



A STUDY ON FINANCIAL DERIVATIVES



Money Market: The money market refers to the market where borrowers and lenders exchange short-term funds to solve their liquidity needs. Money market instruments are generally financial claims that have low default risk, maturities under one year and high market ability.

Capital Market: It is a wide term used to comprise all operations in the new issues and stock market. New issues made by the companies constitute the primary market, while trading in the existing securities relate to the secondary market. It is to be noted that we can only buy in the primary market and not sell, but we can buy and sell securities in the secondary market. All long-term borrowings and lending constitute the capital market. The securities market, however, refers to the market for those financial instruments that are commonly and readily transferable by sale. The securities market has two inter-dependent and inseparable segments they are, new issues

1. Introduction:

The purpose of this paper is to provide a comprehensive review of the theoretical and empirical literature on this issue, and more generally on the relationships between underlying and derivative markets. Much of the early literature in this area focused on the role of speculators in

smoothing out seasonal price fluctuations in commodity markets. When these assumptions are violated, it is often found that speculative trading can stabilize or destabilize prices, depending on parameter values. Our study analyses the effect of the introduction of derivative markets on the underlying market in the National Stock Exchange of India. More specifically we study whether the introduction of the futures and the options on the NSE Nifty -50 index has affected the volatility and the trading volume of the underlying asset. There is not a clear hypothesis about the contribution of futures and options separately, so, we attempt to synthesize the net effect of introducing these new derivative markets. Conclusions derived from the study could serve as information for the policy makers when establishing market regulations.

2. Need of the Study

Derivative market as a counter part of security market has been accepted worldwide. Even the developing countries have realized the importance of derivatives market. Despite the growing importance of derivative market over the past decades in depth study in derivative market are very few which can throw light on various relationship and on its inherent characteristics etc. Though studies are plenty in stock market, very few

studies have been done on derivatives at national and international level. Even within the available researchers at the international level also the studies are mostly confined to U.S and Australia, and there is very little evidence of the existing literature in South Asia. Those few studies also do not throw much light on the in depth understanding of the derivative market characteristics as the results of consensus. The impact of derivative market on the spot market in terms of market volatility, price changes etc also need careful and consorted analysis. Financial sector reforms, impact of technology, liberalization policy of the government, trend of globalization, etc., are the contributors to the development of derivative markets.

3. Objectives of the Study:

- ✓ To know the operational concepts of Financial Derivatives
- ✓ Top analyse the operations of futures and options
- ✓ To find the profit/ Loss position of Future buyers and Seller
- ✓ To give findings and suggestions based on the study

Scope of the Study:

The study is limited to “Derivatives” with special reference to Futures and Option in the Indian context and the Inter-connected Stock Exchange have been taken as a representative sample for the study. The study has only made a humble attempt at evaluation derivatives market only in India context.

Limitations of the Study:

The study analyses the effect of the introduction of derivative markets on the underlying market in the National Stock Exchange (NSE) & Bombay Stock Exchange(BSE) of India

4. Literature Review:

One of the topics most studied in financial research is the effect of derivatives on the underlying assets. Especial interest is devoted to studying whether derivative markets stabilize or destabilize the underlying markets. Theoretically, what these effects would be is not yet clear. Some authors have used arguments related to the new information that is generated when the derivative assets are traded.

Others have taken into account reasons based on market micro structure. Cox (1976) asserts that the introduction of derivatives markets causes a stabilizing influence on the underlying market because of the speed at which information is incorporated into the prices as well as the amount of information reflected in expected prices. This event would be mainly because derivative markets attract an additional set of traders to the market and because these markets, which have lower transaction costs, transmit the new information to the spot market more quickly. It provides circumstances, which are more favorable to entering the financial markets, and therefore the distribution of the risk is improved. Some pioneer work was done when the trading of options on securities in the United States began in 1973. However it is only in recent years that more empirical evidence is found about this subject. Most of the evidence is about the impact of derivative markets on volatility mainly after the Crash of October 1987. At this time, large volatility in the market was attributed to the derivative markets, as has been noted before. Some authors have concluded that trading of derivatives is not a destabilizing factor in the spot market. Others have found opposite results and there are also some studies that have not found any effect on the volatility.

Types of Derivatives

The most commonly used derivatives contracts are forwards, futures, options. Here we take a brief look at various derivatives contracts that have come to be used.

