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ARTICLE INFO	Sangram Keshari Jena and Ashutosh Dash (2016). Does contract size matter for price discovery and risk management in stock index futures?. *Investment Management and Financial Innovations*, *13*(3), 62-74. doi:10.21511/imfi.13(3).2016.05
DOI	http://dx.doi.org/10.21511/imfi.13(3).2016.05
RELEASED ON	Tuesday, 23 August 2016
JOURNAL	"Investment Management and Financial Innovations"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
0	0	0

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Does contract size matter for price discovery and risk management in stock index futures?

Abstract

In an effort to increase the liquidity and accessibility to the investors, National Stock Exchange of India (NSE) had reduced contract size of its Nifty index futures two times from 200 to 100 and, subsequently, to 50 units. How does this change in contract size of index futures impact the informed and hedge based trading, thereby contributing to the twin objectives of price discovery and risk management, respectively? VAR model is applied to daily return volatility, volume and open interest to study the impact. Significant feedback relationship between volume and volatility following the reduction in contract size establishes the informational trading and price discovery. However, no causality from volatility to open interest implies contract size is not a determinant of hedging. But significant causality from open interest to volatility is establishing the non-informational and liquidity trading. So stock exchanges should consider the appropriate lot size before going for introducing new futures contract.

Keywords: VAR, price discovery, risk management, granger causality, variance decomposition, impulse function.
JEL Classification: G12, G14.

Introduction

Contract size is one of the important attributes of the futures contract. Because not only too large contract will inhibit small players to enter the market, but also making hedging difficult for big players. Again, changing contract size also impacts the relationship amongst the futures return volatility, and it's trading activity measured by volume and open interest. Because any change in market microstructure due to regulatory changes, it impacts the dynamics of the volatility, volume and open interest (Watanabe, 2001). This dynamic relationship plays important role in asset pricing and portfolio insurance and return predictability in futures market. Wang and Yu (2004) in their study in 24 US futures market confirm that short term profits on a contrarian portfolio (buying past losers and selling past winners) can be predicted from past trading activity variables such as volume and open interest. According to them, lag volume and lag open interest share a positive and negative relationship, respectively, with the current profit, so higher volume and lower open interest futures contract will give better contrarian profit. Further, in emerging market, index futures provide opportunity for excess risk adjusted return due to inefficiency characterized by higher persistence of return and volatility. In their comparative study of the performances of passive and active trading strategy on Taiwan stock index futures, Chiang et al. (2012) found that active index futures trading strategy outperform the passive, i.e., buy and hold strategy.

On part of the exchange, the objective of designing optimal contract size is to enhance the accessibility, attractiveness and liquidity of the futures contract, simultaneously achieving the two most important economic objectives of price discovery and risk management (Sibler, 1981). That's why redesigning the futures contract is taken as the last resort to attract the attention to unsuccessful contract wherever, diminishing in trading demand is observed (Bollen, Smith and Whaley, 2003). Apart from this, lower transaction cost and leverage attracts large number of traders to futures market making faster dissemination of information in futures market, thereby contributing towards price discovery function (Zhou et al., 2014). Also futures market helps players in managing the risk they are exposed to in the spot market (Darrat & Rahaman, 1995, Pericli & Koutmos, 1997; Darrat et al., 2002).

The study on redesigning of the contract size by Bjursell et al. (2010) found that reduction in size of the contract leads to increase in trading activities in terms of higher adjusted volume and open interest and also higher volatility due to increase in trading frequency. Further, greater liquidity in terms of lower spread and higher trading volume is documented following the reduction in contract size (Karagozoglu and Martell, 1999). Also, the study by Huang and Stoll (1998) predicted an increase in liquidity and smooth in price fluctuation following the decrease in contract size due to more participation of small investors who are so far restrained from the futures markets due to capital constraint because of higher contract value. However, Karagozoglu et al. (2003), in their study on the impact on price volatility of the reduction in contract size of S&P 500 trading in Chicago Mercantile Exchange (CME), reported no significant impact. Nevertheless, their result might have been confounded by the de-facto reduction in

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contract size which refers to the introduction of E-mini S&P 500 futures contract on CME in September 1997 during the period of the study.

The literature on the redenomination of contract size mainly concentrated on the impact on liquidity and volatility. In this paper, the study is extended further to find out the impact of redesigning of the contract size on the twin economic functions of futures market, i.e., price discovery and risk management. Specifically the impact of reduction in contract size is studied on informed trading and hedged based trading in Nifty futures through the dynamics of return volatility and trading activity proxied by trading volume and open interest.

The National Stock Exchange of India (NSE) is the perfect ground to study this dynamics. The size of the Nifty index futures contract had been reduced two times during the sample period of the study from 200 to 100 on April 1, 2005 and further to 50 units on February 7, 2007, since it started trading in NSE from June 2001. The underlying Nifty index, consisting of 50 stocks, is the Bellwether index representing the 22 sectors of the economy and 63% of the market capitalization of the National Stock Exchange of India, giving compounded annual growth rate of 13.13% from 2000-2001 to 2009-2010. It is the third largest exchange by number of stock index future contract traded in 2009 after CME group and Eurex[1].

In Figure 1, in terms of no of contracts traded, the Nifty index futures stands out as the second largest contract trading in National Stock Exchange of India (NSE) only after all the stock futures taken together, apparently showing a steady growth in the trading activity in Nifty futures. Also, it is clearly evident from the descriptive statistics presented in Table 1 for the three different sub-periods of the study in which each period represents a particular contract size following the change, there is an increase in trading activity such as volume and open interest following the reduction in contract size from a multiple of 200 to 100 and, finally, to 50. The volume and open interest represent total turnover of Nifty futures in lakhs and number of futures contracts outstanding at the end of the day's closing, respectively. When contract size is reduced from 200 to 50 units, average volume went up from 104403.2 lakhs per day to 1277367 lakhs and open interest from 3629920 to 29714684 contracts. Also, conditional volatility has been increased during the same period from 0.000253 to 0.000605. These market episodes indicate a possible well-built interrelationship among the sign and scale of price movements, volatility of prices and the trading volume as shown in many previous studies (Gallant et al., 1992). How does the change in contract size impact this dynamics of Nifty futures volatility and its trading activity variables such as volume and open interest? Are there more informational trading or hedgebased trading happening due to this change and leading to the growth in turnover and volatility, as observed in Nifty futures in the Figure 1 and Table 1. The study tried to go deep into trading activity and return volatility dynamics of Nifty index futures following the two consecutive reductions in the contract size.

