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Credit and Market Risk of Unusual Changes in Daily Stock Prices

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中文摘要:本文旨在分析股價不尋常波動的影響因子，以探討其信用風險與市場風險。研究發現市場與流動性是影響股價不尋常上漲的因子，而動能因子是解釋股價不尋常下跌的因子。另外本研究也發現公司大小和 B/M 比並無不影響公司股價的不尋常波動。

關鍵詞: Cox hazard proportional model, survival function, hazard function, hazard ratio.

Abstract: This article investigates the determinants of the possibility of an unusual change in stock price. The empirical evidences show that market and liquidity are the most important explanatory variables which explain the likeliness of the big gains in stock prices. But the explanatory power that explains the likeliness of a sharp decline in stock price comes mostly from the momentum effects. In addition, size and book-to-market ratio proved have little power in explaining the unusual changes in stock prices. The asymmetry phenomenon in determinants of unusual changes in stock price is also found in three individual stock exchanges, respectively. Namely, in NYSE, momentum effect account for most of the likelihood for big gains in stock prices, while liquidity factors count for sharp stock price declines. Interestingly, the converse is true for those firms traded in Amex and NASDAQ, respectively.

Keywords: Cox hazard proportional model, survival function, hazard function, hazard ratio.

The patterns of unusual changes in stock prices provide information about the acute movements in stock returns that can be used to identify the risk factors which affect the extreme expected returns of the stocks. Occasionally, the stock prices may be volatile by gaining or losing more than ten percent or even more daily. Large abnormal returns in the extremes convey more information about the force which drives the stock prices to move up or down. What the probability of the event that the stock prices move acutely in next period is might shed some light in identifying the risk factors which explain the expected return and has not received much attention in the existing literature. The reason we focus on this topic is not that an over ten percent change in stock price has more or less information about expected returns than a less than ten percent change in stock price, but rather that unusual changes account for the lion's percent of stock price change. Hence, in our article, we investigate the recurrences of the event that the stock price is volatile by more than ten percent in a trading day using the well-known five factors documented in existing work to examine whether these factors are also the determinants of the likeliness of unusual price changes.

The determinants affecting the expected returns of the stocks have been well established in finance fields of research. Scholars have already proved that many determinants documented in the extensive literature are important in explaining the returns by extensive empirical studies. In particular, starting the pioneering work of Fama and French (1993) who construct a three-factor model to explain the expected returns, there are two other risk factors documented in existing work. Especially, we have market returns (Sharpe (1964), Lintner (1965), Black et al. (1972), Fama and French (1993)), size of a firm (Banz (1981), Roll (1981), Chan and Chen (1991), Fama and French (1993)), book-to-market ratios (Rosenberg et al. (1985), Lakonishok et al. (1994), Fama and French (1993, 2008), past short-term returns (Jegadeesh and Titman (1993), Chan et al. (1996)), and turnover rates (Datar et al. (1998)) as the factors to explain the expected returns of the stocks.

Most traditional empirical studies in financial field, however, generally utilize ordinary least square to explore the relationships between the expected returns and the explanatory variables. Here we take another approach which has been used in many other fields of research, namely recurrent event data analysis. This technique has some advantages. First, it incorporates the historical data for the event to happen many times instead of a single event. Second, it can deal with the nonlinear dependence and heterogeneity among the explanatory variables, by imposing the frailty effect or the robust variance. Third, it allows us to study the collective effects of market prices by examining the hazard rate estimated from each individual firm's explanatory variables.

By investigating the entire sample of the firms in NYSE, Amex, and NASDAQ stock markets whose stock price rises or drops more than ten, fifteen, seventeen and a half, and twenty percent in a trading day during past thirteen-year[1] period and using five factors as covariates, we find a very interesting result that there exists asymmetry in considering the determinants which affect the likeliness of stock prices to move upward and downward acutely. Since the empirical results are profound in many aspects, we first present the results of a big gain in stock prices. While we examine a sharp increase in stock prices, all five factors are significantly related to the likeliness of the events of price gains over 10%, 15%, 17.5%, and 20%. Among these factors, the market factor is the most important explanatory variable to explain the probability of stock price to rise more than 10%. However, as we consider stock prices rises more than 15, 17.5%, and 20%, liquidity factor becomes the most important factor. It implies that it is a good strategy for an investor to chase a stock whose price rises more than 15% a day if the big gain in stock price is accompanied by an increase in turnover rate.