- **Forwards:** A forward contract is a customized contract between two entities, where settlement takes place on a specific date in the future at today's pre-agreed price.
- **Futures:** A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. Futures contracts are special types of forward contracts in the sense that the former are standardized exchange-traded contracts.
- **Options:** Options are of two types - calls and puts. Calls give the buyer the right but not the obligation to buy a given quantity of the underlying asset, at a given price on or before a given future date. Puts give the buyer the

right, but not the obligation to sell a given quantity of the underlying asset at a given price on or before a given date.

- **Warrants:** Options generally have lives of up to one year, the majority of options traded on options exchanges having a maximum maturity of nine months. Longer-dated options are called warrants and are generally traded over-the-counter.
- **Swaps:** Swaps are private agreements between two parties to exchange cash flows in the future according to a prearranged formula. They can be regarded as portfolios of forward contracts.

Players in Derivative Markets

Derivatives markets have been outstandingly successful. The main reason is that they have attracted many different types of traders and have a great deal of liquidity. When an investor wants to take one side of a contract, there is usually no problem in finding someone who is prepared to take the other side. Three broad categories of traders can be identified among the players in the market they are: hedgers, speculators, and arbitrageurs. Hedgers use futures, forwards, and options to reduce the risk that they face from potential future movements in a market variable. Speculators use them to bet on the future direction of a market variable. Arbitrageurs take offsetting positions in two or more instruments to lock in a profit.

Hedgers

Hedging is the prime reason which has led to the emergence of derivatives. The availability of derivatives allows one to undertake many activities at a considerably lower risk. Hedgers, therefore, are important components of the derivatives markets. Hedgers are the traders who wish to eliminate the risk associated with price of an asset and they may take a long position or short position on a commodity to lock in existing profits. The main purpose is to reduce the volatility of a portfolio, by reducing the risk. Nevertheless, while a forward contract requires no payment, an option contract involves an initial cost. In the event of call is not exercised, the premium paid for it becomes a net loss while if it is exercised, the profit resulting from the call exercise compensates the cost.

Speculators

Hedgers are the people who wish to avoid the price risk; while speculators are those who are willing to take such risk. These are the people who take positions in the market and assume risks, to profit from fluctuations in prices. In fact, the speculators consume information, make forecasts about the prices and put their money in these forecasts. In this process, they feed information into prices and hence contribute to market efficiency. By taking positions, they are betting that a price would go up or they are betting that it would go down. Depending on their perceptions, they may take long or short positions on futures or options or may hold spread positions. Derivatives make speculation easy with least investment. In the absence of the derivatives, speculative activity would become very difficult as it might require huge funds to be invested. Speculators in the derivatives market may be categorized as scalpers, day traders and position traders. Scalpers attempt to profit from small changes in the contract price. Day traders speculate on the price movements during single trading day, thus open and close positions many times a day but do not carry any positions at the end of the day. Obviously, they monitor the prices continuously and generally attempt to make profit from just a few ticks per trade. On the other hand, the position traders attempt to gain from price fluctuations by keeping their positions open for longer durations - may be for a few days, weeks or even months. They use fundamental analysis, technical analysis and other information available to them to form their opinions on the likely price movements Vohra and Bagri (2008).

Arbitrageurs

Arbitrageurs attempt to earn risk-free profits by exploiting market imperfections. An arbitrageur profits by trading a given commodity or other items that sells for different prices in different markets. Thus, arbitrage involves making risk-less profit by simultaneously entering into transactions in two or more markets. If a certain share is quoted at a lower rate on the NSE and at a higher rate on the BSE, an arbitrageur would make profit by buying the share at NSE and simultaneously selling it at BSE, this type of arbitrage is "arbitrage over space". If an arbitrageurs feels that the futures are being quoted at a high level

considering the cost of carry, the arbitrageurs would buy securities underlying today and sell the future in market maturing in a month or two hence. Similarly, since futures and options with various expiration dates are traded in the market, there are likely to be several arbitrage opportunities in trading. Thus, if a trader believes that the price differential between the futures contracts on the same underlying asset with differing maturities is more or less than what the arbitrageur perceives them to be, then appropriate positions in them may be taken to make profits. It may be noted that the existence of well-functioning derivatives markets alters the flow of information into the prices. This is because, in a purely cash market, speculators feed information into the spot prices. In contrast, the presence of a derivatives market ensures that a major part of the transformation of information into prices, due to lower transactions costs involved in derivative a market, and then it gets transmitted to the spot markets. It is here that the arbitrageurs provide a link between the derivatives market and the cash market by synchronizing the prices in the two markets. Thus, through their actions, the arbitrageurs provide a critical link between the cash and derivatives markets.