The rest of the paper is organized as follows. Section 1 briefly reviews the relevant literature and hypotheses development. Data and methodology are described in section 2. Section 3 covers the empirical analysis and final section concludes the study.

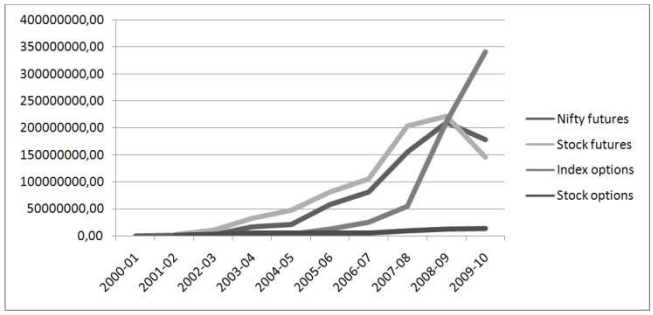

Fig. 1. Product wise no of contracts traded in NSE futures and options segment from June 2000 to September 2009

1. Literature

Besides fundamental factors, optimal size of the futures contract impacts the relationship dynamics amongst price volatility, volume and open interest, as one of the important determinants of the trading by speculators (informed and noise traders) and hedgers (Silber, 1981; Watnabe, 2001). Further, there is existence of informational relationship between volatility and both volume and open interest (Brooks, 1998). In this section, two hypotheses are formulated to address the objective of the study. The objective is to find out the impact of change in contract size on the informed trading and hedgebased trading (liquidity trading) which

[1] Indian Security Market – A Review, Volume XIII 2010, www.nseinda.com.

leads to price discovery and risk management, respectively, in Nifty index futures. The small contract size is expected to lead to better informed trading and more hedging activities? Otherwise, it may lead to noise brought about by speculators which will destroy the whole purpose of index future. Due to reduction in lot size more small traders who are uninformed are interested to enter the market, creating more price volatility which is opposite to the price discovery function of the futures contract (Bjursell et al., 2010).

The informational dynamics in financial market, in general, and futures market, in particular, depends on the relationship between trading volume and return volatility. Mixture Distribution Hypothesis (MDH) advocated by Clark (1973) regarding theory of information in financial market states that the relationship between volatility and volume is positive and contemporaneous which depends on the rate of arrival of information into the market. Sequential Information Arrival Hypothesis (SIAH) by Copeland (1976) maintains that the relationship between volume and volatility is causal, because information arrives sequentially into the market. Most of the studies across the futures market found a positive relationship between trading volumes and return volatility (Clark, 1973; Cornell, 1981; Tauchen and Pitts, 1983; Grammatikos and Sunders, 1986)).

Concerning stock index futures positive impact of daily trading volume on volatility is reported in S&P futures contract (Kawaller et al., 1987; Board and Sutcliffe, 1990; Kutan and Aksoy, 2003), and significant lead lag relationship is reported by Mougoue and Aggarwal (2011). The objective is to see the relationship dynamics between return volatility and trading volume following the reduction in the size of the contract. A stronger relationship is expected, as small contract size in combination with other inbuilt features of leverage, lower transaction cost of futures contract would attract informed traders, subsequently, contributing towards informational trading in the Nifty futures contract.

Further, futures market is more reactive to information in comparison to spot market because of leverage and lower transaction cost. So, the resultant trading activities create volatility in the futures market when new information arrives. Thus, in derivative market, the magnitude of volatility as a measure of information flow (Ross, 1976), is related to the trading activities. This view is complimented by Fung and Patterson (1999) who state that volatility is greater during the trading hour than the non-trading hour and also the findings of French and Roll (1986) who state that more information is released during the trading hour than the non-trading hour.

Thus, when new information arrives into the market, both volatility and trading volume would impact each other. That's why causality from volume to volatility and vice versa establishes informational trading leading to better price discovery. So, our **null hypothesis (1)** is that there is no price discovery in Nifty futures following the change in the size of the contract.

Besides trading volume, open interest in futures market is an additional measure of trading activity generated by large hedges (Bessembinder and Seguin, 1993). In their study, in eight physical and financial futures markets, after dividing trading volume and open interest into expected and unexpected parts, strong positive contemporaneous relationship between volume and volatility is reported. But volatility is found to be negatively related to both expected and unexpected open interest. That means, as a proxy for hedging activity and market depth, increase in open interest as of the close of the day (Bessembinder and Seguin, 1993; Kyle, 1985) alleviates volatility. As a result, open interest reflects the non-informed or liquidity trading and willingness of the traders to risk capital in futures market. Similar negative relationship is reported in Nikkei 225 stock index futures between volatility and open interest (Watanabe, 2001). Chang et al. (2000) found that increase in spot index volatility leads to increase in open interest of S&P 500 futures contract. It's a reflection of higher demand for futures contract by the traders for hedging in response to higher level of uncertainty in spot market. Thus, increasing use of futures contract is triggered by greater volatility in futures market (which is a reflection of future expected volatility in spot and cash market). That's why, with smaller contract size, hedgers can fine tune their hedge ratio which might not have been so smooth in larger lot size. Thus, stronger negative led lag relation from open interest to volatility following the changes in contract size would be an indication of more hedging or risk management activities in Nifty index futures. Norden (2006), in the context of split of OMX index futures contract in the Swedish exchange for options and futures, found that futures split led to lowering of basis risk and improved hedging efficiency. Thus, open interest as a proxy for hedging activity caused by volatility is expected to increase following the reduction in contract size. This, result support the hedged based trading in index futures. Thus, our null **hypothesis (2)** is that there is no impact on hedgebased trading following the change in the size of the Nifty index futures.

