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Interaction in Euro Area Sovereign Bond Markets During the Financial Crisis

Applying a t-DCC-GARCH model to daily spread data, four phases of interaction in euro area sovereign bond markets are identified between January 2008 and June 2013. The initial period (January-October 2008) is followed by a general rise in pairwise correlation values between November 2008 and late 2009/early 2010. Interaction then declines on a piecemeal basis up to early 2012. In autumn 2012, coinciding with the announcement of the Outright Monetary Transactions programme by the European Central Bank, there is evidence of some re-engagement of bond markets with one another. Policy then seems to have had an influence on euro area sovereign bond market behaviour. While it can act to calm markets, policy may also be unduly influencing market dynamics and raising moral hazard issues.

Developments in euro area sovereign bond markets in recent years – widely considered to be a period of crisis in those markets – have been receiving due attention in academic and policy debate. Much of the literature has sought to identify what factors influenced the historically large rises and falls in bond yield values from late 2008 onwards. For example, in a relatively early study of the late 2000s euro area sovereign bond market, Caceres, Guzzo and Segoviano identify global risk aversion, contagion (defined as the probability of distress of a country conditional on other countries becoming distressed) and country-specific fundamentals as factors influencing bond yield spreads in the euro area.[1] Their analysis of the data leads them to conclude that heightened risk aversion among investors affected euro area government bond markets, particularly those of "core" euro area member states, up to September 2008. For the following 12 months, contagion, or systemic, effects came to the fore as sovereign support to financial institutions in some member states provoked concern that it might also be needed in other countries. Finally, a third phase, commencing in October 2009, saw bond spreads diverge as country-specific factors came to prominence.

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1 C. Caceres, V. Guzzo, M. Segoviano: Sovereign Spreads: Global Risk Aversion, Contagion, or Fundamentals? IMF Working Paper No. 10/120, 2010.

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This characterisation of the early phases of the euro area sovereign bond crisis ties in with other scholarly contributions in this area. Mody and Mody and Sandri, for example, also posit domestic financial sector developments having greater influence on sovereign bond spreads after the rescue of Bear Stearns by the Federal Reserve Bank of New York in March 2008.[2] The nationalisation of Anglo-Irish Bank in January 2009 by the Irish government marked a time after which financial market shocks would have a rapid impact on sovereign yields.

Country-specific concerns (i.e. not related to financial sector developments but to the fiscal position) have also been highlighted as determining pricing behaviour in sovereign bond markets in recent years. Manasse and Zavalloni find the influence of country-specific fundamentals on sovereign CDS spreads becoming more important during the financial crisis.[3] The deteriorating fiscal position in Greece from late 2009 onwards is the most obvious example of a country-specific event influencing bond markets. While such a development would have been expected to raise Greek sovereign bond yields, its influence on other sovereign bond markets could, in principle, have taken any of a number of forms. Adverse developments in Greece might have little effect on other member states. Alternatively, they might encourage investors to sell their Greek bond holdings

2 A. Mody: From Bear Stearns to Anglo Irish: How Eurozone Sovereign Spreads Related to Financial Sector Vulnerability, IMF Working Paper No. 09/120, 2009; A. Mody, D. Sandri: The Eurozone Crisis: How Banks and Sovereigns Came to be Joined at the Hip, in: Economic Policy, Vol. 27, No. 70, 2011, pp. 199-230.

3 P. Manasse, L. Zavalloni: Contagion in Europe: Evidence from the Sovereign Debt Crisis, VoxEU, 2012, available at: http://www.voxeu.org/article/contagion-europe-evidence-sovereign-debt-crisis.

and acquire sovereign bonds that would be viewed as “safe havens” for holding wealth. Such substitution effects have been detected in euro area sovereign bond markets, with De Santis, for example, finding higher risk aversion among investors effecting a stronger demand for the German Bund over the September 2008 to August 2011 period.[4]

It is also feasible that adverse developments in Greece could lead market participants to view other sovereign markets in a more negative light, particularly other member states with fiscal sustainability issues. Missio and Watzka attribute the rise in correlation values between Greece and, in turn, Portugal, Spain, Italy and Belgium in mid-2010 to such a market perspective.[5] By their estimation, this effect was not sustained over time, however. What the market might view as a satisfactory improvement in a sovereign’s fiscal position, owing to, for example, a policy development, could also influence its relationship with other markets. Policy initiatives such as sovereign bailouts and ECB programmes and commitments have been a feature of the euro area macroeconomic environment since 2010. Their influence, consequently, has become a focus of the literature. Conefrey and Cronin find the second Greece bailout (in March 2012) led to the Greek bond market decoupling from other euro area sovereign bond markets (both core and periphery markets).[6]

The literature then proposes a number of factors that could influence the relationship between, and the observed behaviour in, euro area sovereign bond markets in the type of turbulent financial environment experienced since 2008. In this article, a particular Dynamic Conditional Correlation-Generalised Autoregressive Conditional Heteroscedasticity (DCC-GARCH) methodology owing to Pesaran and Pesaran is used in conjunction with Bai-Perron multiple breakpoint testing and estimation to shed further light on this subject.[7] Sovereign bond spread data up to mid-2013 are used in the econometric analysis, meaning that the influence of certain events that had not yet occurred at the time that some of the aforementioned studies were written can be considered. Prominent among those are policy initiatives such as the second Greece bailout in March 2012 and the adoption of the Outright Monetary Transactions (OMT) programme by the ECB in August 2012.