Significance of Derivative Market

The derivatives market performs a number of economic functions, they are:-

1. **Price Discovery:** Prices in an organized derivatives market reflect the perception of market participants about the future and lead the prices of underlying to the perceived future level. The prices of derivatives converge with the prices of the underlying at the expiration of the derivative contracts. Thus derivatives help in discovery of future as well as current prices.

2. **Risk Transfer:** Due to the inherent link of derivatives market with the underlying cash market, witnesses higher trading volumes because of participations by more players who would not have otherwise participated for lack of an arrangement to transfer risk.

3. **Controlled Speculative Trading:** Speculative trades shift to a more controlled environment due to the existence of derivatives market. In the absence of an organized derivatives market, speculators trade in the underlying cash

markets and margining, monitoring and surveillance of the activities of various participants become extremely difficult in derivative markets.

4. **Financial Architecture:** An important incidental benefit that flows from derivatives trading is that it acts as a catalyst for new entrepreneurial activity. The derivative has a history of attracting many bright, creative, well-educated people with an entrepreneurial attitude. They often energize others to create new business, new products and new employment opportunities, the benefit of which is immense.

5. **Enhances Volume of Activity:** Derivatives market help to increase savings and investment in the long run and transfer of risk enables the market participants to expand their volume of activity.

Derivatives Market in India

The derivatives market is a new market design of the Indian equity market, which play a vital role in disseminating information and offsetting undesirable price risks. It ensures the cheapest trading facilities to the investors and shareholders. The development of markets for derivatives was initially not possible in view of prohibition in the Securities Contracts (Regulation) Act, 1956 (SCRA). The preamble to Act itself spoke of prohibiting options trading. Section 20 of the Act explicitly prohibited all options in securities. Under this Act, by a notification in 1969, Government prohibited all forward trading in securities in order to curb unhealthy practices and to prevent undesirable transactions. The introduction of trading in derivatives required withdrawal of these prohibitions Narain (2003).

The first step towards introduction of derivatives trading in the Indian financial markets was the promulgation of the Securities Laws (Amendment) Ordinance, 1995, which withdrew the prohibition on options in securities. The market for derivatives, however, did not take off, as there was no regulatory framework to govern trading of derivatives. SEBI set up a 24 member committee under the chairmanship of Dr. L.C.Gupta on November 18, 1996 to develop appropriate regulatory framework for derivatives trading in India. The committee submitted its report on March

17, 1998 prescribing necessary pre conditions for introduction of derivatives trading in India. The committee recommended that derivatives should be declared as “securities” so that regulatory framework applicable to trading of “securities” could also govern trading of securities. SEBI also set up a group in June 1998 under the Chairmanship of Prof. J. R. Varma, to recommend measures for risk containment in derivatives market in India. The report, which was submitted in October 1998, worked out the operational details of margining system, methodology for charging initial margins, broker net worth, deposit requirement and real – time monitoring requirements. In December 1999, amendment to Securities Contracts (Regulation) Act, was notified, making way for derivatives trading in

India. In June 2000, Futures contracts on Nifty and Sensex were launched, followed by Options contracts on Nifty and Sensex (European style). The Options contracts on stocks (American style) and Futures contracts on stocks in June, July and November 2001, respectively. The number of underlying stocks and indexes has increased over the years and presented in Table: 3.5 showing exponential increase of options & futures traded. In the Indian market, the Index option contracts are cash settled European style options. Stock options are also cash settled American style contracts. Interest rate derivatives are based on notional 10-years bonds and 91-days T-bill. All exchange-traded equity derivatives contracts are cash settled contracts.

