

Assessment of Effectiveness of foreign currency future Hedging in India

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Abstract:

Through an analysis of four main international currencies—the US dollar, euro, Japanese yen, and British pounds—against the Indian rupee, the research study assesses the effectiveness of hedging in India's foreign exchange futures market. The research attempts to quantify how well futures contracts mitigate currency risk by examining the relationship between price changes in the spot and futures markets. The study uses a variety of econometric techniques, such as the ADF test for stationarity, the Johansen Cointegration Test for long-term relationships, and the computation of Optimal Hedge Ratios for identifying effective hedge positions, using daily spot and futures price data over a five-year period (2019–2023). Hedging efficiency is further assessed to quantify how well futures markets offset risk in the spot market. The major findings offer insights into the comparative performance of currency futures for USD, EUR, JPY, and GBP, contributing to the understanding of currency risk management in the Indian financial markets and enhancing market participants in making informed hedging decisions.

Key Words: *Hedging Efficiency, International Currencies, Optimal Hedge Ratios and Risk Management.*

1. Introduction:

The foreign currency futures market plays a crucial role in the global financial system, providing a platform for investors, companies, and financial institutions to manage and mitigate the risks associated with fluctuations in exchange rates. In a world where international trade and investment have become commonplace, the need to protect against adverse movements in currency values has never been more important. The concept of hedging, which refers to strategies used to reduce or eliminate financial risks, is at the heart of this market. This project focuses on understanding the efficiency and effectiveness of hedging within the context of India's foreign currency futures market.

Foreign currency futures are standardized contracts that allow buyers and sellers to exchange a specific amount of currency at a predetermined price on a future date. These contracts are traded on formal exchanges, providing transparency, liquidity, and regulation, making them an attractive tool for hedging. Companies engaged in international business, investors holding foreign assets, and financial institutions with exposure to currency risk often turn to these futures contracts to protect themselves from unfavourable changes in exchange rates.

India, with its rapidly growing economy and increasing integration with the global market, has seen a significant rise in foreign currency transactions. This has led to the development of



a robust foreign currency futures market. However, the efficiency of this market, particularly in terms of its ability to provide effective hedging, remains a critical area of study. Hedging efficiency, in simple terms, refers to how well these futures contracts can protect against the risk of currency fluctuations. An efficient hedging mechanism should minimize losses or provide stability in cash flows when exchange rates move unfavourably.

To understand hedging efficiency, one must consider several factors. First, the relationship between the futures prices and the spot prices of currencies is crucial. A close correlation between these prices indicates that the futures market accurately reflects the underlying currency movements, making it a reliable hedging tool. Second, the liquidity of the market, or the ease with which these contracts can be bought or sold without significantly affecting their price, plays a significant role. A liquid market ensures that participants can enter and exit positions with minimal friction, enhancing the effectiveness of hedging.

In the Indian context, the foreign currency futures market has undergone significant developments over the years. The introduction of currency futures in 2008 marked a milestone in the country's financial landscape, providing an additional tool for managing exchange rate risks. Since then, the market has grown, with increased participation from various sectors, including corporations, banks, and individual investors. However, the question remains: how efficient is this market in providing the desired hedging benefits?

This paper aims to explore the hedging efficiency of the foreign currency futures market in India by analysing the relationship between futures and spot prices, examining the liquidity of the market, and evaluating the overall effectiveness of these contracts in mitigating currency risk. By doing so, it seeks to provide insights into the strengths and weaknesses of the Indian foreign currency futures market, offering valuable information for market participants and policymakers alike.

The hedging efficiency of the foreign currency futures market is a vital aspect of financial risk management, particularly in an economy like India, where exposure to foreign currency is growing. This project will contribute to a better understanding of how well the market functions in protecting against exchange rate risks, ultimately helping businesses and investors make more informed decisions.

2. Review of Literature:

Kaur et al. (2023), Optimal hedge ratio and hedge effectiveness of equity and currency futures contracts: evidence from NSE paper author taken the same benchmark indices and four currencies with respect to review of literature 1. Here they used five different kinds of constant ratio models namely Naïve, OLS, VAR Autoregressive moving average ordinary least square and VECM and three time-varying hedge ratio models like GARCH, EGARCH and TARARCH, the objective of the study is simple that hedging effectiveness in case of equity and currency but here they used different measures to find-out optimal efficiency. And hedging effectiveness has been studied using



two approaches i.e., Variance-reduction approach and risk-return approach. All results indicate that traditional hedge ratio models generate superior hedging effectiveness than time-varying models that are difficult to understand. Overall, the study finds that effective hedging in equity futures market as variance could be reduced to a large extent (more-than 96%), whereas in currency futures market, variance reduction is less than 40 %.

