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Sustainable Currency Derivative Framework for Effective Risk Management of Indian Corporates

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Abstract

In the first decade of the current century, the liberalized economy of India witnessed manifold increase in global trade, owing to which Indian corporates were exposed to the foreign currency fluctuation thus risk of loss due to currency fluctuation. Although forward contracts are the most prevalent derivative contracts to hedge currency risk. However, Indian corporates have undertaken other form of derivatives such as swap, option, and swap option to hedge foreign currency risk. However, lack of inherent understanding of the risk on these derivative instruments, which was meant for hedging currency risks, lead several corporates to incurred huge losses, forcing them to near bankruptcy. The decade 2005-2010 and thereafter saw large losses owing to derivatives both in India and across many other economies, thus impacting corporate profitability, leading to bankruptcy or near bankruptcy for some Indian firms and firms across the globe. The losses incurred by corporates led to acrimonious viewpoints between market intermediaries such as banks and Indian corporates on aspects such as need to undertake such derivatives, leading to litigation, some of which are still pending in Indian courts. Thus, the financial system suffered, and continues to suffer, from many structural gaps and lacks clear understanding of the products, indicating the need for a robust risk management framework. It is still felt that corporates are yet to define their proper risk appetite and risk management framework to undertake derivatives, particularly currency derivatives. Hence, this study is focused on evolving a suitable framework in developing a currency derivative framework for effective risk management for Indian corporates.

Keywords: Currency Derivatives, Risk Management, Foreign Exchange, Currency Losses, Forward, Swap, Option

Introduction

Derivatives are financial products whose value is derived from the value of one or more underlying financial products or commodities. Derivatives under Securities Contracts (Regulation) Act, 1956 [SC(R)A] defines "derivative" to include (a) a security derived from a debt instrument, share, loan whether secured or unsecured, risk instrument or contract for differences, or any other form of security; (b) a contract which derives its value from the prices, or index of prices, of underlying securities. The currency derivative is a type of derivative, wherein the underlying exposure is the foreign currency exposure, which can be because of exposure of a corporate due to trade-related import and export, or borrowing, raised domestically or overseas. Currency derivatives can be classified based on cash-flow pattern into four "generic" types, i.e. forward, futures, option, and swap. The types of derivatives used to hedge foreign exchange risk are forwards. This is a private agreement between two entities, to buy or sell any underlying asset at a future date at today's pre-specified price. 'Futures' is a standardized exchange traded contract between two parties to buy or sell the underlying asset at a specified future date at a pre- specified price. 'Swaps' are bilateral agreements between two parties to periodically exchange cash flow in future at pre-specified rates. Finally, 'options' does not buy or sell the underlying

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directly, but rather buys or sells the right without obligation to the underlying. The right can be the right to buy (called call option) and the right to sell (called put option). The currency option is a contract where the purchaser of the option has the right but not the obligation to either purchase or sell, and the seller of the option agrees to sell or purchase an agreed amount of a specified currency at a price agreed in advance and denominated in another currency (known as the strike price) on a specified date (European option) or by an agreed date (American option) in the future. Ideally, an option agreement for the buyer has limited losses (by way of premium paid), but has unlimited potential gain opportunity. The options are one of the complex form of derivatives and have the option technical such as a) call option, where the option buyer has the right (without obligation) to buy, and put option, where the option buyer has the right (without obligation) to sell. b) Strike price is the price level of the asset to be sold or bought at the time of expiry, if the option is exercised. c) Volatility is the standard deviation of the continuously compounded returns of the asset in a specific time horizon. d) Implied volatility is the volatility of the market price of the option. The Black schools model is a generally accepted model for pricing options. e) Greeks are quantities representing the sensitivities of the price of an option to a change in underlying parameters on which the value of the option is dependent. f) Delta measures the change of the option value against the change in underlying asset's value. g) Gamma measures the rate of change in the option's delta against the change in the underlying asset's value. h) Vega measures the rate of change in option value against changes in underlying asset's volatility. i) Theta measures the rate of change in option value against the change in underlying expiry time. j) Rho measures the change in option value against changes in the interest rates. k) Moneyness describes the relationship between the strike price of the option and fair market price. The terms used in moneyness are as follows:

- At the Money, wherein strike price equals the mon ey level.
- In the Money, wherein strike price is lower than the money level.
- Out of Money, wherein the strike price is higher than the money level.

The categories of options are as follows:

Vanilla Option:

The vanilla option is the European type of option giving the option buyer the right, and not the obligation, to buy and sell at a pre-determined exchange rate. The pay-off structure of the vanilla option is simple:

- if the Spot Rate <= Strike Price (K), then pay-off is K - Spot rate.
- if the Spot Rate > Strike Price (K), then pay-off is 0.

