Impact of Volatility and Perceived Risk on Return in Chinese Stock Market

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Abstract

This research examines the relationship between stock returns and volatility in the Chinese stock market and finds that in contrast with the negative relationship between market returns and volatility in mature stock markets, their relation in the Chinese stock market is dependent on whether market returns are positive or negative. The contemporaneous volatility or its change is the most important factor in determining market returns. The relationship between market returns and volatility observed in this study is consistent with a behavioral explanation with extrapolation bias and herding instinct rather than those relating to a longer-term lagged effect between market returns and volatility. Combination of contemporaneous and lagged perceived risk, as measured by the lower partial moments, and volatility has more explanatory power for market returns than just contemporaneous and lagged volatility (or their changes). The perceived risk and market returns have a negative relationship in the Chinese stock market.

Keywords: lower partial moment; return; stock market**;** perceived risk; volatility;

JEL: G02; G10

1. Introduction

The modern portfolio theory was developed in 1950's by Harry Markowitz, one of the most important concepts in this theory is the relationship of market returns and volatility, i.e. expected returns are positively related to volatility. However, empirical evidence seems to show a negative relation between realized market returns and volatility (Bollerslev et al., 2007). To explain this negative relation between market returns and volatility, two theories have been put forward. The first theory is the leverage effect hypothesis, introduced by Black (1976) and further developed by Christie (1982), which assumes that changes in market volatility are caused by changes in stock prices. When the price of a stock drops, the debt to equity ratio of the firm (or, leverage of the firm) increases; an increase of the leverage will increase shareholder's risk, thus push up the future volatility of stock returns. However, Christie (1982) and Schwert (1989) argue that empirically testing the leverage effect may have some measurement problems, because it is very difficult to correctly measure a firm's leverage. An empirical study using daily data by Schwert (1989) fails to find any supportive evidence. More recent studies from Figlewski and Wang (2001) and Bloowerslev and Zhou (2006) also confirm that changes in volatility cannot simply be explained by changes in firms' financial leverage.

An alternative explanation for the negative relationship between market returns and volatility is the volatility feedback hypothesis (French, Schwert and Stambaugh, 1987; Campbell and Hentschel, 1992), which focuses on how returns can be affected by changes in stock's volatility.

In a theoretical model by Campbell and Hentschel (1992), they show that increase in current period volatility will increase future expected return, in the absence of news of future cash flow, higher future expected return means an immediate price drop, thus we should observe a negative current period return when volatility rise. Volatility feedback hypothesis is supported by Glosten et al. (1993) and Engle and Ng (1993) in their various GARCH models testing. Comparison studies by Bekaert and Wu (2000) and Wu (2001) find volatility feedback effect received more empirical support compared with leverage effect. Real market data suggest that both "good news" and "bad news" will increase market volatility, while studies by Bekaert and Wu (2000) and Wu (2001) find that volatility responds differently to positive and negative returns, and the relation of return and volatility is stronger in the market down-turn partition (Glosten, Jagannathan and Runkle, 1993; Engle and Ng, 1993; Low, 2004), especially, Hibbert, Daigler and Dupoyet (2008) report that volatility is consistently and significantly negatively related to both contemporaneous return and lagged return in their negative return partition regressions.

Above studies all focus on well-developed capital markets; a mature capital market has the characteristics of dominant position of institutional investors, more rational investment behaviors and less market volatility (Ross, 1998). The relationship between market returns and volatility has not been well studied in emerging capital markets such as the Chinese stock market. The Chinese stock market has some very unique characteristics compared to well-developed capital markets. Shares in the Chinese stock market are classified into negotiable shares and non-negotiable[1] shares, and negotiable shares are shares that listed in either Shanghai or Shenzhen Stock market and can be traded among different investors. According to the annual report by China Securities Depository and Clearing Corporation (CSDCC), by the end of 2009, negotiable shares account 99.49% of total shares issued. The Chinese capital market is well known for its large number of individual investors; 97.67% of the total trading accounts in China belong to individual investors, and 92.01% [2]of these individual accounts have market values less than 0.1 million RMB, while institutional investors[3] only control 54.62% of the total market value of listed shares in the Chinese A-share market, as reported in CSDCC report in early 2009. Yates, Lee and Bush (1997) report that investors in Asia have more behavioral bias than US based investors, and individual investors tend to follow the market trend to make their investment decision.

Thus individual investors start to buy shares when the stock market has already risen for a period of time; and they tend to sell after they observe share prices have dropped substantially from their high point. Moreover, individual investors usually have less experience or knowledge using financial derivatives to control the risk, which is likely to result in extra volatility in the Chinese capital market. Therefore, the Chinese capital market provides us an ideal opportunity to examine the relationship between market returns and volatility in a market that is dominated by less rational individual investors. The aim of the present study is to examine the market return-volatility relationship in the Chinese stock market.

There are generally three lines of literature on the proxy of volatility: the simplest one is the directly observed realized market-based volatility, which use standard deviation or sum of squared returns. The second method is the expected volatility (Whaley, 2000); this proxy is generally derived by calculating implied volatility from the option market and only available in well-developed financial market with well-functioned derivative products. Even in well-developed financial market, options are only available for a modest portion of public traded firms. Index option was introduced into Chinese stock market in 2010, thus we are unable to use implied volatility in this research. The third method is the volatility based on certain ARCH or stochastic volatility models. However, Koopman and Uspensky (2002) and Smith (2007) show that the volatility feedback hypothesis highly depends on the formulation of either ARCH or other stochastic models, and the length of volatility calculation horizon can also affect the test results (Harrison and Zhang, 1999). Thus a model-based volatility is unable to provide reliable testing results for the return-volatility relationship. Furthermore, there is also evidence which suggests that realized volatility can be a consistent estimator of actual volatility (Anderson and Bollerslev, 1998; Barndorff-Nielsen and Shephard, 2001). For above reasons, we use realized standard deviation of aggregate return as proxy of volatility.

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[1] Non-negotiable shares in China includes: State-owned share; State-owned legal person share; Domestic legal person share; foreign legal person share and staff shares.

[2] Above data are reported by China Securities Depository and Clearing Corporation, at early 2009.

[3] Institutional investors in China include: securities companies; securities investment fund; social securities fund; QFII; banks, trust; insurance companies; investment companies; fund management companies; and other financial companies.

In Markowitz's study, the return-volatility relation is a proxy of the return-risk relation. However, using objective measures of risk such as standard deviation may not adequately reflect investors' subjective perception of risk. Roy (1952) is the first to point out that investors prefer safety of their principle first and prefer investment with smallest probability of going below a target level. Farrelly and Reichenstein (1984) show that investors' perception of and reaction to risk is essential to understanding how risk affects stock price. Lipe (1998) demonstrates with an experimental study that using only variance/ standard deviation as description of risk might be inadequate. Following Roy (1952)'s suggestions, Bawa (1975) and Fishburn (1977) developed the Lower Partial Moment (LPM) method to improve measurement of downside risk, and empirical studies generally demonstrate that LPM is a better risk proxy than the traditional variance/ standard-deviation measurement (Unser, 2000). Survey studies by Olsen (1997) find investment experts define risk as the potential for a large loss, while DeBondt (1993) shows that "downward potential" can affect people's investment decision. Unser (2000) uses an experimental study to compare LPMs and several traditional risk measures (e.g., variance) and demonstrate that LPMs are most closely correlated to investors' risk perceptions. In the present study, we also look into the influence of perceived risk as measured by LPMs on returns in the Chinese stock market. We do not choose the method to survey the investment professionals for assessing subjective risk, because we find it is difficult to continuously update such surveys.

