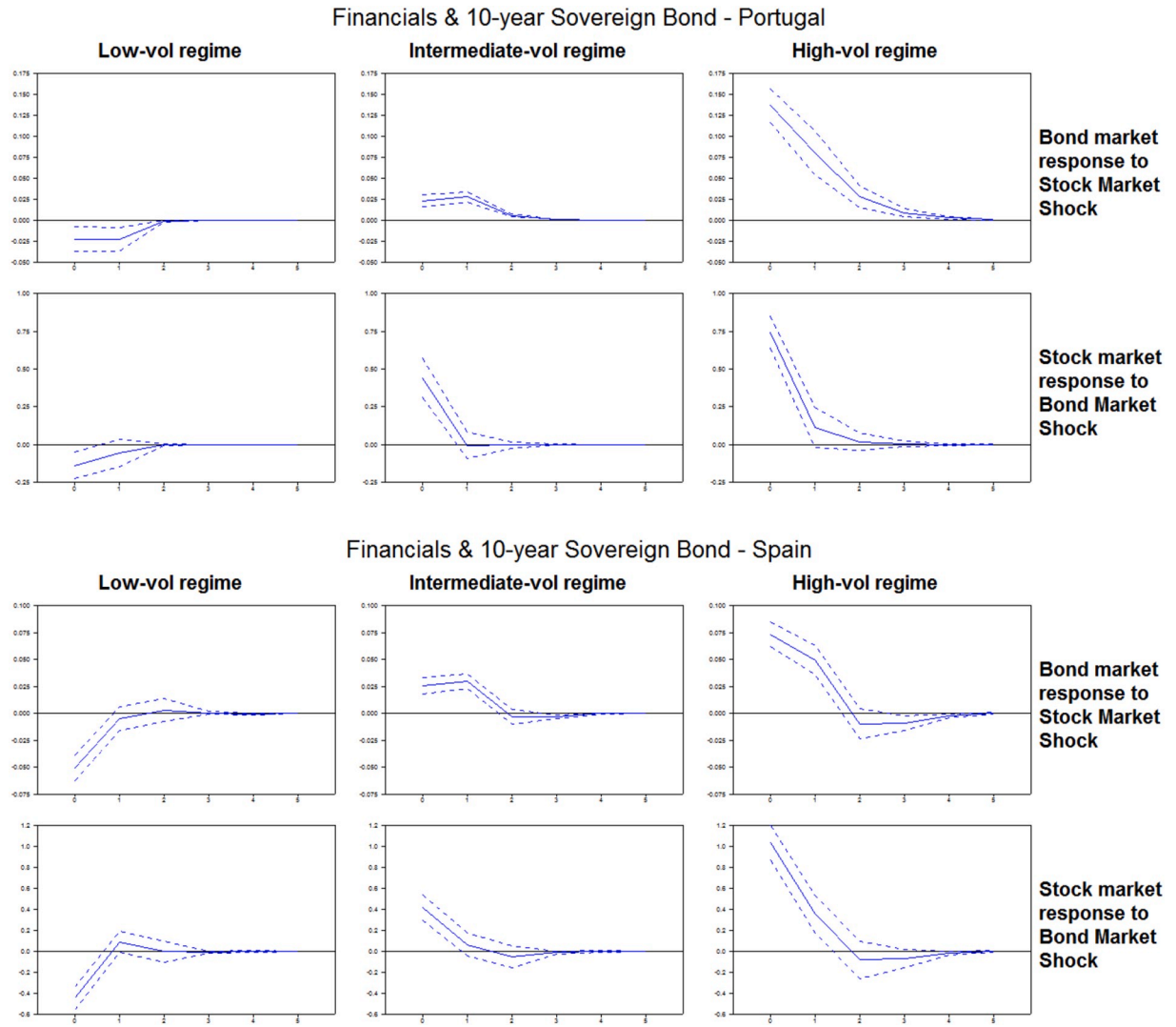

Fig. 3. (*continued*).

