Asymmetric Volatility Phenomenon: Evidence from Professional Fund Manager Behavior in Emerging Market

SungSin Kim[1] and Pando Sohn[2]

[1]*Division of Business Administration, College of Business , Sangmyung University, 20, Hongjimun 2-gil, Jongno-gu, Seoul 110-743, Korea*
[2]*Dong-A University, 2-1 Se-Gu, Bunin-Dong, Busan 602-760, Korea*
[1]*scolass71@gmail.com*, [2]*pdsohn@dau.ac.kr*

Abstract

This paper investigates whether there is the heterogeneity for fund manager as investor and an asymmetric volatility under short-sales constraints and if so, which factors are driving for it in Korean fund market using fund return data over period of 2002-2008. Specifically, with short-sales constrains we test the hypothesis of the difference of opinion developed by Chen et el. (2001) and Hong and Stein (2003). The result from GJR-GARCH (1, 1) model shows that there is an asymmetric volatility in fund return, as well. While, when turnover is used as the proxy for differences of opinion among fund managers, there isn't enough evidence that asymmetric volatility is based on investor heterogeneity effect. The existence of leverage effect is not observed in the Korea fund market as well.

Keywords: *asymmetric volatility, leverage hypothesis, investor heterogeneity hypothesis, GJR-GARCH model, negatively skewed*

1. Introduction

The goal of this paper is to identify a volatility asymmetric effect and the role of opinion dispersions of fund manager behavior with short sale-constraints on fund asset return in Korea fund market as one of most important emerging markets.

Over several decades, great financial scholars have studied asymmetric volatility phenomenon of stock return. Previous literatures have demonstrated that in fact asymmetric volatility is inherently related to the negative skewness of returns. Understanding the sources and magnitude of asymmetric volatility may help us to explain the sources of negative skewness and the equity premium it commands.

Identifying the sources of asymmetric volatility also has important implications for asset pricing and portfolio risk management, as well as managing fund asset in aimed increasing more profit and decreasing fund risk.

Harvey and Siddique (2000) develop an asset pricing model in which individual asset returns have systematic skewness and their expected returns are rewarded for this risk. They show that conditional skewness helps explaining the cross-sectional variation in expected returns across assets.

The economic cause of asymmetric volatility of stock return can be explained based on leverage, time-varying risk premium and investor heterogeneity hypothesis.

In leverage hypothesis view, suggested by Black (1976) and Christie (1982), if stock price drops, firm's operating and financial leverage increase, so that make stock return's volatility raise. The time-varying risk premium hypothesis suggests that if volatility is pricing factor

[1] First author
[2] Corresponding author

and changes over time, investors require required return of time-varying risk premium. In conclusion, a shock to firms raises an increase in stock return's volatility and therefore raises a drop in stock price.

Hong and Stein (2003) demonstrate why stock markets tend to reveal negative skewness and exposed to market crashes based on the difference of investors's opinion (investor heterogeneity) hypothesis. Their model argues that bearish investors do not initially engage in the market and their information is not revealed in price because of short-sales constraints as well as the existence of difference of opinion. Therefore, given on divergence of opinion among investors and short-sale constraint, their model predicts that negative skewness is most pronounced if short sale constraint is prohibited and the difference of opinion among investors is high. Furthermore, it predicts that the returns will be more negatively skewed conditional on high trading volume.

Under practical view and law, many fund managers in Korea fund market field confirm that short selling is restricted in operating fund portfolio from fund investor's money. Thus, we implement testing the difference of opinion with short sale constraints in fund market.

In this paper, we examine how investment behavior of fund manager with short-sales constraints in Korea fund market influences the volatility asymmetric as fund risk. Hence we use conditional volatility model and analyze the existence of asymmetric volatility which is incorporated into the asymmetric volatility parameters as GJR-GARCH (1, 1) model over 2002 to 2008. Equivalently in testing the effect of short-sale constraint on fund return's volatility, it is focusing on the differences of opinions among fund manager suggested by Hong and Stein (2003). The asymmetric volatility or equivalently negative skewness means a tendency for volatility to go up with negative fund returns.

Specifically, this study empirically identifies an asymmetric volatility and looks at the determinants of the asymmetric volatility in Korea fund market. Both of differences of fund manager's opinions and short sale constraint are considered. That is, as employed in Harris and Raviv (1993) and Chen, *et al.*, (2001), we use fund monthly turnover ratio as a proxy for the differences of fund manager opinion using GJR-GARCH (1,1) model and show the extent to investor heterogeneity. We believe that it is firstly implemented to explore the role of differences of fund manager's difference opinions in explaining asymmetric volatility in domestic.

