“Foreign Exchange Risk Management: A Study of Indian Companies”

by

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CANDIDATE'S DECLARATION

I, hereby declare that the thesis titled "Foreign Exchange Risk Management: A Study of Indian Companies" is submitted in the fulfillment of the requirement for the award of degree of Doctor of Philosophy is an authentic record of my research work carried out under the guidance of Dr. Archana Singh. Any material borrowed or referred to is duly acknowledged.

The matter presented in this thesis has not been submitted elsewhere in part or fully to any other University or Institute for the award of any degree.

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SUPERVISOR'S CERTIFICATE

It is to certify that the thesis titled "Foreign Exchange Risk Management: A Study of Indian Companies", submitted in the fulfillment of the requirement for the award of degree of Doctor of Philosophy is an original research work carried out by Ms. Varuna, under my supervision. The matter presented in this thesis has not been submitted elsewhere in part or fully to any other University or Institute for the award of any degree, to the best of my knowledge.

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गुरुर ब्रह्मा गुरुर विष्णु गुरुर देवो महेश्वरः

गुरुः साक्षात्परब्रह्मा तस्मै श्री गुरुवे नमः

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Abstract

Foreign exchange risk management is an important activity which is carried out by the companies all over the world. This is an important activity for the Indian companies also which engage in hedging this forex risk. Majorly, there are two prominent methods of hedging this risk. First, operational hedging and second, financial hedging. Operational hedging is internal to the companies and the treasurers adjust the operations of the firm or company to handle this risk. Financial hedging, however, is external to the firm or company and involves the use of derivatives like forwards and futures for risk management. Since, a wrong hedging decision impacts companies' financials as well as the financial markets worldwide, the policy makers upgraded the financial accounting norms in order to facilitate efficient hedging and reduce unwarranted impact of wrong hedging decisions. These new accounting guidelines mandates the evaluation of hedge effectiveness by the companies and provide flexibility to these companies in choosing an appropriate statistical method for the same.

With this background, the present research study makes an effort to understand the current foreign exchange risk management practices of Indian companies. Taking cues from the literature, the study builds a theoretical structure and then conducts a primary data analysis for the same and interviews hundred treasures to identify these practices. This analysis largely identifies the role of treasures in risk management process, popular derivative instruments which the companies use, prevalent currencies against which these companies book a position in the market and the hedge effectiveness methodology which these companies adopt. The results of this analysis recognize that the companies do not adopt statistical method for evaluating hedge effectiveness. After identifying the general framework of the companies for

the foreign exchange risk management, the present research study conducts a secondary data analysis.

The secondary data analysis focuses on the popular derivatives instruments and currencies identified from the primary analysis and uses various hedge effectiveness models to find out the effectiveness of the hedging as per these models. This analysis is conducted on time series data for forwards and futures contracts for United States Dollar (USD), Great Britain Pound (GBP) and EURO. This data is collected for daily frequencies for a period of seven years from February 2010 to December 2017. The study uses three static models and two dynamic models for this purpose. The three static models are Ordinary Least Square (OLS), Vector Autoregression (VAR) model and Vector Error Correction model (VECM) models. These models do not consider time-varying heteroskedasticity of the residual of the time series and provide one static hedge ratio, therefore are static in nature. The two dynamic models are Constant Conditional Correlation (CCC) Multivariate GARCH model and Dynamic Conditional Correlation (DCC) Multivariate GARCH model. These two models consider time-varying heteroskedasticity of the residual of the time series and provide dynamic hedge ratio to the hedgers and are therefore, dynamic in nature.

The results of the analysis reveal 1-month forward contract as the effective hedging instrument and dynamic multivariate GARCH model as better model for measuring the hedge effectiveness which the companies should use. These results are shared by the treasurers who agree with the analysis but present certain challenges in adopting these results. The study then concludes by providing implications and recommendations to the companies and treasurers as well as the policy makers to rationalize the hedging process, educate the professionals on the statistical methods and foster the use of efficient hedge effectiveness methods by sensitizing the companies on appropriateness of hedge effectiveness models.

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Abbreviations Used

ADF	Augmented Dickey Fuller	IFRS	International Financial Reporting Statements
AIC	Akaike Information Criterion	Ind-AS	Indian Accounting Standards
ARCH	Autoregressive Conditional Heteroskedasticity	INR	Indian National Rupee
AS	Accounting Standards	IT	Information Technology
BOP	Balance of Payment	JPY	Japanese Yen
BEKK	Baba, Engle, Kraft and Kroner Model	KPSS	Kwiatkowski–Phillips–Schmidt–Shin
CCC-MGARCH	Constant Conditional Correlation Multivariate GARCH	NSE	National Stock Exchange
DCC-MGARCH	Dynamic Conditional Correlation Multivariate GARCH	OLS	Ordinary Least Square
ECB	External Commercial Borrowings	OTC	Over The Counter
ECM	Error Correction Model	PP	Phillips-Perron
EGARCH	Exponential GARCH	PWC	Price Waterhouse Cooper
FERA	Foreign Exchange and Regulation Act	RBI	Reserve Bank of India
FX/Forex	Foreign Exchange	UK	United Kingdom
GAAP	Generally Accepted Accounting Principles	US	United States
GARCH	Generalized Autoregressive Conditional Heteroskedasticity	USD	United States Dollar
GBP	Great Britain Pound	VAR	Vector Autoregression
IAS	International Accounting Standards	VEC	Vector Error Correction
IASB	IASB	VECM	Vector Error Correction Model

Chapter 1

CHAPTER – 1: INTRODUCTION

1.1 Introduction

Foreign Exchange risk arises because of an unfavourable movement in the foreign exchange rate for a currency viz a viz other currency. This undesirable movement directly impacts the profits or the future cash flow of a company. Therefore, it becomes important for the treasurers of the company to manage the currency risk. Research has pointed out various reason for currency risk like growth of the companies, international operations of the companies, increase in the competition etc. (Williamson 2001, Faff and Marshall 2005 and Hutson and Stevenson 2010). Over the years, the currency market has become vast, intricate, complex and interdependent. As a result of which, even the companies which never operated beyond their domestic territory, now face the exchange rate risk. Indian companies too face this increasing currency risk. Indigo saw fall in profits by 97 percent in the first quarter of 2018 because of falling rupee even though the sales had increased. SpiceJet also reported a loss in the first quarter of 2018 because of falling rupee. Tata motors reported a loss of more than Rs.1800 crore in the beginning of 2018 because of unfavourable exchange rate movement.

There are multiple methods and instruments available to manage the currency risk. Two major approaches for currency or foreign exchange (forex) risk management are operational (internal) hedging and financial (external) hedging. Operational hedging involves making internal adjustments in the operations of the company to mitigate the risk like leading a payment or lagging a payment, invoicing in the domestic currency, intercompany netting of the receipts etc. Financial hedging involves using different derivative tools available in the international financial market like futures, forwards, options and swaps for mitigating this risk. Research has shown that both kinds of hedging – operational and financial work together for managing the currency risk (Bartram and Bodnar 2007, El-Masry et al. 2007, Faseruk and Mishra 2008, Chong et al. 2014). Since financial hedging involves the use of derivatives, which are complex instruments, the treasurers must take extra precaution while using these for the risk management. An incorrect hedging decision by a company can lead to much more aggravated losses than a no hedging decision. For example, Delta airlines reported currency hedging losses of more than 2 million USD in 2014, US company Anadarko Petroleum Corp lost 298 million US dollar in pretax income due to hedging losses and

Cenovus Energy Inc lost 469 million US dollars on oil hedges due to aggressive hedging program. In India, Tech Mahindra lost $4 million in forex because of bad currency hedges in 2013. Tata motors reported a loss of 95 percent in net profits in late 2016 when Jaguar Land Rover experienced a steep decline of 60 percent even after maintaining large hedges which ran into 4-5 years.

Warren Buffet did well by quoting derivatives as "financial weapons of mass destruction" because of their ability to quickly expand the losses from a wrong hedge undertaken by a participant to impact everybody in the world because of now interconnect financial market. Recognizing this strong and expansive impact of the derivatives, the policy makers introduced improved regulatory measures in the form of IFRS 9, to systematically and effectively account for hedging undertaken for risk management. The policy makers made many changes in the regulation, processes and accounting guidelines to limit the damages that might occur because of derivative hedging. One major change brought by these guidelines brought was mandatory evaluation of the effectiveness of hedging. These guidelines however, are flexible and allow the companies to choose an appropriate statistical method which suits their risk management policies and procedures.

While a lot of literature is available on the studies associated with the currency (forex) risk management or practices of companies to manage and mitigate this risk or effectiveness of hedging but these either singularly study currency risk management or focus on effectiveness of hedging. Most of these studies examine developed countries with little or no focus for emerging economies. Also, nothing much has been discussed on the importance of hedging effectiveness in light of new regulatory changes brought by the policy makers. The present study therefore, in addition to studying the currency risk management practices of the Indian companies offer significant implications for the treasurers and policy makers regarding effective currency risk management. Additionally, it offers recommendations to the future researchers contemplating to study this area.

The present study starts by understanding the existing literature on the topic and identifying theoretical context for the forex or foreign exchange risk management. The study then moves on to achieve the first objective of studying the forex or foreign exchange or currency risk management practices of Indian companies. This is achieved by conducting a primary study where in-depth questions related to currency (forex) risk management are asked from the treasurers of the company. It was evident from the primary data analysis that the treasurers follow a general

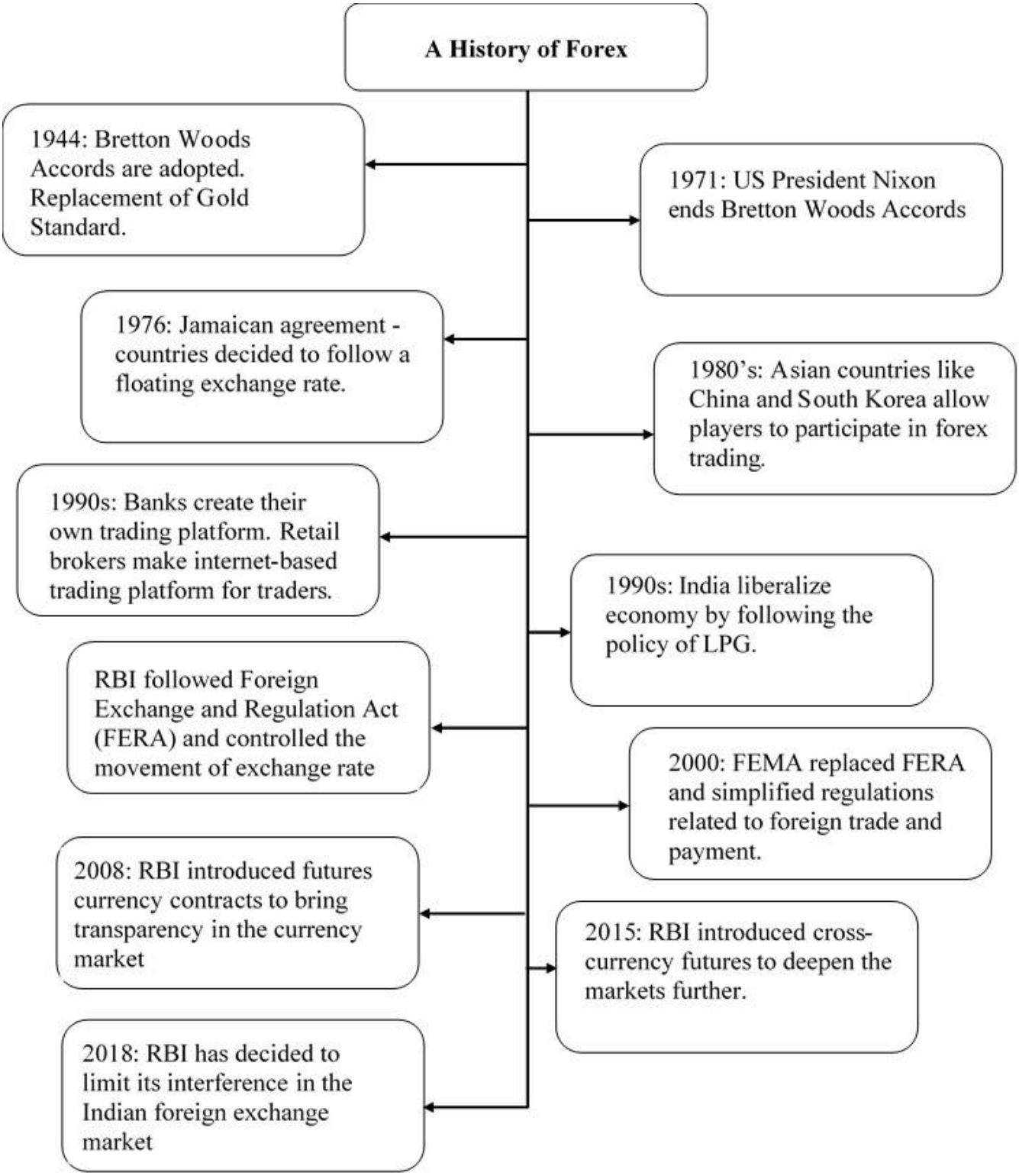
process for currency risk management where they hedge the risk as and when it is generated. The treasurers did not conduct any statistical analysis to either examine the forex market or effectiveness of the hedge. The study then moves on to accomplish the second objective which is to examine the Indian foreign exchange or currency market by performing cointegration analysis on the variables of the currency market. This step is important for identifying the correct effectiveness model which enables the accomplishment of the next objective of the study. The third objective of the study is to conduct effectiveness tests of the financial hedges undertaken by the companies. This analysis would help in identifying effective financial hedges for the companies. The results obtained are further verified by developing a case for an Indian company which actively hedges its forex or currency risk. All this analysis is conducted with the intention of assisting the treasurers of the companies to realize the importance of statistical testing in measuring the hedging effectiveness. This would also assist the policy makers to identify the challenges faced by the companies in evaluating hedge effectiveness. Together they could take effective measures to overcome these challenges.

1.2 The Foreign Exchange / Forex (FX) / Currency Market

The foreign exchange (FX) market began to develop after the Bretton Woods conference in 1944, held after the second world wars. The premise behind this conference was to set up fixed exchange rates. A major development of the conference was the replacement of the Gold Standard with the US Dollar. USD being the dominant currency of the world became the primary reserve currency which would then be backed by gold. The US government faced a series of challenges after US Dollar was placed as the reserve currency. Therefore, the Smithsonian Conference in 1971, ended the Bretton Woods system by ending dollar convertibility into gold. The European currencies were then following an ad hoc system of exchange rate where they would float together against the US Dollar in a narrow band. But during the 1973 oil crisis, the price of the oil shot up which surged the demand of US Dollar since the oil importing countries were making the payment in that currency. This posed a challenge to the European currencies which were still maintaining a narrow band for the currency movement against US Dollar. In the 1976 Jamaican agreement, the countries decided to follow a floating exchange rate where the exchange rate was managed by dollarization, pegged rate and a managed floating rate.

The Indian currency market has also undergone many changes. The year 1987 was path-breaking as it permitted banks to commence intra-day trade in foreign exchange. This step can be regarded as the origin of the foreign exchange market in India (RBI 2008). During the early stages of the development, the exchange rate market in India was highly regulated by Reserve Bank of India (RBI) with many restrictions on transaction and barriers to entry. RBI followed Foreign Exchange and Regulation Act (FERA) and controlled the movement of exchange rate by pegging the Indian rupee against a basket of currencies that were not publicly announced. This closed and restricted system encouraged the development of the unofficial hawala market which indirectly influenced the currency movement and prices but were beyond the control of the authorities and policy makers. After facing acute Balance of Payment (BOP) challenges, the government passed the regulation for opening and liberating Indian Economy which altered the complete foreign exchange (forex) market scenario. The 1991 policy of liberalization, privatization and globalization paved way for the advancement of the Indian foreign exchange market. Wide ranging reforms were adopted on the recommendation of the Expert Group on Foreign Exchange Market which was chaired by Shri O.P. Sodhani (RBI 2008). Indian foreign exchange market flourished and foreign reserves stood at 412.9 billion US Dollars at the end of March 2019 (RBI 2019). RBI over the years has limited its intervention in the Indian currency market and has introduced many instruments for the market participants. RBI introduced futures contract in the year 2008 to exert more control over the currency market. It made many other significant changes and in 2015, announced cross-currency exchange traded futures and options which further deepened the market and added to hedging the forex exposure. Then a year later, RBI clarified hedging of the ECB's (External Commercial Borrowings), and set guidelines for the foreign companies for hedging their forex exposure. Then it offered operational flexibility to companies specifically multinationals and subsidiaries, in managing forex exposure by modifying existing norms in March 2017. RBI further simplified hedging for resident entities and permitted them to operate in foreign derivative market with specified authorized banks. RBI has been sensitizing companies about the importance of managing the foreign exchange market or currency market risk. It has also been encouraging banks to assist the companies in this process.

Fig.1.1: Foreign Exchange (FX) or Currency Market – Evolution

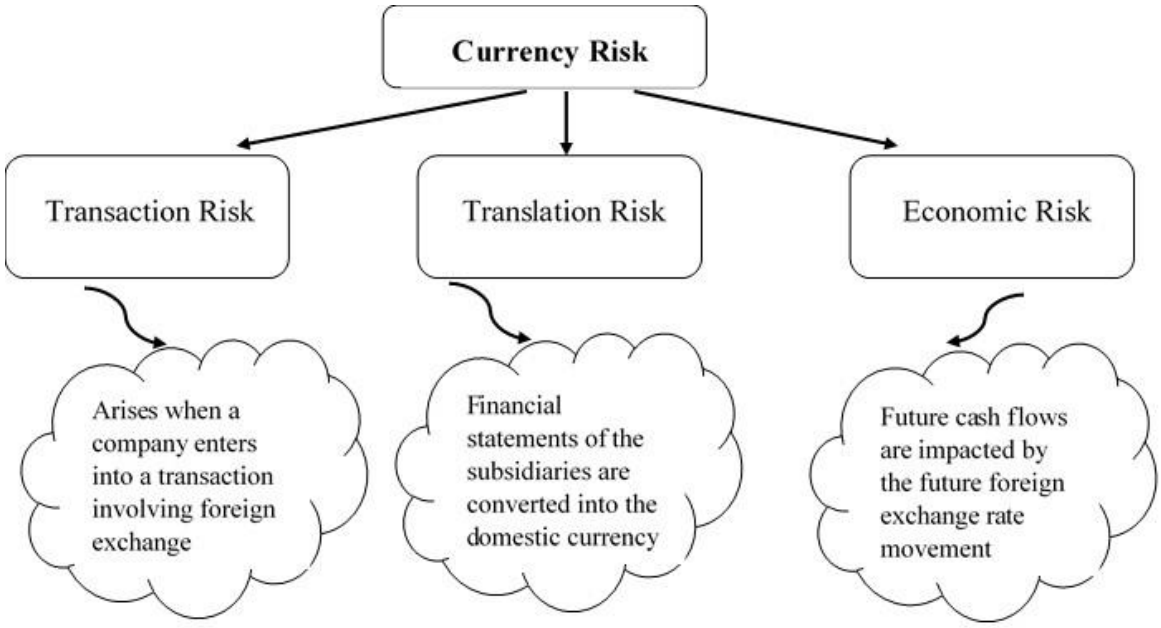


1.3 Foreign Exchange Risk Management

A multinational is one of the main participants in the currency market as it operates in numerous countries and deals with multiple currencies. This international operation of the company give rise to the foreign exchange (forex) risk exposure. Researchers like Faff and Marshall (2005) and Hutson and Stevenson (2010) also pointed out that the internal operations of the companies add to its forex risk. In order to contain this risk, the companies carry out foreign exchange (forex) risk management. Forex risk management is, therefore, a series of activities which a market participant, here a company, adopts to limit their exposure to the untoward currency movement. The currency risk is segregated into three categories – (a) transaction risk, (b) translation risk and (c) economic risk. Transaction risk arises every time a company enters into a transaction involving foreign currency receipt or payment. Translation risk results when the financial statements of all the subsidiaries are converted into the home or domestic currency. Economic risk arises when the treasurers forecast the future foreign exchange (FX) rate movement impacting the future cash flows.

The corporates or companies can either manage these separately or combine them together before devising risk management strategies. Many researchers like Miller and Reuer (1998), Glaum (2000), Bradley and Moles (2001), Aabo (2001) pointed out that treasurers of the companies consider transaction risk to be most important risk and therefore they actively manage it. They further identified that these treasurers ignore translation risk since it did not directly impact the profits of the company and only arises in case of consolidation of the financial statements of all the subsidiaries. Researchers further pointed out that the treasures also ignore economic risk and did not actively manage it because they find it complicated and difficult to measure.

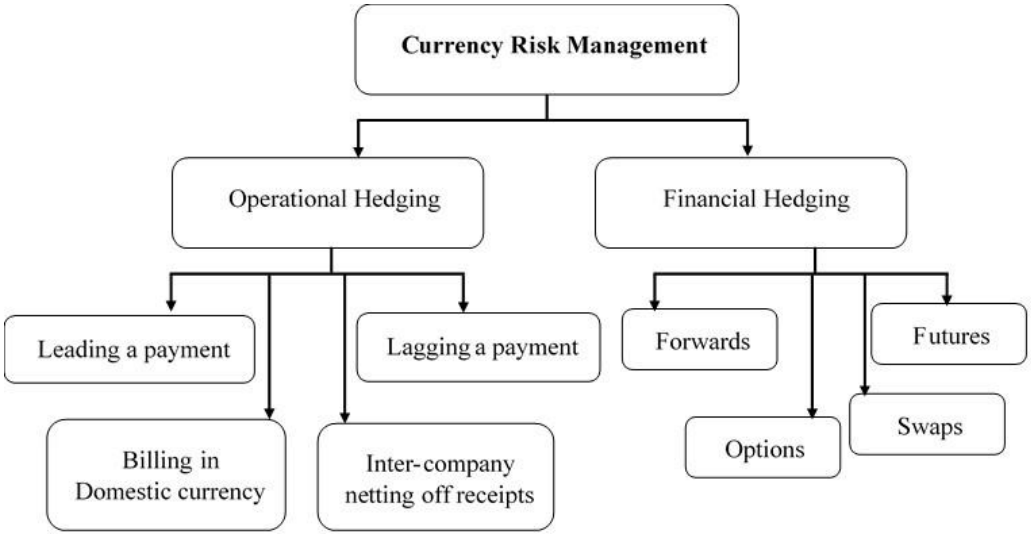
Fig. 1.2: Foreign Exchange (FX) or Currency Risk Categories



One of the leading mechanisms for handling the currency (FX) risk is hedging the risk. Two broad hedging strategies for dealing with the currency risk are operational and financial hedging. Operational strategies are also called as internal hedging strategies since these involve managing the daily operations of the company in such a manner that there is limited impact of the currency movement on the cash flows or profitability. This involves taking decisions like leading or lagging a payment, billing in domestic currency, inter-company netting off receipts and payments etc. Financial hedging strategies involve using financial derivatives like forwards, futures, options or swaps for controlling the forex risk. Research has identified that it is relevant for the companies to contain the currency risk since it impacts the profitability and cash flows of the company (Booth and Rotenberg 1990, Williamson 2001, Bodnar and Gentry 1993, Chow and Chen 1998, Choi and Prasad 1995, Kiymaz 2003, Bartram 2008, Agyei-Ampomah 2013, Hua at al. 2018). Researchers also argued that the value of the company and returns of the stock are also influenced by the exchange rate fluctuations which necessitates that the companies should take conscious steps for its management (El-Masry et al. 2007, Chiao and Hung 2000, Faff & and Marshall 2005, Fornés and Cardoza 2009).

Researchers however, offer divided opinion on the preference for one particular strategy for currency risk management. Choi and Jiang (2009), Aabo (2006), Kim et al. (2006) and Pantzalis et al. (2001) identified that large firms prefer operational hedging strategies. Whereas Allayannis et al. (2001), Clark and Judge (2009), Campello at al. (2011) and Júnior (2013) identified that geographically dispersed firms with higher growth opportunities and better corporate governance use derivatives for hedging the risk. Few researchers like Faff and Marshall (2005), Luo and Wang (2018) argue that since derivative hedging lead to larger stock return and more value creation for the companies, they should only use the derivatives for forex risk management. The choice for a particular forex risk management strategy also depend upon the characteristics of the companies like company size, structure and policies adopted by the top management for risk mitigation. Tai et al. (2018) highlighted that the board of directors and especially, the audit committee, have an important role in monitoring the company's hedging decisions for risk management. Overall both hedging strategies, financial and operational, lead to currency risk management and researchers, Allayannis and Ofek (2001), Kim et al. (2006), Dewenter et al. (2005), Fornés and Cardoza (2009), Bartram and Bodnar (2007) suggest that these two hedging strategies (operational and financial) complement and assist each other in the overall forex risk management for the company. Other researchers who also agree that the operational and financial strategies work together to manage the risk include Bartram and Bodnar (2007), El-Masry et al. (2007), Faseruk and Mishra (2008), Chong et al. (2014).

Fig. 1.3: Methods of Managing Foreign Exchange (FX) or Currency Risk



Over the years, financial hedging has gained popularity in currency risk management. Companies use the financial derivatives for various reasons like geographical diversity of their business operations, growth of the financial markets, availability of the financial instruments, involvement and encouragement of the various stakeholder etc. Albuquerque (2007) also showed that the forwards contracts dominate other derivatives as hedges of downside risk. Debasish (2008) and Sivakumar and Sarkar (2008) also found the same result for Indian companies. But only hedging the currency risk using financial instruments does not ensure that the currency (FX) risk management is complete and the companies are safe from any untoward currency exchange movement. The treasurers of the companies must use financial hedges carefully since a wrong hedging decision can quickly spiral out of control and result in devastating effects for the companies.

There are many such examples where a bad currency hedge or forex hedging loss has resulted in bigger losses for companies. For example, Tech Mahindra lost $4 million due to bad currency hedges in 2013 whereas JSW Steel lost Rs. 8.51 billion in forex market. Then in June 2015, Jaguar Land Rover, a Tata-Motors luxury car division company lost 123 million pounds on account of hedging the exposure. Further in 2017, new income of General Motors dropped partly due to forex losses of up to $500 million. Nissan Motor Co. also confirmed drip in operating profits by 6.4 percent in the 2016-17 on account of forex losses. It, therefore, becomes important to evaluate the effectiveness of the foreign exchange or currency hedges. The policy makers have also realized the strong and negative impact of the derivatives hedging and therefore, they have updated the international accounting guidelines and introduced IFRS 9 which contains improved regulation for derivative hedging. These are an improvement over the previous guidelines, IAS 39, as these have eased out hedge effectiveness testing for the companies (Deloitte 2017). These guidelines have also made it mandatory to evaluate the effectiveness of the foreign exchange or currency hedges initiated by the companies.

Taking cue from global market, the Indian accounting guidelines too are improved with the similar change. The new guidelines, Ind-AS, have widened the range of situations where one can hedge, have opened more choices for the treasurers for hedging and are more practical and less strict in terms of applying hedging effectiveness (PWC 2017). Earlier, only the hedges which

met the 80-125% effectiveness criteria could be recorded but these new guidelines have widened that scope and allow hedges with lower effectiveness to be recorded too. Another change is that these guidelines have made it compulsory for the firms or companies to assess and report the effectiveness of all their hedges in order to avoid any unforeseen surprises in the financial market. The new guidelines also offer flexibility in the choice of the quantitative method for evaluating hedge effectiveness. The treasurers of the companies are thus, free to choose the methods which suit their risk management policy.

Hedge effectiveness means measuring the success of the financial hedge undertaken to safeguard the company's cash flows or profits from any unpleasant forex currency price movement. The literature offers different methods of measuring hedging effectiveness. These are categorized – static and dynamic models. Techniques or methodologies like OLS – Ordinary Least Square, VAR – Vector Autoregression and VECM – Vector Error Correction Model are static since these do not contemplate time-varying conditional heteroscedasticity of the data (Park and Bera 1987, Herbst et al. 1993). Dynamic models include CCC-MGARCH and DCC-MGARCH which take the time-varying nature of time series data into consideration (Brooks and Chong 2001, Yang and Pavlov (2011). There are different studies which examine the effectiveness of the currency hedges using these different methods like Lien et al. (2002), Casillo (2004), Ku et al. (2007), Kenourgios et al. (2008), Czekierda and Zhang (2010), Betancourt and Al Azzawi (2013), Pradhan (2011), Lingareddy (2013), Jampala et al. (2015).

1.4 Role of Policy Makers

The financial integration of the foreign exchange markets enables the companies to operate and exercise currency risk management in multiple geographies with different financial instruments. This has, of course, increased the risk of misuse or incorrect use of these financial instruments. The role of the policy makers has therefore, increased and they are now also the watchdogs for the financial hedging operations of the companies. The policy makers realize the hazards of unfitting use of the financial derivatives and have therefore updated the accounting guidelines so that the firms or companies or corporates could account for the foreign exchange or currency or forex risk management approaches. The International Accounting Standard Board

(IASB) issued new proposals for hedge accounting which is called IFRS 9. These long-awaited reforms replace the old accounting standards IAS 39, which were restrictive, complicated, confusing and not entirely followed by the companies. The motivation behind IFRS 9 is to facilitate the application of hedge accounting standards by the companies. These new guidelines remove the previous 80-125 percent hedge effectiveness range for the hedges to be qualified for accounting. Thus, making hedging more accommodating for the companies (Deloitte 2015). Further, these new guidelines are also more flexible than previous as they leave it up on the management of the companies to choose an appropriate method for evaluating hedge effectiveness.

Indian policy makers have also evolved Indian Accounting guidelines. The old guideline had no comprehensive literature on accounting for the financial instruments and these instructions were scattered in Accounting Standards 13 (AS 13) and Accounting Standards 11 (AS 11). The AS 13 covered the accounting for investments while AS 11 covered the outcome of a change or variation in the forex rates. These standards were also not complete in themselves and required the support from other standards like AS 30, AS 31 and AS 32. All this created confusion and underpinned the need for a more comprehensive and complete accounting standard which covered all the aspects of financial instrument accounting just like the international accounting standard IFRS 9. Indian policy makers thus, introduced Ind-AS, as the new comprehensive accounting regulation in India to deal with accounting of financial instruments and hedging of risk, evaluation of hedge ratio and effectiveness.

The Ind-AS mandates the companies to create documented guidelines for risk management which should provide details about the hedging instrument, hedging item, nature of the risk and specification of the hedging relationship to meet the hedge effectiveness requirement. Like the international standards, these guidelines are also flexible and allow the company to choose an appropriate statistical method for evaluation of hedging effectiveness based on their risk management policy. These guidelines further mandate the companies to evaluate the hedge ratio to identify the quantity of the hedging instrument to be used to cover their exposure and allow the companies to adjust the quantity of the derivative instrument, if required, to make it effective. The Ind-AS are applicable on the Indian companies mandatorily from the financial year 2017-2018.

With this background, the study attempts to understand the foreign exchange (forex) risk management practices of companies in India and find out if these practices align with the requirements of the policy makers. The study further attempts to identify effective instrument for foreign exchange (FX) risk hedging by utilizing different statistical models. These models measure effectiveness of hedging position taken by companies for this risk management. The appropriate model for the evaluation is chosen after understanding the relationship between different currency market variables.

1.5 Motivation of the Study

International operations of Indian companies, interdependence of the financial market and the updates in the regulatory environment to protect the international financial markets has become the motivation for this study. Although previous researchers have tried to understand currency risk management process of a company like like Faff and Marshall (2005), Campello at al. (2011), Júnior (2013), Li and Milne (2014), Araujo and Leao (2016), Kim and Chance (2018), Luo and Wang (2018) but little or no attention was paid to emerging Indian companies. The Indian corporates or companies face forex risk and use various forex derivatives for hedging this risk. Therefore, the first motive of this study is to understand the foreign exchange (forex or FX) risk management practices of Indian companies. This is achieved by conducting a primary data collection and analysis where in-depth questions were asked to corporate treasurers about their currency risk management practices.

Apart from this, RBI and policy makers have been empowering and encouraging Indian companies to hedge the risk. They have deepened the currency markets by introducing different derivatives tools to the companies. They have also updated the accounting norms to ensure that the derivative hedging does not create any negative impact on the company's profits and eventually on the financial market. As these norms stress on the use of effective hedging instrument and evaluation of overall hedge effectiveness, the second motive of the study is therefore, to identify a suitable statistical model for evaluation of hedge effectiveness and identify an effective hedging instrument for covering the forex risk. It becomes important to understand the inter-relationship between the market variables, therefore, the study also evaluates the efficiency of the foreign

exchange (forex or FX) market. The result of the efficiency in turn, helps in the choice of an appropriate model of hedging effectiveness.

1.6 Relevance of the Study

The present study categorically studies three aspects of foreign exchange or forex risk management. First, it conducts a comprehensive investigation of the company practices for the forex or currency risk management using primary analysis. Next, it attempts to understand the Indian currency market and studies the inter-relationship between different market variables. Further, it bases that result to identify an appropriate method of evaluating hedge effectiveness and moves on to identify effective currency risk management instruments. This study is, therefore, appropriate, helpful and relevant to the treasurers of the companies as it enhances their knowledge about different quantitative methods for hedging the currency (forex) risk. The study is relevant for the policy makers as they would be able to identify appropriate method for evaluating hedge effectiveness. They would then be able to promote these efficient methods and encourage the companies to choose the same. All the same, the study also helps in identifying the challenges faced by the companies in adopting the changes prescribed by the new accounting guidelines regarding risk management through hedging.

These reasons clearly make the present study relevant for the treasurers of the company and the policy makers.

1.7 Thesis Structure

The organization of the thesis is diagrammatically presented in Fig 1.4. The thesis contains nine chapter each of which is discussed below:

Chapter 1: Introduction

This chapter of the present research study introduces the topic and further dwells on the background of the study, defines and explains various types of foreign exchange (forex) risk, explains the foreign exchange (forex) risk management practices of the companies. The chapter also highlights the role of the policy makers in foreign exchange (forex) risk management. This chapter then goes on to discuss the evolution of the foreign exchange or currency market. The foreign exchange or currency market in India and the relevance of hedge effectiveness. This chapter further discusses the relevance of the present study and sketches the motivation behind the research study. This chapter ends with the discussion on the structure or assembly of the thesis.

Chapter 2: Review of Literature

This chapter of the present research study segregates the literature into five parts –review on relevance of currency risk management by companies, review on strategies for managing the currency risk (forex) by companies, review on hedging the currency risk, review on the foreign exchange (forex) market and review on the hedge effectiveness and regulation for currency risk management. The chapter commences by providing an overview of the studies conducted in the past with respect to identifying the foreign exchange (forex) risk management practices of companies. This chapter details out the relevance of hedging the foreign exchange (forex) risk, identifies the strategies for hedging this risk and focuses on the hedging of the currency risk through the financial derivatives. The chapter then discusses the literature on the techniques of measuring the efficiency of the risk management and identifies cointegration as the most use technique for this purpose. The literature also highlights the connection between determining the efficiency of forex or currency market and hedging of the foreign exchange (forex) risk by

companies. The literature then moves to discuss hedge effectiveness, methods for evaluation of the same and relevance and importance of measuring hedge effectiveness. The literature also ties up the reasons for evaluating efficiency of the market before choosing a method of evaluating hedge effectiveness.

Chapter 3: Theoretical Framework

This chapter of the present research study builds the theoretical framework on the basis of the literature review done in the previous chapter (chapter 2). This chapter systematically brings out the linkages between the foreign exchange (forex) risk management by companies, the strategies they follow, the need for the evaluation of efficiency of the forex market and the various hedging evaluation methods available in the academic for measuring the effectiveness of the hedge. This chapter then identifies the research problem and gaps and concludes by providing the framework of the study.

Chapter 4: Research Methodology

This chapter of the present research study discusses the research objectives and the research design used for the study. The research design elaborates on the sample size, periods, source of the data, data variables used in the study and model specifications. Further this chapter details the methodological framework for analyzing the objectives of the study. This includes a discussion about the statistical software used and the techniques applied to analyze the data.

Chapter 5: Primary Data Analysis

This chapter of the present research study determines the finding of the first objective of the study by analyzing the interviews conducted with companies to identify their practices for the currency risk management. This chapter brings out necessary details about the hedging practices of Indian companies, the role that the treasurers plays and attempts to understand the practices of Indian companies for evaluating hedge effectiveness.

Chapter 6: Determination of Cointegration between Spot & Forwards and Spot & Futures

This chapter of the present research study determines the finding of the second objective of the study by conducting secondary data analysis. The study first checks for the presence of unit root in the data by using both unit root and stationarity tests. This also fulfills the initial assumption for cointegration test which is further applied on the data. Then this chapter applies the cointegration test to identify long-term relationship between the market variables which could indicate inefficiency. The presence of inefficiencies in the data is confirmed by Vector Error correction model. This approach helps to identify the efficiency of the market.

Chapter 7: Hedge Ratio and Hedge Effectiveness

This chapter of the present research study determines the finding of the third objective of the study by conducting secondary data analysis. The study uses five models for evaluating the ratio and the effectiveness of the hedges assumed by the companies. These five models include three static models – OLS or Ordinary Least Square, VAR or Vector Autoregression Model and VECM or Vector Error Correction Model and two dynamic models – CCC-MGARCH or Constant Conditional Covariance model and DCC-MGARCH Dynamic Conditional Covariance model.