Table: Futures and Options Traded on NSE & BSE

Financial Year	NSE - Stocks	NSE - Index	BSE - Stocks	BSE - Index
2001 - 2002	31	1	31	1
2002 - 2003	41	1	38	1
2003 - 2004	53	2	42	1
2004 - 2005	52	2	46	1
2005 - 2006	117	3	76	7
2006 - 2007	155	3	89	7
2007 - 2008	265	7	126	7

India's Experience in Future & Options

India's experience with the launch of equity derivatives market has been extremely positive with the global derivatives market. The derivatives turnover on the NSE has surpassed the equity market turnover. The turnover of derivatives on the NSE increased from Rs. 23,654 million in 2000 - 01 to Rs. 130,904,779 million in 2007- 08. India is one of the most successful developing countries in terms of a vibrant market for exchange-traded derivatives. This reiterates the strengths of the recent developments of India's securities markets, which are based on nationwide market access, anonymous electronic trading, and a predominantly retail market. There is an increasing belief that the equity derivatives market is playing a major role in shaping price discovery. As per Indian Securities Market Review (ISMR) 2009, NSE ranked as the eighth largest derivatives exchange in the world, the second largest exchange in terms of number of contracts traded in single stock futures and the third largest in terms number of

contracts traded in the index futures category. The derivatives trading at NSE commenced on June 12, 2000 with futures trading on S&P CNX Nifty Index. Subsequently, the product base has been increased to include trading in options on S&P CNX Nifty Index, futures and options on CNX IT Index, Bank Nifty Index, CNX Nifty Junior, CNX 100, Nifty Midcap 50 Indices, S&P CNX Defty and 234 single stocks were observed in Table: 3.7 as of March 2009.

National Stock Exchange (NSE) and its Data Base:

National Stock Exchange of India is India's leading stock exchange set up as a company limited by shares and recognized in the year April 1993. NSE has set up infrastructure that serves as a role model for the securities industry in terms of trading systems, clearing and settlement practices and procedures. It provides screen-based automated trading system with a high degree of transparency and equal access to investors irrespective of geographical location. The Wholesale Debt Market Segment of NSE, which

provides a trading platform for Government Securities, also has been reporting record turnover and at times surpasses the volume in the cash market.

Trading of equity derivatives in India began in June 2000. Two contracts were introduced simultaneously, the future and the option on the NSE Nifty-50 index, so we have studied the joint effect of the initiation of trading of futures and options. The Nifty-50 Index is a capitalization-weighted index comprising the 50 most liquid Indian stocks that are traded in the continuous market. Futures and options on index are cleared through NSE settlement and clearing body. NSE is the official Indian market for financial futures and options for equity derivatives and it is one of the most important future and option exchanges in India. The option on NSE Nifty-50 index is American, so it can be exercised any time with an expiration date that is the last Thursday of each month. The last trading day is the expiration day and the trading calendar is the three nearest consecutive months. The future on the NSE Nifty -50 index has the same expiration day as the option.

We have used the daily closing prices of the NSE Nifty-50 index and the trading volume of this index. The trading volume of the options on the NSE Nifty-50 index has also been considered as a way of calculating a proxy dummy variable associated with the relative importance of the derivatives assets in relation to the underlying asset. Daily returns have been computed using the following expression:

$$R_t = \ln(P_t/P_{t-1}), \text{----- (1)}$$

P_t being the closing price of the NSE Nifty-50 index on day t . Trading volume is calculated using logarithms. The use of the logarithm, as Tauchen et al (1996) argue, aims to stabilize the variance of the volume, due to the fact that this is non-negative and it tends to be more volatile at higher levels and less volatile at lower levels. The period analyzed covers from April 2001 to March 2006.

5. Research Methodology :

The principal aim of this paper is to study the behavior of the volatility and trading volume of the Indian market when the derivative markets are introduced. In order to analyze the volatility, the use of conditional volatility models seems to be appropriate. To determine the robustness of our conclusions three models of the ARCH family have

been chosen for use in our study. Following the paper of Antoniou and Holmes (1995) a dummy variable that indicates the introduction of derivatives is included in the conditional volatility models proposed. This dummy variable is zero before the date of the introduction of derivative markets and 1 after this date. The error term, which is subsequently modelled, is obtained from the following equation:

$$R_t = 1DM + 2DTU + 3DW + 4DTH + 5DFR + 6R_{t-1} + u_t \text{----- (2)}$$

Where DM, DTU, DW, DTH and DFR are dummy variables, which identify the day of the week, and the R_{t-1} variable is the lagged dependent variable. We include these variables because in a preliminary analysis we have detected not only the presence of daily seasonality but also the presence of auto correlation. Initially the GARCH model (proposed by Bollerslev, 1986) is used. The GARCH(1,1) model specification has proven to be an adequate representation for most financial time series, Lamoreux and Lastrapes (1990). The specification of the GARCH(1,1) model is:

$$t_2 = 0 + 1u_{2t-1} + 2t_{2-1} \text{----- (3)}$$

Where u_t follows a $N(0, \sigma^2)$ Nevertheless, the estimation from the GARCH model imposes a restriction on the parameters because they must be positive. Furthermore, possible asymmetric effects that appear in the series are not taken into account. Nelson (1991) proposes the EGARCH model which makes it possible to solve some of these questions. The structure of variance is:

$$\log(t_2) = 0 + 1 \log(t_{2-1}) + u_{t-1} + 3 \{ u_{t-1} - \sqrt{2/1} \} \text{----- (4)}$$

$$2\sqrt{t_2-12}\sqrt{t_2-1}$$

Where u_t follows a $N(0, \sigma^2)$ Additionally we have used an asymmetric model that is less sensitive to outlier than the EGARCH model (Engle and Ng, 1993). This is the GJR model (Glosten et al, 1993). The GJR model is:

$$t_2 = 0 + 1t_{2-1} + 2u_{2t-1} + 3St_{-1} u_{2t-1} \text{----- (5)}$$

Where u_t follows a $N(0, \sigma^2)$ and where St_{-1} is 1 when u_{t-1} is negative and 0 when u_{t-1} is positive or zero.

Table I contains the results obtained from the estimation of the three models and shows the coefficients of the conditional volatility, the dummy variable and the log likelihood function that could

help us to choose the model. The most interesting conclusion that we can emphasize is the significance of the dummy variable (0,1) in the three models and specially the negative sign of the coefficient. So in the GARCH model and in the EGARCH and GJR models are significant at conventional levels³. Therefore these results lead us to think that the introduction of derivative markets in India produced a decrease in the conditional volatility of the underlying market. Thus the increase of the stability of the spot market seems to be clear. Another question arising from the results in Table I is the existence of symmetric effects in the series analyzed. Coefficients in EGARCH and in GJR prove that negative stocks increase the volatility in a greater way than positive stocks do. Thus, the asymmetric component in volatility must be reflected when the volatility of Nifty- 50 is modeled.

We are aware that the dummy variable used is measuring the effect of the introduction of derivative markets together with any other effect that happened at the same time. The idea of creating a new dummy variable is to try to separate the introduction effect from other effects. The aim of using this variable is to distinguish the effect most directly associated with the derivative assets and for this reason we think that the dummy variable must be very closely related to the derivative markets. We therefore take the approach of including the trading volume of options on the Ibex-35. The dummy variable is calculated as the ratio of the volume of options on the Ibex-35 divided by the volume of the underlying index traded

The models presented above are estimated with the new dummy variable. Results from these estimations are shown in Table II. Coefficients associated with the dummy variable in GARCH and in EGARCH and GJR models are again negative and significant in all cases. Asymmetric components in variance in EGARCH and in GJR models also appear significant as in Table I. The sign of the dummy variable indicates that since April 2001 the volatility of the NSE Nifty-50 index has decreased and this decline in the level of conditional volatility has been produced by the introduction of derivatives on the NSE Nifty-50 index.

So the hypothesis detected in the first

estimates is confirmed by these second ones, which demonstrate that the decrease in volatility is associated with derivative markets. However in both Tables I and II the log likelihood function is also presented. This is useful when choosing which model is preferable. Using the Likelihood Ratio test and the Akaike Information Criteria to distinguish and choose between nested and non-nested models respectively, the GJR model is the best when the dummy variable is 0,1 and the EGARCH model when the dummy variable is the ratio of volumes of trading. Nevertheless, we stress the importance of the results because of the unanimity obtained from all models and the fact that this offers a greater guarantee of the reliability of the results.

5. FINDINGS:

1. The introduction of derivative markets on the NSE Nifty-50 index does not produce an increase in the uncertainty in the underlying market. On the contrary the net effect on the volatility of the index has been a considerable decrease.

2. The most satisfactory explanation of this question could be the presence of new investment possibilities, thus making the market more complete. Derivative markets improve the transmission and speed of the information, which provides stability for the market.