The methodology used here may identify the influence these policy actions had on bond market relationships, as well as affirm, or contradict, some of the interpretations that have been made of bond market developments between 2008 and 2011. It must be stressed that the focus is on interaction in euro area sovereign bond markets rather than, for example, trying to identify specific episodes of contagion. While contagion may have occurred at various times since 2008, it requires bond markets to react to events in one particular national market. The literature, however, identifies other factors such as generalised flight-to-safety and pan-national concerns about the sovereign-banking relationship as also being relevant to euro area sovereign bond market developments in recent years. Moreover, some of the more important policy initiatives that have arisen have had a broad cross-national focus (e.g. OMT). These factors suggest a broader focus is required than looking for contagion effects alone. A narrow focus on contagion would also bring with it “contentious issues associated with the definition and existence of episodes of ‘contagion’ or ‘herd behaviour’”.[8] Thus, the focus here is on analysing market co-movements (represented by correlation values), relating them to economic events, including policy initiatives, pertinent to the euro area sovereign bond crisis, and assessing what the empirical analysis tells us about policy effectiveness.

Four phases of changing interaction in euro area sovereign bond markets are identified between January 2008 and June 2013. The initial period (January-October 2008) is followed by a general rise in pairwise correlation values between November 2008 and late 2009/early 2010. Interaction then declines up to early 2012. In autumn 2012, coinciding with the announcement of the OMT programme, there is evidence of a degree of re-engagement of bond markets with one another. Economic interpretations of these empirical results are offered. Policy implications are considered in the concluding section.

Methodology

Measuring how the correlations between pairs of asset returns change over time is one means of assessing the interaction between different assets. An increase in correlation values would suggest a stronger relationship occuring while a decline, if substantial, would point to a decoupling of asset markets from one another. There is, however, a

4 R. De Santis: The Euro Area Sovereign Debt Crisis – Safe Haven, Credit Rating Agencies and the Spread of Fever from Greece, Ireland and Portugal, ECB Working Paper, No. 1419, 2012.

5 S. Missio, S. Watzka: Financial Contagion and the European Debt Crisis, CESifo Working Paper, No. 3554, 2011.

6 T. Conefrey, D. Cronin: Spillover in Euro Area Sovereign Bond Markets, Central Bank of Ireland Research Technical Paper, 5/RT/13, 2013.

7 B. Pesaran, M.H. Pesaran: Modelling Volatilities and Conditional Correlations in Futures Markets with a Multivariate t Distribution, CESifo Working Paper, No. 2056, 2007; J. Bai, P. Perron: Computation and Analysis of Multiple Structural Change Models, in: Journal of Applied Econometrics, Vol. 18, No. 1, 2003, pp. 1-22.

8 F.X. Diebold, K. Yilmaz: Better to Give than to Receive: Predictive Directional Measurement of Volatility Spillovers, in: International Journal of Forecasting, Vol. 28, No. 1, 2012, p. 57.

shortcoming of unconditional correlations in undertaking such analysis of financial data. It is that, during periods of financial crisis, increases in the volatility of asset returns will occur. One consequence of this is that unconditional correlations will be biased upwards.[9]

DCC-GARCH models are a means of addressing this difficulty.[10] They account for the time-varying behaviour of data series (often financial data), with the estimated conditional correlations between variables being used as a basis for assessing how asset relationships respond to news and innovations. The DCC-GARCH approach is also computationally advantageous over other multivariate GARCH methodologies, such as VEC and BEKK, when more than two data series are being used in estimation, as is the case here.

Pesaran and Pesaran propose a t-DCC-GARCH methodology, assuming a multivariate t-distribution of innovations, to capture the fat-tailed nature of the distribution of asset returns.[11] It provides devolatized returns computed as returns standardised by realised volatilities rather than by GARCH-type volatility estimates. It is utilised here as it presents valid representations of the data (as will be shown below) and allows structural changes in correlation values to be detected.

In order to test for changes in the mean of the DCC coefficients over time, the Bai-Perron breakpoint procedure is applied to the estimated DCC series.[12] A benefit of this procedure is that structural breakpoints in the correlation parameter series are data-dependent and do not require a pre-specification of expected breakpoints. Moreover, the procedure can detect numerous breaks and provide estimates of mean correlation values between breakpoints. This is particularly useful when investigating euro area sovereign bond yield data in recent years where numerous country-specific and pan-national events which could influence interaction between sovereign bond markets occurred.