The remainder of this paper is organized as follows. In Section 2, the empirical design is shown, and in Section 3, we describe the sample data and statistics for variables. In Section 4, the empirical results are showed, and finally Section 5 concludes.

2. Model

2.1. An Asymmetric Volatility Model

To find the asymmetric volatility of fund return, we employ the GJR-GARCH model as asymmetric GARCH, which is also known as GJR model proposed by Glosten et el. (1993). Among many asymmetric GARCH models such as EGARCH, QGARCH, TGARCH and GJR-GARCH, it is well known that GJR-GARCH model has best fitted superior predictive power for the asymmetric effect of volatility of return (Engle and Ng, 1993). Thus, we adapt the GJR-GARCH model in this paper. The conditional variance of fund return is based on as follows GJR-GARCH model with AR(1), which is called vanilla GJR-GARCH(1,1) with AR(1):

$$r_t = \Phi_0 + \Phi_1 r_{t-1} + \varepsilon_t \quad (1)$$

$$\varepsilon_t = \sqrt{\sigma_t} \cdot e_t,\ e_t \sim iid(0,1)$$
$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \gamma I_{t-1}\varepsilon_{t-1}^2 \quad (2)$$

where α, β and γ are constant parameters and It is an following indicator dummy variable:

$$I_{t-1} = \begin{cases} 1 & if\ \varepsilon_{t-1} < 0 \\ 0 & if\ \varepsilon_{t-1} > 0 \end{cases}$$

The impact of ε_t^2 on the conditional variance σ_t^2 in Eq.(2) is different according to ε_t^2's sign. The negative innovation, which means bad news, has a higher impact than positive ones. When ε_{t-1} is positive, the total contribution to the volatility of innovation is $\alpha\varepsilon_{t-1}^2$ whereas the total contribution to the volatility of innovation is when ε_{t-1} is negative. This implies that the negative impact adds up more volatility shock to model. Thus we expect γ to be positive, so that the "bad news" has larger impacts3. The GJR-GARCH(1,1) model is asymmetric as long as $\gamma \neq 0$. As suggested by Ling and McAleer (2002), the regularity conditional for the existence of the second moment of GJR-GARCH(1,1) model is under $(\alpha+\beta)+\gamma/2 < 1$.

We also employ extended GJR-GARCH(1,1) with AR(1) to control for characteristic variable related to equity fund's return and volatility. This estimation model is given by

Mean Equation:

$$r_{i,t} = \Phi_0 + \Phi_1 r_{i,t-1} + \beta_1 Cumreturn_{i,t} + \beta_2 Ln(NAV)_{i,t} + \beta_3 NGR_{i,t} + \varepsilon_{i,t} \quad (3)$$

Variance Equation:

$$\sigma_{i,t}^2 = \omega + \alpha\varepsilon_{i,t-1}^2 + \beta\sigma i_{i,t-1}^2 + \gamma I_{i,t-1}\varepsilon_{i,t-1}^2 + \omega_1 M_{d_i} + \omega_2 Turnover_{i,t}$$
$$+\omega_3 Leverage_{i,t} + \omega_4 Ln(freq)_{i,t} + \omega_5 Ln(NAV)_{i,t} \quad (4)$$

where r is fund excess return as fund daily raw return minus risk free rate (Treasury note with maturity of 3 years), Cumreturn is cumulative fund daily excess return based on past 6 months using rolling window, Ln(NAV) is logarithm of net asset value of fund, NGR is new money growth of fund. In addition, we include time dummy as month (TimeDummy) in mean equation (3). In variance Eq.(4), we include Monday dummy (Md) to control for Monday effect because abnormal pattern usually can appear on Monday. The leverage is computed as $\sum_{j=1}^{N} w_{j,i,t}(Leverage_{j,i,t})$ and weighted average leverage ratio which is calculated as total debt over total asset, which is used to control leverage effect of asymmetric volatility, where $w_{j,i,t}$ is the value weight of stock j in fund portfolio i at time t. Ln(freq) is the number of portfolio holdings held in each fund.

[3] In general, it is called a leverage effect.