4. Conclusions

We examine the stock-bond relationship for the GIIPS countries and, in particular, analyze its stability across different market conditions. This is an important issue in assessing the diversification potential of long-term government bonds for equity investors. The recent literature suggests that the Eurozone peripheral countries are different to other big developed financial markets in that returns to equity and sovereign bonds became positively correlated during the recent financial crisis and hence long-term sovereign bonds do not provide a safe haven for equity investors and offer limited diversification benefits against adverse stock market shocks.

Employing a MS-VAR model, we confirm this result for the total market. However, a sectoral analysis sheds greater light on the driving force behind this finding. In fact, the financial sector is the most consistent driver of this positive comovement across countries. Two-way feedbacks between domestic banks and sovereign debt markets served to amplify the initial financial disturbance through the transfer of banking debts and risks to the sovereign during the crisis and relatively large holdings of domestic government by the banking sector. This meant that the fortunes of the banking sector and sovereign debt instruments became inextricably linked and that sovereign bonds were no longer suitable 'safe-haven' assets for holders of financial stocks.

In general, the relationship between equity market sectors and the domestic sovereign bond becomes positive as markets enter a crisis regime. It appears that this is mainly associated with periods of bond market volatility and inflation uncertainty (see Campbell, Sunderam and Viceira 2017). However, are some notable exceptions. During high-volatility regimes in Ireland and Spain, many sectors

Table 6
Cross-market contemporaneous responses of markets during the low-volatility regime.

	Greece	Ireland	Italy	Portugal	Spain
Panel A: response of sovereign bond market to a shock in the indicated equity market sector					
Total market	N	Z	Z	N	N
Financials	N	Z	N	N	N
Basic materials	Z	Z	P	Z	N
Industrials	Z	Z	Z	N	Z
Consumer services	Z	Z	N	N	N
Consumer goods	Z	Z	Z	NA	N
Telecoms	Z	NA	N	N	N
Utilities	Z	NA	N	Z	N
Healthcare	NA	NA	Z	NA	N
Oil & gas	Z	Z	Z	NA	N
Panel B: response of indicated equity market sector to a sovereign bond shock					
Total market	N	Z	N	N	N
Financials	N	Z	N	N	N
Basic materials	N	Z	Z	Z	N
Industrials	N	Z	Z	N	Z
Consumer services	N	Z	N	N	N
Consumer goods	N	Z	Z	NA	Z
Telecoms	N	NA	N	N	N
Utilities	N	NA	Z	N	N
Healthcare	NA	NA	Z	NA	N
Oil & gas	N	Z	Z	NA	N

Notes: N, Z and P denote that the contemporaneous response was negative, zero and positive respectively. NA signifies that there was no (or partial) data available for that sector and it has been omitted.

Table 7
Cross-market contemporaneous responses of markets during the intermediate-volatility regime.

	Greece	Ireland	Italy	Portugal	Spain
Panel A: response of sovereign bond market to a shock in the indicated equity market sector					
Total market	P	P	P	P	P
Financials	P	N	P	P	P
Basic materials	P	Z	N	Z	P
Industrials	P	P	Z	P	P
Consumer services	P	P	Z	Z	P
Consumer goods	P	P	P	NA	P
Telecoms	P	NA	P	P	P
Utilities	P	NA	P	P	P
Healthcare	NA	NA	Z	NA	Z
Oil & gas	P	Z	P	NA	P
Panel B: response of indicated equity market sector to a sovereign bond shock					
Total market	P	P	P	P	P
Financials	P	N	P	P	P
Basic materials	P	Z	P	Z	P
Industrials	P	N	N	P	P
Consumer services	P	P	Z	Z	P
Consumer goods	P	P	P	NA	P
Telecoms	P	NA	P	P	P
Utilities	P	NA	P	P	P
Healthcare	NA	NA	Z	NA	P
Oil & gas	P	Z	P	NA	P

