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Econometric measures of connectedness and systemic risk in the finance and insurance sectors[☆]

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ABSTRACT

We propose several econometric measures of connectedness based on principal-components analysis and Granger-causality networks, and apply them to the monthly returns of hedge funds, banks, broker/dealers, and insurance companies. We find that all four sectors have become highly interrelated over the past decade, likely increasing the level of systemic risk in the finance and insurance industries through a complex and time-varying network of relationships. These measures can also identify and quantify financial crisis periods, and seem to contain predictive power in out-of-sample tests. Our results show an asymmetry in the degree of connectedness among the four sectors, with banks playing a much more important role in transmitting shocks than other financial institutions.

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1. Introduction

The Financial Crisis of 2007–2009 has created renewed interest in systemic risk, a concept originally associated

with bank runs and currency crises, but which is now applied more broadly to shocks to other parts of the financial system, e.g., commercial paper, money market funds, repurchase agreements, consumer finance, and

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Over-The-Counter (OTC) derivatives markets. Although most regulators and policymakers believe that systemic events can be identified after the fact, a precise definition of systemic risk seems remarkably elusive, even after the demise of Bear Stearns and Lehman Brothers in 2008, the government takeover of American International Group (AIG) in that same year, the “Flash Crash” of May 6, 2010, and the European sovereign debt crisis of 2011–2012.

By definition, systemic risk involves the financial system, a collection of interconnected institutions that have mutually beneficial business relationships through which illiquidity, insolvency, and losses can quickly propagate during periods of financial distress. In this paper, we propose two econometric methods to capture this connectedness – principal components analysis and Granger-causality networks – and apply them to the monthly returns of four types of financial institutions: hedge funds, publicly traded banks, broker/dealers, and insurance companies. We use principal components analysis to estimate the number and importance of common factors driving the returns of these financial institutions, and we use pairwise Granger-causality tests to identify the network of statistically significant Granger-causal relations among these institutions.

Our focus on hedge funds, banks, broker/dealers, and insurance companies is not coincidental, but is motivated by the extensive business ties between them, many of which have emerged only in the last decade. For example, insurance companies have had little to do with hedge funds until recently. However, as they moved more aggressively into non-core activities such as insuring financial products, credit-default swaps, derivatives trading, and investment management, insurers created new business units that competed directly with banks, hedge funds, and broker/dealers. These activities have potential implications for systemic risk when conducted on a large scale (see Geneva Association, 2010). Similarly, the banking industry has been transformed over the last ten years, not only with the repeal of the Glass-Steagall Act in 1999, but also through financial innovations like securitization that have blurred the distinction between loans, bank deposits, securities, and trading strategies. The types of business relationships between these sectors have also changed, with banks and insurers providing credit to hedge funds but also competing against them through their own proprietary trading desks, and hedge funds using insurers to provide principal protection on their funds while simultaneously competing with them by offering capital-market-intermediated insurance such as catastrophe-linked bonds.

For banks, broker/dealers, and insurance companies, we confine our attention to publicly listed entities and use their monthly equity returns in our analysis. For hedge funds – which are private partnerships – we use their monthly reported net-of-fee fund returns. Our emphasis on market returns is motivated by the desire to incorporate the most current information in our measures; market returns reflect information more rapidly than non-market-based measures such as accounting variables. In our empirical analysis, we consider the individual

returns of the 25 largest entities in each of the four sectors, as well as asset- and market-capitalization-weighted return indexes of these sectors. While smaller institutions can also contribute to systemic risk,⁴ such risks should be most readily observed in the largest entities. We believe our study is the first to capture the network of causal relationships between the largest financial institutions across these four sectors.

Our empirical findings show that linkages within and across all four sectors are highly dynamic over the past decade, varying in quantifiable ways over time and as a function of market conditions. Over time, all four sectors have become highly interrelated, increasing the channels through which shocks can propagate throughout the finance and insurance sectors. These patterns are all the more striking in light of the fact that our analysis is based on monthly returns data. In a framework where all markets clear and past information is fully impounded into current prices, we should not be able to detect significant statistical relationships on a monthly timescale.

Our principal components estimates and Granger-causality tests also point to an important asymmetry in the connections: the returns of banks and insurers seem to have more significant impact on the returns of hedge funds and broker/dealers than vice versa. This asymmetry became highly significant prior to the Financial Crisis of 2007–2009, raising the possibility that these measures may be useful out-of-sample indicators of systemic risk. This pattern suggests that banks may be more central to systemic risk than the so-called shadow banking system. One obvious explanation for this asymmetry is the fact that banks lend capital to other financial institutions, hence, the nature of their relationships with other counterparties is not symmetric. Also, by competing with other financial institutions in non-traditional businesses, banks and insurers may have taken on risks more appropriate for hedge funds, leading to the emergence of a “shadow hedge-fund system” in which systemic risk cannot be managed by traditional regulatory instruments. Yet another possible interpretation is that because they are more highly regulated, banks and insurers are more sensitive to value-at-risk changes through their capital requirements, hence, their behavior may generate endogenous feedback loops with perverse externalities and spillover effects to other financial institutions.

In Section 2 we provide a brief review of the literature on systemic risk measurement, and describe our proposed measures in Section 3. The data used in our analysis are summarized in Section 4, and the empirical results are reported in Section 5. The practical relevance of our measures as early warning signals is considered in Section 6, and we conclude in Section 7.

⁴ For example, in a recent study commissioned by the G-20, the International Monetary Fund, Bank for International Settlements, and Financial Stability Board (2009) determined that systemically important institutions are not limited to those that are the largest, but also include others that are highly interconnected and that can impair the normal functioning of financial markets when they fail.

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