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The global financial crisis saw many Eurozone countries bearing excessive public debt. This led the government bond yields of some peripheral countries to rise sharply, resulting in the outbreak of the European sovereign debt crisis. The debt crisis is characterized by its immediate spread from Greece, the country of origin, to its neighbouring countries and the connection between the Eurozone banking sector and the public sector debt. Addressing these interesting features, this book sheds light on the impacts of the crisis on various financial markets in Europe.

This book is among the first to conduct a thorough empirical analysis of the European sovereign debt crisis. It analyses, using advanced econometric methodologies, why the crisis escalated so prominently, having significant impacts on a wide range of financial markets, and was not just limited to government bond markets.

The book also allows one to understand the consequences and the overall impact of such a debt crisis, enabling investors and policymakers to formulate diversification strategies and create suitable regulatory frameworks.

Go Tamakoshi is a Research Fellow at Department of Economics of Kobe University in Japan. He received his PhD in Economics from Kobe University, MBA from MIT Sloan School of Management, MS and MPP from the University of Michigan, Ann Arbor, and BA from Kyoto University. He has published many papers in refereed journals, such as *European Journal of Finance, Applied Financial Economics*, and *North American Journal of Economics and Finance*.

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To Tomoko - Go Tamakoshi

To Naoko - Shigeyuki Hamori

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Contents

Introduction

The global financial crisis, which began in the US subprime loan market in 2007, heavily affected the banking industry across the world. It culminated with the bankruptcy of Lehman Brothers on 15 September 2008. The Eurozone banking system was not segregated from such developments. Indeed, governments in the Euro area rescued the financial institutions that were considered systematically important. As a result, some peripheral economies, countries usually known as GIIPS (Greece, Ireland, Italy, Portugal, and Spain), bore an excessive burden of public debt. The government bond yields of these nations rose sharply, with a perceived deterioration of their creditworthiness. Greece became the first country to lose investor confidence in its capacity to repay the debt, which resulted in the onset of the European sovereign debt crisis. The nation agreed on a bailout package with the EU and the International Monetary Fund (IMF) in May 2010, followed by Ireland in November 2010 and Portugal in May 2011. Nonetheless, the bailouts did not attenuate the crisis throughout 2011 and 2012, with the sovereign risks of Spain and Italy to be the next under scrutiny by market participants. Observing this background, economists usually regard the debt crisis as a by-product of the global financial crisis (e.g. Arghyrou and Kontonikas, 2012; Kalbaska and Gatkowski, 2012; Ahmad et al., 2013).

Some aspects of the institutional framework of the European Monetary Union (EMU) also may have made member countries more vulnerable to increases in their sovereign default risks. Introducing the single currency implied that each country could no longer rely on monetary policies in order to pursue devaluation in improving its price competitiveness or to facilitate inflation for reducing the real value of its debt (Klose and Weigert, 2014). In addition, abandoning national currencies led to the member countries depending more on fiscal policies as countercyclical macroeconomic measures, potentially resulting in increases in their budget deficits (Gali and Monacelli, 2008; Lane, 2012). To address these potential issues, an initial design of the EMU included such requirements as the Stability and Growth Pact (SGP) that set limits on the percentage of budget deficits and the ratio of public debt to GDP, as well as the 'no-bailout' clause of the Maastricht Treaty that prohibited a member country from assuming the debts of another country. However, such formal rules turned out to be insufficient in depressing the incentives to incur excessive debts, which were inherent in the

institutional features of the EMU in the case of national governments of some peripheral countries (Baltatescu, 2013; Whelan, 2013).

This book is motivated by the following three intriguing aspects of the recent European sovereign debt crisis. First, the crisis originated in the government bond market of a relatively developed nation such as Greece, although high sovereign debt risks had historically been associated with emerging countries. Specifically, until the inception of the recent financial turmoil, it had been widely believed that government bonds of Eurozone countries, including Greece, would bear no country-specific risks, as euro-denominated bond markets were extremely standardized. This belief was supported by the so-called 'convergence trade' hypothesis, contending that investors' purchases of the bonds of peripheral European nations were justified by the scenario in which their yields would achieve a full convergence to that of Germany (Oliveria et al., 2012). In fact, since the introduction of the euro until mid-2007, the spreads of long-term government bond yields of almost all other Eurozone countries with that of German bond yields had narrowed substantially. Hence, under the 'convergence trade' hypothesis prevailing in markets, Eurozone countries felt little pressure to utilise public finances effectively. Therefore, it is interesting to see that the recent debt crisis occurred in a place where little attention was paid to the possibility of sovereign default.

