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Measuring sovereign risk contagion in the Eurozone☆

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ABSTRACT

This paper proposes new measures of financial contagion, as observed during the recent Eurozone sovereign debt crisis. The new measures, referred to as contagion Value-at-Risk and contagion Expected Shortfall, are based on popular risk exposure measures and therefore can provide useful practical information for investors. For this purpose, we construct a new model that disentangles contagion from interdependence. We find that contagion effects fluctuate dynamically, sometimes greatly deviating from mean levels. In addition, the economic value of contagion proves to be quite large, even in stable economies.

1. Introduction

For several years, the Eurozone sovereign debt crisis has had significant negative effects not only on the Eurozone economy but also on other economies. Given the economic importance of the Eurozone, many studies, from multiple perspectives, have been conducted on the Eurozone crisis. In this paper, we aim to provide information about contagions associated with the recent Eurozone crisis that is useful from the perspective of actual investors who have exposure to Eurozone sovereign debt. In particular, we seek to measure the extent of investor risk exposure due to contagion from crisis countries. This perspective is rare in the Eurozone crisis literature; hence, this information will be useful from a risk management view.

The literature on Eurozone sovereign yields (spreads) has grown in recent years, including many studies belonging to the large literature on the empirical determinants of sovereign yield spreads.[1] Examples include Attinasi, Checherita, and Nickel (2009), Sgherri and Zoli (2009), Caceres, Guzzo, and Segoviano (2010), Arghyrou and Kontonikas (2011), Caporale and Girardi (2011), von Hagen, Schuknecht, and Wolswijk (2011), Gibson, Hall, and Tavlas (2012), and Favero (2013). Beyond the euro area, this line of research includes Edwards (1986), Eichengreen and Mody (2000), Min (1998), Beck (2001), Ferrucci (2003), Hilsher and Nosbusch (2010), and Maltritz and Molchanov (2014) among others. These studies largely seek to test for the existence of contagion, measure

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[1] Relatedly, Fong and Wong (2012) apply CoVaR, which was proposed by Adrian and Brunnermeier (2011), into European sovereign credit default swap data to measure the risk of contagion.

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mean contagion effects, or find the determinants of contagion; thus, they lack a risk management perspective from investors. Clearly, as contagion effects are time-varying, measuring only the mean effects of contagion may be inappropriate for risk management purposes. Measuring contagion effects in a time-varying manner would be more informative.

Possible international transmission of contagion effects through stock or foreign exchange markets has also been extensively studied. Several studies, including Boyer, Gibson, and Loretan (1999), Loretan and English (2000), Forbes and Rigobon (2002), Rigobon (2003), and Corsetti, Pericoli, and Sbracia (2005) among others, define contagion as an increase in the correlation between two variables during a crisis period. Latent factor models are widely employed to distinguish between interdependence and contagion, as demonstrated in Dungey and Martin (2001), Forbes and Rigobon (2002), Bekaert, Harvey, and Ng (2005), Corsetti et al. (2005), and Dungey, Fry, Gonzalez-Hermosillo, and Martin (2007). Other methods are also utilized in contagion analysis: for example, the VAR approach of Favero and Giavazzi (2002), the probability model of Eichengreen, Rose, and Wyplosz (1995, 1996), the co-exceedance approach of Bae, Karolyi, and Stulz (2003), and the simultaneous statistical analysis framework of Pesaran and Pick (2007).[2] Dornbusch, Park, and Claessens (2000), Pericoli and Sbracia (2003), and Dungey, Fry, Gonzalez-Hermosillo, and Martin (2005) provide an overview of the literature. It is notable that among countries with a common currency, the dynamics of stock returns and of foreign exchange rates differ from those of sovereign yields. For instance, sovereign yields typically exhibit close co-movements before a crisis but divergent movements during a crisis. Therefore, contagion in some cases may be detected not by an increase but by a decrease in correlations among sovereign yields. This difference in dynamics may necessitate a new methodology.

