Project Dissertation Report on

ARBITRAGE OPPORTUNITIES IN INDIAN DERIVATIVE MARKET

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CERTIFICATE

This is to certify that the **"ARBITAGE OPPORTUNITIES IN INDIAN DERIVATIVE MARKET"**, is a bonafide work carried out by Mr. Siddharth Gupta of MBA 2016-2018 batch and has been submitted to Delhi School of Management, Delhi Technological University, Bawana Road, Delhi-110042 in partial fulfillment of the requirement for the award of the Degree of the Masters of Business Administration in subject of Summer Training Report.

Signature of Guide

Signature

Head of Department (DSM)

DECLARATION

I, Siddharth Gupta, student of MBA 2016-2018 of Delhi School of Management, Delhi Technological University, Bawana Road, Delhi-110042 declare that the project Report on **"Arbitrage opportunities in Indian derivative market"** has been submitted in partial fulfillment of Degree of Masters of Business Administration is the original work conducted by me.

The information and data given in the report is authentic to the best of my knowledge.

Place: Siddharth Gupta (2K16/MBA/65).
Date:

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EXECUTIVE SUMMARY

Derivatives are financial contracts whose values are derived from the value of an underlying primary financial instrument, commodity or index, such as: interest rates, exchange rates, commodities, and equities. Derivatives include a wide assortment of financial contracts, including forwards, futures, swaps, and options. Market deregulation, growth in global trade, and continuing technological developments have revolutionized the financial marketplace during the past two decades. A by-product of this revolution is increased market volatility, which has led to a corresponding increase in demand for risk management products.

Two portfolios with the same payoffs should be priced similarly if not, then there exists an arbitrage opportunity where the trader can make a profit, the trader can sell the higher priced portfolio and buy the cheaper portfolio. Arbitrage brings back prices of such portfolios to their fundamental price. According to Classical theories such arbitrage opportunities arise due to market inefficiencies and are taken care by the market consisting of rational investors and arbitrageurs. In reality, these inefficiencies/opportunities do persist from time to time - due to information asymmetry and various other risks associated with performing the arbitrage.

One such arbitrage opportunity exists while trading one of the NSE's equity derivative product i.e. NIFTY50 Futures. The purpose of this project is to study the NIFTY 50 index to find out such opportunities in the NSE’s Nifty 50 Index future derivative. In this project work the mispricing in the NIFTY50 Futures have been identified by calculating its theoretical value using cost of carry model and comparing it with its spot value for past 5 years. With the help of statistical tools in MS-Excel, the correlation in the Spot and future price has been established to empirically provide the evidence for existence of arbitrage opportunity. The methodology for pricing of future instruments is studied and reasons for mispricing have been identified. The net Annual return obtained by undertaking arbitrage trading is also estimated. the data is collected from NSE and RBI website and statistical tools pack in MS-excel have been used to carry out the calculations.

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1. INTRODUCTION

Derivatives are financial contracts whose values are derived from the value of an underlying primary financial instrument, commodity or index, such as: interest rates, exchange rates, commodities, and equities. Derivatives include a wide assortment of financial contracts, including forwards, futures, swaps, and options. The International Monetary Fund defines derivatives as "financial instruments that are linked to a specific financial instrument or indicator or commodity and through which specific financial risks can be traded in financial markets in their own right. The value of financial derivatives derives from the price of an underlying item, such as asset or index. Unlike debt sis advanced to be repaid and no investment income accrues." While some derivatives instruments may have very complex structures, all of them can be divided into basic building blocks of options, forward contracts or some combination thereof. Derivatives allow financial institutions and other participants to identify, isolate and manage separately the market risks in financial instruments and commodities for the purpose of hedging, speculating, arbitraging price differences and adjusting portfolio risks.

The emergence of the market for derivatives products, most notable forwards, futures, options and swaps can be traced back to the willingness of risk-averse economic agents to guard themselves against uncertainties arising out of fluctuations in asset prices. By their very nature, the financial markets can be subject to a very high degree of volatility. Through the use of derivative products, it is possible to partially or fully transfer price risks by locking-in asset prices. As instruments of risk management, derivatives products generally do not influence the fluctuations in the underlying asset prices. However, by locking-in asset prices, derivatives products minimize the impact of fluctuations in asset prices on the profitability and cash flow situation of risk-averse investors.

Financial markets are, by nature, extremely volatile and hence the risk factor is an important concern for financial agents. To reduce this risk, the concept of derivatives comes into the picture. Derivatives are products whose values are derived from one or more basic variables called bases. These bases can be underlying assets (for example forex, equity, etc), bases or reference rates. For example, wheat farmers may wish to sell

their harvest at a future date to eliminate the risk of a change in prices by that date. The transaction in this case would be the derivative, while the spot price of wheat would be the underlying asset.

Market deregulation, growth in global trade, and continuing technological developments have revolutionized the financial marketplace during the past two decades. A by-product of this revolution is increased market volatility, which has led to a corresponding increase in demand for risk management products. This demand is reflected in the growth of financial derivatives from the standardized futures and options products of the 1970s to the wide spectrum of over-the-counter (OTC) products offered and sold in the 1990s.

Many products and instruments are often described as derivatives by the financial press and market participants. In this guidance, financial derivatives are broadly defined as instruments that primarily derive their value from the performance of underlying interest or foreign exchange rates, equity, or commodity prices. Financial derivatives come in many shapes and forms, including futures, forwards, swaps, options, structured debt obligations and deposits, and various combinations thereof. Some are traded on organized exchanges, whereas others are privately negotiated transactions. Derivatives have become an integral part of the financial markets because they can serve several economic functions. Derivatives can be used to reduce business risks, expand product offerings to customers, trade for profit, manage capital and funding costs, and alter the risk-reward profile of a particular item or an entire balance sheet.

Although derivatives are legitimate and valuable tools for banks, like all financial instruments they contain risks that must be managed. Managing these risks should not be considered unique or singular. Rather, doing so should be integrated into the bank's overall risk management structure. Risks associated with derivatives are not new or exotic. They are basically the same as those faced in traditional activities (e.g., price, interest rate, liquidity, credit risk). Fundamentally, the risk of derivatives (as of all financial instruments) is a function of the timing and variability of cash flows.

Derivatives are high-risk instruments and hence the exchanges have put up a lot of measures to control this risk. The most critical aspect or risk management is the daily monitoring of price and position and the margining of those positions.

1.1 Derivatives Market

Derivatives Market is the market for financial instruments whose value is derived from an underlying stock, commodity or currency. Derivatives trading is expected to start with index futures followed by index options and security options as per the recommendations of the SEBI appointed L. C. Gupta Committee. The Derivatives segment is expected to take off shortly.

Derivatives market has the following roles:

1. Derivatives allow hedging of market risk.
2. It allows for a separate market to be developed for lending of funds and securities to the market.
3. It helps in making the underlying cash market more liquid.
4. It helps in innovations and the creation of new financial products.

Commodities whose value is derived from the price of some underlying asset like securities, commodities, bullion, currency, interest level, stock market index or anything else are known as “Derivatives”. In more simpler form, derivatives are financial security such as an option or future whose value is derived in part from the value and characteristics of another security, the underlying asset. It is a generic term for a variety of financial instruments. Essentially, this means you buy a promise to convey ownership of the asset, rather than the asset itself. The legal terms of a contract are much more varied and flexible than the terms of property ownership. In fact, it’s this flexibility that appeals to investors. Derivatives have probably been around for as long as people have been trading with one another. Forward contracting dates back at least to the 12th century, and may well have been around before then. Merchants entered into contracts with one another for future delivery of specified number of commodities at specified price. A primary motivation for pre-arranging a buyer or seller for a stock of commodities in early forward contracts was to lessen the possibility that large swings

would inhibit marketing the commodity after a harvest. To summarize the definition, a derivative security is a financial contract whose value is derived from the value of something else, such as a stock price, a commodity price, an exchange rate, an interest rate, or even an index of prices.

Derivatives may be traded for a variety of reasons. A derivative enables a trader to hedge some preexisting risk by taking positions in derivatives markets that offset potential losses in the underlying or spot market. In India, most derivatives users describe themselves as hedgers (Fitch Ratings, 2004) and Indian laws generally require that derivatives be used for hedging purposes only. Another motive for derivatives trading is speculation (i.e. taking positions to profit from anticipated price movements). In practice, it may be difficult to distinguish whether a particular trade was for hedging or speculation, and active markets require the participation of both hedgers and speculators.

When a person invests in derivative, the underlying asset is usually a commodity, bond, stock, or currency. He bet that the value derived from the underlying asset will increase or decrease by a certain amount within a certain fixed period of time. 'Futures' and 'options' are two commodity traded types of derivatives. An 'options' contract gives the owner the right to buy or sell an asset at a set price on or before a given date. On the other hand, the owner of a 'futures' contract is obligated to buy or sell the asset. The other examples of derivatives are warrants and convertible bonds (similar to shares in that they are assets). But derivatives are usually contracts. Beyond this, the derivatives range is only limited by the imagination of investment banks. It is likely that any person who has funds invested, an insurance policy or a pension fund that they are investing in, and exposed to, derivatives – wittingly or unwittingly. Shares or bonds are financial assets where one can claim on another person or corporation; they will be usually being fairly standardized and governed by the property of securities laws in an appropriate country. On the other hand, a contract is merely an agreement between two parties, where the contract details may not be standardized. Derivatives securities or derivatives products are in real terms contracts rather than solid as it fairly sounds.