2. Data and methodlogy

2.1. Data. To address the hypothesis postulated in the previous section, daily closing prices, rupee

trading volume (turnover) and open interest of near month Nifty futures contract are taken from 6 June 2000 through 29 September 2009. In total, we have 2,323 daily observations of closing price, trading volume and open interest obtained from the official website of National Stock Exchange of India (NSE)[2]. CNX Nifty is a Bellwether index of the NSE representing 50 stocks across 22 sectors, 52% of the traded volume and 63% of market capitalization of the NSE. NSE, in order to attract more market participants to the Nifty futures contracts, reduced the lot size from 200 to 100 and then 100 to 50 units w.e.f April 1, 2005 and February 7, 2007, respectively, two times in the sample period. Accordingly, data have been divided into three subsamples considering the no of split in contract size of the index futures during the period of the study. The first subsample period spans from 06/12/2000 to 03/31/2005 with the lot size of 200 multiples of Nifty index. The second sample period starts from 04/01/2005 to 02/06/2007 with 100 multiples of the Nifty index futures and, finally, lot size of 50 from 02/07/2007 to 09/24/2009.

Following Campbell et al. (1993) and Fung & Patterson (1999), for the study, we have formed stationary time series of trading volume and open interest by incorporating the following procedure through Eq. (1) using 100 days backward moving average. The resultant time series captures the change in the long run movement in trading volume and open interest.

$$V_t = \frac{VT_t}{\frac{1}{100}\sum_{i=1}^{100} VT_{t-i}}, \quad (1)$$

where VT_t is the log of trading volume at time t and, for open interest, it represents the log open interest at time t. In the denominator, 100 days moving average starting from $t-1$ to $t-100$ of volume and open interest is taken. The transformation through Eq. (1) helps to mitigate the mechanical link between volume and open interest in the actual trading and enables to interpret the information structure relating to volume, open interest and price movements through VAR analysis. V_t is the average trading volume (VOL_100) and open interest (OI_100) for time t which is taken for further study through equation (5). The daily return series (r_t) is calculated as the first difference of the logarithms of daily closing prices of near month Nifty index futures contracts which is taken for calculation of daily conditional volatility through equation (2), (3) and (4) for further study.

The unconditional daily mean return of the Nifty index futures is 0.000531%, with a standard deviation of 0.018%. The return series is fat-tailed, as reported by excess kurtosis of 11.53 and negatively skewed, since the reported skewness is –0.48. The Jarque-Bera test rejects the null hypothesis of normality. The evidence of the existence of excess kurtosis is due to a possible time varying variance, as documented by Akigary et al. (1991) and Fujihara and Mougoue (1997). Further, the presence of heteroscedasticity in the index return is significant at lag 10 as per the ARCH LM test (Engle, 1982) (available on request). Therefore, conditional volatility of Nifty index futures is taken for the study of the dynamic interrelationship among volatility, volume and open interest in near month future contract. The ARCH class of model, i.e., GARCH (1, 1) being parsimonious is used to estimate the conditional volatility of return.

Conditional volatility following GARCH (1, 1) model proposed by Bollerslev (1986) is estimated from Eq. (2) through (4). In GARCH (1, 1) model, the conditional variance h_t in Eq (4) is a function of a long run average variance rate (ω), lagged squared error term represented by news (ε^2_{t-1}) and its own lag (h_{t-1}).

$$r_t = c + br_{t-1} + \varepsilon_t, \quad (2)$$

$$\varepsilon_t / I_{t-1} \sim N(0, h_t), \quad (3)$$

$$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}. \quad (4)$$

Augmented Dicky-Fuller (ADF, 1979) test is used to test the stationarity in the return volatility series (h_t), volume and open interest. The ADF test results[3] strongly reject the null hypothesis that the Nifty index futures return volatility series and trading volume and open interest series are non-stationary. Therefore, three resultant time series variables, i.e., conditional volatility h_t (GARCH01), volume (VOL_100) and open interest (OI_100) are taken for further analysis in this study in equation (5) through (8).

2.2. Methodology. To investigate the interrelationship between Nifty index futures volatility, volume and open interest in the near month contract, Vector Autoregressive (VAR) model is used in the study. It is the generalized multivariate form of univariate autoregressive model, carrying the most valuable feature of estimating the dynamic interrelationship between variables without any choice of having dependent and independent variables. Further, Granger causality is conducted on the estimates of VAR model to determine the causal relationship among Nifty index futures volatility and trading activity variables such as volume and open interest. Causal

[2] www.nseindia.com.

[3] Results are available on request.

relationship does not imply any cause and effect relationship, rather it is based on "predictability or forecastability" (Granger, 1969). The nature of forecastability depends on the strength of the association among the system variables. So, the variance decomposition is done to find out magnitude of the dynamic relationship and impulse response function to trace out the direction and speed of the dynamic effect among the volatility, volume and open interest of Nifty index futures. Variance decomposition helps in finding the variation in each variable in the system that is contributed by its own shock, and shocks produced from other variables. The impulse response function provides the direction and time profile of the effects of own shocks, and shocks from other variables in the system on the future behavior of the variables.

The reduced form of the VAR model used in this study is presented as follows through equation (5) to estimate the interrelationships among daily volatility, trading volume and open interest of Nifty index futures:

$$Y_t = c + \sum_{k=1}^{L} a_k Y_{t-k} + e_t, \quad (5)$$

where Y_t is a 3×1 column vector of volatility (GARCH01), adjusted trading volume (VOL_100) and adjusted open interest (OI_100) at time t. c and a_k are 3x1 and 3×3 matrices of coefficients, L is the lag length, e_t is the 3x1 column vector of error terms. The direct effect of i_{th} variable upon j_{th} variable after k periods is measured by the (i, j) component of α_k. Specifically, the i_{th} component of e_t is the innovation of the i_{th} variable that cannot be predicted from the other variables in the system.

The VAR is rewritten in the form of following individual equations through equation (6), (7) and (8) to test the joint hypothesis that "Does volume (*VOL*_100) granger cause volatility (*GARCH*01) ceteris-paribus"? Likewise, for other joint hypothesis for causality from OI_100 to VOL_100, GARCH01 to OI_100, OI_100 to GARCH01, and VOL_100 to OI_100. As all the variables in the VAR system are stationary, their joint hypothesis can be tested using F-statistics.

H1, the first null hypotheses postulates that there is no informed trading following the change in contract size. That means there is no granger causality between volatility and trading volume and vice versa following the reduction in lot size.

