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Trader Type E¤ects 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 di¤erent types of traders (members vs non-members, institutional vs individual) have a positive or negative e¤ect 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 …nd 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 coe¢ cients 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 e¤ects, 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; …nancial crisis; foreign investors; trading volume

C32, C52, G12, G15.

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The process of price discovery and information assimilation under di¤erent 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, Karpo¤ (1987) cites 18 separate studies that document a positive contemporaneous correlation between trading volume and price volatility in a variety of …nancial 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 …nding that trades causing changes in open interest have a larger e¤ect 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 ‡oor traders often exhibits an inverse relationship between volatility and volume. In line with these studies we investigate whether di¤erent types of traders (members vs non-members, institutional vs individual) have a positive or negative e¤ect upon volatility. Another contribution of our study is to assess whether the behavior of di¤erent 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 e¤ect 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 di¤erent 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 di¤erent and usually more e¢ cient 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 …ndings of Daigler and Wiley (1999). Moreover, this …nding is consistent with the theoretical models of Harris and Raviv (1993) and Shalen (1993), who …nd a positive relationship between absolute price changes and volume due to the dispersion of beliefs partly caused by di¤erent interpretation of common information and partly caused by the 'noisy' liquidity demand. As regards member investors, we primarily …nd 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 signi…cant relations between long-run changes in non-member investors' trading volume and volatility while after the …nancial 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 …nancial 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 signi…cant relationship between volatility and the expected component of non-member individuals as well as the negative and signi…cant relationship between volatility and the moving average component of non-member foreign investors' trading volume.

Another interesting result of our study is that the coe¢ cients 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 e¤ects, surprises in open interest are associated with more volatility around the futures contract expiration probably due to the wider price range over which less

[2] Another 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

(Hindy, 1994) or because they simply interpret commonly known data in a di¤erent way (Harris and Raviv,

In this study, the member …nancial institutions characterized as securities companies represent the informed traders due to their direct access to the trading system. By comparison we de…ne the non-member …nancial institutions, individual and foreign investors as uninformed or less informed as their orders are channeled through members' trading pits. Clearing members of the exchange enjoy lower trading costs and information advantages. Their direct access to the trading system provides them with short term information about pit dynamics such as trading activity at speci…c prices and price trends. In addition they have speci…c information about their own customers' supply and demand in the cash and futures markets. Furthermore, they bene…t from increased information in the cash markets because of their access to trading screens and in house knowledge in these markets. As Daigler and Wiley (1999) argue this access to private information allows clearing members to better distinguish liquidity demand from fundamental information and to estimate current value more precisely, which translates into smaller dispersion of beliefs and less price volatility. The non-member investors do not enjoy such information advantages as member investors since they do not have direct access to the trading system. If they receive some information this happens on a delayed or a second hand basis. Since the non-member investors hold less information, we would expect them to have a greater dispersion of beliefs and to trade over a wider range of prices around the fair value of the futures contract.

The trading behavior associated with non-member investors is consistent with the noise literature (Black, 1986, DeLong, Shleifer, Summers and Waldman, 1990, 1991). Black (1986) argues that noise trading increases liquidity in the markets and also puts noise into the prices as they re‡ect both information and noise induced trading. DeLong et al. (1990a) show that the unpredictability of noise traders' beliefs creates excess risk and signi…cantly reduces the attractiveness of arbitrage. In cases where arbitrageurs have short horizons noise trading can lead to a large divergence between market prices and fundamental values. DeLong et al. (1991) …nd that noise traders who form incorrect expectations about

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 (Karpo¤, 1987). Gallant, Rossi and Tauchen (1992) …nd a positive contemporaneous volatility-volume relationship robust to non-normalities, stochastic volatility, and other forms of conditional heterogeneity. Bessembinder and Seguin (1992) …nd that equity volatility covaries positively with spot equity and futures equity trading volume with the unexpected component of spot trading volume being more e¤ective. In a similar way, Bessembinder and Seguin (1993) examine the relationship between trading activity and volatility in eight futures markets. They …nd 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 e¤ect of changes in expected volume. Moreover, they …nd that the expected open interest is negatively related to volatility in all markets, a result consistent with the belief that variations in open interest re‡ect changes in market depth.