The need for a derivatives market

1. The derivatives market performs a number of economic functions:
2. They help in transferring risks from risk averse people to risk oriented people
3. They help in the discovery of future as well as current prices
4. They catalyze entrepreneurial activity
5. They increase the volume traded in markets because of participation of risk averse people in greater numbers
6. They increase savings and investment in the long run

The participants in a derivatives market

- **Hedgers** use futures or options markets to reduce or eliminate the risk associated with price of an asset.
- **Speculators** use futures and options contracts to get extra leverage in betting on future movements in the price of an asset. They can increase both the potential gains and potential losses by usage of derivatives in a speculative venture.
- **Arbitrageurs** are in business to take advantage of a discrepancy between prices in two different markets. If, for example, they see the futures price of an asset getting out of line with the cash price, they will take offsetting positions in the two markets to lock in a profit.

Types of Derivatives

1. **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.
2. **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
3. **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.

4. **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.
5. **LEAPS**: The acronym LEAPS mean Long-Term Equity Anticipation Securities. These are options having a maturity of up to three years.
6. **Baskets**: Basket options are options on portfolios of underlying assets. The underlying asset is usually a moving average or a basket of assets. Equity index options are a form of basket options.
7. **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. The two commonly used swaps are:
8. **Interest rate swaps**: These entails swapping only the interest related cash flows between the parties in the same currency.
9. **Currency swaps**: These entails swapping both principal and interest between the parties, with the cash flows in one direction being in a different currency than those in the opposite direction.
10. **Swaptions**: Swaptions are options to buy or sell a swap that will become operative at the expiry of the options. Thus, a swaption is an option on a forward swap. Rather than have calls and puts, the swaptions market has receiver swaptions and payer swaptions. A receiver swaption is an option to receive fixed and pay floating. A payer swaption is an option to pay fixed and receive floating.

<u>Disadvantages of Derivatives:</u>

If derivatives are misused, they can boomerang on the company.

1. **Credit Risk:** While derivatives cut down on the risks caused by a fluctuating market, they increase credit risk. Even after minimizing the credit risk through collateral, you still face some risk from credit protection agencies.

2. **Crimes:** Derivatives have a high potential for misuse. They have been the caused the downfall of many companies that used trade malpractices and fraud.
3. **Interest Rates**: Wrong forecasts can result in losses amounting to millions of dollars for large companies; it can wipe out small businesses. You need to accurately forecast the long term and short-term interest rates, something that many businesses cannot do.

Factors driving the growth of financial derivatives

1. Increased volatility in asset prices in financial markets,
2. Increased integration of national financial markets with the international markets,
3. Marked improvement in communication facilities and sharp decline in their costs,
4. Development of more sophisticated risk management tools, providing economic agents a wider choice of risk management strategies, and
5. Innovations in the derivatives markets, which optimally combine the risks and returns over a large number of financial assets leading to higher returns, reduced risk as well as transactions costs as compared to individual financial assets.

1.2 Market Inefficiencies

An arbitrage is the simultaneous purchase and sale of an asset to profit from a difference in the price. It is a trade that profits by exploiting the price differences of identical or similar financial instruments on different markets or in different forms. Arbitrage is described as risk free because participants are not speculating on market movements. Instead, they bet on the mispricing of a share/asset that has happened between two related markets. Therefore, Arbitrage exists as a result of market inefficiencies. Classical theories suggest that the market, assuming it has rational investors and arbitrageurs, take care of the mispricing and brings back the prices of the assets to their fundamental price. But in reality, these mispricing do persist from time to time.

So, now the question arises – "Why do the inefficiencies persist?" The answer to this question can be understood from the learnings of the groundbreaking research papers: Shleifer and Vishny (1997) and Barberis and Thaler (2003). These papers discuss about the real-world arbitrage and frictions that are associated with it, which make these inefficiencies to persist.

Theoretically if we have two securities giving the same payoffs in time, then the two securities must be priced same, this is also intuitively understood from the law of one pricing. Even the Efficient market hypothesis states the same – when there are anomalies in pricing of a security, i.e. the price of the security, if it moves away from its fundamental value then the rational investors and the arbitrageurs would come into picture and drive the misplaced price back to the fundamental value and hence eliminating the misplaced price. But in reality, the inefficiencies or the misplaced pricings would still persist.

The persistence of these inefficiencies suggests that there are serious limitations to arbitrage. In practice, arbitrage strategies are risky and costly. There are various risks and the costs associated with the arbitrage.

Fundamental risks: Fundamental risks refer to the risk that new bad information may arrive to the market after you have purchased the security. In any arbitrage, a trader has to take a long position of the lower priced security, the trader takes a long position suspecting that the lower priced security would converge to its fundamental value and hence making him/her profit. But still this security is prone to fundamental risk i.e. its price may still go down. Theoretically this risk can be perfectly hedged by buying a closely related security. Unfortunately substitute securities are rarely perfect, making it impossible to remove all the fundamental risk.

1. **Noise trader risk:** Noise trader risk refers to the risk that the mispricing worsens in the short run because there is possibility that pessimistic traders become even more pessimistic about the future. Once a position is taken, noise traders may drive prices farther from fundamental value, and the arbitrageur may be forced to

invest additional capital, which may not be available, forcing an early liquidation of the position.

2. **Information gap and financing issues:** Generally, the arbitrageurs are informed but wealth constrained and the investors are uninformed and wealthy. In a situation where noise trader risk rises and the mispricing worsens and the fund has to pay lot of margin calls to hold the position, the investors may panic and the arbitrageur might face financing issues to carry on with his arbitrage strategy. The investor might doubt arbitrageur's abilities and they might withdraw their precisely when the expected gain is at the maximum – lost opportunity which could have covered all the expenses incurred till now. This might make the arbitrageur to participate less in such similar trades in the future.
3. **Implied Volatility:** As implied volatility rises, the options prices will also rise (predicted by the Black-Scholes options pricing formula) this may affect the prices for the long positions adversely in some situations and decrease the overall expected profits. Also, implied volatility is different from the historical volatility, it is the market's expectations of the stock's price volatility in the future. As this implied volatility rises, risk associated with the option raises so arbitrageurs expect more returns. Present market arbitrage value may not be as great as the expected returns of the arbitrageurs.
4. **Portfolio management issues:** arbitrage opportunities are short time and involves huge amount of money which has huge opportunity cost. Portfolio managers may not willing to disturb their portfolio for these short-term profits.
5. **Liquidity:** Liquidity in the stock and futures segments or the options market contribute to the uncertainty, and therefore risk. In an arbitrage trade, when trader has to take long positions, if the liquidity is less then he may not find the securities to buy. In futures and options, we buy in lots - and when we execute the contract we need to take delivery or buy few hundreds of stocks per lot, if liquidity is less, the trader may not be able to purchase the desired number of stocks at the given price. Also, futures and options contracts usually get squared off at expiration date. The trader has to sell the stocks before the market closes on the expiration date. If for some reason, there isn't enough liquidity then the

trader can't short the stocks and this may give rise to losses to the fund – since the entire profit can't be attained and the short position can't be taken over to the next month because of lack of opportunity.

6. **Implementation costs:** These refer to the transaction costs such as commissions, bid-ask spreads, premium payments and margin payments. Along with these costs there are other costs related to finding and learning about a mispricing, as well as the costs of the resources needed to exploit it – the state of the art technology and IT infrastructure that can trade at high-frequency speeds.

1.3 Dynamics of Derivative Market in India

The first step towards introduction of derivatives trading in India 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.

A distinctive feature of the reforms of the 1990s has been the accent on financial sector reforms. Financial sector reforms in India were brought to the front burner owing to the fixed income and stock market Scam of 1992; this luckily enabled a policy focus in India upon the financial sector well in advance of the East Asian debacle of 1997. The first three inputs in reforms on the securities markets are now well in place: a new

electronic exchange (NSE), reforms to clearing (NSCC) and the depository (NSDL). NSE commenced equities trading in November 1994, the clearing corporation was started in April 1996 and the depository was inaugurated in November 1996. Of these steps, the depository was much delayed and many critics have highlighted the policy failures in these delays. Yet, from November 1994 to November 1996, India's policy makers undeniably achieved a remarkably rapid transformation of securities markets in the country.

On June 9, 2000, the Bombay Stock Exchange (BSE) introduced India's first derivative instrument - the BSE-30 (Sensex) index futures. It was introduced with three-month trading cycle - the near month (one), the next month (two) and the far month (three). The National Stock Exchange (NSE) followed a few days later, by launching the S&P CNX Nifty index futures on June 12, 2000. The plan to introduce derivatives in India was initially mooted by the National Stock Exchange (NSE) in 1995. The main purpose of this plan was to encourage greater participation of foreign institutional investors (FIIs) in the Indian stock exchanges. Their involvement had been very low due to the absence of derivatives for hedging risk. However, there was no consensus of opinion on the issue among industry analysts and the media. The pros and cons of introducing derivatives trading were debated intensely. The lack of transparency and inadequate infrastructure of the Indian stock markets were cited as reasons to avoid derivatives trading. Derivatives were also considered risky for retail investors because of their poor knowledge about their operation. In spite of the opposition, the path for derivatives trading was cleared with the introduction of Securities Laws (Amendment) Bill in Parliament in 1998.