So, $\beta_{21} = \beta_{22} = \text{----------} = \beta_{2L} = 0$ in equation (6) and in equation (7) $\gamma_{11} = \gamma_{12} \text{----------} = \gamma_{1L} = 0$

A rejection of the joint hypotheses of zero value for lagged β_{2k} and γ_{1k} supports the information based trading in Nifty futures.

H2, our second null hypothesis postulates that change in contract size does not impact the hedging activities. That means there is no Granger causality from volatility to open interest. So, in equation (8):

$$\delta_{11} = \delta_{12} = \text{----------} = \delta_{1L} = 0$$

A rejection of the joint hypotheses of zero value of the lagged δ_{1k} supports the hedgebased trading in Nifty futures.

$$GARCH01 = c_{10} + \beta_{1k} \sum_{k=1}^{L} GARCH01_{t-k} +$$

$$+ \beta_{2k} \sum_{k=1}^{L} VOL_{t-k} + e_{1t}, \quad (6)$$

$$VOL_t = c_{20} + \gamma_{1k} \sum_{k=1}^{L} GARCH01_{t-k} + \gamma_{2k} \sum_{k=1}^{L} VOL_{t-k} +$$

$$+ \gamma_{3k} \sum_{k=1}^{L} OI_{t-k} + e_{2t}, \quad (7)$$

$$OI_t = c_{30} + \delta_{1k} \sum_{k=1}^{L} GARCH01_{t-k} + \delta_{2k} \sum_{k=1}^{L} VOL_{t-k} +$$

$$+ \delta_{2k} \sum_{k=1}^{L} VOL_{t-k} + \delta_{3k} \sum_{k=1}^{L} OI_{t-k} + e_{3t}. \quad (8)$$

In an effort to provide further insight into the dynamic interrelationship among the variables, VAR model is represented as moving average model of innovations of the system variables through equation (9):

$$Y_t = \sum_{k=1}^{\infty} A_k e_{t-k}. \quad (9)$$

The m step ahead forecast error of Y_t can be computed from the moving average model of VAR in Eq. (9). Breaking up of the variation of the forecast error of the variable Y_t, variance decomposition explains the unexpected change in the variation of each variable produced by shocks from other system variables.

Impulse response function traces out the responsiveness of the dependent variable in the system to the shocks/innovations or impulses of own and other variables in the system.

Eq. (9) is transformed and presented through equation (10) and (11) to remove the contemporaneous correlation across equation by the process of orthogonalization. Though the innovations e_t is serially uncorrelated, but, across equations in the VAR system, they might be correlated:

$$Y_t = \sum_{k=1}^{\infty} A_k V u_{t-k}. \quad (10)$$

Such that,

$$Y_t = \sum_{k=1}^{\infty} C_k u_{t-k}. \quad (11)$$

V is a lower triangular matrix.

Now, u_t is serially and contemporaneously uncorrelated innovation which is orthogonalized innovation from $e = V_u$ with an independent covariance matrix.

3. Empirical analysis

In this section, the results of VAR analysis are reported, the Granger causality through Table 2, the variance decomposition in Table 3 and the impulse response function through Figures 2, 3 and 4.

3.1. Individual behavior of volume, volatility and open interest. The volatility has been increasing over the period (Table 1) and also became more persistent following the change in contract size (last column of Figure 4) signifying more information flow through more trading activities. It's evident from descriptive statistics presented in Table 1 that there is an increase in trading activities represented by volume and open interest over the changed period. The response of volatility to its own shock became highly persistent, i.e., the impact does not die out (last column of Figure 4) and also it got impacted by volume shock at lag 1 following the change in contract size to 50 multiple (Panel C, Table 3). But there is a change in persistence level of volume and open interest from high to low over the period following the changes in the contract size. In case of open interest, the impact dies out within 11 days and, for volume, within 4 days of the shocks.

3.2. Volume and volatility. From the reported result of Granger causality in Table 2, is evident that the coefficients $\beta_{21,}$ $\beta_{22,\cdots}\beta_{2L}$ in Panel C and $\gamma_{11,}\gamma_{12\cdots,}\gamma_{1L}$ in Panel B become significant under the contract size of 50 multiple in contrast to the previous two period sat 5% level of significance, thereby rejecting the null hypothesis 1. Thus, the relationship dynamics between the volume and volatility over the period of reduction of contract size changed from no causality to significant feedback relationship. Now, volume is Granger caused by volatility and vice versa. Thus, given the information on previous day's volume, volatility can be predicted, and vice versa, the dynamics is associated with the sequential arrival of information to Nifty futures market. It confirms the findings of Chen and Daigler (2008) who found that information reaches the different group of traders at different times. Further, the speed of adjustment of information into the prices also becomes stronger, as evident (in the Figure 3) from the impulse response of volatility to one unit shock to volume which dies out in 5 days. It's in contrast to the results relating to the previous two periods where high volatility persistence is apparent. Thus, information - based trading is strengthened following the reduction in lot size, subsequently, contributing to the price discovery. Moreover, the mean value of volatility and volume rose from .000253 to .000605 and 104403.2 to 1277367, respectively (see Table 1) following the reduction from 200 to 50 multiple, and are driven by information, as the first moment of volatility process is driven by information and the second moment of volatility, i.e., excess volatility is attributed to different interpretation of information and reactions of traders to information (Shalen, 1993). Its supplemented by the 4% decomposed variance of volatility, which caused the variation in the volume in Panel C, Table 3.

However, partly this may be attributed to noise trading by uninformed investors which normally trade on changes on volume and price happened in the market due to informed trading (Delong, Shelifer, Summers and Walmann, 1990). It causes increase in the second moment of volatility called transitory volatility which is not permanent like fundamental volatility caused by informed trading (Shalen, 1993; Chen and Daigler, 2008). Since around 4% of the forecasted error of volatility is explained by the shocks, i.e., unexpected volume, noise trading cannot be completely ruled out in Nifty index futures following the split of the contract into smaller lot size.