Data

The data consist of daily bond spreads of national generic ten-year benchmark bond yields over the ten-year generic German bond yield, with the data being sourced from Datastream. The dataset covers the period from 2 July 2007 to 28 June 2013, providing 1565 daily observations for estimation purposes.[13] During the course of estimating the t-DCC-GARCH model, up to ten sovereign bond yield spreads were considered, covering the euro area 12 group excluding Luxembourg and Germany, the numeraire. The first-difference series for Belgium, Finland, Italy, the Netherlands, and Spain, however, could not be modelled using the first-order autoregressive model applied here to provide the form of OLS residuals required for the DCC model to be applied to them. In particular, the error terms were serially correlated.[14]

We proceeded then with the five other first-difference yield spread series for, respectively, Austria (AT), France (FR), Ireland (IE), Portugal (PT) and Greece (EL). While the inclusion of other member states' spreads would have been preferable, but proved impractical, the five variables do include two member states (Austria, France) often classified as part of the euro area "core" and three member states from its "periphery" (Ireland, Portugal, Greece). The inclusion of Greece is welcome as it has been the member state with the most prominent fiscal difficulties in recent years and whose influence on developments in other member states, both core and periphery, has been a major focus of the literature.

The bond yield spreads and their first differences are shown in columns (a) and (b) of Figure 1, respectively, while Table 1 shows the descriptive statistics of the latter series over the sample period. The table indicates that the standard de-

Table 1

Descriptive statistics of first differences of sovereign bond yield spreads

	AT	FR	IE	PT	EL
Mean	0.2473E-3	0.03687E-3	0.001485	0.0029197	0.0057769
Std. dev.	0.03426	0.03360	0.11072	0.15676	0.79823
Skewness	0.47796	-0.058339	-0.76911	0.64891	-25.5751
Kurtosis	11.0984	11.7218	19.769	30.1115	897.3306
ADF	-25.6371	-26.597	-22.6922	-23.1657	-28.0646

Source: Author's calculations.

9 See, for example, K. Forbes, R. Rigobon: No Contagion, Only Interdependence: Measuring Stock Market Co-movements, in: Journal of Finance, Vol. 57, No. 5, 2002, pp. 2223-2261.

10 See R.F. Engle: Dynamic Conditional Correlation – A Simple Case of Class of Multivariate GARCH Models, in: Journal of Business Economics and Statistics, Vol. 20, No. 3, 2002, pp. 339-350.

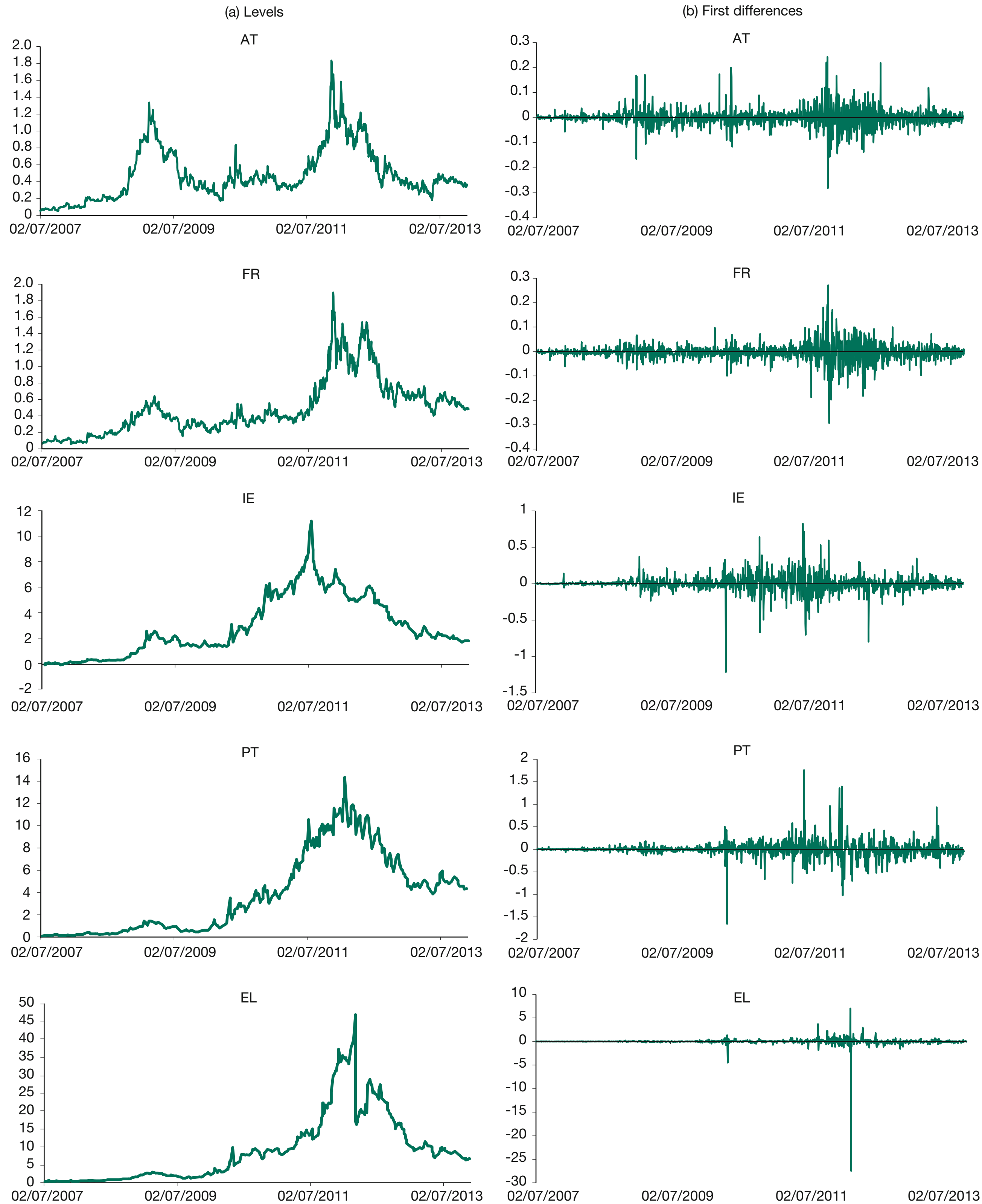
11 For the technical details of the t-DCC-GARCH methodology, see B. Pesaran, M.H. Pesaran, op. cit.

