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Trader Type Effects on the Volatility-
Volume Relationship. Evidence from the
KOSPI 200 Index Futures Market

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Trader Type Effects on the Volatility-Volume Relationship. Evidence from the KOSPI 200 Index Futures Market.

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This paper examines empirically the volatility-volume relationship implied by various market microstructure models which associate movements in prices and trading volume with information, dispersion of beliefs and trading motives. Our unique dataset allows to investigate whether different types of traders (members vs non-members, institutional vs individual) have a positive or negative effect upon volatility. Our empirical results show that surprises in non-member investors' trading volume are positively related with volatility in most of the cases. These results are more reinforcing in the case of log-volume and generally consistent with existing theoretical and empirical evidence. As regards member investors, we primarily find that unexpected volume is positively related to volatility, providing further support for the argument that informed rational speculators exacerbate volatility especially when noise traders follow positive feedback strategies. Another result of our study is that the coefficients relating the unexpected component of open interest with volatility are uniformly negative, implying that an increase in open interest during the day lessens the impact of a volume shock in volatility. Finally, when we allow for time-to-maturity effects, non-member institutional investors are not associated with any movement in volatility while surprises in open interest are associated with more volatility towards the end of the contract life.

: futures markets; range-based volatility; financial crisis; foreign investors; trading volume

C32, C52, G12, G15.

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The process of price discovery and information assimilation under different market settings has been the key issue on market microstructure research over the years (O'Hara, 1995). Several theoretical models attempt to associate movements in prices and trading volume with information, dispersion of beliefs and trading motives. For example, a positive correlation between price changes and trading volume is found in most of the theoretical market microstructure models which involve strategically interacting traders with asymmetric information and rationally formed expectations (Shalen, 1993).¹ On the empirical side, Karpoř (1987) cites 18 separate studies that document a positive contemporaneous correlation between trading volume and price volatility in a variety of financial markets including equities, futures, currencies, and Treasury bills. This paper aims to provide additional empirical evidence on the volatility-volume relationship implied by various market microstructure models.

Bessembinder and Seguin (1993) suggest that the volatility-volume relationship might depend on the type of trader after finding that trades causing changes in open interest have a larger effect on volatility than do trades that leave the open interest intact. Moreover, Daigler and Wiley (1999) found that using trader categories is a better way to describe the link between volatility and volume than total volume. Their empirical results for the futures market show that the general public drives the positive volatility-volume relationship whereas trading by clearing members and floor traders often exhibits an inverse relationship between volatility and volume. In line with these studies we investigate whether different types of traders (members vs non-members, institutional vs individual) have a positive or negative effect upon volatility. Another contribution of our study is to assess whether the behavior of different trader types changes around the expiration of the futures contracts. Hong (2000) argues that as the futures contract rolls to its expiration date less private information is impounded into the futures price and so, all else being equal, the futures price moves less as the contract expires. Moreover, the effect of changes in open interest on futures volatility will provide some evidence on the ability of the market to absorb trading volume shocks by the different types of trader.

(information) or hedgers versus speculators (motives). Our econometric technique (Schwert, 1990, Davidian and Carroll, 1987) allows for unbiased estimation of the conditional volatility while at the same time documents partial relations between price revisions and shocks to volume and open interest in line with the Mixture of Distributions Hypothesis.² Additionally, the range (high, low, open, close) of daily prices for the KOSPI200 Index futures contract is available, which allows us to test the volatility-volume relationship for different and usually more efficient volatility proxies.

Our empirical results show that surprises in non-member investors' trading volume are positively related with volatility in most of the cases. These results are more reinforcing in the case of log-volume and generally consistent with the empirical findings of Daigler and Wiley (1999). Moreover, this finding is consistent with the theoretical models of Harris and Raviv (1993) and Shalen (1993), who find a positive relationship between absolute price changes and volume due to the dispersion of beliefs partly caused by different interpretation of common information and partly caused by the 'noisy' liquidity demand. As regards member investors, we primarily find that unexpected volume is positively related to volatility and this further supports the argument of DeLong et al (1990b), that trading by informed rational speculators can drive prices further away from fundamentals if it triggers positive feedback strategies by noise traders.

