



Industry characteristics and financial risk contagion



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ABSTRACT

This article proposes a new measure of tail risk spillover: the conditional coexceedance (CCX), defined as the number of joint occurrences of extreme negative returns in an industry, conditional on an extreme negative return in the financial sector. The empirical application provides evidence of significant volatility and tail risk spillovers from the financial sector to many real sectors in the U.S. economy from 2001 to 2011. These spillovers increase in crisis periods. The CCX in a given sector is positively related to its amount of debt financing and negatively related to its valuation and investment. Therefore, real economy sectors—which require relatively high debt financing and whose value and investment activity are relatively lower—are prime candidates for stock price volatility and depreciation in the wake of a financial sector crisis. Evidence also suggests that the higher the industry's degree of competition, the stronger the tail risk spillover from the financial sector.

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1. Introduction

In many countries, the financial sector is a key funding source for industrial and service (i.e., real economy) firms with limited internal funds. Intuitively then, real economy firms' risk and return should be strongly affected by the vagaries of the financial sector—in particular, its profitability and stability. The financial crisis of 2007–2009 illustrates a situation in which acute distress in the financial sector caused a severe credit crunch, with devastating effects on the real economy. Therefore, it is not surprising that the links between the financial sector and real economy sectors have been widely explored. Previous literature has focused on

industrial real output (see Rajan and Zingales, 1998),¹ stock market returns (Baur, 2011),² and the links between other measures of returns and profitability. However, the linkage between risk in the financial sector and that in the real economy sector has received little attention so far. This is surprising, given the aforementioned evidence from the 2007–2009 financial crisis. This article is an attempt to fill this literature gap with two contributions: a new measure of

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¹ Rajan and Zingales (1998) point out that the industry's growth is related to its dependence on external sources of finance, stemming from industry-specific technological factors, which can affect initial project scale, gestation period, cash-harvest period, and further investment needs. Accordingly, an extensive body of literature tests the impact of banks on the real economy at country, industry, and firm levels across countries and over time (Beck et al., 2000; Beck and Levine, 2002, 2004; Cetorelli and Gambera, 2001; Chava and Purnanandam, 2011; Cole et al., 2008; Claessens and Laeven, 2005; Dell'Ariccia et al., 2008; Hoggarth et al., 2002; Kroszner et al., 2007; Levine, 2005; Vives, 2001).

² Baur (2011) finds that the 2007–2009 crisis led to an increased comovement of returns among financial sectors' stocks across countries and between the financial sector's and real economy sector's stock returns.

tail risk spillovers and some empirical evidence on this important subject.

We explore the extent to which the financial industry's risk spills over to industrial and service sectors' risk from several perspectives. First, we determine whether risk spillover from the financial sector to real economy sectors existed over the past decade and to what extent the intense distress of the financial sector in the 2007–2009 financial crisis affected it. Second, we consider both volatility and tail risk spillover, because they provide different insights on risks. Note that whereas volatility characterizes dispersion from average returns, tail risk focuses on the left tail of the return's distribution. Third, we investigate whether tail risk spillover is affected by the real economy sector's product market structure (competition versus concentration). Fourth, we investigate whether the tail risk spillover is driven by three industry characteristics: net debt financing, valuation, and investment. These characteristics are closely related to the industry's investment opportunities and future perspectives.

Furthermore, we develop a new proxy for capturing financial tail risk spillover: conditional coexceedance (CCX). The CCX measures the frequency of simultaneous extreme negative stock returns in the financial and real economy sectors. We also compute probabilities of tail risk spillover at the industry level over time, distinguishing crisis and non-crisis periods. Finally, we study the determinants of the CCX measure in terms of the industry's structural characteristics. We use U.S. stock market data for 2001–2011. The main empirical results are as follows: (1) Increases in financial industry's volatility and tail risk cause corresponding increases in the real economy sector's risk variables, and the effect of this spillover is stronger during a financial crisis period. (2) The tail risk spillover from the financial sector to the real economy sector, as measured by the CCX, is stronger if the real economy industry is more competitive, uses a high proportion of net debts, and has a relatively low level of valuation and investments.