This study examines the return-volatility relationship in the Chinese stock market between 1991 and 2008 as well as the influence of LPMs. Both weekly and monthly return-volatility and LPM series are investigated in order to address the concern that return-volatility series maybe highly correlated in shorter evaluation periods. We find that the return-volatility relationship is return-dependent in the Chinese stock market by using contemporary realized aggregate market returns and realized standard deviations. Positive innovations to returns are correlated to positive innovations to volatility; negative innovations to returns are correlated to negative innovations to volatility; and these effects are more pronounced in extreme market return quintiles. We also find that combination of volatility and perceived risk measurement is superior to the traditional standard deviation method in explaining innovations in market return. This phenomenon might be explained by the dominant position of Chinese individual investors in the stock market, and the strong "disposition effect" from these individual investors. The rest of the paper is organized as follows: Section 2 describes our data and develops our hypotheses; Section 3 presents our main results and behavioral explanations of return-volatility relation in Chinese stock market. Section 4 concludes this paper.

2. Data and Hypotheses

2.1 Data Description

The individual firm's return data are collected from the China Stock Market and Accounting Research Database (CSMAR) from 1991 to the end of 2008. We use aggregate market returns as proxy for realized returns, and the aggregate market return is the sum of value-weighted returns for all the firms traded in that particular week or month. The realized weekly and monthly standard deviation is used as proxy for the realized volatility, and it is calculated as:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2} \ . \qquad (1)$$

where μ is the average daily return over the calculation period and x_i is the daily aggregate market return in each calculation period (either weekly or monthly). In total, we have 912 pairs of weekly aggregate market return and realized weekly standard deviation observations and 216 pairs of monthly aggregate market return and realized monthly standard deviation observations between 1991 and 2008.

As shown in Panel (a) of Table 1, the average of aggregate weekly market returns is around 0.36%, significantly larger than 0 at 10% level and that of aggregate monthly market returns is 1.7%, also significant at 10% level. While the realized standard deviation (all samples) is about 1.85% and 2.04% for weekly and monthly data respectively, both of them are significant at 1% level.

The average weekly realized standard deviation is 1.85% for positive return group and 1.86% for negative return group; the difference in volatility (standard deviation) between positive and negative return groups is not significant from zero, similar results also found in monthly standard deviations (Table 1). Panel (b) of Table 1 summarized the realized standard deviations by return quintiles, where Quintile 1 (extreme positive returns) contains top 20% of return samples, and Quintile 5 (extreme negative returns) contains bottom 20% of all return samples. The difference in realized standard deviations between Quintile 1 and Quintile 3 is about 0.93% per week and 1.45% per month, and that between Quintile 5 and Quintile 3 is 1% per week and 1.12% per month, all of them are significant at 1% level.

Table 1: Sample Statistics

Panel (a)

	Weekly Sample		**Monthly Sample**	
All Sample (Combined)	Mean	Median	Mean	Median
Realized Return	0.0036*	0.0003	0.0177*	0.0038
Realized Volatility (STDEV)	0.0185***	0.0140	0.0204***	0.0166
Positive Return Partition				
Realized Return	0.0401	0.0239	0.1086	0.0647
Realized Volatility (A)	0.0185	0.0143	0.0214	0.0180
Negative Return Partition				
Realized Return	-0.0333	-0.0234	-0.075	-0.0627
Realized Volatility (B)	0.0186	0.0137	0.0193	0.0157
Difference of Realized Volatility (A-B)	0.0001		-0.0021	

Panel (b)

	Weekly Sample		**Monthly Sample**	
	Mean	Median	Mean	Median
Quintile 1 (Extreme positive return)	0.0243	0.0183	0.0287	0.0246
Q2	0.0146	0.0125	0.0177	0.0146
Q3	0.0149	0.0113	0.0142	0.0124
Q4	0.0137	0.0108	0.0158	0.0135
Quintile 5 (Extreme negative return)	0.0249	0.0196	0.0254	0.0248
Realized Volatility Difference (Q1-Q3)	0.0093***		0.0145***	
Realized Volatility Difference (Q5-Q3)	0.0100***		0.0112***	

Note: Panel a sorts returns into positive return and negative return groups, and Panel b sorts returns into 5 quintiles, with Quintile 1 contains the highest return samples and Quintile 5 contains the lowest return samples. *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

Table 2 shows the Portmanteau test for the serial correlation of weekly and monthly realized returns and realized volatility. The weekly realized aggregate market returns are serially correlated up to lag 10, while there is no such strong autocorrelation effect in our monthly return samples. The realized volatility has a much stronger autocorrelation effect for both weekly and monthly standard deviation series, even after lag 30. Similar return and volatility characteristics are also documented in Thomakos and Koubouros (2004), where they show that realized returns and volatility are also autocorrelated up to lag of 30 in the Athens stock market.

Table 2: Portmanteau teat for the serial correlation

	Weekly Return		Weekly STDEV	
Lag	Q Value	P-Value	Q Value	P-Value
1	7.34	0.01	171.70	0.00
2	7.55	0.02	243.67	0.00
3	9.47	0.02	287.84	0.00
4	10.76	0.03	366.76	0.00
5	12.39	0.03	415.65	0.00
6	12.85	0.05	457.13	0.00
7	12.99	0.07	517.63	0.00
8	14.44	0.07	568.25	0.00
9	14.73	0.10	603.88	0.00
10	14.81	0.14	624.52	0.00
15	16.99	0.32	732.00	0.00
20	18.73	0.54	792.14	0.00
25	24.23	0.51	839.04	0.00
30	35.81	0.21	883.72	0.00

	Monthly Return		Monthly STDEV	
Lag	Q Value	P-Value	Q Value	P-Value
1	1.31	0.25	53.08	0.00
2	1.51	0.47	85.03	0.00
3	1.54	0.67	102.51	0.00
4	1.88	0.76	110.40	0.00
5	2.19	0.82	119.04	0.00
6	2.96	0.81	125.29	0.00
7	6.98	0.43	136.73	0.00
8	8.35	0.40	149.21	0.00
9	15.32	0.08	164.54	0.00
10	18.87	0.04	170.00	0.00
15	20.83	0.14	197.77	0.00
20	28.83	0.09	221.29	0.00
25	35.72	0.08	261.34	0.00
30	38.95	0.13	307.65	0.00

2.2 Perceived Risk Calculation

To derive subjective risk (perceived risk), this research uses market index as a basis to measure market-wide downside risk, because market index is directly observable for investors. We apply the same method as in Unser (2000) and use LPMs as proxy for perceived risk in the Chinese stock market, the formula for calculating LPMs is:

$$LPM = \frac{1}{K} * \sum_{T=1}^{K} [MAX(0, (\frac{TA - I_t}{TA})]^2 \quad (2)$$

Where I_t is the daily Shanghai Composite Market Index in each examination period, TA is the reference point to calculate the downward potential, and K is the number of daily observations for calculating weekly and monthly LPMs.