For the entire period we report very significant relations between long-run changes in non-member investors' trading volume and volatility while after the financial crisis all these relations become insignificant. The results for the whole sample reveal a stabilizing role for non-member institutional and foreign investors while a destabilizing one for non-member individuals especially up to the period of the financial crisis. Interestingly, in the case of log volume, the moving average component of member institutional investors turns to negative, indicating a stabilizing role for these types of traders, at least up to the end of the crisis period. Further, it is worth mentioning the uniformly positive and significant relationship between volatility and the expected component of non-member individuals as well as the negative and significant relationship between volatility and the moving average component of non-member foreign investors' trading volume.

Another interesting result of our study is that the coefficients relating the unexpected component of open interest with volatility are uniformly negative, meaning that an increase in open interest during the day lessens the impact of a volume shock in volatility. This is consistent with the Bessembinder and Seguin (1993) results, who also report a negative relation between surprises in open interest and volatility. However, when we allow for time to maturity effects, surprises in open interest are associated with more volatility around the futures contract expiration probably due to the wider price range over which less

²Another type of theory attempting to explain the volatility-volume relationship is the Mixture of Distributions Hypoth-

further pursued by Andersen and Bollerslev (1997) who demonstrate that by interpreting the volatility as a mixture of heterogeneous short-run information arrivals, the observed volatility process may exhibit long-run dependence. Li and Wu (2006) suggest a version of the mixture of distributions hypothesis

A plethora of empirical studies have examined the relationship between volatility and volume in cash and futures markets and a positive contemporaneous relationship between the two variables is often documented (Karpov, 1987). Gallant, Rossi and Tauchen (1992) find a positive contemporaneous volatility-volume relationship robust to non-normalities, stochastic volatility, and other forms of conditional heterogeneity. Bessembinder and Seguin (1992) find that equity volatility covaries positively with spot equity and futures equity trading volume with the unexpected component of spot trading volume being more effective. In a similar way, Bessembinder and Seguin (1993) examine the relationship between trading activity and volatility in eight futures markets. They find a strong positive relationship between contemporaneous volume (expected and unexpected) and volatility and that the impact of an unexpected volume shock is between 2 and 13 times greater than the effect of changes in expected volume. Moreover, they find that the expected open interest is negatively related to volatility in all markets, a result consistent with the belief that variations in open interest reflect changes in market depth.

Bessembinder and Seguin (1993) suggest that the volatility-volume relationship might also depend on the class of traders after finding that trades resulting in changes in open interest appear to have a larger impact on prices than do trades that leave the open interest unaltered. Daigler and Wiley (1999), in line with Bessembinder and Seguin's (1993) suggestion, try to investigate the impact of trader type on the futures volatility-volume relationship. They find that the positive volatility-volume relationship is driven by the general public, a group of traders distant from the trading floor, less informed and with greater dispersion of beliefs. On the other hand clearing members and floor traders often decrease volatility and this is attributed mainly to the informational advantage from holding a seat in the futures market. Moreover, Avramov, Chordia and Goyal (2006) show that informed (or contrarian) trades lead to a reduction in volatility while non-informational (or herding) trades lead to an increase in volatility. Bjornes et al (2007) also find that the volume-volatility relation depends on the group of market participants trading. Specifically, institutional investors' trading volume has the highest correlation with volatility while trading by non-financial investors is not correlated with volatility at all when controlling for trading by other market participants.

Descriptive Statistics

This table presents daily volume descriptive statistics for four categories of investors. The categories are: Member Institutional Investors (MFI), Non-member Institutional (NMFI), Non-member Individual Investors (NMI) and Non-member Foreign Investors (NMF). Panel A shows the breakdown in percent of volume by category of traders and the total daily volume (in trillion Korean won). Percentages sum to 100 over each period. Panel B provides the cross correlations between each pair of volume variables. An ARIMA(0,0,10) model calculates the expected (predicted) value using the 10-day moving average of the change in volume. The unexpected volume is detrended volume minus expected volume.