Second, the debt crisis immediately spread from Greece, a country contributing only a small fraction of the Eurozone's total GDP, to Ireland and Portugal and further affected even Italy and Spain to a lesser extent. Such a spillover manifested in the form of sharp increases in sovereign bond spreads between these peripheral countries of the EMU and Germany. GIIPS countries had experienced the deterioration of fiscal and other macroeconomic fundamentals for the period 2001–2009, and then, after the onset of the debt crisis, sovereign bond markets began to place heavier penalties on such macroeconomic imbalances (Arghyrou and Tsoukalas, 2011; Arghyrou and Kontonikas, 2012). Interestingly, recent empirical studies have found evidence that sudden increases in sovereign bond spreads can be viewed as a 'wake-up call' contagion. It is a phenomenon where a crisis, initially restricted to one country, supplies new information which triggers investors' reassessment of the default risk of other nations and, thereby, the crisis is spread to other countries (Mink and Haan, 2013; Giordano et al., 2013).

Third, the debt crisis is characterised by the connection between the Eurozone banking sector and public sector debt. A deteriorated banking sector can cause a contraction of the economy because of the limited credit flow available. This potentially exacerbates the fiscal outlook through the decline in present values of future tax streams. The risk transfer from the banking to the public sector can occur if governments intervene to bail out troubled banks (Gray et al., 2008; Acharya et al., 2011; Alter and Schuler, 2012). Such linkages between banking and sovereign risks are complicated by the fact that Eurozone banks hold substantial amounts of sovereign debt. The dramatic increases in the sovereign bond yields of GIIPS countries implied that the banking sector in the area would suffer

from the impairment of their balance sheets (Arnold, 2012; Bruyckere et al., 2013). It is worthwhile to note that before the debt crisis, this subtle relationship between the banking sector and the public sector had not attracted much attention from the policymakers in the EMU.

The main objective of this book is to shed light on the impacts of the European sovereign debt crisis on various financial markets in Europe. Particular attention is paid to the impacts of the crisis on dynamic correlations among financial markets (Part I); the impacts of the crisis on causalities among financial markets (Part II); and the timing of structural changes in financial markets due to the crisis (Part III). As the analysis presented in this book uncovers, the crisis not only affected the sovereign bond markets of vulnerable GIIPS countries but also altered the inter- and intra-country relationships of other financial markets across the entire Eurozone. Indeed, the three unique and interesting features of the debt crisis presented earlier help us to understand why the crisis escalated so prominently, having significant impacts on a wide range of financial markets. Moreover, this book also contributes to drawing implications for investors and policymakers who wish to use the knowledge of the consequences of the recent debt crisis. We now provide a brief overview of each chapter.

Part I: How were dynamic correlations among financial markets changed by the crisis?

Chapter 1 is titled 'Co-movements among stock markets of European financial institutions'. This chapter investigates the dynamic relationships between the stock returns of five important financial institutions in the Eurozone, whose exposure to Greek government bonds was particularly high. We use the multivariate dynamic conditional correlation (DCC) model of Engle (2002) and then assess the impacts of the global financial crisis and the European debt crisis, employing autoregressive models with crisis dummy variables. Despite differences in core businesses and location of headquarters, we find significant increases in the dynamic correlations for some pairs of financial institutions during the global financial crisis. In addition, contrary to the results of previous studies such as Savva (2011), we also detect significantly positive effects of the sovereign debt crisis on the DCC estimates for several pairs, indicating the existence of contagion effects. These findings imply the diminished benefits of diversification for global traders by holding stocks of financial institutions across various countries during the recent financial turmoil. We also argue that regulators should pay attention to the exposure of European financial institutions to the deteriorated sovereign risk of Greek government bonds and the resulting systemic risks, as reflected in the increased DCC estimates between their stock returns.

Chapter 2 is titled 'Co-movements among GIIPS national stock indices'. This chapter examines the dynamic interrelationships among the national stock index returns of Greece, Ireland, Portugal, Italy, and Spain. We employ the dynamic equicorrelation (DECO) model of Engle and Kelly (2012) and assess potential

driving factors, such as the recent financial turmoil in Europe and several other economic variables, for the evolution of the estimated dynamic equicorrelation, with autoregressive models. We detect substantial fluctuations of the estimated equicorrelation over time and, specifically, significant increases in the co-movements during both the global financial crisis and the European sovereign debt crisis periods. Further, we find that the global risk aversion factor, represented by the US corporate–government bond spread, also increased the equicorrelation significantly. Our findings suggest that for traders, portfolio diversification effects among the national stock indices were rather limited when they were most needed, namely during the two crises that hit Europe. Our empirical results also highlight the need for policymakers to recognize that contagion in the equity markets can occur even in a debt crisis, which originated in sovereign bond markets, and to conduct policy coordination in order to avoid contagion among the affected countries.