Kaur et al. (2020), Testing the hedging effectiveness of Indian equity and currency futures contracts, an attempt has been made to examine the hedging effectiveness of both equity as well as currency futures contracts traded at NSE for the period of eight years near month contracts, by considering the three benchmark indices of equity futures market (i.e., NIFTY50, NIFTYIT and BANKNIFTY) and four currency futures (i.e., USD, GBP, JPY, EUR). Various econometric tools like OLS regression, VAR, VECM, GARCH were used to find the optimal hedge ratio among equity and currencies. It is observed that futures contracts in equity market are more efficient than currency futures in hedging and also it suggests that investor can use OLS regression model to achieve the highest hedging effectiveness than using complicated time varying models.

Kharbanda at el. (2020), Futures market efficiency and effectiveness of hedge in Indian currency market mainly focuses on evaluating the effectiveness of hedging US currency futures for corporate treasurers as US dollars are the most prevailing currency medium for

international business. In this study author used two dynamic econometric model for finding the optimal hedge ratio and efficiency such as CCC-MGARCH and DCC-MGARCH models. This paper finds that both the model provides the more are less similar results i.e., hedge ratio is more than 1 and effectiveness nearer to 100%, in the relative comparison CCC-MGARCH gives better hedging effectiveness and thus should be preferred. Treasurer of the company must choose a hedge effectiveness models which justifies their risk profile.

Kharbanda at el. (2018), Hedging and effectiveness of India currency futures market aims to measure how effective currency futures contracts are in hedging for corporate companies. This is important because new Indian accounting standards require companies to measure how well their hedging strategies work, especially in a highly volatile market. The paper compares three different models for evaluating hedging effectiveness: OLS, VECM &DCC-MGARCH. OLS and VECM are static models, meaning they don't change over time, while DCC-MGARCH is a dynamic model that adapts to changing market conditions.

Kumar at el. (2017), Effectiveness of currency futures market in India: an empirical investigation paper explores how the introduction of currency futures in India has impacted the volatility (price fluctuations) of the spot market for three major international currencies: USD (U.S. Dollar), GBP (British Pound), and EUR (Euro), compared to the Indian Rupee (INR). The study covers an eight-year period from 2006 to 2013 and uses a

statistical model called GARCH to measure volatility. The findings show that after currency futures were introduced in India, the volatility in the spot market decreased for GBP and EUR, but not for USD. Since India primarily deals with USD, the volatility of USD in the spot market is a significant concern. Additionally, the study finds that negative news doesn't necessarily cause much volatility in the Indian currency market. In terms of the relationship between the spot and futures markets, the study observes that for USD and EUR, changes in the spot market tend to cause changes in the futures market (unidirectional causality). However, for GBP, there is a two-way relationship where changes in both the spot and futures markets affect each other (bidirectional causality).

2.1 Research GAP:

Despite the growing significance of currency futures markets in India as tools for managing exchange rate risk, limited research has comprehensively explored their hedging efficiency, particularly in the context of emerging markets like India. Existing studies often focus on developed economies or analyze a single currency pair, leaving a gap in understanding the comparative performance of currency futures for multiple major currencies (USD, EUR, JPY, GBP) against the Indian rupee. Furthermore, the dynamic relationship between spot and futures prices in the Indian context remains underexplored, particularly concerning the evolving market structures and regulatory frameworks. This research aims to address these gaps by evaluating the hedging

effectiveness and comparative performance of these futures markets.

3. Methodology :

3.1 Statement of the Problem:

In current globalized world corporate treasurers, traders, hedgers are always trying to manage the currency risk of their organization as well as their own by hedging through futures contracts. Exchange rates are highly fluctuating it affects the financial position of corporate treasurers, traders and hedgers etc, one way of hedging is through futures contracts. Therefore, this study aims to evaluate the efficiency of hedging currency risk using futures contract in the Indian market.

3.2 Objectives:

The objectives of the studies are as follows:

- 1) To study the relationship between price movements of the spot currency market and futures market.
- 2) To investigate the hedging efficiency of futures market in India in hedging currency risk.
- 3) To compare the hedge performance of futures markets for US Dollar, Euro, Japanese Yen and British Pounds with respect to Indian rupee.