Notes: N, Z and P denote that the contemporaneous response was negative, zero and positive respectively. NA signifies that there was no (or partial) data available for that sector and it has been omitted.

exhibit a negative relationship with the domestic sovereign bond. Without any government guarantees for firms operating in these sectors, their fortunes appear to be largely disconnected from the long-term sovereign bond during periods of financial distress. Hence, equity investors in Ireland and Spain continue to enjoy diversification benefits from holding domestic sovereign bonds. While there are a number of examples in Italy and Portugal across the different phases of the crisis, there is little pattern to guide investors a priori in identifying which sectors are likely to remain decoupled from the sovereign bond. It is, therefore, probably advisable for investors to seek alternative safe-haven assets such as precious metal or non-domestic sovereign bonds. Policy makers need to be cognizant of the spillovers from equity market shocks to sovereign bonds. Financial stocks tend to generate contagious effects for domestic bonds and thus resilience needs to be built into the financial system to curb contagion.

Table 8
Cross-market contemporaneous responses of markets during the high-volatility regime.

	Greece	Ireland	Italy	Portugal	Spain
Panel A: response of sovereign bond market to a shock in the indicated equity market sector					
Total market	P	N	Z	P	P
Financials	P	P	P	P	P
Basic materials	P	Z	P	Z	N
Industrials	P	N	P	P	N
Consumer services	P	N	P	P	N
Consumer goods	P	Z	N	NA	N
Telecoms	P	NA	Z	Z	P
Utilities	P	NA	P	Z	N
Healthcare	NA	NA	P	NA	P
Oil & gas	P	N	N	NA	P
Panel B: response of indicated equity market sector to a sovereign bond shock					
Total market	P	N	P	P	P
Financials	P	P	P	P	P
Basic materials	P	Z	N	Z	N
Industrials	P	P	P	P	N
Consumer services	P	N	P	P	N
Consumer goods	P	Z	N	NA	N
Telecoms	P	NA	Z	P	P
Utilities	P	NA	P	P	N
Healthcare	NA	NA	P	NA	N
Oil & gas	P	Z	N	NA	P

Notes: N, Z and P denote that the contemporaneous response was negative, zero and positive respectively. NA signifies that there was no (or partial) data available for that sector and it has been omitted.

Acknowledgements

We are grateful to Mardi Dungey for insightful comments on an earlier version of this paper. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

None.