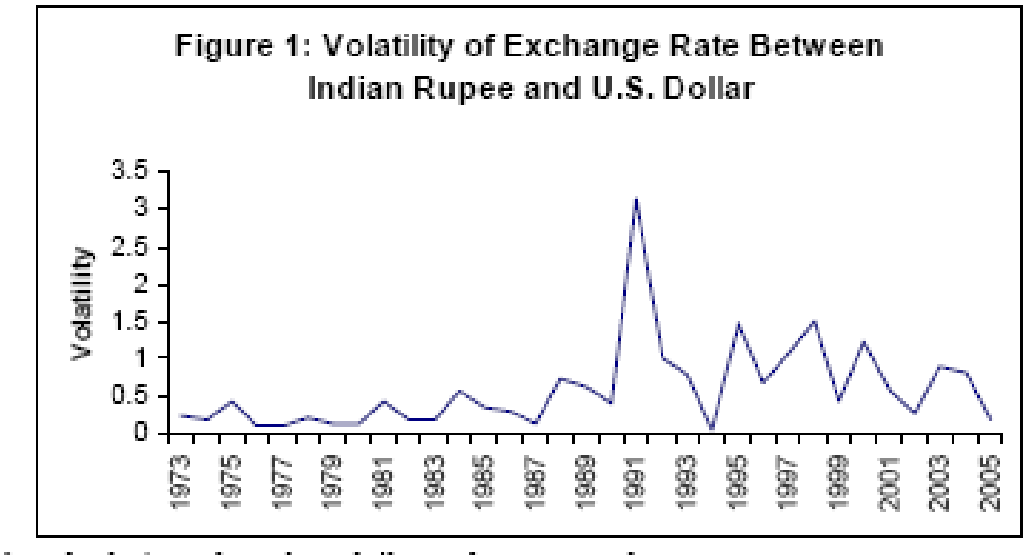

Figure 1.1

The initial steps to launch derivatives were taken in 1995 with the introduction of the Securities Laws (Amendment) Ordinance, 1995 that withdrew the prohibition on trading in options on securities in the Indian stock market. In November 1996, a 24-member committee was set up by the Securities Exchange Board of India (SEBI) under the chairmanship of LC Gupta to develop an appropriate regulatory framework for derivatives trading. The committee recommended that the regulatory framework applicable to the trading of securities would also govern the trading of derivatives. Following the committee's recommendations, the Securities Contract Regulation Act (SCRA) was amended in 1999 to include derivatives within the scope of securities, and a regulatory framework for administering derivatives trading was laid out. The act granted legality to exchange-traded derivatives, but not OTC (over the counter) derivatives. It allowed derivatives trading either on a separate and independent derivatives exchange or on a separate segment of an existing stock exchange. The derivatives exchange had to function as a self-regulatory organization (SRO) and SEBI acted as its regulator.

Those who opposed the introduction of derivatives argued that these instruments would significantly increase speculation in the market. They said that derivatives could be used for speculation by investors by taking large price positions in the stock market while

committing only a small amount of capital as margin. For instance, instead of an investor buying stocks worth Rs.1 million (mn), he could buy futures contracts on Rs.1 mn of stocks by investing a few thousand rupees as margin. Thus, trading in derivatives encouraged investors to speculate - taking on more risk while putting forward less investment. They were quick to point out some of the disasters of the past that had occurred due to the mismanagement of trading in derivatives.

Once the basic structures of a cash market fall into place, the logical next step for market development is the commencement of exchange--traded financial derivatives. Derivatives give people the ability to manage and control risk. Today, in India, fluctuations in the stock market or in the dollar--rupee generate a political constituency which seeks government interventions into the market to prevent price fluctuations. This discomfort with price risk is a basic source of the political opposition to liberalization, which inevitably exposes Indian citizens to greater price risk. Derivatives are hence a central part of the reforms process; by giving individuals and firms the power to make choices about what risks they are comfortable with and what risks are best hedged away, derivatives make individuals and firms more tolerant of price risk and hence liberalization.

In addition, from a purely financial sector perspective, derivatives are important insofar as they are part and parcel of market development. Derivatives trading helps improve market liquidity, raises skills and knowledge among market players, and is a vital ingredient of market reforms such as the transition to rolling settlement. Hence, the commencement of derivatives trading at an exchange is of utmost important, from the perspective of financial sector development and with respect to the larger problem of creating a constituency for reforms. This step has unfortunately been plagued by delays, and is one where the policy establishment is not shown in good light. In terms of knowledge and capabilities, exchange--traded derivatives could have commenced in India in middle 1996. The story ever since has been one of delays that are reminiscent of pre--reforms India:

1.4 Financial derivative Instruments available in India

The National stock Exchange (NSE) has the following derivative products:

Table 1.1

Products	Index Futures	Index Options	Futures on Individual Securities	Options on Individual Securities
Underlying Instrument	S&P CNX Nifty	S&P CNX Nifty	30 securities stipulated by SEBI	30 securities stipulated by SEBI
Type		European		American
Trading Cycle	maximum of 3-month trading cycle. At any point in time, there will be 3 contracts available : 1) near month, 2) mid month & 3) far month duration	Same as index futures	Same as index futures	Same as index futures
Expiry Day	Last Thursday of the expiry month	Same as index futures	Same as index futures	Same as index futures
Contract Size	Permitted lot size is 200 & multiples thereof	Same as index futures	As stipulated by NSE (not less than Rs.2 lacs)	As stipulated by NSE (not less than Rs.2 lacs)
Price Steps	Re.0.05	Re.0.05		
Base Price-First day of trading	previous day closing Nifty value	Theoretical value of the options contract arrived at based on Black-Scholes model	previous day closing value of underlying security	Same as Index options
Base Price-Subsequent	Daily settlement price	daily close price	Daily settlement price	Same as Index options
Price Bands	Operating ranges are kept at + 10 %	Operating ranges for are kept at 99% of the base price	Operating ranges are kept at + 20 %	Operating ranges for are kept at 99% of the base price
Quantity Freeze	20,000 units or greater	20,000 units or greater	Lower of 1% of marketwide position limit stipulated for open positions or Rs.5 crores	Same as individual futures

BSE also offers similar products in the derivatives segment.

1.5 Objectives of the study

- To find out the frequency and level of return while arbitraging between Index future with spot index.
- To find out efficiency of index future market by finding out degree of arbitrage opportunities available in Indian market.

1.6 Scope the study

The scope of this study is wide. The results will be useful to the new entrants and existing investors in this segment. The outcome of the study would be taken to formulate various trading strategies for investors.

2. LITERATURE REVIEW

This research work relates to the literature of the few research papers which were referred to study and understand the Arbitrage opportunities in various financial markets.

In the paper, 'Arbitrage opportunities in the futures market: A study on NSE NIFTY 50' by Dr.Dheeraj Mishra, Dr.R.Kannan, Dr.Sangeeta Mishra, the failure of the spot-futures parity was studied. The various factors such as time to maturity, rising or declining of markets, markets being in Contango or Normal Backwardation, were examined to check the parity. The paper finds that the parity fails in some stocks. It was found that the arbitrage profits were higher for far the month futures contracts than for near the month futures contracts; for undervalued futures market (relative to the spot market) than for overvalued futures market (relative to the spot market); for high liquid futures than for less liquid futures; when new contracts are added than when outstanding contracts are settled. The results do not indicate anything whether the arbitrage profits are higher in declining markets or in rising markets.

In the paper 'Price discovery and arbitrage efficiency of Indian equity futures and cash markets' by Dr.Balwinder singh, the author finds that strong and long run relationship exists between equity futures and cash markets. However, during short run significant deviations have been observed. It was empirically found that price discovery happens in both the markets but the futures markets dominates the information transmission process. The study investigates the price discovery efficiency and validity of Law of One Price in the Indian equity market by using tick-by-tick data available at National Stock Exchange of India. The study finds that strong and stable long-run relationship exists between Indian equity futures and cash markets, however, during short-run significant deviations from equilibrium relationship have been observed. Empirical findings in the study suggest that price discovery takes place in both markets, whereas, the Indian equity futures market dominates the information transmission process and the duration of lead-lag between two markets has been found to be varying in the range of five to fifty-five minutes. The study has further found that days to expiry do not play

significant role in the price discovery mechanism of Nifty futures contracts. However, mispricing for individual stock futures contracts have been found to be significantly negatively associated with days to expiry, which implies that near to the expiration date more arbitrage opportunities are available and these findings support the early liquidation option as proposed by Brennan and Schwartz (1990). Regulatory restriction on the participation of institutional traders may be a significant factor leading to negative association between mispricing of futures contracts and days to expiry, therefore, they might be preferring either to unwind or to rollover their positions before maturity date, which not only makes money available to them but also enables them to take new positions.