3.3. Open interest and volatility. Inconsistency in causality from volatility to open interest is observed in Table 2 over the changed period of the contract size. The coefficients $\delta_{11,}\delta_{12,\ \cdots,}\delta_{1L}$ in Panel Aare statistically insignificant during the period of contract size of 200 and 50, though it is significant in the period of 100 contract size. Thus, the non-rejection of null hypothesis 2 indicates that change in the size of the contract from 200 to, finally, 50 does not improve the hedging activities in Nifty index futures. It is also evident in the impulse response function of open interest to one unit of shock to volatility in column two, Figure 2 which is almost zero. However, open interest Granger causes volatility only when size of the contract is changed to 50, as the coefficient β_{3k} is significant at 1% level significance in equation (7) and panel C of Table 2. Also, the impulse response function of volatility to shocks in open interest is positive and very persistent in column one, Figure 3. That means volatility in Nifty index futures is caused by uninformed and liquidity trading; open interest being a proxy for uninformed and liquidity trading (Bessembinder and Seguin, 1996). It supports the findings of Delong et al. (1990a) and (1990b) that, following the cutback in the contract size, uninformed traders are prevalent in the index futures market.

3.4. Volume and open interest. Both volume and open interest are complementary to each other, as is evidenced from feedback relationships from the significant Granger causality runs from volume and open interest and vice versa over the period (Panel A and B, Table 2). Thus, both open interest and volume are endogenous which is in contrast to the findings of Fung & Patterson (1999). It is also supplemented by variance decomposition of volume in which around 3% is explained by the shocks of open interest. However, our results support Bessembinder et. al. (1996), as open interest is a determinant of volume. Further, from impulse response functions in column two, Figure 2, it is observed that the time profile and direction of the response of open interest to volume shocks is changed from positive to negative and it becomes less persistence.

Conclusions

Through the dynamics of the relationship between volatility, volume and open interest, the study examined the impact of the change in size of the Nifty index futures contract on the two most important functions of futures market, i.e., price discovery and risk management, besides satisfying all other stakeholders of the futures market. The relationship dynamics between volatility and volume, volatility and open interest and volume and open interest has been changed over the period with the change in the size of the futures contract from 200 to 100 and, subsequently, to 50. The stronger causality between volume and volatility establishes the informational trading in Nifty futures contract. However, no evidence hedgebased trading is observed following reduction in the size of the contract. But, non-informational and liquidity trading is manifested in the Nifty futures market due to the smaller size of the futures contract. Nonetheless, no change in causality from volume to open interest had been observed over the period, but its direction and time profile changed in the smaller lot size. Though it is a regulatory issue, changing the size of the futures contract impacts the informational and not the hedging activities of index futures contract. So, stock exchanges should consider the appropriate lot size before going for introducing new futures contract. This study is undertaken on daily data for index futures. Further research could be undertaken on intraday data on both index and stock futures to investigate price discovery and hedging effectiveness in futures market following the change in contract size.

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Appendix

Table 1. Descriptive statistics of adjusted trading volume (VOL_100), actual volume in lakhs (VOLUME), adjusted open interest (OI_100), actual open interest (OI) and unconditio volatility (GARCH01) of different contract size of 200,100 and 50 units for three sub periods from 06/12/2000 to 03/31/2005, 04/01/2005 to 02/06/2007 and 02/07/2007 to 04/24/20 respectively

	Contact size 200					Contract size 100					Contract size 50				
	GARCH01	OI_100	OI	VOL_100	VOLUME	GARCH01	OI_100	OI	VOL_100	VOLUME	GARCH01	OI_100	OI	VOL_100	VOLUME
Mean	0.000253	1.017575	3629920	1.035022	104403.2	0.000267	1.004925	22075967	1.007433	671516.7	0.000605	0.999544	29714684	1.003027	1277367
Median	0,000168	1.016775	1893000	1.026211	16587.18	0.000165	1.009936	22981500	1.005801	663118.5	0.000461	1.003187	30927250	1.002118	1244392
Maximum	0,006006	1.134429	17198400	720437.5	720437.5	0.002151	1.035065	37084200	1.086502	1863217	0.004689	1.027973	44400050	1.078559	3091293
Minimum	6.19E-05	0.888918	4000	0.763283	51.87	6.90E-05	0.9321	5534900	0.849056	101241.3	7.54E-05	0.923456	7272150	0.851591	131141.5
Std.dev.	0,000395	0.033931	4006149	0.065963	144365.5	0.000309	0.01921	5723029	0.028013	312250.1	0.000593	0.01786	7467872	0.023086	399724.7
Skewness	9.051996	0.490164	1.136981	0.686921	1.380761	3.440982	-1.60552	- 0.680226	-0.393311	0.732384	3.175952	-1.44672	- 0.6968	-0.367287	0.84816
Kurtosis	107.4346	4.624241	3.14451	4.896333	4.155072	15.68247	5.610481	3.683959	6.1528	3.86036	16.35718	5.397237	3.180091	7.068493	4.869162
Jarkue-Bera	565462.3	166.4632	261.5364	253.6128	451.3695	4025.327	331.0909	44.82682	204.1391	55.79149	5924.773	382.3825	53.44756	462.9147	172.5553
Probability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	0.30524	1129.508	4.39e+09	1148.875	1.26E+08	0.123984	466.2851	1.02E+10	467.449	3.12E+08	0.393376	649.7037	1.93E+10	651.9674	8.30E+08
Sum. sq. dev.	0.000188	1.276774	1.94E+16	4.825373	2.52E+13	4.42E-05	0.17804	1.52E+16	0.363334	4.51E+13	0.000229	0.207019	3.62E+16	0.345893	1.04E+14
Observations	1208	1110	1209	1110	1209	464	464	464	464	464	650	650	650	650	650

Table 2. Granger causality between open interests (OI_100), Volume (VOL_100) and return volatility (GARCH01) over three sub-periods for contract size starting with 200 (secor column), followed by 100 (third column), 50 (fourth) and, finally, for the full period (fifth column)