3.3 Research Methodology:

- a. **Type of Research:** Descriptive research was used for the study, which the data for this study includes daily spot prices and futures prices of four international currencies i.e., US Dollar, Euro, Japanese



- Yen and British Pounds for period of five years (From 1-1-2019 to 31-12-2023).
- b. **Method of sampling:** The sampling technique followed is Convenience Sampling. Sample units chosen are daily spot prices and futures prices of four international currencies i.e., US Dollar, Euro, Japanese Yen and British Pounds.
 - c. **Sample Size:** The study covers four international currencies i.e., US Dollar, Euro, Japanese Yen and British Pounds for period of five years (From 1-1-2019 to 31-12-2023)
 - d. **Research Technique:** The following econometrics tools were used for analyzing the study.

Table 1: Different research techniques used for the study

Sl.No	Statistic/Econometric Tools	Purpose
1	Descriptive-Statistics	It describes nature of the data-set used for the research purpose.
2	Log returns and Annual returns	Log returns are a way to measure how much the price of an asset has changed over time, expressed as a percentage. Annual returns measure the percentage change in the value of an investment(currencies) over a year.
3	Unit-Root-Test: Augmented Dickey Fuller Test	The selected data will be tested for the stationary.
4	Johansen cointegration test	Cointegration test is conducted to measures the long-run equilibrium relationship between variables (spot and futures prices).
5	Optimal Hedge Ratio (OHR)	The Optimal Hedge Ratio (OHR) or Minimum Variance Hedge Ratio is the ratio of the size of the futures market position to the size of the spot market.
6	Hedging Efficiency	Hedging Efficiency measures the degree to which the simultaneous gains or losses in the physical market are equalised by the respective losses or gains in the futures market-thereby ensuring effective locking.

4. Empirical Analysis:

4.1 Descriptive Statistics

Descriptive statistics is the necessary tool for basic analysis of any data set, from which we can infer mean values, volatility and correlation between the spot returns and futures returns. It provides insights into the risk and returns characteristics of currencies and helpful for further analysis.

Parameters		USD	JPY	GBP	EUR
Mean	Daily spot returns	0.00014	-0.00006	0.00014	0.00011
	Daily futures returns	0.00016	-0.00009	0.00016	0.00015
SD	Daily spot returns	0.00307	0.00599	0.00582	0.00463
	Daily futures returns	0.00334	0.00958	0.00658	0.00737
Correlation	Daily returns	0.66886	0.41922	0.56749	0.44020

The mean, standard deviation (SD), and correlation of daily spot and futures returns for the following four currencies are displayed in Table 2: USD, EUR, GBP, and JPY. The average daily returns for all currencies are low, as indicated by the mean values for both spot and futures returns being near zero. Futures returns have higher standard deviations than spot returns, indicating that futures prices are more volatile than spot prices. Standard deviations are a measure of return variability. The US dollar has the highest correlation (0.668866), suggesting a stronger relationship between spot and futures prices, while the Japanese yen has the lowest correlation (0.419225), suggesting a weaker relationship between daily spot returns and daily futures returns. These correlations differ among currencies.

4.2 Augmented Dickey-Fuller Test (Data stationarity test) The price series of futures and spot prices of all the four currencies are used to find ADF test. Where US dollars are better than other currencies.

Currencies	Spot Prices		Futures prices	
	Level	First difference	Level	First difference
USD	-0.7127	-34.9428*	-0.8247	-36.9229*
JPY	-1.2139	-35.7360*	-2.0923	-27.2982*
GBP	-1.7762	-33.4459*	-2.0989	-37.0078*
EUR	-1.3046	-34.4618*	-2.1381	-37.9387*

Note: Figures showed are t-statistic of ADF Test Significance at 5% level*

All of the currencies used in this study have data series that are not stationary at the level (the dataset where its statistical properties change over time), but that become stationary after the first difference, according to the results of the unit root test (the dataset where its statistical properties don't change over time).

Both spot and futures prices are non-stationary for price series data, but stationary for return series in both the spot and futures markets, according to the results in Table 2.

4.3 Johansen Cointegration Rank Test

This co-integration test in conducts to measures the long-run equilibrium relationship between variables (spot and futures prices). It means two variables are trending together and there is a fundamental relationship between variables that makes them trend together.

Whenever they diverge in the short-run an error correction mechanism brings them back to the equilibrium.