In the paper, Mispricing in single stock futures: Empirical examination of Indian markets by Shankar R.L. Professor, Great Lakes Institute of Management, Chennai, Ganesh Sankar Manager, Standard Chartered Scope International, Chennai Kiran Kumar K Associate Professor, Indian Institute of Management, Indore, it examines the dynamic relationship among liquidity, volatility and mispricing in single stock futures. Data was used from the National Stock Exchange of India; mispricing bounds were computed using multi-regime models for over hundred stocks. The size of the mispricing window - defined as the distance between these bounds - increases with decrease in liquidity. Liquidity of the futures market has a larger impact on the size of the mispricing window compared to that of the spot market. After controlling for these liquidity effects, the size of the mispricing window is found to increase with an increase in volatility. This suggests that concerns related to margin calls and execution shortfalls dominate the early exit options. Volatility has an asymmetrical effect on mispricing bounds

In the paper, Arbitrage Opportunities in Indian Derivatives Markets by Ananthula Rambabu, Swapnil Chaudhari, Tarun Sangishetty, Ramesh Naidu G. Two portfolios with the same payoffs should be priced similarly if it doesn’t happen, then there exists an arbitrage opportunity where the trader can make a profit, the trader can sell the higher priced portfolio and buy the cheaper portfolio. Arbitrage brings back prices of such portfolios to their fundamental price. According to Classical theories such arbitrage opportunities arise due to market inefficiencies and are taken care by the market

consisting of rational investors and arbitrageurs. In reality, these inefficiencies/opportunities do persist from time to time - due to information asymmetry and various other risks associated with performing the arbitrage. The mispricing in spot and futures markets have been found in stocks such as IDEA, ONGC, BPCL, COALINDIA, BHARTIARTL, INDUSINDBK, GAIL, YESBANK, KOTAKBANK, AUROPHARMA, BANKBARODA, TATAPOWER, MARUTI, HCLTECH, HEROMOTOCO, ICICIBANK. All the stocks are found to be in the normal backward markets.

Index Arbitrage between Futures and ETFs: Evidence on the limits to arbitrage from S&P 500 futures and SPDRs' by Nivine Richie and Robert Daogler. The paper examines how long mispricing lasts and the impact of volatility on mispricing. It was found that the mispricing was far more frequent in high volatility months than in low volatility months. The duration of mispricing was found to be independent of the monthly level of volatility. This paper examines the spot-futures pricing and arbitrage relationships by using both the SPDR and the S&P 500 cash index as the "underlying cash asset." Conceptually the S&P 500 futures should track the basket of stocks in the index, based on their weights in the index. However, using such a portfolio is expensive. Using the SPDR as the cash asset examines whether a liquid tradable single asset can be used for pricing and arbitrage purposes. The analysis examines how long mispricing lasts and the impact of volatility on mispricing. Results show that mispricings exist regardless of the choice of underlying asset. Also, more negative mispricings using the SPDR and more positive mispricings using the S&P 500 cash index, but the former disappear more rapidly as the size of transactions costs is increased. Furthermore, it was found that mispricings are far more frequent in high volatility months than in low volatility months, but the length of time that a mispricing exists and the associated volume appear to be unrelated to the monthly level of volatility.

In the paper, The Impact of the Introduction of Index Futures on Volatility and Noise Trading by Suhasini Subramanian March 2012, it examines the impact of index futures on volatility and noise trading. Academic interest in the issue has been on the rise since the late 1980s, when derivatives were considered the key cause of the October 1987 US

market crash; however, studies have been unable to arrive at a definite conclusion about the impact of index futures. On the one hand, several studies claim that index futures cause an increase in spot volatility due to the dominance of either rational or noise investors at the futures segment. On the other hand, several other studies suggest that the dominance of rational traders in the futures markets implies greater efficiency in futures pricing, followed by a reduction in spot volatility. This paper analyses contrasting theoretical approaches and empirical evidence relating to the issue. The paper concludes that the issue remains unresolved, despite the many years of research that have gone into investigating the impact of index futures.

The Limits of Arbitrage by ANDREI SHLEIFER and ROBERT W. VISHNY* Textbook arbitrage in financial markets requires no capital and entails no risk. In reality, almost all arbitrage requires capital, and is typically risky. Moreover, professional arbitrage is conducted by a relatively small number of highly specialized investors using other people's capital. Such professional arbitrage has a number of interesting implications for security pricing, including the possibility that arbitrage becomes ineffective in extreme circumstances, when prices diverge far from fundamental values. The model also suggests where anomalies in financial markets are likely to appear, and why arbitrage fails to eliminate them.

Having stated that the arbitrage opportunities exist from time to time, the purpose of this paper is to study the NIFTY 50 index to find out such opportunities in the NSE’s Nifty 50 Index future derivatives market.

3. RESEARCH METHODOLOGY

A Research Methodology defines the purpose of the research, how it proceeds, how to measure progress and what constitute success with respect to the objectives determined for carrying out the research study. The appropriate research design formulated is detailed below.

In general terms research is characterized into two different types, viz: Primary and Secondary.

Primary research is interaction or communication based research, it is in general conducted by the researcher/(s) (or hire someone to do for you.) It involves reaching directly to the source which are the users, customers and prospective customers in our target field of research, in order to ask questions and gather relevant information. Some examples of primary research are:

- Direct Interviews
- Telephonic Interviews
- Questionnaires (online or mail)
- Surveys (online or mail)
- Focus groups
- Hand on experience of product

The outcome of primary research, yield us relevant data, which could be further characterized into two basic kinds of information, as per this criterion primary research could be further characterized into two types, viz:

- Exploratory: This form of primary research is basic in nature and requires open-ended responses, it typically involves lengthy interviews with an individual or small target group.
- Specific: This form of primary research is more concise and precise, it is used in succession to solve a problem which was earlier identified through the exploratory research. It involves more specifically structured, and formal interviews.

Primary research in general, is highly cost consuming, and often takes longer durations of time to conduct, as compared with secondary research, but it gives conclusive results.

Secondary research is a type of research has already been compiled, gathered, organized and published by others. It includes reports and studies by government agencies, trade associations or other businesses in your industry. Especially for small businesses with limited budgets, most research is typically secondary, because it can be obtained faster and more affordable than primary research.

A lot of secondary research is available right on the Web, simply by entering key words and phrases for the type of information you're looking for. You can also obtain secondary research by reading articles in magazines, trade journals and industry publications, by visiting a reference library, and by contacting industry associations or trade organizations. (Note: When you locate the research you want, check its publication date to be sure the data is fresh and not outdated.)

One excellent source of secondary research data is government agencies; this data is usually available free of charge. On the other hand, data published by private companies may require permission, and sometimes a fee, for you to access it.

Use of Descriptive statistics

Descriptive statistics are brief descriptive coefficients that summarize a given data set, which can be either a representation of the entire population or a sample of it. Descriptive statistics are broken down into measures of central tendency and measures of variability, or spread. Measures of central tendency include the mean, median and mode, while measures of variability include the standard deviation or variance, the minimum and maximum variables, and the kurtosis and skewness.

Descriptive statistics, in short, help describe and understand the features of a specific data set, by giving short summaries about the sample and measures of the data. The most recognized types of descriptive statistics are the mean, median and mode, which are used at almost all levels of math and statistics. However, there are less-common types of descriptive statistics that are still very important.

People use descriptive statistics to repurpose hard-to-understand quantitative insights across a large data set into bite-sized descriptions. A student's grade point average (GPA), for example, provides a good understanding of descriptive statistics. The idea of a GPA is that it takes data points from a wide range of exams, classes and grades, and averages them together to provide a general understanding of a student's overall academic abilities. A student's personal GPA reflects his mean academic performance.

Measures of Descriptive Statistics

All descriptive statistics, whether they be the mean, median, mode, standard deviation, kurtosis or skewness, are either measures of central tendency or measures of variability. These two measures use graphs, tables and general discussions to help people understand the meaning of the data being analyzed.

Measures of central tendency describe the center position of a distribution for a data set. A person analyzes the frequency of each data point in the distribution and describes it using the mean, median or mode, which measure the most common patterns of the data set being analyzed.

Measures of variability, or the measures of spread, aid in analyzing how spread-out the distribution is for a set of data. For example, while the measures of central tendency may give a person the average of a data set, it doesn't describe how the data is distributed within the set. So, while the average of the data may be 65 out of 100, there can still be data points at both 1 and 100. Measures of variability help communicate this by describing the shape and spread of the data set. Range, quartiles, absolute deviation and variance are all examples of measures of variability.

3.1 Future Pricing methodology

The futures instrument derives its value from its respective underlying. The futures instrument moves in sync with its underlying. If the underlying price falls, so would the futures price and vice versa. However, the underlying price and the futures price differs and they are not really the same. This difference in price between the futures price and the spot price is called the **"basis or spread"**.