Barrier Option:

The barrier option include barriers such as Knock In (KI), i.e. the option comes into existence if KI level is touched, Knock Out (KO),where the option ceases to exist when KO level is touched, and Knock In-Knock Out (KIKO), which is a combination of both KI and KO, when added over the vanilla option. The barriers in option reduce the cost of option, but can decrease or increase the risk of a zero-cost option.

There are four categories of participants in the currency derivatives market: hedgers, who use currency futures to protect an existing portfolio (or an anticipated investment) against possible adverse currency movements; arbitrageurs, who profit from price differentials of similar products in different markets, e.g. price differentials between the spot

exchange rate and futures price; investors, who use currency futures to enhance the long- term performance of a portfolio of assets; and finally, speculators, who use currency futures in hopes of making a profit on short-term movements in prices. Speculators, therefore, seek to enhance risk with the aim of making a profit. A successful and efficient market is made up of a healthy balance of all the participants.

Types of Currency Derivatives and Indian Currency Derivative Market

The forward contracts are the most widely used derivative contracts by Indian corporates, and the combined turnover of both merchant and interbank was almost USD 1.846 trillion in FY 16-17, out of which transactions by Indian corporates accounted for USD 1.36 trillion, indicating a huge currency derivative market in India and also a strong presence of Indian corporate in the market, basically owing to the trade transactions of Indian corporates with the rest of the world. The future contracts, which are another form of derivative contracts, are standardized forms, which are traded in currency exchanges and also receive wider acceptance among Indian corporates with the turnover in Indian currency exchanges going up from Rs. 1,62,272 Cr in FY 09 to Rs. 22,25,840 Cr in notional principal in FY 17. The currency option and its variants (which are the focus of the study because of its potential to cause substantial losses for Indian corporates) are a complex form of derivatives. Its volume has exponentially increased globally and in India. These are OTC products and suffer from risks involved in non-exchange traded products. The swaps, which are the fourth form of derivatives, can be used in a plain form or with a complex mix of derivatives if added along with currency option, and helps us understand what has caused substantial losses to Indian corporates. It is also the focus of the current study.

The barrier option consists of exotic derivatives in a complex option structure to hedge foreign currency risk compared to a forward contract, which is simple with a linear pay-off. The barrier option has been the bane of a lot of Indian corporates during the years 2005-2010 and also thereafter. These instruments were the point of litigation between Indian corporates and banks as corporate alleged that they have been mis-sold on the product, without an understanding of the intrinsic risks. The pay-off structures of all these exotic derivatives are hugely risky and non- linear with losses increasing exponentially. In some cases, loss in the structure is more than the notional principal. A structure which was prevalent among the corporates in India during the period was a zero-cost structure, which subsequently became the nemesis to companies. The structure that evolved in Indian conditions was due to a regulatory prohibition that Indian corporates cannot receive premium or write an option structure. The zero- cost structure involves a long and short option position of unequal notional principal, wherein the premium paid by the corporate on buying an option is offset by the premium to be received on the short option position. However, as the notional principal is unequal, the risk of downside losses due to adverse movement of currency has increased and risky, thus causing losses to Indian corporates. Swaps are foreign currency contracts, wherein the buyer and seller exchange equal initial principal amounts of two different currencies at spot rate. The swaps include interest rate swaps and currency swaps. The combination of both interest rate swap and principal-only swaps is CCIRS, which was typically done by Indian corporates to reduce the cost of borrowing, effectively converting INR borrowing to foreign currency borrowing.

Exotic Derivatives and Indian Corporates, Losses Suffered and Litigation thereof and the Global Perspective of Currency Derivatives

In the exuberance of hedging derivative

transactions, the underlying were not properly ensured by Indian corporates. In other words, Indian corporates presumably entered a large number of speculative derivative transactions rather than the required hedge transactions. Initially, the corporates gained money, but later suffered losses due to subsequent adverse currency movement, with option and barriers getting triggered. The losses were huge, placing some mid- and large-sized companies near bankruptcy. Some classic cases of Indian corporates incurring huge losses and near bankruptcy are as follows

Wockdhadt Limited:

Life after Debt: *Economic Times*, 17 August 2010: "A trusted lieutenant of Mr Habil Khorakiwala dialed a Singapore number to contact a gentleman named Ponty Singh, a former banker with Morgan Stanley and Citi, who owned the financial services firm Tricolor Capital. The conversation that followed was the first of its kind by an official of an Indian company. Wockhardt Ltd, the company that Mr Khorakiwala founded in 1967, was sitting on a mountain of losses—nearly Rs. 1,500 Crore—after a series of cross-currency derivative deals backfired.