Most empirical studies use average index value within each examination period as the reference point to calculate the LPM value, but Unser (2000) finds that it is better to use starting value as the reference point for capturing investor’s risk judgment. Using starting value as reference points is closer to the real investment behavior, since most investors tend to measure their gain or loss based on their starting investment value. Therefore, we set TA equals to the starting market index in each weekly / monthly examination period, to calculate downward potential.

Table 3: Correlation Matrix of Standard Deviation and Perceived Risk

Panel (a): weekly series

	SD	SD t-1	SD t-2	SD t-3	LPM	LPM t-1	LPM t-2	LPM t-3
SD	1.0000							
SD t-1	0.4384	1.0000						
SD t-2	0.2841	0.4387	1.0000					
SD t-3	0.2239	0.2836	0.4390	1.0000				
LPM	0.3136	0.2858	0.0872	0.1099	1.0000			
LPM t-1	0.1563	0.3135	0.2858	0.0871	0.0610	1.0000		
LPM t-2	0.1239	0.1580	0.3137	0.2876	0.0316	0.0614	1.0000	
LPM t-3	0.1247	0.1237	0.1581	0.3136	0.0845	0.0316	0.0619	1.0000

Panel (b): monthly series

	SD	SD t-1	SD t-2	SD t-3	LPM	LPM t-1	LPM t-2	LPM t-3
SD	1.0000							
SD t-1	0.4937	1.0000						
SD t-2	0.3846	0.4936	1.0000					
SD t-3	0.2854	0.3840	0.4914	1.0000				
LPM	0.2692	0.1115	0.1777	0.1499	1.0000			
LPM t-1	0.3333	0.2699	0.1141	0.1795	0.1733	1.0000		
LPM t-2	0.2607	0.3342	0.2733	0.1160	0.3675	0.1727	1.0000	
LPM t-3	0.2837	0.2606	0.3261	0.2680	0.1226	0.3775	0.1802	1.0000

Note: This table reports the correlation matrix between standard deviation and lower partial movement (LPM). SD is the traditional risk measurement: standard deviation. SD t-1, SD t-2, SD t-3 are the lag standard deviation for past three periods. LPM is the perceived risk measurement, LPMt-1, LPM t-2, LPM t-3 are the lag perceived risk for past three periods.

Panel (a) of Table 3 shows the correlation matrix of traditional risk measurement (standard deviation) and perceived risk measurement (LPMs), including the contemporary risk measurement as well as lagged risk measurements between period t-1 to period t-3. The correlation coefficient between contemporary weekly realized standard deviation and perceived risk is 0.31, while the correlation coefficient between lagged standard deviation and lagged LPMs are generally below 0.3, suggesting that perceived risk measure is not highly correlated with traditional risk measurement. Similar monthly correlation can also be found in Panel (b) of Table 3, where the correlation between monthly standard deviation and perceived risk is generally lower than 0.3.

2.3 Hypothesis Development

According to the volatility feedback hypothesis, contemporary returns are determined by innovations to volatility, and as shown in Section 2.1 realized volatility has stronger autocorrelation than the realized return series. To examine market return-volatility relation in the Chinese stock market, we develop the following hypotheses:

Hypothesis 1: contemporaneous realized volatility is the most important factor that determines the current realized market return.
Hypothesis 2: lagged volatilities are also important factors used by market to determine current returns, and the lagged change of volatility has a significant effect on realized returns if the volatility feedback effect also exists in the Chinese stock market.

Our regression model 1 is designed for Hypothesis 1, to examine both contemporary volatility and lagged volatility and their influence on contemporaneous realized returns.

Model 1:
$$r = a + \beta_1 * \mathrm{Vol}_t + \beta_2 * \mathrm{Vol}_{t-1} + \beta_3 * \mathrm{Vol}_{t-2} + \beta_4 * \mathrm{Vol}_{t-3} \quad (3)$$

Where r is the contemporary realized return and Vol_t are the contemporary realized volatility, Vol_{t-i} are used to stand for volatilities in the previous 1 to 3 period (lagged 1 to 3 periods).

Regression model 2 is used to test the relationship between market returns and innovations to realized volatility in the Chinese stock market.

Model 2: $$r = a + \beta_1 * \Delta Vol_t + \beta_2 * \Delta Vol_{t-1} + \beta_3 * \Delta Vol_{t-2} + \beta_4 * \Delta Vol_{t-3} \quad (4)$$

Where r is the contemporary realized return and ΔVol is the change of volatility over previous several periods.

Hypothesis 3: perceived risk measurement LPMs can supplement standard deviations (SD) in explaining volatility feedback effect in the Chinese stock market.

Model 3: $$r = a + \beta_1 * SD_t + \beta_2 * SD_{t-1} + \beta_3 * SD_{t-2} + \beta_4 * SD_{t-3} + \beta_5 * LPM_t + \beta_6 * LPM_{t-1} + \beta_7 * LPM_{t-2} + \beta_8 * LPM_{t-3} \quad (5)$$

Model 4: $$r = a + \beta_1 * \Delta SD_t + \beta_2 * \Delta SD_{t-1} + \beta_3 * \Delta SD_{t-2} + \beta_4 * \Delta SD_{t-3} + \beta_5 * \Delta LPM_t + \beta_6 * \Delta LPM_{t-1} + \beta_7 * \Delta LPM_{t-2} + \beta_8 * \Delta LPM_{t-3} \quad (6)$$

Model 3 and Model 4 are used directly to compare the perceived risk and traditional risk measurement in the risk-return relation analysis.

Empirical evidence from Bekaert and Wu (2000) and Wu (2001) shows that volatility responds differently to positive and negative returns and the relation between market returns and volatility is stronger in the market down-turn partition, this phenomenon is called volatility asymmetry, and thus we further develop our hypothesis 4.

Hypothesis 4: The relationship between realized market returns and volatility is dependent on whether the market returns are positive or negative in the Chinese stock market, and is more pronounced at the extreme return partitions.

We test the above hypotheses by dividing the data into market up-turn and down-turn partitions or into different quintiles according to their returns.

3. Results and Behavioral Explanations

3.1. Relationship between realized returns and volatility (weekly series)

We first examine the relationship between realized market returns and volatility in the Chinese stock market, where realized volatility is measured by realized standard deviation of each weekly examination interval.

Model 1 is the regression of contemporaneous realized aggregate market returns on realized volatility and lagged volatility over previous 3 periods. As shown in Panel (a) of Table 4, the contemporaneous realized volatility is the only factor that is significant in our all sample regression (Model 1), which supports hypothesis 1 that contemporaneous realized volatility is the most important factor that determines the current realized market return. However, in contrast with findings in mature capital markets, the contemporaneous realized volatility has a significantly positive influence on the realized current market returns in the Chinese stock market. Since the R^2 is very small in this regression, one explanation is that the relationship between realized market returns and volatility depends on the sign of market return.

