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Systemic risk measures: The simpler the better?

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ABSTRACT

This paper estimates and compares two groups of high-frequency market-based systemic risk measures using European and US interbank rates, stock prices and credit derivatives data from 2004 to 2009. Measures belonging to the macro group gauge the overall tension in the financial sector and micro group measures rely on individual institution information to extract joint distress. We rank the measures using three criteria: (i) Granger causality tests, (ii) Gonzalo and Granger metric, and (iii) correlation with an index of systemic events and policy actions. We find that the best systemic measure in the macro group is the first principal component of a portfolio of Credit Default Swap (CDS) spreads whereas the best measure in the micro group is the multivariate densities computed from CDS spreads. These results suggest that the measures based on CDSs outperform measures based on interbank rates or stock market prices.

1. Introduction

Systemic risk appears when generalized malfunctioning in the financial system threatens economic growth and welfare. The causes of this malfunction are multiple and therefore a single measure of systemic risk may neither be appropriate nor desirable. The financial system plays a fundamental role in the global economy as the middleman between both agents who need to borrow and those who are willing to lend or invest and is naturally linked to all economic sectors therefore, if the financial system does not work properly, its problems have a strong impact on the real economy. For this reason, policymakers, regulators, academics and practitioners should pay close attention to the soundness and stability of this sector.

The causes of malfunctions can be related to multiple mechanisms such as macro imbalances (e.g. excessive credit expansion in the private or public sector), correlated exposures (e.g. herding behavior), contagions, asset bubbles, negative externalities (e.g. banks too big to fall) or information disruptions (e.g. freezes in the interbank market). Given this lengthy but incomplete list of possible mechanisms influencing systemic risk, it seems safe to posit that more than one risk measure is needed to capture its complex nature, in particular, that policymakers charged with the responsibility of ensuring financial stability should rely on a wide array of measures. These measures should detect at least two kinds of situations and cover two different groups of potential systemic risk's detectors. They should warn of a persistent build-up of imbalances within the financial sector or be able to capture the abrupt materialization of systemic risk. With regard to the potential systemic risk's group detector, measures should be based on the aggregate market level (e.g. interbank rates, stock market and CDS indexes) or at the level of individual institutions. For the sake of clarity we will refer to those groups as macro and micro group, respectively. These kinds of indicators should be underpinned by measurable patterns of systemic stability which form the basis for early warning and correcting. If a systemic risk measurement indicates that destabilizing systemic events are looming, preventive policies such as stricter financial regulation and more rigorous supervision may be justified.

In the years leading up to the crisis in August 2007, we witnessed some of the above mentioned malfunctions. Explosive growth in the US subprime market, unprecedented increase in credit in private sector in the UK, Ireland and Spain, generalized external imbalances in many Western countries and of course, once the crisis started, the Lehman Brothers bankruptcy and persistent stress in the European and US banking sectors are examples of the most salient events. As a consequence, from 2007 to 2009,

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macroeconomic indicators such as real GDP growth or government deficits were strongly eroded in many countries.[1]

Measuring systemic risk has been addressed from a wide variety of perspectives (see surveys by De Bandt and Hartmann (2000), Acharya et al. (2010) and International Monetary Fund (2011)). Essentially, two types of indicators are suggested: first, slow moving low-frequency indicators based on balance sheet aggregates or macroeconomic data and second, high-frequency indicators based on market prices and rates. However, little is known of the relative quality of the different measures. In this paper we focus on systemic risk measures based on high-frequency, market-based indicators (daily prices and rates) for the two potential systemic risk's group detectors mentioned above (aggregate market or macro and individual institution or micro). The measures we study in this paper are near-coincident indicators of financial stress and could be useful in alerting regulators of imminent and serious strains on the financial system.

The selection of the financial institutions to be included in the study is a critical issue. Billio et al. (2010) found that banks may be more central to systemic risk than non-bank financial institutions engaging in banking functions. Tarashev et al. (2010) convincingly argued that larger size implies greater systemic importance, that the contribution to system-wide risk increases disproportionately to relative size, and that a positive relationship between size and systemic importance leads a robust result. Thus, we restrict our sample to the biggest banks according to the size's criteria proposed by the BIS, IMF and FSB (2009). Thereby concentrating on some of the most important systemic actors: the biggest banks in the two main economic areas (the Western Europe and the US). Our sample spans from January 2004 to November 2009 and comprises the 20 biggest European and 13 biggest US banks.[2]