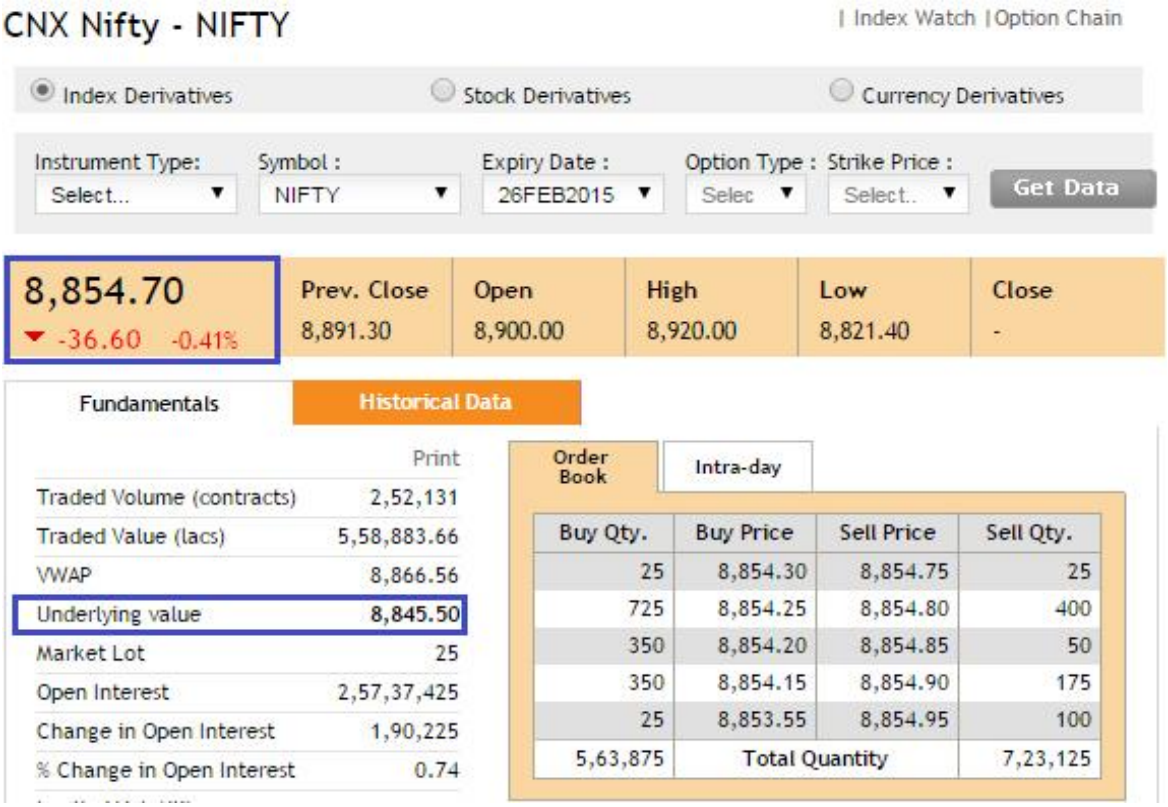

Figure 3.1

The difference in price is attributable to the **'Spot – Future Parity'**. The spot future parity the difference between the spot and futures price that arises due to variables such as interest rates, dividends, time to expiry etc. In a very loose sense it is simply is a mathematical expression to equate the underlying price and its corresponding futures price. This is also known as the **futures pricing formula**.

The futures pricing formula simply states –

Futures Price = Spot price *(1+ rf – d)

Where,

r_f = Risk free rate

d = Dividend

Note, 'r_f' is the risk-free rate that one can earn for the entire year (365 days); considering the expiry is at 1, 2, and 3 months one may want to scale it proportionately for time periods other than the exact 365 days. Therefore, a more generic formula would be –

Futures Price = Spot price * [1+ rf*(x/365) – d]

Where,

x = number of days to expiry.

Risk free rate calculation:

T_c = The Call money rate

T_b = The 91 days T-bill rate

n = The number of days for the futures contract expiration

thus, risk-free rate = $T_c + (T_b - T_c) *n/90$.

The calculated future price is called the **'Fair value'** of futures. The actual price at which the futures contract trades is called the **'Market Price'.**

The difference between the fair value and market price mainly occurs due to market costs such as transaction charges, taxes, margins etc Besides, the market could be factoring in some financial yearend dividends as well. However by and large the fair value reflects where the futures should be trading at a given risk free rate and number of days to expiry.

However, the key point to note is as the number of days to expiry increases, the difference between the fair value and market value widens.

In fact, this leads to another important commonly used market terminology – **the discount and the premium.**

If the futures is trading higher than the spot, which mathematically speaking is the natural order of things, then the futures market is said to be at '**premium**'. While 'Premium' is a term used in the Equity derivatives markets, the commodity derivatives market prefers to refer to the same phenomenon as '**Contango**'. However, both contango and premium refer to the same fact – The Futures are trading higher than the Spot.

Here is a plot of Nifty spot and its corresponding futures for the January 2015 series. As you can see the Nifty futures is trading above the spot during the entire series.

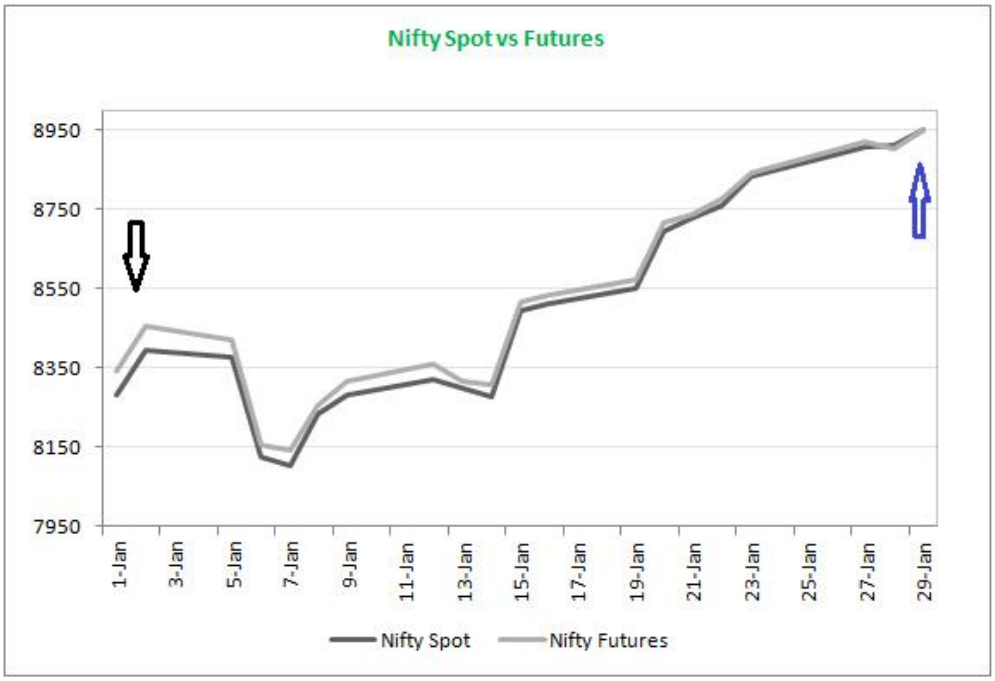

Figure 3.2

1. At the start of the series (highlighted by a black arrow) the spread between the spot and futures is quite high. This is because the number of days to expiry is high hence the x/365 factor in the futures pricing formula is also high.
2. The futures remained at premium to the spot throughout the series
3. At the end of the series (highlighted by a blue arrow) the futures and the spot have converged. In fact, this always happens. Irrespective of whether the future

is at a premium or a discount, **on the day of the expiry, the futures and spot will always converge**.

4. If you have a futures position and if you fail to square off the position by expiry, then the exchange will square off the position automatically and it will be settled at the spot price as both futures and spot converges on the day of the expiry

Not always does the futures trade richer than the spot. There could be instances – mainly owing to short term demand and supply imbalances where the futures would trade cheaper than its corresponding spot. This situation is when the futures is said to be trading at a discount to the spot. In the commodities world, the same situation is referred to as the **"backwardation".**

Cost of Carry

The cost of carry refers to costs incurred as a result of an investment position. These costs can include financial costs, such as the interest costs on bonds, interest expenses on margin accounts, and interest on loans used to purchase a security. They can also include economic costs, such as the opportunity costs associated with taking the initial position.

Cost to carry may not be an extremely high financial cost if it is effectively managed. For example, the longer a position is made on margin, the more interest payments will need to be made on the account. When making an informed investment decision, consideration must be given to all of the potential costs associated with taking that position. In capital markets, the cost of carry is the difference between the yield generated from the security and the cost of entering and maintaining the position. In the commodities markets, the cost of carry includes the cost of necessary insurances and the expense of storing the physical commodity over a period of time.

3.2 The Cost of Carry Model

There is a financial model that is used in the forwards market to determine the cost of carry (if the forward price is known), or the forward price (if the cost of carry is known). While this works for forwards, it provides a good approximation for futures prices as well. The formula is expressed as follows:

F = Se ^ ((r + s - c) x t)

Where:

F = the forward price of the commodity

S = the spot price of the commodity

e = the base of natural logs, approximated as 2.718

r = the risk-free interest rate

s = the storage cost, expressed as a percentage of the spot price

c = the convenience yield, which is an adjustment to the cost of carry

t = time to delivery of the contract, expressed as a faction of one year

This model expresses relationship between the forward price, the spot price and the cost of carry. For example, assume that a commodity's spot price is $1,000. There is a one-year contract available, the risk-free rate is 2%, the storage cost is 0.5%, and the convenience yield is 0.25%. The equation would be set up as follows:

F = $1,000 x e ^ ((2% + 0.5% - 0.25%) x 1) = $1,000 x 1.0228 = $1,022.80.

The forward price of $1,022.80 shows that the cost of carry in this situation is 2.28%, ($1,022.80 / $1,000) - 1.

Practical Application- Cash & Carry Arbitrage

Consider this situation –

Wipro Spot = 653

R_f = 8.35%

x = 30

d = 0

Given this, the futures should be trading at –

Futures Price = 653*(1+8.35 %(30/365)) – 0 = 658

Accommodate for market charges, the futures should be trading in and around 658. Now what if instead the futures contract is trading at a drastically different price? Let’s say

700? Clearly there is a trade here. The difference between the spot and futures should ideally be just 5 points, but due to market imbalances the difference has shot up to 47 points. This is a spread that we can capture by deploying a trade.