Panel A: Average Trader Category Volume as a percentage of Total Volume

Investor Type	MFI	NMFI	NMI	NMF	Total
Period					
1996-97	69.60%	4.33%	23.19%	2.88%	0.6158
1998-99	41.63%	7.13%	48.59%	2.65%	4.8226
2000-01	33.49%	10.09%	49.76%	6.66%	8.1794
2002-03	24.42%	8.39%	53.69%	13.5%	19.0362
2004-05	23.97%	6.37%	47.11%	22.55%	23.4083

Panel B: Cross - Correlations between Trader Categories

Series	MFI - NMFI	MFI - NMI	MFI - NMF	NMFI - NMI	NMFI - NMF	NMI-NMF
Total	0.828	0.858	0.769	0.821	0.739	0.804
Moving Av.	0.935	0.925	0.873	0.933	0.793	0.898
Expected	0.521	0.656	0.388	0.414	0.579	0.320
Unexpected	0.502	0.608	0.458	0.380	0.593	0.397

As regards cross correlations between traders, amongst the non-member investors, individuals show the highest correlation with member investors over all trading volume components. Moreover, the pair correlations between non-member investors reveal that the total and moving average components of institutional and individual investors are highly correlated but the correlations concerning the expected

The econometric techniques that we use in this paper are mainly parametric and consistent with previous studies that investigate the impact of trading volume on volatility (see Daigler and Wiley, 1999, Bessembinder and Seguin, 1992, 1993 and Schwert, 1990). This procedure allows for unbiased estimation of the conditional daily return volatility while at the same time accounting for effects such as the day

Regressions of Volatility on Expected and Unexpected Volume by Trader Type

Volumes are detrended by subtracting the 200-day centered moving average from each series, prior to partitioning into expected and unexpected components using an ARMA (0,10) model. Values in brackets are t-statistics for the hypothesis that the coefficient is zero using White (1980) heteroscedasticity consistent standard errors. Test statistics for 10 lagged coefficients are F-statistics for the hypothesis that the sum of the 10 coefficients is zero. Coefficients on raw volumes are scaled so the underlying unit is one trillion of Korean Won. Time series means are deducted from each volume

increased informativeness and lower volatility.

Overall we find that unexpected levels of volume and open interest are more important in explaining

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Regression coefficients	Volatility measures		
	Return VLT	Garman-Klass VLT	High-Low VLT
Intercept	1.6087 (7.19)***	0.1905 (6.04)***	0.1285 (8.59)***
KOSPI200 futures volume			
Member Institutional Inv.			
Moving average	-0.1267 (-0.59)	-0.0033 (-0.09)	0.0018 (0.15)
Expected	0.2338 (0.89)	0.0304 (0.71)	0.0125 (0.81)
Unexpected	0.4795 (2.29)***	0.1486 (4.30)***	0.0792 (6.51)***
Non-member Institutional Inv.			
Moving average	-0.2311 (-0.81)	-0.0542 (-1.17)	-0.0132 (-0.85)
Expected	0.4402 (1.45)*	0.0093 (0.19)	0.0191 (1.13)
Unexpected	0.3133 (2.10)***	0.0666 (2.89)***	0.0332 (3.66)***
Non-member Individuals Inv.			
Moving average	-0.1569 (-0.65)	-0.0469 (-1.26)	-0.0149 (-1.08)
Expected	0.1316 (0.38)	0.0484 (0.91)	0.0155 (0.84)
Unexpected	-0.3145 (-1.43)*	0.2523 (6.91)***	0.0864 (6.52)***
Non-member Foreign Inv.			
Moving average	0.1536 (0.75)	0.0298 (0.84)	0.0041 (0.34)
Expected	-0.0704 (-0.64)	-0.0219 (-1.06)	-0.0115 (-1.67)**
Unexpected	0.2491 (2.64)***	-0.0177 (-0.99)	0.0013 (0.23)
KOSPI200 open interest			
Moving average	-0.5886 (-1.85)**	-0.0871 (-1.67)**	-0.0344 (-1.81)**
Expected	-0.1321 (-0.33)	0.0407 (0.55)	-0.0041(-0.17)
Unexpected	-0.4723 (-0.92)	-0.2848 (-2.61)***	-0.0896 (-2.67)***
Sum of 10 lagged volatilities	0.4072 (28.2)***	0.5910 (82.9)***	0.6142 (183.3)***
Sum of 10 lagged unex. returns	-0.0918 (1.55)	-0.0209 (1.79)	-0.0081 (3.36)**
Regression R ²	0.202	0.393	0.492