Derivatives:

Impact of Indian Corporates and Banks: After getting to the risky underbelly of exotic derivatives that includes swap and swap op- tion, a series of Indian corporates came out and de- clared losses amounting to a billion Indian rupees. A few examples are as follows:

- KPIT Cummins Info systems Ltd reported MTM losses on foreign exchange derivatives, which stood at Rs. 89.27 Cr in FY 2008.

- Bharti Airtel Ltd reported MTM losses of Rs.204.5 Crores, including Rs.123 Cr toward embedded derivatives, in the same year.

- Maruti Suzuki reported loss due to derivatives, amounting to Rs. 50.50 Cr.

- Hexware Technologies announced that it had made provisions of Rs. 98.25 Cr to cover exposure from unauthorised deals entered into by an employee that involved derivatives.

Similarly, Indian banks that have written all these derivative transactions started making provisions for default, on the part of their clients, to pay the loss of derivatives to settle the transactions. Some examples are as follows:

- Axis Bank provided for Rs.71.97 Cr in FY in its book, not due to its own derivative structures, but because two of its firms suffered losses on derivatives and took to the courts against the bank.

- ICICI Bank had made provisions worth Rs.400 Cr in a FY, due to MTM losses for the bank's exposure to credit derivatives obligations. The losses resulted in acrimonious disputes and litigation between Indian corporates and banks. Gary Acrylite Ltd. filed a case against Axis Bank; Nahar Industrial Enterprises Ltd., Gary Acrylite, NCS Sugars Limited, Sabre International Ltd., and Sundaram Multi Pap Ltd. filed a case against ICICI Bank. Kohinoor Food Ltd. filed a case against PNB. On the other hand, banks approached the Debt Recovery Tribunal for recov- ery of dues from corporates.

The result of the journey of derivatives of the Indian corporates during the period was, therefore, a debacle. The events recorded for the study included derivatives entered during 2007-12 and litigation registered during 2010-13. The genesis of the Indian corporates can be characterized by the following:

- Unbridled growth of currency derivatives in India, without proper checks and balances;

lack of proper risk management policy and framework.

- Entering into a derivative structure without proper underlying.
- Huge cost reduction structures on rupee borrowing without having any foreign currency exposure.
- Employing more option contracts compared to sim- ple forward contracts to hedge foreign exchange risk.
- The pay-off structure of option contracts were not understood by the Indian corporates before under- taking the structure.
- Deals and transactions were highly influenced by initial carry or upfront receipt of premium without understanding that subsequent carry has to be nega- tive or there would be payout.
- Structures backed underlying FX exposures; also, MTM losses on derivatives were ascertained vis-a- vis profit in underlying as the underlying were not products of Mark to Market.
- Regulatory framework was not strong to prevent banks mis-selling derivative products. This study tries to develop a framework to control risk factors so that *"Derivatives work as an instrument of hedg- ing rather than current Indian scenario of without it.*"

Global Perspective: According to the 2016 Triennial Survey, turnover in global FX market averaged 5.1 trillion USD in 2016 and this was down from USD 5.4 Trillion in April 2013. However, the daily turnover of foreign currency instruments increased from USD 1.617 trillion in 1998 to USD 5.067 trillion in 2016, an increase of 211%. The currency derivative market (forward and swaps), which was USD 1,059 trillion, increased to USD 3,415 trillion (222% increase). Although in the global scenario, after the derivatives and sub-prime crisis, the market still had a modest growth, in the Indian market, the derivative market had seen a huge decrease, with almost all banks stopping the offer of these instruments due to a bad experience of the derivative debacle.

Objectives of the Study

The objective of this study is to

- Analyze the interrelationship between currency derivatives, risk management, and corporate finance.
- Understand the level of awareness and understand- ing of derivatives by users of foreign exchange derivatives in Indian corporates.
- Map the risk profile of corporates vis-a-vis the inherent risk of derivatives so that corporates are capable of withstanding large losses in adverse market conditions.
- Develop a suitable and effective currency derivative framework to hedge currency risk of Indian corporates.
- To satisfy the objectives of the current study, the building block is to develop the framework involved.
- To develop an effective risk management framework that involves:
- The study of supervisory oversight required to satisfy the requirement of the research.
- Bringing awareness of or understanding the risk involved in derivative instruments by

Indian corporates.

- Understanding the relationship of the financial structure of the corporates to undertake derivative transactions.

- Developing a predictive model, which will allow corporates to predict its portfolio losses or gain in deriving a risk management framework.