Table 4: Realized Volatility, Perceived Risk and Aggregate Market Return (Weekly series)

Panel (a)

	All Sample		Positive Return		Negative Return	
	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)
SD	0.6705***	0.9487***	2.3776***	2.4271***	-0.9386***	-0.8232***
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
SD t-1	-0.0084	0.2734*	0.1995	0.2591	0.1742*	0.2464***
	(0.9580)	*(0.0850)*	*(0.3620)*	*(0.2530)*	*(0.0580)*	*(0.0090)*
SD t-2	-0.1179	1.5070*	-0.2940	-0.4419**	-0.1262	-0.1023
	(0.4550)	*(0.0850)*	*(0.1140)*	*(0.0210)*	*(0.2250)*	*(0.3530)*
SD t-3	-0.0154	0.0839	0.2440	0.3781*	-0.0494	-0.0039
	(0.9170)	*(0.5800)*	*(0.2130)*	*(0.0720)*	*(0.5780)*	*(0.9660)*
LPM		-10.2100***		-6.9952***		-2.3053***
		(0.0000)		*(0.0010)*		*(0.0020)*
LPM t-1		-2.1777*		1.0293		-0.7107
		(0.0900)		*(0.6700)*		*(0.3010)*
LPM t-2		-0.6014		5.1935**		-0.9262
		(0.6400)		*(0.0150)*		*(0.1880)*
LPM t-3		-2.1658*		-2.2424		-1.4123
		(0.0880)		*(0.1470)*		*(0.1020)*
Intercept	-0.0064	-0.0113***	-0.0058	-0.0078	-0.0161***	-0.0177***
	(0.1200)	*(0.0050)*	*(0.2760)*	*(0.1480)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.0223	0.0918	0.3308	0.3567	0.2319	0.2455

Note: Table 4 reports the relation of realized weekly aggregate market return, contemporary / lagged standard deviation and contemporary/ lagged perceived risk. Model 1: r = a+β1* Volt+β2*Volt-1 +β3*Volt-2 +β4*Volt-3; Model 3: r = a+β1* SDt+β2*SDt-1 +β3*SDt-2 +β4*SDt-3 +β5* LPM+β6*LPMt-1 +β7*LPMt-2 +β8*LPMt-3. SD is the traditional risk measurement: standard deviation. SD t-1, SD t-2, SD t-3 are the lag standard deviation for past three periods. LPM is the perceived risk measurement, LPMt-1, LPM t-2, LPM t-3 are the lag perceived risk for past three periods. P-values are in parentheses, *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

Table 4: Realized Volatility, Perceived Risk and Aggregate Market Return (Continue) (Weekly Series)

Panel (b)

	Quintile 1 (Extreme Positive Return)		Q2		Q3		Q4		Quintile 5 (Extreme Negative Return)	
	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)
SD	2.8875***	2.9616***	-0.0219	-0.0141	0.0321	0.0332	-0.0010	0.0006	-0.7151***	-0.6190***
	(0.0000)	*(0.0000)*	*(0.6260)*	*(0.7620)*	*(0.4390)*	*(0.5210)*	*(0.9830)*	*(0.9910)*	*(0.0000)*	*(0.0000)*
SD t-1	0.4666	0.2842	0.0069	-0.0072	-0.0426	-0.0428	0.0061	0.0119	-0.1973	-0.1661
	(0.2400)	*(0.5070)*	*(0.8630)*	*(0.8620)*	*(0.2470)*	*(0.3080)*	*(0.8330)*	*(0.6950)*	*(0.2000)*	*(0.2790)*
SD t-2	-0.4893	-0.7021*	0.0666**	0.0629*	-0.0399	-0.0417	0.0539	0.0907	-0.2262	-0.2544
	(0.1650)	*(0.0600)*	*(0.0390)*	*(0.0630)*	*(0.1940)*	*(0.1940)*	*(0.1360)*	*(0.0520)*	*(0.1650)*	*(0.1230)*
SD t-3	0.3523	0.4501	-0.0101	0.0303	0.0448	0.0549	-0.0452	-0.0480	0.1371	0.1276
	(0.2950)	*(0.2140)*	*(0.7940)*	*(0.5090)*	*(0.1800)*	*(0.1240)*	*(0.1810)*	*(0.2300)*	*(0.2690)*	*(0.3130)*
LPM		-33.4106**		0.0634		-0.3323		-0.1177		-3.4221***
		(0.0390)		*(0.7950)*		*(0.8230)*		*(0.6360)*		*(0.0020)*
LPM t-1		4.6716		0.2356		-0.0692		-0.3733		-0.3003
		(0.4340)		*(0.4810)*		*(0.8040)*		*(0.1150)*		*(0.8090)*
LPM t-2		4.2871		-0.0990		0.5035		-0.0438		0.0605
		(0.1730)		*(0.8900)*		*(0.4580)*		*(0.9690)*		*(0.9360)*
LPM t-3		-2.6986		-0.3112		-0.5006		-0.4620		-0.3377
		(0.4660)		*(0.1430)*		*(0.4480)*		*(0.6350)*		*(0.7120)*
Intercept	0.0030	0.0068	0.0182***	0.0177***	0.0003	0.0002	-0.0188***	-0.0190***	-0.0382***	-0.0358***
	(0.8130)	*(0.5960)*	*(0.0000)*	*(0.0000)*	*(0.6730)*	*(0.7890)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.4013	0.4117	0.0118	0.0059	0.0003	-0.0187	0.0004	-0.0062	0.2457	0.2766

Note: Table 4 reports the relation of realized weekly aggregate market return, contemporary / lagged standard deviation and contemporary/ lagged perceived risk. Model 1: r = a+β1* Volt+β2*Volt-1 +β3*Volt-2 +β4*Volt-3; Model 3: r = a+β1* SDt+β2*SDt-1 +β3*SDt-2 +β4*SDt-3 +β5* LPMt+β6*LPMt-1 +β7*LPMt-2 +β8*LPMt-3. SD is the traditional risk measurement: standard deviation. SD t-1, SD t-2, SD t-3 are the lag standard deviation for past three periods. LPM is the perceived risk measurement, LPMt-1, LPM t-2, LPM t-3 are the lag perceived risk for past three periods. Returns are sorted into 5 quintiles, with Quintile 1 contains the highest return samples and Quintile 5 contains the lowest return samples. P-values are in parentheses, *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

To test our hypothesis that the relationship between realized market returns and volatility is dependent on whether the market returns are positive or negative in the Chinese stock market, we did the regression analysis on positive and negative return partitions separately. We find that the contemporaneous realized volatility is significantly positively related to the realized current returns in upward market movements and significantly negatively related to the realized current returns in downward market movements, and the R^2 has a dramatic improvement for both positive and negative return partitions. R^2 is higher in the upward market movement partitions, suggesting the existence of volatility asymmetry in the Chinese stock market.

Panel (b) of Table 4 shows the regression results where returns are divided into 5 quintiles, with Quintile 1 containing highest positive returns and Quintile 5 containing lowest negative realized returns. Our results clearly show that a robust relationship between volatility and contemporaneous returns only exists in extreme return quintiles (either Quintile 1 or Quintile 5). Within two extreme return quintiles, the contemporaneous realized volatility is the factor that determines current market returns, and R^2 is also significantly improved in these two extreme return quintiles. These results support our hypothesis 4 that return-volatility relationship is stronger in extreme market movements.

3.2. Effect of perceived risk (weekly series)

Model 3 in Table 4 includes both contemporary/ lagged standard deviation and perceived risk measurement (LPMs); perceived risk is calculated as downward potential from market index. In all sample regression of Panel (a), we find both the contemporaneous realized standard deviation and the perceived risk are significant factors that determine the current realized weekly aggregate market return, but the contemporaneous LPM has a larger coefficient than the standard deviation. Moreover, while the return-volatility relation depends on the sign of realized market returns, the return-perceived risk relation is negative for both positive and negative market return partitions (Table 4); suggesting that downward potential is a significant factor for investors in both upward and downward market movement situations. The adjusted R^2 is much higher than that when perceived risk measurements are not included (9.18% vs. 2.23%).