*, **, *** Denotes statistical significance at 0.15, 0.10, 0.05 level.

Further, we have investigated the effect of the number of active value motivated traders by considering the natural logarithm of trader type volume (see Appendix). This alternative specification of trading volume helps interpret surprises in trading activity in terms of percentage deviations from trend so that the unexpected log volume series is unaffected by trend growth in volume. The positive relationship between volatility and surprises in non-member investors' trading volume is further reinforced, with individuals being the most active in the case of range-based volatility and foreigners in the case of return

volatility and the expected component of non-member individuals as well as the negative and significant relationship between volatility and the moving average component of non-member of foreign investors trading volume. Interestingly, the slowly changing components of non-member individual and member institutional investors exert a strong destabilizing and stabilizing effect, respectively, over volatility up to the period of the financial crisis. As regards the unexpected component of open interest its effect on volatility remains negative and significant. Finally, the explanatory power of the volatility-volume regressions does not seem to improve in the log-volume case as we get smaller R^2 values.

In this section we try to investigate whether the trader type behavior around the expiration of the futures contracts has a different impact on the volatility-volume relationship evidenced over the whole sample.

can arise even when traders simply interpret commonly known data in a different way, especially near contract expiration.

This study provides empirical evidence on the volatility-volume relationship for different trader types of the Korean index futures market. The different types of traders have been selected according to the information they possess and their access to the trading system. Moreover, the trading activity variables are partitioned into expected and unexpected components and the econometric techniques that we use allow for an unbiased estimation of daily standard deviations conditional on the trading activity variables, day of the week, lagged volatilities and lagged unexpected returns.

A key finding of this study is that surprises in volume and open interest are more important in

the period of the financial crisis.

We also investigated the volatility-volume relationship as the futures contract roll to its expiration by adding trading volume slope dummies near the expiration date. Our results reveal a less significant role for non-member institutional investors as the futures contract moves towards expiration while we do not experience any change in trading behavior for the remaining trader types. Another result of this exercise is that surprises in open interest during the day are associated with much bigger price movements near the expiration of the contract, indicating that volatility becomes more sensitive to volume shocks especially when trades result in an increase on open interest as well. This result is consistent with the argument of Hong (2000) that as the futures contract rolls to its expiration date, its sensitivity to nonmarketed risk shocks increases and uninformed investors can learn less about the fundamental by looking at prices. Therefore, information asymmetry rises and less informed investors face a higher adverse selection cost in trading with informed investors near the futures contract expiration. As a result those uninformed traders who choose to trade with informed investors near the futures contract expiration will probably cause wider price movements so as to induce them to take the other side of the trade.

The inclusion of variables such as lagged volatilities and unexpected returns in the volatility regressions are significant in most of the cases, with the effect of lagged unexpected returns being consistently negative. Further, we find that when the high-low volatility measure is used, models that incorporate trader type volume, lagged volatilities and unexpected returns can explain up to 59 percent of the variability in volatility. In future work we aim to investigate the trader type effect on volatility using alternative detrending methods for trading volume, such as the band pass filtering and non parametric regressions. Finally, an interesting exercise is to use nonparametric and semi-parametric techniques for analysing the trader type effect on volatility as we could capture simultaneously the long memory characteristics often evidenced in trading volume and volatility.