Furthermore, size factor is positively related to the possibility of price rises over ten percent. To our surprise, the estimates for size factor are not positively related to the likeliness any more while the prices rises more than 15%, 17.5%, and 20%. Even more, size factor is significantly negatively related to the possibility of the events in those cases. It indicates that it is more unlikely for a large firm's stock price to move upward more than 15%, 17.5%, and 20% daily, no matter with or without frailty effects[2]. The momentum effect for the abnormal change in stock prices is undergoing until stock prices rises more than 15% daily. The momentum effect goes away when stock prices rise more than seventeen and a half percent, also is true for twenty percent, without frailty effect. It implies that the probability for stock price to keep rising in a trading day after a 17.5 % gain is low. We do, however, observe that the momentum effect stays for all levels of stock price changes if frailty effects are taken into account. The book-to-market factor, which can be seen as a value/growth indicator, is always positively related to the probability of the events to occur, with significant but minor effects. This factor has been investigated thoroughly in Fama and French (2008) by decomposing it into three different components which convey independent information about expected cashflows that can help estimates of expected returns. The results we obtained here is similar to those of Fama and French (2008), but their importance are quite different.

The empirical evidences obtained here for the events of stock prices collapse

[1] The reason we only collect data for 13 years is that many firms in NASDAQ market established less than 13 years. Considering the representative firms in NASDAQ, we limit our sample to 13 years.

[2] The frailty effect is regarded as the effect which comes from some unobservable variables. The model with frailty effect is defined later.

give us a totally different story. First of all, the candidate for the most important factors switches to momentum effect instead of liquidity factor. The possibility for a firm's stock price drops more than 10%, 15%, 17.5%, and 20% is positively related to momentum effect, with or without frailty effect. That means the likeliness of a sharp decline in stock prices is higher if the stock return in the previous trading day is positive. That is, a sharp decline in stock prices is likely to happen as a surprise to the investors since the returns in the preceding day is positive.

Moreover, without considering frailty effect, the book-to-market ration has no longer any effects on the possibility of the stock prices to decline. Even when frailty effect is considered, the signs of the estimates for the book-to-market ratio are always negative, which is contrary to the case of stock prices rises. Our results for the unusual changes in stock prices are consistent with earlier work. Specifically, stocks typically move to high expected returns value portfolios as a result of low growth in book equity accompanied by even sharper declines in stock prices (Fama and French (1995)). The market factor will only affect that of stock prices drop more than 17.5% and 20%, but not 10% and 15%. It implies that market factor is likely to affect a firm's stock price while it declines more than 17.5% and 20%. If a stock price decreases in the range of 15%, the market factor provide no explanatory power to explain it. Thus, it is reasonable for us to expect that as market crashes, individual stock's price is more likely to collapse.

The asymmetry effects arising from the likeliness of stock prices move up or down are very important in identifying risk factors which affect the likeliness of an unusual change in stock prices in different aspects. To disentangle the effects across the different trading markets, we provide estimates for three different stock exchanges, namely NYSE, Amex, and NASDAQ, respectively. It is interesting to compare the results for NYSE and those for the NASDAQ exchanges since most of the NYSE constituents are large firms in traditional industries but most of the firms in NASDAQ are middle or small firms in high-tech industries. The most important factor to explain the likeliness of a firm's stock price in NYSE increases sharply is momentum effect rather than market factor and liquidity which are most influential on a big gain in stock prices of the firms in NASDAQ. The results shed some light on the fact that it is likely for the high-tech firms to drop with the market at 10%, and keep declining if the turnover rate is getting higher. As for NYSE firms, if the stock return in the preceding day is positive, the stock price in next day is likely to have a big gain. Our empirical results are similar to those of Nguyen, Fetherston and Batten (2004), but differ in many aspects. They confirm that the relationship between size, book-to-market, beta and stock returns in information technology stocks is different from that in other non-financial stocks.