12 For the technical details of the Bai-Perron breakpoint procedure, see J. Bai, P. Perron, op. cit.

13 The data observations prior to that time were not used in the estimation process as the volatility required for GARCH modelling was largely absent in the data prior to mid-2007, reflecting the relatively uneventful economic and financial environment that arose prior to 2008. Daily observations from 1 July to 29 November 2013 are used for testing the validity of the model but are not used in the main set of computations.

14 Alternative univariate and multivariate specifications, as well as increasing lag lengths, did not provide serially uncorrelated error terms for these series either.

Figure 1
Ten-year sovereign bond spreads
in %



Source: Author's calculations.

viations of the first differences of the periphery member states' yield spreads are considerably larger than those of the core member states. Each series has excessive kurtosis. The Greece series has negative skewness which, examining Figure 1, may be attributable to spread values in March 2012. Finally, the Augmented Dickey-Fuller (ADF) statistics indicate the series to be first-order stationary processes.

Econometric results

As the first part of the t-DCC-GARCH estimation process, we estimate ordinary-least-squares (OLS) autoregressions for each of the five first-difference series where the regressors are the first-lag of that variable and a constant term. The equation for Greece also includes a dummy variable with a value of one for each observation between 6 and 12 March 2012, to account for particularly large changes in Greece spread values, and a value of zero otherwise. The residual diagnostics from these estimations are shown in Table 2. Non-normality and autoregressive conditional heteroscedasticity (ARCH) appear to be present in each series, so GARCH modelling of the series may be appropriate. This is prima facie evidence that ARCH is present in each series. All residuals are serially uncorrelated at standard significance levels.

The second step of the estimation process involves applying the multivariate GARCH model with underlying multivariate t-distribution to the OLS residuals. It is estimated with unrestricted volatility decay factors which are different for each variable, and unrestricted correlation decay factors which are the same for all variables. A rolling volatility window of 20 is employed. The estimation converges after 85 iterations.

Table 3 shows the maximum likelihood estimates of the t-DCC-GARCH model. The estimated degrees of freedom (υ) value for the t-distribution is 4.8505. This suggests that the t-distribution captures better the fat-tailed nature of the distribution of the series than a normal distribution. A further test of the validity of the t-DCC-GARCH model utilises an evaluation period from 1 July 2013 to 29 November 2013 (110 observations) for all five series and uses a procedure based on probability integral transforms.[15] Under the null hypothesis of correct specification of the t-DCC-GARCH model, the transform estimates are serially uncorrelated and uniformly distributed. The Lagrange Multiplier statistic in this case has a value of 12.92 which is less than the χ^2_{12} critical value at the five per cent significance level. This test, thus, also supports the validity of the model in representing the data.

15 See J. Berkowitz: Testing Density Forecasts with Applications to Risk Management, in: Journal of Business & Economic Statistics, Vol. 19, No. 4, 2001, pp. 465-474.