Research Design

The research design for this study was involved as follows a}Survey data from a large pool of financial professionals of Indian corporate .b) Understanding 19 derivative contracts, i.e. one for- ward contract, 11 option contracts, and eight swap structures; mapping the risk on these instruments to understand the suitability of these instruments for Indian corporates. c) Collecting data from 166 listed corporates for a 5-year period to set up an objective framework with a predictive statistical model. Results of the survey data collected from finance professionals of a large number of corporates, intriguingly, show that they have the most important corporate point of view for entering derivative transactions. Their viewpoint is that:

"A corporate should have a proper, well-defined treasury set-up, with skilled manpower, and a well- documented risk management system with limit framework for managing derivative transactions. The risk management framework should have clearly defined limits with adequate management and professional oversight. The survey also confirmed that a firm having adequate capital structure with better financial ratios such as liquidity ratio, working capital management, and return on investment is more likely to survive in a negative pay-off rather than a firm lacking them. Hence, as a regulatory measure, complex derivatives should be restricted to firms having an adequate risk management framework with sound financial parameters."

Understanding the risk of instruments is the key to undertaking derivative transactions. In this context, the study was undertaken for 11 types of option derivative contracts, for measuring their risk in terms of premium, and delta hedge, and eight swaps derivative contracts, for measuring their risk in terms of Modified Duration and DV01 in comparison to spot and forward derivative contracts (simple derivative instruments) to understand the capacity of the corporate to absorb the negative pay- off of the derivative transactions. The same is tabulated based on risk of trades as follows:

Delta Hedge:

Delta is the change in value of an option for each dollar change in the market price of the underlying asset. For example, a cap with a delta of 0.50 means a half-point rise in premium for every dollar that the underlying asset goes up. For a floor option, the premium rises as the underlying asset's price falls.

Option Premium:

Option premium is the premium that the option buyer has to pay for buying the option. The option premium goes up for the option seller, if the risk of the derivative transaction goes up.

Modified Duration:

It captures the change in val- ue of the option contract to the change in value of interest rate.

DV01: It is the change in dollar price for 1 basis point.

Table 1: Option Risk Evaluations of 11 Option Contracts Entered for a Notional Principal of USD 1 Mio on 24.08.2018

Sr.No.	Type of Derivative	Notional Principal in USD	Underlying Currency	Premium	Delta Hedge	Remarks
1	Spot	1,000,000	USD	0	(-) 1,000,000	
2	Forward	1,000,000	USD	0	(-) 987,568	
3	Option Vanilla	1,000,000	USD	26893	(-) 480,735	
4	Option Straddle	1,000,000	USD	2799	0	Leg 1: (-) 250,000
						Leg 2: 250,000
5	Option Strangle	1,000,000	USD	53506	0	Leg 1:(-) 492,712
						Leg 2: (-) 492,712
6	Option Knock In	1,000,000	USD	26853	(-) 417,234	
7	Option Knock Out	1,000,000	USD	26442	(-) 417,234	
8	Option Accumulator	1,000,000	USD	9406	(-) 469,664	
9	Digital Option	1,000,000	USD	474451	(-) 5,978,720	
10	Digital Knock In	1,000,000	USD	447937	(-) 7,285,679	
11	Digital One Touch	1,000,000	USD	634347	(-) 9,200,985	
12	Digital double one touch	1,000,000	USD	792586	(-) 2,951,837	
13	Option Sequential KIKO	1,000,000	USD	1594	862	

Observations:

It can be observed that delta hedge for purchase of USD 1 mio in a spot contract is (-) USD 1 mio, whereas in the case of forward purchase of USD 1 mio, the delta hedge is (-) USD 987,586. This means that for undertaking a spot or forward transaction, the underlying transactions are exactly the opposite of the derivative transaction of equal or near-equal value. For deals 3, 6, 7, and 8, the delta hedge is in the range of approximately (-) USD 4,70,000 to (-) USD 4,80,000, and premium is in the range of USD 9,400 to USD 26,000. However, structures 9, 10, 11, and 12, the premium is in the range of USD 474,451 to USD 791,586, and the delta hedge (-) USD 2.90 mio to (-) USD 9.20 mio. However, for structures 4, 5, and 13 the premium and delta hedge are less.

The Reserve Bank of India, which acts as the regulator, in its guidelines indicated that the value of derivatives should not exceed the value of underlying. Thus, entering into any structure, wherein the delta hedge is higher than the notional principal, can normally not be termed as derivative for effective hedging; it is meant for trading and speculative purposes and should be avoided or minimized to lower the risk owing to derivative transactions.