Panel C	**Contract size 200**			**Contract size 100**			**Contract size 50**			**Full period**		
Dependent variable: OI	Chi-sq	df	Prob.	Chi.sq	df	Prob.	Chi.sq	df	Prob.	Chi.sq	df	Prob.
VOL	13.13644	2	**0.0014*****	4.73782	1	**0.0295****	2.690562	1	**0.1009***	23.82611	2	0.000***
GARCHO01	2.931166	2	0.2309	3.754203	1	**0.0527****	0.581999	1	**0.4455**	6.635211	2	0.0362**
Panel B												
Dependent variable: VOL	Chi-sq	df	Prob.	Chi-sq	df	Prob.	Chi-sq	df	Prob.	Chi-sq	df	Prob.
OI	16.97928	2	**0.0002*****	2.053432	1	0.1519	3.210704	1	**0.0732***	41.65201	2	0.000**
GARCHO01	3.33855	2	0.1884	0.001742	1	0.9667	5.141418	1	**0.0234****	11.05285	2	0.004***
Panel C												
Dependent variable: GARCHO01	Chi-sq	df	Prob	Chi-sq	df	Prob.	Chi-sq	df	Prob.	Chi-sq	df	Prob.
OI	2.939719	2	0.23	1.192222	1	0.2749	5.440987	1	**0.0197*****	4.761144	2	0.0925*
VOL	3.563612	2	0.1683	30.75514	1	**0.000*****	5.402987	1	**0.0201****	0.100914	2	0.9508

Notes: ***, ** and * indicate 1%, 5% and 10% level significance.

Table 3. Variance decomposition of open interest (OI_100), volume (VOL_100) and volatility (GARCH01). It explains the variance one variable caused by the shocks in another variable over three sub-periods for contract size starting with 200 (second column), followed by 100 (third column), 50 (fourth) and finally for the full period (fifth column)

Various decomposition of OI: Panel A	**Lot size 200**			**Lot size 100**			**Lot size 50**			**Full Period**		
Period	OI	VOL	GARCH01	OI	VOL	GARCH01	OI	VOL	GARCH01	OI	VOL	GARCH01
1	100	0	0	100	0	0	100	0	0	100	0	0
2	99.6081	0.3158	0.0761	99.4024	0.5612	0.0364	99.7821	0.2077	0.0102	99.8486	0.0968	0.546
3	99.0725	0.7335	0.1939	98.6421	1.2409	0.1171	99.5159	0.4568	0.0273	99.3715	0.4884	0.1400
4	98.4198	1.2475	0.3328	97.9595	1.8071	0.2334	99.2942	0.6585	0.0473	98.7760	0.9658	0.2582
5	97.7388	1.7805	0.4807	97.4053	2.2208	0.3740	99.1347	0.7978	0.0675	98.1054	1.4940	0.4006
10	94.8283	3.9956	1.1760	95.8534	3.0127	1.1339	98.8657	0.9918	0.1426	95.1172	3.5930	1.2897
15	93.1896	5.1635	1.6469	95.0798	3.2131	1.7071	98.8238	1.0003	0.1759	93.3827	4.4917	2.1256
20	92.4082	5.6860	1.9058	94.5998	3.3146	2.0856	98.8104	1.0004	0.1891	92.4977	4.7837	2.7186
25	92.0589	5.9082	2.0329	94.2900	3.3779	2.3321	98.8053	1.0004	0.1943	92.0554	4.8650	3.0796
Various decomposition of VOL: Panel B	**Lot size 200**			**Lot size 100**			**Lot size 50**			**Full Period**		
Period	OI	VOL	GARCH01	OI	VOL	GARCH01	OI	VOL	GARCH01	OI	VOL	GARCH01
1	4.2595	95.7405	0.0000	0.2596	99.7404	0.0000	3.1545	96.8455	0.0000	3.2885	96.7115	0.0000
2	5.2138	94.7054	0.0808	0.6486	99.3513	0.0000	4.1095	95.7851	0.1054	4.0097	95.7489	0.2415
3	6.5197	93.2889	0.1914	0.9837	99.0162	0.0000	4.7900	94.9014	0.3086	5.5680	94.0733	0.3587
4	7.7822	91.8732	0.3446	1.2057	98.7941	0.0002	5.2044	94.2368	0.5588	7.1103	92.3740	0.5156
5	9.0099	90.4782	0.5119	1.3312	98.6681	0.0007	5.4271	93.7577	0.8152	8.6388	90.6906	0.6706
10	13.6224	85.0988	1.2789	1.4473	98.5458	0.0069	5.5868	92.6803	1.7329	13.9708	84.5235	1.5057
15	15.9141	82.3808	1.7051	1.4484	98.5383	0.0133	5.5664	92.3152	2.1184	16.0864	81.6798	2.2338
20	16.9216	81.1841	1.8944	1.4484	98.5337	0.0179	5.5615	92.1698	2.2687	16.7772	80.4801	2.7427
25	17.3473	80.6795	1.9732	1.4485	98.5307	0.0209	5.5605	92.1124	2.3272	16.9780	79.9706	3.0514
Various decomposition of GARCH 01: Panel C	**Lot size 200**			**Lot size 100**			**Lot size 50**			**Full Period**		
Period	OI	VOL	GARCH01	OI	VOL	GARCH01	OI	VOL	GARCH01	OI	VOL	GARCH01
1	0.0729	0.0008	99.9263	0.0129	0.8071	99.1801	0.1022	4.1677	95.7301	0.1178	0.2331	99.6491
2	0.0584	0.1261	99.8154	0.0774	5.1862	94.7364	0.0864	2.9794	96.9342	0.0661	0.2328	99.7012
3	0.0957	0.1637	99.7406	0.2507	8.9056	90.8438	0.1945	2.3076	97.4979	0.0584	0.2558	99.6859
4	0.1477	0.1967	99.6555	0.4712	11.5780	87.9508	0.3536	1.9099	97.7365	0.0600	0.2837	99.6563
5	0.2044	0.2218	99.5738	0.6998	13.4332	85.8670	0.5250	1.6624	97.8126	0.0656	0.3125	99.6220
10	0.4891	0.3105	99.2004	1.5484	17.2148	81.2368	1.1730	1.2140	97.6030	0.1154	0.4370	99.4476
15	0.6900	0.3617	98.9483	1.9438	18.2743	79.7818	1.4557	1.1088	97.4356	0.1698	0.5192	99.3111
20	0.7968	0.3881	98.8151	2.1340	18.7314	79.1346	1.5655	1.0741	97.3603	0.2117	0.5676	99.2207
25	0.8466	0.4004	98.7530	2.2356	18.9711	78.7934	1.6078	1.0615	97.3307	0.2388	0.5941	99.1671