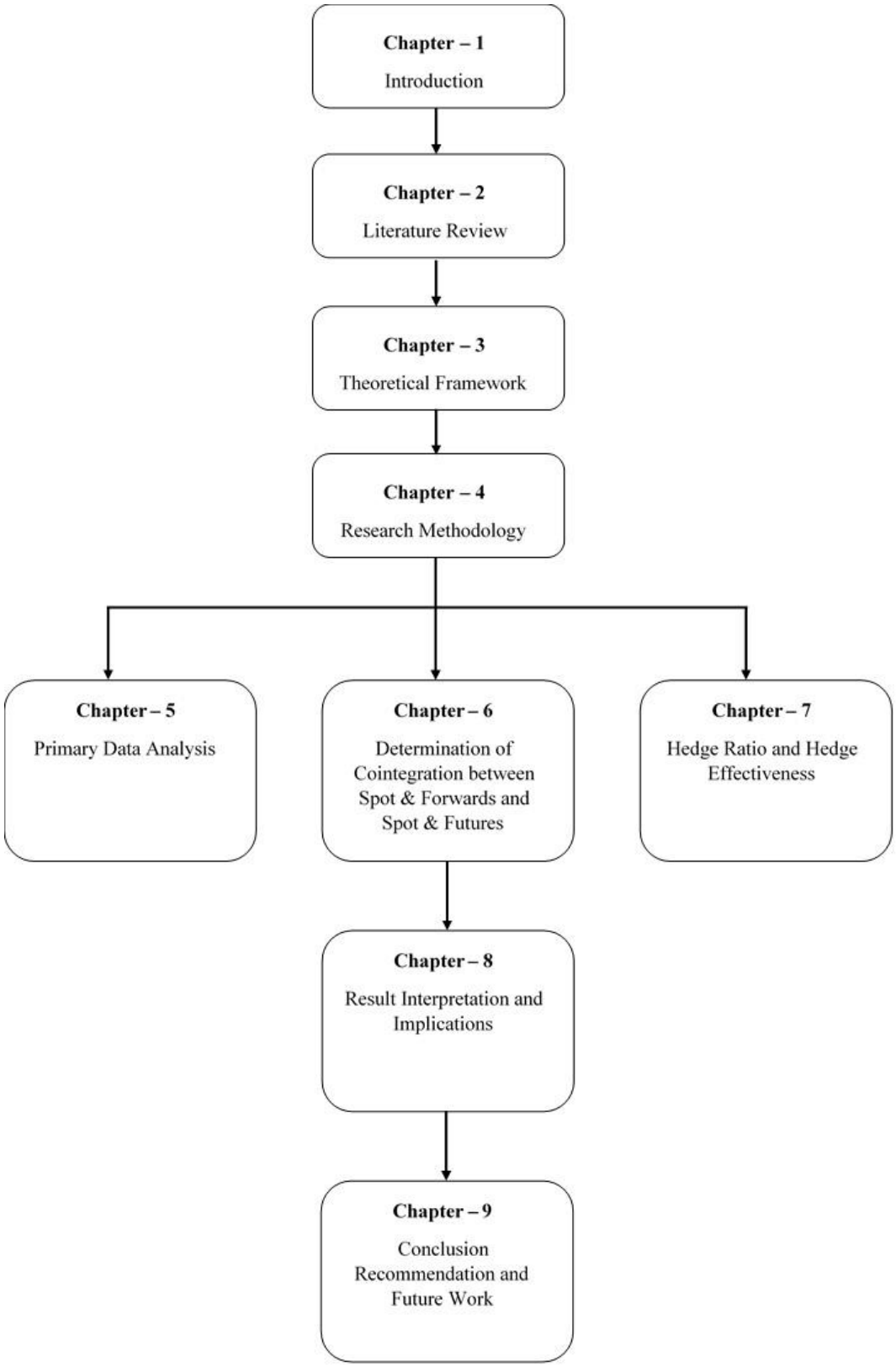
Chapter 8: Result Interpretation and Implication

This chapter of the present research study builds the interpretations of the findings from the analysis conducted in the previous chapters of the thesis. This chapter also addresses the fourth objective of the study by developing a case for an Indian company which hedges the forex or currency risk. This chapter then brings findings and interpretations into implications for the company, treasurers and policy makers. This chapter addresses the question as to why the company should use the hedge effectiveness model to assess hedge ratio and effectiveness and identifies the challenges faced by the companies implementing the new guidelines for risk management through hedging.

Chapter 9: Conclusion Recommendation and Future Work

This chapter of the present research study lists all the conclusion pertaining to each of the objectives of the study. It also highlights the implications of the study from the view of the treasurers, the policy makers and the researchers. It also outlines some recommendations for the treasurers and policy makers so that they can channelize their efforts in effectively hedging the foreign exchange risk. This chapter concludes with the limitations of the present research study and provides the scope to the prospective future researchers.

Fig. 1.4: Structure of Thesis



Chapter 2

CHAPTER – 2: REVIEW OF LITERATURE

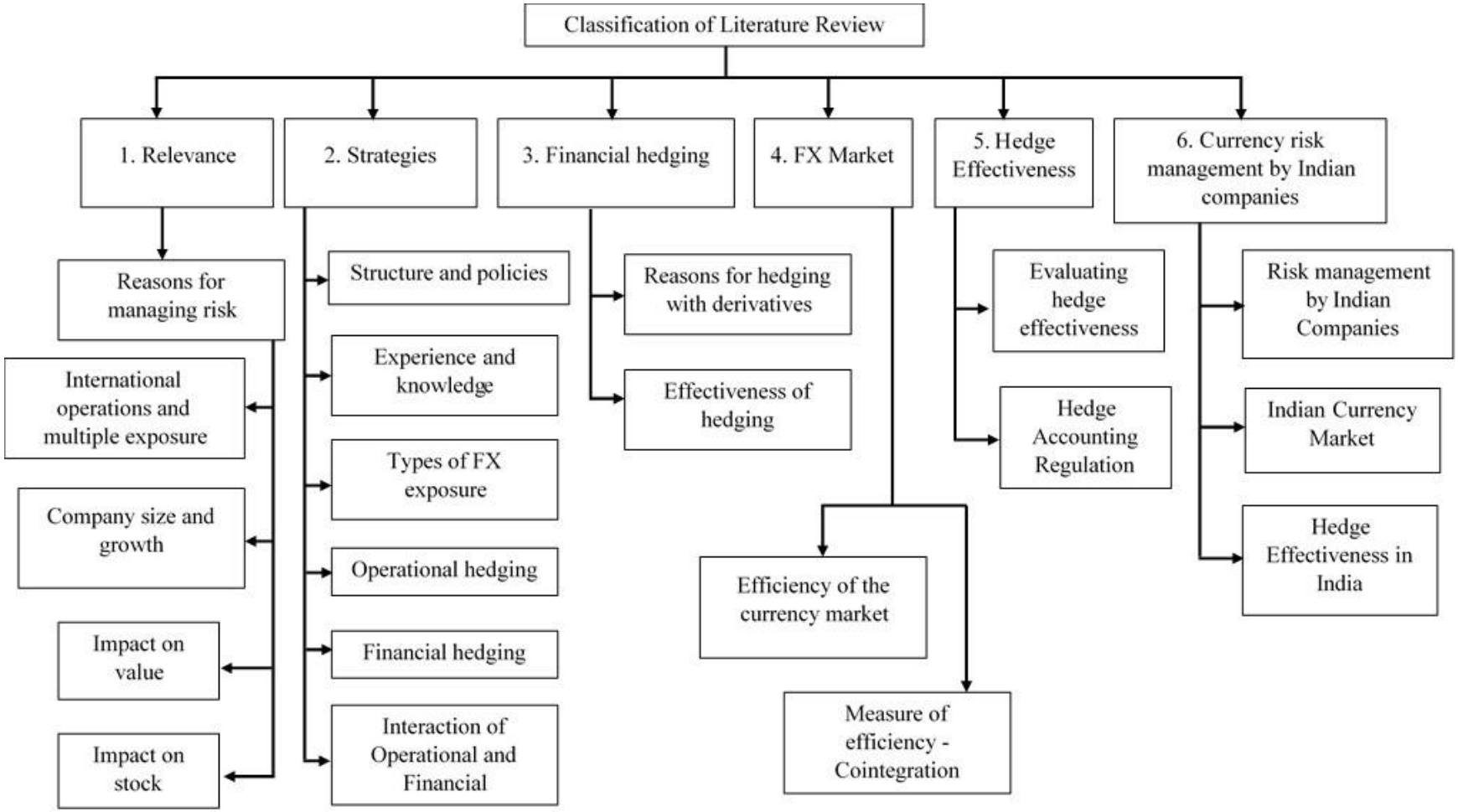
2.1 Introduction

"Exchange rates are a major source of uncertainty for multinationals, being typically four times as volatile as interest rates and ten times as volatile as inflation." (Jorion 1990). Numerous researches in the past have examined currency risk management from different perspective like reasons and benefits of foreign exchange or currency or forex risk management, hedging of this risk by companies. Studies have also been conducted on to examine hedging effectiveness and success of hedging in managing the foreign exchange (forex) risk.

Keeping in view the background of the study, the literature review has been conducted under the following heads:

1. Review or appraisal of the literature on the relevance of foreign exchange or currency risk management by companies.
2. Review or appraisal of the literature on the strategies for managing the foreign exchange or currency risk by companies.
3. Review or appraisal of the literature on hedging the foreign exchange or currency risk.
4. Review of literature on the foreign exchange market.
5. Review of literature on the hedge effectiveness and regulation for currency risk management.

Fig. 2.1: Classification of Literature Review



The detailed discussion of all the above classification of literature, as pointed in Fig. 2.1, is as under:

2.2 Review or appraisal of the literature on the relevance of foreign exchange or currency risk management by companies

Several studies have been conducted which analyze the importance or relevance of the foreign exchange or currency risk management by companies. The topic gained significant attention as early as 1980s when Dufey & Srinivasulu (1983) pointed out that the market imperfections like incomplete information, transaction cost and agency cost make it necessary for the companies to manage this currency risk. Studies later identified that mostly companies with foreign assets and operations in multiple currencies face this risk. Studies further related that the structure or characteristics of the company like the size of the company, policies of the companies, experience and skill of the managers also impact the exchange rate risk faced by the companies. Such studies are discussed in detail in subsequent sections.

2.2.1 Reasons for managing the currency risk

Previous studies have examined various reasons for the management of the currency risk. Researchers like Choi and Prasad (1995), Bodnar and Gentry (1993), Booth and Rotenberg (1990), Williamson (2001), Kiymaz (2003), Bartram (2004), Doidge et al. (2006), Wei and Starks (2013) and El-Masry and Abdel-Salam (2007) investigate the role of international operations of the companies in generating currency exposures. Researchers like Chow et al. (1997), Belk and Edelshain (1997), He and Ng (1998), Pantzalis et al. (2001), Hagelin and Pramborg (2004) and Sirpal (2009) explain that the large companies, operating in multiple geographies, with high growth opportunities are exposed to foreign exchange or currency risk. Researchers like Chow and Chen (1998), Shin and Soenen (1999), Aabo (2001), Chen and So (2002), Choi and Kim (2003), Faff and Marshall (2005) and Fornés and Cardoza (2009) highlight that the foreign exchange (forex) rate movement negatively impact the value of the company. Researchers like Bartov and Bodnar (1994), Khoo (1994), Chiao and Hung (2000), Dewenter et al. (2005), El-Masry (2006),

Muller and Verschoor (2006), Agyei-Ampomah et al. (2013) and Luo and Wang (2018) explains that the stock returns of a company are impacted by the exchange rate movement.

2.1.1.1 International operations and multiple exposure of the company

Literature has given significant importance to the fact that companies with foreign operations like foreign sales, exports and imports and whose income is generated in foreign currency are further exposed to the forex rate movement. The researchers who supported this are Choi and Prasad (1995), Booth & Rotenberg (1990) Jorion (1990), Williamson (2001), Kiymaz (2003), Faff & Marshall (2005). El-Masry & Abdel-Salam (2007) and Jong et al. (2006) also supported that the companies with large international sales and profits are additionally exposed to currency rate fluctuations. Allayannis et al. (2001) further explain that the geographical dispersion of the company does not reduce their exchange rate exposure, instead, it adds to the exchange rate risk. Choi & Kim (2003) findings also confirm this. They examine the US companies after Asian financial crisis to conclude that the management of US companies have heightened their focus on the exposure to Asian companies which confirms that the international operations of a company make it more vulnerable to the negative impact of the foreign exchange (forex) rate fluctuation. El-Masry and Abdel-Salam (2007) conclusion of their research study further contributes to this reason when they state that companies which generate more percentage of the revenue from foreign operations face higher exchange rate exposure. Finally, Hutson & Stevenson (2010) in their study also purport a positive or encouraging relationship between foreign exchange (forex) exposure and openness of trade of the company. Therefore, international operation of the company is one of the significant reasons for currency or forex risk management for the treasurers of the companies.

2.1.1.2 Size and growth of the company

Literature has also given significant importance to the size and growth opportunities of the company. Researchers have found that companies with large size and greater diversification face a magnitude of foreign exchange (forex) risk (Chow et al. 1997, Belk and Edelshain 1997, Chow and Chen 1998, He and Ng 1998, Pantzalis et al. 2001 and Chiao and Hung 2000). Hagelin and Pramborg (2004) also explain that the foreign exchange (forex) exposure of the company increases

with its size. Muller and Verschoor (2006) support this view in their study when they establish that firm size asymmetries are of greater importance for determining a link between stock returns and currency movements. Jong et al. (2006) also contributes to this result when they confirm that the firm size is positively related to the foreign exchange (forex or currency) rate exposure.

2.1.1.3 Impact on the value of the company

Apart from recognizing that international exposure and the large size of the firm or company both contribute to the foreign exchange (forex) rate exposure faced by the company, the researchers further identify that this exposure expressively or significantly impacts the value of the company. Booth and Rotenberg (1990) state that the foreign exchange (forex) rate risk impacts the value of the company or firm even if they do not have any material foreign assets, foreign revenue or foreign debt. Such conclusion is supported by Shin and Soenen (1999), Choi and Prasad (1995), Aabo (2001), Choi and Kim (2003), Doidge et al. (2006), Fornés and Cardoza (2009) and El-Masry et al. (2007). Faff and Marshall (2005) survey data on the goals of US, UK and Asia-pacific MNC's for exposure management and conducts a two-stage experiment which explain that a company have different objectives for managing the exchange rate exposure and all these objectives may impact the value of the company.

2.1.1.4 Impact on the stock return or value of the company

Stock returns refers to the benefit which the common shareholders receive as a result of increase in dividends and increase in price of the share. Researchers has attempted to analyze the influence of the foreign exchange (currency) rate on the stock return or value of the companies. Researchers like Bartov and Bodnar (1994), Shin and Soenen (1999), Chiao and Hung (2000), Chen and So (2002) and Doukas et al. (2003) conducts their studies on different geographies and identifies that the stock returns or value of the companies or firms are affected by the exchange rate movements. They however, explain that these stock prices do not fully reflect the currency rate changes on a timely basis. El-Masry (2006) conducts their study on UK non-financial companies and find stronger evidence of association between firm's stock return and exchange rate (currency) changes. Wei and Starks (2013) examines financially distressed companies in US

and concludes that stock prices of financially distressed firms are sensitive to exchange rate movements.

The research papers discussed above have conducted these studies across various geographies and many non-financial companies. They explain and justify various ways in which the exchange rate fluctuations impact the company. The treasurers of the companies should be considerate of these reasons and should strategize and take necessary steps to contain this risk. The next section discusses existing literature of strategies for managing the foreign exchange or currency risk.

2.3 Review or appraisal of the literature on the strategies for managing the foreign exchange or currency risk by companies

Tai et al. (2018) points out that the board of directors and especially, the audit committee, play an important role in monitoring the company's hedging decisions for risk management. Along with this, experience, knowledge and skills of the managers also play a crucial part in the successful implementation of the currency risk mitigation or management strategies. It is, therefore, important for the companies to lay down a well invested strategy for currency (forex) risk management. Since the currency risk impacts the value, stock returns, cash flow and the profitability of the firm or company, the treasurers of the firm or company must ensure that their strategy for containing the foreign exchange (forex) risk is allied with the mission, goals, objective and structure of the company. Since, the currency risk is more for companies with diversified business operations in various countries, the treasurers could either follow a centralized or a decentralized risk management policy. Researchers like Stanley and Block (1980), Collier and Davis (1985), Chow and Chen (1998), He and Ng (1998), Williamson (2001), Belk (2002) and Bartram and Bodnar (2007) examine the overall structure, policy and objectives of the company to identify an appropriate foreign exchange (forex) risk management strategy. It must also be highlighted that the experience, skills and knowledge of the manager formulating and executing the policy for the management of the exchange rate exposure is also imperative.

Researchers like Collier and Davis (1985), Collier et al. (1992), Belk and Edelshain (1997), Bradley and Moles (2001), Faff and Marshall (2005), Hu and Wang (2006) examine the role of the managers in the foreign exchange or currency or forex risk management. To plan a systematic foreign exchange (forex) risk management strategy, it becomes important to understand the theoretical aspects of currency risk related to the categorization of the different types of risk, different financial and operational strategies for managing the risk and the interaction between these strategies. Researchers like Duangploy et al. (1997), Belk and Edelshain (1997), Miller and Reuer (1998), Chowdhry and Howe (1999), Marshall (2000), Glaum (2000), Allayannis and Ofek (2001), Keloharju and Niskanen (2001), Bartram et al. (2005), Kim et al. (2006), Davies et al. (2006), Clark and Judge (2009) and Chong et al. (2014) study different categorization of the foreign exchange (forex) risk and identified the category which is extensively managed. They further examine the role of the financial and operational hedging strategies in handling the currency or foreign exchange exposures.

2.3.1 Structure and policies of the company

Over the years the treasury management has become more sophisticated and the currency risk management has largely become the preserve of treasury (Belk 2002). Largely, currency or forex risk management is the function of the finance department. But many researchers have argued and questioned if it is appropriate for only finance to handle this territory. Researchers have pointed out that the top management should shoulder more responsibility and other functional areas like marketing and production should also be involved. Fornés and Cardoza (2009) agree there should be coordination among different functional areas in a company to successfully strategize and manage the forex risk. Aabo (2001) points out that foreign exchange risk management policy depends upon structured setting of the companies. This also includes the perspective of these companies towards risk. If the companies are risk averse and consider risk management to be an important activity, they should take immediate action to prevent the risk. These companies should also be prepared to handle risky situations which might arise in the future. Majority of the researchers agree that the companies in general are risk averse (Belk 2002, Aabo 2001, Davies et al. 2006).

2.3.2 Experience, skills, knowledge, and ability of the managers

Collier and Davis (1985) points out that in the case of large exchange rate exposures, it became the responsibility of the finance director to handle the foreign exchange or currency exposure whereas in case of small exposures, this responsibility falls on the shoulders of treasurers of the company. These treasurers, then manage the currency exposure to the best of their ability. Collier et al. (1992) examine the role of managers and draw comparison between US companies and UK companies. They find that US companies allow managers discretion till certain limit to manage the currency exposure while the UK companies follow the already established strategy closely. All in all, the managers and executives of the company have a challenging role to formulate comprehensive risk management guidelines and to executive these guidelines appropriately. This further indicates that the effectiveness of the foreign exchange (forex) risk management could be improved if the managers better understand the exposure and its effect on the organization. This would also help the managers in adopting better techniques for risk management (Belk and Edelshain 1997).

Therefore, managers knowledge, skill and ability are an important consideration for effective currency or forex risk management. In addition to the awareness about company policy, structure and objectives, the managers should be knowledgeable about the structure of the foreign exchange or currency market, the types of exchange rate exposure and different ways to handle it. The companies must also be considerate of the compensation which it offers to these treasurers (Hu & Wang 2006). Tai et al. (2018) points out that the board of directors and especially, the audit committee, play an important role in monitoring the company's hedging decisions for risk management. Along with this, experience, knowledge and skills of the managers also play a crucial part in the successful implementation of the currency risk management strategies. But this in no way undermines the role of the policy makers for enabling the currency risk management by the corporate treasurers. Policy makers facilitate corporate hedging by creating strategies for the expansion and development of the currency derivatives markets (Bartram 2017).

2.3.3 Categories of foreign exchange or forex exposure

There are three categories in which the foreign exchange or forex or currency exposure could be classified – transaction exposure, translation exposure and economic exposure. Transaction exposure is short-term and nominal in nature and arises because of contractual obligations (Aabo 2001). Translation exposure arises when the financial statements of the company are consolidated and converted into domestic currency and therefore, is just an accounting exposure. Economic exposure arises because of future foreign exchange rate fluctuations (Miller and Reuer 1998). Studies conducted across different geographies have attempted to identify most important exposure which the companies focus on. Majority of these research identify that most companies place more importance on transaction exposure and take measures to manage it (Collier et al. 1992, Duangploy 1997, Belk and Edelshain 1997, Chowdhry and Howe 1999 Marshall 2000, Glaum 2000, Aabo 2001). This is because transaction exposure impacts the profits of the company directly. The research further clarify that the companies do not pay much attention on translation exposure since it is only an accounting exposure and not a real exposure which impacts any profits.

Theory has emphasized economic exposure to be a significant aspect of the forex risk management. But the literature has identified that companies find this exposure as complicated and therefore, refrain from managing it. Bradley and Moles (2001) provides the clarification that companies find it complex to classify economic exposure as it requires the use of sophisticated evaluation techniques. Belk and Edelshain (1997) specify that only large firms manage the economic exposure as it is costly to manage. Bartram et al. (2005) however mentions that even though the economic exposure is complicated and complex to manage, but companies with long-term forward-looking perspective should make efforts to tackle it. There are various methods through which the company can manage the currency risk. One of the leading mechanisms for managing this risk is hedging the currency risk. The treasurers of the company could devise operational hedging strategies and financial hedging strategies and plans for treating the foreign exchange (forex) risk.

2.3.4 Operational or Internal hedging strategies

Operational hedging strategies involve internal operational adjustments which the company makes to manage the foreign exchange exposure. These include leading a payment or lagging a payment, invoicing in domestic currency, netting off receipts during business transactions etc. Since these strategies involve internal adjustments, these are also called as internal hedging strategies. Literature offers divided opinion whether these strategies help in containing the exposure. Researchers like Miller and Reuer (1998), Keloharju and Niskanen (2001), Hagelin and Pramborg (2004) and Sirpal (2009) agree that not all the companies prefer using internal hedging strategies. Companies with large scale business operations and large geographical presence prefer using these strategies. Further researchers also state that these methods only help in containing a portion of foreign exchange rate exposure and not necessarily result in reducing this exposure. Therefore, the treasurers should not just rely on these methods but also consider financial hedging for handling the risk.

2.3.5 Financial or external hedging strategies

Financial hedging involves the use of financial derivatives like forwards contracts, futures contracts, options contracts and swaps contracts for covering the exchange rate exposures. This is why the financial hedging strategy is also called as external hedging strategy. Marshall (2000) explains that multinational companies use large number of external instruments and exchange traded instruments for managing the forex risk. Researchers like Stanley and Block (1980), Duangploy (1997), Belk and Edelshain (1997), Chowdhry and Howe (1999), Nguyen and Faff (2003), Davies et al. (2006), Clark and Judge (2009), Kim et al. (2006) and Zhou and Wang (2013) explain that companies prefer using derivatives for managing the short-term foreign exchange rate exposure. These researchers also identify forwards to be the most popular instrument for hedging the short-term risk. He and Ng (1998) explain that multinational large companies prefer derivatives for hedging the risk as these companies have stricter and tighter financial constraints.

2.3.6 Interaction of Operational and Financial strategies

There are many factors which help a company in determining the hedging strategy for currency risk management. Brown (2001) elaborates that the hedging strategy of the company depends upon various factor like exposure volatility, forex volatility, different technical factors and current hedging outcomes. Although the operational and financial hedging strategies are diverse but literature also points out that these strategies are complementary to each other and companies also use both of these together to manage and accommodate the foreign exchange (forex) risk. Researchers like Allayannis and Ofek (2001), Kim et al. (2006), Dewenter et al. (2005), Bartram et al. (2005), El-Masry et al. (2007), Faseruk and Mishra (2008), Bartram & Bodnar (2007) and Fornés and Cardoza (2009) support this view and point out these strategies are complementary and harmonizing and work together to lessen the forex or currency exposure. As both these strategies work well together, the firms, therefore, use of the operational or internal hedges in combination with the financial or external hedges. Together these also improve and benefit the value of the firm. Davies et al. (2006) however notes that companies prefer financial hedging over operational hedging.

The treasures of the companies have varied ways of managing the currency exposure. The popular strategy for containing the exposure is hedging the risk. The treasurers can choose either operational hedging strategies or financial hedging strategies. They can also use these together to manage the risk. The choice of the strategy for risk management depends upon different factors like structure of the company, knowledge and skill of the managers, policies of the companies and long-term vision of the company.

2.4 Review of literature on financial or external hedging

The literature has clarified that financial hedging the forex or currency risk is the popular mechanism for managing it. It involves use of different derivative tools available on the Over-the-Counter (OTC) and exchange market like BSE, NSE. The treasures identify the derivative tool and use it to cover their exposure. Researchers like Géczy et al. (1997), Shin and Soenen (1999), Glaum (2000), Allayannis and Weston (2001), Allayannis and Ofek (2001), Brown (2001), Hagelin

(2003), El-Masry et al. (2007), Faseruk and Mishra (2008), Clark and Judge (2009) and Afza and Alam (2011) have explained various reasons behind companies hedging with derivatives for risk management.

2.4.1 Reasons for hedging with derivatives

Géczy et al. (1997) explains that the companies with low or little approach to internal and external methods of financing and higher growth opportunities were most likely to use currency derivatives to reduce currency exposure. Research study by El-Masry et al. (2007) supports this reason. They point out that companies with low liquidity, high leverage and growth opportunities have more encouragement to hedge their foreign exchange (forex) rate exposure. Faseruk and Mishra (2008) study Canadian companies with an exposure to the US dollar and explain that the companies with higher level of US sales use derivatives more often. Many researchers also claim that the large companies use derivatives for risk management because it enhances the value of these companies (Shin and Soenen 1999, Hagelin 2003 and Afza and Alam 2011). There are thus various reasons with the companies for using derivatives for risk management. It is the responsibility for the treasurers to take a derivative position for mitigating the risk. These treasurers must also ensure that the hedging through derivative has actually helped in tackling the currency exposure. This can be understood well once the treasurers evaluate the effectiveness of the hedges undertaken for risk mitigation.

2.4.2 Effectiveness of Hedging

A hedge is called effective when it is successful in reducing the currency risk (Hagelin and Pramborg 2004). This effect of reduction in risk through currency or forex derivatives provides a clear indication that the hedging is successful and is therefore effective. Belk and Edelshain (1997) explain that the hedging effectiveness for the company is directly related to the hedging effort of the company. This implies that if the managers take an appropriate decision and choose the correct hedging instrument with correct duration and put in significant effort to understand the currency market, then this hedging would result in lowering the risk and therefore, it would be effective. There are very few studies which examine the effectiveness of the hedges undertaken by the

companies. One such study is led by Nguyen and Faff (2003) which examines the hedging effectiveness of the Australian companies. The study finds that the Australian companies effectively hedge the short-term foreign exchange (forex) exposures but were not capable in hedging the long-term foreign exchange (forex) exposure.

It is clear that the manager is responsible for formulating hedging strategy and ensuring that the hedging is effective. This implies that the treasury manager must be skillful, able and knowledgeable. In order to strategize better and employ effective hedging policy, the treasurer must develop an understanding of the financial market that he operates in.

2.5 Review or appraisal of literature on the foreign exchange market

Management of foreign exchange or forex or currency risk deals with managing any untoward movement in the currency prices and the exchange rate. It gained significance as early as 1980s with Dufey and Srinivasulu (1983) pointing out that the market imperfections like incomplete information, transaction cost and agency cost make it necessary for the companies and firms to take steps in managing this exposure. The study uses the CAPM model, MM theorem and market efficiency arguments to explain the currency risk management by the companies. They emphasize that a company could use the CAPM model to bundle together the various risk it faces and pass it along to the capital market. As per the MM approach, hedging by companies could be substituted with hedging by investor which enables the exposure to be managed by anybody. Elucidating the market efficiency argument, their study further explained that if the markets are efficient, then the companies need not to manage the currency risk. Thus, the decision to hedge or not depends upon the market structure and efficiency of the market. Another reason for studying efficiency is explained by da-Hsiang in their study conducted in 1996. This study clarifies that a hedger who chooses the hedge to minimize the overall risk should consider the cointegration between the different variables of the market. This is so because ignoring this cointegration, which also reflects the inefficiency of the market, would result in selecting a non-optimal derivatives position for hedging. The study explained that such a hedger would choose a lower position than optimal. Therefore, it is necessary for the treasurer and the company to study the currency market.

2.5.1 Efficiency of the currency market

Theory that share prices follow a random walk was floated in 1900 by Louis Bachelier in his thesis. Few studies on the US stock market conducted in 1930s and 1940s indicates that the prices follow a random walk and investors would not earn excess return when in comparison with the market return (Cowles 1944). The interest in the field of testing market efficiency is renewed in 1960's with the efforts of Paul Samuelson after he publishes the theory which generalizes that prices followed random walk in 1965. This concept is further developed by Fama (1970). After the flexible exchange rates are introduced in 1970s, the theory of random walk gains significance in the currency or forex exchange rates also. Earlier studies are not able to refuse the efficient market hypothesis in the exchange rate market. Later on, studies take this notion forward to study the price relationships and profit opportunities present in these relationships between the market variables. One prominent study is conducted by Levich (1989) where he examines various theories of different researchers on efficiency of foreign exchange or currency market. Earlier studies on efficiency of exchange rate market are conducted on the forward markets and spot market currency market. Economist often argue that there could be one to one interaction between derivative and spot markets (Paul and Kimata 2016). Different researchers, over time, have studied these varied interactions of these markets.

Geweke and Feige (1979) study the forward market in seven different currencies and find the markets to be inefficient. Frenkel and Mussa (1980) use different test and time periods for the spot and forward market but could not reach a unanimous consensus about the efficiency hypothesis. Hakkio (1980) finds that forward exchange rates provide an optimal forecast for the future spot exchange rate for five different currencies and thus indicate market inefficiency. Baillie et al. (1983) use regression analysis on the forward and the spot data and find that the forward market rate is a biased or prejudice predictor of spot market rate. Since forwards are over-the-counter traded instruments which are not regulated by an exchange and are outside the direct jurisdiction of the policy makers, there was a need for an instrument which the policy makers could directly control. Therefore, the currency futures were launched in 1972. These are exchange traded instrument which bring transparency into the system. After their launch, various researchers shifted focus on assessing the efficiency of the futures market also. Nieto et al. (1998), Kenourgios

(2004), Noman and Ahmed (2008), Mehrara and Oryoie (2012), Makovský (2014), Akbar (2016) and Paul and Kimata (2016) are few of the studies conducted to assess the efficiency of the forex or currency futures market in many countries.

Ghosh (1993) examined the forex futures market for S&P 500 index and establishes a long-term association between the futures and spot prices thus, finding the market to be inefficient. Kenourgios (2004) finds bi-directional causality between spot and derivative (futures) stock index markets in Athens. Giannellis and Papadopoulos (2009) finds the Poland/Euro forex market to be efficient, the Czech/Euro market to be inefficient and the Slovak/Euro market to be quasi-efficient. Mehrara and Oryoie (2012) examine the efficiency of the forex market after the 2007-08 financial crisis. Their BDS independence test rejects efficient markets hypothesis after the crisis. Similar such studies are conducted in the different emerging markets by various researchers like Wickremasinghe (2004), Noman and Ahmed (2008), Bashir et al. (2014) Ahmed (2015), Akbar (2016) and Paul and Kimata (2016).

2.5.2 Measure of efficiency – Cointegration

Cointegration is extensively utilized by multiple researchers to find out the efficiency of market, discover the prices in the market and recognize the lead-lag connection between different variables of a financial market. This concept is introduced in the year 1982 by Granger and since then researchers have used this concept to identify one to one correspondence and establish long-term equilibrium between the market variable. Kellard (2006) also confirms the robustness of cointegration test for investigating the market efficiency. He concludes that the Johansen cointegration test as more robust for measuring market efficiency and recommends it to be favored by researchers over the other test. Ghosh (1993) uses cointegration on the S&P 500 index (India) and identifies a long-term relationship between the market variables – spot and futures prices. Thus, pointing out inefficiency of the market. Nieto et al. (1998) conducts the study in the Spanish stock exchange using cointegration and causality (granger) method and finds that the prices in derivative (future) market cause prices in spot market. Wickremasinghe (2004) studies the Sri Lanka forex market and finds the market to be semi – strong efficient. Kühl (2007) finds the market

to be efficient after the introduction of Euro and Noman and Ahmed (2008) find the forex market of seven SAARC countries to be efficient.

Iwatsubo and Kitamura (2008) studies the Japanese market to investigate the informational efficiency and finds that the volume of the financial market positively affects the efficiency of foreign exchange market. Moore and Payne (2011) identifies that large floor traders have larger impact on the market. They further claim that information spillovers between market variables imply inefficiency. Makovský (2014) finds the central European forex market to be efficient. Bashir et al. (2014) conducts the study for Pakistan's forex market and indicates inefficiency in the forex market. Ahmed (2015) uses regression to investigate foreign exchange market efficiency in Pakistan to find that the market is inefficient. Sehgal et al. (2015) study the currency market, the commodity market and the stock market to examine the volatility spillover and price discovery. They find that futures play a significant role in the discovery of price and volatility spill-overs. Akbar (2016) conducts the efficiency study on Nigerian market and finds the it to be inefficient (semi-strong form).

Paul and Kimata (2016) examine the Indian market for price discovery, informational linkage and efficiency and finds the bi-directional causality and the markets to be inefficient. Kitamura (2017) conducts his study on the Japanese forex market. He finds that market efficiency is enhanced because of high liquidity in the market which further enhances the price discovery. Nath and Pacheco (2017) studies the currency futures and spot market and finds volatility spillovers. They examine if futures predict the spot price using GARCH which identifies the market as inefficient. Kumar et al. (2017) examines if the introduction of futures (currency) contracts lead to reduction in volatility. The results find no reduction in the volatility in the Indian forex market. They further find the market to be inefficient since the results also depict causality between the market variables.

The research papers discussed above singularly examine forex market efficiency. This market efficiency is also linked with the kind of tests chosen for computing hedging effectiveness. da-Hsiang (1996) explains that ignoring cointegration results in choosing a non-optimal hedging position. Such a hedger ends up choosing a lower than optimal derivatives position for hedging

the currency risk. Further, identifying the cointegration between two different markets like derivatives and spot, helps in choosing an appropriate model for evaluating the effectiveness of the hedges thus constructed for risk management. Therefore, it becomes necessary to conduct the cointegration test before choosing a statistical technique for evaluating hedging effectiveness.

2.6 Review or appraisal of literature on the hedge effectiveness

Hedge effectiveness is a longstanding concept which is initially researched by Markowitz (1959). He provides the mean variance framework in his portfolio theory which helps in the development of advanced methods for hedge effectiveness. Over the years, the literature has provided different statistical approaches for evaluating hedge effectiveness. The regulatory body and the policy makers have also grasped and understood the need of measuring hedge effectiveness. Therefore, they have updated the accounting guidelines for the companies. These new accounting guidelines, IFRS 9, have made the evaluation of hedge effectiveness compulsory for the companies. The guidelines, however, are flexible and allow the company to choose a suitable method of evaluation based on their policies and risk management approach.

2.6.1 Evaluating hedge effectiveness

The mean variance concept of Markowitz (1959) is taken forward by researchers Johnson (1960) and then, Stein (1961). Both these econometricians define risk as a variance or change in expected returns or cash flows. The hedge effectiveness is therefore, a measure of reduction in this variance. Following these works, Ederington (1979) developed OLS model for hedge effectiveness where he defines that hedging would reduce the variance in the cash portfolio. These earlier studies in the literature calculate hedge ratios on the ideologies of portfolio theory. The principle of the theory defined hedge effectiveness as a ratio that minimized the variation in the price changes of hedged portfolio (Kavussanos & Nomikos 2000). Hedging effectiveness is also defined in terms of risk and return (Howard and D'Antonio 1984). Their empirical study indicate that hedging effectiveness depend heavily on the risk-return component. This approach faces criticism when Chang and Shanker (1987) points out the error in the equation provided by Howard and D'Antonio leading inconsistent results. In turn, the solutions offered by Chang and Shanker were criticized

by Howard and D'Antonio. Out of the above two approaches for measuring hedging effectiveness, risk minimizing measure is more popular and used by many authors in their studies for measuring hedging effectiveness Yang and Allen (2005), Casillo (2004), Choudhry (2004), Ku et al. (2007), Rao and Thakur (2008), Bhaduri and Durai (2008), Czekierda and Zhang (2010), Yang and Pavlov (2011), Betancourt and Al Azzawi (2013) and Jampala et al. (2015).

Ordinary Least Square (OLS) method is considered as the conventional method for measuring the hedging effectiveness. This approach has also faced criticism from researchers over the years. Park and Bera (1987) investigate the validity of conventional OLS regression model and find that the model did not consider conditional and unconditional heteroscedasticities. They further mention that ARCH model provides better results. Herbst et al. (1993) mention that the model ignores the convergence of futures or a derivative and spot prices in the future. Lien et al. (2002) mentions that the conventional OLS approach ignores time-varying conditional heteroscedasticity by assuming the second moments of the errors of data series to be constant hence static. The advanced models however, resolve this issue.

The ARCH method – Auto-Regressive Conditionally Heteroscedastic provided by Engle (1982) and a further advanced method the GARCH – Generalized ARCH provided by Bollerslev (1986) are time-varying as they identify the variances of returns of the series to be time-varying and hence dynamic (Brooks and Chong 2001). The researchers therefore, shift their focus on the more appropriate methods for measuring effectiveness. These methods consider cointegration of the data series and heteroscedasticity of the residuals and are called time-varying or dynamic methods of measuring hedge effectiveness. Brooks and Chong (2001) mention that ARCH model by Engle (1982) and GARCH model by Bollerslev (1986) recognize that time-varying return of the expected variances and are known as dynamic models. Many researchers compare the static and dynamic methods for measuring hedge effectiveness.

Kroner and Sultan (1993) appreciates a dynamic hedging strategy involving GARCH error structure since it considers cointegration between the market variables and is able to handle the dynamic nature of the time series distribution. Bos and Gould (2007) examine advanced GARCH techniques and find these as finest models for providing lower hedge ratio variance. Kumar et al.

(2008) find that highest variance reduction is provided by the dynamic model of VAR-MGARCH rather than static model of OLS, VAR, and VECM. Lien et al. (2002) compare OLS and VGARCH model and find OLS model better. Yang and Allen (2005) compare four models, three static model – OLS, VAR, VECM; one dynamic model diagonal-vec GARCH. They find dynamic model to perform better than the static models. Casillo (2004) draws a comparison of the static and dynamic model – OLS, VAR and GARCH and finds hedge ratio of dynamic models outperforms the static model. Choudhry (2004) compares OLS with GARCH and finds the latter to be better. Ku et al. (2007) conducts their study in the currency futures market of Japan using DCC-MGARCH, OLS and ECM model. They find that dynamic model outperforms the static models. Kenourgios et al. (2008) calculated hedge effectiveness for S&P 500 index futures by employing OLS, ECM and EGARCH method and find ECM to be the appropriate method for estimating optimal hedge ratios.