Table 2: Swap Risk Evaluation of Eight Contracts of a Notional Principal of USD 1 mio Entered on 24.08.2018

Sr.No.	Products	Risk (ModifiedDuration)	DV01
1	Loans	1.01	0.10
2	Single Currency Fixed Floating	0.75	75.47
3	Single Currency Basis Risk Swap	0.00	0.01
4	Cross Currency IRS	0.75	0.08
5	Swaption	0.37	0.04
6	Cap		-0.41
7	MIFOR	0.47	0.05
8	TRS	-0.13	-0.01

Observations:

The risk associated with a swap instrument is the modified duration of the swap instrument. In other words, it creates a long or short USD bond equivalent to the modified duration, which will be impacted by the up and down movement of the swap rate, which is captured by its DV01. Thus, the lower the modified duration and DV01 lower is the risk associated with the instruments. From the analysis of the transactions, all types of swap indicate that some transactions are highly risky and far outweigh the risk originating from the underlying. The pay-off structure indicates the risk profile of the trades at different exchange rates. It can, therefore, be concluded that

1. The delta hedge should be used as a key risk indicator by Indian corporates. A delta hedge above the value of the underlying is a trading position and speculative trade. The framework for derivative trade for Indian corporates should, therefore:

a. Include a limit for delta hedge such that transactions should not exceed the value of notional principal.
b. Fix delta hedge of the portfolio of derivatives at a percentage of notional principal, such that it does not exceed the value of underlying portfolio, as it would contravene the regulatory guidelines (i.e. value of derivatives should not exceed value of the underlying).

2. The higher the premium on the structure, higher the risk associated with the derivative trade; it should be linked with the corporate risk appetite and limits should be fixed for a corporate total premium to the profit or net worth, for an evolving risk frame- work.

3. The swap transaction should be evaluated from modified duration and DV01, and limits such as modified duration limit and DV01 limit may be fixed for a corporate as part of the risk management framework.

4. An understanding of pay-off at the time of concluding a deal is the key to the professional undertaking of derivative transactions and also important for management insight. The pay-off must be obtained and documented with due signature by the key professional of the corporate before undertaking the derivative transaction.

5. The value of the derivative transactions must be mapped for mark to market profit, and losses and strict-cut loss must be fixed as part of the risk management framework.

The pay-off structure should be the key evaluation and scenario must be the key evaluation of the derivative structure

Predicting Forex Losses of a Firm based on the Statistical Model

This study involves analyzing 17 financial parameters of 66 Indian corporates under large, medium, and small listed companies, as per their published annual reports of five years (2010 to 2015) to figure out the relationship with Forex Losses, to measure the determinants of the corporate's financial structure and its ability to incur foreign currency profit and losses. The data considers Forex Losses (Gain) as the dependent variable and 14 independent variables such as export earnings, import, net exposure, gross exposure, O/S contracts, USD/INR rate, DER, CR, average stock price, profit, ROCE, size of firm, unhedged exposure, and market capitalization. The regression model has been developed by using statistical factors.

Dependent Variable: Forex Loss

Independent Variables: Export Earnings, Import, Net Exposure, Gross Exposure, O/S Contracts, USD/INR Rate, DER, CR, Average Stock Price, Profit, ROCE, Size of Firm, Unhedged Exposure, Market Capitalization.

The statistical parameters considered for the research study are:

Multiple R:

Pearson Correlation Coefficients between the predicted and the actual value of the dependent variable in a linear regression model.

R-square:

Coefficient of determination is the measure of the "goodness of fit" of the regression. It is interpreted as a percentage of variation in the dependent variable explained by the independent variable.

Adjusted R-square:

R-square may not be a reliable measure as it almost always increases as independent variables are added to the model. It is used to overcome the problem of overestimating the impact of additional variables on the explanatory power of a regression model.

Adjusted R-square can be expressed as: $R_a^2 = 1-[\{(n-1) / (n-k-1)\} * (1-R^2)]$

Where :

n = number of observations

k = number of independent variables R_a^2 = adjusted R^2

Standard Error:

The standard error of regression (SER) measures the uncertainty about the accuracy of the predicted values of the dependent variable.

Intercept Term:

The intercept term is the value of the dependent variable when the independent variables all equal zero.

Residuals:

The residuals are calculated as the difference between the actual value observed and predicted value based on the regression model.

Model Building

To build a regression model, regression analysis has been run on different scenarios to obtain satisfactory year basis to predict forex losses and gains for the next year.