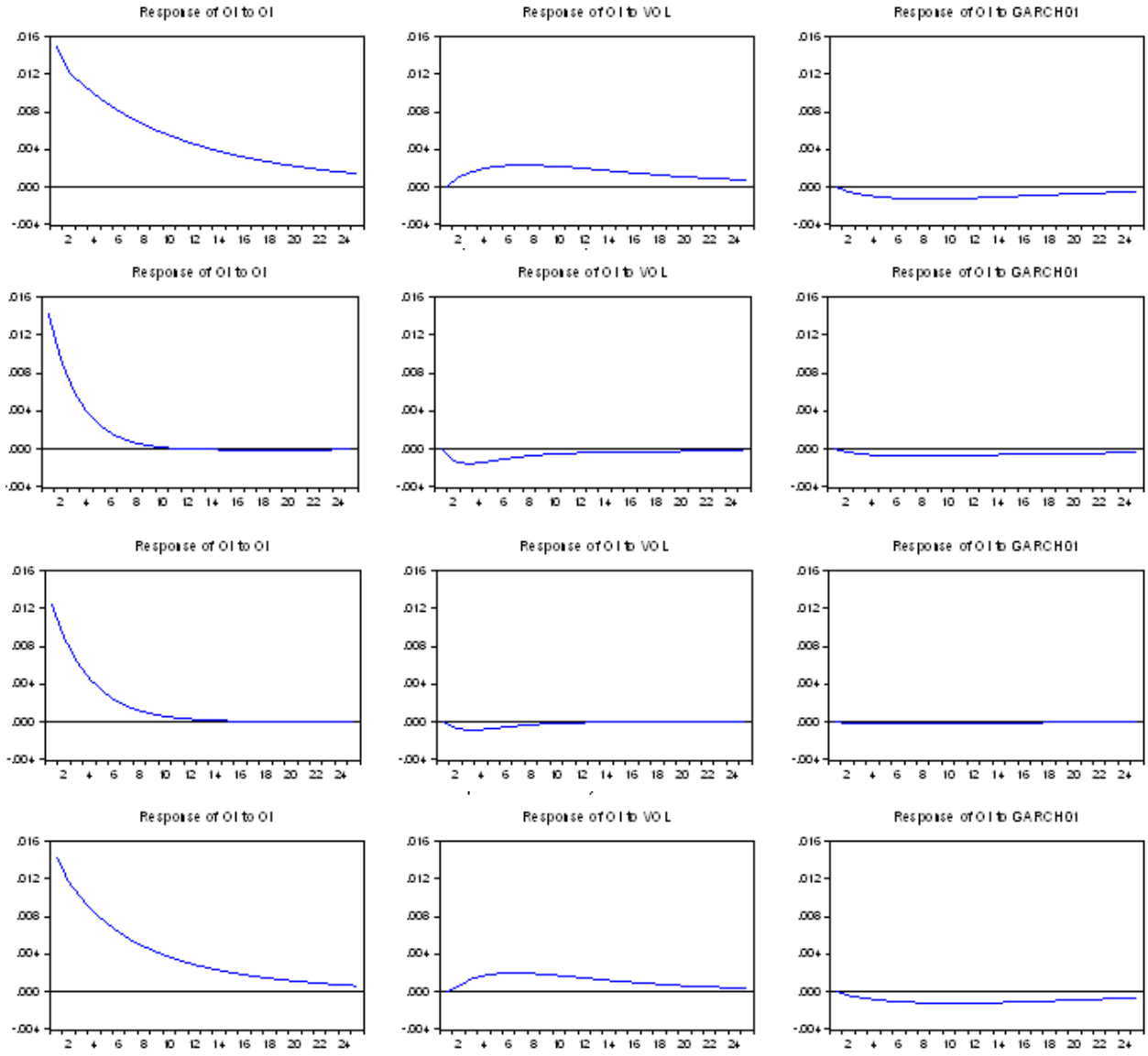

Fig. 2. Impulse response of open interest to shocks in volume and volatility over three sub-periods for contract size starting with 200 (first row), followed by 100 (second row), 50 (third row) and, finally, for the full period (fourth row).First, second and third column starting from left reflect impulse response of open interest toshocks of its own, volume and volatility, respectively