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As regards trading volume of the KOSPI 200 futures index, the Korean Stock Exchange publishes the daily amount of contracts traded by eight types of domestic investors and the total amount by foreign Investors. Domestic investors are categorized as institutional and individual investors. Moreover, domestic institutional investors consist of securities and non securities companies. The latter are divided into Insurance, Investment, Bank, Merchant and Mutual Fund, Pension Fund and Others. Membership is granted only to the securities companies licensed by the Financial Supervisory Commission to conduct securities business. Moreover, no individual members are accepted. Members of the Korean Stock Exchange have the right to trade and the responsibility of clearing the trade and access to the trading system is granted to the member firms only. Any members who have their own system, which is a client server interface for customers or multi-functioning system, can access the KSE system directly. Overseas brokers or dealers cannot access the Korean Stock Exchange system directly, but they can connect to a member's system located in Korea through international securities companies' global network.

We first construct a detrended activity series¹³ by deducting an equally weighted moving average of length 200 days, centered on the estimated trend component, from the original series. Standard one-sided (weighted) averages are used for the start and end of the sample as suggested by Brockwell and Davis (1987). Further we partition the detrended activity series into expected and unexpected components using an ARIMA(0,0,10) model. The ARIMA (0,0,10)¹⁴ model estimates the expected value using the 10-day moving average of the change in detrended volume. This is in line with the Bessembinder and

In this section we try to evaluate whether the number of active value-motivated traders can have a significant impact on the volatility-volume relationship (Kyle, 1985, Admati and Pfleiderer, 1988). We repeat the prior analysis using the natural logarithm of each trader type volume and open interest. By taking the log differences of the original trading volume series and its 200 day centered moving average, we get a detrended series interpreted as percentage deviations from trend. The approach is motivated by the fact that log differences of volume series are approximately stationary, as argued by Andersen (1996). Further we decompose the resulting correlated detrended series into expected and unexpected components using an ARIMA(0,0,10). Trading volume shocks now represent deviations of volume from its expectation (the 10-day moving average of the change in percentage deviation from trend). Thus, the unexpected log volume series is unaffected by trend growth in volume.

Table A1 shows the results of regressing volatility on the natural logarithm of member and non-member investors' trading volume. The unexpected trading activity of all non-member investors (institutional, individual and foreign) is significant and positively associated with all volatility measures (Return VLT, Garman-Klass VLT and High-Low VLT). The effect of non-member individuals is the highest on the range-based volatility (Garman-Klass, High-Low) but negligible on the return volatility. Also surprises on member institutional investors trading volume are positively associated with range-based volatility and negatively associated with return volatility. The expected component of trading volume is significant for the two major players of the Korean Stock Exchange, namely the member institutional and non-member individual investors. The effect of member institutional investors is negative and significant while the effect of non-member individuals is positive and significant over all volatility estimators.

Interestingly the moving average component appears to be quite significant. $\Delta \ln V_{i,t} - \Delta \ln V_{i,t-1}$ and $\Delta \ln V_{i,t} - \Delta \ln V_{i,t-10}$

Regressions of Volatility on Expected and Unexpected Log - Volume by Trader Type

Volumes are detrended by subtracting the 200-day centered moving average from each series, prior to partitioning into expected and unexpected components using an ARMA (0,10) model. Values in brackets are t-statistics for the hypothesis that the coefficient is zero using White (1980) heteroscedasticity consistent standard errors. Test statistics for 10 lagged coefficients are F-statistics for the hypothesis that the sum of the 10 coefficients is zero. Coefficients on raw volumes are scaled so the underlying unit is one trillion of Korean Won. Time series means are deducted from each volume series. VLT stands for volatility. ENTIRE PERIOD RESULTS.

