The Quarterly Review of Economics and Finance xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

The Quarterly Review of Economics and Finance

journal homepage: www.elsevier.com/locate/qref

Intraday industry-specific spillover effect in European equity markets

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ARTICLE INFO

Article history:
Received 17 August 2013
Received in revised form 12 February 2016
Accepted 15 April 2016
Available online xxx

JEL classification:
G1
G15

Keywords:
Financial contagion
Consumer confidence index
European stock markets
Spillover effect

ABSTRACT

This paper investigates the existence of financial contagion between the US and 10 European stock markets. Using intraday minute-per-minute data of a large set of 374 equities from three different industries, over the period from January to June 2011, we investigate the impact of increased volatility in the US on the inter-country industry-level spillover effect. Self-built industry indices are used, which allows the implementation of the same index methodology across different markets. We first show that the spillover of asset price volatility from the US to European markets does exist; the greatest spike in the volatility in the target markets is observed in the first minute, and is absorbed in the first 5 min after the volatility increase. Second, we can state that euro-denominated markets amplify the spillover effect of volatility from the US market. Third, we provide evidence of the industry heterogeneity of the spillover effects, and claim that an analysis of financial contagion across different industries is desirable, using industry indices instead of global market indices.

1. Introduction

In August 2011, Wall Street experienced one of the most volatile weeks in its history. This wild volatility spread rapidly across Europe and Asia, due to the high level of linkages and interactions between stock markets around the world. Financial contagion is not a new phenomenon, but its incidence has been growing over time. Recent advances in computer technologies and information processing have increased integration between different markets by responding quickly to news, shocks and market announcements, and have accelerated the transmission of information and consumer sentiment spillover around the world.

A significant strand of academic literature has analyzed the spillover effect across markets by using daily data, which does not properly account for how quickly interconnected trading venues spread information, and how this is reflected in increased volatility. Recent academic papers have examined short-run information transmission based on 5-min frequency data. The results show signs of very strong interdependence between different stock markets; however, they do not reveal any indication of contagion. Jung and Maderitsch (2014) investigated non-overlapping realized volatility transmission between stock markets in Hong Kong, Europe and the United States for the 2000–2011 period, using 5-min sampled stock index data. The paper documents sudden shifts in volatility transmission driven by market co-movements without a sign of contagion. In turn, Hussain (2011) analyzed lagged trading activity using concurrent data from the German and British equity markets, and highlighted the impact of trading volume on stock volatility. However, the research was unable to measure the information transmission mechanism between stock markets. Several papers, including those of Égert and Kočenda (2007) and Wu, Li, and Zhang (2005), emphasized the signs of short-term spillover effects, both in terms of stock returns and stock price volatility. Evans (2011) examined intraday jumps associated with US macroeconomic news announcements, and also observed dramatic reactions of financial markets to economic fundamentals in the very short term.

Taking into the consideration the previous literature, the aim of this paper is to provide more highlights on volatility spillover effects between the US market and 10 European markets (Athens, Brussels, Paris, Frankfurt, London, Madrid, Dublin, Milan, Stockholm, and Zurich). Our major target is to shed new light on the industry heterogeneity of the spillover effects, and the speed and patterns of information transmission across different industries. Following the recent studies on industry-specific volatility (Wang, 2010), and financial risk contagion and tail risk spillover between financials and non-financials (Chiu, Peña, & Wang, 2014; Grammatikos & Vermeulen, 2012), we claim that volatility transmission between stock markets may differ across industries. In contrast to the previous studies, which have tended to use global

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http://dx.doi.org/10.1016/j.qref.2016.04.011
1062-9769/

market indices for the analysis of the whole market movements, the main contribution of this paper is the proposition of a novel approach featuring a unique construction methodology for industry indices. We argue that the use of global market indices is not desirable for the analysis of inter-market industry spillover effects, since the weight of each sector in the indices composition between countries is different. The self-built industry indices proposed in this paper will lead to a more accurate test of the industry-level spillover effect, and will allow the implementation of the same index methodology across different markets.

According to the SEC report from March 2014, high-frequency trading exceeded 50% of total volume in US-listed equities, and was called "a dominant component of the current market structure which is likely to affect nearly all aspects of its performance." Therefore, in this paper we estimate a spillover effect between the US and European markets in an even shorter term than previously analyzed, using minute-per-minute intraday data for a total of 374 equities, from January to June 2011.