Rao and Thakur (2008) conduct their study on the Indian equity market by comparing HKM methodology with JSE methodology. They find HKM method to be better. Yang and Pavlov (2011) compare OLS, VAR, VECM with VAR-MGARCH and find VAR-MGARCH to be better. Czekierda & Zhang (2010) examine bivariate GARCH, OLS and naïve hedging strategy and find that the bivariate GARCH failed to outperform static models. Pradhan (2011) conducts their study on the Indian index futures via OLS, VAR, VECM, VAR-GARCH and VEC-GARCH model. He finds VEC-GARCH to be better. Betancourt and Al Azzawi (2013) compare dynamic models with the traditional OLS hedge ratio and naïve hedge ratio and do not find any significant difference in the performance of dynamic model of hedge effectiveness. Lingareddy (2013) compare Indian futures and forwards market for hedge effectiveness using OLS model and find forward market to be more effective. Jampala et al. (2015) conducts their study on the commodity future market in India using static and dynamic models. They find ARCH model better. Chang et al. (2013) compare dynamic models – CCC, VARMA-AGARCH, DCC and BEKK and found first two models with better results.

Overall, the literature has identified dynamic models to perform better in evaluating hedge effectiveness. The treasures of the company therefore must utilize these methods for evaluating effectiveness.

2.6.2 Regulation on hedge accounting

Policy makers facilitate corporate hedging by identifying and implementing strategies for development of the forex derivatives markets (Bartram 2017). Rising need for hedging has also increased the importance for hedge accounting. International Accounting Standard Board (IASB), formed in 2001, issued IFRS – International Financial Reporting Standards for common public interest units all over the world. Another prominent international accounting board is FASB – Financial Accounting Standards Board which formulates GAAP – Generally Accepted Accounting Principles. The main objective behind creating IFRS is to make company accounts understandable and comparable across international boundaries. Since, international cooperation and comparability is necessary for saving public interest and protecting investors, FASB also contributed in the creation of IFRS. In November 2013, IASB introduced new version of IFRS 9, which specifically deals with hedge accounting. These guidelines are adopted by over 100 countries including India.

The new improved international accounting guidelines, IFRS 9 make it compulsory for the firms to examine the effectiveness of the hedging position taken for risk management. These are an improvement over the previous guidelines, IAS 39 as these have eased out hedge effectiveness testing for the companies (Deloitte 2017). These guidelines have widened the range of situations where one can hedge, have opened more choices for the treasurers for hedging, are more practical and less strict in terms of applying hedging effectiveness (PwC 2017). Earlier, only the hedges which met the 80-125% effectiveness criteria could be recorded but these new guidelines have widened that scope and allow hedges with lower effectiveness to be recorded too. Another change is that these guidelines have made it compulsory for the companies to examine and report the effectiveness of all of their hedges in order to avoid any unforeseen surprises in the financial market. There is also flexibility in the choice of the quantitative method for evaluating hedge effectiveness. The treasurers of the companies are free to choose the method which suits their risk management policy. Following suit, Indian policy makers also updated their accounting guidelines and introduced Ind-AS.

Initially when the businesses were more domestic, a local GAAP was sufficient to report business financials. But today for globalized businesses, Ind-AS serve the dutiful purpose of consistent accounting standards throughout the world which facilitate comparability. There are many changes which these new guidelines have brought like focus on substance-driven accounting which clearly reflects underlying business rationale, fair value driven accounting and high quality and transparent accounting (PwC 2015).

2.7 Review or appraisal of literature on foreign exchange (forex) risk management by Indian companies

2.7.1 Foreign Exchange (Forex) Risk Management by Indian Companies

The early 1990s are a significant period of growth for India. This was the time when the policies of liberalization, privatization and globalization were adopted. These policy changes increased the reach of the Indian economy and brought tremendous changes in the financial markets which lead to further growth and development. With time, this growth and development helped the Indian companies to reach out the global markets. These changes in the world, highlight the significance of the foreign exchange (forex) risk management by companies. Different researchers have studied the foreign exchange (forex) risk management by Indian companies. The earlier studies describe the practices of currency or forex risk management by Indian companies focusing on alternatives available for the management, techniques and methods for hedging the currency risk. Singh (1998) describes the currency risk management practices of Indian companies and finds that the companies do not have any forecasting model and no certain mechanism of evaluating or examining effectiveness of hedges. Debasish (2008) finds that Indian companies favor forward currency contracts for managing the currency risk and Value-at-Risk method for the evaluation of the risk.

Sivakumar and Sarkar (2008) conduct a descriptive study and analyze the alternatives for managing the currency risk. It is found that companies hedge for short-term using forwards and options contracts while for long-term using swaps. Maniar (2010) studies the hedging instruments used by Indian firms and conclude that forward contracts are preferred for short term hedging.

Sivarajadhanavel and Ch (2012) find that the exchange rate fluctuations impact the corporate profits for the IT companies. They suggest that this risk can be managed by the firms by systematically adopting hedging mechanism. Jain (2013) points out that the Indian companies started using derivatives for managing the risk of exchange fluctuations because of increased volatility and global exposure of Indian companies. Raghavendra and Velmurugan (2014) find the forex risk as the most significant risk accomplished by the Indian IT firms.

Pandey (2014) mentions that Indian firms today are more exposed to the currency risk and use both over-the-counter and exchange traded derivative instruments for risk management. Singhraul and Bal (2014) study the hedging practices of Indian IT companies with diverse trade links and point out that in the rising global challenges, the companies should prepare risk management policies and framework for facing future challenges. Mittal et al. (2015) conduct their study on selected Indian companies and find forwards and futures to be widely used contracts for mitigating the currency risk. Malik (2016) concludes hedging and invoicing to be complementary strategies for forex risk management. He further adds that diversification of the Indian companies neutralized long-term exposure from currency exchange rate movements. Dalvadi and Warrier (2017) find that the IT firms in India prefer forward contracts to manage the currency risk and use value at risk approach along with actuarial model and scenario analysis for measuring the risk. Sahu and Sahoo (2017) identify a rise in the use of derivative for risk management by Indian companies. Bhagawan and Jijo Lukose (2017) point out that size, leverage and foreign exposure of the firm determine the decision for hedging the currency risk by the firms.

2.7.2 The Indian currency market

The annihilation of trade barriers and liberalization of the emerging economies has integrated the world and companies today, as a result, are operating in several countries and dealing with multiple currencies. The financial markets have also undergone tremendous changes in the last decade. The Indian currency market has undergone many changes in the past years. Initially, only forward instruments were available to the market participants for derivative trading which were traded over-the-counter with less control of the market regulators. Futures, which are traded on the exchange, were introduced in August 2008 in US dollar currency to bring more transparency

and fairness into the system. Since then these have been expanded to include other currencies like GBP, EURO and JPY. Different variation of futures contracts like cross-currency contracts were also introduced in 2015 to deepen the market further and provide more variety to the market players. Over the years, RBI has also reduced its intervention in the foreign exchange (forex) or currency market. With such changes in the Indian forex or currency market, it becomes imperative to study this market.

Different studies have been conducted to comprehend operations of Indian currency market. Studies on the regulation and structure of the Indian currency market find it to be well regulated in comparison to the foreign markets (Arora & Rathinam 2011). Studies examining the volatility spillovers between the market variables like spot, futures and forwards find the market to be volatile and sensitive to internal and external changes (Behera 2011 and Kotai 2013). Many studies are conducted which examine the role of futures and forwards in the development of Indian currency market and examine the efficiency by studying the information flows between these different market variables like Pallavi E.V.P.A.S. (2015), Sasikumar (2011), Sehgal et al. (2015), Nath and Pacheco (2017) and Kumar et al. (2017). They find that forwards and futures are a useful tool in managing the currency risk by the companies and find volatility spill-overs between currency (forex) derivative and currency (forex) spot market. This is also an indication of the inefficiency of the market.

2.7.3 Hedge Effectiveness in India

Prominent studies on evaluation of hedge effectiveness in India include Rao and Thakur (2008) who examine the optimal hedge ratio in the exchange traded derivative (futures and options) market in India for the equity holders. They compared HKM methodology with JSE methodology for the futures (equity) and FBM with Black-Scholes model for options (equity) market. They find the HKM method and fBM provide good estimates for optimal hedge ratio. Kumar et al. (2008) examined dynamic (VAR-MGARCH) and static (OLS, VAR, and VECM) hedge ratios. They find that the dynamic hedge ratio provided highest variance reduction. Bhaduri and Durai (2008) compare OLS, VAR, VECM and multivariate GARCH and find dynamic models (GARCH) to work well for longer time horizons.

Pradhan (2011) compares OLS, VAR, VECM and VAR-GARCH and VEC-GARCH model for estimating optimal hedge ratio in the index futures market in India and finds that the VEC-GARCH model as better. Lingareddy (2013) compares hedging effectiveness of Indian futures and forwards contracts in the currency market using OLS model and finds futures market with lower effectiveness. Jampala et al. (2015) compare OLS, VAR and ARCH methods for Indian commodities futures market and found ARCH (dynamic) method to be better. These studies of various Indian researchers discussed above are based on probing the hedge effectiveness for either equity markets or the commodity markets. The Indian foreign exchange (forex) or currency markets are still unexplored in this regard. Additionally, these studies by Indian researchers inspect the static and dynamic models for effectiveness. The literature has identified major issues or limitations with the static models that could lead to spurious results. The literature has further clarified that dynamic models could cure these issues or limitations. Since dynamic models are advanced models and are apt in handling time series data, it is relevant to compare these different models for investigating hedging effectiveness.

It can be seen from the literature above that the foreign exchange (forex) risk management has gained prominence in recent time. Even the regulators and policy makers have reframed the accounting guidelines to account for hedging and ensure that it is effective. The treasurers have this responsibility of formulating comprehensive currency risk management guidelines and identify appropriate derivative instrument for hedging and method of evaluating hedge effectiveness. But before they choose an appropriate method, they must examine the currency market. The present study therefore attempts to analyze the current hedging practices of the Indian companies, examine the Indian currency market and use different hedge effectiveness methods to identify better instrument for hedging the currency risk.

This study is significant as it not just studies the practices of the Indian companies but extends the analysis to include the examination of the currency market which makes this study is important for the treasurers, policy makers and auditors. The next chapter develops the theoretical framework based on the literature review.

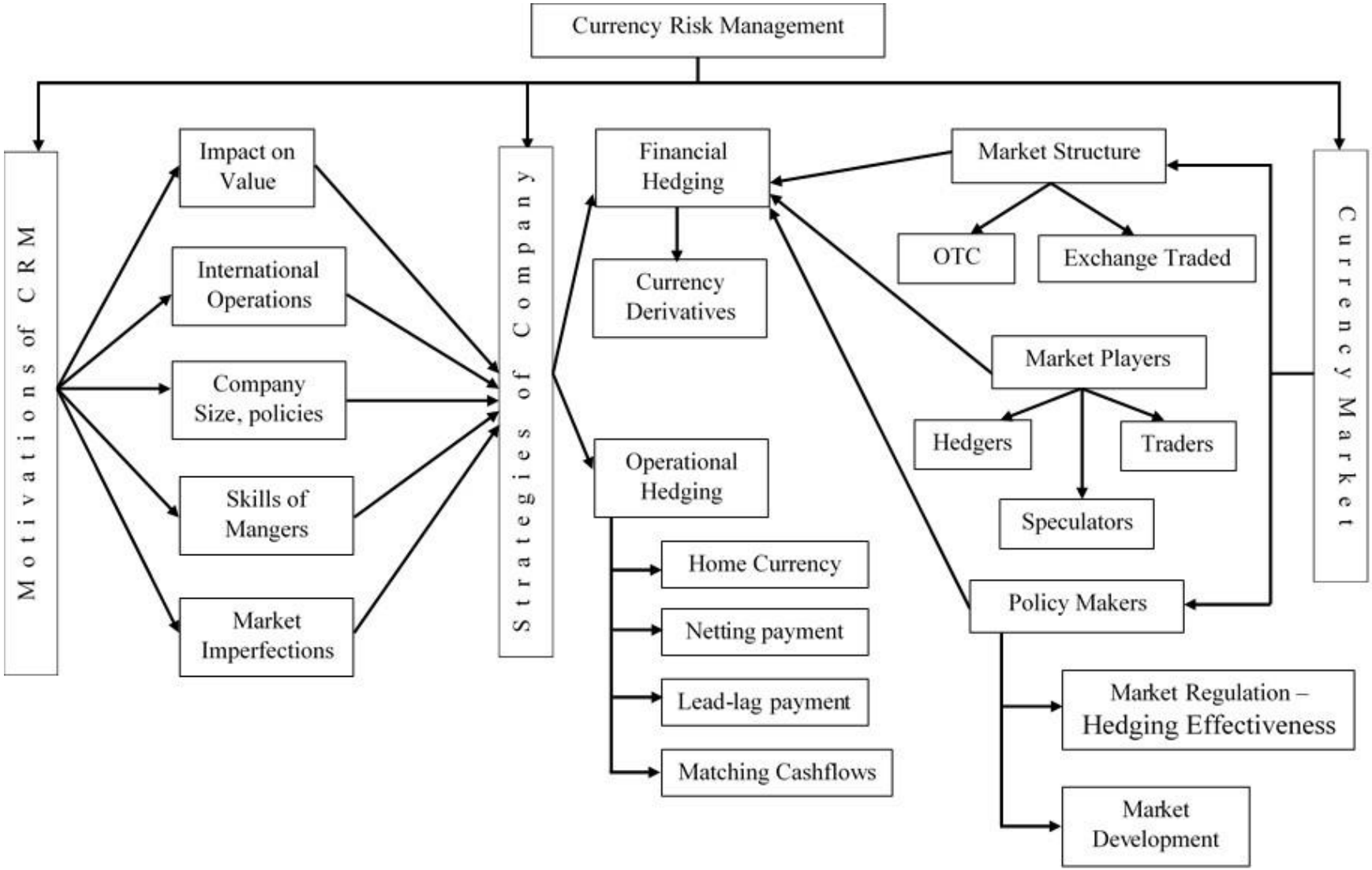
Chapter 3

Chapter – 3: THEORETICAL FRAMEWORK FOR THE STUDY

3.1 Introduction

Based on the review of literature, this section of the thesis builds a theoretical framework for the study. This framework is shown in Fig. 3.1 This part discusses theories regarding (a) hedging by companies, (b) foreign exchange (forex) or currency risk management process, (c) examination or investigation of the foreign exchange (forex) market and (d) various internal (operational) and external (financial) means for hedging this risk.

Fig. 3.1: Theoretical Framework of the Study



The detailed discussion of the theoretical framework, as pointed in Fig. 3.1, is as under:

3.2 Foreign Exchange (forex) Risk Management

3.2.1 Understanding the Foreign Exchange (forex) Risk

An international company is exposed to many risks and one of the prominent risks is the currency risk which is generated because of an untoward currency movement. An unpleasant movement in the currency exchange rate could impact the financial performance and the value of the company (Choi and Prasad 1995, Chow and Chen 1998, Bradley and Moles 2001, Kiymaz 2003, El-Masry et al. 2007, Bartram 2008, Wei and Starks 2013). This risk is sorted into three major categories – (a) the Transaction exposure which is generated from the ordinary business transactions; (b) Translation exposure which is the balance sheet risk or the accounting risk and (c) Economic exposure which measures the impact of the exchange rate variability on the future cash flows of the company

This cash flow variability is generated on account of transaction exposure because of time delay in the entry and settlement of the contract. This risk increases with the increase in the time delay of the settlement of the transaction. Transaction risk could be managed by internal (operational) or external (financial) hedging. Translation risk is created when a multinational company consolidates its financial statements and values all the assets and liabilities of the subsidiaries in the home currency. This exposure can be managed by creating balance sheet hedge i.e. an equal and appropriate amount of foreign exchange asset or liabilities are matched on the combined balance sheet for the entire company. A major problem with the translation exposure is to choose an appropriate exchange rate for the currency at the time of consolidation. A company could choose from historical rate, spot rate or a combination of both. Economic exposure is concerned with the impact of the unanticipated change in the exchange rate. This exposure could be measured as a change in the expected value of the investment but most treasurers find it relatively difficult to measure. Companies consider transaction exposure as more important than other exposures since it directly impacts the cash flows and profits of the companies. Translation exposure is more or less generated because of an accounting calculation which does not create any

real impact on the profits. Moreover, this exposure is not taxable, as the gain or loss is reflected only in the owner's equity unlike the transaction exposure which impacts the taxable income. Therefore, majority of the firms manage the transaction exposure and chose to reduce it (Collier et al. 1992, Marshall 2000, Aabo 2001, Nguyen and Faff 2003, Clark & Judge 2009, Chong et al. 2014). It, therefore, could not be stressed enough that the managers must decide the exposure which they consider as most important and then should take steps to manage that first.

3.3 Companies Hedging the Foreign Exchange Risk

Multinational companies with operations in many countries or currencies have been carrying out hedging for managing the exposures raised because of untoward movement in forex prices. Hedging means applying strategies which include taking newer risks for offsetting existing risks. This (hedging) helps in reducing the variance in the futures cash flow of the firms.

3.3.1 Traditional Hedging Theories

Traditional theory stresses that the hedgers are risk averse and undertake futures or forward market contract in order to save themselves from any unpleasant security price movement. For example, a hedger would protect his inventory position, say US Dollars, from the price fluctuation in the currency market by selling a sufficient number of the US Dollars futures or forwards derivative for a stipulated period of time. When the US Dollar is sold at a future time, the derivative contract is liquidated and same number of derivative contracts are purchased, cancelling the earlier positions. If the net change in the price of the spot (cash) market is same as the net change in price of the futures or forward (derivative) market then the gains enjoyed in the first market are offset by the losses in the other market and the hedger is left by the normal profit from his merchandise.

Working (1953) confronts this view that hedgers are only risk mitigators or minimizers. He emphasizes on profit expectations and claims that hedgers work like speculators and most hedging is conducted in the expectations of a change in the cash-derivative price relation. He further mentions that the hedge effectiveness rests on the disparities amid the movement of the derivative and cash market prices and the predictability of such prices. Portfolio theory provided

by Markowitz (1959) explains that the investors prefer more return on their investments which are stable in nature and had less uncertainty. Stein (1961) and Johnson (1960) view exposure hedging as a practical application of portfolio theory. They could assimilate the traditional hedging theory and Working's view of including expected profit in hedging (Ederington 1979). Johnson (1960) and Stein (1961) both focus on maximizing utility of the investor holding i.e. maximizing the return and minimizing the risk of the holding. This risk is described as a deviation from the expected return and is denoted as variance. Ederington (1979) furthered this work and developed the framework for computing the effectiveness of the hedges take on by an investor.

Miller and Modigliani (1958) say that in perfect markets with no agency problem, no taxes or bankruptcy costs and informational asymmetry, the value or worth of the firm is not influenced by its financing means or methods. They propagate the idea that the capital structure of the company does not impact the value of the firm. Further, the investors have the same opportunities as the firm and if they are not confident about firm's strategies, then they could hedge the risk on their own. These theories conclude that risk reducing measures do not have any effect or influence on the value or worth of the firm if the markets are perfect. A derivative contract will impact the value or worth of the firms in case of market irregularity or imperfection. Researchers like Froot et al. (1993), Nance et al. (1993), Bessembinder (1992) and Smith and Stulz (1985) have demonstrated to further that claim that market imperfections justify hedging.

3.4 Motivations for Foreign Exchange (forex) Risk Management

Using derivatives to hedge the forex (FX) or currency risk reduces the variability of the cash flows for the companies which in turn enhances its value. With reduced cash flow variability, the firms could predict the future cash flows more accurately and improve their planning capabilities. Further, effective hedging provides companies with wider access to investors and increases protection from unpredictable events. The literature has identified five major motivations for the hedging of the currency risk by companies.

3.4.1 Impact on Stock Return and Firm Value

The companies or firms are adversely influenced by the foreign exchange (forex) rate movements since these untoward movements impacts the cash flows, stock return and value of the company (Booth and Rotenberg 1990, Bodnar and Gentry 1993, Shin and Soenen 1999, Chow and Chen 1998, Chiao and Hung 2000, Bartov and Bodnar 1994, Chan et al. 2002, Chen and So 2002, Choi and Kim 2003, Doukas et al. 2003, Kiymaz 2003, Dewenter et al. 2005, Doidge et al. 2006, Jong et al. 2006, El-Masry 2006, Muller and Verschoor 2006, El-Masry et al. 2007, Wei & Starks 2013).

3.4.2 International Operations and Multicurrency Exposure

The fluctuations in the currency prices impacts the companies which have large foreign sales, foreign assets and income and higher degree of export and import (Choi and Prasad 1995, Booth and Rotenberg 1990, Jorion 1990, Williamson 2001, Kiymaz 2003, Jong et al. 2006, Bartram 2004, Doidge et al. 2006, El-Masry & Abdel-Salam 2007). The geographical dispersion of the company increases exposure to the foreign exchange (forex) risk which induces the companies to use financial hedges (Chiao and Hung 2000, Allayannis et al. 2001, El-Masry & Abdel-Salam 2007, Doukas et al. 2003, Choi and Kim 2003, Faff and Marshall 2005, Aabo 2006, Hutson and Stevenson 2010).

3.4.3 Company Size, Structure and Policies

The size of the company, the growth opportunities, the liquidity in the company, the overall structure and risk management policies make it more pertinent for the firms to manage this exposure (Stanley and Block 1980, Collier and Davis 1985, Aabo 2001, Williamson 2001, Agyei-Ampomah 2013). Researcher explain that foreign exchange (forex) rate exposure is higher for large companies and smaller for small companies (El-Masry et al. 2007, Chow et al. 1997, Belk and Edelshain 1997, Chow and Chen 1998, Chiao and Hung 2000, Hagelin and Pramborg 2004, He and Ng 1998, Muller and Verschoor 2006).

3.4.4 Experience, Skills and Knowledge of the Managers

The foreign exchange (forex) risk is managed by the treasurers of the companies. These treasurers aim at enhancing or increasing the effectiveness of their hedging strategy. This becomes easier for managers when they have good understanding of their exposure's nature, the impact on the company and knowledge of the currency derivatives (Collier and Davis 1985, Collier et al. 1992, Belk and Edelshain 1997, Bradley and Moles 2001, Hu and Wang 2006). Faff and Marshall (2005) mention that the managers lacked this knowledge.

3.4.5 Market imperfections

Market imperfections like bankruptcy costs, financial distress, private information, asymmetric informational flows in the market and agency problems also induce a company to manage the currency risk (Stulz 1984, Bessembinder 1992, Smith and Stulz 1985, Nance et al. 1993, DeMarzo and Duffie 1995).

The major non-motivator of hedging is the cost associated with it (Nance et al. 1993, Belk and Edelshain 1997, Géczy 1997, Haglin 2003 and Afza and Alam 2011). The cost of hedging could potentially lower the future cash flows which may end up negatively impacting the value of the company. Further, since the currency risk management is a dynamic concept that requires continuous improvements in the current strategies, any change in the existing policies or strategies could be expensive and demanding for the companies. But an effective hedging strategy would reap in benefits of limited or no risk. Therefore, the manager must evaluate these costs and benefits of the hedging strategies before considering them (Lomenzo and Spieler 2015).

3.5 Market Structure

3.5.1 Exchange and Over-the-Counter market

Financial markets are divided into two prime categories: (a) Primary Market; (b) Secondary Market. Primary market is also known as the new or fresh issue market where initial issue of a security is sold to the buyers for the first time by a company or a government undertaking. Secondary market is where already issued or allotted securities are bought and sold by various investors and traders. Secondary markets are further categorized as: (a) Exchange-Traded; (b) Over-The-Counter (OTC). The market which is regulated by an authority which monitors and controls all the trades and settlements is exchange-traded like National Stock Exchange (NSE), Bombay Stock Exchange (BSE) and Delhi Stock Exchange (DSE) are the examples of such exchanges in India. OTC trades are those where the contracts are not executed on a regulated market. The instruments traded on these exchanges include shares, bonds, debentures, mutual funds etc. One of the most popular and prominent instruments of a financial market are derivatives. Derivative is a tool or instrument which stems its value or worth from a primary security which is also called as an underlying asset. For example, the value or worth of a future depends upon the security on which it is based. This security could be a stock, a commodity like wheat or gold, a currency, a weather etc. These derivatives could also be exchange-traded or OTC traded.

There are many differences between the exchange-traded and OTC market. The former offers more security, takes care of the counter party risk and protects the investors interest by offering investor insurance for a fee; whereas latter offers customized instruments for trading which are privately negotiated and settled. Here, the private parties to the contracts bear the risk of default of the other party. These markets are also not abided by the rules for reporting and information pertaining to the prices and volume of the trade, trading time, details on the underlying assets is not publicly available. This is the reason that OTC market is considered as a less reliable.

3.5.2 The Foreign Exchange (forex or FX) Market

The foreign exchange (forex or FX) market or currency market moves and functions continuously throughout the 24 hours a day in all the seasons of the year. It is regarded as the biggest financial market in the world with $5.1 trillion dollars of trading per day, as reported by BIS Triennial Survey 2016. The survey further confirms the US Dollar to be the most dominant vehicle currency with 88 percent of the trade being carried out against US dollar. There are many participants trading in the forex market who could get in and get out of the trades quickly at any time which make it one of the most liquid market in the world.

Indian forex market has also seen tremendous growth over the years. The spot market foreign exchange turnover stood at USD 5433 million at end-August 2017 and the forex reserves stood at USD 400.21 billion as at end-September 2017 (Source RBI Website).

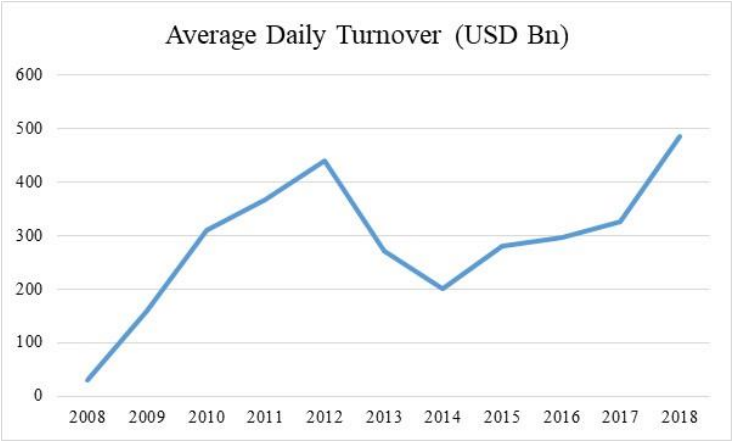
3.5.3 The Indian Foreign Exchange (forex) Market

The beginning of the Indian foreign exchange (forex or FX) market can be sketched from 1978. This is the year when banks are granted the permission for conducting intra-day trade in forex (foreign exchange). Later, the decade of the 1990's brings many significant changes in Indian currency or forex market. The pegged exchange rate, on the recommendations of C. Rangarajan's report, is first partially floated 1992 (March) and then fully floated a year later in 1993 (March). Then the 1995 Expert Group which is formulated under the Chairmanship of O.P. Sodhani recommends opening and widening of the Indian forex market. A decade later, in 2005, Internal Technical Group reviews the measures taken by the Reserve Bank of India to further liberalize the Indian currency market and since then there has been momentous development of the Indian currency market. The developments have evolved the Indian FX market as deep and liquid (Dua and Ranjan 2012).

3.5.3.1 Structure of the Indian forex market

The Indian forex market comprises of the spot and the derivatives market with a decentralized multiple dealer structure. The spot market trades are carried out at the prevailing rates with the settlement in two business date ahead which gives parties adequate time to adjust and instruct their banks for payment. The derivative market, on the other hand, comprises of forwards, futures, swaps and options. Majority of these forward contracts are traded for one month, three month and six months, even though the maturities exists for longer duration. The long duration forward contracts are not popular because of pricing and uncertainty issues (RBI 2017). There has been a gradual increase in the activities of the derivative segment in the forex. The turnover in the derivatives segment has risen from USD 3 billion in April 2017 to USD 4.2 billion in April 2018 (approx.). This growth is also depicted in Graph I below. The derivatives market includes four different instruments which the market players can use namely, forwards, futures, swaps and options. Futures and options are the exchange traded instruments while forwards and swaps are traded over the counter.

Graph 3.1: Average Daily Turnover (USD bn)



3.5.3.2 Market Players

The major market players in the Indian forex market are: (a) Authorized Dealers (ADs) which are mostly banks; (b) Foreign Exchange Brokers who are the main intermediaries; (c) Customer which are individuals and companies that require foreign exchange for transaction and business (RBI 2016). These customers are the significant players who depend on the ADs and brokers for their requirements who dominate the market. RBI regulates the market to ensure orderly market conditions. The Indian central bank indulges in the sale and purchase of foreign currency in the period of surplus demand or supply and maintains the appropriate level of foreign exchange in the economy. RBI also intervenes to protect and develop this market. Over the years, the central bank (RBI) has taken various measures to deepen and strengthen the Indian currency or forex market. It has introduced different instrument in the currency market for the players to use and benefit from. There are various forms of derivative instruments in Indian forex market like forwards which are the oldest derivative instrument. RBI introduced the futures contracts in US dollar in August 2008 on NSE and extended it to include three other currencies – GBP (Great Britain Pound), EURO and JPY, in next two years. These were announced to bring transparency and control into the operations of the currency market. Today, the Indian foreign exchange market is equipped with many sophisticated derivative instruments as a result of which the trading volume has also improved significantly over the last years.

The growth and amalgamation of the financial market globally has made the currency market very volatile and RBI has also been encouraging the companies to use the currency market derivatives for risk management purposes. It has introduced different derivative instruments for the same purpose. RBI has also evolved its role and has limited its intervention in the currency market. Earlier, it used to meddle in the exchange rate movement but since early 2018, RBI has been acting more as a watch dog of the market and has in turn empowered the market players, especially the companies to utilize the diverse instruments for their benefit.

3.6 Foreign Exchange (forex) Risk Management by Companies

The Indian central bank – RBI, insisted in Financial Stability Report 2012, that excessive volatility in the exchange rate make it difficult to take optimal business decisions, therefore, it is required to understand, measure and then manage the currency risk embedded in the business using appropriate derivative instruments. RBI along with ICAI – (Institute of Chartered Accountants of India) formulated new accounting standards – Ind-AS to enable better management of forex risk. These guidelines are in line with the international guidelines for accounting and mandate that the companies or firms should conduct hedging effectiveness test as soon as they take a hedging position. This position, once taken, should then be periodically reviewed by company or firm. This is done because the policy makers realize that only taking a cover for the exposure is not a solution to the risk management but the hedgers need to regularly check the hedging effectiveness for proper management of the risk. The standards specify that the effectiveness should be evaluated using quantitative methods but leave it to the company to choose the quantitative method consistent with their risk management policies.

3.6.1 Strategies for Hedging

There are two categories of strategies which a company could undertake – (a) External or financial hedging; (b) Internal or operational hedging. External hedging strategy which is also called as financial hedging, involves derivatives for risk management. Internal hedging strategy which is also called as operational hedging involves adjustment of the internal operations of the company to manage the currency (forex) risk.

3.6.1.1 External Hedging Strategies

(i) Forwards currency derivatives

Forward are flexible, OTC traded contracts that are frequently used by the companies for forex risk management. Hull (1997) defined these forward derivatives as “an agreement or a

promise to either sell or buy a security at a determined future time for a certain or determined price". These contracts do not involve an immediate cash transaction when entering into the contract. Their value is instead, provided by the spot rate prevalent at the maturity date. If the spot rate increases at maturity, it gives a positive value to long position and a negative value to the short position.

(ii) Futures currency derivatives

Just like forwards, this is an agreement between two parties, where they agree to buy or sell the security, here a currency, at a particular date in the future, for a particular or pre-determined price. Futures are closed, regulated and standardized contracts that operate on the exchange. They involve cash settlement in most cases and physical delivery of the good to the buyer of the contract, in the case of physical goods (Hull, 1997). The price of future is determined by the mechanism of the demand and supply. If more investors want to go long i.e. buy the particular currency in future than to go short i.e. sell the particular currency in future, the price of the future contract would go up.

3.6.1.2 Internal Hedging Strategies

(i) Choice of Home Currency

This strategy involves creating invoices or bills in domestic or home currency and transferring the risk of fluctuations in foreign exchange to the foreign importer. But the catch is that not all foreign importers are willing for the risk transfer. It is also likely that importer would demand extra payment for taking the currency risk.

(ii) Netting the receipts and payments

This involves using exposures in different currencies for netting out the risk. Thus, under this strategy, the receivables and payables in different currencies are matched and netted out. For example, a company square off the intra-organizational forex flows with its foreign subsidiaries. This can be done at the end of each period for balancing the exposure.

(iii) Matching the cash flows

Under this strategy, the company could acquire a long-term debt to match an ongoing export sale. Here, the cash flows are matched once the firm or company receives a foreseeable foreign currency cash inflow from exports and thus, the currency risk is managed.

(iii) Lead-Lag a payment

It comprises of leading or going forward with the payables and lagging or deferring the receivables. This helps in avoiding losses as payments and receivables are managed by the firm or company.

(iv) Back-to-Back Loans

This strategy is also identified as a parallel loan or a credit swap. Here, two companies or firms belonging to different countries make an arrangement and borrow each other's currency but just for a specific time period and then deliver it back once the exposure is managed.

Apart from the above-mentioned strategies, a company could also follow a strategy to do nothing and simply wait on its exposures. It could also use money market instruments for currency (forex) risk management. The treasurers of the company have a difficult job to choose from these various alternatives available to them to manage the foreign exchange (forex) risk. In addition, these treasurers and managers must also be aware about the changes taking place in the ever-dynamic forex market to make an informed decision. The added clause of mandated hedge effectiveness calculation under the new accounting guidelines, Ind-AS, has put more responsibility on the treasurers to identify an effective hedging strategy for their company.

3.7 Research Gaps

After reviewing the literature and recognizing the theoretical framework, some major research gaps are identified.

3.7.1 Problem Overview and Research Gap

Currency risk management is a prominent activity carried out by various treasurers for their companies who use financial hedges like futures and forwards to cover this risk. The new accounting standards make it mandatory or compulsory for the firms to assess the hedge ratio and hedge effectiveness for these hedges undertaken for risk management. The guidelines, however, leave it on the treasurers to choose an appropriate method for the same. In order to make an informed decision about the technique for evaluating the hedge effectiveness, the treasurers must consider the cointegration of the market variables and hence the efficiency of the markets. The literature review points out various studies by different researchers on currency (forex) risk management by companies, the cointegration of the market variables and the hedging effectiveness but these studies are independent of each other. The present research work brings these different concepts together to understand the foreign exchange (forex) risk management scenario for Indian companies.

The currency risk management has gained prominence in India over the past years. Although there are many researchers who studied the forex risk management carried out by different companies but only handful of studies have highlighted the practices of Indian companies. Therefore, the first gap is limited number of studies carried out on foreign exchange (forex or FX) risk management practices of the Indian companies. The present study fills this research gap by conducting a detailed primary study on foreign exchange (forex or FX) risk management practices followed by the Indian companies. There are also plenty of research studies examining the efficiency of the forex (foreign exchange) market but such studies are mostly limited to developed economies. Indian researchers have conducted efficiency studies for Indian financial market but majority of these concentrate on the stock and the commodities market. Therefore, the

second research gap of fewer studies on efficiency of Indian forex (foreign exchange) market is addressed in the present research study. The third gap highlighted by the literature is limited studies which focus on evaluation of hedge effectiveness on Indian forex market. Since this topic of hedge effectiveness has gained more importance recently and companies too have to conduct a mandatory evaluation of the same, the present study addresses this gap and evaluates the hedge effectiveness of forward and futures currency contracts. The literature has also pointed out that hedge effectiveness and cointegration of the market variables is linked together. Therefore, the fourth gap that there are sparsely any studies available which talk about both the concepts together is also addressed in the present study.

3.7.2 Research Questions

There are six important research questions which the present study answers:

(i) What are the practices or methods of Indian companies for foreign exchange or currency risk management in reference to the modern corporate risk management policies?

(ii) Whether the foreign exchange or currency market variables i.e. forwards/ futures and spot move are cointegrated?

(iii) Which is the appropriate method of evaluating the effectiveness of hedge?

(iv) Do the time-varying models or the static models perform equally good in measuring hedging effectiveness?

(v) Which instrument provides better hedging alternative to the companies?

(vi) What are the challenges which the treasurers of the companies face in implementing the hedge effectiveness evaluation models?

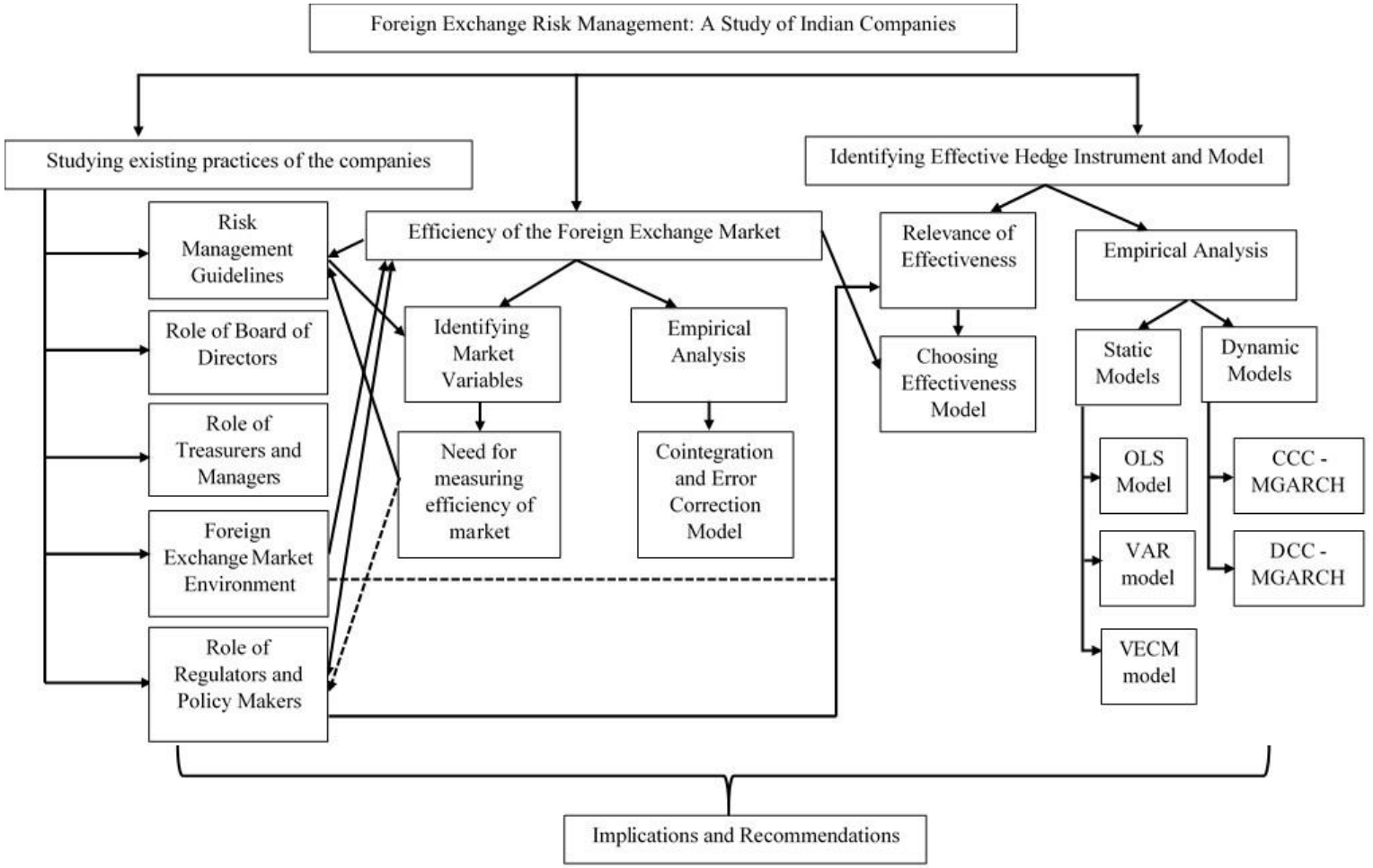
The research question number one is based on the primary research analysis where detailed questions are asked from the treasurers of the Indian companies about their currency risk management practices. The second question evaluates if the forwards/futures and spot markets are cointegrated which would identify if these markets are in disequilibrium in short-run and converge to meet the equilibrium in long-run indicating market inefficiency. This question is analyzed using secondary data analysis. The analysis for the second question further helps in identifying an

appropriate method for evaluating hedge effectiveness which in turn explains the third question. The secondary data analysis further helps in examining questions fourth and fifth. Different static and dynamic model are used to test the effectiveness of the currency hedges and best method for hedge effectiveness is identified. This analysis also helps in identifying the instrument which provides better effectiveness in hedging the forex risk. The final sixth question was examined through interviews with the respondents where the treasurers explain the challenges, they face in implementing the results of the study.