Table 2
Residual diagnostics from AR (1) equations

	AT	FR	IE	PT	EL
Serial correlation (χ^2,1)	0.004	0.141	4.68	0.67	1.96
ARCH (χ^2,1)	100.46	98.95	31.27	17.39	4.02
ARCH (χ^2,12)	351.46	426.61	106.39	102.69	127.01
Bera-Jarque (χ^2,1)	8131.5	8770.7	34599	97423.3	675.15

Source: Author's calculations.

Table 3
Multivariate GARCH with underlying multivariate t-distribution

Parameter	Estimate	Standard error	t-ratio [Probability]
$\lambda_{AT,1}$	.74739	.050148	14.9039 [.000]
$\lambda_{FR,1}$	.85266	.025975	32.8259 [.000]
$\lambda_{IE,1}$	.83888	.022569	37.1698 [.000]
$\lambda_{PT,1}$	.82135	.026756	30.6982 [.000]
$\lambda_{EL,1}$	.69828	.021472	32.5203 [.000]
$\lambda_{AT,2}$	.15313	.025415	6.0253 [.000]
$\lambda_{FR,2}$	.092064	.014099	6.5301 [.000]
$\lambda_{IE,2}$	.12157	.015427	7.8807 [.000]
$\lambda_{PT,2}$	.11765	.015222	7.7290 [.000]
$\lambda_{EL,2}$	.26709	.018231	14.6502 [.000]
$\varnothing_1$	.98229	.0028696	342.3061[.000]
$\varnothing_2$	.013357	.0016027	8.3338 [.000]
υ	4.8505	.16315	29.7305 [.000]

Source: Author's calculations.

Table 4
Testing for mean reversion of volatility series

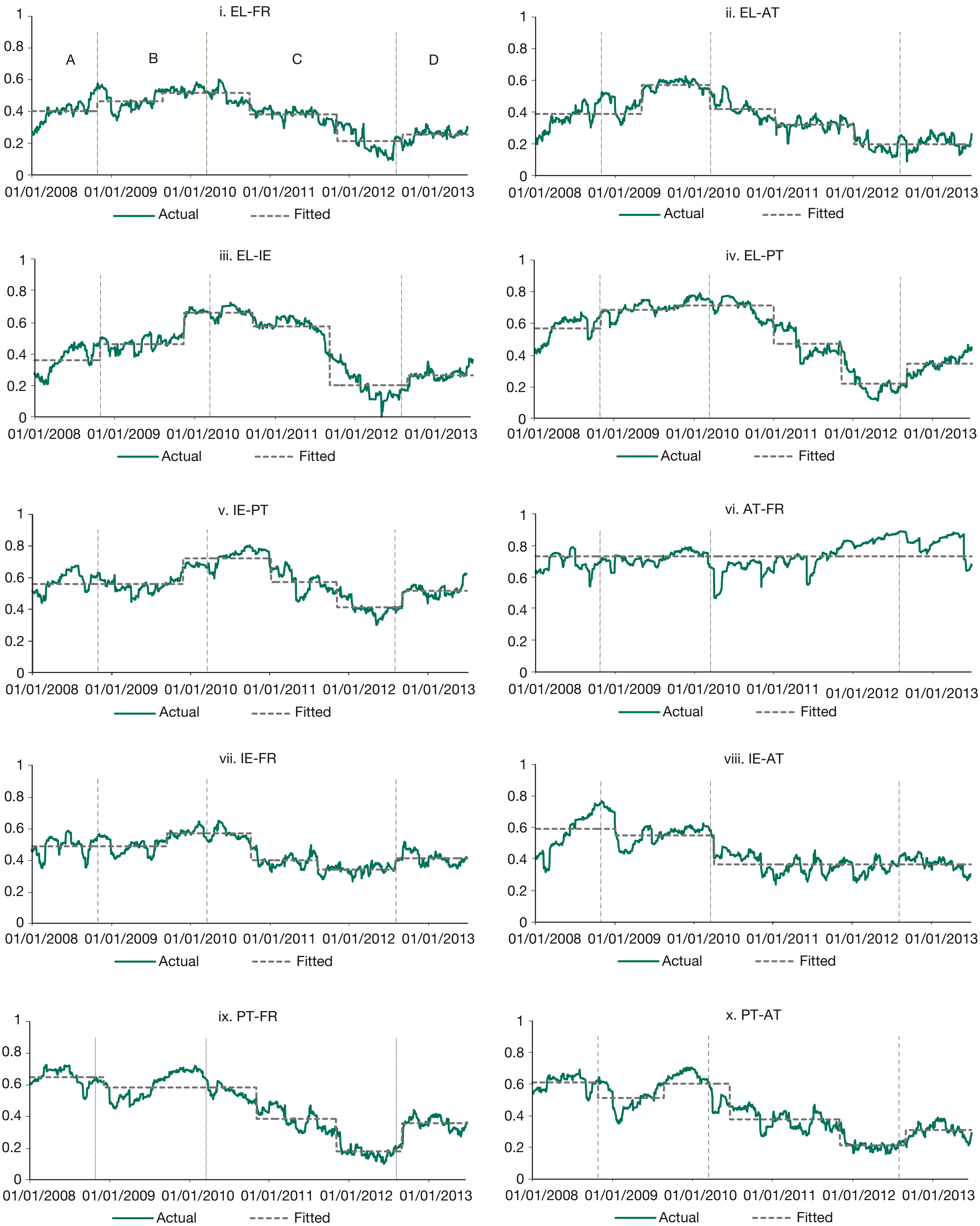
	Estimate	Standard error	t-ratio
$1 - \lambda_{AT,1} - \lambda_{AT,2}$	0.100	0.028	3.53
$1 - \lambda_{FR,1} - \lambda_{FR,2}$	0.055	0.014	3.84
$1 - \lambda_{IE,1} - \lambda_{IE,2}$	0.040	0.011	3.67
$1 - \lambda_{PT,1} - \lambda_{PT,2}$	0.061	0.015	3.97
$1 - \lambda_{EL,1} - \lambda_{EL,2}$	0.035	0.073	4.77

