Geographic Proximity of Information to Financial Markets and Impact on Stock Prices: Evidence from the Ebola Outbreak

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Abstract: Behavioral finance studies reveal that investors' sentiment affects investment decisions and may therefore affect stock pricing. This paper examines whether the geographic proximity of information disseminated by the 2014 Ebola Outbreak combined with intense media coverage affected asset prices in the United States. The results show that the effect is generally negative on the stock prices, also local media coverage strongly affects local trading, and the effect is more pronounced in small and more volatile stocks and in companies belonging to less stable industries. Furthermore, we find that both retail and institutional investors are more sensitive to the intensity of coverage than to the content of information. Additional tests suggest significant return spillover effects from U.S. markets to other markets one day after the determined event date.

Keywords*:* Ebola outbreak, Information dissemination, Geographic proximity, Media coverage, Investors' sentiment

JEL Codes: G10, G11, G14

1. Introduction

One of the central issues in the behavioral finance studies is explaining why market participants make decisions contrary to the assumptions of rational market participants. A large number of studies show that "bad moods" and anxiety may affect investor decisions; anxiety in particular, drives investor sentiment against taking risks, contributes to pessimism regarding future returns and thus dictates corresponding asset prices (see for e.g. Kaplanski and Levy, 2010). The prime focus of this study is the geographic proximity of information to the financial markets and their impact on stock prices within the scope of the 2014 Ebola outbreak events. Our main hypothesis is that the Ebola outbreak events unequally affect investors' mood, thus their sentiment about stock returns, depending on their distance to the events. Generally, we expect to find that investors' anxiety as a result of the outbreak events negatively affects the investment in risky assets. Indeed, we find significant evidence that Ebola outbreak events negatively affect stock prices of different magnitudes depending on investors' distance to the market.

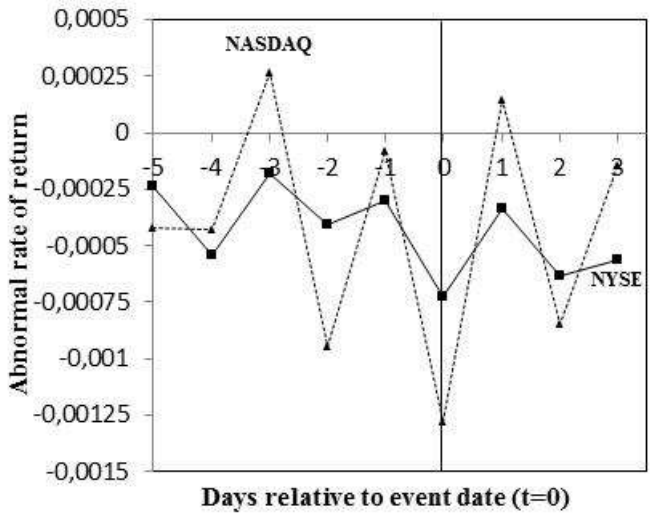

Fig. 1 Abnormal rate of return. The figure depicts the average abnormal return (AR) around the event date (t=0). The abnormal return is calculated using the market model on both NYSE and NASDAQ Composite Indexes. The events occurred during the 2014 Ebola outbreak period and include 40 event days of outbreak.

The effects found in this study comprise both event effects and reversal effects one day after the event. Possible reasons for these effects may be that first, investors act irrationally to the news on the Ebola outbreak and after one day they stabilize their behavior, and second, investors' mood affects their preference about certain stocks; hence it affects the degree of risk aversion. Fig.1 presents the main findings in this study. Fig.1 depicts the average abnormal returns (ARs) around dates when Ebola outbreak events occurred. On event days, when the newspapers and media are flooded with articles, pictures and live streaming, the abnormal market returns sharply decline. This decline represents an average loss of about $300 million per event, whereas the upper bound of the total Ebola outbreak cost is roughly estimated at $30 billion (Thomas, 2015). Furthermore, we find that the event effect is followed by a reversal effect on the first day after the event when it reverts again on the second day. What can we learn from this? If the market loss were due to loss resulting from the outbreak events rather than due to anxiety and investors' mood, we would not expect to find double reversals or no reversal effect at all. The fact that we clearly observe reversal effect is one more element in favor of our hypothesis asserting that mood and anxiety induce the effect.