Bessembinder and Seguin (1993) suggest that the volatility-volume relationship might also depend on the class of traders after …nding 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 …nd that the positive volatility-volume relationship is driven by the general public, a group of traders distant from the trading ‡oor, less informed and with greater dispersion of beliefs. On the other hand clearing members and ‡oor 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. Bjonnes et al (2007) also …nd that the volume-volatility relation depends on the group of market participants trading. Speci…cally, institutional investors' trading volume has the highest correlation with volatility while trading by non-…nancial investors is not correlated with volatility at all when controlling for trading by other market participants.

di¤erent types of domestic investors and total open interest is available. The di¤erent types of domestic

and quite close to the daily integrated variance [5] Andersen and Bollerslev (1998) show that the daily range is about as e¢ cient a volatility proxy as the realized volatility based on returns sampled every three-four hours. Upon availability of high frequency data for the Korean Stock spot/futures market and to provide more robustness to our results, we aim to estimate realized volatility proxies either using minute-by-minute squared returns (Andersen et al 2001) or squared ranges (Martens and vanDijk, 2007, Christensen and Podolskij, 2007). Various measures of range-based volatility have been employed in empirical …nance research (Daigler and Wiley,1999, Kawaller et al., 2001, Wang, 2002, Chen and Daigler, 2008).[6]

In this study we use total trading volume as well as disaggregated data of four di¤erent types of investors, namely member institutional (securities companies), non-member institutional (non securities), non-member individual and non-member foreign investors. We select these trader type volume categories

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 e¤ects 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 coe¢ cient is zero using White (1980) heteroscedasticity consistent standard errors. Test statistics for 10 lagged coe¢ cients are F-statistics for the hypothesis that the sum of the 10 coe¢ cients is zero. Coe¢ cients 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 …nd that unexpected levels of volume and open interest are more important in explaining

Regressions of Volatility on Expected and Unexpected Volume by Trader Type

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	Volatility measures		
Regression coe¢ cients	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 signi…cance at 0.15, 0.10, 0.05 level.

Further, we have investigated the e¤ect of the number of active value motivated traders by considering the natural logarithm of trader type volume (see Appendix). This alternative speci…cation of trading volume helps interpret surprises in trading activity in terms of percentage deviations from trend so that the unexpected log volume series is una¤ected 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 signi…cant 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 e¤ect, respectively, over volatility up to the period of the …nancial crisis. As regards the unexpected component of open interest its e¤ect on volatility remains negative and signi…cant. 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 di¤erent impact on the volatility-volume relationship evidenced over the whole sample.

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

Time-to-maturity e¤ects			
	Volatility measures		
Regression coe¢ cients	Return VLT	Garman-Klass VLT	High-Low VLT
Intercept	-0.1647 (-1.23)	-0.0371 (-1.62)**	-0.0122 (-1.61)**
KOSPI200 futures volume			
Member Institutional Inv.			
Moving average	0.2265 (0.47)	-0.0132 (-0.19)	-0.0134 (-0.52)
Expected	1.1051(1.53)*	0.2767 (2.48)***	0.1141 (2.87)***
Unexpected	-0.1111 (-0.22)	0.0632 (0.81)	0.0138 (0.47)
Non-member Institutional Inv.			
Moving average	-0.6337 (-0.90)	-0.1266 (-0.99)	-0.0274 (-0.72)
Expected	-1.3453 (-1.74)*	-0.1129 (0.98)	-0.0987 (-2.27)***
Unexpected	-0.9509 (-3.25)***	-0.1150 (-2.44)***	-0.0438 (-2.58)***
Non-member Individuals Inv.			
Moving average	0.1648 (0.29)	0.1313 (-1.25)	0.0211 (0.63)
Expected	0.7464 (0.90)	-0.0679 (-0.54)	0.0059 (0.12)
Unexpected	0.4643 (0.91)	-0.0657 (0.65)	-0.0045 (-0.12)
Non-member Foreign Inv.			
Moving average	-0.3517 (-0.92)	-0.0519 (-0.82)	-0.0163 (-0.78)
Expected	-0.5367 (-2.07)***	-0.1079 (-2.38)***	-0.0446 (-2.79)***
Unexpected	0.0628 (0.35)	-0.0007 (-0.01)	0.0051 (0.42)
KOSPI200 open interest			
Moving average	0.3614 (0.58)	0.0423 (0.43)	0.0211 (0.58)
Expected	0.0089 (0.01)	0.0519 (0.25)	-0.0238 (-0.35)
Unexpected	3.7989 (2.68)***	0.7545 (2.96)***	0.3161 (3.82)***

*,**,*** Denotes statistical signi…cance at 0.15, 0.10, 0.05 level.