We propose a new model that can disentangle contagion from interdependence. Relative to existing approaches, the new model captures not only interdependence but also contagion in a flexible and time-varying manner. Moreover, to provide useful practical information to investors, we also propose new contagion measures that are linked to popular risk measures, such as Value-at-Risk (VaR) and Expected Shortfall (ES). Both measures have clear economic interpretations. As a measure of the risk of loss on a portfolio of financial assets, VaR is defined as a threshold value such that the mark-to-market loss on a portfolio over a given time horizon will exceed this value with a given probability. As an alternative to VaR, ES is the expected return on a portfolio in a worst-case scenario at a given probability. Our approach is novel in that it links the measurement of contagion to the two most popular risk management measures.

We provide measurements of contagion for ten selected Eurozone countries, specifically, five crisis countries and five stable countries. We find that contagion effects dynamically fluctuate, sometimes greatly deviating from their mean levels. In addition, the economic value of contagion proves to be quite large, even in stable economies.

The remainder of this paper is organized as follows. The next section briefly describes Eurozone sovereign-debt crisis developments and the characteristics of sovereign yield data. Section 3 presents the model and our measures of contagion effects. Section 4 reports the estimation results of ECB policy rate effects on sovereign yields and presents empirical results related to the measurements of sovereign risk contagion. Section 5 concludes. Appendix A provides a chronicle of the Eurozone sovereign-debt crisis.

2. Eurozone sovereign-debt crisis developments

The Eurozone sovereign debt crisis is not only a fiscal crisis but also a financial one, an event that had not occurred since the inception of the Euro (January 1, 1999) yet is still ongoing. Beginning in late 2009, fears of sovereign debt insolvency in some Eurozone countries developed among investors. Causes of the debt crisis vary by country. In several countries, governments greatly increased their debt levels due to bailouts of weak banking systems and/or expansionary fiscal responses to slowing economies, both of which arose from the bursting of property bubbles. In Greece, by contrast, unsustainable public wage and pension commitments engendered a substantial increase in sovereign debt. The structure of the Eurozone has been cited as a fundamental cause of the crisis. The Eurozone is a monetary union with one currency, not a fiscal union. The various countries have different taxes and fiscal expenditures. Hence, the union lacks an appropriate stabilizing force.

Concerns intensified in early 2010 and thereafter.[3] While sovereign debt has risen substantially in only a few countries, it has become a perceived problem for the Eurozone as a whole; speculation about a possible breakup has continuously arisen, which may be an important channel of contagion to other countries in the Eurozone. To restore confidence in the Eurozone, Eurozone leaders have taken various measures to aid countries suffering from debt crises. By contributing to or promising huge bailout packages, debt burdens have been transferred to other countries in the Eurozone, which may be another contagion channel.

For our empirical analysis, we select ten countries (Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain) among the 17 Eurozone countries. Cyprus, Estonia, Malta, Slovakia, and Slovenia are excluded because they joined the Eurozone recently. Finland and Luxembourg are also excluded due to their small economic size. Because of their popularity as a benchmark indicator of sovereign risk, we focus on 10-year sovereign debt yields. To obtain balance between tranquil and turbulent periods, we choose a sample period of 7 years, from October 1, 2005 to September 30, 2012. Fig. 1 demonstrates the 10-year benchmark sovereign debt yields during the whole sample period.

To facilitate the analysis, we exogenously determine tranquil and turbulent periods. During tranquil periods, without significant sovereign risk, the sovereign debt yields of the member countries exhibit virtually the same level, whereas during turbulent periods, characterized by significant sovereign risk, yields are differentiated. To identify turbulent periods, we take the maximum difference between yields among the ten sovereign Eurozone countries considered, illustrated in Fig. 2. We identify the turbulent period as the period from October 1, 2008 to September 30, 2012. Thus, overall, there is a tranquil period of 3 years and a turbulent period of 4 years.

[2] Metiu (2012) applies the framework of Pesaran and Pick (2007) into the analysis of sovereign risk contagion in the Eurozone.
[3] See Appendix A for the detailed chronicle of the Eurozone sovereign-debt crisis developments.