Currencies	Trace Statistics	
	None	At most 1
USD	159.5562*	0.4959
JPY	81.88523*	1.5611
GBP	142.4859*	3.4114
EUR	102.5778*	2.1521

*Note: * Significance at 5%.*

*The spot and future prices for all currencies are cointegrated at most one, indicating a long-term equilibrium relationship, as determined by Table 4's Johansen cointegration rank test. One crucial feature is that prices show a correlated movement when they are heading either upward or downward; otherwise, the futures market's ability to effectively hedge against exposure declines. Better and more effective hedging opportunities are also made possible by a strong correlation between the spot and future markets.

At 5%, the null hypothesis—that a cointegrating link does not exist—is rejected.

The stationarity test confirmed that the price series are non-stationary. Two non-stationary variables are said to be cointegrated, if they trend together in the long-run and share an equilibrium relationship, where the deviations if any, are corrected at short intervals. Johansen's test is used to identify cointegration between the markets.

4.4 Mean, Standard Deviation and Correlation

Table-5 shows the data of mean and standard deviation of both spot prices and futures prices of all four currencies (USD, JPY, GBP and EUR) for the four different time horizons (1-day, 10-days, 20-days, and 30-days).

Currencies	Parameter	Days Prices	1-Day	10-Days	20-Days	30-Days
USD	Mean	Spot prices	0.0113	0.1105	0.2151	0.3201
		Future Prices	0.0113	0.1091	0.2139	0.3177
	SD	Spot prices	0.2308	0.7438	1.0678	1.2320
		Future Prices	0.2504	0.7579	1.0814	1.2482
JPY	Mean	Spot prices	-0.0039	-0.0526	-0.1201	-0.1990
		Future Prices	-0.0041	-0.0538	-0.1222	-0.2019
	SD	Spot prices	0.3835	1.2314	1.6953	2.0312
		Future Prices	0.6100	1.5813	1.7832	2.1147
GBP	Mean	Spot prices	0.0142	0.1377	0.2460	0.3461
		Future Prices	0.0138	0.1354	0.2323	0.3305
	SD	Spot prices	0.5536	1.7233	2.2122	2.6077
		Future Prices	0.6427	1.7627	2.1885	2.5840
EUR	Mean	Spot prices	0.0100	0.0931	0.1705	0.2536
		Future Prices	0.0098	0.0897	0.1673	0.2478
	SD	Spot prices	0.3896	1.2481	1.6986	2.0229
		Future Prices	0.6324	1.5784	1.8820	2.1816



The table-5 presents the mean and standard deviation (SD) for spot and future prices of four currencies (USD, JPY, GBP, EUR) over different time periods (1- day, 10-days, 20-days, 30-days). The mean values show the average price movement, with USD and GBP generally having positive means, indicating upward trends, while JPY shows negative means, indicating a downward trend. The EUR also has a positive trend but with lower mean values. The standard deviation, which measures volatility, increases with time for all currencies, indicating that prices become more volatile over longer periods. Futures prices generally have slightly lower means and higher standard deviations compared to spot prices, suggesting that while futures markets closely follow spot markets, they tend to be slightly more volatile.

We are attempting to determine the relationship between spot prices and futures prices over various time periods, and correlation evaluates the relationship between two variables. Higher numbers indicate a stronger correlation between spot and futures prices, and vice versa. The values range from 0 to 1.

The table-5.1 shows the correlation between spot prices and futures prices for over four different time horizons (1-day, 10-days, 20-days and 30-days) for all four international currencies (USD, JPY, GBP and EUR).

Table-5.1 Correlation				
Day's Currencies	1-Day	10-Days	20-Days	30-Days
USD	0.6691	0.9561	0.9816	0.9840
JPY	0.4316	0.6399	0.7378	0.7979
GBP	0.5536	0.9052	0.9501	0.9590
EUR	0.4273	0.6866	0.8195	0.8380

The correlation values between spot and futures prices during a certain time period are summarized in Table 5.1. It is evident that the USD and GBP have the strongest correlations over all time periods, especially over longer time frames (20–30 days), where they go closer to 1, indicating that their spot and futures prices move in parallel. Particularly in the near term (1-day), the JPY and EUR exhibit lower correlations, suggesting less of a connection between spot and futures prices. That said, the connection between these currencies also gets stronger as the time period grows, indicating that futures contracts are more suited for long-term hedging than short-term hedging.

4.5 Optimum Hedge Ratio

Optimum hedge ratio is computed to know how many futures contracts one should buy in futures market to hedge the size of exposure he has in spot market.

Table-6 provides the results of optimum hedge ratio when we consider the rate of prices of both spot and futures market. Computation has been done as per the equation (1).