The study is related to several strands of literature. Our results are consistent with [Diebold and Yilmaz \(2012\)](#) in the sense that the financial sector's volatility generally increases sharply and spills over to other economic sectors in times of financial distress.³ Furthermore, our study pertains to tail risk dependence (e.g., [Bae et al., 2003](#)), in that we introduce the CCX measure and document the financial sector's role in affecting the industrial sector's tail risk. We document a risk increase in real economy sectors stemming from increases in the instability of the financial sector and the consequent negative impact on the economy, in line with [Kroszner et al. \(2007\)](#). Moreover, while recent evidence supports the view that the intensity of competition in a given industry has significant implications for firms' cash flows and stock returns ([Hoberg and Phillips, 2010](#); [Hou and Robinson, 2006](#)), the significant effect of the degree of competition on the linkage of tail risks between the real economy and financial sectors is a novel result. Finally, we provide a possible reason for the higher risks of highly competitive industries ([Valta 2012](#)): their tail risk connection with the financial sector.

In summary, our contributions to literature are as follows. First, we develop novel empirical methodologies for testing the effect of volatility and tail risk spillover from the financial to the real economy sectors before and during the 2007–2009 financial crisis. Second, our empirical analysis in the U.S. market over the preceding decade confirms that risk spillovers (in both volatility and tail risk dependence) increased during the crisis period. Third, we relate the financial risk spillover measure CCX to the real economy industry's product market structure, investment opportunities, and valuation. Finally, we empirically document that the effect of the real economy industry characteristics on tail risk spillover measures exhib-

its variation across industries: It is stronger for industries that face more competitive product markets, use higher net debts, and have lower levels of valuation and investment.

The study in turn provides two key implications. First, our findings demonstrate the close connection between the financial and real economy sectors. This result is important for practitioners, because it supports the view that difficulties in the financial sector are, sooner or later, followed by large increases in uncertainty in other industries. Second, our CCX-based results imply that the financial sector's extreme returns are a concurrent indicator of real economy sectors' extreme returns. Therefore, our CCX measure can provide warning signals of impending turmoil in stock prices of real economy firms when a financial crisis materializes. Policy makers and regulators interested in evaluating the economic costs of financial crises should find our results useful. In particular, one of the Basel III capital accord's key objectives is to reduce the risk of spillover from the financial sector to the real economy. Given that the purpose of Basel III norms is to reduce the frequency and severity of these spillovers, our modeling approach could be used to assess their effectiveness. Finally, because real sectors, which require debts and whose value and investment activity are relatively lower, are prime candidates for depreciation in the wake of the financial sector crisis, investors can benefit from our findings as well.

The remainder of the paper proceeds as follows. The next section discusses how risk spillover and industry characteristics interact. Section 3 addresses empirical methodologies. Section 4 introduces the database and construction of the industry characteristic variables. Section 5 discusses the empirical results. Section 6 describes robustness tests, and Section 7 concludes with a discussion of limitations and suggestion for further research.

2. Risk spillover and industry characteristics

2.1. Volatility spillover

Evidence regarding the extent to which risk increases in the financial sector spill over to risk increases in industrial sectors is relatively scarce. [Houston and Stiroh \(2006\)](#) find that in the U.S. economy, the financial sector's volatility has had a significant and negative impact on economic growth from 1985 to 1994.⁴ Noting volatilities, [Wang \(2010\)](#) shows that the financial sector's volatility leads non-financial sectors' in the U.S. market from 1963 to 2008, and [Cheong et al.'s \(2011\)](#) results support this view in the United Kingdom's economy from 1990 to 2010. However, to our knowledge, there is no evidence from other economic areas or time periods.

A related question is whether the 2007–2009 financial crisis affected the risk spillover mechanism from the financial sector to the real economy. If a sudden loss occurs within the financial system, its contractionary impact on real economy sectors is bound to be strong (see [Kroszner et al., 2007](#)). The 2007–2009 crisis has led to an increased comovement between the financial sector's and real economy's stock returns ([Baur, 2011](#)). Recent evidence indicates that the 2007–2009 financial crisis has had a negative impact on industrial sectors' investment activities ([Campello et al., 2010](#)).⁵ Finally, the shortage of external funding weakens firms' operating flexibility during crisis periods because firms face budget constraints, reducing their investments and thereby increasing their equity risk ([Ortiz-Molina and Phillips, forthcoming](#)). In line with previous evidence, we hypothesize:

⁴ It was a turbulent period for the U.S. banking sector. Large banks suffered huge losses from loans to developing countries. Savings and loans failures peaked in 1988 and 1989.

⁵ They report that 86% of U.S. chief financial officers canceled or postponed attractive investment opportunities because they were unable to borrow externally.

³ The leading role of the financial sector with respect to aggregate volatility is also documented in [Houston and Stiroh \(2006\)](#), [Wang \(2010\)](#), and [Cheong et al. \(2011\)](#).

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