To further study the event effect, we perform several additional analyses. Adopting Baker and Wurgler's (2006) idea, we test whether there is a difference in the magnitude of the effect in portfolios constructed by size, volatility, industry and portfolios exposed to intense media coverage. At the end, we also observe whether the effect spills over to other international financial markets. Indeed, we not only find that the effect exists in all observed portfolios, but a relatively large effect is found in small firms, in more volatile stocks, in specific industries and especially in stocks highly exposed to media coverage. In observing potential spillovers, we find that financial markets are integrated among themselves, thus any news arising in one country has an impact on another country to some extent.

Our findings shed new light on the role of geographic proximity of information to the financial markets and its psychological effects on investors' decision making process. The results show that there is a clear association between the relevancy of the Ebola outbreak events to U.S. investors'

actions and the magnitude of the event effect. Namely, the effect is stronger and arrives more quickly when the events occur on U.S. soil than when the effect corresponds to faraway events, Europe and West African countries region in our case. This association may also be related to the intensity of media exposure, public attention and the sophistication of information channels1. Given the practical importance of these findings, our results will be appealing to individual and institutional investors, portfolio managers and financial and industry analysts.
The remainder of the paper goes as follows. Section 2 provides theoretical background. Section 3 describes the data, the methodology and presents the hypotheses tested in this study. Section 4 presents the results and the additional assessment. Section 5 concludes the paper.

2. Data, methodology and hypotheses

The data examined cover the entire history of mass-media circulated after the Ebola outbreak events in the U.S., in the time period from December 2013 to June 2016. The period incorporates 20 non-overlapping2 events, which we consider to be our main event days. We use the LexisNexis news provider to browse the three largest by coverage U.S. newspapers and the WHO disease database34 to double check the relevancy of the news published about the events in our sample. About 51% of the news events are published in "The New York Times" and the rest in the "Washington Post" and "The Wall Street Journal" combined. All news items that we encounter are official statements communicated to the public with regards to any new information related to the 2014 Ebola outbreak. For example, on the 8th of October 2014 the first death case5 on U.S. soil was publicly reported by the WHO and the U.S. media. In addition, the WHO emergency committee stated the conditions and security guidelines for disease prevention. Usually, the mass media uses such WHO news releases to communicate the information to the greater public. Last but not least, to avoid missing event-information bias we include release dates of official statements provided by government institutions and stock market listed companies. For instance, information disseminated in the media about a particular company's actions against the Ebola outbreak may positively affect that company as well as its competitors' stock prices.
To test whether the geographic proximity of information to the financial markets has an impact on companies' stock prices, we employ the value-weighted6 return index (see Appendix, "RI") on both NYSE and NASDAQ Composite Indexes taken from the CRSP7. In addition, we use the S&P500 index as a market performance benchmark. We chose the NYSE Composite because it primarily contains large stocks, taking into account the fact that shares of large companies generally do enjoy information dissemination, whereas the NASDAQ Composite primarily includes a bunch of tech stocks. Both markets have two important reasons to be chosen: 1) they are the most closely followed in the world, thus very efficient with respect to dissemination of new information (Kaplanski and Levy, 2010a, b); 2) U.S. stock markets are among the leading stock markets in the world and account for almost 50% of the global market (Hou et al., 2011). To fully

[1] For further knowledge on information channels to financial markets, consult Kaplanski and Levy (2010).
[2] Notice that there are 41 Ebola outbreak news events in the US, however after filtering out the overlapping events we end up with the current number of 20. Detailed overview of the event data is available in Table A.2 in the appendix.
[3] http://who.int/mediacentre/news/statements/en
[4] http://www.who.int/mediacentre/news/ebola/press-releases/en/
[5] WHO: Ebola response Roadmap Situation Report. http://apps.who.int/
[6] Calculated from the stock market index whose components are weighted according to the total market value of their outstanding shares.
[7] Center for Research in Security Prices

capture the impact of geographic proximity, we further use the Orbis database setting its filter8 to produce only the sample of companies which are listed on the U.S. stock markets and operate in the regions of interest. In our case we distinguish between three different geographic regions: United States, Ebola outbreak region i.e. West African Countries region9 and Europe. At the end, the sample consist all companies listed on NYSE and NASDAQ Composite from which 67 are classified for the West African Countries region and 164 for Europe.