Finally, the evidences of estimations on hazard functions reveal that with the influences caused by the explanatory variables, a sharp increase in stock prices is prominent in bear market, and a sharp decline in stock prices is more likely in bull market. The phenomenon we observe here is contrary to our intuition in a sense that we expect to have more sharp increase in stock prices when the market is good and vice versa. However, it has been used for a rule of thumb to distinguish a bull market from a bear market that stock prices increase gradually with sharp drops during the bull market and the opposite is true during the bear market.

The remaining portion of this article is organized as follows. In Section I, we provide descriptions of financial models used in this study. The empirical results are presented and discussed in Section II, and Section III contains the concluding remarks.

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Table 1 Model Estimations for stock prices increasing by more than 10%

	VWR	ME	BM	Mom	Liq		
	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_4$	$\hat{\beta}_5$	Likelihood ratio test	adjusted R-square
entire sample							
Model 1	2.1800***	0.00001***	0.0209***	0.1620***	0.5310***	1733***	0.025
	(0.3130)	(0.0000)	(0.0009)	(0.0121)	(0.0295)		
Model 2	1.6700***	0.00001***	0.0087***	0.1710***	0.5490***	25283***	0.306
	(0.3310)	(0.0000)	(0.0014)	(0.0083)	(0.0311)		
New York Stock Exchange							
Model 1	0.0071	0.00001***	0.0501	2.9100***	0.1020***	470***	0.071
	(0.0100)	(0.0000)	(0.0138)	(0.2880)	(0.0097)		
Model 2	-0.0085	0.00001***	-0.0060	3.5800***	0.0830***	3730***	0.442
	(0.0105)	(0.0000)	(0.0180)	(0.2730)	(0.0117)		
American Stock Exchange							
Model 1	0.8503	-0.0002*	0.0026	0.1143***	7.6556***	223***	0.03
	(1.0300)	(0.0000)	(0.0056)	(0.0235)	(0.9320)		
Model 2	0.8280	-0.0001 **	-0.0116	0.1120***	8.9800***	2816***	0.316
	(1.0600)	(0.0000)	(0.0088)	(0.0185)	(0.9910)		
NASDAQ Stock Market							
Model 1	1.9100***	0.00001**	0.0166***	0.4210***	0.5130***	602***	0.011
	(0.3560)	(0.0000)	(0.0011)	(0.0242)	(0.0319)		
Model 2	1.3500***	0.00001	0.0080***	0.4480***	0.5470***	15300***	0.241
	(0.3750)	(0.0000)	(0.0015)	(0.0166)	(0.0319)		