3.8 Framework of the Study

Based on the literature, theoretical framework and research gaps, the present thesis follows the framework described in Fig. 3.2

Fig. 3.2: Framework of the Study



Chapter 4

Chapter – 4: RESEARCH METHODOLOGY

4.1 Introduction

This chapter of the study discusses the objectives of research and the design for research used for study. Research design elaborates on the sample size, period, source of data, variables involved and statistical model specification. Further, this chapter provides the details about the methodological framework for analyzing the objectives of the study. This includes the discussion about the statistical software used and the techniques applied to analyze the data.

4.2 Research Objectives

On the basis of the above research questions, the present study has following objectives:

1. *To study the practices/methods that the companies follow to manage foreign exchange (forex or FX or currency) exposure in India*
2. *To examine the efficiency of the foreign exchange (forex or FX or currency) market in India*
3. *To study the effectiveness of foreign exchange financial hedges*
4. *To develop a case study of an Indian company for supporting the findings*

4.3 Research Design for the Study

4.3.1 Sample size for the study

This research work contains primary and secondary data analysis. For the primary study, treasurers of 100 Indian companies are identified as respondents. The parameters for the secondary study are identified from the primary data analysis. The secondary study is conducted on three popular currencies used by Indian companies and whose exposure the treasurers of these companies regularly manage, namely, United States Dollar (USD), Great Britain Pound (GBP)

and EURO. Additionally, the study focuses on most used derivatives by Indian companies which are forwards currency derivatives and futures currency derivatives.

4.3.2 Period of the study

The primary data collection process is initiated in October 2016 and carried on till April 2018, spreading over a period of 18 months. For the secondary data set, the data is collected for the time frame seven years, from February 2010 to December 2017.

4.3.3 Sources of the data for the study

4.3.3.1 Primary Data

The sample is chosen using PROWESS database. The total number of non-financial companies that reported foreign exchange earnings in their annual report for the year 2015 was 20,237. Out of these, 1040 companies reported or stated foreign exchange (forex or FX) earnings in last five years from 2010 to 2015. It was planned to send the questionnaire to all these 1040 firms. A pilot study was also conducted where in-depth questions were asked from 20 different 'Treasury Managers' in India contacted over a period of 5 months. The response rate for this study was approximately seven percent. On the basis of this experience it was decided to follow judgement and snowball sampling method.

Primary data is collected through questionnaire (Appendix I: Questionnaire for the companies) using judgement and snowball sampling method. The respondents are the treasurers or the CFOs or financial directors responsible for the management or organization of the currency (forex) risk for these companies. The profile of such respondents is scrutinized over LinkedIn and a request for participation in the study is sent. The identified respondents are further asked to share new references who are also requested for participation. The questionnaire is sent to the treasurers and managers through emails and over LinkedIn. Eighty percent of the interviews are conducted over telephone while twenty percent participants responded via email. The questionnaire mainly

contains open-ended and descriptive questions and detailed responses are captured for understanding the foreign exchange risk management practices.

4.3.3.2 Secondary Data

The primary data analysis identifies that Indian companies deal majorly in United States Dollar (USD); Great Britain Pound (GBP) and EURO. It is also identified that these companies use forwards and futures derivative contracts for managing the currency risk. Therefore, the secondary data (daily frequency) for the study is collected for forwards and futures contracts in USD from February 2010 to December 2017. The futures data is gathered from the NSE – National Stock Exchange website, the forwards data is gathered from Reuters and the spot data is gathered from RBI website.

4.4 Methodological Framework for Objective # 1: To study the practices/methods that the companies follow to manage foreign exchange (forex or FX or currency) exposure in India

4.4.1 Software tools used for this objective of the study

This objective is achieved using primary data. The responses captured are analyzed using MS-Word and MS-Excel.

4.4.2 Analysis techniques used for this objective of the study

The study uses thematic content analysis method for analyzing the qualitative data (Kinner et al. 2007 and Jepsen and Rodwell 2008). In this, the captured data is transcribed using MS-Word. This transcript helps in the organization of data in MS-Excel. The verbatim is coded, then classified and categorized in identifying the main themes and patterns. These themes are connected and interrelationships are identified to create interpretations. The explanations are added to provide more meaning and connectivity to the verbatim.

4.5 Methodological Framework for Objective # 2: To examine the efficiency of the foreign exchange (forex or FX or currency) market in India

4.5.1 Statistical software used for this objective of the study

E-Views software (Version 7.0) is used to apply the econometric techniques to examine the second objective of the study.

4.5.2 Techniques used for this objective of the study

Johansen cointegration test is conducted to test this objective. Before this cointegration test following tests are applied to check the assumptions.

4.5.2.1. Checking stationarity: The data for the study is first checked for stationarity. This is because financial data is a time series data that is frequently non-stationary and have means, variances and co-variances which are changing and time-varying, therefore, it becomes important to check stationarity in the data. The study uses confirmatory data analysis for this purpose. Confirmatory data analysis is the combination of three techniques – (a) ADF, which is, Augmented Dickey Fuller (Dickey and Fuller, 1979) test; (b) Phillips-Perron (PP) test; (c) Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. The first two are unit root test and the third is stationarity test. Using all these three tests collectively, make the results for stationarity more robust. This joint use these three methods or analysis is identified as confirmatory data analysis.

ADF Test

This test is the augmented form of Dickey-Fuller test and is suitable for large and complex time series. The equation for ADF is:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad \text{.....(I)}$$

where α is constant,

β is coefficient on a time trend, and

p is the lag order of the autoregressive process

Once the value of the statistic (test) is calculated, it is equated for comparison with the critical values, and a suitable decision is made. This test is carried out under the null hypothesis – the data series contains unit root.

PP Test

This test shapes on ADF test and involves fitting regression equation of ADF test and corrects any serial correlation and heteroskedasticity in the errors. The null hypothesis for this test assumes that the data contains unit root.

KPSS Test

This test checks if the time series observed under study is stationary and is represented by the model:

$$Y_t = \beta t + (r_t + \alpha) + e_t \quad \text{..... (II)}$$

where r_t is $r_{t-1} + u_t$ is a random walk, the initial value $r_0 = \alpha$ is intercept,

t is time index, and

u_t are i.i.d (independent identically distributed).

This stationarity test is carried out under the null hypothesis that the data series is stationary.

4.5.2.2. Lag Selection

Lag selection is an important step to be fulfilled applying cointegration test. The present study uses the value of AIC (Akaike Information Criterion) for the purpose. The lower the value of AIC

indicates a better model. Therefore, the lag with bottommost AIC value is selected for the particular data series.

4.5.2.3. Cointegration Test

Cointegration is widespread and expansively used method for reviewing the efficiency of market. Further, it assists in investigating other features of financial market like lead-lag association amid market variables, price discovery in the market etc. (Srivastava and Singh 2015, Judge and Reancharoen 2014, Sriram and Senthil 2013, Ilter and Alguner 2013, Ünlü and Ersoy 2012, Choudhary and Bajaj 2012 and Mallikarjunappa and Afsal 2010). Kellard (2006) in his study approves the robustness cointegration test and concludes that the Johansen cointegration test should be favored other test for determining market efficiency.

This study also utilizes Johansen's cointegration test. This test is conducted to understand long-run equilibrium between the derivatives and spot markets. This understanding of the long-run equilibrium further points out short-run inefficiency of market. The results of the cointegration test are utilized to further apply VECM model. This assists in studying error correction mechanism of the short-run (indicated by the cointegration) and confirming inefficiency of market.

Johansen Cointegration Test

This is a vector cointegration test which uses maximum likelihood method and not common OLS method to examine the series for cointegration. This method was proposed in 1988. The two likelihood ratios that this test considers are the trace test and maximum eigenvalue test. The trace test checks the presence of linear combinations in the data series and recognizes at least one cointegrating relationship between the variables. The maximum eigenvalue test checks for the likelihood of 'm' possible cointegrating relationships.

This method takes vector autroregression (VAR) of order *p* as a starting point. This equation (III) is mentioned below:

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \cdots \ldots\ldots\ldots\ldots + \Pi_p X_{t-p} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(III)}$$

X_t is an n*1 vector of variables integrated of order one,

μ_t is a vector of innovations, and

Π_1 through Π_p are m*m coefficient matrices.

On subtracting X_{t-1} from both sides, we obtain equation (IV):

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots \ldots\ldots\ldots\ldots + \Gamma_{p-1} \Delta X_{t-p+1} - \Pi X_{t-p} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\text{(IV)}$$

where, $\Gamma_1 = \Pi_1 - I$, $\Gamma_2 = \Pi_2 - I_1$, $\Gamma_3 = \Pi_3 - I_2$, and $\Pi = I - \Pi_1 - \Pi_2 - \ldots\ldots\ldots - \Pi_p$.

The matrix Π is called the impact matrix and determines the extent to which the system is co-integrated. The number of distinct cointegrating vectors depends on the row rank of Π (Österholm et.al 2007). In order to detect the number of cointegrating vectors this test considers two likelihood ratios discussed above.

4.5.3 Interpretation of Result Analysis

If two or more series are cointegrated, it implies that these series might not meet in equilibrium in short-run, however, these will find equilibrium in long-run. It further indicates the presence of a ECM or error correction mechanism that brings the two series in long-run equilibrium. Vector Error Correction Mechanism helps in identifying the correction for the short-run disequilibrium. This then confirms the inefficiency of the market (Choudhary and Bajaj 2012).

4.6 Methodological Framework for Objective # 3: To study the effectiveness of foreign exchange financial hedges

4.6.1 Statistical software used for this objective of the study

E-Views software (Version 7.0) and STATA software (Version 13.0) were used to apply the econometric techniques to examine the third objective of the study.

4.6.2 Techniques used for this objective of the study

4.6.2.1 Hedge Ratio and Hedge Effectiveness

Ratio of the derivative position's size to the cash position's size determines the optimal hedge ratio. This ratio further helps in minimizing total risk of portfolio (Kumar and Singh 2008). The effectiveness of hedge is measured as a percentage decrease in hedged portfolio in comparison to the unhedged portfolio. This is stated in the variance reduction equation below:

$$[\text{Var}(U) — \text{Var}(H)] / \text{Var}(U) \quad \text{.....(V)}$$

where, variance of un-hedged $[\text{Var}(U)] = \sigma_s^2$ .....(VI)

$$\text{variance of hedged } [\text{Var}(H)] = \sigma_s^2 + h^{*2}\, \sigma_f^2 - 2h^*\sigma_{sf} \quad \text{.....(VII)}$$

4.6.2.2 Models for calculating Hedge Ratio and Hedge Effectiveness

The present research study uses five models for estimating optimal hedge ratio and its effectiveness – conventional OLS model, VAR, VECM, CCC-MGARCH and DCC-MGARCH. There are three important features of the time series data considered in this study. First, the autocorrelation of residuals; second, cointegration of futures and spot return; and third, time-varying conditional heteroscedasticity of the series. The OLS is the conventional model used by many researchers like Myers and Thompson (1989), Myres (1991), Lien and Lou (1994), Lien et al. (2002), Yang and Allen (2005), Casillo (2004), Kenourgios et al. (2008), Bhaduri and Durai (2008), Czekierda and Zhang (2010), Yang and Pavlov (2011), Cotter and Hanly (2012), Sahoo (2014) and Jampala et al. (2015) etc. to examine or calculate the effectiveness of hedge. We therefore, have used the OLS model as the first step of analysis. But since OLS ignores all these three properties, we apply VAR (Vector Auto Regression) and VECM (Vector Error Correction Model) model as the second step of analysis. These models eliminate the problem of autocorrelation of residuals. Since, VAR model does not consider cointegration therefore, VECM is applied which further eliminates the problem of cointegration of the derivative market and spot market. Both VAR and VECM ignore the important property of time-varying conditional

heteroscedasticity. It is noted that since OLS, VAR and VECM ignore the time-varying or dynamic presence of variances, these are categorized as 'Static' models.

The static hedge ratio considers the regression of derivative on spot. But when novel information enters the market, the distribution of spot or cash and derivative is not static but is time-variant. Static hedge ratio fails to consider this dynamic aspect of the market. The information flow makes the static hedging strategy as unfitting. The dynamic models for calculating the hedge ratios better represent the dynamic environment changes. The study further applies dynamic models, which is the third step of analysis. The dynamic models are GARCH family models – CCC-MGARCH and DCC-MGARCH. The multivariate GARCH model considers autocorrelation of residuals, cointegration of series and recognizes that the time-varying nature of variances.

I. Conventional OLS Model

This is the simplest model where a linear regression equation of change in spot price and change in futures price is equated.

$$\Delta S_t = \alpha + h^* \Delta F_t + \varepsilon_t \quad \text{.....(VIII)}$$

where, ΔS_t is change in spot price, ΔF_t is change in future price, α is intercept term, and ε_t are residuals. This linear equation measures the minimum variance hedge ratio, h^* measures the hedge ratio and R^2 measures the effectiveness of hedge. R^2 of more than 90 percent implies hedge effectiveness.

II. Vector Auto Regression Model

This model is represented by the following two equations.

$$\Delta S_t = \propto_{s,0} + \sum_{i=1}^{p-1} \propto_{s,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{s,i} \Delta F_{t-i} + \varepsilon_{s,t} \quad \text{.....(IX)}$$

$$\Delta F_t = \propto_{F,0} + \sum_{i=1}^{p-1} \propto_{F,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{F,i} \Delta F_{t-i} + \varepsilon_{F,t} \quad \text{.....(X)}$$

F_t is futures price series and S_t is spot price series, $\propto_{s,0}$ and $\propto_{F,0}$ are intercept terms, $\propto_{s,i}$, $\propto_{F,i}$, $\beta_{s,i}$ and $\beta_{F,i}$ are the short-run coefficients. The number of lags is identified by using the Akaike Information Criterion (AIC) for the model.

The hedge ratio under VAR model is calculated as:

$$H = \frac{\sigma_{SF}}{\sigma_F} \quad \text{.....(XI)}$$

where,

$$\text{Var}\ (\varepsilon_{F,t}) = \sigma_F$$

$$\text{Var}\ (\varepsilon_{S,t}) = \sigma_S$$

$$\text{Cov}\ (\varepsilon_{S,t}, \varepsilon_{F,t}) = \sigma_{SF}$$

The VAR model does not consider the possibility of cointegration between the market variables which is well taken care of by VECM model.

III. Vector Error Correction Model (VECM)

This model identifies the presence of error correction mechanism and is applied after cointegration is identified between two variables. It further helps in identifying the lead-lag connection amongst the market variables. This further verifies inefficiency of market.

VECM is estimated by using OLS equations (X) and (XI):

$$\Delta S_t = \propto_{s,0} + \sum_{i=1}^{p-1} \propto_{s,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{s,i} \Delta F_{t-i} + \alpha_s Z_{t-1} + \varepsilon_{s,t} \quad \text{..... (XII)}$$

$$\Delta F_t = \propto_{F,0} + \sum_{i=1}^{p-1} \propto_{F,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{F,i} \Delta F_{t-i} + \alpha_F Z_{t-1} + \varepsilon_{F,t} \quad \text{..... (XIII)}$$

F_t is futures price series,

S_t is spot price series,

$\propto_{s,0}$ and $\propto_{F,0}$ are intercept terms,

$\propto_{s,i}$, $\propto_{F,i}$, $\beta_{s,i}$ and $\beta_{F,i}$ are the short-run coefficients, and

Z_{t-1} is the error correction term.

The number of lags is identified by using the Akaike Information Criterion for the model. Decision is made by looking at α_S and α_F values. If these are significant, it means there is bi-directional relation between the two markets, lead or lag market is also identified by looking at these values. T-test and F-test are used to know the significance of the coefficients of error correction of lagged values respectively. (Choudhary and Bajaj 2012). The hedge ratio under this model is calculated in the same manner as under VAR model.

IV Multivariate GARCH Method

Before applying the GARCH family models the data series need to be checked for the assumption of ARCH effect.

Checking ARCH effect:

Time series data showing shows wide swings when extended for long periods of time and the series with volatility is generally expressed as having 'ARCH' effect. To identify this effect, the study checks for the presence of clustering volatility in the residuals of VAR and VECM models. Financial time series frequently display the behavior of volatility clustering i.e. the volatility of the data under study has a tendency to persist but change over time. So, there could be time periods showing low volatility and time periods showing high volatility. This phenomenon of the time series data is called as 'Autoregressive Conditional Heteroskedasticity' or ARCH effect. Such a time series is usually approached by ARCH and GARCH family models.

This ARCH effect is also confirmed by running White's heteroskedasticity test on the data series.

Dynamic Models – GARCH

The dynamic models or multivariate GARCH model in this case, should be: (a) flexible i.e. should be able to use the conditional variance and covariance, and (b) parsimonious i.e. use as few variables as possible to simplify or ease the estimation. A most important aspect of MGARCH (dynamic) models is that its covariance matrix must be positive definite. VECH, BEKK, CCC,

DCC models are the four most used multivariate GARCH models. The first of these models is VECH which was proposed in 1988 by Bollerslev. Two drawbacks of this model are, first, it does not consider interaction or communication amongst conditional covariances and variances and second, this makes the parameters of the model as more restrictive. Then in 1990, Baba, Engel, Kraft and Kroner or more popularly known as the BEKK model was defined. This model suffers from the difficulty of large computations and use of many non-linear parameters which makes the model less parsimonious.

The CCC–MGARCH and DCC–MGARCH are better models than other two as these consider conditional correlation also in the data series in addition to considering conditional covariances and variances. This advantage allows room for flexibility in specifying variances which further makes the calculation under the model as simpler and easier than other models (Minović 2009). The Constant Conditional Covariance model was introduced in 1990 by Bollerslev but it assumes conditional covariance to be constant which is an impractical assumption. Dynamic Conditional Correlation model was introduced by Engle in 2002 which is a generalized version of CCC model.

Additionally, high number of undetermined parameters in VECH and BEKK, even after imposing restrictions, makes the estimation difficult. Since this is not the case with CCC and DCC models, they become relatively easier to compute. The present research study, thus uses CCC and DCC model for evaluating dynamic ratio and effectiveness.

The following equation estimates optimal hedge ratio for multivariate GARCH models:

$$\gamma_t | \, \Omega_{t-1} = \frac{h_{SF,t}}{h_{F,t}} \quad \text{..... (XIV)}$$

γ_t = This is optimal hedge ratio at time t

Ω_{t-1} = Information set available at time t-1

$h_{SF,t}$ = Conditional Covariance between spot and futures at time t

$h_{F,t}$ = Conditional Variance of the future at time t

The following equation estimates optimal hedge effectiveness for multivariate GARCH models:

$$HE = [\frac{variance_{unhedged} - variance_{hedged}}{variance_{unhedged}}] \text{..... (XV)}$$

Higher value of HE specifies higher hedge effectiveness and more reduction in risk. Thus, hedging method with higher HE indicates better hedging strategy. This methodology is consistent with Ku et al. (2007) and Chang et al. (2013).

(i) CCC–MGARCH (Constant Conditional Correlation)

This model is provided by Bollerslev in 1990. This model has constant conditional correlations which are proportional to the product of corresponding or matching conditional standard deviations. This restriction makes the model parsimonious as it reduces the quantity of unknown parameters. This also simplifies the estimation of the model (Bauwens et al. 2006). The following equation defines the model:

$$H_t = D_t R D_t \text{.....(XVI)}$$

where, R is a matrix containing constant conditional correlation ρ_{ij} and D_t is diag($h_{11t}^{½}$,…., $h_{NNt}^{½}$). This model can be rewritten as:

$$H_t = \rho_{ij} \, (h_{iit} \, h_{jjt})^{1/2} \text{.....(XVII)}$$

This model has a GARCH (1,1) specification for each conditional variance in D_t:

$$h_{iit} = \omega_i + \alpha_i \epsilon_{i,t-1}^2 + \beta_i h_{ii,t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(XVIII)}$$

where, i = 1,……,N

H_t is positive definite if and only if all the N conditional variances are positive and R is positive definite.

This model makes the assumption that the conditional correlations are time-invariant. This assumption is unrealistic and hence, Engle (2002) proposed generalized version of CCC which is DCC model that makes conditional correlation as time-variant.

(ii) DCC–MGARCH (Dynamic Conditional Correlation)

This model is introduced in 2002 by Engle with the biggest advantage that the conditional variance and covariance for two related series are modeled simultaneously. This model therefore provides time varying hedge ratio. The conditional covariance matrix for this model is presented below. The equation displays the correlation matrix and the conditional standard deviations as:

$$H_t = D_t R_t D_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(XIX)}$$

where D_t is diag($h_{1t}^{½}$,…., $h_{1t}^{½}$) and R_t is the correlation matrix and both are designed to be time-varying.

where,

$$h_{it} = \alpha_{i0} + \sum_{q=1}^{Qi} \alpha_{iq}\, \alpha_{i,t-q}^2 + \sum_{p=1}^{Pi} \beta_{ip}\, h_{i,t-p} \ldots\ldots\ldots\ldots\ldots\ldots\text{(XX)}$$

R_t is the conditional correlation matrix of the standardized disturbances ϵ_t, i.e.

$$\epsilon_t = D_{-1}^t \alpha^t \sim N(0, R_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(XXI)}$$

4.6.3 Interpretation of Result Analysis

Higher value of hedge effectiveness (HE) specifies further drop in the risk. Therefore, higher HE for a hedging method indicates healthier hedging strategy (Ku et al. 2007 and Chang et al. 2013). The results of the models compared in the study are examined to determine the hedging method with highest hedge effectiveness.

4.7 Methodological Framework for Objective # 4: To develop a case study of an Indian company for supporting the findings

4.7.1 Software tools used for this objective of the study

A case study of prominent Indian company is developed. This objective is achieved by conducting in-depth interview with an Indian company which manages its foreign exchange risk using financial derivatives. Further, the case also uses secondary data to evaluate hedge ratio and hedge effectiveness to identify appropriate hedging tool for the company. This objective is accomplished using MS-Word, MS-Excel, E-Views and Stata software.

The reference for developing the case is taken from Rowley (2002). In-depth interview is conducted with the treasurer of the company for building the case. Along with it the results obtained in the primary data analysis and secondary data analysis assisted in the development of the case study.

4.8 Conclusion

This chapter of the research study discussed the research objectives and research design used for the study. Research design elaborated on the sample size, period, source of data, variables involved and statistical model specification. Further, this chapter provided the details about the methodological framework for analyzing the objectives of the study. This also included the discussion about the statistical software used and the techniques applied to analyze the data. The

next chapters 5-7 will discuss the results derived from the analysis conducted for each of the objectives of the study mentioned in this chapter.

Chapter 5

Analysis: I

Chapter – 5: Primary Data Analysis

5.1 Introduction

The primary analysis is mostly descriptive and is based on the responses of 100 respondents. So, a total of 100 companies are considered for the primary data analysis in the study. All the companies chosen for the study faced and managed foreign exposure in the past years. Majority of the companies (close to sixty percent) have more than fifty percent of their revenue and expenditure in the foreign currency. Close to 94 percent of the companies deal in US dollar, 30 percent of the companies deal in GBP and 46 percent of the companies deal in EURO. Only six percent and five percent of the companies deal in Japanese Yen and Chinese Yuan respectively, whereas, less than five percent companies deal in other currencies like Australian Dollar, Singapore Dollar and Canadian Dollar etc. Since, USD, GBP and EURO are identified as the three prominent foreign currencies that majority of the companies transact in, the secondary data analysis is conducted for these three prominent foreign currencies. Although the sample was a mix of companies from various sectors. But six percent of the companies belonged to the IT sector. Of course, the results could not be generalized for this sector because of lesser number of companies in the sample.

5.2 Profile of the Respondent

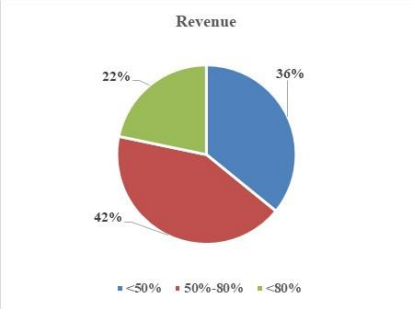
The information provided in this section is based on the response to the background questions of the survey. 85 percent of the respondents interviewed for the study have more than 10 years of work experience, 35 percent of the respondents have over 20 years of experience and close to 10 percent have over 30 years of work experience. All of the respondents have over 5 years of work experience in the foreign exchange (forex) risk management of their company. Majority of these respondents hold senior positions in their organization like CFO, Chief of Finance, Director – Treasury, Chief Manager – Treasury, Associate Director, Global Finance Manager etc. The study refers to these professionals as treasurers. 77 percent of the respondents have either a professional

degree like CA/ CPA and ICWA or MBA (Finance Major). 9 percent have CA and MBA both, 11 percent had CPA and ICWA and rest 3 percent hold a bachelor's degree.

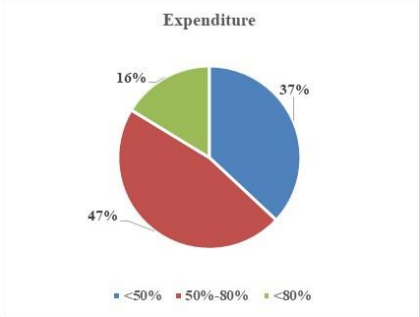
5.3 Policy for foreign exchange risk management

Thirty-six and thirty-seven percent of the companies have more than 50 percent of the total revenues and expenditure in the foreign currency respectively. Forty-two and forty-seven percent of the companies have 50 to 80 percent of total expenditure and revenues in the foreign currency respectively. Twenty-two and sixteen percent of the companies have more than 80 percent of the total expenditure and revenues in the foreign currency respectively. Majority of the companies i.e. more than 95 percent consider foreign exchange (forex or currency) risk management as a significant or important activity and all of these companies in the study take steps to manage this risk. The management of risk is one of the many activities of the treasury of the company. The treasurers confirm that the companies have risk management guidelines, which help in containing the currency risk. These guidelines direct them to follow an active, risk averse foreign exchange exposure management process. Treasurers explain further, that these guidelines are exhaustive in nature and clearly define the foreign exchange (forex or currency) exposure, the aim and objectives of the exposure management, maximum and minimum allowed exposure, permissible derivatives, time horizon and performance evaluation measures. Treasurers further clarify that these are formulated by top management and are approved by the board of the company before being implemented for risk management. Table 5.1 shows the different points covered under the risk management guidelines followed by the companies.

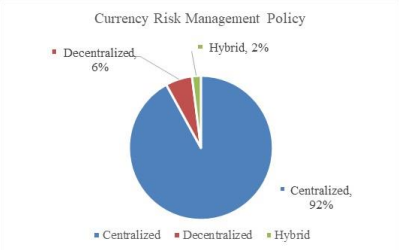
Graph 5.1: Revenue in Foreign Currency



Graph 5.2: Expenditure in Foreign Currency



Graph 5.3: Forex Risk Management Policy



92 percent of the companies follow a centralized risk management process, six percent follow decentralized process for risk management and only two companies combine the two ways and follow a hybrid process. The majority of the companies in the study, 72 percent approximately, have proper document risk management guidelines which direct the treasurers to follow an active, risk averse foreign exchange exposure management process. These documented guidelines clearly define the foreign exchange (forex or currency) exposure, the aim and objectives of the exposure management and specify the maximum and minimum allowed exposure. These guidelines further clarify the permissible derivatives, hedging methods, trading techniques, time horizon and performance evaluation measures. The treasurers explain that these guidelines are exhaustive in nature and described every possible detail associated with hedging the forex exposure. Therefore, the treasurers do not deviate from these policies.

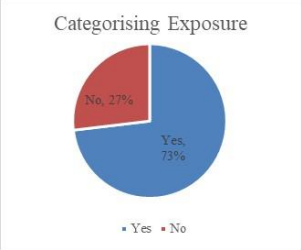
Table 5.1: Risk Management Guidelines

Statements	Currency Exposure Definition	Aim of Currency Risk Management	Description of Procedures	Time horizon of Exposures	Maximum level of exposure	Minimum level of exposure	Targeted level of exposure	Hedging Methods	Permissible Derivatives	Permissible trading techniques	Allocation of Responsibilities	Hedge performance evaluation measures	Performance compensation to employees	Internal controls	Policy approval authority
Respondents (N)	95	96	91	77	79	52	58	80	100	65	77	93	14	32	97
R1	1	1	1	1	1	1			1		1	1		1	1
R2	1	1		1	1				1						1
R3	1	1	1	1		1		1	1	1	1	1		1	1
R4	1	1	1	1	1			1	1	1	1	1		1	1
R5	1	1	1	1	1			1	1	1	1	1			1
R6	1	1	1	1	1			1	1	1	1	1			1
R7	1	1	1	1	1	1		1	1	1	1	1		1	1
R8	1		1	1	1				1	1	1	1			1
R9	1	1	1	1		1		1	1		1	1			1
R10	1	1	1	1	1		1	1	1	1	1	1	1	1	1
R11	1	1		1	1				1		1	1			1
R12	1	1	1	1	1		1	1	1	1	1	1			1
R13	1	1	1	1	1			1	1	1	1	1	1	1	1
R14	1	1	1	1	1	1	1	1	1	1	1	1		1	1
R15	1	1	1	1	1			1	1	1		1			1
R16	1	1	1	1	1	1		1	1	1	1	1		1	1
R17	1	1	1	1	1		1	1	1	1	1	1		1	1
R18	1			1	1		1		1					1	
R19	1	1	1	1	1			1	1	1	1	1			1
R20	1	1	1	1	1				1	1		1			1
R21	1	1	1	1	1	1		1	1	1	1	1			1
R22	1	1	1		1		1	1	1	1	1	1			1
R23	1	1	1	1		1	1	1	1	1	1	1			1
R24		1	1		1				1		1	1			1
R25	1	1	1	1		1	1	1	1	1	1	1	1	1	1
R26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R27	1	1	1		1			1	1		1			1	1
R28	1	1	1	1		1	1	1	1	1	1	1			1
R29	1	1	1	1	1			1	1	1		1			1
R30	1	1	1	1	1			1	1	1	1	1			1
R31	1	1	1	1	1			1	1	1	1	1		1	1
R32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R33	1	1	1		1			1	1		1	1			1
R34	1	1	1	1		1	1	1	1	1	1	1	1	1	1
R35	1	1	1	1	1	1		1	1	1	1	1		1	1
R36	1	1	1		1			1	1		1	1			1
R37	1	1	1		1			1	1			1			1
R38	1	1	1	1			1	1	1						1
R39	1	1	1	1	1	1	1		1		1	1	1	1	1
R40	1	1	1	1	1			1	1	1	1	1			
R41		1	1		1				1		1	1			1
R42	1	1	1	1		1	1	1	1	1	1	1	1	1	1
R43	1	1	1	1	1			1	1	1		1			1
R44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R45	1	1		1	1				1					1	1
R46	1	1	1	1		1	1	1	1	1	1	1	1	1	1
R47	1	1	1	1	1	1		1	1	1	1	1		1	1
R48	1	1	1	1	1	1	1	1	1	1	1	1		1	1
R49	1		1		1				1		1	1			1
R50	1	1	1		1		1		1		1	1			1

Statements / Respondents	Currency Exposure Definition	Aim of Currency Risk Management	Description of Procedures	Time horizon of Exposures	Maximum level of exposure	Minimum level of exposure	Targeted level of exposure	Hedging Methods	Permissible Derivatives	Permissible trading techniques	Allocation of Responsibilities	Hedge performance evaluation measures	Performance compensation to employees	Internal controls	Policy approval authority
R51	1	1	1	1		1		1	1	1	1	1			1
R52	1	1	1	1	1			1	1	1	1	1			1
R53	1	1	1	1	1			1	1	1		1			1
R54		1			1				1			1			1
R55	1	1	1	1		1	1	1	1	1	1	1			1
R56	1	1	1	1	1			1	1	1	1	1			1
R57	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R58	1	1	1		1				1		1	1			
R59	1		1				1		1			1			1
R60	1	1			1		1	1	1			1			1
R61	1	1	1	1		1	1	1	1	1	1	1	1	1	1
R62	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R63	1	1	1	1	1	1	1	1	1	1	1	1		1	1
R64		1			1				1						1
R65	1	1	1	1		1	1	1	1	1	1	1	1	1	1
R66	1	1	1	1	1	1	1		1						1
R67	1	1	1	1	1	1	1	1	1	1	1	1		1	1
R68	1	1	1	1	1	1	1	1	1	1	1	1		1	1
R69	1	1	1		1				1		1	1			1
R70	1	1	1	1		1	1	1	1	1	1	1		1	1
R71	1	1	1		1				1			1			1
R72	1	1	1	1	1		1	1	1		1	1			1
R73	1	1	1	1	1		1	1	1		1	1			1
R74		1			1		1	1	1		1	1			1
R75	1	1	1	1	1	1	1	1	1		1	1			1
R76	1	1	1	1			1	1	1	1		1			1
R77	1	1	1	1	1	1	1	1	1	1		1			1
R78	1	1	1	1	1	1	1	1	1	1	1	1			1
R79	1	1	1	1	1	1	1	1	1	1	1	1			1
R80	1	1	1	1	1	1	1	1	1	1	1	1			1
R81	1	1	1	1	1	1	1	1	1	1	1	1			1
R82	1	1	1		1	1	1	1	1		1	1			1
R83	1	1	1	1		1	1	1	1	1		1			1
R84	1	1	1	1	1	1	1	1	1	1	1	1			1
R85	1	1	1	1	1	1	1	1	1	1	1	1			1
R86	1	1	1		1	1	1	1	1			1			1
R87	1	1	1	1			1	1	1	1	1	1			1
R88	1	1	1		1	1	1		1		1	1			1
R89	1	1	1		1		1	1	1		1	1			1
R90	1	1	1	1		1	1	1	1	1		1			1
R91	1	1	1		1			1	1		1	1			1
R92	1	1	1	1	1	1		1	1	1	1	1			1
R93	1	1	1	1	1	1	1	1	1	1	1	1			1
R94	1	1		1	1	1	1	1	1			1			1
R95	1	1	1				1	1	1		1	1			1
R96	1	1	1	1		1	1	1	1	1	1	1			1
R97	1	1	1	1	1	1	1	1	1	1	1	1			1
R98	1	1	1	1	1	1	1	1	1	1	1	1			1
R99	1	1	1	1	1	1	1	1	1	1	1	1			1
R100	1	1	1	1	1	1	1	1	1	1		1			1

Theoretically, the forex (currency) exposure is separated into three types – transaction, translation and economic. 73 percent of the companies manage the FX exposure individually and majorly these companies focus on transaction exposure. Rest of the companies do not categorize their exposure in these categories. They manage the FX exposure by combining all these exposures together. Majorly the companies (98 percent) manage transaction exposure as it is easy to manage and it directly impacts the profits of the companies. Companies consider it an important aspect of foreign exchange exposure and focus on it entirely. Treasurers explain that the transaction exposure tell them "what actually happened". Since the companies are impacted by the currency pricing, therefore, it becomes important for them to manage the exposure generated by each transaction. 75 percent of the companies do not manage the translation exposure because treasurers mention that this is not a real exposure which impacts their profits. They explain that since translation exposure occur on collating the financial accounts, therefore, it is insignificant in identifying the actual exposure. Few companies have even accepted translation exposure as part and parcel of business and make no attempt to contain it. Companies which managed translation exposure prefer invoicing in domestic currency. Most of the treasurers are not clear about the economic exposure and some treasurers refer to economic exposure as difficult to measure. Therefore, close to 87 percent of the companies do not manage it. 13 percent said that since economic exposure is based on the future forecasted cashflows, they focus on it and manage it through hedging.

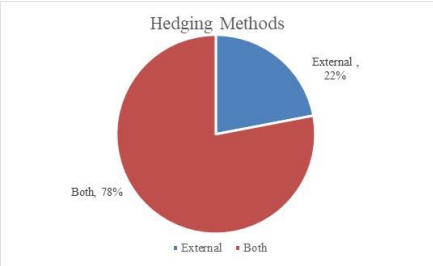
Graph 5.4: Categorizing Exposure



5.4 Managing the foreign exchange (forex or currency) rate exposure

The two ways with the companies to manage the foreign exchange rate exposure are – internal (operational) hedging methods and external (financial) hedging methods. The operational or internal hedging methods include methods like leading or lagging a payment, adjusting the currency rate in the contract clause, invoicing in the domestic

Graph 5.5: Hedging Method



Graph 5.6: Favored Contract

currency. External hedging methods involve using different derivatives instruments for hedging forex (currency) risk. Out of the companies considered under the study, majority of the companies, 78 percent use both operational and financial hedging methods. 22 percent of the companies use only external or financial methods. The treasurers mention that internal hedging methods are natural hedges which they prefer when domestic currency fared well. These methods are also preferred because these are uncomplicated, natural to use and mitigate risk without any additional cost. Few treasurers add that the internal hedging methods occur naturally during the course of their business and they intentionally do not use these methods for risk management. These treasurers also point out that the internal methods help in putting off the risk for a small duration only and do not actually save the company from the exposure. Therefore, the treasurers do not rely on just these methods and prefer external (financial) hedging methods over internal (operational) hedging methods for forex risk management.