3. Trading volume of the underlying NSE Nifty-50 index could also be influenced by the introduction of derivative markets. The decrease in volatility of the Ibex-35 index is consistent with a possible increase in the trading volume. If trading volume increases, a greater liquidity will be reflected in the prices of the underlying market and then the market will become more stable.

To reveal any effects of derivatives trading on the trading volume of the NSE Nifty-50 index this regression model is estimated:

$$LVOL_t = 1DM + 2DTU + 3DW + 4DTH + 5DFR + 6Dint + \sum_{t=1}^6 LVOL_{t-1} + ut \quad (6)$$

Where $LVOL_t$ is the logarithm of trading volume in day t , where DM , DTU , DW , DTH and DFR are dummy variables related to the day of the week, $Dint$ is the dummy variable which is one in the period after the introduction of derivatives and zero

otherwise and LVOLt-I are the different variables obtained by lagging the dependent variable by different periods (represented by I).

Results obtained from OLS estimation are in the left hand column of Table III. The coefficient related to the introduction of derivatives is significantly different from zero at the 5% level. An increase in trading volume is observed from the date of introduction of derivative assets. Auto correlation and heterosk elasticity are not detected as the Ljung-Box, Breusch and Pagan and Engle test prove. Therefore the OLS procedure is an appropriate method. In order to take into account a virtual increase in trading volume on the expiration days that could be more closely related to the expiration effects, we have removed the observations of the expirations days (last Thursday of the month). The previous regression model is replicated again. The results are reported in the right hand column of Table III. The sign and significance of the dummy variable confirms that trading volume on the underlying index has increased significantly. This effect cannot only be due to effects of the expiration day but also to a greater average trading of the underlying asset. Consequently it can be concluded from Table III that derivatives trading has a significant positive effect on the volume of the NSE Nifty-50 index

6. Conclusion:

In summary, the theoretical research has revealed that there are many different aspects of the relationship between cash and derivative markets. Although many models predict that derivatives should have a stabilizing effect, this result normally requires restrictive assumptions. As for the empirical literature, research has uncovered several stylized facts, most of which suggest that derivatives tend to help stabilize prices and improve liquidity in the underlying market, and that some price discovery occurs in derivative markets. Derivative markets were introduced in India in June 2000. Our study has looked at the impact of introduction on the conditional volatility and trading volume of NSE Nifty-50 index. We use different ARCH conditional volatility models to analyze the volatility of the underlying market. Results obtained prove the decrease in the level of volatility when the derivatives markets were introduced as dummy

variables have shown. So, a net positive influence is observed from the trading of the derivatives on index. The trading volume of the NSE Nifty-50 index has also increased since the derivative markets were introduced and this effect appears even when the volume traded on the expirations days is removed. The introduction of derivatives does not represent a problem for the spot market because their impact is beneficial. These conclusions contradict the popular belief that derivatives market trading increases the volatility and reduce the liquidity of the underlying market. So, we do not agree with authors that promote a larger regulation of derivative markets because this regulation could limit the possibilities of investment. Finally, the introduction of derivative markets in markets possessing characteristics similar to the Indian market, small size and scarce liquidity, could help to stabilize their spot markets, expanding the investment opportunity set and improving the daily operation of the market.

References:

1. Antoniou A. and Foster A.J. (1992) "The effect of futures trading on spot price volatility: evidence for brent crude oil using GARCH" *Journal of Business Finance & Accounting*, 19(4), 473-484.
2. Antoniou A. and Holmes P. (1995) "Futures trading, information and spot price volatility: evidence for the FTSE-100 Stock index futures contract using GARCH" *Journal of Banking & Finance*, 19, 117-129.
3. Baldauf B. and Santoni G.J. (1991) "Stock price volatility: Some evidence form an ARCH model" *The Journal of Futures Markets*, 11, 2, 191-200.
4. Bansal V.K., Pruitt S.W. and Wei K.C.J. (1989) "An empirical reexamination of the impact of CBOE Option initiation on the volatility and trading volume of the underlying equities: 1973-1986" *The Financial Review*, 24, 1, 19-29.
5. Bollerslev T. (1986) "Generalized autoregressive conditional heteroskedasticity" *Journal of Econometrics*, 31, 307-327.
6. Brorsen B.W. (1991) "Futures trading, transactions costs, and stock market volatility", *The Journal of Futures Markets* 11, 2, 153-163.

