Management Dynamics

Volume 6 | Number 2 Article 6

December 2006

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Recommended Citation
Tripathi, Shikha (2006) "Relevance of Arbitrage in the Indian Derivatives Market," *Management Dynamics*: Vol. 6: No. 2, Article 6.
DOI: https://doi.org/10.57198/2583-4932.1210
Available at: https://managementdynamics.researchcommons.org/journal/vol6/iss2/6

Relevance of Arbitrage in the Indian Derivatives Market

Shikha Tripathi

Abstract

The Futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future for certain agreed price. Since its introduction in the Indian market, futures are on the rise, attracting the three types of players i.e., hedgers, speculators & arbitrageurs. These players are able to book their profit only if there is any mis-match between spot –future relationship.

The objective of this paper is to find out whether the spot-futures relationship holds in case of Index Futures in the Indian stock market which results in the arbitrage opportunity. This paper also aims at finding out different factors responsible for the violation of spot-futures relationship thereby determining the extent of arbitrage profits earned by the players in the Indian stock market.

Reforms during the 1990s brought significant development in the Indian securities market. Reforms modernized the operations by making them more capital intensive and provided more investment preference to the investors.

The market has been highly volatile both in terms of volume and price during this period. As the market became more risky due to significant fluctuations in securities prices, there was a need on the part of the Indian investors to hedge the risk. As a result of this, in June 2000, there was another development in the Indian securities market that is, trading in derivative of securities was permitted by Securities and Exchange Board of India (SEBI). SEBI permitted two stock exchanges viz. National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) and their clearing houses to commence derivative trading with the introduction of Index Futures Contracts based on S & P NSE Nifty Index and BSE-30 (Sensex) index. Derivative in securities is a relatively recent but extremely important class of financial assets. These are securities which do not have a value

of their own but the prices of which are derived from the prices of other securities. That is the payoffs of derivative securities depend on the prices of the other securities.

Options and Futures are both derivatives as their payoffs depend on the values of other securities. Because the value of derivatives depends on the values of other securities, they can be powerful tools of speculation, hedging and arbitraging. The derivative products can be used to meet with uncertainties arising out of fluctuations in asset prices. One can partially or fully transfer the price risk by locking-in asset prices through the use of derivative products. Financial derivatives came into existence in the post 1970 period in the market due to increased volatility in the securities prices in the financial market and today the share of financial derivatives in the total transactions in derivative products is the maximum amounting to more than 75%. In today's scenario, the financial derivatives market has grown significantly both from the point of view of variety of products available and also, the turnover.

In spite of the fact, that the Indian derivative market is less than six years old, there has been a spectacular growth in this field. The Futures and Options (F & O) segment of NSE reported a total turnover of Rs.25,46,986 crores during 2004-2005 as against Rs.21,30,612 crores in 2003-2004, Rs.4,39,863 crores in 2002-2003, Rs.1,01,925 crores during 2001-2002 and only Rs.2365 crores in 2000-2001.

Although, futures are more popular than options and contracts on individual securities are more popular than those on indices, there has been massive growth in the turnover of index options. The F & O segment of NSE reported an index option turnover (based on NSE Nifty) of Rs.52,816 crores (call index option: Rs.31, 794 crores; put index option: Rs.21, 022 crores)during 2003-2004 as against only Rs.3766 crores (call index options: Rs.2466 crores and put index option: Rs.1300 crores). The total turnover of stock futures was Rs.1, 484,052 crores and that of index futures was Rs.772,147 crores in 2004-2005 as against Rs51,516 crores and Rs.21,482 crores in 2001-2002 respectively.

Option contract is one of the variants of the derivative contracts. Option contract gives its holder the right, but not the obligation to buy or sell a specified quantity of the underlying asset for a certain agreed price (exercise / strike price) on or before some specified future date (expiration date). The underlying asset

may be individual stock, stock market index, foreign currency, gold, silver, fixed income securities. A call option gives its holder the right to buy where as the put option gives its holder the right to sell. The call option holder exercises his option only if the value of the underlying asset on the maturity of the option is more than the exercise price. The put option holder exercises the option if the value of the underlying asset on the maturity is less than the exercise price. To purchase the right to buy and sell the underlying asset, the option holder has to pay a certain price for purchasing the right, called the option premium.