When all weekly realized returns are divided into 5 quintiles (results shown in Panel (b) of Table 4), the improvement in regression robustness by including perceived risk is more pronounced in extreme return quintiles, where R^2 has reached 41.7% and 27.7% in Quintile 1 and 5 respectively. The combination of standard deviation and perceived risk has a much stronger explanatory power than standard deviation alone (our hypothesis 3). There is hardly any significant relation between returns and perceived risk in the middle 3 return quintiles, which again supports our Hypothesis 4.

3.3. Relationship between realized returns and changes in volatility (weekly series)

We now turn to regression model 2 and examine the relationship between market returns and changes in volatility (realized volatility in period t minus realized volatility in period t-1). Results are shown in Table 5, which are very similar to what we found in Table 4, confirming that contemporaneous changes in volatility determine current returns. Consistent with hypothesis 2, the lagged changes in volatility seem to be used by market to determine current returns as well. As shown in Panel (a) of Table 5, the lagged volatility variables are significant in both positive and negative return partitions. Again, the contemporaneous change in realized volatility has a significantly positive influence on the realized current market returns in the Chinese stock market, contradicting the findings in mature capital markets. Since the R^2 is also very small in this regression, it is likely that the relationship between realized market returns and changes in volatility depends on the sign of market returns.

The Panel (a) of Table 5 confirms that the relationship between realized market returns and changes in volatility depends on the sign of market returns. When the regression analysis is performed on positive and negative return partitions separately, the contemporaneous change in realized volatility is significantly positively related to the realized current return in upward market movements and significantly negatively related to the realized return in downward market movements. The R^2 also has a dramatic improvement for both positive and negative return partitions. R^2 is higher in the upward market movement partitions as well, suggesting the existence of volatility asymmetry in the Chinese stock market. An increase in volatility can further push up market returns when aggregate market returns are high; and an increase in volatility will reduce market returns even further when aggregate market returns are negative. The relationship between returns and volatility is less clear-cut in the 3 modest market movement quintiles (results shown in Panel b of Table 5).

Table 5: Change of Realized Volatility, Perceived Risk and Aggregate Market Return (Weekly series)

Panel (a)

	All Sample		Positive Return		Negative Return	
	Model (2)	Model (4)	Model (2)	Model (4)	Model (2)	Model (4)
ChSD	0.4722***	0.6586***	1.6204***	1.6870***	-0.6997***	-0.5975***
	(0.0010)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
ChSD t-1	0.3673**	0.6775***	1.2224***	1.3733***	-0.3912***	-0.2428**
	(0.0160)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0350)*
ChSD t-2	0.1732	0.3349**	0.5737***	0.5822***	-0.2927***	-0.1798
	(0.2570)	*(0.0350)*	*(0.0050)*	*(0.0080)*	*(0.0090)*	*(0.1240)*
ChSD t-3	-0.0160	0.1111	0.1179	0.1776	-0.1873*	-0.0787
	(0.9100)	*(0.4420)*	*(0.5150)*	*(0.3370)*	*(0.0730)*	*(0.4820)*
ChLPM		-7.4817***		-7.5122***		-1.9367***
		(0.0000)		*(0.0000)*		*(0.0080)*
ChLPM t-1		-6.9340***		-7.4088***		-2.1060**
		(0.0000)		*(0.0050)*		*(0.0150)*
ChLPM t-2		-4.4764***		-0.9306		-2.3721**
		(0.0020)		*(0.6750)*		*(0.0120)*
ChLPM t-3		-3.8356***		-0.9285		-2.1412***
		(0.0010)		*(0.5750)*		*(0.0070)*
Intercept	0.0037*	0.0037**	0.0405***	0.0390***	-0.0333***	-0.0329***
	(0.0780)	*(0.0690)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.0112	0.0556	0.1533	0.1809	0.0939	0.1095

Note: Table 5 reports the relation of realized weekly aggregate market return, change of contemporary / lagged standard deviation and change of contemporary/ lagged perceived risk. Model 2: $r = a+\beta 1*\Delta Volt+\beta 2*\Delta Volt\text{-}1 +\beta 3*\Delta Volt\text{-}2 +\beta 4*\Delta Volt\text{-}3$; Model 4: $r = a+\beta 1*\Delta SDt+\beta 2*\Delta SDt\text{-}1 +\beta 3*\Delta SDt\text{-}2 +\beta 4*\Delta SDt\text{-}3 +\beta 5*\Delta LPMt+\beta 6*\Delta LPMt\text{-}1 +\beta 7*\Delta LPMt\text{-}2 +\beta 8*\Delta LPMt\text{-}3$. ∆SD is the change of traditional risk measurement: standard deviation. ∆SD t-1, ∆SD t-2, ∆SD t-3 are the lagged change standard deviation for past three periods. ∆LPM is the change of perceived risk measurement, ∆LPMt-1, ∆LPM t-2, ∆LPM t-3 are the change of lag perceived risk for past three periods. Returns are sorted into 5 quintiles, with Quintile 1 contains the highest return samples and Quintile 5 contains the lowest return samples. P-values are in parentheses, *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

Table 5: Change of Realized Volatility, Perceived Risk and Aggregate Market Return (Continue)

(Weekly series)

Panel (b)

	Quintile 1 (Extreme Positive Return)		Q2		Q3		Q4		Quintile 5 (Extreme Negative Return)	
	Model (2)	Model (4)	Model (2)	Model (4)	Model (2)	Model (4)	Model (2)	Model (4)	Model (2)	Model (4)
ChSD	2.2700***	2.4297***	-0.0100	-0.0184	0.0600	0.0529	0.0200	-0.0132	-0.5600***	-0.4962***
	(0.0000)	*(0.0000)*	*(0.7100)*	*(0.6140)*	*(0.1200)*	*(0.2100)*	*(0.6700)*	*(0.7900)*	*(0.0000)*	*(0.0000)*
ChSD t-1	1.8000***	1.8712***	0.0000	-0.0159	0.0100	0.0055	0.0200	-0.0027	-0.4300***	-0.3314**
	(0.0000)	*(0.0000)*	*(0.9500)*	*(0.7210)*	*(0.7000)*	*(0.8790)*	*(0.6400)*	*(0.9590)*	*(0.0100)*	*(0.0440)*
ChSD t-2	0.5900*	0.4620	0.0500	0.0346	-0.0200	-0.0269	0.0800**	0.0768**	-0.4400***	-0.3701**
	(0.0900)	*(0.2070)*	*(0.1800)*	*(0.4020)*	*(0.5400)*	*(0.4700)*	*(0.0400)*	*(0.0670)*	*(0.0100)*	*(0.0370)*
ChSD t-3	0.1800	0.1444	0.0600**	0.0557	0.0500	0.0523	0.0400	0.0195	-0.1700	-0.1320
	(0.5900)	*(0.6670)*	*(0.0400)*	*(0.0830)*	*(0.1100)*	*(0.1240)*	*(0.2600)*	*(0.6080)*	*(0.2800)*	*(0.4060)*
ChLPM		-25.7929***		0.0794		0.2195		-0.0376		-2.6881**
		(0.0010)		*(0.7210)*		*(0.8010)*		*(0.8660)*		*(0.0150)*
ChLPM t-1		-13.1291**		0.2505		0.1396		-0.3249		-2.9874**
		(0.0270)		*(0.5210)*		*(0.8650)*		*(0.2590)*		*(0.0360)*
ChLPM t-2		-3.4017		0.1017		0.3897		0.0687		-3.4666**
		(0.4850)		*(0.7530)*		*(0.6160)*		*(0.9170)*		*(0.0180)*
ChLPM t-3		-0.4332		0.0026		-0.0013		0.1452		-3.7926**
		(0.8800)		*(0.9920)*		*(0.9990)*		*(0.4690)*		*(0.0130)*
Intercept	0.0700***	0.0628***	0.0200***	0.0191***	0.0000***	0.0003	-0.0200***	-0.0184***	-0.0600***	-0.0576***
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.4800)*	*(0.4690)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.2468	0.3001	0.0217	0.0478	0.0169	0.0414	0.0109	0.0483	0.1013	0.1275