When we include the trading volume dummies, in order to capture time to maturity e¤ects, the volatility-volume relationships across trader categories do not change sign while their signi…cance in most cases changes a little. We conclude that, despite adding the slope dummies on trading activity, there is no evidence that trading activity across di¤erent types of traders a¤ects volatility in a di¤erent way apart from the case of non-member institutional investors. In general we …nd small changes in signi…cance among di¤erent trader types. The most apparent change concerns the non-member institutional trading, which becomes much less associated with volatility as the contract rolls to its expiration. Surprises in open interest during the day are associated with much bigger price movements near the expiration of the contract, meaning that volatility becomes more sensitive to volume shocks especially when trades result in an increase on open interest as well. Moreover, the expected component of investors' volume becomes more signi…cant near contract expiration while the level of volatility decreases slightly for the same period. The other variables included in the volatility regressions such as lagged volatilities and lagged unexpected returns are also very signi…cant and of the same sign and magnitude compared to the values in Table 2. Finally, when the slope dummies on trading activity are added, the explanatory power of the trading activity and other variables in the volatility regressions is almost the same and consistent with the evidence in Table 2.

This study provides empirical evidence on the volatility-volume relationship for di¤erent trader types of the Korean index futures market. The di¤erent 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 …nding of this study is that surprises in volume and open interest are more important in

the period of the …nancial 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 signi…cant 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 signi…cant in most of the cases, with the e¤ect of lagged unexpected returns being consistently negative. Further, we …nd 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 e¤ect on volatility using alternative detrending methods for trading volume, such as the band pass …ltering and non parametric regressions. Finally, an interesting exercise is to use nonparametric and semi-parametric techniques for analysing the trader type e¤ect on volatility as we could capture simultaneously the long memory characteristics often evidenced in trading volume and volatility.

[1] Admati, A., and P ‡eiderer, P., (1988). A Theory of Intraday Patterns: Volume and Price Variability. Review of Financial Studies, 1, 3-40.

[2] Alizadeh, S., Brandt, M., and Diebold, F., (2002). Range-based estimation of stochastic volatility models. Journal of Finance, 1047-1091.

[3] Andersen, T., (1996). Return volatility and trading volume: an information ‡ow interpretation of stochastic volatility. Journal of Finance, 1, 169-204.

[4] Andersen, T., and Bollerslev, T., (1996). Heterogeneous Information Arrivals and Return Volatility Dynamics: Uncovering the Long-Run in High Frequency Returns. Journal of Finance, 52, 975-1005.

[5] Andersen, T., and Bollerslev, T., Diebold, F., and Ebens, H., 2001. The distribution of realized stock return volatility. Journal of Financial Economics, 61, 43-76.

[6] Andersen, R., and Danthine, J., (1983). The time pattern of hedging and the volatility of futures prices. Review of Economic Studies, 50, 249-266.

[7] Avramov, D., Chordia, T., and Goyal, A., 2006. The impact of trades on daily volatility. Review of Financial Studies, 19, 1241-1277.

[8] Baxter, M., and King, R., 1999. Studying business cycles: approximate band-pass …lters for economic time series. The Review of Economic and Statistics, 81, 575-593.

[9] Beckers, S., (1983). Variance of security price returns based on high, low, and closing prices, Journal of Business 56, 97–112.

[10] Bessembinder; H., and Seguin, P., (1992). Futures-Trading Activity and Stock Price Volatility. Journal of Finance, 47, 2015-2034.

[11] Bessembinder; H., and Seguin, P., (1993). Price Volatility, Trading Volume, and Market Depth:

[14] Blume, D., Easley, L., and O'Hara, M., (1994). Market Statistics and Technical Analysis: The Role of Volume. Journal of Finance, 49. 153-181.

[15] Brockwell, P. and Davis, R (1987). Time series:Theory and methods. Springer-Verlag.

[16] Brown, D., and Jennings, R., (1989). On technical Analysis. Review of Financial Studies, 2,527-552.

[17] Christiano, L., and Fitzgerald, T., (2003). The Band Pass …lter. International Economic Review, 44, 435-465.

[18] Chou, R. Y., 2005. Forecasting …nancial volatilities with extreme values: the conditional autoregressive range (CARR) model. Journal of Money, Credit, and Banking, 37, 561-582.