On the other hand, the Futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future for a certain price. Unlike forward contracts, futures contracts are traded on an exchange. To make trading possible, the exchange specifies certain standardized features of the contract. As the two parties to the contract do not know each other, the exchange provides a mechanism that gives the two parties confidence that the contract will be honored.

There are three important players in the derivative market

- **Hedgers** these are the operators who want to transfer the risk component of their portfolio.
- **Speculators** these are those operators who intentionally take the risk from the hedgers with the objective to earn profit.
- **Arbitrageurs** these are those operators who operate in different markets simultaneously in the anticipation of profit and eliminate mis-pricing.

A speculator use the futures contract to earn profit from the movement in futures prices, a hedger uses the futures contract to protect against price movement while the arbitrageur takes the advantage of difference in prices in the spot market and the futures market.

THEORETICAL FRAMEWORK

In futures contract there are two parties involved – the seller of the contract and the buyer of the contract. The payoffs of the sellers and the buyers in the futures market are as follows:

Payoff of the long futures = $S_T - F_O$

Payoff of the short futures = $F_O - S_T$

S_T is the market price of the underlying asset in the spot market

F_0 is the price of the underlying asset in the futures market

Consider a portfolio, which involves selling a futures contract with a risk free rate with annual compounding (r), dividend per share (D), time to maturity (T) and investment in the spot market.

The value of this portfolio at time T when the future expires is:

Value of futures	$\mathbf{F_0 - S_T}$
Value of stock	$\mathbf{S_T + D}$
TOTAL	$\mathbf{F_0 + D}$

The portfolio mentioned above has a certain payoff on maturity. The risk free market is expected to earn risk free rate. So, we can say that:

$$\mathbf{F_0 + D = S_0 (1 + r)^T}$$

Or $$\mathbf{F_0 = S_0 (1 + r)^T - D}$$

$\mathbf{S_0}$ = value of stock at the current date.

If the stock is not expected to pay any dividend before the maturity of futures (i.e. D=0), the above relationship can be written as:

$$\mathbf{F_0 = S_0 (1 + r)^T}$$

The above relationship is called **spot-futures theorem** because it represents the proper relationship between futures and spot price. If this relationship is ever violated, an arbitrage opportunity arises and it indicates mispricing. To exploit mispricing the arbitrageur buys the relatively cheap portfolio and sells the relatively expensive portfolio to earn arbitrage profits.

MODEL

As mentioned earlier, one of the main objectives of this paper is to find out whether spot-futures theorem holds in case of NSE Nifty and if it does not hold, what factors are responsible for this violation. To verify the spot futures relationship, theoretical futures price is computed for a given value of NSE Nifty, risk free rate and time to maturity. As far as the present study is concerned, the risk free rate is assumed to be 5% with annual compounding. The theoretical futures price has been computed as follows:

$$F_{Th,t} = S_{A,t}(1+r)^T$$

$F_{Th,t}$ is the theoretical futures price on a particular day t

$S_{A,t}$ is the actual spot price on a particular day t

r is the risk free rate

T is the time to maturity on day t

After computing the theoretical futures price of day t for a given risk free rate and time to maturity, this theoretical futures price is compared with actual futures price of day t. This is done by subtracting theoretical futures price from actual futures price with the same tome to maturity. That is,

$$A = F_{A,t} - F_{Th,t}$$

$F_{A,t}$ is the actual futures price

$F_{Th,t}$ is the theoretical futures price

|A| (absolute value of A) is the arbitrage profit

If A is significant and greater than zero, it means that actual futures price is too high relative to theoretical futures price and an arbitrageur can exploit the situation by earning arbitrage profits. In this scenario, he should short NSE Nifty futures, buy Nifty in the spot market and borrow from the risk free market. By acquiring such a position, the arbitrageur will be able to generate sure profits with zero investment.

If A is significant and less than zero, it means that the actual futures price is low relative to theoretical futures price and an arbitrageur can exploit the situation by buying NSE Nifty futures, selling them in the spot market and lending in the risk free market.