Regression coefficients	Volatility measures		
	Return VLT	Garman-Klass VLT	High-Low VLT
Intercept	1.2479 (6.15)***	0.1709 (4.72)***	0.1389 (9.86)***
KOSPI200 futures volume			
Member Institutional Inv.			
Moving average	-0.8917 (-2.18)***	-0.0731 (-0.94)	-0.0295 (-1.40)*
Expected	-1.4987 (-2.44)***	-0.3371 (-2.76)***	-0.0465 (-1.75)**
Unexpected	-0.5425 (-2.21)***	0.0721 (0.92)	0.0283 (1.44)*
Non-member Institutional Inv.			
Moving average	-0.0313 (-0.15)	-0.067 (-1.81)**	-0.0053 (-0.49)
Expected	0.3609 (0.87)	0.1179 (1.27)	0.0239 (1.13)
Unexpected	0.6122 (2.69)***	0.0663 (1.35)*	0.0417 (3.81)***
Non-member Individuals Inv.			
Moving average	0.8677 (3.73)***	0.1986 (4.39)***	0.0731 (6.57)***
Expected	0.9464 (1.75)**	0.1851 (1.69)**	0.0792 (2.97)***
Unexpected	0.0408 (0.12)	0.4845 (6.68)***	0.1705 (9.38)***
Non-member Foreign Inv.			
Moving average	-0.7505 (-5.19)***	-0.1640 (-4.89)***	-0.0680 (-8.50)***
Expected	0.2015 (1.12)	0.0678 (1.74)**	0.0054 (0.54)
Unexpected	0.7950 (6.31)***	0.1293 (6.04)***	0.0553 (8.73)***
KOSPI200 open interest			
Moving average	0.8411 (2.73)***	0.1448 (2.47)***	0.0443 (2.71)***
Expected	-0.2979 (-0.74)	0.0301 (0.36)	0.0003 (0.01)
Unexpected	0.2592 (0.42)	-0.2126 (-1.43)*	-0.0867 (-2.41)***
Sum of 10 lagged volatilities	0.4835 (45.3)***	0.5721 (41.8)***	0.5446 (147.8)***
Sum of 10 lagged unex. returns	-0.127 (3.12)**	-0.0468 (7.38)***	-0.0131 (10.1)***
Regression R ²	0.275	0.428	0.579

*, **, *** Denotes statistical significance at 0.15, 0.10, 0.05 level.

The results for the after crisis period (Table A2) reveal that the unexpected component of all non-member investors remains positive and significant for most of the cases. The strongest effect on volatility is imposed by individuals in the case of range-based volatility while their effect remains still negligible in the case of return standard deviation. As regards surprises in the trading activity of member institutional investors, the mixed and significant effect on volatility evidenced for the whole sample becomes insignificant after the crisis. Moreover, activity forecastable across days (expected component) remains highly significant and of the same sign (positive) only for non-member individual investors. So after the crisis, the expected component of non-member individuals' trading volume continues to fluctuate in the same direction as volatility. The expected trading activity of member investors is still negative in sign; however, it becomes insignificant after the crisis.

component of open interest is negative in sign and more significant after the crisis. This result provides further evidence on the negative relation between unexpected open interest and volatility. It is consistent with the results found using raw volume as well as with the results in other studies such as Bessembinder and Seguin (1993) and Daigler and Wiley (1999).

The results for this alternative specification of trading volume support some of the conclusions reached on the raw volume regressions. Again we find that surprises in non-member investors' trading volume are positively associated with volatility in most of the cases. This result is consistent with Daigler and Wiley's (1999) finding that the positive volatility-volume relationship is driven by the general public or less informed investors. Recall that non-member investors are treated as less informed here due to the fact that they do not have direct access to the trading system. Moreover, we find that member investors' unexpected trading volume also exhibits a mixed relation with volatility. The positive effect is consistent

has better explanatory power over range based volatility proxies than close to close return volatility ones.