Here is how one can do this – since the future contract is trading above its fair value, we term the futures market price as **expensive relative to its fair value**. Alternatively, we can say, the spot is trading cheaper with respect to the futures.

The thumb rule in any sort of 'spread trade' is to buy the cheaper asset and sell the expensive one. Hence going by this, we can sell Wipro Futures on one hand and simultaneously buy Wipro in the spot market. Let us plug in the numbers and see how this goes –

Buy Wipro in Spot @ 653

Sell Wipro in Futures @ 700

On the expiry day, both the spot and the futures converge into one single price (refer to the Nifty graph posted above). Let's assume a few random values at which the futures and the spot converge – 675, 645, 715 and identify what happens to the trade –

Table 3.1

Expiry Value	Spot Trade P&L (Long)	Futures Trade P&L (Short)	Net P&L
675	675 – 653 = +22	700 – 675 = +25	+22 + 25 = +47
645	645 – 653 = -08	700 – 645 = +55	-08 + 55 = +47
715	715 – 653 = +62	700 – 715 = -15	+62 – 15 = +47

Once the trade is executed at the expected price, the spread has been essentially locked in. So irrespective of where the market goes by expiry, the profits are guaranteed! Of course, it goes without saying that it makes sense to square off the positions just before the expiry of the futures contract. This would require to sell Wipro in spot market and buy back Wipro in Futures market.

Calendar Spreads

The calendar spread is a simple extension of the cash & carry arbitrage. In a calendar spread, one attempts to extract profit from the spread created between two futures contracts of the same underlying but with different expiries. Let us continue with the Wipro example and understand this better –

Wipro Spot is trading at = 653
Current month futures fair value (30 days to expiry) = 658
Actual market value of current month futures = 700
Mid-month futures fair value (65 days to expiry) = 663
Actual market value of mid-month futures = 665
From the above example, clearly the current month futures contract is trading way above its expected theoretical fair value. However, the mid-month contract is trading close to its actual fair value estimate. Thus, it can be assumed that current month contract's basis will eventually narrow down and the mid-month contract will continue to trade close to its fair value.

Now with respect to the mid-month contract, the current month contract appears to be expensive. Hence, we sell the expensive contract and buy the relatively cheaper one. Therefore, the trade set up would require to buy the mid-month futures contract @ 665 and sell the current month contract @ 700. the spread is the difference between the two future contracts i.e. 700 – 665 = 35 points.

Do note – because buying and selling the same underlying futures of different expiries, the margins are greatly reduced as this is a hedged position.

Now after initiating the trade, one has to wait for the current month's futures to expire. Upon expiry, the current month futures and the spot will converge to a single price. Of course, on a more practical note, it makes sense to unwind the trade just before the expiry.

Table 3.2

Expiry Value	**Current monthP&L (Short)**	**Mid-MonthP&L (Long)**	**Net P&L**

660	700 – 660 = +40	660 – 665 = -5	+40 – 5 = +35
690	700 – 690 = +10	690 – 665 = +25	+10 + 25 = +35
725	700 – 725 = -25	725 – 665 = +60	-25 + 60 = +35

Impact Cost

Liquidity is the ease at which one can buy or sell a particular stock or futures. If a stock is highly liquid (read it as very easy to buy/sell) then it would attract seasoned traders to trade in large quantities at ease, without really affecting the stock prices. A highly liquid stock/contract invariably attracts a lot of institutional interest as well. Besides if stock/futures is highly liquid then it usually translates to lesser volatility. Most importantly, if the stock is liquid then placing a 'market order' is hassle free.

Impact cost is the loss associated by executing a 'round-trip' trade. The loss is expressed as a percentage of the average of the bid and ask price. Round-tripping is an instantaneous arbitrary trade you carry out by buying at the first best available sell price and selling at the first best available buy price.

- Impact cost gives a sense of liquidity
- The higher the liquidity in a stock, the lesser is the impact cost
- The spread between the buying and selling price is also an indicator of liquidity
- Higher the spread, the higher the impact cost
- Lower the spread, the lower is the impact cost
- Higher the liquidity, lesser the volatility
- If the stock is not liquid, placing market orders is not a great idea

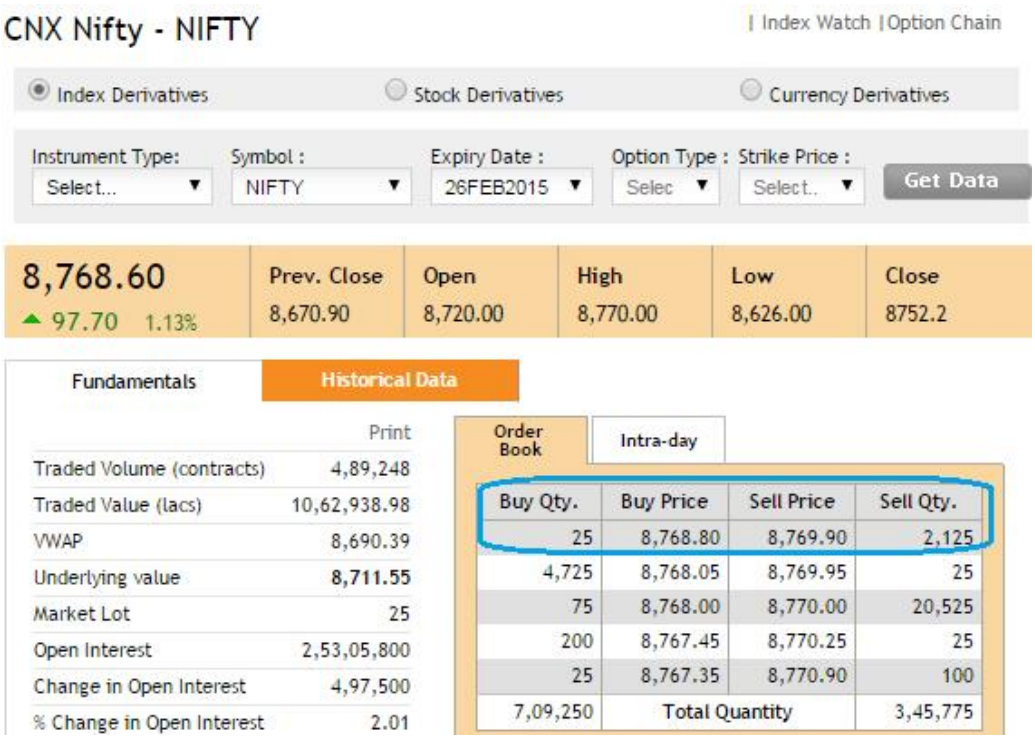

Figure 3.3

Buy Price = Rs. 8,769.9

Sell Price = Rs. 8,768.8

Round trip Loss = Rs. 1.1 (8769.9 – 8768.8)

Average of Bid Ask = (8769.9 + 8768.8)/2 = 8769.35

Impact Cost = 1.1 / 8769.35 = 0.0125%

This means if one buys or sells nifty futures at market price, the investor is likely to lose just about 0.0125%. Besides Nifty Futures there are few other future contracts that are quite liquid in the Indian markets such as the Bank Nifty Futures, Reliance Industries, Tata Motors, SBIN, Infosys, TCS, ITC, DLF, Cipla etc.

3.3 Why trading Nifty makes sense

1. The Nifty Index is a basket of 50 stocks. These stocks are selected to represent a wide section of the India economic sectors. This makes Nifty a good representative of the broader economic activity in India. This naturally means if

the general economic activity is going up or at least expected to go up then Nifty's value also goes up, and vice versa. This also makes trading Nifty Futures a much better choice as compared to single stock futures. There are many reasons for this, here are some –

2. **It is diversified** – At times taking a directional call on a single stock can be a tough task, this is mainly from the risk perceptive. For example, let us just say someone decides to buy Infosys Limited with a hope that the quarterly results would be good. In case the results don't impress the markets, then obviously the stock would take a knock and so would investor's P&L. Nifty futures on the other hand has a diversified portfolio of 50 stocks. As it is a portfolio of stocks, the movement of the Index does not really depend on a single stock. Of course, occasionally a few stocks (index heavy weights) can influence Nifty to some extent but not on an everyday basis. Thus, trading in Nifty futures completely eliminate the 'unsystematic risk' and deal with only with 'systematic risk'.
3. **Hard to manipulate –** The movement in Nifty is a response to the collective movement in the top 50 companies in India (by market capitalization). Hence there is virtually no scope to manipulate the Nifty index. However, the same cannot be said about individual stocks (remember Satyam, DHCL, Bhushan Steel etc)
4. **Highly Liquid (easy fills, less slippage)** –The Nifty is so highly liquid one can literally transact any quantity of Nifty without worrying about losing money on the impact cost.
5. **Lesser margins** – Nifty futures require much lesser margins as compared to individual stock futures. Nifty's margin requirement varies between 12-15%, however individual stock margins can go as high as 45-60%.
6. **Broader economic call –** Trading the Nifty futures requires one to take a broad based economic call rather than company specify directional calls.
7. **Application of Technical Analysis –** Technical Analysis works best on liquid instruments. Liquid stocks are hard to manipulate; hence they usually move based on the demand supply dynamics of the market, which obviously is what a TA mainly relies on.

