

Stock Crash and R^2 around a Catastrophic Event: Evidence from the Great East Japan Earthquake *

KATSUHIKO MURAMIYA,[†] TATSUSHI YAMAMOTO,[‡] and TAKASHI YAMASAKI[§]

Abstract: We investigate the effects of opacity of information a firm discloses on stock price synchronicity and crash risk. We develop an analytical model in the presence of firm-specific information and market-wide information. Stock price synchronicity is predicted to increase with the opacity of firm-specific information. Our model also reveals that stock crashes are more frequent and more severe for the opaque firms. These predictions are confirmed empirically. Further, our model predicts that after a catastrophic event stock prices become synchronous with the market because of investors' limited attention, and hence the frequency and severity of a stock crash increase. We use the Great East Japan Earthquake as a representative catastrophe to examine these implications, and provide support for the model. Finally, we find that a stock price of a firm disclosing opaque information tends to be synchronous with the market, and hence experiences a more serious crash from the earthquake, which is consistent with the model.

Keywords: Financial reporting opacity, Stock crash, Stock price synchronicity, Limited attention, the Great East Japan Earthquake

JEL classification: G12, G14, M41

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[†]Graduate School of Economics, Osaka University (muramiya@econ.osaka-u.ac.jp)

[‡]Graduate School of Economics and CSFI, Osaka University (yamamoto_tatsushi@econ.osaka-u.ac.jp)

[§]Graduate School of Business Administration, Kobe University (yamasaki@kobe-u.ac.jp)

1 Introduction

We investigate the effects of opacity of information a firm reports on the stock price synchronicity and the crash risk. We also examine how synchronous stock prices are, and whether the crash risk in the market increases or not where investors' attention is severely limited, for example, due to a catastrophic event. Finally we examine whether or not the stock price of opaque firms are more likely to crash in the situation than that of the transparent firms.

Crash risk is important for investors since it is the unique risk that cannot be eliminated through diversification. It is generally said that unique risk which stems from the perils around an individual firm can be eliminated through diversification but that market risk which stems from the economy-wide perils cannot. However even through diversification, we cannot avoid the crash risk that stems from an exogenous catastrophe (e.g., an earthquake, tsunami).

Several prior studies show that an opaque firm are more likely to crash than a transparent firm (e.g., Jin and Myers, 2006; Hutton, Marcus and Tehranian, 2009). A manager has an incentive to hide bad news and absorb losses due to it for the job protection. This makes the firm opaque. However there exists a certain threshold that he can do. Once the amount of bad news exceeds the threshold, he releases all the bad news he has accumulated. That makes a crash.

Synchronicity is a degree that a stock price comoves with market. There has been considerable research concerning the determinant of stock price synchronicity and the relation between synchronicity and market efficiency (e.g., Morck, Yeung and Yu, 2000; Fernandes and Ferreira, 2009, Gul, Kim and Qiu, 2010) since Roll (1988) found that stock prices do not always co-move with the whole market and argued that informed traders acting on private information play an important role. Roll (1988) measured the synchronicity as R^2 of a regression of a stock return on market portfolio return (i.e., market model specified by Sharpe (1963)). A high R^2 means high synchronicity (i.e., low idiosyncratic volatility).

Several prior studies show that low synchronicity (i.e., high idiosyncratic volatility) reflects that the stock price incorporates more firm-specific information (e.g., Durnev, Morck, Yeung, and Zarowin, 2003; Piotroski and Roulstone, 2004; Fernandes and Ferreira, 2009). Wurgler (2000) argues that the efficiency of capital allocation is positively correlated with the amount of firm-specific information. That is the reason why we focus synchronicity. Morck *et al.* (2000) shows that stock returns are more synchronous in poor economies than in rich economies and argues that the degree of public investor property rights causes the difference.