As the time reference point for the analysis, we use the US consumer confidence announcement. The consumer confidence index provides information on present and expected economic activity, and is based on five major questions about current and expected business conditions, job availability and respondents' expected income. As a result, it helps to track labour market conditions, the growth in payroll employment, and it represents information about future household spending. The existing literature states that consumer confidence is highly correlated with real economic activity (Batchelor & Dua, 1998; Chen, 2011; Jansen & Nahuis, 2003); that it is a leading indicator in many macroeconomic forecasts (Gelper, Lemmens, & Croux, 2007; Van Oest & Franses, 2008); and that it can be viewed as a key determinant of near-term economic growth (Howrey, 2001; Ludvigson, 2004). Several studies, such as those of Weder (1998) and Chen (2011), suggest that consumer confidence is one of the transmission channels through which consumer sentiment spreads between markets and may cause economic fluctuations. Otoo (1999) and Jansen and Nahuis (2003) provide evidence that stock returns and changes in consumer sentiment are generally positively correlated. Following the above, we claim that the announcement of the consumer confidence index will provoke an increase in volatility with a spread between markets, and that it will make an impact on the decision-making process in the three industries analyzed: *Financials*, *Healthcare*, and *Industrials*. Thus, we choose the consumer confidence index among the other announcements, as an example and a good reference point for the investigation of volatility spillover.[1]

Since we state that the recent advanced technologies have accelerated the speed of information processing and have considerably shortened the time of information transmission between markets, we claim that only the analysis of overlapping trading hours can reveal accurate information about market dynamics. This approach is consistent with that of Grammig, Melvin, and Schlag (2005), who studied where price discovery occurs and how stock prices adjust to an exchange rate shock, using cross-listed prices from New York (NYSE) and Frankfurt (XETRA) during overlapping trading hours.

To calculate asset volatility we apply Garman and Klass's (1980) volatility estimator, which differs from the classical volatility estimator that cannot reflect fluctuations within a period. The Garman–Klass estimator is well known for coping with high-frequency or intraday data by using opening, closing, high and low prices for the calculation of volatility, which can create a better picture of fluctuations in high-frequency data.

[1] In this research we do not aim to investigate the effect of the consumer confidence index.

This study adds to the existing literature on financial spillovers in a number of ways. First, it provides a novel methodology for industry indices construction, which is more accurate for the analysis of industry heterogeneity of spillover effects, compared to global market indices. Second, to our knowledge, it is the first research that has conducted intraday analysis of volatility spillovers between markets based on minute-per-minute data. Third, this paper sheds light on the patterns in information transmission across different industries, and shows that such industries as *Healthcare* and *Industrials* are less interconnected between markets than *Financials*. Fourth, it contributes to the literature on the effect of denominated currency on financial contagion.

The results can be summarized as follows. First, we find evidence that spillover of asset prices volatility from the US to European markets does exist in the examined period from January 2011 to June 2011. Second, the greatest impact on the volatility in the target markets is observed in the first minute after the increase in asset prices volatility in the US market, and it is highest in the first 5 min over the analyzed period of 30 min. It highlights how recent technologies influence markets, making them even more interconnected and exposed to financial contagion. Third, the results show that the level of market interrelation is different among industries. Hence, spillover effects between the US and European markets are less pronounced for *Healthcare* and *Industrials*, in contrast to the *Financials* sector. Therefore, an analysis of financial contagion across industries is desirable and should be conducted with the use of industry indices, instead of global market indices. Finally, we confirm that denominated currency is an important factor affecting the spillover effect of volatility from the US market to the target markets. These results add to further understanding of industry heterogeneity of spillover effects, and can be practically implemented for risk management procedures, short-term trading strategies, as well as being used for the purpose of portfolio diversification and portfolio asset allocation.

The remainder of the paper proceeds as follows. The next section discusses the theoretical framework and empirical evidence for financial contagion. Section 3 describes the data sample, volatility and indices calculations, and model specification. Section 4 presents the empirical results for the volatility spillover effect in European equity markets. Section 5 concludes the study.

2. Background of financial contagion

2.1. Understanding financial contagion: empirical evidence

The definition of financial contagion is a highly debatable issue (Pericoli & Sbracia, 2003). Contagion is most commonly defined as a significant increase in inter-market links conditional on a crisis occurring in one market (Chiang, Jeon, & Li, 2007; Corsetti, Pericoli, & Sbracia, 2011; Forbes & Rigobon, 2001; Pritsker, 2001; Yiu, Ho, & Choi, 2010; among others). Caporale, Cipollini, and Spagnolo (2005) state that financial contagion is a significant increase in the degree of co-movements between stock returns in different countries. Bekaert, Harvey, and Ng (2005) explain contagion as excess correlation, which is the correlation over and above what is expected. Edwards (2000) defines contagion as a situation where the extent and magnitude of the international transmission of shocks exceed what was expected by market participants.

The empirical evidence for the existence of financial contagion is not conclusive. Several studies, such as those of Boyer, Gibson, and Loretan (1999), Forbes and Rigobon (2002), and Bordo and Murshid (2001), have examined an increase in correlation between asset returns in pairs of crisis-hit countries, and reached the conclusion that there was "no contagion, only interdependence." Corsetti, Pericoli, and Sbracia (2005) used the same methodology as Boyer

Please cite this article in press as: Mateus, C., et al. Intraday industry-specific spillover effect in European equity markets. *The Quarterly Review of Economics and Finance* (2016), http://dx.doi.org/10.1016/j.qref.2016.04.011