Furthermore, to observe a potential differential effect regarding company industry, company size and stock volatility, we employ Fama and French's (1993) 10 value-weighted portfolios constructed by industry, size and volatility accordingly.

To test whether the information disseminated about certain event leads to bad moods and anxiety among investors which may therefore negatively affect portfolio returns, we use the VIX and VXO10 indexes as proxies (see Whaley, 2009). Referring to Bloom (2009)'s idea, we observe statistically significant volatility shift when the U.S. stock market volatility shows matched-pair t-test on the VIX and VXO values significant on at least 10% level.

To assess whether intense media coverage has a significant impact on a specific company, we use the number as well as the frequency of news articles published about that stock in the media. We refer to LexisNexis "relevance score" to measure the quality of matching an article to a specific company and we use 70% or above news frequency score as a threshold to distinguish the company's securities heavily exposed in the media.

Last but not least, we theoretically assess whether the events in our sample enhance spillover effects across various international stock markets. For this, we use the S&P Dow Jones Indices to retrieve the market return data and the correlation matrix between each of the markets of interest.

To test the null hypothesis, as well as to estimate the impact that the events have on company securities, we use the traditional event-study methodology based on the single-factor11 and the two-factor model12 as adopted by prior research (see, e.g. Kaplanski and Levy, 2012; Kamstra, Kramer and Levi, 2003; Brown and Warner, 1985). We position 100 days in the estimation period and 21 days in the event window symmetrically distributed around the event day noted as day 0. The sample of events we observe is temporarily clustered, meaning that if all events were taken into account, the event study would suffer from overlapping windows. For this reason, as stated before, we use only events with non-overlapping event windows. Hence, we run the following regression model:

$$AR_t = \gamma_0 + \sum_{i=1}^{5} \gamma_{1i} AR_{t-1} + \sum_{i=1}^{5} \gamma_{2i} AR_{t+1} + \sum_{i=1}^{4} \gamma_{3i} D_{it} + \epsilon_t \,, \qquad (1)$$

where AR_t is the daily abnormal return on the day of the event, γ_0 is the regression intercept and AR_{t-1} is the *i*th previous day abnormal rate of return. AR_{t+1} is the abnormal rate of return on the day after the determined event day and D_{it} is a dummy variable for the day of the week: Monday, Tuesday, Wednesday and Thursday.

[8] Orbis database can be found from Bureau Van Dijk's menu of databases. Furthermore, we set the filter to sort all active companies in the period from December 2013 until June 2016. Second, we choose the companies listed on NYSE Composite and NASDAQ Composite Indexes only. Third, we match the companies corresponding to the benchmark-S&P 500. Fourth, we filter out the U.S. companies owning branch, subsidiary or affiliates in the region of interest. This is necessary in order to sufficiently match each foreign unit to its parent/domestic unit listed on the financial markets and thus establish the geographic proximity relation between the two.

[9] WAC region: Liberia, Guinea, Sierra Leone, Nigeria, Mali and Senegal.

[10] Retrieved from Chicago Board of Options Exchange (CBOE) website: www.cboe.com

[11] Single-factor model where the factor is the AR

[12] Two-factor model where the first factor is the AR and the second is the Industry AR

The reason for observing the previous days' abnormal rates of return, AR_{t-1}, is the possible presence of serial correlation. As recorded by previous studies, serial correlation may occur as a result of time-varying expected returns, non-synchronous trading, transaction costs and etc. (see, e.g., Schwert 1990a, b).We look at as many past abnormal returns as is necessary to ensure that all significant correlations have been accounted for. In our case it is the first five previous days' abnormal rates of return. Furthermore, we use the first five abnormal rates of return, AR_{t+1}, following the main event day to control for possible reversal effect, or differently put, for potential positive sentiment effect (Kaplanski and Levy, 2010 a). Lastly, taking into account that the Ebola outbreak events may not be evenly distributed over the week, we use dummy for the day of the week, D_{it}, to capture the so-called "Monday effects". For more evidence of this effect, see French (1980), Schwert (1990a) and Cho, Linton and Whang (2007).

Below, we present the hypotheses tested in this study.