8. **Less volatile** – Nifty futures are less volatile compared to individual stock futures. The Nifty futures has an annualized volatility of around 16-17%, where as individual stocks like say Infosys has annualized volatility of upwards of 30%.

3.4 Arbitrage opportunities in the Spot and Futures market

In normal market conditions, futures price would be greater than the spot price because of the effect of cost of carry and it moves in tandem with the price of the underlying asset. Thus, based on the cost of carry principle, if the spot price of a share on a given day is 'x' then, the futures price on that day would be 'x' + the interest for holding the spot to the duration of futures contract (minus) any dividend accrued on the spot.

So, to compute the cost of carry accurately a participant needs accurate information on interest rates and expected dividends. However, futures market is not so perfect where all the requisite information is readily available to all. Imperfections are common and that results in a mismatch between spot and futures price based on the cost of carry principle.

When this logic between spot and futures does not hold, the futures are incorrectly priced and that results in arbitrage opportunities.

3.5 Spot-futures parity

It is a parity condition whereby, if an asset can be purchased today and held until the exercise of a futures contract, the value of the future should equate the current spot price adjusted for the cost of money, dividends, convenience yield and any carrying costs (such as storage). When the relationship between spot and futures does not hold, the futures are incorrectly priced and that results in arbitrage opportunities. The mathematical representation of the theoretical relationship between the spot and futures price can be put into the following equation:

Theoretical Futures price = Spot price (1 + risk-free interest rate – income yield – convenience yield) ^t

The equation (1) describes that the futures contract should be for a strike price equivalent to F. When the futures price doesn't follow the parity condition described above, then there are two cases which can arise, they are as follows:

1. The actual futures price (F0) is greater than the theoretical futures price F

2. The actual futures price (F0) is less than the theoretical futures price F

In each case the arbitrageur has a risk less opportunity to make profit, the arbitrage strategy is discussed further in the following sections.

The spot prices and the future prices are recorded and the spot-futures parity is examined to check if the parity holds or not. An Excel based model is created to run the calculations to find out the arbitrage profit that can be collected by the arbitrageur.

The two possible scenarios for a market resulting into arbitrage opportunities have been named as Contango markets and Normal Backward markets.

Case 1: Contango market: if the spot futures price (F0) is greater than the theoretical futures price (F) as suggested by the parity equation, in this scenario the trader can BUY STOCK and SELL FUTURES (Assuming the trader operates in India and also assuming that the arbitrageur already possesses the futures)

Case 2: Normal Backward market: if the spot futures price (F0) is less than the theoretical futures price (S0ert) as suggested by the parity equation then the trader can SELL STOCK and BUY FUTURES (Assuming the trader operates in India and also assuming that the arbitrageur already possesses the stock)

These are the only two strategies that any arbitrageur can use to see if he/she makes any profit by taking a long position in one market and a short position in another.

Methodology steps

- The basic requirement of project was the prices of Nifty spot and Nifty future. This data was collected from the website of the National Stock Exchange of India (www.nseindia.com). The data was collected monthly wise from the month of February 2013 to March 2018 which was stored in excel sheets (See Annexure).
- Programs were written in the excel sheet to find out theoretical value of the future from the spot price taken.
- The theoretical values of such prices were found by using COST OF CARRY MODEL. It was taken compared with the actual future price as on the date. The comparisons revealed the arbitrage opportunities that existed in the market.
- CORRELATION TEST was used to find out the dependences of spot index on the index future market.
- CHI SQUARE TEST (Test of homogeneity) was conducted to find out if there is any association between the existence of arbitrage opportunity and the market trend.
- To find out the deviation of spot index and future index the LOG DIFFERENCE between two prices has been taken.
- In order to find out the maximum return on arbitrage a VOLATILITY TEST was conducted.

4. DATA ANALYSIS

4.1 Data sources

1. NSE India - NIFTY 50 Index is chosen to form the underlying asset in the arbitrage trades. The appropriate data regarding the stock spot and futures prices are collected from the NSE website

2. RBI – The data for the call money rate and 91-day T-bill rate used for the risk-free rate calculations were taken the RBI website.

4.2 Assumptions

Arbitrage Opportunity Between Spot and Futures Nifty Assumptions:

1. No brokerage charges
2. Margin amount is 20%, no margin paid during selling of futures.
3. At the expiry date, spot and futures will converge.
4. Impact cost is not considered.

Formulae used:

1. When Futures at a premium:

Cost of Carry = (Spot Nifty price * (Interest – Return from dividends)* Days to expiry)

Net Return = Futures Nifty price-(Spot Nifty + Cost of Carry)

2. When Futures at a Discount:

Cost of Carry = (Margin* Interest* Days to expiry)

Net Return = (Spot Price + Returns from funds deployed) - (futures price + Cost of carry)

Returns from funds deployed = (Spot price * Interest* Days to expiry)

Note:

Days to expiry is in Years

Margin amount is 20%

Interest rate in decimals

- For calculating Chi Square, it was considered that arbitrage opportunities existed only when the difference is above 5 points.
- 5% significance level is assumed during Chi Square test. And trends (up trend and down trend) in the market are considered from February 2013 to February 2018.
- Difference between log of spot Nifty and log of Futures Nifty was calculated to draw the Log Chart.
- It was assumed that money obtained from selling Spot Nifty was deployed to get a return of 5% and margin amount to buy futures was paid using borrowed funds.

4.3 Correlation Test

The correlation coefficient (a value between -1 and +1) tells you how strongly two variables are related to each other. We can use the CORREL function or the Analysis Tool pack add-in in Excel to find the correlation coefficient between two variables.

- A correlation coefficient of +1 indicates a perfect positive correlation. As variable X increases, variable Y increases. As variable X decreases, variable Y decreases.
- A correlation coefficient of -1 indicates a perfect negative correlation. As variable X increases, variable Z decreases. As variable X decreases, variable Z increases.
- A correlation coefficient near 0 indicates no correlation.

Correlation test was performed between Spot Nifty and Futures Nifty.

Correlation coefficient
0.999659409

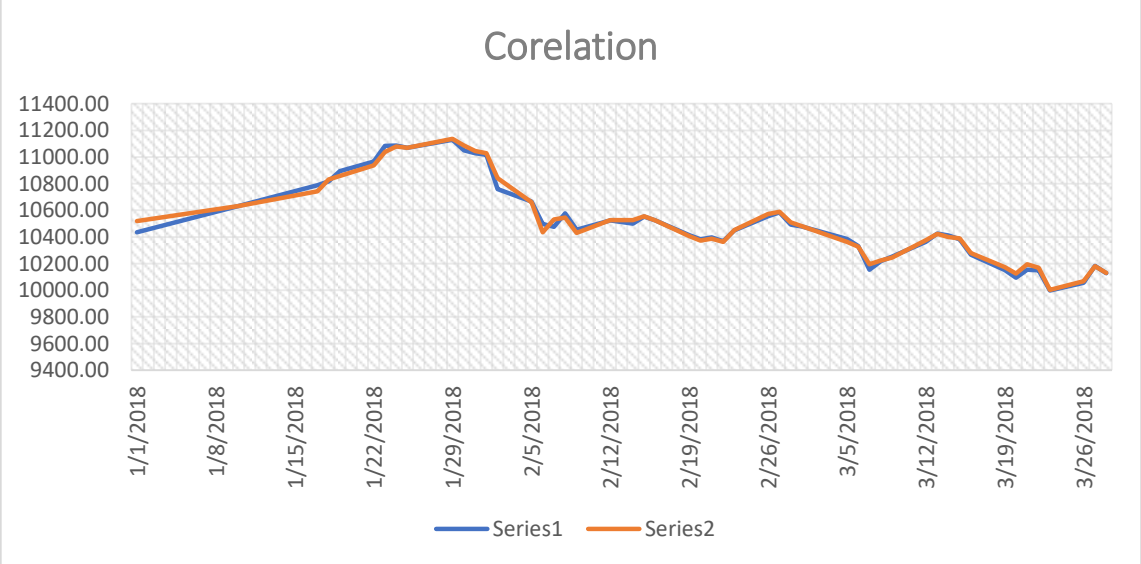

Figure 4.1, Series 1-Spot price; Series 2-Future price

Frequencies

Table 4.1 Descriptive Statistics

Statistics	Spot	Future
Mean	8006.530801	8023.100982
Standard Error	39.13778188	39.11498967
Median	8127.35	8142.9625
Mode	5916.3	5820.8125
Standard Deviation	1396.401834	1395.588627
Sample Variance	1949938.081	1947667.617
Kurtosis	-0.735652861	-0.737794387
std error of kurtosis	0.137252703	0.137252703
Skewness	-0.044087501	-0.050172577
Range	5845.4	5902.475
Minimum	5285	5233.65
Maximum	11130.4	11136.125
Confidence Level (95.0%)	76.78170294	76.73698848

The statistics establishes the relationship between the Nifty futures and spot Nifty. It is evident that the spot Nifty influences the Nifty futures; as a result, the movement in spot market will create a simultaneous movement in the futures market. Because of this phenomenon, the arbitrage opportunities exist between these two markets.

Scenario Analysis

Uptrends and Downtrends were identified using daily price movements and not using moving average. Trends were identified based on Futures Nifty closing price.