In Eq.(3) and (4), the determinants of asymmetric volatility are controlled to make sure the differences of opinion among investors. First, we set up the proxy of differences of opinion. In this empirical analysis, we construct this variable as following way: Turnoveri,t is daily turnover ratio for each fund i at time t and is measured as following way: $Turnover_t = \frac{Min(Sell_t, Buy_t)}{NAV_t}$ where sell and buy are selling and buying amount, respectively. Thus it is used as a proxy for differences of opinion in this paper.

Hong and Stein (2003) have distinctive empirical implications that are not shared by the representative investor theories. In particular, their model predicts that negative skewness in returns will be most pronounced around periods of heavy trading volume. This is because – like in many models with differences of opinion – trading volume proxies for the intensity of disagreement (Harris and Raviv, 1993).

With respect to differences of opinion among investors, as addressed in Hong and Stein (2003), when disagreement (trading volume) is high, it is more likely that bearish investors will wind up at a corner, with their information incompletely revealed in prices.

2.2. Test of Asymmetry

To investigate further the existence of asymmetric effect on the volatility of return, the asymmetric GARCH, called GJR-GARCH model will be estimated. According to Engle and NG (1993), we conduct testing on the residuals from a asymmetric GJR-GARCH(1,1) model with AR(1). If the asymmetric GJR-GARCH(1,1) is a sufficient model for the returns, the residuals generated from such model will display any sign bias, negative size bias or positive size bias. Then it would be justifiable to use an asymmetric conditional volatility model. The joint test for asymmetry as proposed in Engle and Ng (1993) is as follow:

Sign bias: $$e_t^2 = b_0 + b_1 S_{t-1}^- + v_t \quad (5)$$

Negative size sign bias: $$e_t^2 = b_0 + b_1 S_{t-1}^- e_{t-1} + v_t \quad (6)$$

Positivesize sign bias: $$e_t^2 = b_0 + b_1 S_{t-1}^+ e_{t-1} + v_t \quad (7)$$

Joint test: $$e_t^2 = b_0 + + b_1 S_{t-1}^- + b_2 S_{t-1}^- e_{t-1} + b_3 S_{t-1}^+ e_{t-1} + v_t \quad (8)$$

where S_{t-1}^- is an dummy variable that takes the value of one if $e_{t-1} < 0$ and zero otherwise and $S_{t-1}^+ = 1 - S_{t-1}^-$. In the Sign Bias Test, the squared standardized residuals are regressed on a constant and a dummy variable, denoted S_{t-1}^-. The Sign Bias Test Statistic is the t-statistic for the coefficient on S_{t-1}^-, which shows whether positive and negative innovations have different impact on future volatility.

In the Negative Size Bias Test, the squared standardized residuals are regressed on a constant and $S_{t-1}^- e_{t-1}$, which shows whether larger negative innovations are correlated with larger biases in predicted volatility.

In the Positive Size Bias Test, the squared standardized residuals are regressed on a constant and $S_{t-1}^+ e_{t-1}$. The Positive Size Bias Test Statistic is the t-statistic for the coefficient

on $S_{t-1}^{+}e_{t-1}$, which shows whether larger positive innovations are correlated with larger biases in predicted volatility

3. Data and Statistics

In this paper, we investigate whether asymmetric volatility exists and asymmetric volatility in Korea fund market can be explained by fund manager's difference of opinions. The sample period is from 2002 to 2008. The sample data used in empirical test are collected from ZeroIn Fund Evaluation Company. This database contains the stockholdings information at monthly level related to fund such as portfolio holding, fund cost, fund age and so on. However, because of no information of individual firm held in fund, we merge fund stockholding with KisValue and FnGuide to collect firm level information. For the sample of the empirical test, we use only well managed domestic equity funds, which includes above 70% of stock share. In addition, we exclude the funds of international, sector, index, mixed and bond. Finally, the numbers of total fund used as final sample are 1,588.

Table 1 reports descriptive statistics of main variables used in this paper. ExRet is daily fund excess return and CumExRet is daily cumulative fund excess return based on prior 6 months using rolling window. Ln(NAV) is logarithm of net asset value of fund and NGR is growth rate of fund flow. Turnover is monthly turnover ratio for each fund at time t, which is the mean of monthly buy and sell turnover rate and measures the frequency of trading. Turnover is used as a proxy for fund manager's heterogeneity when short sales are under constraint. As turnover is high, fund manager's heterogeneity is large. Leverage is the weighted average leverage ratio which each fund holds at time t and Ln(freq) is the number of portfolio holdings held in each fund.