The next objective of this paper is to find the various factors responsible for the violation of spot-futures relationship. The variables that have been considered as the determinants of this violation are:

a. Market conditions- whether the market is on the rise or on the decline. This has been measured by introducing the dummy variable:

D = 0 when market declines

D = 1 when market rises

b. Time to maturity of the futures contract. That is the number of days after which the futures contract will expire.

c. Number of contracts. In case of NSE Nifty futures, 100 future make one contract

Thus, the final model which has been considered for this study is:

$$|F_{A,t} - F_{Th,t}| = \alpha + bT_t + c\,D + \delta NOC_t + U$$

Where $|F_{A,t} - F_{Th,t}|$ is the absolute difference between actual futures price and the theoretical futures price on day t and time to maturity T_t.

D is the dummy variable

NOC is the number of NSE Nifty futures traded on day t

U is random disturbance term

Positive and significant estimator of β will indicate that higher the time to maturity of the futures, more the arbitrage profit. This means that far the month futures generate more profits than near the month futures. If β negative and significant, it indicates that near the month futures generate more profits than far the month futures.

If estimated δ is positive and significant, it indicates that futures which are more liquid generate more arbitrage profits than futures which are less liquid. Negative and significant δ indicates that less liquid futures generate more arbitrage profits than more liquid futures.

The model has been tested for NSE Nifty futures and this follows is established through subsequent analysis.

DATA

The basic data for this study has been taken from www.nseindia.com, an official website of National Stock Exchange. The spot futures relationship has been verified using daily data on prices available on trading; value of NSE Nifty; maturity for different prices available for trading; and number of contracts traded.

To verify the spot futures relationship, the sample carrying one year time period from 1st January 2004 to 31st December 2004 has been taken. During this period, there were total 254 days available for trading. On an average, there

were 80 observations per day available for trading. At any point of time, there were only three contracts available with 1 month, 2 months and 3 months to expiry. The expiry date for these contracts is last Thursday of the expiry month.

EMPIRICAL RESULTS

The model described above has been tested for the NSE Nifty futures. The first objective of the paper is to find out whether there is a violation of spot futures theorem and if there is, what factors are responsible for such a violation. Three main factors that have been identified as the important causes of violation are: number of contracts traded, market conditions denoted by the dummy variable and time to maturity.

The arbitrage profits due to violation of spot futures relationship have been given in the following table:

Arbitrage Profits Per Contract (Rs.)

Mean	Maximum	Minimum	Standard Deviation
4484.21	**16,138.85**	**9.85**	**3496.38**

Another objective of this paper is to analyze the different factors responsible for the violation of spot futures theorem. The model specified earlier has been used to find out different variables responsible for this violation. The regression model has estimated the different ranges of contracts, time to maturity and market conditions.

Regression model

$$|F_{A,t} - F_{Th,t}| = \alpha + \beta T_t + \chi D + \delta NOC_t + U$$

α	β	χ	δ	R-SQUARE
268.792(0.80)	96.2802(18.99)*	172.4331(0.89)	0.003919(2.26)**	0.44

* Significant at 1% level

** Significant at 5% level

The results show positive and significant findings indicating more the time to maturity, higher the arbitrage profits. This means that far the month futures generate more profits than near the month futures. Regarding the significance of the dummy variable, the response is mixed. The results also show that arbitrage profits are more in case of highly liquid assets and less in case of less liquid assets.

CONCLUSION

Futures and options have constituted an important segment of the Indian Derivative Market. The development in the Indian securities market during the1990s refined the market microstructure modernized the operations and broadened the investment choice for the investors. In June 2000, in another development in the Indian securities market, trading in derivatives of securities was permitted by SEBI on the recommendation of the report of a 24 member committee under the chairmanship of Prof.L.C.Gupta.

In spite of the fact, that the Indian derivative market is less than six years old, there has been a spectacular growth in this field.

The introduction of the Derivative Market in the Indian Financial Sector brought together three most important players in the market that is the Hedgers, the Speculators and the Arbitrageurs. Out of these three players the arbitrageurs have been on the rise and there has been in an increase in the profits earned by them over the years. Through this paper, one has learnt how the arbitrageurs earn profit and, in this way, the paper also shows the importance of arbitrageurs in the Indian stock market.