[19] Clark, P., (1973). A Subordinated Stochastic Process Model with Finite Variance for Speculative Prices. Econometrica, 41, 135-155.

[20] Cleveland, W., 1979. Robust locally weighted regression and smoothing scatterplots. J. Amer. Statist. Assoc. 74, 829–836

[21] Daigler, R., and Wiley, M., (1999). The impact of trader type on the futures volatility-volume relation. Journal of Finance, 6, 2297-2316.

[22] DeLong, B., Shleifer, A., Summers, L., and Waldman, R., (1990a). Noise trader risk in …nancial markets. Journal of Political Economy, 98, 703-739.

[23] DeLong, B., Shleifer, A., Summers, L., and Waldman, R., (1990b). Positive feedback investment strategies and destabilizing rational speculation. Journal of Finance, 45, 379-395.

[24] DeLong, B., Shleifer, A., Summers, L., and Waldman, R., (1991). The survival of noise traders in …nancial markets. Journal of Business, 64, 1-19.

[25] Easley, D., and O'Hara, M., (1987). Price, trade size, and information in securities markets. Journal of Financial Economics, 19, 69-90.

[26] Easley, D., Kiefer, N., and O'Hara, M., (1997). The information content of the trading process. Journal of Empirical Finance, 4, 159-186.

[27] Ederington, L., and Lee, J., (1993). How Markets Process Information: News Releases and Volatility. Journal of Finance, 48, 1161-1191.

[28] Ederington, L., and Lee, J., (1995). The Short-Run Dynamics of the Price Adjustment to New Information. Journal of Financial and Quantitative Analysis, 30, 117-134.

[29] Epps, T. and Epps, M., (1976) The Stochastic Dependence of Security Price Changes and Transaction Volumes: Implications for the Mixture of Distributions Hypothesis. Econometrica, 44, 305-321.

[30] French, K., and Roll, R., (1986). Stock return variances: The arrival of information and reaction of traders. Journal of Financial Economics, 17, 5-26.

[31] Fan, J., and Gijbels, I., (1996). Local Polynomial Modelling and its Applications. Chapman & Hall, London.

[32] Gallant, A., Rossi, P.,and Tauchen, G., (1992). Stock Price and Volume. Review of Financial Studies, 5, 199-242.

[33] Garman, M., and Klass, M., (1980). On the estimation of security price volatilities from historical data. Journal of Business, 1, 67-78.

[34] Glosten, L., and Milgrom, P., (1985). Bid, ask, and transaction prices in a specialist market with heterogeneously informed tradrers. Journal of Financial Economics, 13, 71-100.

[35] Granger, C., and Hatanaka, M., (1964). Spectral analysis of economic time series. Princeton University Press.

[36] Grossman, S., and Stiglitz, J., (1980). On the impossibility of informationally e¢ cient markets. American Economic Review, 70, 393-408.

[37] Grundy, B., and McNichols, M., (1989). Trade and revelation of information through prices and direct disclosure. Review of Financial Studies, 2, 495-526.

[38] Harris, M. and Raviv, A., (1993). Di¤erences of Opinion Make a Horse Race. Review of Financial Studies, Vol. 6, No. 3. (1993), pp. 473-506.

[39] Hindy, A., (1994). Dynamic price formation in a futures market with double auctions. Economic Theory, 4, 539-564.

[40] Holthaussen, R. W., and Verrecchia, R., (1988). The E¤ect of Informedness and Consensus on Price and Volume Behavior. Accounting Review, 65, 191-208.

[41] Hong, H., (2000). A model of returns and trading in futures markets. Journal of Finance, 55, 959-988

[42] Ito, T., Lyons, R., and Melvin, M., (1988). Is There Private Information in the FX Market? The Tokyo Experiment. The Journal of Finance, 53, 1111-1130.

[43] Jones, C., Kaul, G., and Lipson, M., (1994a). information, trading and volatility. Journal of Financial Economics, 36,127-154.

[44] Karpo¤, J., (1987). The relation between price changes and volume: a survey. Journal of Financial and Quantitative Analysis, 22, 109-126.

[45] Kartsaklas, A. and Karanasos, M., (2009) Dual long-memory, structural breaks and the link between turnover and the range-based volatility. Journal of Empirical Finance, 16, 838- 851

[46] Kodres, L., and Pritsker, M., (1997). Directionally similar position taking and herding by large futures market participants. Working paper, Internationally Monetary Fund, Washington, D.C.