We employ two groups of measures. The first group gauges the overall tension in the financial sector and the second relies on individual institution information to extract joint distribution distress at portfolio level. The set of measures in the first category (macro) are (i) the LIBOR spreads (LS), (ii) the principal component analysis (PCA) of portfolios of CDS spreads, and (iii) the systemic factor extracted from the CDS indexes (CDX and iTraxx) and their tranches. The measures in the second group (micro) are (i) the systemic risk index (SI) based on structural credit risk models, (ii) the multivariate densities (MD) computed from groups of individual bank's CDS spreads, and (iii) the aggregate of individual co-risk (CR) measures. All the above measures belong to different branches of literature and in most cases systemic risk is measured using alternative specifications. So, for every measure we consider all these alternative categories. The comparison procedure is as follows. We first select the best performing category within each measure using their correlation with an index of systemic events and policy actions as the basic criterion. For instance the LS measure contains two categories, the LIBOR-OIS and the LIBOR-TBILL. The former has the highest correlation with the index and therefore it is the one we use for the subsequent analysis. We then compare the best performing categories within each group using two additional criteria: (i) Granger causality tests, and (ii) Gonzalo and Granger (GG) metric. The first criterion gives information about whether measure X is a leading indicator of measure Y. The second criterion relates to each measure with a common component, which may be interpreted as the underlying systemic risk trend in the economy. The intuition is that if measure X contributes to this common component to a greater extent than measure Y, X is preferable. The performance of each measure is judged by their scores on each of the three criteria. For instance, to rank the measures according to the Granger causality test we give a score of +1 to measure X if X Granger-causes measure Y and we give a score of -1 to X if X is caused in the Granger sense by Y. By doing this, the best measure gets the highest positive score and the worst measure the highest negative score. We apply the same procedure to the correlation index and the GG metric. We then add the scores provided by the three criteria for each measure.

We find that the best high-frequency, market-based systemic risk measure based on the macro group, in both US and in Europe portfolios, is simply the first principal component of a portfolio which contains the CDS of the main banks (PCA). The worst measure is the one based on the LIBOR-OIS spread. The best measure based on micro group in both economic areas is the multivariate densities (MDs) again based essentially on bank's CDS and the worst is the aggregate of co-risk (CR) measures. According to these results, measures based on credit derivatives (CDSs) seem to perform better than measures based on interbank rates or stock market prices. Therefore the high-frequency credit derivatives market-based measures are the best indicators in our sample to warn that a systemic event or crisis is close at hand. This result holds both in the case of measures in the macro group as well as those measures in the micro group. It certainly seems that signals of impending financial distress that come from the CDS market are clearer and louder than the ones coming from other markets.

The paper is divided into six sections. Section 2 reviews literature and presents the systemic risk measures. Section 3 describes the data set. Section 4 summarizes the empirical estimates of the systemic risk measures. In Section 5, we compare the measures using three criteria. Section 6 outlines some suggestions for policymakers and concludes.

2. Literature review

Until recently, risk management in the financial industry has usually focused on individual institution's market, credit and operational risks and ignores systemic risk. In this vein, the Basel I (1988) and Basel II (2004) Capital Accords advise risk management policy on the basis of the banks' portfolios, ignoring interconnection among banks. However, as the 2007–2009 crisis has shown, this firm-specific perspective is not sufficient to appropriately ensure the soundness of the financial system. This is because the risk it poses the system is greater than the sum of the risk faced by individual institutions.[3] Nevertheless, this issue was addressed in the new Basel III (2011) Accord in which capital buffers were improved (quality and quantity) and a macro-prudential overlay proposed to deal with systemic risk.

[1] For instance, the annual GDP growth rate decreased from 3.09% in 2007 to −4.09% in 2009 in the European Union while in the US this rate decreased from 2.14% to −2.45%. Regarding the government deficits, they dramatically increased from 0.8% in 2007 to 6.7% in 2009 in the European Union, and in the same period, US government deficits increased from 1.14% to 9.9%. Meanwhile, in the same period the unemployment rate increased from 7.8% in January 2007 to 9.4% in November 2009 in the European Union and from 4.6% to 10% in the US during the same period.

[2] Regarding the relative size of systemic risk in large European and US banks, ex-ante it is not easy to say much about its size because measures have to be contextualized. The question should be how much systemic risk is the banking sector able to assume before collapsing. Given that systemic risk measures cover a sufficiently long time (which cover tranquil periods and systemic events) we can use these measures to estimate the thresholds that determine different stress regimens. For instance, on the basis of econometric tools such as thresholds-VAR models the different regimes (normal times, stress times) of the time series can be identified. When a given measure rises above the critical value separating the two regimes, the regulator should carry out an assessment of the situation. Additionally, depending on the measures on stress (i.e., aggregate vs. individual institution level) the policy actions should differ. At the aggregated level macro measures may be called for (interest rates moves, restrictions on aggregate credit growth) whereas at the individual institution level tailored measures are more appropriate (new equity issuances, restrictions on specific trading activities) to decrease the stress

[3] See speech by Jaime Caruana, General Manager of the Bank for International Settlements, "Basel III: towards a safer financial system" September 2010.