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Systemic risk of European financial institutions: Estimation and ranking by the Marginal Expected Shortfall

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ABSTRACT

The task of processing systemic events and its negative externalities requires approaches to measure systemic risks and break it down into contributions of different institutions. The main objective of the present paper is to estimate the systemic risk of European banks following the financial crisis of 2007. To do so, we estimate the systemic risk of a sample composed of 281 financial institutions grouped in 16 European countries during the period from January 01, 2006 to December 31, 2012. We use the Marginal Expected Shortfall (MES) to measure systemic risk. The empirical results show that the systemic risk supported by European banks is very high. Moreover, the contribution of financial institutions in the risk of their system is very important as a result of the high correlation between institution returns and market returns. This correlation is measured by DECO-GARCH (1,1) introduced for the first time to assess systemic risk of financial institutions. This high level of systemic risk prompted the international authorities to intervene, as is the case of the countries of the Euro zone, where the International Monetary Fund, the European Central Bank and the World Bank intervened but did not lead to a permanent solution to limit the accumulation of systemic risk.

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1. Introduction

The recent financial crisis has emphasized the importance of contagion and systemic risk, defined as the risk which can influence the stability of the financial system as a whole. For instance, the economic aggregates such as interest rates, trade structure, inflation rates, industrial production, regional effects, and investors' risk aversion contribute to international contagion (Luchtenberga and Vu, 2015). To observe the impact of contagion on the risk perception of financial market, we can refer to the study of Chevapatrakul and Tee (2014). They find that the contagion effects in the United Kingdom support the argument that spreads and contagion are solely a consequence of the behavior of investors or other financial market participants throughout the financial crisis period between 2007 and 2009. This contagion has highlighted the fragility of the international financial system under several respects, especially the US and the European financial systems. These financial fragilities can be used to identify macroeconomic and financial turbulences over both short and long term horizons (Bagliano and Morana, 2014). The succession of the financial fragilities, such as, the collapse of the US investment bank Lehman Brothers

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on September 15, 2008, the discovery of the debt ratio and excessive deficit of Greece and many European countries have a significant impact on the failure of many financial institutions. These failures have had a significantly positive effect on the propagation of systemic events.

The failure of some financial institutions such as Lehman Brothers, Northern Rock and HRE after the financial crisis of 2007 showed that the failure of a single firm may have a negative and drastic impact on the financial system as a whole. Therefore, the approach of a specific firm or micro-prudential regulation is not sufficient to promote the financial stability. Careful evaluation of the contribution of a financial company in the systemic risk should be an important part in the macro-prudential financial supervision (Puzanova and Düllmann, 2013).

The risk which refers to a financial system as a whole is often treated as a systemic risk. This term was defined as the risk of financial collapse with a loss in the overall system. The identification of systemic risk is the first step to assess it accurately. However, despite the ever increasing number of studies regarding this issue, there is still no agreement over unique systemic risk identification. For example, Kaufman (1995) describes the systemic risk as the risk of occurrence of a chain reaction of bankruptcies. The European Central Bank (ECB, 2004), on the other hand, defines it as the probability that the default of one financial institution will make other financial institutions default. This risk interdependence would harm liquidity, credit and the stability and confidence of the markets. Acharya et al. (2009) find that systemic risk may be seen as generalized bankruptcies or capital market freezing, which may cause a substantial reduction in financial intermediation activities.

The task of processing systemic events and its negative externalities requires many approaches to measure systemic risk and break it down into contributions of different institutions. In addition, the macro-prudential approach will be based on measurements of the magnitude of the potential loss or the cost associated with systemic events on procedures for the establishment of an adequate capital base in the financial system that absorbs this cost.

The financial regulations require micro-prudential and macro-prudential implementations to limit systemic risk and their negative externalities. The main implementations proposed by the Board of Governors are risk based capital requirements, leverage limits, liquidity requirements, resolution plan and credit exposure report requirements, concentration limits, a contingent capital requirement, enhanced public disclosures, short term debt limits, and overall risk management requirements. In addition, the application of these prudential regulations needs the identification and the measurement of the systemic risk.

The systemic risk measures took into account the risk of extreme losses for a financial company in the event of market disruption. Many methods of assessing systemic risk and the contribution of risk were discussed in the financial literature. Several recent approaches have been developed to detect the extreme risk of a financial system by examining the direct and indirect links of the financial sector.

This paper contributes to the systemic risk indicator building literature in several ways. First, we use market data which reflect the real financial situation of each institution. Market data becomes relevant when analyzing financial system stability when Credit Default Swaps (CDS), stocks and other public information are not available for every financial institution. Then, this paper expands the applicability of the measures proposed by Acharya et al. (2010) including the analysis of the systemically important financial institutions. In addition, the systemic risk is measured by the Marginal Expected Shortfall (MES). The estimation of the MES is obtained by recording to the application of the DECO-GARCH (1,1) proposed by Engle and Kelly (2009) focusing on the problem of reducing the scale of estimation by the DCC-GARCH (1,1). The resolve of this problem is called Dynamic Equicorrelation GARCH models (DECO-GARCH), which reduces the sample risk caused by large scale covariance matrix.

The purpose of this paper is to measure the systemic risk of European banks. This objective is a quantification of the propagation of default in European banking systems mainly during the period following the financial crisis of 2007. Then, we use the Marginal Expected Shortfall (MES) to estimate the systemic risk of a sample composed of 281 European financial institutions which belong to 16 European countries during the period from January 01, 2006 to December 31, 2012. So, we present a descriptive analysis of the systemic risk indicators as measured by the MES and we proceed to the ranking of European financial institutions based on the level of their contributions on the systemic risk of their financial systems. These rankings concern only the top 50 of the systemically important financial institutions in the Euro zone.

The remaining of this paper is organized as follows; in Section 2, we report the literature review of systemic risk measurement, Section 3 describes the overview of systemic risk in the world, Section 4 presents the econometric methodology, Section 5 summarizes data characteristics used in this study. In Section 6, we analyze and interpret the empirical results. Finally, Section 7 provides the concluding remarks.

2. Literature review

To measure systemic risk, Lehar (2005) proposes a methodology derived from correlated multi-assets portfolios. He employs the structural approach and uses the contingent claims analysis to estimate the market value of a bank's assets. Then, he uses the Monte Carlo simulations to encounter the probability of these multi-assets portfolios lessening below a given proportion of the total assets of the whole financial system.

Similarly, Gray et al. (2008) use the contingent claims analysis to present a general form of systemic risk measurement between countries and various sectors of the economy.

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