Chapter 3 is titled 'Co-movements among European exchange rates'. This chapter analyses the time-varying linkages of three US dollar (USD) exchange rates expressed in the euro (EUR), British pound (GBP), and the Swiss franc (CHF). We adopt the multivariate, asymmetric DCC model of Cappiello et al. (2006) and conduct a sensitivity analysis for impacts of the recent European crises on the dynamic correlations by employing autoregressive models with crisis dummies. We detect asymmetric responses in the correlation between the three exchange rate returns, namely, higher dependency during periods of joint appreciation than during periods of joint depreciation. We also find significant decreases in the estimated DCCs for the CHF–EUR pair, particularly after the debt crisis, and for the GBP–CHF pair, especially after the global credit crisis. These findings imply that global investors may identify more diversification opportunities, owing to the lower degree of dependency between the exchange rates, during crisis periods. In addition, the high level of interdependence during the pre-crisis period may indicate the difficulty faced by policymakers in controlling exchange rates only through local monetary policies. Moreover, our findings of the dynamic dependence between the exchange rates will help policymakers to decide whether and how they need to implement foreign exchange market interventions.

Part II: How were causalities among financial markets altered by the crisis?

Chapter 4 is titled 'The causality between Greek sovereign bond yields and southern European banking sector equity returns'. This chapter investigates cross-country mean and volatility transmission effects between Greek long-term bond yields and the banking sector stock returns of four southern European countries (Greece, Portugal, Italy, and Spain), with a focus on uncovering impacts of the European sovereign debt crisis. We use the cross-correlation function approach of Hong (2001). We find that the causality-in-mean effects vary across countries, casting a doubt on the assumption of a unidirectional causality, from

interest rates to stock returns, which is commonly used in economic literature. More importantly, we detect evidence of bidirectional causality-in-variance effects between Greek long-term bond yields and the banking sector equities of Portugal, Italy, and Spain, which emerged after the onset of the debt crisis. Our findings on the complex linkage between the public sector debt and the banking sector are of great importance for both bank managers and regulators in the region. In particular, the empirical results may suggest the need to monitor volatility spill-overs between government bonds of one country, faced with increasing sovereign risks, and the banking sector stocks of a neighbouring country, in order to prevent cross-country contagion effects.

Chapter 5 is titled 'Causality between the US dollar and the euro LIBOR-OIS spreads'. This chapter empirically analyses causality-in-mean and causality-in-variance between the USD and EUR LIBOR-OIS spreads, which are viewed as measures of liquidity stress and credit risk, in the interbank markets. We apply the cross-correlation function approach of Hong (2001) to examine the lead-lag relationships of mean and volatility transmissions. During the global financial crisis, we find not only significant bidirectional mean transmissions between the two spreads, consistent with the results of previous studies, but also significant unidirectional volatility transmissions from the EUR to the USD spread. The identified difference underscores the importance of policymakers to monitor causality-in-variance between the spreads, as it can capture information flow in the interbank markets and thus represent potential root causes of apparent instability. Moreover, we detect no significant causality at the mean and variance levels between the spreads during the debt crisis period. This provides support for the view that several of the measures that the European Central Bank (ECB) took to boost liquidity in the wake of the debt crisis were effective at least in terms of eliminating contagion effects in the interbank markets, as reflected in the no-causality observed between the LIBOR-OIS spreads.

Chapter 6 is titled 'Causality between the Euro and Greek sovereign CDS spreads'. This chapter examines the causal relationships between the value of the EUR and the Greek sovereign credit default swap (CDS) spreads, with the 3-month EUR LIBOR as a control variable. We employ the lag-augmented VAR (LA-VAR) methodology of Toda and Yamamoto (1995) to test for long-run Granger-causality between the series and then adopt the generalized impulse response function (G-IRF) analysis of Koop et al. (1996) and Pesaran and Shin (1998) to assess short-run effects in responses to shocks. We find evidence of significant causality from the EUR to the Greek sovereign CDS spreads during the debt crisis period, which is reinforced by the G-IRF analysis. Throughout the sample period, no significant causality from the Greek CDS spreads to the EUR is identified, while the EUR LIBOR significantly Granger-causes the EUR. Our findings imply that policymakers should be aware of potential transmission effects from variability in the exchange rate to the sovereign CDSs in times of market turbulence. It is also suggested that from the traders' perspectives, the Greek sovereign CDS spreads are a less valuable indicator than the EUR LIBOR for predicting EUR exchange rate movements.