3.4. Influence of changes in perceived risk (weekly series)

We use the Model 4 to analyze the influence of changes of perceived risk on current returns in the Chinese capital market. Regression results (Panel (a) and (b) in Table 5) confirm that changes in both standard deviation (contemporary and lagged) and perceived risk (contemporary and lagged) have significant influence on market returns. Even the 3 lagged perceived risk variables are significant in all sample regression, which indicates that changes in perceived risk in previous periods can significantly affect aggregate market returns. The return-perceived risk relation is negative in both positive and negative market return partitions, whereas the return-change in volatility relation is positive in the positive market return partition and negative in the negative market return partition (Table 5). This result appears to suggest a perceived risk feedback effect in the Chinese capital market instead of a volatility feedback effect. The magnitudes of coefficients on perceived risk variables are larger than those of standard deviations, which support our hypothesis that perceived risk contributes to the determination of market returns (Hypothesis 3). When all weekly realized returns are divided into 5 quintiles, the relationship between changes in perceived risk and returns is more pronounced in extreme return quintiles. The R^2 has increased to 30% and 12.7% for extreme positive return quintiles and extreme negative return quintiles respectively.

3.5. Relationship between realized returns, volatility and perceived risk (monthly series)

We re-run the above 4 models by using monthly series in both positive/ negative return partition and in 5 return quintiles, in order to address the concern that aggregate market returns may be highly correlated with market volatility when the calculation horizon is short. As shown in Panel (a) of Table 6, the contemporaneous realized monthly volatility is also highly correlated with aggregate market returns, and this relationship is positive when market returns are positive and negative when market returns are negative. When downward potential is included in the regression, perceived risk has stronger negative relations with aggregate market returns no matter whether market returns are positive or negative; which is same as the result from the weekly data series.

When the monthly series is divided into 5 return quintiles, a significant influence of the contemporaneous realized volatility on aggregate market returns exists only in the extreme positive return quintile, but perceived risk has a significant effect on market aggregate return exists in both extreme positive and negative return quintiles (Panel (b) of Table 6). The adjusted R squares from our monthly return series are generally higher than those from the weekly examination regressions. Table 7 shows the results of regression of market returns on changes in both volatility and perceived risk with the monthly data series. In the all sample regression, contemporaneous and lagged changes in perceived risk are still significantly negatively correlated with aggregate market return, whereas contemporaneous volatility is significantly positively correlated with aggregate market returns (Model 1 and Model 3). When returns are dividend into positive and negative return partitions, realized volatility has a significant positive effect in the positive return partition, while perceived risk has a significant negative effect in the negative return partition (Model 3, Panel (a) of Table 7). When only contemporaneous and lagged volatilities are used in the regression (Model 1), contemporaneous volatility has a significant positive effect in the positive market return partition and significant negative effect in the negative return partition (Panel (a) of Table 7). Further examining the regressions by return quintiles, we found significant influences of realized volatility and perceived risk on aggregate market returns only exist in extreme return quintiles, which is consistent with our hypothesis 4.

Table 6: Realized Volatility, Perceived Risk and Aggregate Market Return (Monthly Series)

Panel (a)

	All Sample		Positive Return		Negative Return	
	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)
SD	4.045***	5.424***	6.955***	7.577***	-2.743***	-1.040*
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0180)*
SD t-1	-0.9800	-1.754*	-2.399*	-1.9530	-0.0005	-0.3990
	(0.2730)	*(0.0240)*	*(0.0130)*	*(0.0500)*	*(0.9990)*	*(0.2910)*
SD t-2	-0.7370	0.0228	1.4570	1.6500	-0.1770	-0.1740
	(0.4100)	*(0.9760)*	*(0.1410)*	*(0.0940)*	*(0.7340)*	*(0.6670)*
SD t-3	0.4100	0.8400	-0.7550	-1.0030	-0.1440	0.6750
	(0.6240)	*(0.2340)*	*(0.3850)*	*(0.2460)*	*(0.7780)*	*(0.0870)*
LPM		-14.81***		-17.20*		-5.690***
		(0.0000)		*(0.0150)*		*(0.0000)*
LPM t-1		2.5750		0.8890		1.3300
		(0.1100)		*(0.6890)*		*(0.1010)*
LPM t-2		1.3100		-2.9060		0.7790
		(0.4180)		*(0.2280)*		*(0.2820)*
LPM t-3		-1.9960		-0.6480		-1.3960
		(0.2220)		*(0.7450)*		*(0.1320)*
Intercept	-0.0381	-0.0446*	-0.0017	-0.0114	-0.0153	-0.0338***
	(0.0810)	*(0.0160)*	*(0.9470)*	*(0.6570)*	*(0.1820)*	*(0.0000)*
Adj R sqr	0.0910	0.3720	0.4080	0.4410	0.2910	0.6350

Note: Table 6 reports the relation of realized monthly aggregate market return, contemporary / lagged standard deviation and contemporary/ lagged perceived risk. Model 1: r = a+β1* Volt+β2*Volt-1 +β3*Volt-2 +β4*Volt-3; Model 3: r = a+β1* SDt+β2*SDt-1 +β3*SDt-2 +β4*SDt-3 +β5* LPM+β6*LPMt-1 +β7*LPMt-2 +β8*LPMt-3. SD is the traditional risk measurement: standard deviation. SD t-1, SD t-2, SD t-3 are the lag standard deviation for past three periods. LPM is the perceived risk measurement, LPMt-1, LPM t-2, LPM t-3 are the lag perceived risk for past three periods. P-values are in parentheses, *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

Table 6: Realized Volatility, Perceived Risk and Aggregate Market Return (Continue) (Monthly Series)

Panel (b)