Several prior studies investigates the relationship between opacity and synchronicity. Jin and Myers (2006) argue that it is not enough that the reason for high synchronicity can be attributed to just poor

protection of investors. They investigate the relation between synchronicity and opacity (lack of transparency) for 40 stock markets from 1990 to 2001 and find theoretical and empirical evidence that more opaque markets have higher synchronicity, leading to their being more likely to crash. Based on a model by Jin and Myers (2006), Hutton *et al.* (2009) test the firm-level relation between synchronicity and opacity using the U.S. firms from 1991 to 2005. Using abnormal accruals (i.e., earnings management) as a proxy for opacity, they find that more opaque firms have higher synchronicity and tend to experience stock crashes. This result suggests that synchronicity and crash risks are driven by accounting opacity.

We focus on limited attention that is a concept in behavioral economics. Consider a situation after a catastrophe. Investors must make decision quickly to avoid big losses. However they do not have enough information about individual firms which they would have in an ordinary situation, that means their attention is severely limited. The Great East Japan Earthquake occurred on March 11, 2011 and soon after that the huge tsunami swallowed up many people and buildings on the east coasts of Japan¹. Besides that, they had huge effects on the Japanese stock market. The price of Nikkei 225 was 10,360.21 JPY at 2:46 pm (just before the earthquake), and 10,254.43 JPY at 3:00 pm (the closing time). That means collapsing by 1.02% only in fourteen minutes! That offers a unique opportunity to examine how investors' limited attention affects synchronicity and crash risk.

Since investors must make decision quickly after a catastrophe where they do not have enough information about individual firms, their decision heavily relies on market-wide information, not firm-specific information. Therefore we hypothesize that investors' limited attention makes synchronicity higher. Peng and Xiong (2006) argues that in such a situation return correlations between firms can be higher than their fundamental correlations. Since soon after a catastrophe bad news is pervasive over the market, we also hypothesize that the crash risk becomes higher where investors' attention is severely limited. Since a stock price of a firm that reports transparent information is less synchronous, we finally hypothesize that it is less likely to crash even where investors' attention is severely limited.

Researchers in accounting and finance have used various kinds of measures to indicate accounting opacity. For example, Bhattacharya, Daouk and Welker (2003) use earnings aggressiveness (i.e., the opposite concept of accounting conservatism), loss avoidance, and earnings smoothness as proxies for differences in accounting opacity and explain the association between accounting opacity and cost of capital and trading volume world-wide. Francis, LaFond, Olsson and Schipper (2004) examine the link between the cost of equity capital and accounting opacity by using the following earnings attributes:

¹More than fifteen thousand people were killed by the earthquake or the following tsunami. Nearly twenty six hundred people were still missing three years after the earthquake. More than one million buildings were completely destroyed or seriously damaged.

accruals quality proposed by Dechow and Dichev (2002), persistent, predictability, smoothness, value relevance, timeliness, and conservatism. Thus, empirical research so far has basically used *reported earnings* to quantify accounting opacity².

We also use reported earnings-based opacity measures and examine the relation between opacity, synchronicity, and crash risk, however those measures have potential weaknesses. First, as Hutton *et al.* (2009) point out, the relation between discretionary accruals and both synchronicity and crash risk essentially disappears in the post-Sarbanes-Oxley Act (SOX) years. They interpret this result as indicating that earnings management has substantially subsided due to greater monitoring and scrutiny of accounting practices after SOX, and then, earnings-based opacity measures could no longer be used as a proxy for opacity after SOX. Because many developed countries including Japan have recently crafted regulations similar to SOX, we need to employ an alternative measure of opacity to replace it.

Japanese listed firms have a distinctive financial reporting system in that almost all of listed firms report point-estimate of management earnings forecasts for the following year as well as actual earnings for the year. In addition, Utilizing this unique setting, we use the precision of management earnings forecasts as the opacity measure. It is reasonable that regardless of whether the causes of less precise earnings forecasts are intentional biases or major changes in the business environment, firms reporting less precise earnings forecasts are regarded as being more opaque by investors, who form their expectations based on the earnings forecasts, especially in uncertain situations.