Source: Author's calculations.

All λ_1 and λ_2 parameter estimates are statistically significant. We test whether each series has non-mean reverting volatility. Formally, this involves testing the null hypothesis that $\lambda_{i,1} + \lambda_{i,2} = 1$ for each country i. The results are shown in Table 4 and indicate mean reverting volatility occurring

Figure 2

Dynamic conditional correlations and Bai-Perron breakpoint regressions



Source: Author's calculations.

in all five cases, with the sum of the λ parameters in each case being less than 1.

Figure 2 then shows the estimated pairwise dynamic conditional correlations (DCCs) between the five euro area member states over the period from 1 January 2008 to 28 June 2013 (solid line).[16] The first five individual graphs (panels i to v) indicate, in general, rising correlation values from 2008 to early-to-late 2011, followed by a decline after that, and then a recovery in values occurring in 2012 and 2013. These panels cover the pairwise correlations between Greece and all four other member states and between the two other peripheral member states, Ireland and Portugal. For panel (vi), which shows the DCC values between the two core member states, Austria and France, there is little variation in correlation values over time. For the remaining panels (vii to x), representing the pairwise DCC values between the core member states and Ireland and Portugal, correlation values are stronger in the first half of the sample period, although Portugal's bilateral correlation values with the two core member states, like Greece's, increase during the second half of 2012. The correlation values between Ireland and the two core member states never fall to as low values as Portugal's and Greece's do in the first half of 2012, which may help explain the absence of any noticeable rise in its bilateral correlation values with Austria and France subsequently.

The null hypothesis of stability is rejected for nine of the ten return DCC series by the Bai-Perron test, detecting multiple breakpoints in each case. The exception is the Austria-France DCC series where the Bai-Perron method does not reject the null hypothesis of no structural break. The identified breaks are shown in Figure 2, using dotted lines.

Analysis and discussion of empirical results

Before discussing the results in detail, a demarcation of the period from 1 January 2008 to 28 June 2013 into four sub-periods can be suggested (and is justified below). These are partitioned by three vertical lines and are marked A to D in panel (i) of Figure 2. The vertical lines occur on 28 October 2008, 15 March 2010 and 3 August 2012. These lines, at the same specific dates, are also used in the subsequent panels in that figure and represent dates on which qualitative changes in mean correlation values began to occur.

16 The DCC values from 2 July to 31 December 2007 are excluded from the charts to allow for initialisation of the estimates. The conditional volatility estimates are not commented upon here as the focus is on the volatility-adjusted correlation values.

The initial period in Figure 2 (phase A) extends from 1 January 2008 to 27 October 2008. While it was a time when there were significant financial market events (the bailout of Bear Stearns in March of that year and Lehman Brothers declaring bankruptcy in September), long-term bond yield values remained relatively stable and spreads with the Germany long-term bond yield low. Greece's mean correlation values with three of the other four member states (the exception being Portugal) are the lowest among the ten series during this time, being less than 0.4 in all three cases. This suggests that movements in its spread were relatively detached from other states at that time. The mean correlation value between Austria and France is strong at 0.73 and does not change throughout the full sample period up to end-June 2013.

The first structural breaks across all ten series occur on 28 October 2008 with Greece's pairwise correlations with France, Portugal and Ireland rising by between 0.06 and 0.1 and mark the beginning of phase B. Using weekly data, Conefrey and Cronin also find end-October 2008 to be one of four important dates in their assessment of spillover effects from euro area member states to one another from 2003 to 2012.[17] They find Greece and Ireland's net spillovers to other member states rising substantially in that week. This may reflect a greater influence of specific peripheral member states on other euro area bond markets. Acharya, Dreschler and Schnabl note a rise in sovereign CDS values during October 2008, reflecting, in their view, a shift in default risk from the banking sector to that of the sovereign.[18] It also broadly corresponds with the beginning of the period when, Caceres, Guzzo and Segoviano argue, systemic effects came to the fore in sovereign bond markets following the collapse of Lehman Brothers, also, in their view, owing to problems in the banking sector spilling over to the sovereign sector.[19] The initial breakpoints in the DCC series reported here then seem consistent with the timing of changes in bond relationships identified in other studies.