	Quintile 1 (Extreme Positive Return)		Q2		Q3		Q4		Quintile 5 (Extreme Negative Return)	
	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)
SD	7.168***	7.748***	-0.2470	-0.4910	-0.2590	-0.0295	-0.3930	0.0083	-0.8260	-0.2090
	(0.0000)	*(0.0000)*	*(0.4970)*	*(0.4390)*	*(0.5390)*	*(0.9510)*	*(0.2440)*	*(0.9820)*	*(0.2140)*	*(0.7000)*
SD t-1	-2.9230	-1.9540	0.1090	0.1410	0.1630	0.2060	-0.0803	-0.3120	0.3510	-0.0714
	(0.1750)	*(0.4050)*	*(0.6410)*	*(0.5800)*	*(0.6420)*	*(0.5890)*	*(0.7580)*	*(0.2640)*	*(0.5430)*	*(0.8790)*
SD t-2	3.8350	3.5330	0.3520	0.3910	0.0759	0.1460	-0.1720	-0.2300	-1.296*	-0.6540
	(0.0500)	*(0.0720)*	*(0.1300)*	*(0.1170)*	*(0.8300)*	*(0.7080)*	*(0.5160)*	*(0.4030)*	*(0.0410)*	*(0.2750)*
SD t-3	-3.0070	-4.3160	-0.364*	-0.366*	-0.2170	-0.3160	0.0815	0.1840	-0.1730	0.7280
	(0.1710)	*(0.0880)*	*(0.0330)*	*(0.0430)*	*(0.5130)*	*(0.4220)*	*(0.7630)*	*(0.5160)*	*(0.7810)*	*(0.1790)*
LPM		-29.04*		-1.2560		0.2790		-4.3320		-3.466***
		(0.0260)		*(0.7220)*		*(0.9400)*		*(0.0880)*		*(0.0000)*
LPM t-1		5.1230		0.1960		-0.9240		0.2710		0.2960
		(0.3260)		*(0.7330)*		*(0.1170)*		*(0.7290)*		*(0.8340)*
LPM t-2		-4.4850		0.2000		-0.6980		0.8780		0.6630
		(0.4130)		*(0.8420)*		*(0.4830)*		*(0.1560)*		*(0.4210)*
LPM t-3		2.8510		0.3900		1.2120		0.2760		-2.4490
		(0.5170)		*(0.5660)*		*(0.3000)*		*(0.6760)*		*(0.1030)*
Intercept	0.0617	0.0571	0.0535***	0.0547***	0.0068	0.0037	-0.0405***	-0.0407***	-0.0862***	-0.0902***
	(0.2970)	*(0.3430)*	*(0.0000)*	*(0.0000)*	*(0.2700)*	*(0.5860)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.4160	0.4540	0.0370	-0.0470	-0.0820	-0.1160	0.0340	0.1120	0.2150	0.5030

Note: Table 6 reports the relation of realized monthly aggregate market return, contemporary / lagged standard deviation and contemporary/ lagged perceived risk. Model 1: r = a+β1* Volt+β2*Volt-1 +β3*Volt-2 +β4*Volt-3; Model 3: r = a+β1* SDt+β2*SDt-1 +β3*SDt-2 +β4*SDt-3 +β5* LPMt+β6*LPMt-1 +β7*LPMt-2 +β8*LPMt-3. SD is the traditional risk measurement: standard deviation. SD t-1, SD t-2, SD t-3 are the lag standard deviation for past three periods. LPM is the perceived risk measurement, LPMt-1, LPM t-2, LPM t-3 are the lag perceived risk for past three periods. Returns are sorted into 5 quintiles, with Quintile 1 contains the highest return samples and Quintile 5 contains the lowest return samples. P-values are in parentheses, *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

Table 7: Change of Realized Volatility, Perceived Risk and Aggregate Market Return (Monthly Series)

Panel (a)

	All Sample		Positive Return		Negative Return	
	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)
ChSD	3.408***	3.914***	5.885***	5.944***	-1.563**	-0.5410
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0080)*	*(0.2220)*
ChSD t-1	2.128*	1.4270	3.115**	3.419**	-0.7440	-0.7050
	(0.0170)	*(0.0740)*	*(0.0050)*	*(0.0040)*	*(0.1840)*	*(0.0920)*
ChSD t-2	1.2750	0.9360	3.299**	3.886**	-1.237*	-1.231**
	(0.1510)	*(0.2430)*	*(0.0050)*	*(0.0020)*	*(0.0210)*	*(0.0030)*
ChSD t-3	1.772*	1.0780	2.1730	1.9980	0.0800	-0.0697
	(0.0270)	*(0.1330)*	*(0.0500)*	*(0.0730)*	*(0.8580)*	*(0.8360)*
ChLPM		-12.09***		-5.7440		-6.293***
		(0.0000)		*(0.0710)*		*(0.0000)*
ChLPM t-1		-6.988***		-4.1700		-3.446**
		(0.0000)		*(0.1500)*		*(0.0020)*
ChLPM t-2		-4.363*		-5.4980		-0.7960
		(0.0290)		*(0.0630)*		*(0.4410)*
ChLPM t-3		-3.754*		-5.757*		-0.1480
		(0.0180)		*(0.0110)*		*(0.8600)*
Intercept	0.0179	0.0184*	0.107***	0.0944***	-0.0729***	-0.0608***
	(0.0670)	*(0.0310)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.0770	0.2930	0.2960	0.3250	0.0660	0.5030

Note: Table 7 reports the relation of realized monthly aggregate market return, change of contemporary / lagged standard deviation and change of contemporary/ lagged perceived risk. Model 2: $r = a+\beta 1^* \Delta Volt+\beta 2^*\Delta Volt\text{-}1 +\beta 3^*\Delta Volt\text{-}2 +\beta 4^*\Delta Volt\text{-}3$; Model 4: $r = a+\beta 1^*\Delta SDt+\beta 2^*\Delta SDt\text{-}1 +\beta 3^*\Delta SDt\text{-}2 +\beta 4^*\Delta SDt\text{-}3 +\beta 5^*\Delta LPMt+\beta 6^*\Delta LPMt\text{-}1 +\beta 7^*\Delta LPMt\text{-}2 +\beta 8^*\Delta LPMt\text{-}3$. ΔSD is the change of traditional risk measurement: standard deviation. ΔSD t-1, ΔSD t-2, ΔSD t-3 are the lagged change standard deviation for past three periods. ΔLPM is the change of perceived risk measurement, ΔLPMt-1, ΔLPM t-2, ΔLPM t-3 are the change of lag perceived risk for past three periods. Returns are sorted into 5 quintiles, with Quintile 1 contains the highest return samples and Quintile 5 contains the lowest return samples. P-values are in parentheses, *, **, and *** denotes significance at 10%, 5% and 1% level, respectively.