Graph 5.7: Purpose of Hedging

5.5 Hedging the foreign exchange (forex) rate exposure

78 percent of the companies use both external and internal hedging methods, whereas 22 percent use only external hedging methods. Treasurers mention that although internal hedging methods are uncomplicated and mitigate risk without any additional cost, these do not save the company from the currency exposures. Therefore, the companies prefer external hedging methods over internal hedging methods. All the companies in the study use derivatives for currency risk management and identify different reasons for using these for the purpose of risk management. Table 5.2 provides respondents views on these reasons. Respondents are asked to rate the twelve statements for reasons of managing forex exposure on a five-point scale which range from 1 as ‘Best Suited’, and 5 as ‘Not at all Suited’.

Table 5.2: Reasons for Using Derivatives

Statements	N	BS (1)	S (2)	SS (3)	SU (4)	NS (5)
Suitable for the company size	81	63%	24%	8%	4%	2%
Integrated financial markets	76	46%	35%	20%	0%	0%
Easy to use	89	81%	17%	2%	0%	0%
Increase earning of the company	94	11%	9%	30%	20%	30%
Generation of funds for investment	89	10%	2%	8%	27%	53%
Managerial ownership	83	11%	2%	8%	8%	72%
Country's economic environment	89	20%	32%	41%	5%	2%
Increase value of the company	78	29%	6%	29%	25%	10%
Managerss knowledge and skills	74	54%	17%	21%	4%	4%
Many options for managing exposures	74	71%	17%	8%	4%	0%
Maximizes manager's utility	84	28%	37%	33%	2%	0%
Reduce cash flows variability	91	51%	44%	3%	2%	0%

On the basis of the responses provided, these statements are ranked to identify the best suited reason for using derivatives for risk management, as displayed in table 5.3. The responses of 'Best Suited (1)' and 'Suited (2)' are combined together to create a ranking.

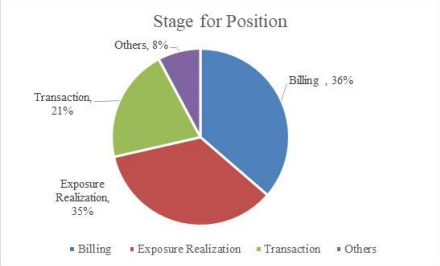
Table 5.3: Ranking of reasons for using derivatives

Statements	Rank
Easy to use	1
Reduce cash flows variability	2
Many options for managing exposures	3
Suitable for the company size	4
Integrated financial markets	5
Managerss knowledge and skills	6
Maximizes manager's utility	7
Country's economic environment	8
Increase value of the company	9
Increase earning of the company	10
Managerial ownership	11
Generation of funds for investment	12

The treasurers identify varied reasons for preferring external hedging methods. Firstly, treasurers agree that the financial hedges are easy to use. Secondly, they affirm that derivatives reduce cashflow variability which help in reducing uncertainty. Thirdly, derivatives provide many different options to the managers for forex risk management. The managers can choose the instrument which suit the risk management policy of the company. Fourthly, the treasurers also prefer the financial hedging because it is suitable and appropriate to use with the size of the company. These help the large companies in containing their large exposures. The treasurers also admired that their team and managers were skilled at using the derivatives for risk management methods which made them easy to utilize. Elaborating on the role of managers and treasurers in the foreign exchange (forex) risk management guidelines, the companies reveal that the treasures of the company have varied responsibilities to fulfill. The treasurer takes care of the cash flows, investments planning, capital management etc. Additionally, the treasurer also handles the hedging and maintains the hedge position in the market. The treasurers stress that foreign exchange (forex or FX or currency) risk management is small part of their varied role in the company operations.

Majority of the companies, 83 percent and 81 percent undertake a derivative position for three-month and six-month period respectively whereas 60 percent and 58 percent of the companies take a derivative contract for one-month and 12-month period respectively. Treasurers specify that since the currency market is dynamic in nature, it makes more sense for them to book a hedge for a short time period. Treasurers also clarify that the sole purpose of hedging is risk mitigation as the companies do not seek to make profits from derivative contracts and they do not speculate in the market.

Graph 5.8: Stage for Position



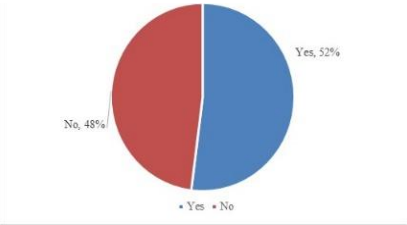
There are various stages when the company take a hedging position in the market. Majority of these companies book a hedge after billing stage (36 percent) or as soon as an exposure is realized (35 percent), 21 percent of the companies book a position in the derivative market as soon as a business transaction is completed. These companies take a derivative to save themselves from any untoward movement of the exchange (forex) rate. The most popular derivative used by the companies is identified to be forward contracts with close to 96 percent of the companies using

forward contracts for risk mitigation. The second most popular derivative instrument is futures contracts. Close to 48 percent companies utilize futures derivatives to manage the currency risk. Only handful of companies, less than 10 percent, used swaps and options for foreign exchange (forex or currency) risk management. The treasurers mention that they prefer simple contracts over the complicated contracts. They further elaborate that they are using forwards for many years to manage the risk which make them easy to understand and simple to follow. They further add that since the main objective is to protect against untoward currency movement, instruments like options and swaps add more complications in the analysis. Treasurers stress that the sorting and winding the complicated hedges generated from using options and swaps is extremely difficult which further exposes them to derivative risk. Therefore, they stick to forward contract for managing the exchange rate risk.

Majority treasurers accept that they regularly manage their derivative position but surprisingly, more than 90 percent of the respondents use only MS-Excel to evaluate their market position and refrain from using any statistical software or technique for this. The treasurers elaborate that the foreign exchange (forex or FX) risk management is a small part of their job description in the company and the exhaustive policy on the foreign exchange (forex or FX) risk management specify the method to be used to maintain, track and update the hedge position. Therefore, they don't go out of their way to find a statistical method for evaluation and just follow the guidelines. Majority of the respondents also said that they perform simple hedging using forward contracts which is handled using their inhouse tracker created on excel and it do not require any complicated statistical technique. Close to 28 percent companies rely on auxiliary systems like SAP and ERP to provide support for forex risk management. 63 percent of the companies do not perform any basic statistical analysis like stress testing, scenario analysis, covariance analysis or value-at-risk etc. Only 15 percent use stress testing, 11 percent use covariance analysis and 8 percent use value-at-risk and simulation analysis for evaluating hedging position. Treasurers mention that they use basic techniques which are achievable in excel and specify that they do not use sophisticated techniques because of smaller size of the companies, outsourcing such calculation to a banking partner, undertaking hedges only for risk mitigation and not for earning profit and to keeping things simple and easy in the company. The role of a bank in the entire risk management process is that of an advisor.

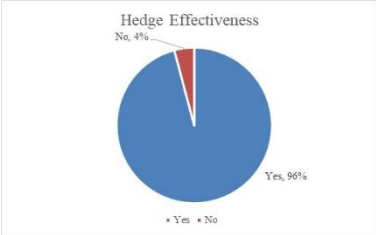
5.5.1 Hedging the foreign exchange rate exposure – Effectiveness of hedge

Graph 5.9: Hedge Ratio



Theoretically, the hedge ratio (HR) relates or equates the value of a position which protected with the usage of derivative with the size of entire position. This is an important concept which many treasurers should use to compare the derivative position with the cash position. But surprisingly, only 52 percent of the companies calculates hedge ratio. For those who use it maintain that their policy prescribed the calculation of hedge ratio as it enables them to issue fresh mandates on future steps. 48 percent of the companies which do not calculate hedge ratio state that their policy covers 100 percent of the exposure which makes the calculation of hedge ratio as irrelevant. Few treasurers also admit to not knowing about hedge ratio.

Graph 5.1: Hedge Effectiveness



An important step which treasurers take in risk management through financial hedges is evaluating the effectiveness of hedges undertaken. 96 percent of the companies evaluate the effectiveness of foreign exchange exposure and four percent of the companies don't evaluate the effectiveness stating that they undertake hedging only when they know that it is going to be useful and beneficial for the currency risk management.

Majority of the companies, close to 65 percent, perform 'what if' analysis where they compared the 'pre-hedging' and 'post-hedging' scenario. 42 percent companies approximately check the impact of hedging on profitability. Other than this companies also use benchmarking and back-testing technique. Under benchmarking, the company compares the performance of the hedge with a benchmark. Under back-testing the company specify a reference rate for every exposure for comparison. Few companies also judge the success of their hedges closer to maturity. Treasurers reveal that although these measures are not statistical in nature but are carried out on comparison basis without putting any specific formula in place. Treasurers which do not use any specific effectiveness measure mention that they evaluate the effectiveness of the hedges by

discussing with the team at the end of a cycle and take a very rudimentary view about what they do and what should have been done. They further defended their actions by mentioning that the company guidelines specify such an evaluation only. The treasurers however, do not evaluate the efficiency of the market. The literature review emphasized that it is important to evaluate the cointegration of the market and hence evaluate the efficiency of the market but treasurers so far ignore this concept of efficiency.

When specifically asked about the statistical methods, treasurers revealed that they have heard about regression analysis and 10 percent of the treasurers mentioned using it sometimes but majority of the respondents have not even heard of advanced models like ARCH and GARCH. Treasurers mentioned that they carry out simple hedging function and thus do not require understanding of these complicated models. To explain further, the treasurers mention that they follow the methods stated in the foreign exchange (forex or FX) risk management guidelines which are prepared by the top management. Every update in these guidelines is approved by the company board. It becomes difficult to explain these complex methods to the board and therefore, the treasurers do not take much pain in establishing these complex models for evaluating hedge effectiveness. Further the treasurers shared that the manager lack specific knowledge of these complex models and implementing such solutions would require hiring new talent with this particular understanding of complex model which is very difficult to find. They further mentioned that these models should be simplified for them to understand and put in place.

5.6 Conclusion

To sum up, the general process of foreign exchange risk management which most companies follow begins with considering the internal dynamics of the company, the structure of the company (reporting currencies, date of receiving a payment, the market they are operating in, the currencies they are dealing in whether these currencies are volatile or not), their risk-taking ability (the parameters to quantify risk, what is companies profitability and how the risk will be absorbed) and their risk management policy (whether it is conservative or adventurous). Companies follow the approach of identifying their net exposure and covering it with derivatives. Companies also track their every significant transaction and take a position as soon as an exposure

is triggered. This exposure could be triggered at billing, transaction or accounting stage. They take a cover in the market soon after this exposure is triggered depending upon the exposure limit of the company.

Simultaneously, they keep an eye on the market and consider global cues like currencies movement, interest rate etc. The companies approach banks and consultants and take quotes to make an informed decision. Banks play the role of an advisor and assist companies by providing currency rate forecast and derivatives quotes. Overall, banks play a passive role in risk management of the companies. The company book a forward or future as soon as the exposure is triggered or a potential exposure is determined. This position is then regularly followed by the companies and treasurers evaluate the effectiveness of the hedges by following risk management guidelines.

Hedging of the currency risk is not a profit-oriented operation of a business. Therefore, this is treated as a back-end operation. The treasurers managing this back-end operation follow the guidelines of the top-management and do not possess the analytical skills of utilizing the advanced statistical models for evaluating the hedge effectiveness, which now the policy makers have stressed on. The companies, therefore, now have to update their guidelines and develop the skills and knowledge of the treasurers. An important consideration in hedging the forex (exchange rate) or currency exposure is to identify the efficiency of the market. As explained by Dufey and Srinivasulu (1983) that the market imperfections like incomplete information, transaction cost and agency cost make it necessary for the firms to manage their currency risk. These market imperfections lead to market inefficiency which could be measured by cointegration. Studying cointegration is also important as explained by da-Hsiang (1996) that ignoring the cointegration or interaction between market variables, which is an indication of market inefficiency, would make a hedger select lower than optimal derivatives position always. Further, identification of cointegration between market variables also helps in the choosing appropriate method for evaluating hedge effectiveness. Surprisingly, majority of the companies do not follow the efficient market hypothesis and do not use cointegration or any other technique to study the currency market.

Chapter 6

Analysis: II

Chapter 6: Determination of Cointegration between Spot & Forwards and Spot & Futures

6.1 Introduction

A market is called efficient if the prevailing prices in that market mirror or echo the available information. If such is the case, then there will be no profit-making opportunity available to the market players because of information symmetry. The existence of cointegration is the indication of information asymmetry which can give rise to information flows and hence inefficiency of market. Kellard (2006) confirms the robustness of cointegration test for testing the efficiency of the market by identifying that cointegration (Johansen) is more vigorous or robust for measuring market efficiency than other tests.

6.2 Model Specification

This method takes vector autroregression (VAR) of order *p* as a starting point. This equation is mentioned below:

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \cdots \ldots\ldots\ldots\ldots + \Pi_p X_{t-p} + \mu_t \quad \text{..... (from eq. III)}$$

X_t is an n*1 vector of variables integrated of order one, μ_t is a vector of innovations and Π_1 through Π_p are m*m coefficient matrices. On subtracting X_{t-1} from both sides, we obtain the following equation:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots \ldots\ldots\ldots\ldots + \Gamma_{p-1} \Delta X_{t-p+1} - \Pi X_{t-p} + \mu_t \quad \text{..... (from eq. IV)}$$

where, $\Gamma_1 = \Pi_1 - I$, $\Gamma_2 = \Pi_2 - I_1$, $\Gamma_3 = \Pi_3 - I_2$, and $\Pi = I - \Pi_1 - \Pi_2 - \ldots\ldots\ldots - \Pi_p$. The matrix Π is called the impact matrix and determines the extent to which the system is co-integrated. The number of distinct cointegrating vectors depends on the row rank of Π (Österholm et.al 2007).

6.3 Empirical Results and Discussion

6.3.1 Confirmatory Data Analysis

The study applies three tests for evaluating the stationarity of the data – ADF test, PP Test and KPSS test. Together these are called confirmatory data analysis.

(A) Augment Dickey-Fuller (ADF) Test

The result of ADF test is shown in Table 6.1. This test presents the null hypothesis that the time series data under consideration has unit root. As a stationary series would not contain unit root, therefore, the time series data used in this study is checked for the presence of unit root at first, level and then, first difference. The table clearly shows that this null hypothesis is not accepted at first difference. Therefore, the series is regarded as stationary at first difference.

Table 6.1: Unit Root – ADF

	Currencies	Level		First Difference	
		t-value	p-value	t-value	p-value
SPOT	**USD**	-1.257664	0.6511	-42.87249	0.0000
	GBP	-1.444382	0.5617	-39.90243	0.0000
	EURO	-1.529023	0.5188	-40.40632	0.0000
FUTURES	**USD**	-1.258493	0.6507	-40.00837	0.0000
	GBP	-1.493442	0.5369	-38.60718	0.0000
	EURO	-1.44068	0.5635	-38.55213	0.0000
Forwards 1 Month	**USD**	-1.29037	0.6361	-42.82397	0.0000
	GBP	-1.450604	0.5586	-39.80694	0.0000
	EURO	-1.526285	0.5202	-40.27831	0.0000
Forwards 3 Month	**USD**	-1.334631	0.6153	-43.22603	0.0001
	GBP	-1.455335	0.5562	-39.76161	0.0000
	EURO	-1.521731	0.5225	-40.1903	0.0000
Forwards 6 Month	**USD**	-1.386482	0.5904	-43.78081	0.0001
	GBP	-1.463315	0.5522	-39.6882	0.0000
	EURO	-1.510354	0.5283	-40.21127	0.0000
Forwards 12 Month	**USD**	-1.488458	0.5395	-43.97488	0.0001
	GBP	-1.467743	0.55	-39.40096	0.0000
	EURO	-1.470317	0.5487	-39.9698	0.0000

(B) Phillips Perron (PP) Test

The results for this test are shown in Table 6.2. The null hypothesis assumes that the series has unit root. A stationary series would not contain unit root. Therefore, the time series data in the study is checked for the presence of unit root first, at level and then, at first difference. The table clearly shows that this null hypothesis is not accepted at first difference. Therefore, the series is stationary (at first difference).

Table 6.2: Unit Root – PP

	Currencies	Level		First Difference	
		t-value	p-value	t-value	p-value
SPOT	**USD**	-1.269282	0.6458	-42.88775	0.0000
	GBP	-1.493887	0.5367	-39.94333	0.0000
	EURO	-1.562004	0.5019	-40.41295	0.0000
FUTURES	**USD**	-1.279321	0.6412	-40.16399	0.0000
	GBP	-1.494827	0.5362	-38.60663	0.0000
	EURO	-1.52384	0.5214	-38.565	0.0000
Forwards 1 Month	**USD**	-1.299978	0.6317	-42.8402	0.0000
	GBP	-1.494092	0.5366	-39.83439	0.0000
	EURO	-1.561403	0.5022	-40.28538	0.0000
Forwards 3 Month	**USD**	-1.34191	0.6119	-43.21482	0.0001
	GBP	-1.502485	0.5323	-39.8069	0.0000
	EURO	-1.545545	0.5103	-40.20134	0.0000
Forwards 6 Month	**USD**	-1.388727	0.5893	-43.72397	0.0001
	GBP	-1.50116	0.533	-39.73218	0.0000
	EURO	-1.531783	0.5174	-40.22008	0.0000
Forwards 12 Month	**USD**	-1.463664	0.552	-43.89308	0.0001
	GBP	-1.504194	0.5315	-39.44181	0.0000
	EURO	-1.485132	0.5412	-39.9692	0.0000

Both the tests – ADF and PP, for the unit root, imply that the time series data used for the present research study are integrated of order one, i.e. I(1).

(C) Kwiatkowski–Phillips–Schmidt–Shin (KPSS) Test

The results for test are displayed in 6.3. The null hypothesis under this test states that data series is stationary. This hypothesis is opposite to the one formulated for ADF and PP test. Therefore, these analyses together are called confirmatory data analysis and make the results for time series stationarity more robust. The results clearly show that the hypothesis (null) is accepted

in first difference. Therefore, as per KPSS model, the time series used for the present study is integrated of order one, i.e. I(1).

Table 6.3: Stationarity Test – KPSS

	Currencies	Level		First Difference	
		t-value	p-value	t-value	p-value
SPOT	**USD**	1152.414	0.0000	1.517605	0.1293
	GBP	1467.07	0.0000	0.548193	0.5836
	EURO	1775.561	0.0000	0.601632	0.5475
FUTURES	**USD**	1153.323	0.0000	1.591173	0.1118
	GBP	1466.617	0.0000	0.571199	0.5679
	EURO	1776.81	0.0000	0.630654	0.5284
Forwards 1 Month	**USD**	1152.539	0.0000	1.527703	0.1268
	GBP	1459.895	0.0000	0.562671	0.5737
	EURO	1762.676	0.0000	0.619208	0.5359
Forwards 3 Month	**USD**	1151.051	0.0000	1.541842	0.1233
	GBP	1445.266	0.0000	0.578147	0.5632
	EURO	1736.571	0.0000	0.638761	0.5231
Forwards 6 Month	**USD**	1144.326	0.0000	1.581389	0.114
	GBP	1420.223	0.0000	0.614248	0.5391
	EURO	1693.504	0.0000	0.681623	0.4956
Forwards 12 Month	**USD**	1121.713	0.0000	1.643257	0.1005
	GBP	1366.449	0.0000	0.679561	0.4969
	EURO	1602	0.0000	0.77046	0.4411

The combined results of all the three test is called the confirmatory data analysis. It is evident now that the derivative and cash series for all the three currencies under study (USD, GBP and EURO) convert to stationary at first difference and is integrated of order one, indicated by I(1).

6.3.2 Lag Selection

Before applying further test for cointegration, for measuring the inefficiency of the market, it is vital to identify the lags for the series. This is an important step and the present research study uses AIC (Aikaike's Information Criterion) for the purpose. Lower value of AIC is an indicator that the chosen model is better. Therefore, the lag value of the series is selected at the lowest value of AIC. The table 6.4, 6.5 and 6.6 below highlights (in bold) the lowest value AIC for all markets which indicates the corresponding number of lags.

Table 6.4: Lag Selection (AIC) – USD

	Lag	Futures	1M Forward	3M Forward	6M Forward	12M Forward
USD	**0**	-9.742424	-11.2537	-9.297713	-8.053632	-6.84703
	1	-16.78365	-20.69166	-19.82915	-18.95482	-18.10972
	2	-16.82972	-20.70231	-19.83901	-18.96205	-18.11623
	3	-16.83912	-20.71282	-19.83793	-18.96493	-18.12076
	4	-16.84085	-20.73855	-19.84367	-18.9658	-18.11929
	5	-16.84509	-20.73667	**-19.84427***	-18.96388	-18.11959
	6	-16.84403	-20.74097	-19.84377	-18.96352	-18.11667
	7	-16.8422	-20.73866	-19.84223	-18.966	-18.11645
	8	-16.83933	**-20.74206***	-19.84124	-18.96845	**-18.12163***
	9	**-16.84594***	-20.73946	-19.84184	-18.96813	-18.11992
	10	-16.84523	-20.74037	-19.84187	-18.9681	-18.11897
	11	-16.84077	-20.73655	-19.83979	-18.96771	-18.11715
	12	-16.83887	-20.73654	-19.8373	-18.96561	-18.11605
	13	-16.83622	-20.74111	-19.83474	**-18.96860***	-18.11632
	14	-16.8349	-20.73844	-19.83113	-18.96734	-18.11268
	15	-16.8367	-20.73688	-19.82768	-18.96611	-18.10851

Note: The lowest value of AIC is highlighted in bold and the respective lag number is chosen against these values

Table 6.5: Lag Selection (AIC) – GBP

	Lag	Futures	1M Forward	3M Forward	6M Forward	12M Forward
GBP	**0**	-9.652711	-12.2291	-10.43965	-9.31092	-8.179157
	1	-15.84602	-20.38315	-19.47076	-18.49874	-17.63684
	2	-15.86184	-20.38989	-19.46892	-18.49856	-17.63844
	3	-15.86355	-20.40692	-19.47618	**-18.50636***	**-17.64539***
	4	-15.86134	-20.44327	**-19.47752***	-18.50337	-17.64192
	5	-15.86969	-20.44396	-19.47358	-18.50111	-17.64059
	6	-15.87044	**-20.44587***	-19.47433	-18.50057	-17.63895
	7	-15.8748	-20.44432	-19.47234	-18.49715	-17.63508
	8	-15.87257	-20.44316	-19.46991	-18.49532	-17.63371
	9	-15.87239	-20.44228	-19.47181	-18.49664	-17.63429
	10	-15.87303	-20.43875	-19.46841	-18.49375	-17.63107
	11	**-15.87559***	-20.43494	-19.46472	-18.48992	-17.62707
	12	-15.87277	-20.43108	-19.46314	-18.4899	-17.62735
	13	-15.87249	-20.43299	-19.46273	-18.49056	-17.62834
	14	-15.87012	-20.43025	-19.45888	-18.48775	-17.626
	15	-15.87178	-20.42693	-19.45632	-18.48437	-17.62135

Note: The lowest value of AIC is highlighted in bold and the respective lag number is chosen against these values

Table 6.6: Lag Selection (AIC) – EURO

	Lag	Futures	1M Forward	3M Forward	6M Forward	12M Forward
EURO	**0**	-10.23303	-12.68591	-10.91083	-9.654499	-8.272947
	1	-15.91705	-20.25486	-19.39953	-18.45185	-17.58534
	2	-15.94214	-20.26354	-19.39889	-18.44961	-17.58509
	3	-15.94629	-20.28373	-19.40731	**-18.45936***	**-17.59573***
	4	-15.9436	-20.31804	-19.40776	-18.45645	-17.59219
	5	-15.95344	-20.31623	-19.40598	-18.45644	-17.59358
	6	-15.95334	**-20.32033***	-19.40654	-18.45486	-17.58966
	7	**-15.95399***	-20.31953	**-19.40809***	-18.45518	-17.5889
	8	-15.95083	-20.31799	-19.40416	-18.45435	-17.58787
	9	-15.9506	-20.31545	-19.40261	-18.45218	-17.58504
	10	-15.9467	-20.3128	-19.40004	-18.4499	-17.58284
	11	-15.94592	-20.30961	-19.39743	-18.4467	-17.57893
	12	-15.94507	-20.30577	-19.39647	-18.44588	-17.57865
	13	-15.94535	-20.30357	-19.39428	-18.44423	-17.57756
	14	-15.94324	-20.29989	-19.39125	-18.44198	-17.57643
	15	-15.93982	-20.29793	-19.38975	-18.43893	-17.57197

Note: The lowest value of AIC is highlighted in bold and the respective lag number is chosen against these values

6.3.3 Johansen Cointegration Test Results

The outcomes of this method are established by two ratios – (a) trace test and (b) maximum eigenvalue test. The null hypothesis is formulated at the vector '0' and '1'. At vector '0', this hypothesis states no cointegration amongst the different series under consideration. Looking at the results for both the ratios, the conforming p-value for currencies does not accept the null hypothesis. This is so because the p-values for USD futures, GBP futures and forwards and EURO futures and forwards are less than 0.05. But it is noted that the null hypothesis at vector '0' is accepted for the USD forwards markets. The results indicate cointegration between the futures and spot data series of all the currencies markets, except for USD forwards.

At vector '1', the null hypothesis states 'at most one' cointegrating relationship amongst different series under consideration. Looking at the results for both the ratios, the conforming p-value for currencies does accept the null hypothesis. This is so because the p-value is greater than 0.05. The outcomes therefore, confirm only one cointegrating relationship for USD futures, GBP futures and forwards and EURO futures and forwards but no cointegration for USD forwards. Table 6.7 and 6.8 displays the results for the same.

Table 6.7: Johansen Co-Integration: Trace Value

Currencies	Vector	λ_{Trace}		
		Test Statistics	Critical Value 5%	Probability Value
USD_{Future}	0	196.3229	15.49471	0.0001*
	1	1.813118	3.841466	0.1781
USD_{Fw1m}	0	13.99323	15.49471	0.0831
	1	1.788749	3.841466	0.1811
USD_{Fw3m}	0	9.260387	15.49471	0.3419
	1	1.470208	3.841466	0.2253
USD_{Fw6m}	0	10.18816	15.49471	0.2665
	1	1.986236	3.841466	0.1587
USD_{Fw12m}	0	8.406708	15.49471	0.423
	1	1.993104	3.841466	0.158
GBP_{Future}	0	197.0842	15.49471	0.0001*
	1	2.665539	3.841466	0.1025
GBP_{Fw1m}	0	31.26085	15.49471	0.0001*
	1	3.11074	3.841466	0.0778
GBP_{Fw3m}	0	20.62345	15.49471	0.0077*
	1	3.323405	3.841466	0.0683
GBP_{Fw6m}	0	21.19041	15.49471	0.0062*
	1	3.031303	3.841466	0.0817
GBP_{Fw12m}	0	20.10833	15.49471	0.0094*
	1	2.802431	3.841466	0.0941
$EURO_{Future}$	0	241.2604	15.49471	0.0001*
	1	2.261527	3.841466	0.1326
$EURO_{Fw1m}$	0	32.49233	15.49471	0.0001*
	1	2.727326	3.841466	0.0986
$EURO_{Fw3m}$	0	21.43677	15.49471	0.0056*
	1	2.9725	3.841466	0.0847
$EURO_{Fw6m}$	0	21.38164	15.49471	0.0058*
	1	2.948491	3.841466	0.086
$EURO_{Fw12m}$	0	17.91219	15.49471	0.0212*
	1	2.791013	3.841466	0.0948

Note: *Rejection of null hypothesis of 'no-cointegration' between market variables

Table 6.8: Johansen Co-Integration: Max Value

Currencies	Vector	λ_{Max}		
		Test Statistics	Critical Value 5%	Probability Value
USD_{Future}	0	194.5097	14.2646	0.0001*
	1	1.813118	3.841466	0.1781
USD_{Fw1m}	0	12.20448	14.2646	0.1032
	1	1.788749	3.841466	0.1811
USD_{Fw3m}	0	7.790179	14.2646	0.4004
	1	1.470208	3.841466	0.2253
USD_{Fw6m}	0	8.20192	14.2646	0.3585
	1	1.986236	3.841466	0.1587
USD_{Fw12m}	0	6.413604	14.2646	0.5607
	1	1.993104	3.841466	0.158
GBP_{Future}	0	194.4187	14.2646	0.0001*
	1	2.665539	3.841466	0.1025
GBP_{Fw1m}	0	28.15011	14.2646	0.0002*
	1	3.11074	3.841466	0.0778
GBP_{Fw3m}	0	17.30004	14.2646	0.0161*
	1	3.323405	3.841466	0.0683
GBP_{Fw6m}	0	18.1591	14.2646	0.0115*
	1	3.031303	3.841466	0.0817
GBP_{Fw12m}	0	17.3059	14.2646	0.016*
	1	2.802431	3.841466	0.0941
$EURO_{Future}$	0	238.9989	14.2646	0.0001*
	1	2.261527	3.841466	0.1326
$EURO_{Fw1m}$	0	29.765	14.2646	0.0001*
	1	2.727326	3.841466	0.0986
$EURO_{Fw3m}$	0	18.46427	14.2646	0.0102*
	1	2.9725	3.841466	0.0847
$EURO_{Fw6m}$	0	18.43315	14.2646	0.0103*
	1	2.948491	3.841466	0.086
$EURO_{Fw12m}$	0	15.12117	14.2646	0.0365*
	1	2.791013	3.841466	0.0948

Note: *Rejection of null hypthesis of 'no-cointegration' between market variables

The results of the cointegration reveal that the USD spot market is cointegrated with USD futures but not with USD forwards market. For GBP and EURO, the spot market is cointegrated with both the derivatives (futures and forwards) market. The presence of the cointegration between USD spot and futures, GBP spot and futures, GBP spot and forwards, EURO spot and futures and EURO spot and forward is an indication of inefficiency in these markets. The presence of cointegration indicates the existence of short-run disequilibrium. This further implies the existence of an error correction mechanism where the market variables come together to reach the long-run equilibrium.

The present results are further substantiated by applying VECM model to confirm the presence of ECM (error correction mechanism) working to correct the short-run disequilibrium. The VECM results are shown in Table 6.9

Table 6.9: VECM – Error Correction

	Variables	Standard Errors	T-Statistics
USD	ΔSt	-0.745962*	[-7.92875]
	ΔFut	0.124815	[1.14747]
GBP	ΔSt	-1.282383*	[-9.69005]
	ΔFut	-0.291962***	[-1.90790]
	ΔSt	-0.360669**	[-2.26924]
	ΔF1Mt	-0.322494**	[-2.03485]
	ΔSt	-0.153762**	[-2.39089]
	ΔF3Mt	-0.134934**	[-2.11545]
	ΔSt	-0.090141**	[-2.43298]
	ΔF6Mt	-0.07164**	[-1.96030]
	ΔSt	-0.048129**	[-2.17898]
	ΔF12Mt	-0.030785	[-1.42445]
EURO	ΔSt	-1.062184*	[-9.75354]
	ΔFut	-0.158088	[-1.31808]
	ΔSt	-0.298535**	[-1.82268]
	ΔF1Mt	-0.257098	[-1.57403]
	ΔSt	-0.14046**	[-2.06544]
	ΔF3Mt	-0.119817**	[-1.77436]
	ΔSt	-0.085232**	[-2.34002]
	ΔF6Mt	-0.067799**	[-1.88012]
	ΔSt	-0.046347**	[-2.37234]
	ΔF12Mt	-0.033189***	[-1.73721]

Note: (*) testifies that values are significant at 1% level (critical Value: 2.58).
(**) testifies that values are significant at 5% level (Critical Value: 1.65).
(***) testifies that values are significant at 10% level (Critical Value: 1.28).

The results of the ECM confirm the existence of short-run disequilibrium. For USD futures market spot market adjusts to meet the futures market in the long run equilibrium. For GBP futures market, 1-month, 3-month and 6-month forward market both cash market and derivative market share feedback relationship and adjust to achieve the long-run equilibrium. However, for 12-month forward market spot market adjusts to meet the forward market in the long run equilibrium. For EURO 3-month, 6-month and 12-month forward market both spot market and forward market share feedback relationship and adjust to achieve the long run equilibrium. However, futures

market and 1-month forward market only spot market adjusts to meet the future/ forward market in the long run equilibrium. (Detailed results are provided in appendix).

The results reveal that the markets are cointegrated which implies the presence of long-run relationship between the market variables. The primary analysis however, reveal that the treasurers do not consider or measure this relationship between the market variables which is essential for the choice of hedge effectiveness model. It is therefore, recommended that the treasurers evaluate and understand the relationship between the market variables for making an effective choice.

6.4 Conclusion

This chapter presented the results for the cointegration test which was used to examine the efficiency of the currency futures market in India. The results revealed that all the markets except for USD forwards were inefficient. The reason could be that USD forwards contracts market is the oldest of the other forward and futures market. Many of the companies and investors deal in this market which is also evident by the increasing volume in USD forward market. Since the forward markets are more flexible and offer greater customization to the investors or companies who could easily tailor these contracts as per their requirement for the forex risk management, the volume of these contracts is more. Hence, the forward market becomes more efficient that other forex markets. These results obtained in this chapter are important since, the establishment of relationship between market variables play a crucial role in the choice of effectiveness model which is discussed in detail in the next chapter. The policy makers are also benefitted by this result as they become aware about the efficient status of the market and can take policy measures to ensure the efficiency of the market.

Chapter 7

Analysis: III

Chapter 7: Hedge Ratio (HR) and Hedge Effectiveness (HE)

7.1 Introduction

Hedge effectiveness has gained relevance in the recent years with the policy makers making it compulsory for the firms or companies to estimate the effectiveness of the hedges. The primary data analysis shows that although companies evaluate the effectiveness of hedge but they do not use any relevant statistical method for the purpose. This part of the analysis compares different method for evaluating hedging effectiveness. The treasurers and the policy makers would be benefitted from the analysis as this would enhance their knowledge on the subject. The outcome of the cointegration found in the earlier chapter would also assist in the selection of an appropriate method of evaluation.

7.2 Conventional OLS model

7.2.1 Model Specification

This model is represented by the following regression equation.

$$\Delta S_t = \alpha + h^* \Delta F_t + \varepsilon_t \quad \text{.....(from equation VIII)}$$

where,

ΔS_t is change in spot price,

ΔF_t is change in future price,

α is intercept term, and

ε_t are residuals.

This linear equation measures the minimum or least variance hedge ratio, h^* measures the HR (hedge ratio) and R^2 measures the effectiveness of hedge. R^2 of more than 90 percent implies hedge effectiveness.

7.2.2 Empirical Result and Discussion

The results obtained by the equation above are shown in Table 7.1 below.

Table 7.1: Hedge Ratio & Effectiveness – OLS

Currencies	Contract	Hedge Ratio (h*)	Hedge Effectiveness (R^(2))
USD	Futures	1.0000	0.9995
	Fwd 1M	0.9986	0.9999
	Fwd 3M	0.9944	0.9993
	Fwd 6M	0.9842	0.9975
	Fwd 12M	0.9561	0.9921
GBP	Futures	0.9988	0.9991
	Fwd 1M	0.9938	0.9999
	Fwd 3M	0.9813	0.9996
	Fwd 6M	0.9608	0.9988
	Fwd 12M	0.9180	0.9965
EURO	Futures	0.9996	0.9987
	Fwd 1M	0.9913	0.9999
	Fwd 3M	0.9737	0.9993
	Fwd 6M	0.9453	0.9978
	Fwd 12M	0.8858	0.9924

The higher value of hedge effectiveness (HE) means better results as this implies that the hedge has been successful in containing the exposure. The table shows that for USD currency derivatives markets, hedge ratio of futures contract is one which indicated hedging the entire exposure. Such a hedge would be 99.95 percent effective. All the contracts of the forward market offer the HR (hedge ratio) of more than 95 percent. The effectiveness of 1-month forward contract is more that rest of the forwards contract which is 99.99 percent. For GBP currency derivatives market, the hedge ratio of futures contract is 99.8 percent and the hedge effectiveness is 99.91 percent. All the contracts of the forward market offer the HR (hedge ratio) of more than 90 percent. The effectiveness of 1-month forward contract is more that rest of the forwards contract which is 99.99 percent. For EURO currency derivatives market, the hedge ratio of futures contract is 99.96 percent and the hedge effectiveness is 99.87 percent. All the contracts of the forward market offer

the HR (hedge ratio) of more than 88 percent. The effectiveness of 1-month forward contract is more that rest of the forwards contract which is 99.99 percent.

Overall, the OLS model of HR (hedge ratio) and HE (hedge effectiveness) on forward and futures currency derivatives provides higher HR and HE. As higher value of hedge effectiveness indicates better hedging strategy, OLS model provides good results to the treasurers. It should however be noted that OLS model suffers from two major drawbacks. First, this model ignores cointegration or convergence of the two-price series under consideration (Herbst et al. 1993). Second, OLS model considers the second moments of the data series as constant and is thus regarded as a constant (Lien et al. 2002) which makes this model time-invariant and hence static. To resolve the issues of cointegration, the study considers VAR and VECM, which resolve the issue of cointegration of data series.

Even though this model is limited by these disadvantages but it is simple to understand and easy to implement. The primary data analysis also show that the 10 percent of the respondents apply OLS model for evaluating hedge effectiveness.

7.3 Vector Auto Regression model

7.3.1 Model Specification

This model is represented by the following two equations.

$$\Delta S_t = \propto_{s,0} + \sum_{i=1}^{p-1} \propto_{s,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{s,i} \Delta F_{t-i} + \varepsilon_{s,t} \text{ ..... (from equation IX)}$$

$$\Delta F_t = \propto_{F,0} + \sum_{i=1}^{p-1} \propto_{F,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{F,i} \Delta F_{t-i} + \varepsilon_{F,t} \text{ ..... (from equation X)}$$

where,

F_t is futures price series,

S_t is spot price series,

$\propto_{s,0}$ and $\propto_{F,0}$ are intercept terms,

$\propto_{s,i}$, $\propto_{F,i}$, $\beta_{s,i}$ and $\beta_{F,i}$ are the short-run coefficients.