There are ten instances of a structural upward shift in correlation values between 28 October 2008 and 16 November 2009 in Figure 2, with an average rise of 0.11. Seven of these ten cases involve Greece's correlation values with the other four member states.[20] The three cases of downward structural shifts in dynamic conditional corre-

17 See T. Conefrey, D. Cronin, op. cit.

18 V. Acharya, I. Drechsler, P. Schnabl: A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk, NBER Working Paper, No. 17136, 2011.

19 C. Caceres, V. Guzzo, M. Segoviano, op. cit.

20 During the period between 28 October 2008 and 16 November 2009, Greece's mean correlation with the other four member states rose by between 0.11 and 0.3.

lations during this period occur in late 2008-early 2009 and involve Ireland-Austria, Portugal-France, and Portugal-Austria. They are small in value, and in the case of Portugal-Austria, the decline is later offset by a rise in the mean correlation value in August 2009. These results suggest that developments in the Greece bond market, in particular, were having greater relative effect on other euro area sovereign bond markets after 28 October 2008. By 16 November 2009, the three mean correlation values between the three peripheral member states had increased substantially compared to October 2008 and were the highest among the ten bilateral correlations at that time, with the exception of the Austria-France correlation. Thus, while systemic effects, generating closer ties between bond markets, may have been at work in general throughout this period, they appear to have been particularly strongly felt among the peripheral member states.

The next phase of changing mean or structural correlation values takes place from 15 March 2010 to 6 January 2012 (during phase C). It represents the sub-period during which the most substantial directional changes in correlation values took place. There are 18 declines in structural correlation values during this timeframe. They range in value between 0.06 and 0.37, with an average decline of 0.17 per change. The sharpest cumulative declines in mean correlation values during this period are between Greece and the two other peripheral member states, Ireland and Portugal, totalling 0.45 and 0.5, respectively. By 6 January 2012, Greece's mean correlation value with each of the other four member states is close to 0.2, suggesting it had effectively decoupled from them at the time. Buchholz and Tonzer find dynamic conditional correlation values among peripheral member states' sovereign CDS spreads falling after the announcement of rescue packages in spring 2010.[21] Greece being a participant in such a programme, along with its extreme fiscal predicament and required retrenchment, would seem to have led it to becoming detached from other markets during this time. Other programmes, such as that agreed for Ireland in November 2010, would have helped differentiate peripheral member states from one another and from core member states. Portugal's mean correlation with France and Austria also falls substantially during this phase, declining to close to 0.2 by early 2012, while Ireland's correlation values with the two core member states is 0.35. The correlation values between Ireland and Portugal also fall during the phase C period but remain relatively strong while the mean value for Austria-France, again, remains unchanged. The focus of markets after late 2009 then may have shifted from systemic concerns to country-specific factors and policy responses, and effected the downward shifts in mean correlation values between March 2010 and early 2012 shown in Figure 2.

There were no structural changes in correlation values between 6 January and 3 August 2012. This was a period when Greece bond yield values fell substantially after its second bailout in March 2012. There were also a number of European policy developments at this time, including the signing of the ESM Treaty in February, the adoption of the "fiscal compact" and an increase in the overall ceiling for EFSF lending in March, and the endorsement of the concept of banking union and acknowledgement of the possibility of direct banking capitalisations by the ESM in June.

These initiatives may have had the effect of bringing a greater sense of stability to euro area sovereign bond markets. The left-hand column of Figure 1 indicates bond spreads started to fall during 2012 in all five member states. The first *increase* in mean correlation values since 1 January 2009 occurs on 3 August 2012 between Ireland and France, a rise of 0.07 (the start of phase D in Figure 2). This takes place after the 2 August announcement by ECB President Draghi that the ECB would consider interventions in the short-term sovereign bond market so as to ensure the proper functioning of monetary policy. On 3 September 2012, increases in the mean correlation values for six of the remaining nine country pairings occur, ranging in value from 0.04 to 0.18 and averaging 0.1. This also coincides with the detail of the ECB bond market intervention initiative being provided in the form of the OMT programme on 6 September. These structural shifts, the last before the sample end-date of 28 June 2013, suggest some re-engagement of sovereign bond markets with one another in the euro area against a background of greater confidence in the support that the ECB would provide to financial markets and, possibly, less concern surrounding fiscal sustainability.[22]

Implications for policy

In this article, a DCC-GARCH methodology was applied to a daily euro area sovereign bond yield spread dataset

21 M. Buchholz, L. Tonzer: Sovereign Credit Risk Co-Movements in the Eurozone: Simple Interdependence or Contagion? Paper presented at SUERF/UniCredit & Universities Foundation Workshop on Banking and Financial Markets between Integration and Segmentation after the Crisis, Vienna, 12 December 2013.