2 Hypothesis Development and Empirical Results

We first develop an investor's valuation model in the presence of firm-specific information and market-wide information under "ordinary" conditions. Our model predicts that (1) stock crashes are likely to be observed in firms that report opaque information and (2) its stock price synchronicity increases with that opacity. Both predictions are confirmed empirically.

We next extend next the model to "extraordinary" conditions in which investors' attention is severely limited due to an unexpected catastrophic shock, and provide predictions about the impact of the limited attention on synchronicity and individual stock crashes. The model predicts that after a catastrophe, (3) stock prices become more synchronous and hence (4) crash risks become higher in the market. In addition, our model predicts that (5) opaque firms are more prone to stock price collapse after an unexpected catastrophe than transparent firms. We use the Great East Japan Earthquake (GEJE) as a representative catastrophe to examine these implications from (3) to (5), and provide evidence that is consistent with our prediction.

²Dechow, Ge and Schrand (2010) provide comprehensive review of earnings-based accounting quality literature.

3 Conclusions and Contribution

This is the first study that develops a theoretical model concerning the effects of a firm's opacity and investors' limited attention on its crash risk and synchronicity, and do empirical tests on the predictions derived by the model in a representative situation of investors' limited attention (ie. immediately after the exogenous catastrophic shock, GEJE). This study contributes to the extant literature in several ways. First, while Jin and Myers (2006) developed an analytical model that explains that opaqueness increases stock price synchronicity by shifting firm-specific risk to managers, they show the relation between firm-level opaqueness and stock crashes anecdotally. They nearly describe that a greater frequency of large, negative, firm-specific returns occurs in countries where firms are more opaque to investors. We developed a simple model that explains the relation between firm-level opaqueness and its stock crash risk, and then, show empirical evidence that the more opaque the firms, the more prone they are to crash.

Second, recent years have seen an increase in studies investigating the determinants of crash risk (e.g., Chen *et al.*, 2001; Hutton *et al.*, 2009; Kim *et al.*, 2011a,b; An and Zhang, 2013). These studies provide surprising results that larger firms are more crash-prone than smaller firms. This seems counter intuitive and casts doubt on the ability of the measures used to accurate stock crash risk. We use the frequency with which weekly returns exceed a certain threshold and severity of stock crashes (i.e., minimum weekly returns) during the year as measures of crash risk. We show that our crash risk measures are intuitively plausible because larger and more profitable firms are less likely to be experience stock crashes. In contrast to previous studies, we use such intuitively plausible measures and provide additional empirical evidence to the growing literature explaining the relation between opacity and crash risk.

Third, Peng and Xiong (2006) develops an analytical model, and shows that investors' limited attention leads to a category-learning behavior, i.e. investors tend to process more market and sector-wide information than firm-specific information than firm-specific information. They also show that this phenomenon combined with investors' overconfidence generates synchronicity. Based on Peng and Xiong (2006), we develop an analytical model using a information theory by Shannon (1948) and show investors' limited attention enhances synchronicity and hence crash risk. We further show a stock price of a less opaque firm is less likely to crash than that of a more opaque firm even where investors' attention is severely limited. Further we test the predictions of the model in a representative situation of investors' limited attention (ie. immediately after the exogenous catastrophic shock, GEJE) and get the results that support the predictions.

Finally, our study contributes to growing literature on the linkage between unexpected shocks and financial reporting. For example, Francis *et al.* (2013) and Watts and Zuo (2012) show that firms with

more conservative financial reporting experience less negative “long-run” stock returns during financial crises. However, there is little evidence documenting what factors affect “short-run” stock returns when unexpected shocks actually happen. We develop the theory that stock price synchronicity is a key factor explaining cross-sectional difference in stock returns around the shocks, and then that synchronicity is positively associated with opacity. As a result, we predict that opaque firms tend to have large negative returns after the shock has occurred. Ample support for this prediction is found in the data relating to a representative unexpected shock, the GEJE. This study demonstrates the importance of transparency when unexpected shocks have occurred.

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