In a given period, daily fund return is 0.03% on average and annualized return based on daily compounding is 7.79% on average. Table 1 shows that fund return series are negatively skewed. This reveals that volatility is higher when negative shock break out among the stock market than when positive shock break out and fund return is negatively correlated with volatility. The average of total net asset value (Ln(NAV)) is 6.75 (unit: 10 million Won). For leverage of firm held in fund, the average and median are 212% and 216%. The average and median for the number of stock held in each fund, Ln(freq) is 3.86 and 3.89, which indicate 47 and 49 of stock shares in each fund.

Table 1. Descriptive Statistics

Variable	Mean	Median	Std.	Skewness	Max	Min
ExRet	0.0003	0.0012	0.0151	-0.3544	0.0663	-0.0722
CumExRet	0.0758	0.0745	0.2016	0.3501	0.7962	-0.4780
Ln(NAV)	6.7545	6.5660	0.6703	0.3090	8.0389	5.6925
NGR	-0.0157	-0.0064	0.0454	-0.8938	0.0928	-0.2146
Turnover	0.0635	0.0628	0.0174	0.4972	0.1337	0.0276
Leverage	2.1181	2.1607	0.4669	-0.1867	3.0400	0.9265
Ln(freq)	3.8635	3.8941	0.1762	-0.1398	4.1380	3.5518

4. Empirical Results

First of all, we test the existence of asymmetric effect of fund return on volatility using GJR-GARCH(1,1) and extended GJR-GARCH(1,1) for daily fund return series. As mentioned above, to identify asymmetric effect on volatility, we utilize Eq.(1)-(4).

Table 2 presents the result of GJR-GARCH(1,1) model in finding the existence of asymmetric effect on volatility. Panel A reports that β is positive and significant at the 1% level. This result indicates the existence of volatility persistence. The asymmetric coefficient,

γ is positive and significant at the 1% level regardless of any specification. This result makes sure that fund return series have asymmetric effect on volatility. That is to say, good news and bad news related to firms have different impacts on volatility and negative shocks cause greater volatility than positive shocks of equal size. Meanwhile, the coefficient of leverage, ω3 is statistically insignificant and the existence of leverage effect is not observed in the Korea fund market's return. Our result is consistent with Bekaert and Wu (2000) who rejects leverage effect in equity market. Moreover, the coefficient of turnover, ω2 is also insignificant. All these findings suggest that leverage and investor heterogeneity aren't the main cause of asymmetric volatility in Korea fund market.

Panel B shows the results for test of asymmetry. First, the results of sign bias test show that positive and negative innovations have different impacts on volatility. In negative bias test, all coefficients are negative and significant at the 1% level regardless of model. Positive innovations tend to increase volatility regardless of the size, while large negative innovations cause more volatility than small ones. This significant negative bias test statistic indicates that big negative innovations cause greater volatility than the model can explain. The results for the joint test for asymmetry show strong evidence for existence of asymmetry in the Korea fund returns.

Table 2. The Result of GJR-GARCH Model

Panel A: GJR-GARCH (1,1)		
	Model 1	Model 2
Φ_1	0.0646**	0.0484***
	(2.33)	(1.74)
b_1		0.0079***
		(5.38)
b_2		-0.0002
		(-0.35)
b_3		0.0123
		(1.59)
α	-0.0023	-0.0234**
	(-0.18)	(-2.31)
β	0.8794***	0.8731***
	(58.19)	(52.55)
γ	0.1694***	0.2093***
	(7.39)	(7.94)
ω_1		-0.0001
		(-0.31)
ω_2		0.0001
		(1.11)
ω_3		0.0001
		(0.04)
ω_4		-0.0001***
		(-3.43)
ω_5		0.0001**
		(2.41)
Skewness	-0.232	-0.258
Kurtosis	3.512	3.476
Like.Ratio	4916.53	4937.29

Panel B: Test of Asymmetry based on Engle and NG(1993)

Sign Bias(×100)	0.008**	0.011***
t-statistics	(2.27)	(2.97)
Positive Bias(×100)	-0.062	-0.116
t-statistics	(-0.31)	(-0.59)
Negative Bias (×100)	-0.985**	-0.935***
t-statistics	(-2.64)	(-4.72)
Joint Bias F-statistics	8.37***	7.72***

