Determinants of sovereign bond yield spreads and contagion in the peripheral EU countries

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ARTICLE INFO

ABSTRACT

This paper investigates the contagion effects in the daily bond yield spreads (relative to Germany) of five peripheral EU countries including Portugal, Italy, Ireland, Greece and Spain, as a consequence of the recent euro-debt crisis, by employing a robust semiparametric copula method. Furthermore, we model both the means and volatilities of daily bond yield spreads in terms of potential determinants. By doing so, we obtain "other effects" free sovereign bond spreads, which together with the robust copula method would correctly uncover the core contagion, when present. The empirical results indicate that the German stock index return, the Euro Interbank Offered Rate, stock index returns of these countries, S&P 500 returns, VIX and sovereign debt ratings have had significant impacts on the bond yield spreads and/or volatilities, particularly in the post-crisis period. We find overwhelming evidence of financial contagion effects among the peripheral countries. The two large countries Spain and Italy appear to be operating independent of each other, whereas Ireland, Greece and Portugal are found to be the exporters of contagion. In globally interconnected financial markets, central bankers and policy makers are concerned about contagion, through which the crisis proliferates around the region and beyond, triggering instability in the financial markets. Thus, our findings have implications for international policy debate, debt crisis risk management and financial market participants.

1. Introduction

In globally integrated financial markets, the contagion triggered by a major crisis is one of the machineries by which financial instability becomes so widespread and the crisis reaches its systemic dimensions (Constancio, 2012). The contagion phenomena play a significant role in intensifying the recent sovereign debt problems in the euro area. To contain and mitigate such contagion, governments, regulators and central bankers focus on appropriate policy measures. This paper employs a semiparametric copula method to identify the presence of contagion in the long term government bond yield spreads (relative to Germany) of the peripheral EU countries, Portugal, Italy, Ireland, Greece and Spain — all have been deeply affected by the recent sovereign debt crisis. Following the outbreak of the sovereign debt crisis, as the contagion would have devastating effects on the bond markets and financial markets in the region and beyond, testing for contagion has been receiving considerable attention in the recent literature; see, Beirne and Fratzscher (2013), Blatt et al. (2015) and Caporin et al. (2013), among others. Several studies including Samitas and Tsakalos (2013) and Reboredo and Ugolini (2015) used high frequency data such as daily or weekly on

sovereign bond yield spreads and employed parametric copula methods to identify contagion as the increase in the tail dependence (correlation) after the crisis. As the policy makers react swiftly to contain contagion, it is crucial to correctly identify the underlying contagion, when present.

The principal contribution of this paper is to establish the contagion in the daily sovereign bond yield spreads (relative to Germany) of five peripheral countries as a consequence of the recent debt crisis. This is the first paper to employ a robust semiparametric copula method to detect contagion in the daily sovereign bond yield spreads. The study by Forbes and Rigobon (2002) is central to proper definition of contagion, which showed that contagion is over-accepted, if one ignores the changes that occur in volatility due to "other factors" when testing for changes in correlation (the tail dependence) from the pre-crisis to post-crisis periods. Moreover, ours is the first paper to model the time series structures for the both mean and the volatility of daily bond yield spreads, and include the potential determinants in the both moments in the pre- and post-crisis periods; more discussion is given later in this section. By doing so, we undertake two tasks. First, to find the significant determinants of daily bond yield spreads and their volatilities. Thereby, we obtain bond yield spreads, which are free of "other factors" influencing their mean and the volatilities, so that the core contagion can be correctly identified. Second, to apply a semiparametric copula method to 'filtered' bond yield spreads to detect the presence

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of contagion. If the contagion is present, in a globally interconnected financial markets, ECB policy makers fear the spread of the crisis to the region and beyond, and the subsequent financial market instability around the word. They come up with policies to contain and mitigate financial contagion in order to stabilise the financial markets. Our empirical analysis and findings would contribute to the debate and discussion on the international monetary policy, debt crisis risk management, and financial market participants.

The first signs of a European sovereign debt crisis were recorded in late 2008, following Lehman's Bankruptcy (Lane, 2012).[1] The downgrading of the Greek sovereign credit rating in 2009, further exacerbated the uncertainty in the European debt markets. Consequently, the debt markets decoupled, introducing different levels of systemic risk across the Eurozone (Reboredo and Ugolini, 2015). However, this negative shock has been witnessed to spread differently across European countries, in particular Southern European countries such as Portugal, Italy and Spain were directly and negatively affected, whereas the direct influence on Northern countries such as Austria, Germany and Denmark appeared to be mild (Paltalidis et al., 2015). Understanding such diverse effects of this recent sovereign debt crisis is crucial to policy makers to establish efficient machinery to minimise the spread of such turmoil. Recently, several researchers contributed to this central topic include Metiu (2012), Samitas and Tsakalos (2013), Philippas and Siriopoulos (2013), Reboredo and Ugolini (2015), Afonso et al. (2012), Blatt et al. (2015), and Engle et al. (2014), among others. The main focus of many of these studies has been on testing for contagion using bond yield spreads at various frequencies and time periods and countries, almost all of these studies included peripheral countries, Portugal, Ireland, Italy, Greece and Spain, as well as some Northern neighbours such as Denmark, France and Belgium, among others. Furthermore, these papers considered distinct definitions for contagion and methodologies, and arrived at various conclusions.