Result of Year 1: (Figures of 2012 without Lag

Regression Statistics	
Multiple R	0.9817
R Square	0.9638
Adjusted R Square	0.9610
Standard Error	95.03
Observations	43

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	24.3467	17.7820	1.3692	0.1788	-11.6207	60.3142	-11.6207	60.3142
UNHEDGED_EXPOSURE	-0.0180	0.0033	-5.4402	0.0000	-0.0246	-0.0113	-0.0246	-0.0113
Net_Exposure	0.0067	0.0010	6.7700	0.0000	0.0047	0.0086	0.0047	0.0086
SIZE_OF_FIRM	-0.0129	0.0015	-8.7361	0.0000	-0.0159	-0.0100	-0.0159	-0.0100

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	24.3467	17.7820	1.3692	0.1788	-11.6207	60.3142	-11.6207	60.3142
UNHEDGED_EXPOSURE	-0.0180	0.0033	-5.4402	0.0000	-0.0246	-0.0113	-0.0246	-0.0113
Net_Exposure	0.0067	0.0010	6.7700	0.0000	0.0047	0.0086	0.0047	0.0086
SIZE_OF_FIRM	-0.0129	0.0015	-8.7361	0.0000	-0.0159	-0.0100	-0.0159	-0.0100

Result of Year 2:

Regression Statistics	
Multiple R	0.9796
R Square	0.9595
Adjusted R Square	0.9563
Standard Error	53.17
Observations	42

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-2.6145	10.0141	-0.2611	0.7954	-22.8869	17.6579	-22.8869	17.6579
PROFIT	0.0263	0.0039	6.6807	0.0000	0.0183	0.0343	0.0183	0.0343
SIZE_OF_FIRM	-0.0086	0.0009	-9.9539	0.0000	-0.0103	-0.0068	-0.0103	-0.0068
UNHEDGED_EXPOSURE	-0.0162	0.0011	-14.8972	0.0000	-0.0184	-0.0140	-0.0184	-0.0140

Result of Year 3:

Regression Statistics	
Multiple R	0.9719
R Square	0.9445
Adjusted R Square	0.9417
Standard Error	122.89
Observations	42

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-16.3882	21.0592	-0.7782	0.4411	-58.9844	26.2080	-58.9844	26.2080
O/S_Contracts	-0.0234	0.0072	-3.2539	0.0024	-0.0379	-0.0088	-0.0379	-0.0088
UNHEDGED_EXPOSURE	-0.0340	0.0014	-23.9958	0.0000	-0.0369	-0.0312	-0.0369	-0.0312

Result of Year 4:

Regression Statistics	
Multiple R	0.6840
R Square	0.4678
Adjusted R Square	0.4374
Standard Error	202.70
Observations	38

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-15.0254	41.0638	-0.3659	0.7166	-98.3893	68.3384	-98.3893	68.3384
SIZE_OF_FIRM	-0.0107	0.0019	-5.5121	0.0000	-0.0146	-0.0068	-0.0146	-0.0068
Net_Exposure	-0.0027	0.0011	-2.5596	0.0150	-0.0049	-0.0006	-0.0049	-0.0006

Running regression on the individual year's data could not provide satisfactory results. So, for better results, we run regression with lag and some adjustments. Regression result of Forex loss with lag year independent variables: We run regression for fourth year's Forex losses as the dependent variable, with the third year's remaining variables as independent variables. The results were as follows:

Regression Statistics	
Multiple R	0.72
R Square	0.52
Adjusted R Square	0.43
Standard Error	235.67
Observations	26

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	(46.06)	66.57	(0.69)	0.50	(184.50)	92.38	(184.50)	92.38
O/S_Contracts (3)	0.01	0.02	0.68	0.51	(0.02)	0.05	(0.02)	0.05
SIZE_OF_FIRM (3)	(0.01)	0.00	(4.28)	0.00	(0.02)	(0.01)	(0.02)	(0.01)
Market_Capitalisation (3)	0.00	0.00	0.47	0.64	(0.00)	0.00	(0.00)	0.00
Net_Exposure (3)	(0.00)	0.00	(1.49)	0.15	(0.00)	0.00	(0.00)	0.00

The results were not so different from previous results. So, in another analysis, we included data for regression analysis as follows:

Dependent Variable - 4th year's Forex loss data
Independent Variable - 4th and 3rd (as lag) year's data

The regression so run, somehow, produced better results compared to the earlier exercise. The results are explained as follows:

Regression Model with 4th and 3rd Year Variables:

In order to obtain better results we consider only those companies who incurred losses in both the fourth and third year. We found 26 such companies. We considered the fourth year Forex loss as the dependent variable. Data for all independent variables, as mentioned earlier, are taken for the fourth year and for the third year as lag. With these considerations regression is run. However, the result shows that all these variables are not significant, i.e. their p-value lies above 5%. Removing each insignificant variable one by one, we obtain our regression results as follows:

Regression Statistics	
Multiple R	0.9965
R Square	0.9931
Adjusted R Square	0.9892
Standard Error	32.52
Observations	26

