



Study on the contagion among American industries



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HIGHLIGHTS

- The non-linear detection method is used to determine the length of moving window.
- Applying transfer entropy to investigate information flows among industries for every window.
- Exploring the contagion process among industries from the perspective of information flow.
- The contagion process does indeed exist among American industries during the sub-prime crisis.
- The sector trading volume correlation is the fundamental reason of the crisis contagion.

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ABSTRACT

Using a sliding window to scan through every industry index from 2 Jan 2003 to 26 Dec 2013 and transfer entropy to investigate information flow among sectors, we figure out corresponding industry's transfer entropy matrix in every given window. Next, a further analysis of information flow's variations between industries is carried out. Finally, we also use daily trading volumes of each group to carefully analyze trading volume correlation between sectors. The obtained facts are as follows. First, as crisis intensified, the amount of information flow between industries continues to grow and finally reaches a peak over full-outbreak periods. Second, Financial sector always has large output transfer entropy, and before January 2007, the main information flow is from Financial sector to Non-Daily consumption, Energy, Raw material and Industrial sectors while around 12 April 2007, it has changed from Energy, Raw material and Industrial groups to Telecom, Daily consumption, Public utilities and Health care industries. Thus, Financial industry is the arch-criminal and it seriously affects Non-Daily consumption, Energy, Raw material and Industrial groups. Later, Telecom, Daily consumption, Health care and Public utilities industries are all plunged into the crisis, and financial crisis sweeps all the industries eventually. Besides, we also find that trading volume correlation is the fundamental reason of crisis propagation.

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1. Introduction

Over the past twenty years, the importance of the domestic stock market in many industrialized economies has grown sharply, while at the same time the frequency of suffering financial crisis seems to be higher. In the last decade or so, stock markets were hit by a series of crises: the 1997 East Asian crisis, the 1998 Russian collapse, the 1999 Brazilian devaluation,

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the 2000 technological crisis, the 2007 US sub-prime mortgage crisis and the 2009 European debt crisis. On the one hand, this increasing financial crisis can be attributed to the enhanced market integration in relation to the close economic and financial links. However, on the other hand, market integration may not fully interpret such financial crisis, and contagion may, in part contribute to it. As we all know, a noticeable feature in a stock market or among markets, during crises, is that stock price tends to move more closely together compared to tranquil times. Such intense co-movement is frequently referred to as contagion. Evaluating if contagion occurs in a stock market and understanding its origin is significant for policy-makers and fund managers to diversify risks. If contagion prevails in times of crises, the benefits of asset diversification will be blocked when they are mostly needed.

Many papers have studied the contagion effect on the stock markets and almost aim at two aspects [1–10]. First, lots of scholars focus on the empirical evidence at the market level and examine whether contagion exists across markets. The question they try to answer is whether idiosyncratic shocks from one particular market are transmitted to the other markets during financial crises. The second aspect is why these crises could propagate among stock markets. For example, Van's team presented evidence that spillovers through bank lending, as opposed to trade linkages and country characteristics, could help to explain contagion [1]. Longstaff investigated the sub-prime credit crisis and contagion in financial markets, and acquired that financial contagion is propagated primarily through liquidity and risk-premium channels [2]. Using the approach of network, Eugene Stanley's group also measured the systemic risk of three major world shipping markets (the new ship market, the second-hand ship market, the freight market), they obtained that all the market sectors tend to be more closely linked during financial crisis [3]. Although here we have had a full understanding about the risk contagion among international markets, but what is the contagion mechanism inside the stock market on earth is still puzzling us. In this paper, we take a different perspective and explore the risk contagion at the dis-aggregated sector level in American stock market, an issue which has not yet been examined totally in the literature. The question we endeavor to answer is whether unexpected turbulence inside a stock market, caused by any major events, will be propagated among sectors and what caused this propagation.

Studying the contagion effect at sector level is important for several reasons. First, sector contagion can be asymmetric. From the point view of portfolio management, the sector heterogeneity of contagion implies that there are sectors which can still provide a channel for achieving the benefits of asset diversification during crises despite the prevailing contagion at the sector level. Thus, a good comprehension of sector contagion is very important for investors to have a good investment direction and risk aversion. And policy-makers may be also very interested in risk contagion among sectors because of its implication for the stability of the domestic stock market. Secondly, as we all know, nowadays the most recognized industry classification schemes incorporate the Standard Industry Classification (SIC), North American Industry Classification System (NAICS) and Global Industry Classification Standard (GICS). However, these schemes' rationale has been questioned by more and more scholars. For instance, see Clarke [11], Guenther and Rosman [12], Kahle and Walkling [13], Fan and Lang [14], Krishnan and Press [15], Bhojraj et al. [16] and Brickley et al. [17]. Full understanding on the sector co-movement root and contagion process can also provide a reasonable basis for the demarcation of industries. Finally, through random matrix theory (RMT), Eugene Stanley's team investigated the functional structure of financial markets (the Sector Dominance Ratio (SDR)), and they proposed the SDR as an indicator for changes in VIX indexes [18]. Thus, it is extremely important for all of the market participants to understand the contagion at sector level and realize its relation with the sector correlation. But these questions are still open.

Fortunately, the importance of industry/sector analysis is also highlighted in other researches. Campbell et al. divided the firms' returns into market, industry and firm specific components to study the volatility at the market, industry and firm levels [19]. They have obtained that all three volatility measures increase substantially in economic downturns and tend to lead recessions. The volatility measures, particularly the industry-level volatility, help to forecast economic activity and reduce the significance of other commonly used forecasting variables, such as market returns and lagged GDP growth rates. Phylaktis's team also takes an asset pricing perspective to investigate the equity market co-movement and contagion at the sector level during the period 1990–2004 across the regions of Europe, Asia and Latin America [20]. They confirm the sector heterogeneity of contagion. Furthermore, Moskowitz and Grinblatt show that industry momentum strategies are profitable and suggest the existence of time-varying industry risk premium [21]. Such results all seem to be very perfect, but we can also find that there is still no consensus on the exact definition of contagion (co-movement) in the literature. Therefore, choosing a suitable and effective measure is still a problem that needs to be solved and to further study the connection between sector correlation and crisis propagation.

In this paper, we will investigate the risk contagion (co-movement) among American industries from the perspective of information flow—that is, by analyzing the information flow variations between all sectors, we obtain the entire risk contagion process. Basically speaking, underlying the sector interaction, there exist various flows, such as the information flow, cash flow, labor force flow and so forth. And these flows result in volatility spillover among stocks, sectors and markets. For a simple example, the real estate crisis means that overmuch commercial housing of developers cannot be sold out so that lots of real estate companies' capital chains break down and turn to collapse. On the other hand, the companies' capital always comprises large bank debt. That is to say, the fracture of capital chain of real estate companies will raise the amount of bank losses and lead to the bank crisis. Therefore, the spread of the crisis is actually the transmission of information and this is the first contribution of this paper. The second contribution is the focus on studying the relation between the sector correlation and contagion. In other words, we further try to answer “why the crisis propagates like this?” Luckily, we got some meaningful results and they will give us more detailed understandings about the contagion between industry groups.

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