1. We first test whether the geographic proximity of the information (disseminated by the determined event) to the financial markets plays important role i.e. has statistically significant impact on companies' stock prices. Since our focus is on the U.S. financial markets, we expect that the event effect will be stronger for U.S. investors and companies operating only on U.S. soil. Thus, the γ_{2i} coefficient will be larger (in absolute terms) than the coefficients corresponding to the companies operating in the West African countries region and Europe.
2. We hypothesize that the event effect is stronger upon the stock returns of small companies relative to large companies. This hypothesis is supported by past research suggesting that local investors are usually the ones investing in small firms, thus their sentiment is affected by event information that is specific to the place and firm that they invest in (see, Brown and Cliff, 2005; Edmans et al., 2007).
3. The Ebola outbreak as a type of event is perceived to increase the bad mood as well as the anxiety among the investors, which may negatively affect company returns. We proxy investors' sentiment through securities' volatility and we hypothesize that the event day coefficient is larger for stocks belonging to relatively small firms rather than for stocks belonging to large firms (see, Kaplanski and Levy, 2010a).
4. Investors quite often hold very polarized stock portfolios. In our case, this means that some investors bet on positive impact from the Ebola outbreak upon certain companies' stocks while others hold the opposite view. Having this in mind, we select the 12 largest industries, by contribution to U.S. GDP, and test how (positively or negatively) the Ebola outbreak events affect each industry. For instance, we expect companies from the pharmaceutical and biotechnological industry to be positively affected in terms of stock returns, whereas the companies from airlines and tourism to experience negative impact.
5. Previous studies confirm that intense media coverage significantly affects stock prices, trading volume, stock liquidity and stock variability (see, Fang and Peress, 2009). We collect the required security data from CRSP and test whether the events and companies exposed to intense media coverage are more affected than the ones receiving no strong media exposure. In addition, we expect to see significant and larger, in absolute terms, coefficients for stocks heavily covered by the media than for the stocks with lower media exposure.

3. Concluding remarks

In this study, we find that the Ebola outbreak events are followed by negative abnormal rates of return in the financial markets accompanied by a reversal effect one day later. As the transitory decline in the financial markets is very different from the total economic loss, we look for an explanation in the realm of behavioral economics. Indeed, behavioral economic studies show that media coverage of Ebola outbreak events can provoke anxiety, bad mood and fear which may induce risk averseness and pessimism among the investors.

The main hypothesis in this study examines whether the geographic proximity of the information to the financial markets plays important role, *i.e.* has a statistically significant impact on companies' stock prices. Indeed, we find that the effect is largest for events taking place on U.S. soil and both smaller, but highly significant for Europe and West African Countries region. Additional tests on the event effects reveal that the market sentiment has a larger effect on stocks with valuations that are highly subjective, stocks of small firms, firms with more volatile stocks and firms belonging to specific industries.

While it is possible that the bad mood and anxiety induces an increase in the degree of risk aversion, we find that the implied volatility, as reflected by the Fear Index (through VIX and VXO) significantly increases, which may imply that the Ebola outbreak events also affect the perceived volatility. Our results confirm the hypothesis stating that fear and anxiety, rather than real economic factors, affect people's decisions in the context of Ebola outbreak.

The relationship between mass media and communication of risks has long been a subject of intense debate. Relying on past research that high-consequence and low-probability events, such as the Ebola outbreak, are overemphasized in the media, our results support both the events' intense media coverage hypothesis and explain possible sentiment effects. We find that although the news about the Ebola outbreak event was publicly available on the day of the event, there is only partial evidence of the effect on this day. On days following the event, when the media is flooded with information on disastrous causalities accompanied with live streaming and pictures, do we detect the full negative effect. What probably affect the investor's anxiety are not only the articles published in the newspapers, but also media's live streams.

Lastly, an assessment of whether the Ebola outbreak events enhance spillovers among various international financial markets shows significant results for the US-Europe relationship. However we do not find evidence on spillovers among the rest of the markets. From these results, one can conclude that the financial markets are integrated among some countries. Any news arising in one country have an impact on the other country to some extent. Moreover, previous day news of a country can influence the future price on another country if markets are well integrated.

Given the practical aspect of our findings, we believe our results will be appealing to individual and institutional investors, portfolio managers, financial and industry analysts and inspiration for further research. In addition, and interesting idea for further research is to study whether one can obtain desired abnormal returns by executing an investment strategy based on the findings of this paper. Another possible idea is to examine the relationship between stock price volatility and option prices and whether returns can be predicted based on this relation and the insights of this study.

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