*Note. * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level*

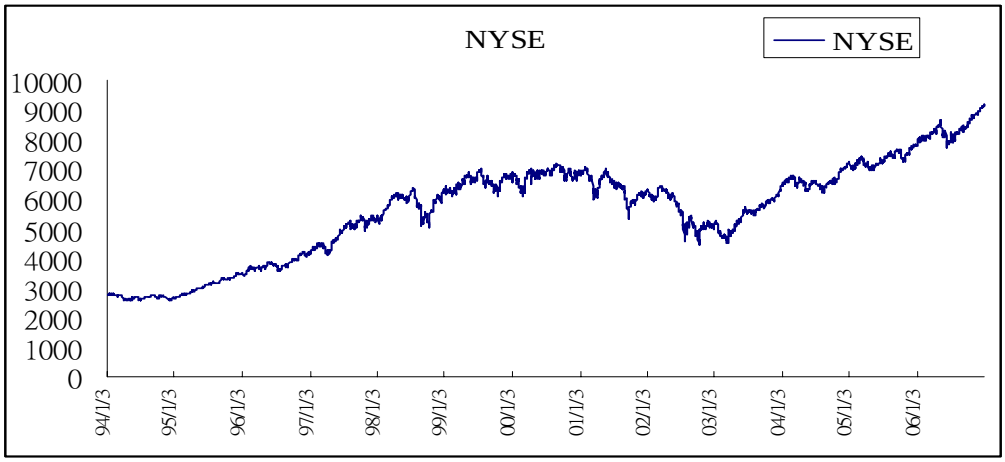

Figure 8: The price trend from 1994 to 2006 of NYSE

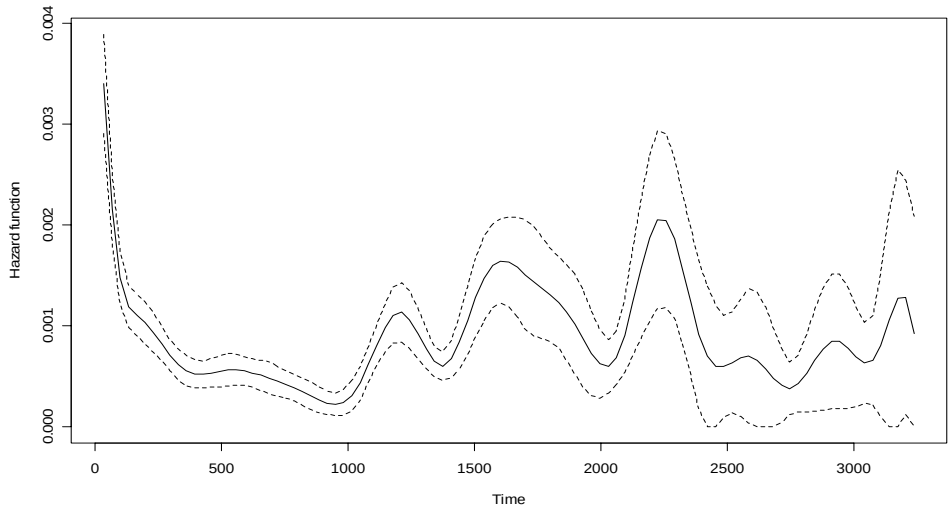

Figure 9: NYSE's hazard function for stock prices increasing by more than 15%

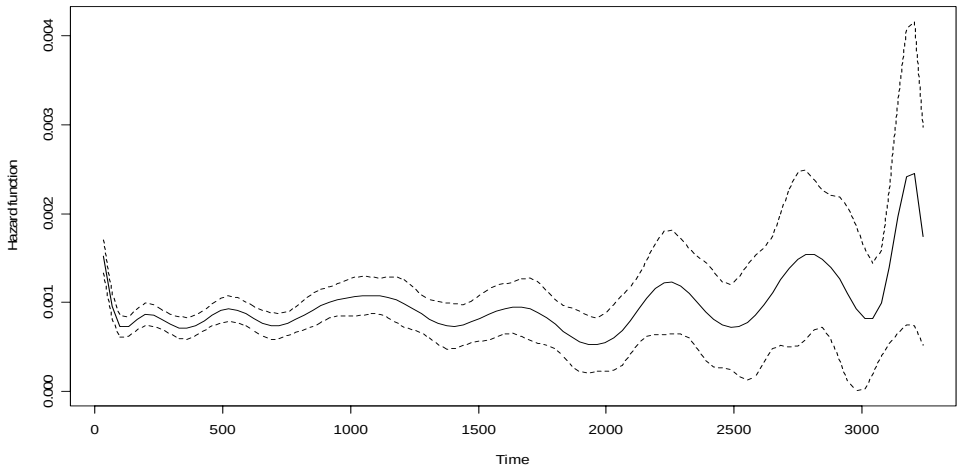

Figure 10: NYSE's hazard function for stock prices decreasing by more than 15%