References

Acharya, V. V., Drechsler, I., & Schnabl, P. (2014). A pyrrhic victory? Bank bailouts and sovereign credit risk. *The Journal of Finance, 69*(6), 2689–2739.
Acosta-González, E., Andrada-Félix, J., & Fernández-Rodríguez, F. (2016). Stock-bond decoupling before and after the 2008 crisis. *Applied Economics Letters, 23*(7), 465–470.
Aït-Sahalia, Y., Andritzky, J., Jobst, A., Nowak, S., & Tamirisa, N. (2009). *How to stop a herd of running bears. Market response to policy initiatives during the global financial crisis* (Working Paper, No. WP/09/204, IMF).
Andersson, M., Krylova, E., & Vähämaa, S. (2008). Why does the correlation between stock and bond returns vary over time? *Applied Financial Economics, 18*(2), 139–151.
Baele, L., Bekaert, G., & Inghelbrecht, K. (2010). The determinants of stock and bond return comovements. *Review of Financial Studies, 23*(6), 2374–2428.
Baur, D., & Lucey, B. (2009). Flights and contagion – An empirical analysis of stock-bond correlations. *Journal of Financial Stability, 5*, 339–352.
Brunnermeier, M. K., Garciano, L., Lane, P., Pagano, M., Reis, R., Santos, T., … Vayanos, D. (2016). The sovereign-banking diabolical loop and ESBies. *American Economic Review: Papers and Proceedings, 106*(5), 508–512.
Campbell, J. Y., Sunderam, A., & Viceira, L. M. (2017). Inflation bets or deflation hedges? The changing risks of nominal bonds. *Critical Finance Review, 6*, 263–301.
Chang, C. L., & Hsueh, P. L. (2013). An investigation of the flight-to-quality effect: Evidence from Asia-Pacific countries. *Emerging Markets Finance and Trade, 49*, 53–69.
Connolly, R., Stivers, C., & Sun, L. (2005). Stock market uncertainty and the relation between stocks and bond returns. *Journal of Financial and Quantitative Analysis, 40*, 161–194.
Connor, G., Flavin, T. J., & O'Kelly, B. (2012). The U.S. and Irish credit crises: Their distinctive differences and common features. *Journal of International Money and Finance, 31*, 60–79.
Cronin, D., Flavin, T. J., & Sheenan, L. (2016). Contagion in Eurozone sovereign bond markets? The good, the bad and the ugly. *Economics Letters, 143*, 5–8.
Dungey, M., Flavin, T. J., & Lagoa-Varela, D. (2018). Are banking shocks contagious? Evidence from the Eurozone. *Journal of Banking & Finance*. https://doi.org/10.1016/j.jbankfin.2018.07.010. forthcoming. Available at.
Dungey, M., Milunovich, G., & Thorp, S. (2010). Unobservable shocks as carriers of contagion. *Journal of Banking & Finance, 34*(5), 1008–1021.
Ehrmann, M., Ellison, M., & Valla, N. (2003). Regime-dependent impulse response functions in a Markov-switching vector autogression model. *Economics Letters, 78*, 295–299.
Fahri, E., & Tirole, J. (2018). Deadly embrace: Sovereign and financial balance sheets doom loops. *The Review of Economic Studies, 85*(3), 1781–1823.
Flavin, T. J. (2019). From bulls to bears: Analysing the stock-bond relationship of European countries across different market regimes. In S. Boubaker, & D. K. Nguyen (Eds.), *Handbook of global financial markets: Transformations, dependence, and risk spillovers (chapter 2, forthcoming)*. World Scientific Publishing.
Flavin, T. J., Morley, C. E., & Panopoulou, E. (2014). Identifying safe haven assets for equity investors through an analysis of the stability of shock transmission. *Journal of International Financial Markets Institutions and Money, 33*, 137–154.
Fleming, J., Kirby, C., & Ostdiek, B. (1998). Information and volatility linkages in the stock, bond, and money markets. *Journal of Financial Economics, 49*(1), 111–137.
Guidolin, M., & Timmermann, A. (2005). Economic implications of bull and bear regimes in UK stock and bond returns. *The Econometrics Journal, 115*(500), 111–143.

Guidolin, M., & Timmermann, A. (2006). An econometric model of nonlinear dynamics in the joint distribution of stock and bond returns. *Journal of Applied Econometrics, 21*(1), 1–22.
Jammazi, R., Tiwari, A., Ferrer, R., & Moya, P. (2015). Time-varying dependence between stock and government bond returns: International evidence with dynamic copulas. *North American Journal of Economics and Finance, 33*, 74–93.
Merton, R. C., Billio, M., Getmansky, M., Gray, D., Lo, A. W., & Pelizzon, L. (2013). On a new approach for analyzing and managing macrofinancial risks. *Financial Analysts Journal, 69*(2), 22–33.
Mody, A., & Sandri, D. (2012). The Eurozone crisis: How banks and sovereigns came to be joined at the hip. *Economic Policy, 27*(70), 199–230.
Reinhart, C., & Rogoff, K. S. (2011). From financial crash to debt crisis. *The American Economic Review, 101*(5), 1676–1706.
Scruggs, J. T., & Glabadanidis, P. (2003). Risk premia and the dynamic covariance between stock and bond returns. *Journal of Financial and Quantitative Analysis, 38*(2), 295–316.
Yang, J., Zhou, Y., & Wang, Z. (2009). The stock-bond correlation and macroeconomic conditions: One and a half centuries of evidence. *Journal of Banking & Finance, 33*, 670–680.