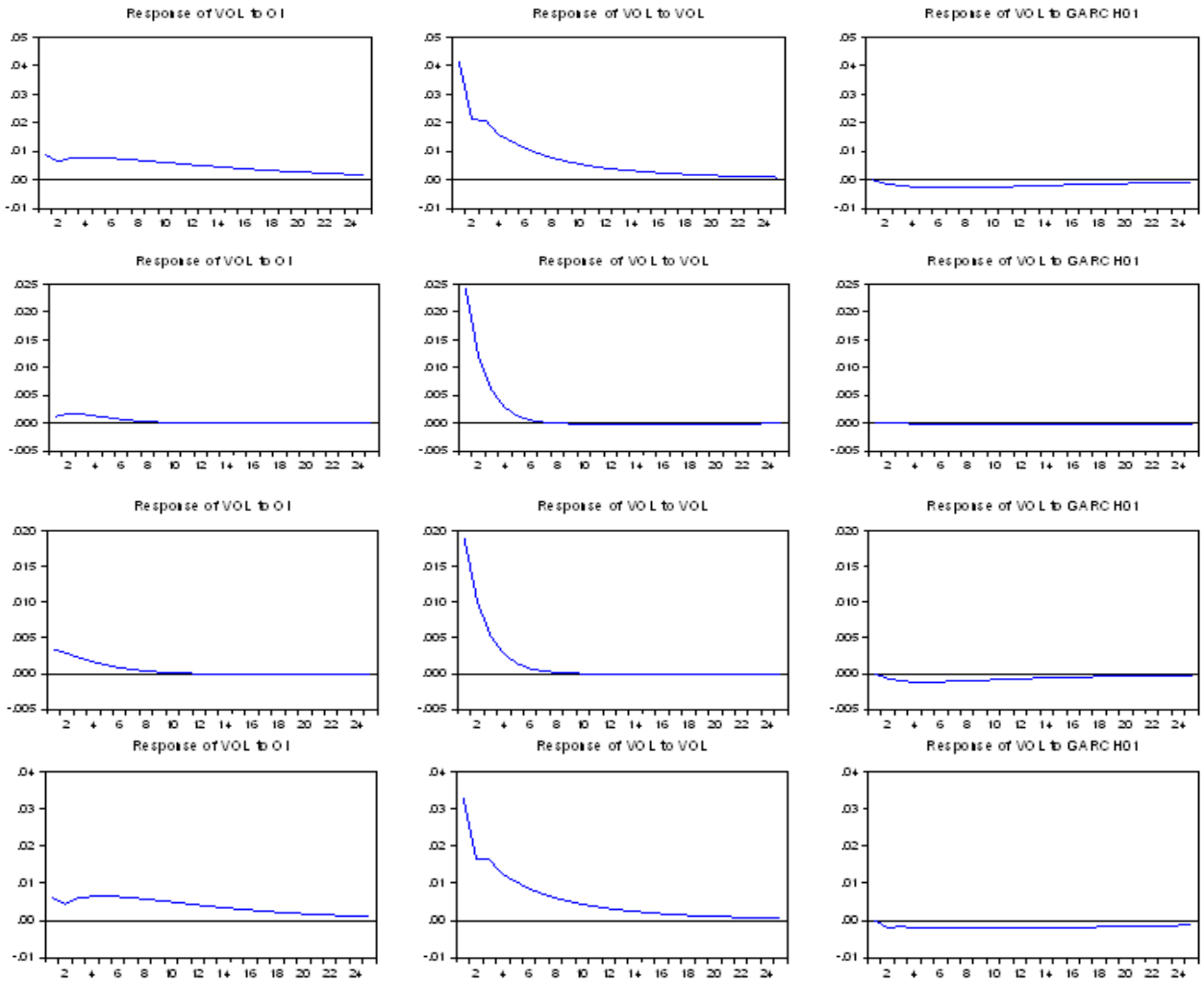

Fig. 3. Impulse response of volume to one unit positive shocks in open interest and volatility over three sub-periods for contract size starting with 200 (first row), followed by 100 (second row), 50 (third row) and finally for the full period (fourth row). First, second and third column starting from left reflect impulse response of volume to shocks of open interest, its own and volatility, respectively

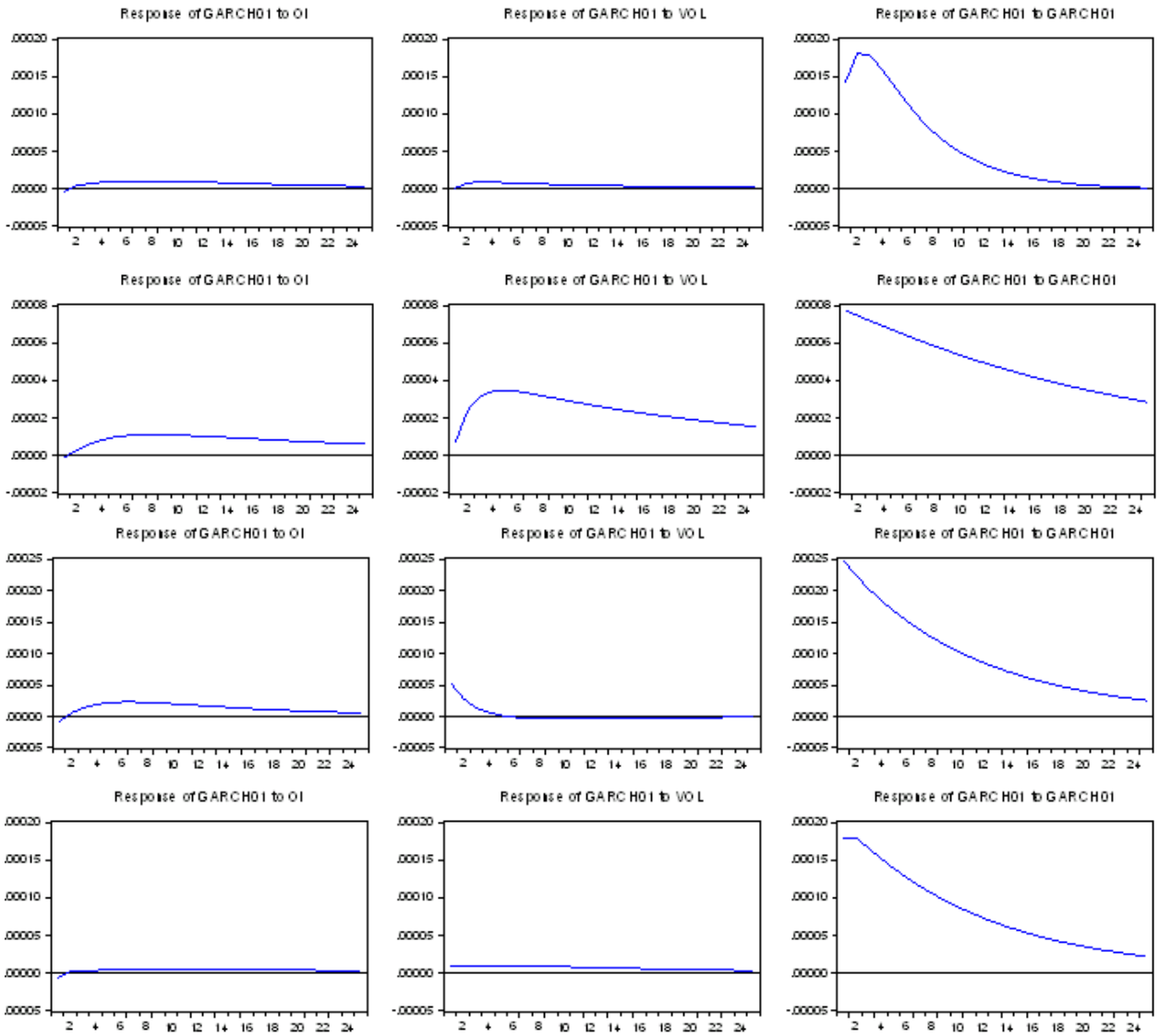

Fig. 4. Impulse response of volatility to shocks in volume and open interest of three sub-periods for contract size starting with 200 (first row), followed by 100 (second row), 50 (third row) and, finally, for the full period (fourth row). First, second and third column starting from left reflect impulse response of volatility to shocks of open interest, volume and its own, respectively