[47] Kyle, A., (1985). Continuous Auctions and Insider Trading. Econometrica, 53, 1315-1335.

[48] Li, J., and Wu, C., 2006. Daily return volatility, bid-ask spreads, and information fow: analyzing the information content of volume. Journal of Business, 79, 2697-2740.

[49] Milonas, N., (1986). Liquidity and price variability in futures markets. Financial Review, 21, 211-237.

[50] Muller, H., (1988). Nonparametric Regression Analysis of Longitudinal Data. Lecture Notes in Statistics, Vol. 46. Springer, Berlin.

[51] O'Hara, M., (1995). Market Microstructure Theory. Blackwell Publishing.

[52] P‡eiderer, P., (1984) The volume of trade and the variability of prices: A framework for analysis in noisy rational expectations equilibria. Working paper, Stanford University.

[53] Phillips, G., and Weiner, R., (1994). Information and Normal Backwardation as Determinants of Trading Performance: Evidence From the North Sea Oil Forward Market. The Economic Journal, 104, 76-95.

[54] Richard, S., and Sundaresan, M., (1981). A continuous time equilibrium model of forward prices and futures prices in a multigood economy. Journal of Financial Economics, 9, 347-371.

[55] Rogers, L., and Satchell, S., (1991), Estimating variance from high, low, and closing prices. Annals of Applied Probability, 1, 504–512.

[56] Samuelson, P., (1965). Proof that properly anticipated prices ‡uctuate randomly. Industrial Management Review, 6, 41-50.

[57] Schneider, J. (2009). A rational expectations equilibrium with informative trading volume. Journal of Finance, 64, 2783-2805.

[58] Schwert, G., (1990). Stock volatility and the crash of '87. Review of Financial Studies, 3, 77-102.

[59] Seguin, P., (1991). The Value of Transactions Reporting. Unpubl. Manuscript, Univ. of Michigan

[60] Shalen, C., (1993). Volume, Volatility, and the Dispersion of Beliefs. Review of Financial Studies, 6, 405-434.

[61] Tauchen, G. and Pitts, M., (1983). The Price Variability-Volume Relationship on Speculative Markets. Econometrica, 51, 485-505.

[62] Wiley, M., and Daigler, R., (1998). Volume relationships among types of traD-20.47ph0(M.,)-20.47Polume5(Financ)-

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 …rms 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 …rst construct a detrended activity series[13] 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 signi…cant impact on the volatility-volume relationship (Kyle,1985, Admati and P‡eiderer, 1988). We repeat the prior analysis using the natural logarithm of each trader type volume and open interest. By taking the log di¤erences 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 di¤erences 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 una¤ected 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 signi…cant and positively associated with all volatility measures (Return VLT, Garman-Klass VLT and High-Low VLT). The e¤ect 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 signi…cant for the two major players of the Korean Stock Exchange, namely the member institutional and non-member individual investors. The e¤ect of member institutional investors is negative and signi…cant while the e¤ect of non-member individuals in positive and signi…cant over all volatility estimators.

Interestingly the moving average component appears to be quite signi…cant 3ld…v3ld…v3ldT and Hi(sign)(ciated)-3.h(b)

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 coe¢ cient is zero using White (1980) heteroscedasticity consistent standard errors. Test statistics for 10 lagged coe¢ cients are F-statistics for the hypothesis that the sum of the 10 coe¢ cients is zero. Coe¢ cients 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.

	Volatility measures		
Regression coe¢ cients	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 signi…cance 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 signi…cant for most of the cases. The strongest e¤ect on volatility is imposed by individuals in the case of range-based volatility while their e¤ect remains still negligible in the case of return standard deviation. As regards surprises in the trading activity of member institutional investors, the mixed and signi…cant e¤ect on volatility evidenced for the whole sample becomes insigni…cant after the crisis. Moreover, activity forecastable across days (expected component) remains highly signi…cant 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 ‡uctuate in the same direction as volatility. The expected trading activity of member investors is still negative in sign; however, it becomes insigni…cant after the crisis.

component of open interest is negative in sign and more signi…cant 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 speci…cation of trading volume support some of the conclusions reached on the raw volume regressions. Again we …nd 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) …nding 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 …nd that member investors' unexpected trading volume also exhibits a mixed relation with volatility. The positive e¤ect is consistent

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