HR (hedge ratio) under VAR model is calculated as:

$$H = \frac{\sigma_{SF}}{\sigma_F} \quad \text{..... (from equation XI)}$$

where,

Var ($\varepsilon_{F,t}$) = σ_F

Var ($\varepsilon_{S,t}$) = σ_S

Cov ($\varepsilon_{S,t}, \varepsilon_{F,t}$) = σ_{SF}

7.3.2 Empirical Result and Discussion

VAR model is applied on the data series which is not cointegrated. Since the results of cointegration reveal that the USD forward market is not cointegrated with USD spot market, the VAR model is applied on this data series. In the case companies are hedging with USD forward contracts, they should consider VAR model for estimating HR (hedge ratio) and HE (hedge effectiveness) instead of VECM model. The results obtained by running the above equations are shown in the Table 7.2 below:

Table 7.2: Hedge Ratio & Effectiveness – VAR

Currency	Contract	Hedge Ratio	Hedge Effectiveness
USD	Fwd 1M	1.0008	0.9943
	Fwd 3M	1.0033	0.9876
	Fwd 6M	1.0076	0.9711
	Fwd 12M	1.0015	0.9315

The hedge ratio of all the forward contracts is more than one and hedging effectiveness (HE) is more than 90 percent. The higher value of HE means better results as this implies that the hedge has been successful in containing the exposure. If the companies employ VAR model to evaluate the hedge effectiveness on their forward derivatives contracts, then they will obtain higher value

of hedge effectiveness which would imply better hedging strategy. These results reveal that 1-month forward contracts are most effective in comparison with other forward contracts.

7.4 Vector Error Correction model

7.4.1 Model Specification

The following regression equation express the model.

$$\Delta S_t = \propto_{s,0} + \sum_{i=1}^{p-1} \propto_{s,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{s,i} \Delta F_{t-i} + \alpha_s Z_{t-1} + \varepsilon_{s,t} \ldots \text{(from eq. XII)}$$

$$\Delta F_t = \propto_{F,0} + \sum_{i=1}^{p-1} \propto_{F,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} \beta_{F,i} \Delta F_{t-i} + \alpha_F Z_{t-1} + \varepsilon_{F,t} \text{ (from eq. XIII)}$$

where,

F_t is futures price series,

S_t is spot price series,

$\propto_{s,0}$ and $\propto_{F,0}$ are intercept terms,

$\propto_{s,i}$, $\propto_{F,i}$, $\beta_{s,i}$ and $\beta_{F,i}$ are the short-run coefficients,

Z_{t-1} is the error correction term.

The HR (hedge ratio) for VECM model is calculated in the same manner as under VAR model

7.4.2 Empirical Result and Discussion

The results of cointegration reveal that USD futures is cointegrated with USD spot, GBP futures and forwards is cointegrated with GBP spot and EURO futures and forwards is cointegrated with EURO spot. Therefore, VECM model is applied on these series to estimate the effectiveness of the hedge. The results obtained by running equation (XII) and equation (XIII) are displayed in the Table 7.3 below:

Table 7.3: Hedge Ratio & Effectiveness – VECM

Currencies	Contract	Hedge Ratio	Hedge Effectiveness
USD	Futures	0.6778	0.6143
GBP	Futures	0.7067	0.6680
	Fwd 1M	1.0012	0.9966
	Fwd 3M	1.0044	0.9924
	Fwd 6M	1.0046	0.9822
	Fwd 12M	1.0006	0.9586
EURO	Futures	0.7615	0.7031
	Fwd 1M	1.0009	0.9966
	Fwd 3M	1.0037	0.9933
	Fwd 6M	1.0019	0.9840
	Fwd 12M	1.0029	0.9619

The hedge ratio of USD futures is close to 68 percent and HE is close to 61 percent. The hedge ratio of GBP futures is near to 71 percent and HE is near to 69 percent. The hedge ratio for the all GBP forward contract is more than one and HE is more than 95 percent. The hedge ratio of EURO futures is near to 76 percent and HE is near to 70 percent. The hedge ratio (HR) for the all EURO forward contract is more than one and HE is more than 96 percent. The higher value of HE means better results as this implies that the hedge has been successful in containing the exposure. Comparing effectiveness of the forwards and futures contracts under VECM, the results show that forward contracts are more effective in containing the exposure than futures contracts. The reason could be that forwards are more flexible than futures contracts and companies could easily customize these contracts for currency risk management. Hence these become more effective than exchange traded futures contracts. These results also reveal that 1-month forward contracts are most effective in comparison with other forward contracts. This is also not surprising since short-run contracts offer more flexibility in making adjustments to the hedge position.

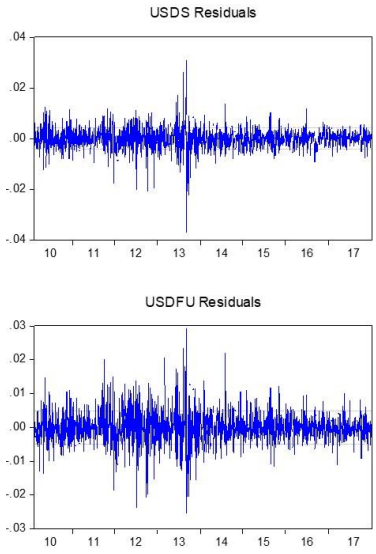
Although VAR and VECM are an improvement over the OLS model, but these are time-invariant models as these models do not consider the important property of time-varying

conditional heteroscedasticity. Therefore, these are also static models. The exchange traded data is dynamic and time-varying therefore, it is meaningful to apply dynamic models for evaluating the hedge effectiveness (HE). The present research study therefore, chooses GARCH models for this purpose.

7.4.3 Checking for ARCH Effect

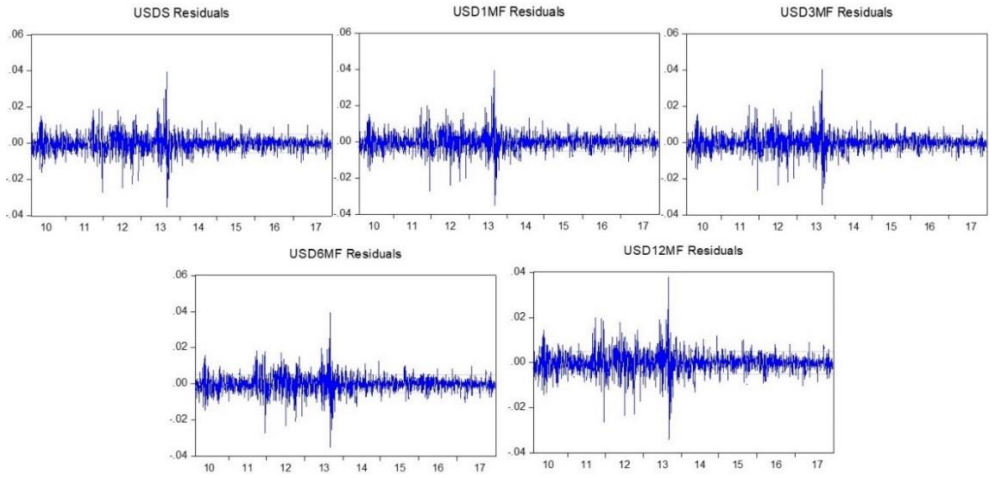
Before applying GARCH models, it is important to check for ARCH effect in data series. ARCH effect is checked by confirming the incidence of clustering volatility in the data series. Clustering volatility is the phenomenon where the volatility in the time series is persistent but changes over time. As a result, the time series has periods of low and high volatility alternatively. This singularity is called autoregressive conditional heteroskedasticity or ARCH effect. This effect is checked by plotting the residuals on a graph. This ARCH effect is further confirmed by running White's heteroskedasticity test on the data series. The time series which exhibit the ARCH is usually approached by ARCH–GARCH family models. The clustering volatility is checked by plotting the residuals on Graph 7.1, 7.2, 7.3 and 7.4.

Graph 7.1: VECM Residuals – USD Futures



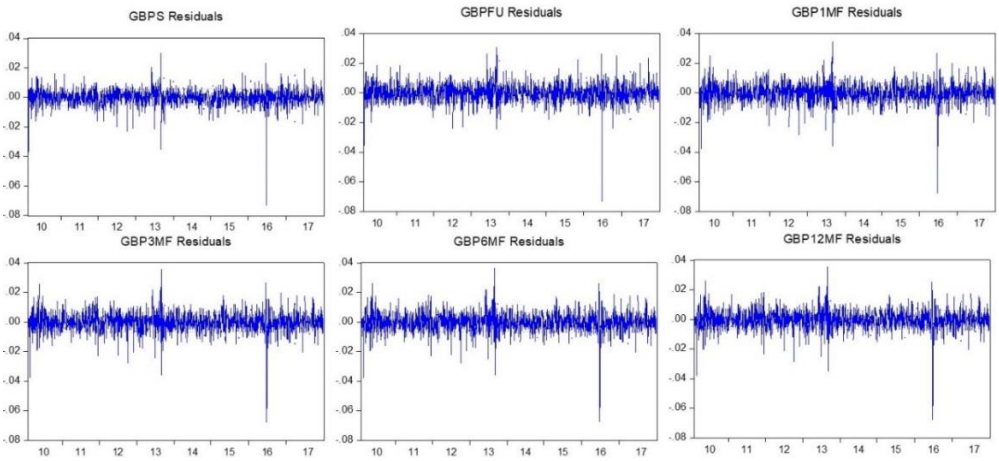
The residuals of the USD futures series show the presence of clustering volatility.

Graph 7.2: VAR Residuals – USD Forwards



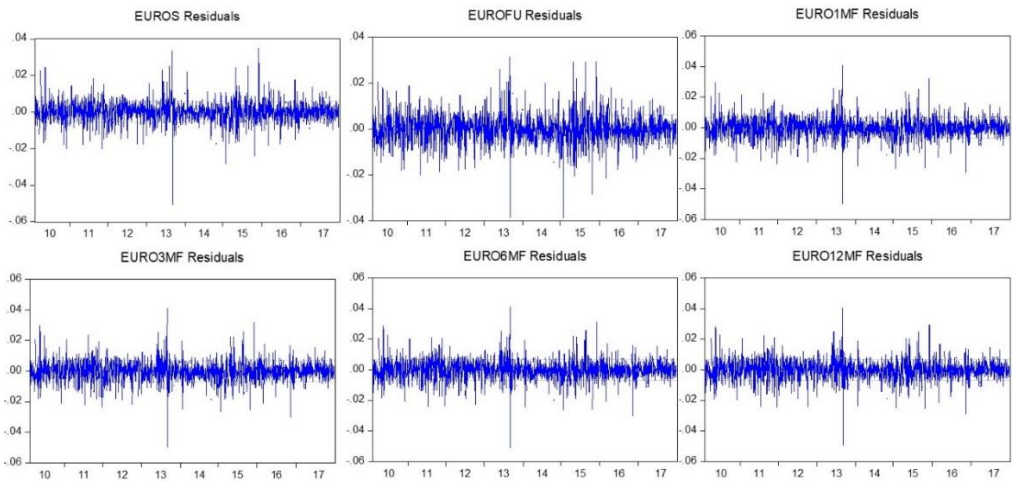
The residuals of the USD forwards series show the presence of clustering volatility.

Graph 7.3: VECM Residuals – GBP



The residuals of the GBP futures and forwards series show the presence of clustering volatility.

Graph 7.4: VECM Residuals – EURO



The residuals of the EURO futures and forwards series show the presence of clustering volatility. All the graphs indicate the presence of clustering volatility. This result is further confirmed by running White's Heteroskedasticity test. Thus, this White's heteroskedasticity test is also applied on the data to confirm ARCH effect. The results are displayed below in Table 7.4 and 7.5.

Table 7.4: VAR Residual Heteroskedasticity Test

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)								
Currency	**Chi-sq**	**Prob.**	**Dependent Chi-Sqaure**					
			res1*res1	**Prob.**	**res2*res2**	**Prob.**	**res2*res1**	**Prob.**
USDFw1m	416.4099	0.0000	261.0653	0.0000	259.6555	0.0000	260.5132	0.0000
USDFw3m	446.9802	0.0000	249.698	0.0000	252.4708	0.0000	251.2419	0.0000
USDFw6m	612.6406	0.0000	300.9335	0.0000	310.8823	0.0000	305.6841	0.0000
USDFw12m	501.9764	0.0000	223.7152	0.0000	233.2141	0.0000	228.1608	0.0000

The null hypothesis that the residuals are homoscedastic is rejected for the time series. The table above clearly display that the time series is heteroskedastic. Since, the VAR residuals show the presence of clustering volatility and heteroskedasticity, this settles the existence of ARCH effect in the data series which justifies using GARCH models.

Table 7.5: VEC Residual Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)								
Currency	**Chi-sq**	**Prob.**	**Dependent Chi-Sqaure**					
			res1*res1	**Prob.**	**res2*res2**	**Prob.**	**res2*res1**	**Prob.**
USDFU	1309.1	0.0000	627.721	0.0000	470.2158	0.0000	509.8655	0.0000
GBPFU	617.3561	0.0000	130.1996	0.0000	141.7757	0.0000	122.9372	0.0000
GBPFw1m	266.2724	0.0000	111.2769	0.0000	113.0278	0.0000	112.1251	0.0000
GBPFw3m	228.3002	0.0000	110.2337	0.0000	113.0422	0.0000	111.4251	0.0000
GBPFw6m	220.9304	0.0000	52.71947	0.0000	58.77816	0.0000	55.31517	0.0000
GBPFw12m	199.4764	0.0000	53.85893	0.0000	57.87651	0.0000	55.27993	0.0000
EUROFU	474.3233	0.0000	278.6141	0.0000	232.9339	0.0000	239.2633	0.0000
EUROFw1m	387.1328	0.0000	242.4362	0.0000	244.092	0.0000	243.3622	0.0000
EUROFw3m	484.3974	0.0000	267.6166	0.0000	271.7813	0.0000	269.7971	0.0000
EUROFw6m	407.9651	0.0000	215.8183	0.0000	235.5215	0.0000	225.4802	0.0000
EUROFw12m	441.5586	0.0000	219.4081	0.0000	248.2325	0.0000	233.1787	0.0000

The null hypothesis of homoscedasticity of residuals is rejected for the time series. The result clearly display that the time series is heteroskedastic. Since, the VECM residuals show the presence of clustering volatility and heteroskedasticity, this confirms the presence of ARCH effect in the data series which justifies using GARCH models.

Since, the ARCH effect is confirmed in both the series, the dynamic GARCH models are applied on the data series to check for hedge effectiveness.

7.5 Multivariate GARCH models

7.5.1 Model Specification

(i) Constant Conditional Correlation (CCC) MGARCH

This model is provided by Bollerslev in 1990. This model has constant conditional correlations which are proportional to the product of corresponding or matching conditional standard deviations. This restriction makes the model parsimonious as it reduces the quantity of unknown parameters. This also simplifies the estimation of the model (Bauwens et al. 2006). The following equation defines the model:

$$H_t = D_t R D_t \quad \text{.....(XVI)}$$

where, R is a matrix containing constant conditional correlation ρ_{ij} and D_t is diag($h_{11t}^{½}$,…., $h_{NNt}^{½}$). This model can be rewritten as:

$$H_t = \rho_{ij} (h_{iit}\, h_{jjt})^{1/2} \quad \text{.....(XVII)}$$

This model has a GARCH (1,1) specification for each conditional variance in D_t:

$$h_{iit} = \omega_i + \alpha_i \epsilon_{i,t-1}^2 + \beta_i h_{ii,t-1} \quad \text{.....(XVIII)}$$

where, i = 1,……,N

H_t is positive definite if and only if all the N conditional variances are positive and R is positive definite.

This model makes the assumption that the conditional correlations are time-invariant. This assumption is unrealistic and hence, Engle (2002) proposed generalized version of CCC which is DCC model that makes conditional correlation as time-variant.

(ii) DCC–MGARCH (Dynamic Conditional Correlation)

This model is introduced in 2002 by Engle with the biggest advantage that the conditional variance and covariance for two related series are modeled simultaneously. This model therefore provides time varying hedge ratio. The conditional covariance matrix for this model is presented below. The equation displays the correlation matrix and the conditional standard deviations as:

$$H_t = D_t R_t D_t \text{..(XIX)}$$

where D_t is diag($h_{1t}^{½}$,…., $h_{1t}^{½}$) and R_t is the correlation matrix and both are designed to be time-varying.

where,

$$h_{it} = \alpha_{i0} + \sum_{q=1}^{Qi} \alpha_{iq}\, \alpha_{i,t-q}^2 + \sum_{p=1}^{Pi} \beta_{ip}\, h_{i,t-p} \text{.....................(XX)}$$

R_t is the conditional correlation matrix of the standardized disturbances ϵ_t, i.e.

$$\epsilon_t = D_{-1}^{t} \alpha^t \sim N(0, \mathrm{R}_t) \text{..(XXI)}$$

(iii) Hedge Ratio and Hedge Effectiveness

The following equation estimates optimal hedge ratio for multivariate GARCH models:

$$\gamma_t |\, \Omega_{t-1} = \frac{h_{SF,t}}{h_{F,t}} \text{ .... (XIV)}$$

γ_t = This is optimal hedge ratio at time t

Ω_{t-1} = Information set available at time t-1

$h_{SF,t}$ = Conditional Covariance between spot and futures at time t

$h_{F,t}$ = Conditional Variance of the future at time t

The following equation estimates optimal hedge effectiveness for multivariate GARCH models:

$$HE = [\frac{variance_{unhedged} - variance_{hedged}}{variance_{unhedged}}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(XV)}$$

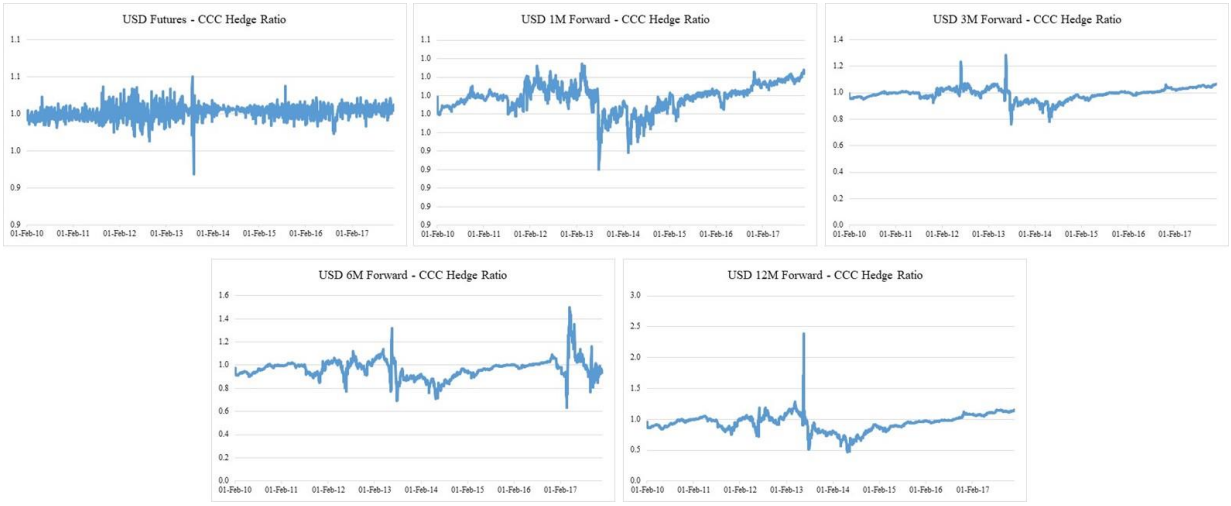
Hedge effectiveness ratio indicates the efficiency with which a company's hedging instrument, here a forward or future, protects the value of specified asset, here forex.

Higher value of HE specifies higher hedge effectiveness and more reduction in risk. Thus, hedging method with higher HE indicates better hedging strategy. This methodology is consistent with Ku et al. (2007) and Chang et al. (2013).

7.5.2 Empirical Result and Discussion

The dynamic GARCH models provides the hedge ratio for each day. These ratios are plotted on a graph to show the movement of hedge ratio for the entire time period selected for the study. The optimal hedge ratio (HR) calculated from the CCC–GARCH model for the futures and forwards contracts is displayed below in Graph 7.5, 7.6 and 7.7.

Graph 7.5: Dynamic Hedge Ratio – CCC GARCH USD

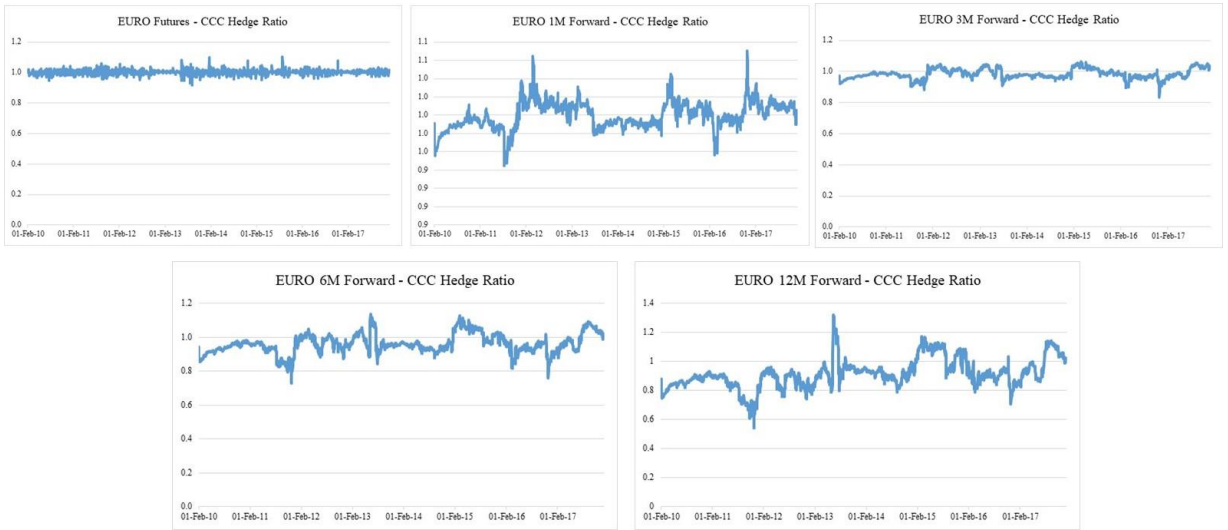


The hedge ratio (HR) attained in CCC-GARCH model for USD futures and forwards contracts changes every day for the entire sample period into consideration. This is reflected in the fluctuations in the graph line.

Graph 7.6: Dynamic Hedge Ratio – CCC GARCH GBP

The hedge ratio (HR) attained in CCC-GARCH model for GBP futures and forwards contracts changes every day for the entire sample period into consideration. This is reflected in the fluctuations in the graph line.

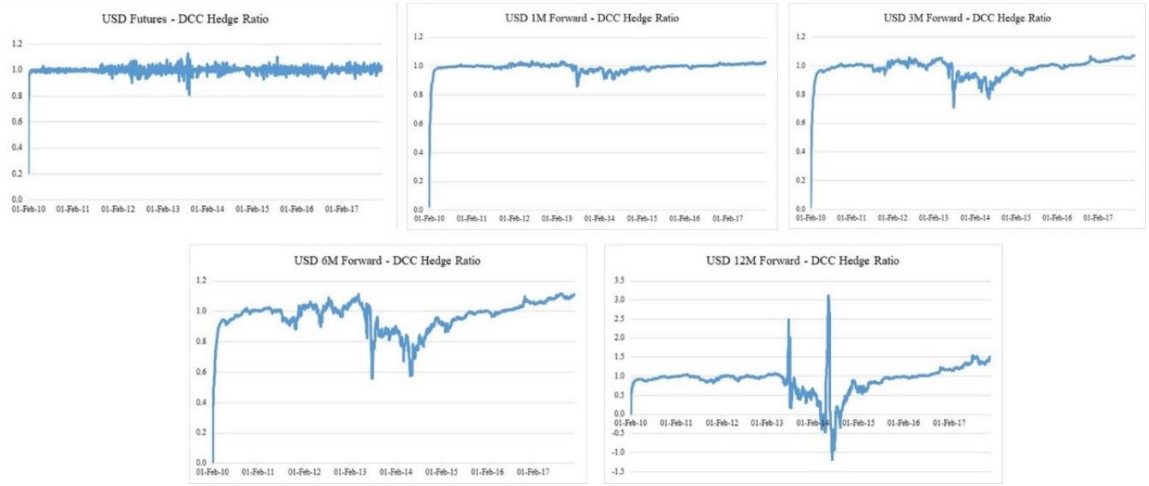
Graph 7.7: Dynamic Hedge Ratio – CCC GARCH EURO



The hedge ratio (HR) attained in CCC-GARCH model for EURO futures and forwards contracts changes every day for the entire sample period into consideration. This is reflected in the fluctuations in the graph line.

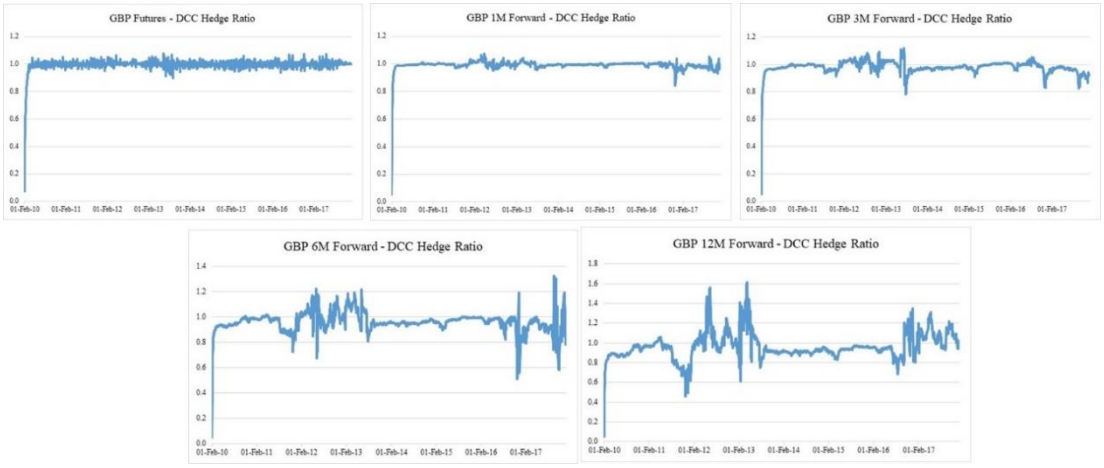
The dynamic GARCH models provides the hedge ratio for each day. These ratios are plotted on a graph to show the movement of hedge ratio for the entire time period selected for the study. The optimal hedge ratio (HR) estimated from the DCC model is presented below Graph 7.8, 7.9, 7.10.

Graph 7.8 – Dynamic Hedge Ratio – DCC GARCH USD



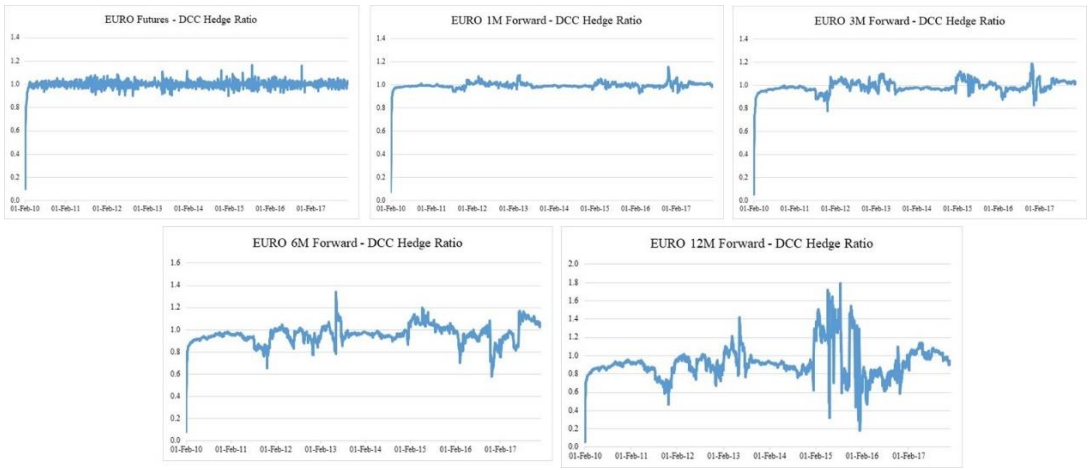
The hedge ratio (HR) attained in DCC–GARCH model for USD futures and forwards contracts changes every day for the entire sample period into consideration. This is reflected in the fluctuations in the graph line.

Graph 7.9 – Dynamic Hedge Ratio – DCC GARCH GBP



The hedge ratio (HR) attained in DCC-GARCH model for GBP futures and forwards contracts changes every day for the entire sample period into consideration. This is reflected in the fluctuations in the graph line.

Graph 7.10 – Dynamic Hedge Ratio – DCC GARCH EURO



The hedge ratio (HR) attained in DCC-GARCH model for EURO futures and forwards contracts changes every day for the entire sample period into consideration. This is reflected in the fluctuations in the graph line.

The dynamic hedge ratios displayed in the above graphs for both dynamic models are less stable and have pronounced fluctuations in comparison to the static hedge ratio. This is also the basic difference between the static and dynamic hedge ratio. This implies that the hedger must continuously regulate his forwards and futures (derivative) position in the currency derivatives market more often. Comparing the overall results of both the dynamic models, the hedge ratios obtained under DCC-GARCH for all the three currencies are more dynamic than the hedge ratios obtained under CCC-GARCH.

This outcome is not startling as both the models decomposes the covariance matrix into two parts – (a) the standard deviation matrix and (b) the correlation matrix. Under DCC model both parts of covariance matrix are active (dynamic) but under CCC model only former (deviation matrix) is dynamic. As a result, the HR (hedge ratio) is more dynamic or fluctuating in DCC-GARCH model. Park and Jei (2010) explained that the hedge performance deteriorates for the model where the HR (hedge ratio) are more unstable. As, HE (hedge effectiveness) is the indicator of the hedging performance, the results of HE (hedge effectiveness) for both the dynamic models (CCC-GARCH and DCC-GARCH) are shown in Table 7.6 and Table 7.7 respectively.

Table 7.6 – Hedge Ratio & Effectiveness – CCC MGARCH

Currencies	Contract	Hedge Ratio	Hedge Effectiveness
USD	Futures	1.0025	0.9996
	Fwd 1M	0.9980	0.9999
	Fwd 3M	0.9913	0.9993
	Fwd 6M	0.9705	0.9975
	Fwd 12M	0.9455	0.9921
GBP	Futures	1.0029	0.9991
	Fwd 1M	0.9938	0.9999
	Fwd 3M	0.9834	0.9996
	Fwd 6M	0.9634	0.9988
	Fwd 12M	0.9575	0.9965
EURO	Futures	1.0026	0.9987
	Fwd 1M	0.9999	0.9999
	Fwd 3M	0.9841	0.9994
	Fwd 6M	0.9633	0.9980
	Fwd 12M	0.9192	0.9928

The dynamic hedge ratio under CCC-GARCH model for USD futures contract is more than one percent and hedge effectiveness for this contract is more than 99 percent. The hedge ratio for USD 1-month forwards contract is 99.8 percent, 3-month forwards contract is 99.1 percent, 6-month forwards contract is 97 percent and 12-month forward contracts is 94.5 percent. This hedge ratio is highest for 1-month forward derivatives contract. The hedge effectiveness for all the forwards contract is more than 99 percent. Overall, the 1-month forward contract have more hedge effectiveness which is 99.99 percent.

The dynamic hedge ratio under CCC-GARCH model for GBP futures contract is more than one percent and hedge effectiveness for this contract is more than 99 percent. The hedge ratio for GBP 1-month forwards contract is 99.3 percent, 3-month forwards contract is 98.3 percent, 6-month forwards contract is 97.3 percent and 12-month forward contracts is 95.7 percent. This hedge ratio is highest for 1-month forward derivatives contract. The hedge effectiveness for all the forwards contract is more than 99 percent. Overall, the 1-month forward contract have more hedge effectiveness which is 99.99 percent.

The dynamic hedge ratio under CCC-GARCH model for EURO futures contract is more than one percent and hedge effectiveness for this contract is more than 99 percent. The hedge ratio for EURO 1-month forwards contract is 99.9 percent, 3-month forwards contract is 98.4 percent, 6-month forwards contract is 97.3 percent and 12-month forward contracts is 91.9 percent. This hedge ratio is highest for 1-month forward derivatives contract. The hedge effectiveness for all the forwards contract is more than 99 percent. Overall, the 1-month forward contract have more hedge effectiveness which is 99.99 percent.

Table 7.7 – DCC GARCH – Hedge Ratio & Effectiveness

Currencies	Contract	Hedge Ratio	Hedge Effectiveness
USD	Futures	1.0024	0.9964
	Fwd 1M	0.9919	0.9934
	Fwd 3M	0.9835	0.9915
	Fwd 6M	0.9677	0.9900
	Fwd 12M	0.9100	0.9370
GBP	Futures	0.9974	0.9919
	Fwd 1M	0.9909	0.9959
	Fwd 3M	0.9801	0.9952
	Fwd 6M	0.9641	0.9853
	Fwd 12M	0.9646	0.9867
EURO	Futures	0.9994	0.9926
	Fwd 1M	0.9969	0.9969
	Fwd 3M	0.9890	0.9946
	Fwd 6M	0.9627	0.9945
	Fwd 12M	0.9254	0.9740

The dynamic hedge ratio under DCC-GARCH model for USD futures contract is more than one percent and hedge effectiveness for this contract is more than 99 percent. The hedge ratio for USD 1-month forwards contract is 99.2 percent, 3-month forwards contract is 98.3 percent, 6-month forwards contract is 96.7 percent and 12-month forward contracts is 91 percent. This hedge ratio is highest for 1-month forward derivatives contract. The hedge effectiveness for all the forwards contract is more than 90 percent. Overall, the 1-month forward contract have more hedge effectiveness which is 99.34 percent.

The dynamic hedge ratio under DCC-GARCH model for GBP futures contract is 99.74 percent and hedge effectiveness for this contract is more than 99 percent. The hedge ratio for GBP 1-month forwards contract is 99.1 percent, 3-month forwards contract is 98 percent, 6-month forwards contract is 96.4 percent and 12-month forward contracts is 96.4 percent. This hedge ratio is highest for 1-month forward derivatives contract. The hedge effectiveness for all the forwards contract is more than 98 percent. Overall, the 1-month forward contract have more hedge effectiveness which is 99.59 percent.

The dynamic hedge ratio under DCC-GARCH model for EURO futures contract is 99.94 percent and hedge effectiveness for this contract is more than 99 percent. The hedge ratio for EURO 1-month forwards contract is 99.7 percent, 3-month forwards contract is 98.9 percent, 6-month forwards contract is 96.2 percent and 12-month forward contracts is 92.5 percent. This hedge ratio is highest for 1-month forward derivatives contract. The hedge effectiveness for all the forwards contract is more than 97 percent. Overall, the 1-month forward contract have more hedge effectiveness which is 99.69 percent.

Both dynamic models offer comparable results and there is not much variation in the effectiveness estimates with either of the approaches. Considering the optimal HR (hedge ratio), it is more than one for both and HE (hedging effectiveness) is also near to hundred percent. Comparison of the outcome of HE (hedge effectiveness) demonstrates that the CCC model provides better results than DCC model. However, since DCC is theoretically a better model as it takes both the correlation and standard deviation matrix as time varying. Considering that both the models give hedge effectiveness as close to 100%, DCC should be preferred by the companies.

The treasurers of the company would be benefitted by the use of these dynamic models. The policy makers should make an effort to popularize these models. They should arrange for workshops and conferences for the treasurers to acquaint them with these models.

7.6 Conclusion

This chapter compared different static and dynamic models for assessing the effectiveness of hedges assumed to accommodate the exchange rate risk. Static models which comprise of OLS model, VAR model and VEC model, do not consider time-varying heteroskedasticity of the residuals and therefore, suffer from the limitation of being static. The dynamic series of exchange rate changes should therefore be studied with dynamic models. The two multivariate GARCH models – CCC and DCC overcome the limitations of the static models and provide a more appropriate result of the hedge effectiveness analysis.

Chapter 8

Chapter 8: Result Interpretation and Implications

8.1: Introduction

The primary data analysis helped in determining the practices of Indian companies for handling the foreign exchange (forex or currency) risk. The secondary data analysis helped in determining the effective derivative for hedging the risk and also identified the optimal model for evaluating hedge effectiveness. This chapter brings examination of primary data and secondary data together with the help of a case of an Indian company to identify the challenges faced by the firms or companies in making changes in the present risk management guidelines and the role of policy makers in assisting the companies in implementing these changes.

8.2 Primary Data Analysis Interpretation

The primary data assembly in the present study worked towards achieving the first objective which was to study the practices or methods adopted by the companies to handle the foreign exchange (forex or currency) exposure in India. It was found that the majority of the companies had a separate Treasury department which formulated centralized risk management guidelines for managing the currency risk and ensured that these guidelines were properly followed. This policy warranted that the company followed an active and risk averse foreign exchange exposure management process. Further, these documented guidelines clearly defined the foreign exchange (forex or currency) exposure, the aim and objectives of the exposure management, the procedure for the management of the same, specified the maximum and minimum allowed exposure, the permissible derivatives, hedging methods, trading techniques, time horizon and performance evaluation measures.

It was further found that the companies focused on managing the transaction exposure since it provided them with a clear picture of the profit and loss. Treasurers also pointed out that the transaction risk was easy to calculate and manage. The treasurers mentioned that since the translation exposure was not a real exposure and resulted only when the accounting statements of all the subsidiaries were converted to home currency, therefore, they did not put much effort in

managing the translation exposure. Majority of the treasurers found the economic exposure as difficult to measure and manage and therefore this exposure was also ignored. This result is supported by the literature and is reinforced by Collier and Davis (1985), Collier et al. (1992), Belk and Edelshain (1997), Bradley & Moles (2001), Marshall (2000), Glaum (2000), Aabo (2001), Bartram et al. (2005)

Majority of the companies used both financial (external) hedges and operational (internal) hedges to manage the currency risk. Treasurers found the operational hedges to be naturally occurring during the course of operations and maintained that they assisted the financial hedges in the currency (forex or FX) risk management for the company. Treasurers further explained that they used financial hedges for covering the exposure as soon as this exposure was triggered which could be any stage of a business operation. However, they did point out that since the currency market was ever fluctuating and dynamic, they used simpler derivative tools like futures and forwards for managing the currency exposure. This result was also supported in the literature by Stanley and Block 1980, Belk and Edelshain 1997, Duangploy, Bakay and Belk (1997), Debasish (2008), Sivakumar and Sarkar (2008), Maniar (2010), Mittal et al. (2015) and Dalvadi and Warrier (2017). The present study identified forward contract as the most popular derivative used by the company followed by futures contract. Companies preferred using these simple instruments over complex derivative instruments. Further, treasurers explained that since the Indian currency market was dynamic in nature, they took a forward or future cover for either three months or six months.