***, **, * Significance at the 1, 5 and 10% level, respectively.

Figure 1 gives the News Impact Curve which is plotted for GJR-GARCH(1,1), which helps explaining and figuring out asymmetric idea. The News Impact Curve measures how new information is incorporated into volatility estimates. It appears from the figure that the News Impact Curve allows good innovations and bad innovations to have different impacts on volatility. The negative side of the curve is steeper than its positive side, which indicates that bad innovations have a greater impact on volatility than good innovations. As a result, we are confident of existence of asymmetric volatility in Korea fund market

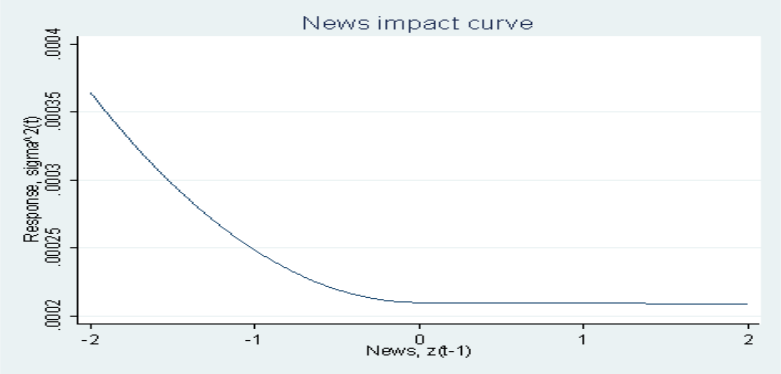

Figure 1. News Impact Curve from GJR-GARCH(1,1)

5. Conclusion

In this paper, we scrutinize whether there is the heterogeneity for fund manager as investor and an asymmetric volatility under short-sales constraints using GJR-GARCH (1,1) and extended GJR-GARCH (1,1) model in Korea fund market.

The results of this study can be summarized as follows: first, we find the strong evidence for existence of asymmetric volatility in Korea fund market from 2002 to 2008. The implication is that good innovations and bad innovations related to firms have different impacts on conditional volatility and negative innovations cause more conditional volatility than positive innovations of equal magnitude. This evidence is evidently revealed in the New Impact Curve as well. Second, when turnover is used as the proxy for differences of opinion among fund managers, there isn't enough evidence that asymmetric volatility is based on investor heterogeneity effect. We didn't find that fund with more differences of opinion among fund managers has more negative skewness. The existence of leverage effect is not observed in the Korea fund market as well.

References

[1] G. Bekaert and G. Wu, "Asymmetric Volatility and Returns in Equity Markets", Review of Financial Studies, vol. 13, **(2000)**, pp. 1-42.
[2] F. Black, "Studies of stock price volatility changes", proceedings of the 1976 meetings of the American Statistical Association, business and economics statistics section, **(1976)**, pp. 177-181.
[3] J. Chen, H. Hong and J. C. Stein, "Forecasting crashes: Trading volume, past returns, and conditional skewness in stock prices", Journal of Financial Economics, vol. 61, **(2001)**, pp. 345-381.
[4] A. A. Christie, "The stochastic behavior of common stock variance-value, leverage and interest rate effects", Journal of Financial Economics, vol. 10, **(1982)**, pp. 407-432.
[5] R. F. Engle and V. Ng, "Measuring and testing the impact of news on volatility", Journal of Finance, vol. 48, **(1993)**, pp. 1749-1778.
[6] L. R. Glosten, R. Jagannathan and D. E. Runkle, "On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks", Journal of Finance, American Finance Association, vol. 48, **(1993)**, pp. 1779-1801.
[7] M. Harris and A. Raviv, "Differences of Opinion Make a Horse Race. Review of Financial Studies", vol. 6, **(1993)**, pp. 473-506.
[8] C. R. Harvey and A. Siddique, "Conditional skewness in asset pricing tests", Journal of Finance, vol. 55, **(2000)**, pp. 1263-1295.
[9] H. Hong and J. C. Stein, "Differences of opinion, short-sales constraints, and market crashes", Review of Financial Studies, vol. 16, **(2003)**, pp. 487-525.
[10] S. Ling and M. McAleer, "Stationarity and the existence of moments of a family of GARCH processes", Journal of Eonometrics, vol. 106, **(2002)**, pp. 109-117.