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## Systemic risk in European sovereign debt markets: A CoVaR-copula approach



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### ABSTRACT

We studied systemic risk in European sovereign debt markets before and after the onset of the Greek debt crisis, taking the conditional value-at-risk (CoVaR) as a systemic risk measure, characterized and computed using copulas. We found that, before the debt crisis, sovereign debt markets were all coupled and systemic risk was similar for all countries. However, with the onset of the Greek crisis, debt markets decoupled and the systemic risk of the countries in crisis (excepting Spain) for the European debt market as a whole decreased, whereas that of the non-crisis countries increased to a small degree. The systemic risk of the Greek debt market for other countries in difficulties increased, especially for Portugal where systemic risk tripled after the onset of the crisis, whereas the systemic impact on the non-crisis countries decreased.

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## 1. Introduction

The recent sovereign debt crisis in Europe has raised concerns about the fragility of debt markets and the potential systemic risk impact of a sovereign default on other European debt markets. Measuring systemic risk among debt markets is crucial to an assessment of how a deteriorated financial position of a sovereign market could impair the performance of other sovereign debt markets. In this paper, we quantify systemic risk in the European sovereign debt markets before and after the

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onset of the European sovereign debt crisis by computing the conditional value-at-risk (CoVaR) through copulas, providing thus quantitative evidence regarding how systemic risk changed as a result of the debt crisis.

One strand of the burgeoning literature on the European sovereign debt crisis examines co-movements and drivers of fluctuations in government bond spreads such as credit risk, exchange rate movements, specific news, rating changes and even the probability of some countries exiting the euro area (see, e.g., [Manganelli and Wolswijk, 2009](#); [Haugh et al., 2009](#); [Schuknecht et al., 2010](#); [Borgy et al., 2011](#); [De Santis, 2014](#); [Beestma et al., 2013](#); [Favero, 2013](#)). Another strand of this literature is concerned with the spillover effects of the European debt crisis on the financial sector. [De Bruyckere et al. \(2013\)](#) studied contagion between bank and sovereign default risk in Europe through asset, collateral and rating channels. [Bhanot et al. \(2014\)](#) investigated the impact of changes in Greek sovereign yield spreads on stock returns in the financial sector. Similarly, [Mink and De Haan \(2013\)](#) analysed the impact of highly volatile Greek bonds on European bank stock prices in 2010. [Alter and Schuler \(2012\)](#) examined the relationship between sovereign default risk and domestic banks. Further studies, using credit default swaps, examined sovereign risk contagion among Eurozone countries (see, e.g., [Missio and Watzka, 2011](#); [Arezki et al., 2011](#); [Alter and Beyer, 2012](#); [Caporin et al., 2013](#)). However, even though systemic risk is an important dimension of contagion that enables the impact of extreme downward movement in one market on other markets to be quantified, no study has yet examined systemic risk in European sovereign debt markets or how this risk changed with the onset of the recent crisis. This paper attempts to fill this gap, contributing, in particular, to the existing literature in two ways.

First, we characterize the CoVaR systemic risk measure—as proposed by [Adrian and Brunnermeier \(2011\)](#) and generalized by [Girardi and Ergün \(2013\)](#)—in terms of copulas. CoVaR captures possible risk spillovers between markets by providing information on the value-at-risk (VaR) of a market, conditional on the fact that another market is in financial distress. Using copulas, the value of the CoVaR can be obtained in a two-step procedure. Given the cumulative probability of the VaR of the market in financial distress and the confidence level for the CoVaR, we can compute the cumulative probability for the CoVaR from a copula function. We then can invert the marginal distribution function for this cumulative probability to obtain the value of the CoVaR. From a computational point of view, this approach is more tractable than other parametric approaches; it is also more flexible, given that copula functions, in providing a measure of both average dependence and upper and lower tail dependence (joint extreme movements), enable the dependence structure of stochastic variables to be fully described. This information is crucial to determining the VaR of one variable conditional on the fact that another variable takes values below or equal to its own VaR. In fact, (lower) tail dependence of a copula function naturally provides this information, but at the limit.

Second, for a sample of sovereign bond benchmark price indices for France, Germany and the Netherlands, for GIIPS economies (Greece, Ireland, Italy, Portugal and Spain) and for an overall sovereign bond price index for the European Economic and Monetary Union (EMU) for the period January 2000 to October 2012, we provide evidence of strong co-movement between European debt markets and the EMU index before the onset of the European debt crisis. All sovereign debt markets shared a similar trend in systemic risk, which was very similar in size across markets. However, with the onset of the European sovereign debt crisis, we find evidence of the decoupling of debt markets in such a way that, on average, GIIPS markets negatively correlate with the EMU index, displaying, in general, market independence at the tails. As a result, systemic risk for the GIIPS markets, with the exception of Spain, was reduced, whereas systemic risk for the non-crisis countries experienced a significant upsurge as a result of a high degree of co-movement with the EMU index. Finally, we examined the systemic risk impact of the Greek debt market on other European debt markets, finding that before the debt crisis, Greek systemic risk was relatively low and different across countries. However, after crisis onset, Greek systemic risk increased for the countries in crisis, especially for Portugal, where systemic risk tripled overall. For non-crisis countries the systemic impact of the Greek debt crisis was less, given that the debt markets of these countries decoupled from the Greek market.

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