The present study found that the treasurers managed their derivative position using basic tools like excel. Other tools which helped the companies in maintain their position were auxiliary systems like SAP and ERP and database software like Reuters and Bloomberg. These databases were used by only few companies to estimate the derivatives quotes. Treasurers refrained from using sophisticated statistical analysis like VaR analysis, LP analysis, Covariance analysis and stress testing for evaluating their hedges. Over 60 percent of firms or companies did not use any of these methods for evaluating their position. The treasurers cited that their exposures were not complicated to require major statistical analysis and they preferred to keep things simple, basic and easy for evaluation.

One surprising finding of the study was to note that hedging ratio and hedging effectiveness which academically were important steps for successfully hedging a risk were not entirely followed by the companies. 48 percent of the companies did not calculate the HR (hedge ratio). The companies which calculated the effectiveness of the hedge generally preferred conducting a what-if analysis followed by checking the impact of hedging on profitability. Other than this, companies also used methods like benchmarking and back-testing for evaluating hedge effectiveness. But these were not supported by statistical analysis for evaluating hedge ratio (HR) and hedge effectiveness (HE). The treasurers of the companies were aware of the regression analysis for evaluating hedge ratio and effectiveness but most of them had not even heard about the advanced statistical models ARCH or GARCH methods. The treasurers mentioned that these methods were complicated for them to understand and use effectually.

The study conducts the secondary data examination in order to supplement the primary study. As the treasurers shoulder the responsibility of making effective hedging decision, the secondary data analysis aids in identifying most suitable hedging instrument which the company should use. The secondary data investigation also assists in identifying a suitable method of evaluating hedge effectiveness. Since the companies were hesitant in sharing their data on hedging the foreign exchange risk, the study drew inferences from the primary data and collected the secondary data of the popular currency derivative (forwards and futures) which were used by the firms or companies for hedging the foreign exchange (forex or FX) risk faced by them against three major currencies. Majority of the companies faced the forex or currency risk against USD, GBP and EURO. The secondary data therefore, was collected for currency forwards and futures for USD, GBP and EURO.

8.3 Secondary Data Analysis Interpretation

The second objective of examining the efficiency of the forex (FX or currency) market in India and third objective of evaluating the hedge effectiveness were examined using secondary data analysis. The efficiency of the currency market was evaluated using cointegration method. The outcomes of the present research study confirmed cointegration between the futures market of all the three currencies and for GBP and EUROS forward market. There was no cointegration

between the USD forward market. The cointegration confirmed a long-run association between the derivative-spot market. This long run connection was an indication of inefficiency. The present study identified the futures market for USD, GBP and EURO and the forwards market for GBP and EURO to be inefficient and USD forward market to be efficient. Major reason for the efficiency could be the extensive and wide-spread use of USD forwards by different market players. USD forwards were a popular instrument which saw a surge in trade from USD 848 million in December 2016 to USD 1827 million in December 2017. This continuous increase in the use of USD forwards had made this market efficient. da-hsiang (1996) stated that the ignoring cointegration amid market variables (which was a reflection of the market inefficiency), would make a hedger choose a less optimal hedging position. Therefore, reviewing and examining this idea was significant for the treasurers of the firms, the analyst for the markets, and the makers of policies etc.

The present study applied static and dynamic models for evaluating the effectiveness of the futures hedging strategy and the forwards hedging strategy. Initially, the OLS model was applied for assessment of the HR (hedge ratio) and (HE) hedging effectiveness. The results showed that the 1-month forward contract was the most effective contract and the hedge effectiveness was more than 99 percent for all the markets. As the futures-spot data series for all the three currencies, and forward and spot series for GBP and EURO were cointegrated, VECM technique was used to determine the hedge ratio (HR) and hedge effectiveness (HE) whereas VAR was used for USD forward market which was not cointegrated. The results for HR and HE of VAR and VECM method showed that hedge ratio is less than one for the futures market for all the three currencies but it is more than one for the forwards market for all the three currencies.

The time series data suffered from the problem of autocorrelation of residuals and heteroskedasticity. Therefore, the results provided by the OLS, VAR and VECM (static) techniques were inappropriate. This study therefore, applied dynamic techniques for the assessment of HR and HE. The results for hedge ratio under CCC-GARCH and DCC-GARCH showed that the hedge ratio for the futures and forwards contract to be close to one. When the hedge ratio approaches one it indicates that the exposure regarding the changes in the primary asset, here a currency, moves down. The effectiveness for both CCC-GARCH and DCC-GARCH

was over 99 percent. Table 8.1 and table 8.2 shows the results of all the models together. Table 8.1 shows the results for all the static models whereas Table 8.2 shows the results of dynamic models.

Table 8.1: Hedge Ratio and Hedge Effectiveness – Static Models

Model		OLS		VAR		VECM	
Currencies	**Contract**	**Hedge Ratio**	**Hedge Effectiveness**	**Hedge Ratio**	**Hedge Effectiveness**	**Hedge Ratio**	**Hedge Effectiveness**
USD	Futures	1.0000	0.9995	-	-	0.6778	0.6143
	Fwd 1M	0.9986	0.9999	1.0008	0.9943	-	-
	Fwd 3M	0.9944	0.9993	1.0033	0.9876	-	-
	Fwd 6M	0.9842	0.9975	1.0076	0.9711	-	-
	Fwd 12M	0.9561	0.9921	1.0015	0.9315	-	-
GBP	Futures	0.9988	0.9991	-	-	0.7067	0.6680
	Fwd 1M	0.9938	0.9999	-	-	1.0012	0.9966
	Fwd 3M	0.9813	0.9996	-	-	1.0044	0.9924
	Fwd 6M	0.9608	0.9988	-	-	1.0046	0.9822
	Fwd 12M	0.9180	0.9965	-	-	1.0006	0.9586
EURO	Futures	0.9996	0.9987	-	-	0.7615	0.7031
	Fwd 1M	0.9913	0.9999	-	-	1.0009	0.9966
	Fwd 3M	0.9737	0.9993	-	-	1.0037	0.9933
	Fwd 6M	0.9453	0.9978	-	-	1.0019	0.9840
	Fwd 12M	0.8858	0.9924	-	-	1.0029	0.9619

Table 8.2: Hedge Ratio and Hedge Effectiveness – Dynamic Models

Model		CCC-MGARCH		DCC-MGARCH	
Currencies	Contract	Hedge Ratio	Hedge Effectiveness	Hedge Ratio	Hedge Effectiveness
USD	Futures	1.0025	0.9996	1.0024	0.9964
	Fwd 1M	0.9980	0.9999	0.9919	0.9934
	Fwd 3M	0.9913	0.9993	0.9835	0.9915
	Fwd 6M	0.9705	0.9975	0.9677	0.9900
	Fwd 12M	0.9455	0.9921	0.9100	0.9370
GBP	Futures	1.0029	0.9991	0.9974	0.9919
	Fwd 1M	0.9938	0.9999	0.9909	0.9959
	Fwd 3M	0.9834	0.9996	0.9801	0.9952
	Fwd 6M	0.9634	0.9988	0.9641	0.9853
	Fwd 12M	0.9575	0.9965	0.9646	0.9867
EURO	Futures	1.0026	0.9987	0.9994	0.9926
	Fwd 1M	0.9999	0.9999	0.9969	0.9969
	Fwd 3M	0.9841	0.9994	0.9890	0.9946
	Fwd 6M	0.9633	0.9980	0.9627	0.9945
	Fwd 12M	0.9192	0.9928	0.9254	0.9740

Comparing different contracts for hedge effectiveness, the table showed one-month forwards contract as the most effective method of hedging. The reason for this was the dynamic nature of the currency market. Since the exchange rate moved rapidly, their impact was significant on the cash outflows. It made more sense for the treasurers to update their hedging position frequently. The one-month forward contracts were more effective because they took the dynamic nature of the currency market into cognizance and such short period contracts could be managed and updated easily in comparison to the long period contracts. Comparing different methods of evaluation of hedge effectiveness, the table showed CCC-GARCH for the futures and forward contracts across all the currencies. The result therefore, confirm dynamic model to be more effective than the static model. This result is unswerving with Kumar et al. (2008), Yang and Allen (2005), Casillo (2004), Ku et al. (2007), Choudhry (2004), Rao and Thakur (2008), Yang and Pavlov (2011), Pradhan (2011) and Jampala et al. (2015).

Since the results clarify 1-month forward as the most effective, and dynamic models as better for evaluating hedge effectiveness, the treasurers should adopt these for hedging purposes. The policy makers should assist the company in this regard.

8.4 Uniting Primary and Secondary Data Analysis

The results obtained from the secondary data analysis were shared with the respondents who were the treasurers of the companies in the sample. The treasurers accepted the results of the study and agreed that one-month forward contract would be more effective in dipping the risk of the exposure. The treasurers also agreed that dynamic models would provide better results on hedge effectiveness than OLS and other static models as they would better capture the essence of the forex or the currency market. But the treasurers listed few hurdles in implementing these results.

First, the treasurers highlighted that the use of complex models and application of the results of dynamic models would increase the cost of hedging. Treasurers explained that booking a hedging position with one-month forward would mean that rolling over this position for the next time period in case of a long duration exposure which adds to the cost. Moreover, adjusting the hedging position on a daily basis as recommended by the dynamic hedge ratio would also lead to increase in cost and effort. Second, maintaining hedges for risk management is the small part of the treasurer's entire job description. Regular maintenance of the currency hedges would disrupt their job balance. Third, treasury managers have limited knowledge of the complex statistical models and lack expertise on it. They further shared the concern that it becomes difficult to recognize and hire individuals with strong statistical knowledge of the models. Fourth, the companies already have risk management guidelines in place and further improvements must be approved by the board, it becomes difficult to explain complex models to the board and get their approval for the same. Fifth, the managers insisted that their simple hedging efforts do not require using these complex models. Sixth, they explained their current practices are providing them results and they don't see a need to change to these complex models. Lastly the managers admitted that these models are difficult to understand and should be made simple for them to understand and apply.

8.5 Foreign Exchange (forex or FX) Risk Management: A Case of Indian Company

To paraphrase the words of Kathleen M. Eisenhardt (1989), developing a case study works as a research strategy that is focused on understanding and examining the dynamics within a solitary setting. The results of the primary data analysis and secondary data analysis are generic in nature and may apply to the companies in general. In order to make the results more customized and understand the currency risk management practice of a company in India and application of the hedging practices more accurately, the following case was developed for an Indian IT company after an in-depth discussion with the CFO of this company. The identity of the respondent has been kept confidential at his request. This IT company is therefore, called ABC Ltd. The case discusses the foreign exchange (forex or FX) risk management practices of this company, focuses on the methods used for evaluation of hedge effectiveness and the role of treasurers and managers in formulation of hedging strategies. The outcomes of the secondary data analysis in the present research study was shared with the CFO to gain his insights on the analysis.

8.5.1 Company Background

ABC Ltd. is Indian multinational (MNC) company which offers business consulting, information technology (IT) and outsourcing services to its clients spread across the world. The company was established in the early 1990s with the idea of providing customized software to their customers. Since its inception the company has grown leaps and bounds with its business operations and services established the world over. This growing business meant dealing with multiple currencies and increased level of currency risk for the company. The CFO of the company explained that since more than 90 percent of their revenues and expenditures are in foreign currency, they take their currency risk (forex or FX) management very seriously. The CFO further added that for the first ten years of the business, they used to only keep track of the foreign exchange rate movement and book a forward only in case they foresee huge exchange rate movements.

The Indian foreign exchange market was also highly regulated in beginning 1990. Reserve Bank of India adopted market-determined exchange rate in 1993. The Reserve Bank of India used to maintain proper control over the exchange rate movements and intervene in case of an adverse movement with the objective to maintain methodical conditions in the foreign exchange (FX or forex) market (Prakash 2012). The CFO agreed that this control of RBI over the untoward foreign exchange rate movement always provided them with the cushion against any serious damage. But now the Indian central bank has been reducing its role as an interventionist in the market and is promoting the firms to hedge their FX risk. Therefore, the responsibility of their company has increased. Moreover, the dynamic nature of the currency market makes it necessary for the company to handle the currency (FX) risk.

ABC Ltd. dedicatedly followed hedging only after the sub-prime crises of 2008-2009 when the company faced serious business losses because of untoward movement of USD against Rupee. They strictly follow the board-approved risk management guidelines put in place by the top management for hedging of the forex (FX) rate risk. These guidelines are based on their business model and cover the details about the determination of the exposure and hedging of the exposure.

8.5.2 Hedging the foreign exchange risk

ABC Ltd. is a pioneer Indian company that has changed the way the world looks at India and has set high standards of expectations from an Indian multinational company. The CFO mentioned that they used forward contracts of 1-month and 3-month duration to hedge their currency risk since the year 2010. The company has a dedicated risk management team which is concerned with implementing the documented guidelines on currency risk management. These documented guidelines define the currency risk and provide details about the entire process of hedging the risk including the target level of exposure, hedging methods to be used, the permissible derivatives and the time horizon for taking a hedging position. The CFO clarified that these risk management guidelines are formulated by the top-level executive after taking a feedback of the treasurers and risk managers. These guidelines are then approved by the board of directors before they are ready for the execution.

Once the forex hedge is undertaken, the company maintains the tracker on MS-Excel to weekly follow the position in the market. At maturity of the contract, the firm or company uses the same tracker to identify whether the hedge was effective. The risk management guidelines of the company have specified that the hedge would be called as effective if the contract at the maturity made them better off than no hedging scenario. For this they compare the prices with the underlying i.e. the spot on the day of the maturity. The CFO mentioned that they also use 'what if' analysis but no specific statistical method. Table 8.3 shows the foreign exchange exposure of ABC Ltd. over the from 2010 to 2017.

Table 8.3 Foreign Exchange Exposure of ABC Ltd.

Year	FX Exposure (in millions)		
	USD	GBP	EURO
2010	4406678	2611907	1389131
2011	6733274	4542054	1767743
2012	4775396	2122555	1314753
2013	5111398	3714905	902436
2014	3893172	2074693	1977308
2015	6360199	4090182	1267691
2016	5245762	2679996	1985610
2017	6326203	2524415	1119036

8.5.3 Importance of implementing the hedging effectiveness methods

Although the policy makers, the world over, have been promoting the usage of derivatives for hedging the currency risk. They also realize the strong and far-reaching impact of a wrong hedging decision on the company financials as well as the foreign exchange (FX) market. The policy makers therefore, have updated the accounting norms for hedging. The Indian policy makers and RBI have issued the new accounting standards called Ind-AS which mandate the companies to identify the effectiveness of hedges assumed for risk management purpose. Although, the earlier accounting guidelines also mentioned evaluating hedge effectiveness, but the previous guidelines maintained that only hedges with 80-125 percent effectiveness should be accounted. This meant that the companies were only recording the hedges which met this range and other hedges were

still unaccounted. The investors and other stakeholders were therefore, not aware of the companies true hedging position. The policy makers realized that this emission of hedging from accounting statements was misleading and therefore the new guidelines removed this 80-125 percent condition. As per the new accounting standards, the companies now were required to account for all the hedges undertaken. Additionally, the standards specify that companies must also choose a quantitative method of evaluating the hedge effectiveness.

The CFO of the ABC Ltd. admitted that they are in process of implementing these new accounting guidelines but also agreed that they do not have a statistical method of evaluating hedge effectiveness for accounting purpose. Describing further, he said that they have a dedicated treasury team which is concerned with implementing hedging for risk management and evaluating hedge effectiveness while the accounts team is responsible for entering the hedges into company financials. The CFO further clarified that the treasurers initially were unclear about what effectiveness meant. He explained that initially treasurers though that the effectiveness meant that they have to hedge the entire exposure for e.g., an exposure of USD 100 million would be called as effective if they hedged this entire UDS 100 million and ineffective if they hedged USD 80 million or USD 120 million. But later the treasurers realized that this was a very crude way of looking at the effectiveness. CFO explained that the definition of the hedging clarified sooner and the treasurers realized that they would have to specifically evaluate the effectiveness of hedge using a statistical model. The CFO described that they maintain a tracker in excel and use it for evaluating hedge effectiveness. He also shared that they also use 'what-if' analysis for this purpose, where they compare the unhedged scenario with hedge scenario. The hedge is termed as effective if the hedging scenario makes the company's financial position better off and it is termed as ineffective, if the hedging scenario makes the company's financial position worse off.

Outlining the role of treasurers and managers of their company in the entire risk management process, the CFO explained that the treasurers and managers follow the already created risk management guidelines. These guidelines are updated annually and the feedback from the treasury team is taken into account for this update. Afterwards, the updated guidelines are vetted from the board before they are followed for risk management purpose.

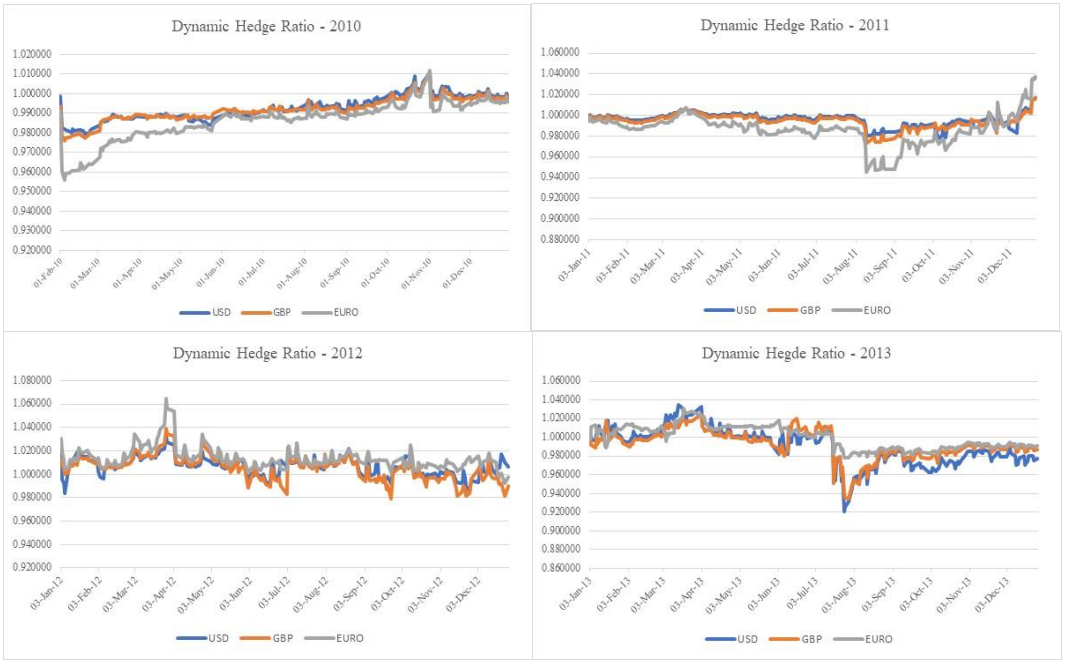
From the information provided by the CFO and information identified from the financials of the company, it was recognized that the company used forwards contracts for three currencies – USD, GBP and EURO for hedging the risk. Further, the treasurer mentioned that they used 1-month and 3-month forward contract for hedging purposes. Extracting this data from the secondary market, the research study identified 1-month forward as the most effective contract. Out of the five models used in the study for evaluating hedge effectiveness, the study showed that dynamic model, CCC-MGARCH provided better results for hedge ratio and hedge effectiveness. On sharing these results with the CFO, he accepted them results and agreed that the 1-month forward could be the most effective instrument for hedging the currency risk since, it locks a position for a short duration only. The results shared are displayed in the table 8.4 below.

Table 8.4 Hedging the Foreign Exchange Exposure of ABC Ltd.

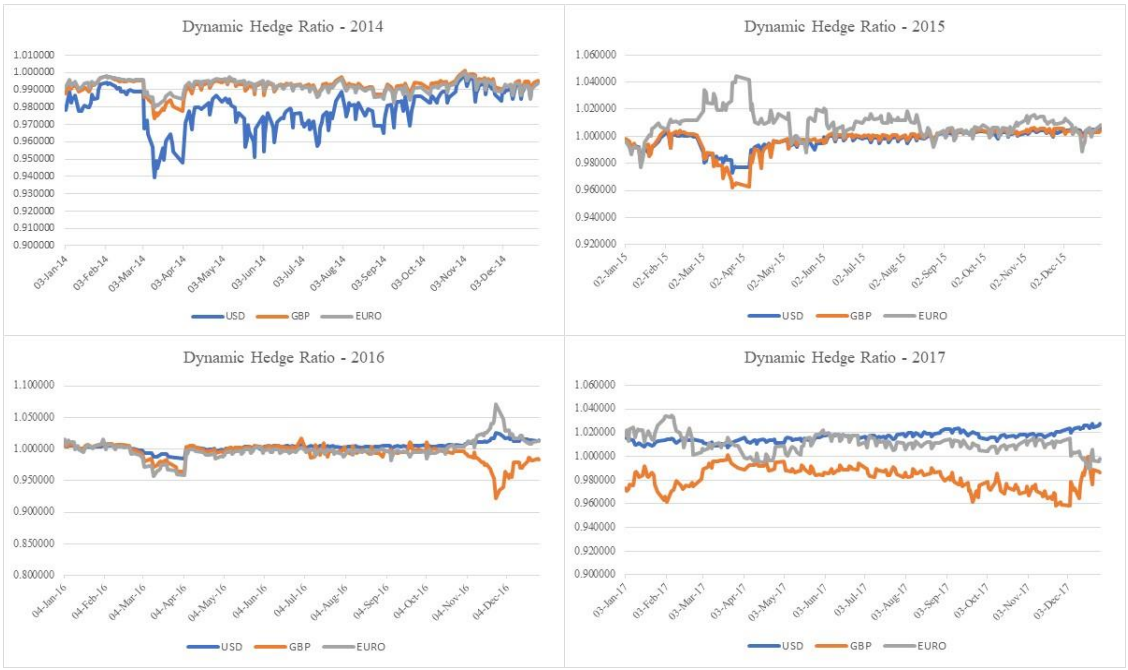
Year	FX Exposure (in millions)			Hedge Ratio - CCC Model (1M Forward)		
	USD	GBP	EURO	USD	GBP	EURO
2010	4406678	2611907	1389131	0.992796	0.992066	0.986434
2011	6733274	4542054	1767743	0.996371	0.994724	0.987435
2012	4775396	2122555	1314753	1.007383	1.006009	1.013951
2013	5111398	3714905	902436	0.990205	0.992342	0.999347
2014	3893172	2074693	1977308	0.978643	0.991594	0.991704
2015	6360199	4090182	1267691	0.997005	0.997054	1.008718
2016	5245762	2679996	1985610	1.003967	0.993872	0.999393
2017	6326203	2524415	1119036	1.016282	0.982357	1.010768
Hedge Effectiveness				**0.999891**	**0.999930**	**0.999880**

The dynamic hedge ratio that the company should maintain every year to achieve the hedge effectiveness of close to 100 percent are displayed in the graphs 8.1 and 8.2.

Graph 8.1: Dynamic Hedge Ratio 2010-2013



Graph 8.2: Dynamic Hedge Ratio 2014-2017



By using this contract, the company can easily meet up with the challenges of the dynamic foreign exchange market.

8.5.4. Challenges faced by the company in implementing statistical model for hedge effectiveness evaluation

The CFO also discussed some of the challenges which the company would have to overcome to implement these changes. First challenge is the cost. The CFO explained that using 1-month forward contract would mean that the company again enter into the forward contract after one month i.e. hedging on a rolling basis. The CFO clarified that this would increase the cost of hedging. Second challenge is convincing he board. The CFO explained that the treasurers and managers followed the guidelines created by the top management and approved by the board. It would be challenging to make them agree to an expensive solution to them. Third challenge is increase in work for treasurers. The CFO clarified that the treasurers have many responsibilities in the company other than managing the foreign exchange hedging position like taking care of borrowings, planning the cash flows, determining financing of operations etc. Following the rolling basis hedging would imply too much work for the treasurers and manager. Fourth challenge was knowledge and skill of the treasurer. The CFO continued that the treasurers and managers lack the specific knowledge to manage the exposure through rolling hedge. They are also unaware about the way to utilize dynamic model of hedging. Therefore, the company would have to train these people or hire new employees for managing this hedge.

8.5.5 Role of the policy makers in assisting companies

It is significant for the firms or companies operating in the dynamic foreign exchange rate market to update their risk management guidelines from time to time. The policy makers also regularly update the regulations concerning foreign exchange risk management. The concern of the policy makers does not close with devising of the policies, instead they need to ensure that the practitioners have actually implemented these changes and are not just trying to fulfill the new requirement by tweaking around the existing practices. The policy makers need to assist the companies in understanding these changes and implementing changes in the existing set of risk management guidelines.

The policy makers need to identify the challenges which the companies face while implementing the new regulations. The policy makers need to understand these ground realities and develop plans to overcome the challenges faced by the companies. They can enlist the help of company auditors to ensure that the companies understand the meaning of hedge effectiveness, use proper models for its evaluation and update their risk management policies as and when the need arises. They can also help by conducting conferences and workshop on foreign exchange (FX or forex) risk management practices so that the companies can benefit from it. This can be done when the policy makers have a sound knowledge of various methods of hedge evaluation and can identify the ones which the company would be most benefitted from and then promoting those methods.

8.6 Conclusion

Foreign exchange risk management is a gradual process which involves regular update in the guidelines and regulation for the same. It is important for the policy makers to sensitize the key market players with these changes and encourage them to create better hedging strategies. The present case highlights the challenges that the firms or companies face in foreign exchange risk management and outlines the ways in which the policy makers can assist the companies in overcoming these challenges. The next chapter offers the conclusion to the entire study.

Chapter 9

Chapter – 9: Conclusion, Recommendation and Future work

9.1 Introduction

The currency market in India is ever dynamic. Internationalization of the companies has put them at the risk of facing losses because of unfortunate foreign exchange fluctuations. Companies majorly hedge the forex risk and use financial as well as operational hedges for the same. Operational hedges are the internal strategies which the treasurers adopt to safeguard the companies from this risk while the financial hedging involve using currency derivatives for the same. The policy makers the world over have realized that the financial hedging could result in damaging consequences for the world financial market if not used properly. This is also proved over time when many financial losses were incurred by the markets because of poor hedging decisions. Therefore, the policy makers the world over have revised the accounting guidelines for the companies to account for the hedges undertaken. Both FASB and IFRS have been revised by the policy makers. Indian policy makers have taken inspiration from IFRS guidelines and have developed new accounting guidelines, Ind-AS for the companies to follow. These guidelines make it compulsory for the firms or companies to estimate the effectiveness of hedge using quantitative methods for analysis. It therefore, becomes important for the companies to revise guidelines and choose a quantitative method of analysis.

Against this backdrop, the present study makes an effort to understand the foreign exchange (forex or FX) risk management practices of the Indian companies. This study conducts the primary data analysis to understand the hedging process which the companies employ for managing the foreign exchange (forex or FX) risk. After identifying the practices of the company for forex risk management, the study recognizes the most used derivative instrument by the companies and common forex currencies against which the companies face this risk. This helped in identifying the secondary data. The study utilizes the secondary data to understand the relationship between forex market variables using cointegration. Further this result assists in selecting the appropriate quantitative technique of evaluating hedge effectiveness.

This chapter of the study lists all the conclusions pertaining to each of the objectives of the study. This chapter also highlights the relevance of the study from the perspective of the treasurers of the companies, policy makers and auditors of Indian companies and researchers globally. It also outlines some recommendations for the companies and policy makers so that they can channelize their efforts in making hedging and its evaluation more practical. The chapter concludes with the limitations or restrictions of the study and describes the source of future research in this area.

9.2 Conclusions drawn

9.2.1 Conclusive statements on objective 1 (*To study the practices/methods that the companies follow to manage foreign exchange (forex or FX) exposure in India*)

To study the practices that the companies follow to handle the foreign exchange (FX) exposure in India, the study conducted in-depth interviews with 100 Indian companies to understand their hedging practices. The analysis revealed that most of the Indian companies faced currency risk generated because of untoward movement of the USD, GBP and EURO exchange rates. These companies had proper risk management guidelines in place which directed the treasurers of the companies on entire risk management process. These documented guidelines were centrally created and dictated the companies to follow an active, risk averse hedging strategy for risk management. These guidelines specified that the hedging to be carried out only for risk mitigation and not for speculation. The guidelines further dictated treasurers of the companies on the permissible derivatives to use for the purpose, the hedging methods to use, maximum exposure which the companies could take, duration of the position etc. In short, these guidelines dictated every detail about the hedging of the foreign exchange (forex or FX) risk management.

The Indian companies followed these risk management guidelines and managed the transaction exposure using forwards or futures contracts to hedge the currency risk generated because of an untoward movement of USD, GBP and EURO. These hedges were taken for a short duration of time generally for three or six months and then the position was updated. Surprisingly, the treasurers revealed that the companies used only MS-Excel software to manage and update their position and did not use any statistical measure like simulation analysis, covariance analysis,

sensitivity analysis etc. Similarly, although these companies did assess the effectiveness of the hedges but they did not use any statistical model like regression or GARCH model for the purpose. Instead, the companies had a very rudimentary view on hedging effectiveness and generally conducted a 'what if' analysis to determine if the hedging was effective. The treasurers further supplemented that their guidelines for risk management were exhaustive in nature. They agreed that the treasurer's knowledge, skill and ability also became an important part of ensuring successful risk management through currency derivative hedging.

With the recent attention on hedge effectiveness, it becomes important for the treasurers to be updated with this knowledge. The academics provide many models for the evaluation of hedge effectiveness, the treasurers must make a sound judgement before choosing a hedging method and an effectiveness model. The next objectives of the thesis helped in appraising this knowledge of the treasurers.

9.2.2 Conclusive statements on objective 2 (*To examine the efficiency of the FX market in India*)

In order to examine the efficiency of foreign exchange (FX or currency) market, the information flows between the market variables were checked using Johansen cointegration test.

I. Outcomes of the Confirmatory Data Analysis

The study first applied confirmatory data analysis to check the unit root in the series. The consequences of this analysis revealed that the time series under consideration was integrated of order one. It was important to identify the unit root in time series data before applying the cointegration method.

II. Outcomes of the Johansen Cointegration Test

The results of the test showed cointegration between the USD futures and spot series, GBP futures and spot series, GBP forwards and spot series, EURO futures and spot series and EURO forward and spot series. There was no cointegration between the USD forwards and spot series. USD forwards is one of the oldest derivative market which involves high trade volume and

multiple player from corporates to banks to institutional investors and retail investors which could be one of the major reasons for no cointegration between the USD forwards and spot.

The presence of the cointegration between the two series is an indication of the inefficiency between the data series. Cointegration implies information flows between the variables. The cointegrated of the two series would be an indication of a short-term disequilibrium. The market forces will work together to correct this short-run disequilibrium and the series would coincide in long-run. This implies that there is a ECM (error correction model) working to correct the error of disequilibrium in short-run and bring both the series together in long-run. The study therefore, further applied an error correction model (ECM) – VECM to identify these informational flows and conclude the inefficiency of the market.

III. Outcomes of the Vector Error Correction Model for informational flows

The results of the VECM to check for the informational flow confirmed the presence of the sort-run disequilibrium.

USD Futures and Spot Market

The outcomes showed that the cointegrating coefficient of the spot market was efficient and this coefficient was also large for spot market than futures market which confirmed that spot (cash) market made greater adjustment to attain long-run equilibrium. This further meant that only spot (cash) market responded to rectify a shock for reaching long-run equilibrium. The price was also discovered in the USD futures (derivative) market.

GBP Futures and Spot Market

The coefficient of the lagged values of variable (independent) were noteworthy for both the spot (cash) and futures (derivative) market which indicated that there was feedback association amid the two markets. The result further showed that cointegrating coefficient for both spot (cash) and futures (derivative) market was significant. This meant that both the markets responded to rectify a shock to reach equilibrium in long-run and therefore, there was presence of feedback connection between GBP derivative and cash market. Further, the cointegrating coefficient was

more for spot (cash) market and less for futures (derivative) market which meant that future was leading spot prices because the adjustment by the spot (cash) prices for finding equilibrium position was more than the futures prices. The futures (derivatives) prices were responding less to disequilibrium.

GBP Forward and Spot Market

The outcomes indicated feedback relationship between the market variables (1-month, 3-month, 6-month forward and spot market) and both the markets responded to rectify a shock to reach long-run equilibrium. Further, the cointegrating coefficient was more for the spot (cash) market and less for the futures (derivative) market which meant that future was leading spot prices because the alteration by the spot prices to find equilibrium position was more than futures (derivative) prices. The futures market was responding less to disequilibrium and thus was leading. However, for the 12-month forward market and spot market, there was no feedback relationship amongst the market variables and the spot market made more adjustment to reach the equilibrium.

EURO Futures and Spot Market

The outcomes showed that the cointegrating coefficient of the spot market was efficient and this coefficient was also large for spot market than futures market which confirmed that spot market made more alteration to find long-run equilibrium. This further meant that only spot market responds to rectify a shock to find long-run equilibrium and the EURO futures (derivative) market lead the spot (cash) market.

EURO Forward and Spot Market

The results indicated feedback relationship between the market variables (3-month, 6-month, 12-month forward and spot market) and both the markets responded to rectify a shock to find long-run equilibrium. Further, the cointegrating coefficient was more for the spot (cash) market and less for the futures (derivatives) market which meant that future was leading spot prices because the alteration by the spot (cash) prices to reach equilibrium position was more than the

futures (derivative) prices and futures was responding less to disequilibrium. However, for the 1-month forward market and spot market, there was no feedback association between the market variables and the spot (cash) market made more alteration to find the equilibrium.

The results safely concluded that the majority of the variables in the Indian foreign exchange (FX or forex or currency) market in the present study exhibited inefficiency of the market. The outcomes further displayed that the future or the forward market i.e., the derivative market, lead the cash market in price adjustment and discovery. Thus, the information flowed from the derivative market to the spot market. This was not surprising since the derivative market was more unstable or volatile than the cash market. The treasurers of the company needed to be aware about the market structure and behavior of the prominent variables before they made a decision like hedging.

9.2.3 Conclusive statements on objective 3 (*To study the effectiveness of foreign exchange financial hedges*)

The study used five models for evaluating the effectiveness of the hedges – OLS technique, VAR technique, VECM technique, CCC-MGARCH technique and DCC-MGARCH technique

I. Results of OLS model

This was one of the oldest and most used models for measuring hedge effectiveness and was based on the concept of variance reduction. This model considered all the hedges with more than 90 percent hedge effectiveness as appropriate. The outcomes of the technique showed that all the derivatives used in the study had hedge effectiveness of more than 90 percent. The model overall showed 1-month forward derivative contract as most effective.

The treasurers had to make an important decision of choosing an appropriate model for evaluating hedge effectiveness. Since OLS model was time-invariant and also ignore the relationship between the market variables, the treasurers should choose a more appropriate model.

II. Results of VAR model

The choice of this technique was based on the premise of cointegration between the market variables. Since, USD forwards were not cointegrated with the USD futures, VAR model was used to evaluate the effectiveness of hedge undertaken through USD forwards. The results showed all the forward contracts with more than 90 percent hedge effectiveness. But 1-month forward had the most hedge effectiveness.

III. Results of VECM model

The choice of this technique was based on the premise of cointegration between the market variables. This model was chosen for the market which exhibited cointegration between different variables namely, USD futures with spot, GBP forward and futures with spot and EURO forward and futures with spot market. The results showed forwards as more effective than futures contracts and 1-month forward for both GBP and EURO emerged with most hedge effectiveness.

IV. Results of CCC-MGARCH model

The models discussed above were static as they suffered from the problem of considering the residuals as time-invariant. The advanced GARCH family models were therefore used to evaluate the hedge effectiveness as they considered residuals are time-variant.

The results of the model provided dynamic hedge ratios which changed every day. This further indicated regular adjustment of the hedge position to make it more effective. Thus, the treasurers should daily update their hedging position to mitigate the risk. Although the hedge effectiveness was more than 90 percent for all the hedging contracts, the results showed that 1-month forward contracts for USD, GBP and EURO as most effective.

V. Results of DCC-MGARCH model

The CCC-MGARCH model suffers from the limitation of considering the standard deviation matric as time-invariant which results in static conditional correlations. In order to remove this unrealistic assumption, DCC-MGARCH model was used for the analysis.

The results of the model provided dynamic hedge ratios which were more volatile than those of CCC model. If the treasures followed this model then they should adjust their hedge position more frequently to make their hedging more effective. Although the hedge effectiveness was more than 90 percent for all the hedging contracts, the results showed that 1-month forward contracts for USD, GBP and EURO as most effective.

The above comparison of different models brought out the limitations and advantages of each model. The treasurers of the company must be aware about these differences before choosing an appropriate model for evaluating hedge effectiveness.

9.2.4 Conclusive statements on objective 4 (*To develop a case study of an Indian company for supporting the findings***)**

To make better comprehend and understand the currency (forex) risk management practice of a company in India and application of the hedging practices more precisely, a case was developed for an Indian IT company after an in-depth discussion with the CFO of this company. This company was called ABC Ltd to keep the respondent as confidential. The case discussed the foreign exchange (forex or FX) risk management practices of this company, focused on the methods used for evaluation of hedge effectiveness and the role of treasurers and managers in formulation of hedging strategies. The secondary data analysis was also conducted and results were shared with the CFO who accepted the results but highlighted four challenges in implementation of the analysis which were increase in the cost of hedging, increase in the work load for treasurers, difficulty in getting the approval from the company board and limited knowledge and skill of the manager to handle the challenging statistical models.

9.3 Implications of the study

9.3.1 Theoretical implications of the study

The present study has identified the linkages between foreign exchange risk management practices followed by the companies, the interrelationship between the variables of the foreign exchange market and their subsequent impact on identifying the effectiveness of the financial hedging of foreign exchange risk. The treasurers of the companies need to understand these inter-linkages and choose the model which not just fits into the risk management policies of the company but is also theoretically apt and sound.