22 We also considered the effect of rating agency downgrades of the five sovereign member states on correlation values according to a dummy-variable-based approach. This was applied to both the DCC series (solid line) and the difference between that series and the fitted values (dotted line) in Figure 2. We found almost all of the 55 downgrades and three upgrades had no significant effect on correlation values. Missio and Watzka, op. cit., find the impact of rating announcements on correlation values to be ambiguous.

covering the period from mid-2007 to mid-2013 with the purpose of seeing how individual member state bond markets interacted with one another during that period. There are a number of salient results. First, the econometric results can be interpreted as lending support to the view that the influence of systemic factors on bond yield spreads was overtaken by the market's increased focus on country-specific factors and policy initiatives after 2009, as well as the related perspective at the peak of the sovereign crisis that some member states could leave the euro. Second, the results point to a pickup in the correlation values from mid-2012 onwards. While not particularly substantial, these rises suggest that euro-area-wide policy initiatives such as OMT may have promoted greater confidence in sovereign markets in general and, in doing so, reversed in part the detachment of markets from one another.

This policy may have had that effect because markets believed that earlier policy actions, specifically the adoption of official assistance programmes at national level, may have addressed or allayed many country-specific concerns, while the new policies gave confidence to euro area sovereign bond markets in general. The market seems to have been persuaded by the policy responses of recent years, leading to historically low yield values now being recorded only two to three years after extremely high yield values prevailed and while government debt ratios still remain at high levels. This raises its own concerns, in particular whether euro area sovereign bond markets are moving between states of overly pessimistic and overly optimistic sentiment and whether policy is playing a part in these swings in market sentiment.

De Grauwe and Ji are of the view that spreads behaviour during 2010-11 was only partly connected to deteriorating fundamentals and was mainly the outcome of negative market sentiments.[23] Should that have been the case, the re-engagement of bond markets with one another in 2012 and 2013, however limited, indicates a calmer perspective being brought to bear by market participants. It also suggests that the types of fiscal austerity programmes adopted in member states in recent years and more radical initiatives such as the 2012 bailout in Greece can provide the platform for greater market confidence.

Nevertheless, while policy developments may have restored confidence in euro area sovereign bond markets, reflected in lower bond yields since 2012, there is the danger that the market may have become too confident about sovereign bonds and, implicitly, the fiscal environment. Just as De Grauwe and Ji showed in their earlier paper[24] that the rise in bond spreads from 2010 on can be only partly explained by deteriorating fiscal fundamentals, a more recent analysis by them indicates that following the announcement of OMT, bond markets have been driven by positive sentiment.[25] Likewise, increasing correlation values, such as those reported in this article for 2012-13, and peripheral member state yield values declining towards core member state values, as is being observed in 2014, may point to the market failing to differentiate between the still differing fiscal positions of peripheral and core member states. A situation where markets have overreacted to "good" news would be expected to lead in due course to an upward correction in at least some yield values.

The role of macroeconomic policy in influencing euro area bond market developments then seems evident in the empirical results reported here and in other recent studies. In a situation where the market is sensitive to new policy initiatives, the application of policy needs to be measured. This was well illustrated by the second Greece bailout in March 2012, which benefitted both that member state and the euro area more generally, unlike the first bailout in 2010. Policy announcements, such as OMT in autumn 2012, and President Draghi's commitment to do "whatever it takes" and "to preserve the singleness of our monetary policy" around that time also seemed to have a calming effect on markets.

Policy initiatives, however, can also bring their own "fragility", as Mody puts it.[26] Not only might markets take too much comfort from policy actions, resulting in bond yields falling below fundamental values, but there is also a danger that a moral hazard will arise, where market participants feel assured that they face no credit risk in holding bonds. Moreover, it leaves official bodies open to being "tested" by market participants through their buying and selling activity. To conclude, policy initiatives seem to be influencing the dynamics of euro area sovereign bond markets but also bring new challenges and issues to consider.

23 P. De Grauwe, Y. Ji: Self-fulfilling Crises in the Eurozone: An Empirical Test, in: Journal of International Money and Finance, Vol. 34, 2013, pp. 15-36.

24 Ibid.

25 P. De Grauwe, Y. Ji: Disappearing Government Bond Spreads in the Eurozone – Back to Normal? CEPS Working Document, No. 396, May 2014.

26 A. Mody: Europhoria Once Again, Bruegel Blog, 2014, available at: http://www.bruegel.org/nc/blog/detail/article/1242-europhoria-once-again.