Table 7: Change of Realized Volatility, Perceived Risk and Aggregate Market Return (Continue) (Monthly Series)

Panel (b)

	Quintile 1 (Extreme Positive Return)		Q2		Q3		Q4		Quintile 5 (Extreme Negative Return)	
	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)	Model (1)	Model (3)
ChSD	6.385***	6.636***	-0.0546	-0.3720	-0.0361	-0.1450	0.0260	0.3040	-0.0425	0.1660
	(0.0000)	*(0.0000)*	*(0.8680)*	*(0.3810)*	*(0.9220)*	*(0.7050)*	*(0.9300)*	*(0.3450)*	*(0.9490)*	*(0.7640)*
ChSD t-1	2.6940	4.2720	0.0256	-0.1590	0.1330	0.2050	0.1180	0.0559	0.7340	0.2110
	(0.2550)	*(0.1670)*	*(0.9190)*	*(0.6170)*	*(0.6390)*	*(0.4770)*	*(0.6590)*	*(0.8430)*	*(0.3240)*	*(0.7350)*
ChSD t-2	5.814*	7.238*	0.4210	0.2930	0.2540	0.4820	-0.3070	-0.2690	-0.7660	-1.0120
	(0.0230)	*(0.0260)*	*(0.0820)*	*(0.2950)*	*(0.4670)*	*(0.2350)*	*(0.2170)*	*(0.2740)*	*(0.2020)*	*(0.0670)*
ChSD t-3	1.8090	1.6770	0.1250	0.1930	0.0681	0.0534	-0.3350	-0.2730	0.0302	-0.3330
	(0.3910)	*(0.4750)*	*(0.6420)*	*(0.5070)*	*(0.6890)*	*(0.7510)*	*(0.2030)*	*(0.3090)*	*(0.9680)*	*(0.6430)*
ChLPM		-5.5700		0.8420		-0.4900		-0.6170		-3.851***
		(0.3050)		*(0.3990)*		*(0.6600)*		*(0.6110)*		*(0.0000)*
ChLPM t-1		-4.1690		1.3940		-1.3170		-0.4750		-1.3520
		(0.3890)		*(0.2220)*		*(0.2700)*		*(0.6430)*		*(0.3640)*
ChLPM t-2		-7.1120		1.5810		-3.3180		-0.5150		0.4820
		(0.2110)		*(0.1670)*		*(0.0690)*		*(0.5570)*		*(0.7250)*
ChLPM t-3		-4.5080		1.6760		-2.0660		-0.9920		0.6110
		(0.2330)		*(0.0770)*		*(0.1370)*		*(0.2280)*		*(0.5730)*
Intercept	0.182***	0.159***	0.0506***	0.0487***	0.0035	0.0027	-0.0494***	-0.0494***	-0.132***	-0.108***
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.1660)*	*(0.3190)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*
Adj R sqr	0.3490	0.3250	0.0350	0.0320	-0.0900	-0.0390	-0.0120	0.0560	0.0520	0.3720

3.6. Behavioral explanations of return-volatility/perceived risk relation in the Chinese stock market

Our regression results show that adding perceived risk as risk measurement has provided additional dimensions to the current volatility feedback hypothesis research. When volatility is represented by the traditional standard deviation method, our regression model 2 suggests positive innovations to the volatility associated with higher positive market returns in positive return partition, and positive innovations to the volatility associated with negative market returns (i.e. larger losses) in the negative market return partition. This phenomenon is consistent with a behavioral explanation with extrapolation bias and herding instinct. Shefrin (2005) points out that investors have "extrapolation bias", i.e. they believe that past performance represents future performance. Because of the extrapolation bias, most recent market performance has a significant influence on current and immediate future market performance. Thus when market is in several downturn movements, investors are more likely to believe the downward movement will continue. As suggested by Ng and Wu (2005), excess selling activities increase stock market volatility and further drive down market returns. When perceived risk is added to the regression model, perceived risk is negatively and significantly related to contemporaneous realized returns in both positive and negative return partitions, which suggests a risk feedback mechanism in the determination of market returns as compared with the volatility feedback mechanism in mature stock markets.

Results from our weekly data series show that perceived risk has a consistent negative influence on aggregate market returns, while the influence of volatility on market returns is return dependent; suggesting that a perceived risk feedback hypothesis would be superior to the volatility feedback hypothesis in the Chinese stock market. Bekaert and Wu (2000) and Wu (2001) proposed that the relationship between returns and volatility is stronger in the market down-turn partition, but this research shows that the influence of volatility on market returns is more robust in Quintile 1 (extreme positive quintile) than Quintile 5 (extreme negative quintile), with R^2 for Quintile 1 is much higher than that for Quintile 5. This difference might be explained by the "disposition effect", i.e. many investors are less willing to sell "losers" because they do not want to have an explicit loss. Behavioral finance literature has identified this "disposition effect" as a combination of "loss aversion" (from prospect theory, Kahneman & Tversk, 1979) and "anchoring" (set purchase price as the reference point to make investment decision). Shapira (2001) finds that professional training and experience can reduce judgment bias for institutional investors, and there is less "disposition effect" with institutional investors than individual investors in emerging markets. Chen et al. (2007) analyze data of 46,969 individual accounts and 212 institutional investor accounts, and find that intuitional investors in China are less susceptible to the disposition effect than individual investors, as individual investors tend to hold their "loser stock" significantly longer than institutional investors. By comparing their results with studies on the US stock market (e.g. Odean, 1998; Dhar & Zhu, 2006), they find that the disposition effect is stronger in the Chinese stock market.

The disposition effect is stronger in the Chinese stock market, probably because the Chinese stock market is still dominated by individual investors. During an upward market movement, on one hand, investors are more willing to buy the stocks with higher returns (Quintile 1: extreme positive return quintile) due to the extrapolation bias, which drives up the stock price further and increases market volatility; on the other hand, individual investors may also want to profit from the higher returns and sell their shares, which generates extra trading volume. Therefore, volatility has a positive relation with market returns when returns are positive. During a downward market movement, individual investors in China are reluctant to sell their shares which have negative returns (Quintile 5: bottom return quintile) because of the disposition effect, which moderates the negative return-volatility relation. Since the perceived risk is measured as downward movement potential, its relation with market returns is less affected by the extrapolation bias during an upward market movement. Thus the relationship between market returns and perceived risk in the Chinese stock market is similar to the market return-volatility relation in mature capital markets.

In the present study, we found that changes in volatility or changes in perceived risk have a more robust influence on aggregate market return when examined with weekly data series (shown in Panel b of Table 5) than those with monthly data series (shown in Panel b of Table 7). These results suggest that evaluation period may also play a role in risk-return relation in the Chinese stock market. Our results here are consistent with previous studies (e.g. Seibenmorgen and Weber, 2000) that investors tend to over-estimate the expected return and perceived risk in a short-term evaluation period than that in a long-term evaluation period, and this phenomenon can be explained by the strong belief of investors around the world in the mean-reverting effect when a longer evaluation period is used.

4. Conclusion

This research examines the relationship between stock returns and volatility in Chinese stock market over the period of 1991 to 2008 and explores the potential mechanisms underlying the observed relation between them. We found that in contrast with the negative relation between market returns and volatility in mature stock markets in developed countries, their relation in the Chinese stock market is dependent on whether the market returns are positive or negative. Positive market returns are positively correlated to innovations to volatility; negative to market returns are negatively correlated to innovations to volatility. And this relation is more pronounced in extreme market movement situations. Since contemporaneous volatility or its change is the most important factor that determines the realized current return, the relationship between market returns and volatility observed in this study is consistent with a behavioral explanation with extrapolation bias and herding instinct rather than those relating to a longer-term lagged effect between return and volatility. Combination of contemporaneous and lagged LPM (or their changes) and contemporaneous and lagged volatility (or their changes) has more explanatory power for market returns than just contemporaneous and lagged volatility (or their changes). The perceived risk and market returns have a negative relation in the Chinese stock market, which is similar to the negative relation between volatility and market returns in mature stock markets, and both the contemporaneous and lagged LPMs have a significant contribution to the determination of contemporaneous market returns. This result shows that there is some feedback effect in the relation between market returns and perceived risk, and behavioral explanations might be used to interpret the relationship between volatility and market returns in the Chinese stock market due to the high proportion of individual investors.

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