Bolton and Jeanne (2011) demonstrate that international contagion in sovereign debt markets are facilitated by exposures of banks to foreign sovereign debt. Prior to the Greek sovereign debt crisis in the pre-crisis period, all Eurozone countries showed a similar pattern in terms of their sovereign debt yields. Conversely, in the post-crisis period, the sovereign debt yields emanating from the peripheral countries distinctively moved much higher from the core Eurozone countries, suggesting high levels of financial distress.

We investigate the potential determinants of daily sovereign bond yield spreads (relative to Germany) movements of the five peripheral European countries for the period spanning 1 January 1999 to 31 December 2013. These countries have similar fiscal imbalances. Consistent with some recent studies on this topic, the potential determinants of bond yield spread include: (i) Euribor rate; (ii) S&P 500 US stock market index returns; (iii) the Chicago Board Options Exchange Volatility Index (VIX); (iv) Euro denominated stock price indices of each of the five EU countries; (v) German 1-month money market interest rates; and (vi) Moody's sovereign debt ratings. We model the mean and the volatility of each bond yield spread series using an ARMA/EGARCH model. The aim is to find out how these variables affect the mean and the volatility of daily bond yield spreads, particularly how these effects differ between the pre- and post-crisis periods. The pre- and post-crisis periods are defined based on the date at which the Lehman Brother's collapsed. There are several studies that included some determinants of the mean of bond yield spread movements. For example, see Metiu (2012) for including global factors as well as country specific factors in daily yield movements, and Reboredo and Ugolini (2015) for one global variable Euribor rate and one country specific factor stock market returns in the weekly spreads movements, as well as the crisis dummy variable in the both mean and variance equations. Furthermore, the degree of contagion has often been measured by a significant increase in correlation between

two countries' financial markets, following a major financial or economic crisis. With the advent of copula models for testing contagion, several studies modelled and estimated the tail dependence and established contagion if there is a significant increase in the tail dependence from the pre- to post-crisis periods. In this paper, we adopt this approach but employing a robust semiparametric copula method.

There are several studies that have applied copula models for testing contagion in debt markets. In studying the Greek contagion phenomenon, Samitas and Tsakalos (2013) employed a dynamic conditional correlation model together with a copula model to investigate the correlation dynamics among Greek and other European markets. Philippas and Siriopoulos (2013) applied a time-varying copula model to investigate the contagion appetite instigated by the current debt crisis in Greece and focussed on six EMU bond markets, excluding Greece. However, in our paper, as explained in the previous paragraph, the bivariate copula with constant parameter is fitted to i.i.d. (filtered) bond yield spreads separately for the both pre- and post-crisis period. Of course, if the contagion effect is present, then the tail parameter estimate will be significantly higher for the post-crisis period than that for the pre-crisis period. Several studies such as Samitas and Tsakalos (2013) and Reboredo and Ugolini (2015), among others, used the constant parameter copula model to sovereign markets to quantify the conditional value-at-risks before and after the Greek debt crisis.

Additionally, our study has some similarities and significant differences from the previous studies in terms of the data frequency and the time period, econometric methodologies used in modelling and testing for contagion. First, in line with many previous studies Metiu (2012), Samitas and Tsakalos (2013), Blatt et al. (2015), among others, we use daily data.[2] There are advantages of using daily data when employing the copula model — a popular technique for testing contagion effects. As opposed to lower frequency data, the daily data would reveal the large fluctuations of bond yield spreads, which are crucial to estimate the copula tail dependence parameters accurately. Second, we use a robust semiparametric copula model for testing for the presence of contagion, while other studies use fully parametric copulas. To see the robustness of the semiparametric copula, recall that bivariate copula modelling involves two stages: in stage 1, the marginal distributions of bond yield spreads are modelled for each series, and in stage 2, a bivariate copula model is fitted to the marginal distributions; see Section 3 for details. The reason for using a parametric copula is that it has well-defined tail dependence parameters which would facilitate testing for contagion effects. However, there exist many shapes for marginal distributions which are largely unknown in practice. Therefore, modelling marginal distributions by a nonparametric method and then fitting a parametric copula makes this copula method robust for misspecification of margins (Kim et al., 2007). Thus, the semiparametric copula modelling offers the much needed flexibility in testing for contagion; see Section 3.2 for details.

We note at the outset that, as discussed in the previous paragraph, we use daily bond yield spreads in this paper to model the underlying daily volatilities of bond yield spreads and, thus to model the tail dependence accurately, from which contagion effects can be correctly identified. Therefore, we do not include economic fundamentals such as monthly/quarterly Debt/GDP ratio, inflation and unemployment in the models, which are the limitations of the paper. Readers interested in such models with economic fundamentals can refer to several studies including Afonso and Jalles (2012), Fernandez-de-Cordoba and Torres (2015) and Gomez-Puig et al. (2014)among others.

This paper is organised as follows: The next section provides a brief review of the related literature. Section 3 explains the methodology used in this paper to find significant determinants of the mean and volatilities of bond yield spreads of five countries, and conducts an

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[1] Lane (2012) provides a clear analysis of how the sovereign debt crisis is deeply tangled with banking crisis and macroeconomic imbalances that distress the euro area.

[2] For example, Afonso and Jalles (2012) used monthly data, Bernoth and Erdogan (2012) quarterly data, whereas Philippas and Siriopoulos (2013) and Reboredo and Ugolini (2015) weekly data.