1. The present study differs from the earlier studies in many ways and enriches the existing literature by including qualitative analysis interspersed with quantitative analysis for determining the exchange rate risk hedging by the companies.
2. This study is significant because it is a unique study which analyses the exchange rate risk management and hedging by the Indian companies and attempts to identify the best hedging practices for the same.
3. There are various studies which study the hedge effectiveness and market efficiency separately. This study bridges the gap and highlights as to why these both should be studied together and the importance it holds for the treasurers to make an informed decision.
4. The present research study details out the different aspects of the Indian currency market like evolution of market, structure of market, participants of market and efficiency of market etc.
5. Different Indian studies have attempted to identify the hedging practices of the Indian companies but the present study takes the analysis further and combines it with the rational of foreign exchange (forex or FX) risk management of the policy makers
6. This research study is also a significant theoretical motivation for the researchers who might take this study further and use the techniques and models of the study to identify the hedging practices of the companies in their countries. The future researchers could also refer to the detailed questionnaire used in the present study.

9.3.2 Managerial implications of the study

1. This study enhances the knowledge of the treasurers and the finance directors or CFOs of the company who would now be able to identify different methods of measuring hedge effectiveness and use them in their companies.
2. This study is also significant for the policy makers as it highlights the gaps between the policies created and the execution of these policies.
3. The present study has also highlighted an appropriate framework for the choice and application of the hedging effectiveness method which would help the treasurers in successful implementation of hedging strategies.
4. At the enterprise level, the corporate manager could use the results of the study to utilize the appropriate tool of evaluating hedging effectiveness. For example, IT companies which face significant forex risk, should use 1-month derivatives contracts as suggested by the results of the study to mitigate their exposures.
5. The present research study would help in analyzing the future scenario for policy framework for currency risk hedging as it highlights the challenges faced by the companies in implementing the changes recommended by the revised accounting standards.

9.4 Recommendations of the study

After the detailed analysis of the interviews with the treasurers (chapter 5) it can be safely concluded that the foreign exchange (forex or FX or currency) risk management is a vital and imperative part of the operations of the company. The treasurers take many measures to ensure that the forex risk is effectively managed. The results derived through cointegration and hedge effectiveness (chapter 6, 7 and 8) showed that it is important for the treasurers to be aware of the market they are operating in before they choose an effective hedging strategy and hedge effectiveness measure. It is also the responsibility of the treasurers to take cognizance of the developments in the policies and guidelines created by the administrators for the regulation of the foreign exchange (FX or forex or currency) market. The recommendations are therefore, provided from two perspectives first, from the perspective of the results derived in the study and second, from the general perspective based on the current scenario.

9.4.1 Recommendations to the companies

From the perspective of the results derived in the study

1. The treasurers interviewed highlighted that they follow the policies created by the top management for effective foreign exchange (forex or FX or currency) risk management. The treasurers therefore, must be aware of the overall risk management attitude of the company before choosing the hedging vehicle.
2. The primary analysis highlighted that the guidelines for the foreign exchange (forex or FX or currency) risk management are prepared by the top management of the company, it is necessary that the top management take cognizance of the policies formulated by the regulators for effective foreign exchange (forex or FX or currency) risk management.
3. The primary analysis revealed that the treasurers merely follow the foreign exchange (forex or FX) risk management guidelines formulated by the companies and use the effectiveness methods mentioned in these guidelines for evaluation. The companies need to update their guidelines with better and efficient methods for evaluating hedge effectiveness.
4. The treasurers and manager handling the foreign exchange (forex or FX) risk management, need to update their knowledge and skill about the advanced statistical methods available for evaluating hedge ratio and hedge effectiveness.
5. It is also imperative to analyze exchange rate market the companies are operating in. The results reveal that the Indian foreign exchange (forex or FX or currency) market is inefficient for USD futures, GBP forwards and futures and EURO forwards and futures, therefore, appropriate technique for evaluating hedge ratio and hedge effectiveness must be adopted.
6. On comparing different techniques for evaluating or estimating hedge effectiveness, the results showed that the advanced statistical methods, dynamic models, provide better results. Therefore, the companies and treasurers should pay attention to these methods.
7. The challenges faced by the companies highlighted that the Indian companies were unwilling to adopt an appropriate statistical model for evaluating hedge effectiveness even

after they accepted that better statistical models provided better results. There is a need to sensitize the treasurers about the usefulness of the statistical analysis.

8. The board of the company should give sufficient freedom to the treasurers of the companies to make appropriate choice regarding hedge effectiveness model.

From the general perspective based on current scenario

1. The currency markets are dynamic and hedging in a dynamic market is risky. The policy makers therefore, keep updating their regulations. The companies should take cognizance of these regulations and then formulate their guidelines for foreign exchange (forex or FX or currency) risk management.
2. The policy makers have made changes in the regulations for risk management and have made it mandatory to evaluate the effectiveness of the hedges. The companies therefore, need to choose an appropriate method for its evaluation.
3. The companies, the world over, have become sensitive to the foreign exchange (forex or FX or currency) risk management. Therefore, best practices among the companies should be shared through a common platform and synergies should be created.
4. Focus should be on developing more knowledge and skills of the treasury managers to efficiently use statistical model for measuring hedge effectiveness.
5. Positive and dynamic attitude should be adopted by the top management for foreign exchange (forex or FX or currency) risk management for their companies. Serious efforts should be put to identify reliable and appropriate methods for hedge evaluation.

9.4.2 Recommendations to the policy makers

From the perspective of the results derived in the study

1. The primary data analysis revealed that the companies have a rudimentary view on evaluating effectiveness of the foreign exchange hedges and use 'what-if' analysis for this purpose. The policy makers should help the companies in choosing and identifying the appropriate methods for evaluating hedge effectiveness.
2. There is a gap between the requirement of the policy makers for hedge effectiveness and the practices of the companies. The policy makers should bridge this gap by listing out appropriate methods for measuring hedge effectiveness.
3. The results of the secondary data analysis could assist the policy makers in identifying and choosing the most appropriate method of evaluation of hedge effectiveness.
4. The policy makers should take assistance of the auditors of the companies in order to identify their current practices and appraise them to the requirements of the accounting regulations.
5. The policy makers could create a list of best practices for foreign exchange (forex or FX or currency) risk management and effectiveness which could then be shared with the companies.

From the general perspective based on currency scenario

1. There is a need to motivate the companies to follow statistical methods for measuring hedge effectiveness.
2. There is a need to educate the treasurer on different available statistical methods for evaluating hedge effectiveness, policy makers should take steps in this direction.
3. It is recommended that more such research work should be taken up by the regulators to identify best instruments and methods for hedging.
4. Focus should be laid on the educating and training of the auditors who can assist the companies in implementing best hedge evaluating techniques.

5. It is understood that the currency risk management is a dynamic and important activity. The role of the policy makers is equally important as that of the treasurer of the company. The policy maker should take cognizance of the practices followed in the other countries over hedging of the currency risk and encourage the Indian companies to imbibe the best practices.
6. Regulators like FASB has listed methods of evaluating hedge effectiveness which the companies should follow for appropriate risk management and effectiveness. The Indian policy makers could take inspiration and identify such possible methods for Indian companies. The results of the present study would be useful to the policy makers.

9.5 Limitations of the study

Although this is an exhaustive study, however, the present research study is not free from limitations due to time and resources. Some of the research limitations:

1. As with other empirical studies, only a small segment of the treasurers of the foreign exchange (forex or FX or currency) risk management was covered in the survey. Though the effort was made to have a representative sample by including many prominent companies, still the fact that the respondents were limited had its own limitations.
2. Though the questionnaire was comprehensive and primary data was collected in over 18 months, there was still scope for further investigation and analysis.
3. It was not possible to study each and every company in detail. Therefore, the suggestions and recommendations are mentioned in a generic manner and sectoral specific conclusion and recommendations could not be generated.
4. Conclusion for primary study was based on the perceptions of the respondents which reflected their opinions based on their work and responsibilities.
5. The currency risk management is a vast area which had many instruments for managing the risk. The major focus of the study was on two main derivative instruments – futures and forwards, used by the majority of the companies.

9.6 Scope of future research

1. The questionnaire used in the study can be used further by future researchers researching similar problems
2. The techniques and model applied in the study can be used by the future researchers to analyze hedging practices in markets other than exchange rate market
3. The present research work can be extended to include more countries, currencies and companies
4. The present research work could be extended to study specific sectors and draw comparisons and recommend best practices for hedging the risk.
5. Future researchers can also compare the guidelines of FASB and IFRS for identifying better and successful approaches for risk management.

To manage or handle the foreign exchange (forex or FX or currency) risk exposure, the companies need to choose an appropriate hedging strategy and evaluate hedging effectiveness using the technique which meet their risk management objective. Since the currency market is dynamic in nature and the system and policies are ever-evolving, this research may continue to incorporate new issues and currency risk management practices in meeting the novel challenges. The companies ought to develop continuously and adjust to the dynamic business and foreign exchange market environment.

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Appendix

Appendix I: Questionnaire for the Primary Study

Foreign Exchange Risk Management: A Study of Indian Companies

Introductory Questions – Background Information.

1. What is the designation that you hold in your organization?
2. How long have you been working in the capacity of your current role?
3. How many years of experience you have in managing the foreign exchange currency for the organization?
4. What is the highest level of your educational qualification?

Part A – General Questions – Foreign Exchange Management and Policy

QA1. What was your company's total revenue in previous year?

QA2. Do you have foreign subsidiaries (partially owned and joint ventures included)?

No	
Yes	

QA3. Approximately what percentage of your total revenues and expenditure was in foreign currency in previous year?

	0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
Revenue										
Expenditure										

QA4. Which of the following foreign currencies does your company use? (Tick more than once if applicable)

USD – United States Dollar	
GBP – Great Britain Pound	
Euro	
CNY – Chinese Yuan	
JPY – Japanese Yen	
SEK – Swedish Krona	
BRL – Brazilian Real	
RUB – Russian Ruble	
DKK – Danish Krone	
Any Other	

QA5. How important is Foreign Exchange (FX) Risk Management to your organization?

Not Important	Somewhat Important	Important	Very Important

QA6. Which of the following statements would you choose regarding your foreign exchange (FX) risk management policy/guidelines? (Tick more than once if applicable)

We do not have a foreign exchange (FX) risk management policy	
We have general guidelines about foreign exchange risk management which are not documented	
We have proper documented guidelines for our foreign exchange risk management policy	
We have a passive policy as the foreign exchange risk is not hedged	
We have an active and risk averse foreign exchange policy where the risk is hedged regularly. We do not speculate.	
We have an active and profit seeking foreign exchange risk management policy where hedging and speculation both are carried out.	
We have an active and profit seeking foreign exchange risk management policy where only speculation is carried out.	
Any other response	

QA7. Would you describe your foreign exchange (FX) risk management to be centralized or decentralized?

Centralized: FX exposure management is performed by a single entity within the company, e.g. group treasury	
Decentralized: no central control over FX exposure management, e.g. each business unit manages its own exposure	
Hybrid: some aspects of FX exposure management are centralized some are decentralized	

QA8. Please mark which of the following items are included in your foreign exchange policy/guidelines? (Tick more than once if applicable)

Definition of foreign exchange exposure	
Aim or objective of foreign exchange exposure management	
Description of foreign exchange management procedures	
Time horizon of exposures	
Definition of maximum allowed exposure	
Definition of minimum allowed exposure	
Definition of targeted exposure level	
Hedging methods to be used	
Permissible derivatives	
Permissible trading techniques	
Allocation of responsibilities to individuals	
Performance evaluation measures	
Performance compensation	

Internal controls	
Policy approval authority	
Anything else	

Part B – Foreign Exchange Exposure Position

QB1. Do you manage each individual foreign exchange exposure (transaction exposure, translation exposure and economic exposure) separately or compile all exposures together into a companywide position calculation?

We manage FX exposure individually	
We compile our FX exposures into a position calculation	

FX = Foreign Exchange

QB2. Which exposure do you focus on? Why? (Tick more than once if applicable)

Exposure	Reason for focus
Transaction Exposure	
Translation Exposure	
Economic Exposure	

QB3. At what stage of transaction (during billing stage or accounting stage or at some other stage) do you take a position to manage the exposure?

Stage of Transaction	Reason
Billing stage	
Accounting stage	
Some other stage	

QB4. Which accounting standard do you follow to accommodate the exposure in your books? (Tick more than once if applicable)

Accounting Standard	Reason for following this standard
Indian Accounting Standard (Ind AS)	
Indian Generally Accepted Accounting Principle (IGAAP)	
International Financial Reporting Standard 9 (IFRS 9)	
US Generally Accepted Accounting Principle (USGAAP)	
Any Other	

QB5. Please mark the statements mentioned below that best describes the use of financial models in your company for calculating FX exposure positions? (Tick more than once if applicable)

We do not use of financial models for position calculation	
We do only simple calculations with excel	
We use excel for simple calculation and basic software for some advanced calculation (also name the software)	
We use separate software for position calculation (also name the software)	

QB6. How frequently do you measure your FX exposure position / update your position calculation?

Daily	Weekly	Monthly	Quarterly	Annually	Other

Reason/Comment:

_____

QB7. Please mark if you use some of the following methods for FX exposure calculation? (Tick more than once if applicable)

Cross hedging, using cash flows in different currencies to offset each other	
Stress testing	
Use of Linear Programming (LP) method	
Use of Simulation	
Use of Monte Carlo simulation	
Use of Historic Simulation	
Use of Covariance Analysis	
Use of Sensitivity Analysis	
VaR	
Any Other	

QB8. Please elaborate on the method/s that you use for FX exposure calculation.

Reason/Comment:

_____

QB9. Do you also calculate hedge ratio in order to determine the optimum level of exposure?

No	
Yes	

Reason/Comment:

_____

QB10. Which method do you use to calculate the hedge ratio?

Reason/Comment:

_____

Part C – Foreign Exchange Rates Forecasting

QC1. Does your company use forecasts of future exchange rates? (Tick more than once if applicable)

No, we do not use any forecasts	
Yes, but we use only short-term (<6 months) forecasts	
Yes, but we use only long-term (>6 months) forecasts	
Yes, we use both short- and long-term forecasts	

QC2. Which of the following ways best describes how your company gets your future FX rate forecasts? (Tick more than once if applicable)

We use our bank's forecasts	
We use other free external sources for forecasts	
We purchase forecasts from an external forecasting service	
We use market-based methods (forward rates, interest rate differentials, inflation) to make forecasts	
We use mainly fundamental analysis to make our own forecasts	
We use mainly technical analysis to make our own forecasts	
Personal Opinion	

QC3. Please provide reasoning behind your personal opinion on FX rate forecast.

Reason/Comment:

_____

Part D – Foreign Exchange Exposure Hedging

QD1. Which of the following hedging methods do you prefer using for managing FX exposure? Also provide reason for the same. (Tick more than once if applicable)

Hedging Methods	Preferred or not	Reason for preference or non-preference
Internal Hedging methods		
External Hedging methods		

QD2. During the last year, has your company used internal and/or external hedging methods (currency derivatives or issued debt in foreign currency in order to manage foreign exchange risk?)

Hedging Methods	Used or not used in last year
Internal Hedging methods	
External Hedging methods	

QD3. How often does your company use the following internal hedging methods?

	This method is used every time we face an exposure	This method is used once in a quarter	This method is used once in six months	Any other response
Invoicing in domestic currency				
Currency rate adjustment clause in sales or purchase contracts				
Currency portfolio diversification				
Leading and lagging (The adjustment of intercompany credit terms — leading means a prepayment of a trade obligation and lagging means a delayed payment)				
Inter-company netting of receipts and payments (Offsetting exposures in one currency with exposure in the same or another currency, where exchange rates are expected to move high in such a way that losses or gains on the first exposed position should be offset by gains or losses on the second currency exposure.)				
Any Other				

QD4. How often does your company use the following external hedging methods?

	This method is used every time we face an exposure	This method is used once in a quarter	This method is used once in six months	Any other response
Foreign currency bank account				
Foreign currency denominated debt				
Forward contracts				
Futures contracts				
Swaps				
Options				
Any Other				

QD5. Rate the following reasons for the use of internal hedging methods for managing foreign exchange exposure in your company on the scale of 1 to 5; (1 = best suited reason 5 = does not suit at all).

1. Best Suited **2**.Suited **3**.Somewhat Suited **4**.Somewhat Unsuited **5**.Not at all suited

Reason	1	2	3	4	5	NA (Not Applicable)
It is safe to use internal hedging methods						
The company has sufficient resources to undertake internal hedging methods						
The size of the company complements use of internal hedging methods						

Risk Management Policy of the company encourages the use of internal hedging methods						
Use of external hedging methods invariably leads to increase in risk						
Risk Management Policy of the company discourages the use of external hedging methods						
Company has sufficient amount of liquidity to manage risk and hence does not require external hedging methods						
Managers lack knowledge and skills which facilitates the use of external hedging methods						
The external hedging methods market is not that well-developed in the country						
The external hedging methods can be misused for personal gains. Management might use these methods for their own benefit at the expense of shareholders						
Any other reason						

QD6. Rate the following reasons for the use of external hedging methods for managing FX exposure in your company on the scale of 1 to 5; (1 = best suited reason 5 = does not suit at all).

1. Best Suited **2**.Suited **3**.Somewhat Suited **4**.Somewhat Unsuited **5**.Not at all suited

Also provide a ranking for these reasons.

Reason	1	2	3	4	5	NA (Not Applicable)	Ranking
Use of external hedging methods reduces the variability of cash flows							
It is easy to use external hedging methods for managing currency exposure							
External hedging methods offer variety of ways to manage currency exposure (forwards, futures, options etc.)							
Use of external hedging methods leads to increase in the value of the company							
Use of external hedging methods leads to increase in the earnings of the company							
Use of external hedging methods helps in generating funds for investment							
The size of the company facilitates the use of external hedging methods							
Managerial ownership is a reason for use of external hedging methods							
Managers are motivated to use external hedging methods because of maximization of utility							
Managers possess knowledge and skills which facilitates the use of external hedging methods							
Economic environment of the country encourages the use of external hedging methods							
Integration of the financial markets worldwide facilitate use of external hedging methods							

QD7. At the present time, what is the average time horizon that your company has covered its foreign exchange exposure by using financial tools (forward contracts, options, swaps, debt in foreign currency etc.)

1 month	3 months	6 months	12 months	2 years	5 years	>5 years	Specify other time horizon

QD8. Do you use foreign exchange derivatives for speculative purposes (profit from an anticipated price movement) also, apart from hedging for risk mitigation?

Yes	No

Part E – Foreign Exchange Risk Management – Effectiveness of hedge

QE1. Do you use any measures to evaluate the effectiveness of your foreign exchange exposure management?

Yes	No

QE2. How do you evaluate the effectiveness of the hedge that you have undertaken?

Check the impact on Profitability (or reduced costs)	
Measure the volatility of net exposure in terms of home currency	
Measure the risk-adjusted performance (profits adjusted for volatility)	
Compare the 'with-hedging' and 'without-hedging' scenario (What if analysis)	
Any Other	

Comment:

_____

QE3. Do you use financial models like Regression, Error Correction Model, ARCH and GARCH models to evaluate the effectiveness of hedges undertaken? Please elaborate.

_____

QE4. Which of the following statements best describes the review process of your FX policy?

Our FX policy hasn't been changed since it was created	
We update our FX policy as the need arises	

We schedule periodical reviews of our FX policy (please share the interval of each review)	
Any Other	

QE5. Please mark the appropriate option regarding department involvement in the foreign exchange risk management in your company?

Department	Frequently involved	Occasionally involved	Never involved
Finance			
Sales			
Marketing			
IT			
Production			
Other			

Part F – Foreign Exchange Risk Management – Discussion Questions

QF1. What is the general process of hedging FX risk?
QF2. Do you follow efficient market hypothesis and use this while formulating the FX policy?

Thank You!

Appendix II: Results for Error Correction Model

Table A1: Error Correction Table for USD Futures

Currency / Variables	USD		Currency / Variables	USD	
	ΔS_t	ΔFu_t		ΔS_t	ΔFu_t
C	0.000142 [1.37971]	0.000147 [1.23269]	Δ USDS$_{t-9}$	0.047073 [1.37583]	0.002709 [0.06848]
E_{t-1}	-0.745962* [-7.92875]	0.124815 [1.14747]	Δ USDFu$_{t-1}$	0.258119* [2.84031]	0.235011** [2.23677]
Δ USDS$_{t-1}$	-0.196453** [-2.20380]	-0.261552** [-2.53780]	Δ USDFu$_{t-2}$	0.009774 [0.11380]	0.15677 [1.57880]
Δ USDS$_{t-2}$	0.071292 [0.84400]	-0.101899 [-1.04342]	Δ USDFu$_{t-3}$	-0.192955** [-2.37939]	-0.040758 [-0.43472]
Δ USDS$_{t-3}$	0.283775* [3.57596]	0.130271 [1.41989]	Δ USDFu$_{t-4}$	-0.271288* [-3.58931]	-0.124567 [-1.42551]
Δ USDS$_{t-4}$	0.26153* [3.53282]	0.126429 [1.47718]	Δ USDFu$_{t-5}$	-0.163412** [-2.34602]	-0.091434 [-1.13538]
Δ USDS$_{t-5}$	0.13243** [1.94001]	0.086458 [1.09550]	Δ USDFu$_{t-6}$	-0.094841 [-1.47988]	-0.015707 [-0.21199]
Δ USDS$_{t-6}$	0.072812 [1.15132]	0.016705 [0.22847]	Δ USDFu$_{t-7}$	-0.053235 [-0.90353]	0.034372 [0.50459]
Δ USDS$_{t-7}$	0.093314 [1.61909]	-0.015269 [-0.22915]	Δ USDFu$_{t-8}$	-0.115206 [-2.17437]	-0.021147 [-0.34521]
Δ USDS$_{t-8}$	0.143841* [2.87430]	0.083678 [1.44626]	Δ USDFu$_{t-9}$	-0.026363 [-0.62959]	0.037002 [0.76434]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A2: Error Correction Table for GBP Futures

Currency / Variables	GBP		Currency / Variables	GBP	
	ΔS_t	ΔFu_t		ΔS_t	ΔFu_t
C	9.23E-05 [0.67947]	9.59E-05 [0.61020]	Δ GBPS$_{t-11}$	0.017629 [0.47621]	-0.020648 [-0.48234]
E_{t-1}	-1.282383* [-9.69005]	-0.291962*** [-1.90790]	Δ GBPFu$_{t-1}$	-0.314176** [-2.44927]	-0.241535 [-1.62842]
Δ GBPS$_{t-1}$	0.398731* [3.19495]	0.295601** [2.04837]	Δ GBPFu$_{t-2}$	-0.474621* [-3.91240]	-0.337849** [-2.40846]
Δ GBPS$_{t-2}$	0.523784* [4.43973]	0.353121* [2.58850]	Δ GBPFu$_{t-3}$	-0.564152* [-4.95699]	-0.384819* [-2.92414]
Δ GBPS$_{t-3}$	0.604728* [5.45131]	0.41958* [3.27096]	Δ GBPFu$_{t-4}$	-0.584035* [-5.46527]	-0.410736* [-3.32396]
Δ GBPS$_{t-4}$	0.57553* [5.52654]	0.421434* [3.49973]	Δ GBPFu$_{t-5}$	-0.494551* [-4.98333]	-0.434457* [-3.78595]
Δ GBPS$_{t-5}$	0.475539* [4.92329]	0.404787* [3.62423]	Δ GBPFu$_{t-6}$	-0.387866* [-4.27252]	-0.344826* [-3.28490]
Δ GBPS$_{t-6}$	0.385205* [4.34110]	0.325339* [3.17076]	Δ GBPFu$_{t-7}$	-0.255264* [-3.10359]	-0.207262** [-2.17928]
Δ GBPS$_{t-7}$	0.229918* [2.85287]	0.171399** [1.83923]	Δ GBPFu$_{t-8}$	-0.194933* [-2.61045]	-0.112987 [-1.30851]
Δ GBPS$_{t-8}$	0.247858* [3.38265]	0.167002** [1.97104]	Δ GBPFu$_{t-9}$	-0.184445* [-2.75670]	-0.119542 [-1.54512]
Δ GBPS$_{t-9}$	0.159492** [2.44646]	0.089187 [1.18309]	Δ GBPFu$_{t-10}$	-0.091891 [-1.60006]	0.02857 [0.43022]
Δ GBPS$_{t-10}$	0.063104 [1.15975]	-0.015904 [-0.25278]	Δ GBPFu$_{t-11}$	-0.035282 [-0.80597]	0.004641 [0.09169]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A3: Error Correction Table for GBP 1-Month Forward

Currency / Variables	GBP		Currency / Variables	GBP	
	ΔS_t	$\Delta F1M_t$		ΔS_t	$\Delta F1M_t$
C	8.52E-05 [0.52917]	8.83E-05 [0.55009]	$\Delta GBPS_{t-6}$	0.803027 [1.58566]	0.779907 [1.54440]
E_{t-1}	-0.360669** [-2.26924]	-0.322494** [-2.03485]	$\Delta GBPF1M_{t-1}$	1.052963** [2.05191]	0.910052*** [1.77849]
$\Delta GBPS_{t-1}$	-1.017224** [-1.98829]	-0.874735 [-1.71466]	$\Delta GBPF1M_{t-2}$	0.451376 [0.87165]	0.300865 [0.58266]
$\Delta GBPS_{t-2}$	-0.43074 [-0.83435]	-0.280353 [-0.54460]	$\Delta GBPF1M_{t-3}$	0.622951 [1.19108]	0.449381 [0.86167]
$\Delta GBPS_{t-3}$	-0.593467 [-1.13820]	-0.420467 [-0.80871]	$\Delta GBPF1M_{t-4}$	-1.12536** [-2.16028]	-1.074249** [-2.06805]
$\Delta GBPS_{t-4}$	1.133654** [2.18391]	1.080534** [2.08753]	$\Delta GBPF1M_{t-5}$	0.036617 [0.07125]	0.112149 [0.21883]
$\Delta GBPS_{t-5}$	-0.035584 [-0.06949]	-0.11258 [-0.22048]	$\Delta GBPF1M_{t-6}$	-0.783929 [-1.54175]	-0.759523 [-1.49802]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A4: Error Correction Table for GBP 3-Month Forward

Currency / Variables	GBP		Currency / Variables	GBP	
	ΔS_t	$\Delta F3M_t$		ΔS_t	$\Delta F3M_t$
C	8.16E-05 [0.50632]	8.73E-05 [0.54626]	$\Delta GBPS_{t-4}$	0.092123 [0.29760]	0.095502 [0.31106]
E_{t-1}	-0.153762** [-2.39089]	-0.134934** [-2.11545]	$\Delta GBPF3M_{t-1}$	0.532468 [1.70029]	0.498811 [1.60597]
$\Delta GBPS_{t-1}$	-0.497823 [-1.60315]	-0.464415 [-1.50792]	$\Delta GBPF3M_{t-2}$	0.410317 [1.31409]	0.300884 [0.97158]
$\Delta GBPS_{t-2}$	-0.382822 [-1.23658]	-0.274669 [-0.89456]	$\Delta GBPF3M_{t-3}$	-0.039932 [-0.12805]	-0.114028 [-0.36869]
$\Delta GBPS_{t-3}$	0.062108 [0.20097]	0.13559 [0.44236]	$\Delta GBPF3M_{t-4}$	-0.077595 [-0.24839]	-0.082906 [-0.26758]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A5: Error Correction Table for GBP 6-Month Forward

Currency / Variables	GBP		Currency / Variables	GBP	
	ΔS_t	$\Delta F6M_t$		ΔS_t	$\Delta F6M_t$
C	7.94E-05 [0.49363]	9.03E-05 [0.56928]	Δ $GBPS_{t-3}$	0.014343 [0.07609]	0.045416 [0.24424]
E_{t-1}	-0.090141** [-2.43298]	-0.07164** [-1.96030]	Δ $GBPF6M_{t-1}$	0.371028 [1.93969]	0.395376 [2.09548]
Δ $GBPS_{t-1}$	-0.334086** [-1.77124]	-0.359329** [-1.93135]	Δ $GBPF6M_{t-2}$	0.304106 [1.59776]	0.197167 [1.05019]
Δ $GBPS_{t-2}$	-0.273301 [-1.45733]	-0.170558 [-0.92201]	Δ $GBPF6M_{t-3}$	0.010639 [0.05559]	-0.022947 [-0.12155]

Note1: Standard errors in ( ) & t-statistics in [ ]
Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A6: Error Correction Table for GBP 12-Month Forward

Currency / Variables	GBP		Currency / Variables	GBP	
	ΔS_t	$\Delta F12M_t$		ΔS_t	$\Delta F12M_t$
C	7.71E-05 [0.47914]	9.86E-05 [0.62649]	Δ $GBPS_{t-3}$	0.049623 [0.40853]	0.068133 [0.57328]
E_{t-1}	-0.048129** [-2.17898]	-0.030785 [-1.42445]	Δ $GBPF12M_{t-1}$	0.298706 [2.40632]	0.329436 [2.71233]
Δ $GBPS_{t-1}$	-0.256105** [-2.10864]	-0.286422** [-2.41021]	Δ $GBPF12M_{t-2}$	0.163922 [1.32461]	0.060455 [0.49929]
Δ $GBPS_{t-2}$	-0.132143 [-1.09260]	-0.037579 [-0.31756]	Δ $GBPF12M_{t-3}$	-0.024817 [-0.19960]	-0.047045 [-0.38672]

Note1: Standard errors in ( ) & t-statistics in [ ]
Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A7: Error Correction Table for EURO Futures

Currency / Variables	EURO		Currency / Variables	EURO	
	ΔS_t	ΔFu_t		ΔS_t	ΔFu_t
C	8.65E-05 [0.61565]	9.84E-05 [0.63583]	Δ EUROS$_{t-7}$	0.03321 [0.81858]	0.007519 [0.16828]
E_{t-1}	-1.062184* [-9.75354]	-0.158088 [-1.31808]	Δ EUROFu$_{t-1}$	0.016997 [0.16333]	0.026952 [0.23514]
Δ EUROS$_{t-1}$	0.075856 [0.75245]	-0.007385 [-0.06652]	Δ EUROFu$_{t-2}$	-0.169309** [-1.78416]	-0.048658 [-0.46557]
Δ EUROS$_{t-2}$	0.251358* [2.73642]	0.115974 [1.14638]	Δ EUROFu$_{t-3}$	-0.297196* [-3.46591]	-0.185795** [-1.96738]
Δ EUROS$_{t-3}$	0.31741* [3.81268]	0.202292** [2.20631]	Δ EUROFu$_{t-4}$	-0.339896* [-4.36930]	-0.260957* [-3.04589]
Δ EUROS$_{t-4}$	0.362726* [4.78082]	0.276666* [3.31100]	Δ EUROFu$_{t-5}$	-0.233992* [-3.32048]	-0.230789* [-2.97366]
Δ EUROS$_{t-5}$	0.218987* [3.21757]	0.213819* [2.85256]	Δ EUROFu$_{t-6}$	-0.131282** [-2.12035]	-0.153557** [-2.25192]
Δ EUROS$_{t-6}$	0.073834 [1.27234]	0.084998 [1.32995]	Δ EUROFu$_{t-7}$	-0.030065 [-0.62315]	-0.019538 [-0.36769]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A8: Error Correction Table for EURO 1-Month Forwards

Currency / Variables	EURO		Currency / Variables	EURO	
	ΔS_t	$\Delta F1M_t$		ΔS_t	$\Delta F1M_t$
C	9.94E-05 [0.59557]	0.000103 [0.61952]	Δ EUROS$_{t-6}$	0.252623 [0.49540]	0.225522 [0.44348]
E_{t-1}	-0.298535** [-1.82268]	-0.257098 [-1.57403]	Δ EUROF1M$_{t-1}$	1.290051** [2.49927]	1.138643** [2.21203]
Δ EUROS$_{t-1}$	-1.263745** [-2.45507]	-1.112925** [-2.16805]	Δ EUROF1M$_{t-2}$	-0.094032 [-0.18031]	-0.254375 [-0.48913]
Δ EUROS$_{t-2}$	0.09992 [0.19213]	0.260348 [0.50200]	Δ EUROF1M$_{t-3}$	0.202144 [0.38296]	0.034372 [0.06530]
Δ EUROS$_{t-3}$	-0.204617 [-0.38870]	-0.036948 [-0.07038]	Δ EUROF1M$_{t-4}$	-0.365795 [-0.69609]	-0.319972 [-0.61057]
Δ EUROS$_{t-4}$	0.402292 [0.76772]	0.355121 [0.67957]	Δ EUROF1M$_{t-5}$	0.115185 [0.22273]	0.20611 [0.39965]
Δ EUROS$_{t-5}$	-0.12344 [-0.23934]	-0.215634 [-0.41925]	Δ EUROF1M$_{t-6}$	-0.291319 [-0.56944]	-0.262076 [-0.51369]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A9: Error Correction Table for EURO 3-Month Forwards

Currency / Variables	EURO		Currency / Variables	EURO	
	ΔS_t	$\Delta F3M_t$		ΔS_t	$\Delta F3M_t$
C	9.29E-05 [0.55544]	9.99E-05 [0.60164]	Δ EUROS$_{t-7}$	-0.253553 [-0.78786]	-0.271549 [-0.84975]
E_{t-1}	-0.14046** [-2.06544]	-0.119817** [-1.77436]	Δ EUROF3M$_{t-1}$	0.664332** [2.04213]	0.617346** [1.91112]
Δ EUROS$_{t-1}$	-0.637274** [-1.97266]	-0.589492** [-1.83765]	Δ EUROF3M$_{t-2}$	-0.144571 [-0.44510]	-0.257137 [-0.79726]
Δ EUROS$_{t-2}$	0.150794 [0.46760]	0.263405 [0.82258]	Δ EUROF3M$_{t-3}$	-0.167796 [-0.51399]	-0.229644 [-0.70841]
Δ EUROS$_{t-3}$	0.159678 [0.49255]	0.21995 [0.68326]	Δ EUROF3M$_{t-4}$	0.3695 [1.13013]	0.348361 [1.07301]
Δ EUROS$_{t-4}$	-0.323915 [-0.99782]	-0.305192 [-0.94679]	Δ EUROF3M$_{t-5}$	0.181237 [0.55570]	0.245079 [0.75676]
Δ EUROS$_{t-5}$	-0.189366 [-0.58481]	-0.254097 [-0.79027]	Δ EUROF3M$_{t-6}$	0.041672 [0.12855]	-0.011416 [-0.03546]
Δ EUROS$_{t-6}$	-0.081388 [-0.25283]	-0.025309 [-0.07918]	Δ EUROF3M$_{t-7}$	0.25809 [0.79632]	0.275485 [0.85600]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A10: Error Correction Table for EURO 6-Month Forwards

Currency / Variables	EURO		Currency / Variables	EURO	
	ΔS_t	$\Delta F6M_t$		ΔS_t	$\Delta F6M_t$
C	9.80E-05 [0.58726]	0.000112 [0.67971]	Δ EUROS$_{t-3}$	-0.004369 [-0.02206]	0.027331 [0.13937]
E_{t-1}	-0.085232** [-2.34002]	-0.067799** [-1.88012]	Δ EUROF6M$_{t-1}$	0.306433 [1.53075]	0.323342 [1.63144]
Δ EUROS$_{t-1}$	-0.280253 [-1.41418]	-0.297464 [-1.51611]	Δ EUROF6M$_{t-2}$	-0.079651 [-0.40093]	-0.195917 [-0.99608]
Δ EUROS$_{t-2}$	0.085607 [0.43525]	0.201273 [1.03361]	Δ EUROF6M$_{t-3}$	0.001509 [0.00754]	-0.033821 [-0.17077]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Table A11: Error Correction Table for EURO 12-Month Forwards

Currency / Variables	EURO		Currency / Variables	EURO	
	ΔS_t	$\Delta F12M_t$		ΔS_t	$\Delta F12M_t$
C	9.27E-05 [0.55627]	0.000122 [0.75017]	$\Delta EUROS_{t-3}$	0.009277 [0.07311]	0.039318 [0.31688]
E_{t-1}	-0.046347** [-2.37234]	-0.033189*** [-1.73721]	$\Delta EUROF12M_{t-1}$	0.301642** [2.32678]	0.313461** [2.47261]
$\Delta EUROS_{t-1}$	-0.26815** [-2.11529]	-0.280592** [-2.26348]	$\Delta EUROF12M_{t-2}$	-0.006731 [-0.05225]	-0.127369 [-1.01118]
$\Delta EUROS_{t-2}$	0.014941 [0.11863]	0.133403 [1.08312]	$\Delta EUROF12M_{t-3}$	-0.012314 [-0.09492]	-0.045698 [-0.36021]

Note1: Standard errors in ( ) & t-statistics in [ ]

Note2: (*) testifies that values are significant at 1% level (critical Value: 2.58). (**) testifies that values are significant at 10% level (Critical Value: 1.65). (***) testifies that values are significant at 10% level (Critical Value: 1.28).

Author's Bio

Varuna is presently an Assistant Professor in Finance at Maharaja Agrasen Institute for Management Studies, Rohini. In the past, she has worked as a Senior Analyst with 'Aon-Hewitt' for a year and as an Analyst with 'Evalueserve' for two years. She has rich experience of research of more than 5 years and have attended many conferences and presented papers over the years. She has also attended many FDP programs to further her research interests.

Varuna holds graduate degree in B.A. (Hons.) Business Economics from University of Delhi. She completed her Post Graduation (PGDM) from Jagan Institute of Management Studies, Delhi (An Autonomous Body) and also holds certification in Data Analytics and Market Research from MICA, Ahmedabad. She is presently completing her PhD from Delhi Technological University.

She is a bookworm and utilizes her free time catching up with books on various themes ranging from fiction, self-help, motivation to biographies. She presently resides in Delhi with her husband, two children and in-laws.

List of Publications

Journal Publications

1. Kharbanda, V. and Singh, A. (2017), "Lead-Lag Relationship between Futures and Spot FX Market", *International Journal of Managerial Finance*, Vol.13 No.1, pp. 560-577 (**SCOPUS indexed and B Ranking**)
2. Kharbanda, V. and Singh, A. (2018), "Futures market efficiency and effectiveness of hedge in Indian currency market", *International Journal of Emerging Market*, Vol.13 No.6, pp. 2001-2027 (**SCOPUS indexed and SSCI indexed**)

Journal Publications (accepted)

1. Kharbanda, V. and Singh, A. (2019), "A Study of Currency Risk Management by Indian MNCs", *International Journal of Management Research*, Vol. 10 No.1

International and National Conference Publications

1. Kharbanda, V. and Singh, A. (2016), "A literature Review on Management of Foreign Exchange Risk by Corporates", *Conference on Innovative Financial Practices and Developments*, 978-93-84935-63-4, Appejay School of Management, Delhi
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