Table 4.2

	Total number of Observation	Number of Arbitrage Opportunity
Down Trend		
From 01/02/2013 to 14/03/2013	28	13
From 13/05/2013 to 10/06/2013	20	12
From 24/10/2013 to 02/01/2014	47	34
From 10/04/2014 to 13/05/2014	19	11
From 09/09/2014 to 25/09/2014	12	6
From 30/01/2015 to 13/03/2015	29	18
From 21/07/2015 to 14/08/2015	14	5
From 31/12/2015 to 27/01/2016	18	12
From 09/09/2016 to 04/10/2016	16	10
From 18/07/2017 to 14/08/2017	19	7
	224	128
UP Trend		
From 15/03/2013 to 09/04/2013	15	11
From 24/07/2013 to 30/09/2013	45	32
From 20/02/2014 to 22/03/2014	20	12
From 26/05/2014 to 26/06/2014	26	19
From 01/12/2014 to 13/01/2015	30	21
From 13/03/2015 to 24/04/2015	27	23
From 23/10/2015 to 09/10/2015	31	20
From 10/02/2016 to 17/03/2016	25	16
From 15/07/2016 to 26/08/2016	29	20

From 04/11/2016 to 19/12/2016	30	23
From 22/05/2017 to 28/06/2017	26	16
From 19/10/2017 to 21/12/2017	44	31
	348	244

4.4 Chi Square Test

Chi square test (Test of homogeneity) was conducted to find out if there is any association between the existence of arbitrage opportunity and the market trend.

Null Hypothesis: Existence of arbitrage opportunity does not depend on the trend. **Alternate Hypothesis**: Existence of arbitrage opportunity depends on the trend

Table 4.3

Observed Table			
Trend	**No Arbitrage Day**	**Arbitrage Days**	**Total**
Up	104	244	348
Down	96	128	224
Total	200	372	**572**

Expected value = (Row total x Column total) / total no. of observation

Table 4.4

Expected Table			
Trend	**No Arbitrage Day**	**Arbitrage Days**	**Total**
Up	121.6783217	226.3216783	348
Down	78.32167832	145.6783217	224
Total	200	372	**572**

Table 4.5

Observed (O)	**Expected (E)**	**(O-E)^2**	**(O-E)^2/E**
104	121.6783217	312.5230574	2.568436621
96	78.32167832	312.5230574	3.99024975
244	226.3216783	312.5230574	1.380879904
128	145.6783217	312.5230574	2.145295565
		Total	**10.08486184**
		5% Significance	**3.84**

Since calculated Chi Square value (10.08486) is more than the table value (3.84) we can reject the null hypothesis, which says that the existence of arbitrage opportunity does not depend on the trend and prove that the existence of arbitrage opportunity depends on the market trend.

4.5 Log Difference Chart

Difference between log of spot Nifty and log of Futures Nifty was calculated to draw the Log difference chart.

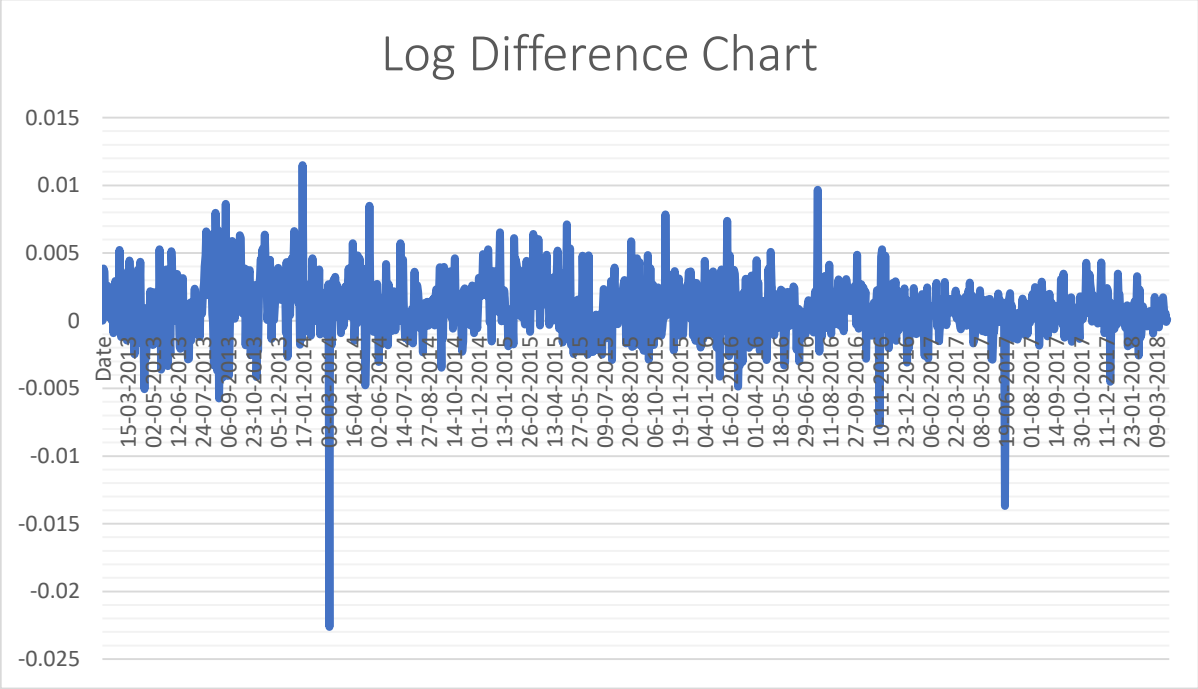

Figure 4.1

Negative values indicate futures are trading at a discount when compared with the spot. The maximum and minimum values of Log difference are 0.0011487782 and -0.022620596.

4.6 Volatility Test

Table 4.6

	Standard deviation
Log Return	0.4373513
Volatility	0.4009339

Daily volatility was computed and volatility chart was drawn. Volatility values were compared with log value of Net returns by taking standard deviation. It was found that volatility and returns had a direct relationship.

4.7 Annual Returns

Table 4.6

Year	Annual Positive Return
2013	211032.3951
2014	236688.3552
2015	255543.3289
2016	226514.0758
2017	179166.1210
2018	17834.6279

Table 4.7

Year	Annual Negative Return
2013	-231833.5313
2014	-212100.7398
2015	-323213.8424
2016	-280340.9748
2017	-271531.0578
2018	-99443.0001

4.8 Result

- One of the major factors to be considered when doing cash and carry arbitrage (when futures at a premium) is the number of days to expiry. When the days to expiry is high, the cost of carry of the borrowed funds (needed to buy spot) is high and the net returns from arbitrage drops significantly even though there is a considerable difference in prices

- Largest difference when futures are trading at a premium is 45 points on 16/01/2014 and when Futures is at a discount the largest difference is 270 points on 04/3/2014.

- Out of 1274 days futures at a premium for 608 days, futures at a discount for 544 days and neutral for 122 days.

- Simple Interest formula was used to calculate the cost of carry and return obtained from deployed funds.

5. CONCLUSION

Lack of institutional participation, high investment cost, poor IT infrastructure to exploit the arbitrage opportunities and lack of knowledge about arbitrage by the retail investors are the key reasons for the high return in this segment. The study brings certain interesting facts, which is of highly useful to investors and derivative traders. The futures market provides excellent arbitrage opportunity. The investors can identify the best opportunities available for arbitrage between the futures and spot in the stock market and enhance their returns. The scope for high returns will create more arbitrage and can attract more players to the market. As a result, the depth of the market will increase providing better opportunities for expanded trading activities.

6. LIMITATION

This study is not free from limitations. The analysis is done based on certain assumptions, which are given below. Many of these assumptions are hypothetical and may vary in the real-life situation. Secondly the study is limited to the equity index futures market. The options segment is not considered for the study. However, utmost caution is taken to avoid any statistical errors.

Assumptions

- No brokerage charges
- Margin amount is 20%, no margin paid during selling of futures.
- At the expiry date, spot and futures will converge.
- Impact cost is not considered.

7. FUTURE SCOPE OF STUDY

The above section shows that there exist arbitrage profits that can be made using the spot and futures markets.

In the normal backward market, a trader would have to short the stock and buy futures, the trader has to have the stock in his/her possession. He would either own the stock or borrow it from some lender, in each case the rate of returns would vary.

if the trader doesn't own the stock then he/she would have to borrow the stock, assuming he/she borrows under the SLB mechanism, then the trader has to pay a margin to the intermediary. The margin for a borrower is roughly 120% of the stock value. Also, the margin for single lot of futures contracts is around 1 lakhs. Hence for the trader, total money blocked is very high. Assuming, the trader has to pay for interest costs of borrowing the asset from the lender, the rate of return would further decrease. It should be noticed that the return is lesser than the return trader would get if he/she invested the same amount in a fixed deposit.

Same goes with the trader who owns the stock, even he/she would face almost the scenario except that the trader here would sell stock, receive cash, pay margin money for futures, invest remaining amount in a bank till the contract expiry date, take out money, and buy the stock at expiry of futures at strike price. Therefore, in either of the case i.e. the trader owns the stock or borrows it, the trader would have a meager rate of return which is not worth the complex actions that need to be taken. This can be one of the reasons that the mispricing continues to persist in the financial markets - since the trade is not worth the expected profits. In today's technologically advanced era these trades of spot and futures arbitrages are done using super computers in hedge funds where the asking rate of return would be higher than the rate of return we would actually receive, therefore, few such opportunities do persist longer.

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9. ANNEXURE