Table 3 :Anova

	Df	SS	MS	F	Significance F
Regression	9	2426489.10	269609.90	255.01	0.00
Residual	16	16915.74	1057.23		
Total	25	2443404.84			

In the above results, variables with (4) in the end correspond to the fourth year, and (3) in the end are of lag year. The model was constructed on the basis of five variables instead of the mentioned 14 variables. The only reason for this was the significance of the variables in this regression model. These five variables have p-value less than 5%, and thus were significant, but it was not the case for the rest of the variables that were excluded.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-20.4701	10.1722	-2.0124	0.0613	-42.0342	1.0939	-42.0342	1.0939
Net_Exposure (4)	-0.0259	0.0035	-7.3449	0.0000	-0.0333	-0.0184	-0.0333	-0.0184
O/S_Contracts (4)	-0.0910	0.0052	-17.4906	0.0000	-0.1021	-0.0800	-0.1021	-0.0800
O/S_Contracts (3)	0.0536	0.0061	8.8526	0.0000	0.0408	0.0664	0.0408	0.0664
SIZE_OF_FIRM (4)	0.0345	0.0044	7.7595	0.0000	0.0251	0.0439	0.0251	0.0439
SIZE_OF_FIRM (3)	-0.0360	0.0042	-8.6028	0.0000	-0.0448	-0.0271	-0.0448	-0.0271
UNHEDGED_EXPOSURE (4)	-0.0037	0.0007	-5.5291	0.0000	-0.0051	-0.0023	-0.0051	-0.0023
Market_Capitalisation (4)	-0.0029	0.0011	-2.6561	0.0173	-0.0051	-0.0006	-0.0051	-0.0006
Market_Capitalisation (3)	0.0040	0.0017	2.3814	0.0300	0.0004	0.0076	0.0004	0.0076
Net_Exposure (3)	0.0233	0.0031	7.5862	0.0000	0.0168	0.0298	0.0168	0.0298

Analysis of the Model

R-square and Adjusted R-square

R-square gives the proportion or percentage of total variation of the dependent variable Y explained by explanatory variable X. It assumes that every independent variable in the model explains the variation in the dependent variable. It gives the percentage of explained variation as if all independent variables in the model affect the dependent variable.

The adjusted R-square compares the descriptive power of regression models (two or more variables)—that include a diverse number of independent variables known as a predictor. The adjusted R-square compensates for the addition of variables and only increases if the new predictor enhances the model above what would be obtained by probability. Conversely, it will decrease when a predictor improves the model less than what is predicted by chance.

In the extant multivariable model defined, the value of r-square is 0.9965 and adjusted r-square is 0.9931. Both are quite high in statistical terms showing strong variation in dependent variable explained by independent variables. There is not much difference in r-square and adjusted r-square, which indicates that a decrease in adjusted r-square is insignificant on addition of variables in the model to improve prediction as compared to what is predicted by chance. As such, it could be considered

that the prediction power of the model is good.

There are chances that in some models R-square and adjusted R-square may be spurious. Therefore, it is pertinent to perform the statistical significance test, i.e. F test, and perform the necessary hypothesis testing analysis. As such, we perform the statistical significance test as follows.

Statistical Significance

Analysis of Variance (ANOVA) is a statistical method used to test differences between two or more means. ANOVA is used to determine whether there are any statistically significant differences between the means of three or more independent groups.

Significance of an Observed Multiple Regression: The F Test

F test is a measure of the overall significance of the estimated regression. It is also a test of significance of R2 In other words, testing the null hypothesis is equivalent to testing the null

$$F = \frac{n-k}{k-1}\frac{\text{ESS}}{\text{RSS}} = \frac{n-k}{k-1}\frac{\text{ESS}}{\text{TSS}-\text{ESS}} = \frac{n-k}{k-1}\frac{\text{ESS/TSS}}{1-(\text{ESS/TSS})} = \frac{n-k}{k-1}\frac{R^2}{1-R^2} = \frac{R^2/(k-1)}{(1-R^2)/(n-k)}$$

hypothesis that R2 is zero

In order to test the significance of regression coefficients, we perform hypothesis testing for the slopes.

To perform the hypothesis test, we shall require:

a. Standard Error: We got standard error (SE) in the regression output as given in column 3. Standard error of the regression represents the average distance of the observed values from the regression line. It may be calculated by using the following equation as well.

$SE = \text{qrt}\ [\Sigma(y_i - \hat{y}_i)^2 / (n-2)] / \text{sqrt}\ [\Sigma(x_i - x)^2]$

b. Slope: We got the slope (bi) of regression line in our regression output as given in column 2**.**

c. Degree of Freedom: For our sample data, degree of freedom is 25, i.e. n-1.

d. Test Statistics: The test statistics is "t" statistics and is defined by the following equation:
t = bi / SEi

*e. Defining Hypothesis***:** In the first step, we define our null hypothesis and alternate hypothesis.

H0 (null hypothesis): The slope of regression line is equal to zero.

Ha (alternate hypothesis): The slope of regression line is not equal to zero.

Decision Rule. Given the k-variable regression model:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \cdots + \beta_k X_{ki} + u_i$$

To test the hypothesis

$$H_0: \beta_2 = \beta_3 = \cdots = \beta_k = 0$$

(i.e., all slope coefficients are simultaneously zero) versus

H_1: Not all slope coefficients are simultaneously zero

compute

$$F = \frac{\text{ESS/df}}{\text{RSS/df}} = \frac{\text{ESS}/(k-1)}{\text{RSS}/(n-k)} \qquad (8.5.7)$$

If $F > F_\alpha(k-1, n-k)$, reject H_0; otherwise you do not reject it, where $F_\alpha(k-1, n-k)$ is the *critical F* value at the α level of significance and $(k-1)$ numerator df and $(n-k)$ denominator df. Alternatively, if the p value of F obtained from (8.5.7) is sufficiently low, one can reject H_0.

Significance Level (P value) for the Test: For this test, we have taken p-value (significance level) as 0.05.

In order to find the significance of observed multiple regression – F-test, we performed the hypothesis testing to check whether the F-test is significant or not.

H0 (null hypothesis): The slope of regression line is equal to zero.
Ha (alternate hypothesis): The slope of regression line is not equal to zero.

It is evident that p-value is close to zero way below the threshold value of 0.05. Therefore, we may reject the null hypothesis, which means that the variation in dependent variable is explained by the independent variables.

Once the regression model is considered as significant based on F-test analysis, we proceed to the analysis of regression coefficients of different independent parameters to understand whether all the parameters can be considered as significant based on the F-test or hypothesis testing, or whether the results of analysis of variance of the model are spurious.

In order to test the significance of regression coefficients, we perform hypothesis testing for the slope

If there is a significant relationship between Forex Loss (dependent variable) and the nine independent variables considered for the regression, the slope will be anything other than zero.

Net Exposure (4): We get the slope (b) and standard error (SE) from the regression output.

b = -0.03
SE = 0.0035

Df = 26-1 = 25

t value = b / SE = -0.03 / 0.0035 = -7.34

Based on the t statistic and the degrees of freedom, we determine the p-value. The p-value is the probability that a t statistic having 25 degrees of freedom is more extreme than 7.34. Since this is a two-tailed test, "more extreme" means less than -7.34 or greater than 7.34. We use the t Distribution table to find P (t > 7.34) and P (t < -7.34), which is approximately 0.00.

Result: Since the p-Value (0.00) is less than the significance level (0.05), we may reject the null hypothesis, finding net exposure as significant to the Forex loss.

In a similar manner, we performed hypothesis testing for all of the parameters and found them significant.

Based on the above results, a regression equation can be defined as:

Forex losses and gain = -20.4701-0.0259 x Net Exposure (n) + 0.0233 x Net Exposure (n-1) - 0.0910 x O/s Contracts(n) + 0.0536 x O/s Contracts(n-1) + 0.0345 x Size of Firm(n) - 0.0360 x Size of Firm(n-1)- 0.0037 x Unhedged Exposure(n) - 0.0029 x Market Capitalization(n) + 0.0040 x Market Capitalization(n-1)

Conclusion

The equation is to predict Forex Losses and Gain due to an Indian Corporate entering derivative transaction which include a certain percentage of Forward contracts, Swap and Option Contracts be it generic and exotic derivatives, so as is to arrive at a Broad factor to predict Forex Losses for Indian Corporate, which is largely dependent on factors relating to the size of firm, Unhedged exposures and Market capitalization apart from the underlying

contracts. Derivatives are by far the most complex of financial instruments the above study gives a greater study of the framework and thus would require further studies and research require to evolve a very strong framework for entering the derivative structure. The Indian Market an also global financial market saw most violent period of Forex Losses almost corporate shun the complex derivatives, but outcome or our research is based on evolving strong framework to operate rather than not entering into contracts.

Lord Krishna in SRIMAD BHAGAVATAM has said

" Whatever has happened, has happened for good
Whatever is happening is also for good
Whatever will happen, shall be good
CHANGE IS THE LAW OF UNIVERSE"

Thus the study on Derivative is to prove a point that these are not the financial instruments for mass destruction as said by Waren Buffets but yes to the fact that these are complex financial instruments, which require detailed understanding with string framework to operate so that it effectively uses to hedge the underlying instruments and prevent losses.

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