Table-6 Optimum Hedge ratio				
Days Currencies	1-Day	10-Days	20-Days	30-Days
USD	0.6166	0.9383	0.9692	0.9713



JPY	0.2713	0.4983	0.7014	0.7664
GBP	0.4768	0.8850	0.9604	0.9677
EUR	0.2632	0.5429	0.7397	0.7770
Note: All slope coefficients are significant at 5%				

In the Table-6 we can observe that all the slope coefficients are significant at 5% level. When we take into the account daily returns, USD and GBP has higher OHR compared to other two currencies, but other two currencies i.e., JPY and EUR are also had reasonable OHR lies between 27%-76% and 26%-77% respectively.

The ideal hedge ratio for the hedge contracts is between 0.26 and 0.97, with US dollars having the highest ratio and European euros having the lowest. Additionally, we can see that the short-term hedging prospects for EUR and JPY are the lowest.

4.6 Hedging Effectiveness

Hedging effectiveness measures how well a hedging strategy reduces the risk of adverse price movements in a currency market. It is typically assessed by comparing the variance (or volatility) of the returns of a hedged position against the variance of the unhedged position.

Currencies	Parameter	1-Day	10-Days	20-Days	30-Days
USD	Covariance	0.0387	0.5390	1.1334	1.5132
	Variance (UH)	0.0533	0.5533	1.1401	1.5178
	Variance (U)	0.0294	0.0476	0.0417	0.0481
	HE	44.77%	91.40%	96.35%	96.83%
JPY	Covariance	0.1010	1.2460	2.2304	3.4271
	Variance (UH)	0.1471	1.5162	2.8739	4.1258
	Variance (U)	0.1197	0.8953	1.3095	1.4994
	HE	18.63%	40.95%	54.44%	63.66%
GBP	Covariance	0.1970	2.7497	4.6002	6.4618
	Variance (UH)	0.3065	2.9697	4.8940	6.7999
	Variance (U)	0.2126	0.5362	0.4759	0.5465
	HE	30.64%	81.94%	90.28%	91.96%
EUR	Covariance	0.1053	1.3526	2.6197	3.6982
	Variance (UH)	0.1518	1.5578	2.8851	4.0922
	Variance (U)	0.1241	0.8235	0.9474	1.2186
	HE	18.26%	47.14%	67.16%	70.22%

Note: HE- Hedging Effectiveness



Table 7 presents the hedging efficacy results for four international currencies: US Dollars, Japanese Yen, British Pounds, and European Euros, across four distinct time frames. (1-day, 10-days, 20-days, and 30-days) computation has been done as per the equation (2), equation (3) and equation (4).

In all the currencies, when we look at short period i.e., 1-day the hedging effectiveness is very low as nobody will go for 1-day hedge by the way. Further, the period increases from 1-days to 10-day, 20-days, 30-days the hedging effectiveness also increases drastically. Hence, we can interpret that when we hedge for the longer duration one can get a better or best hedging effectiveness than for a short duration.

From the table we can observe that, US dollars and British Pounds has a better effectiveness of hedge over the last five years and also as tenure of hedge increases the efficiency also increases. (USD-44.74% for 1-day to 96.83% for 30-days and GBP- 30.64% for Day-1 to 91.96% for days-30). But when we look at the hedging efficiency of EUR and JPY are little low in the same time period as compared to USD and GBP (JPY- 18.63% for day-1 to 63.66% for 30-days and in case of EUR-18.26% for 1-day to 70.22% for 30-days).

5. Conclusion:

In today's globalized world, every corporate company or business organisations has to manage their foreign reserves to bought and sold the required materials across the

boundaries for the wider market reach. Due to the demand and supply of various international currencies are more nowadays the currency exchange fluctuation is also extreme, to reduce the variance of currency risk exposures corporate will go for hedging their risk exposures of spot currency to the futures markets.

This study tries to find the percentage of hedging effectiveness of four international currencies namely USD, JPY, GBP and EUR in India market for the five-year period (January 2019 - December 2023). With the computation of optimum hedge ratio (OHR) and hedging effectiveness.

This study reveals that US Dollars and British Pounds had the highest hedging efficiency for the taken time period. Comparatively Euros and Japanese Yen are lower hedging effectiveness. Even same with optimum hedge ratio i.e., USD and GBP OHR range between 0.61 - 0.97 but in case of JPY and EUR the range is 0.26 - 0.67.

Finally, considering the years 2019–2023, we can conclude that hedging prospects for US dollars and British pounds are greater than those for JPY and EUR.

This study was limited to last five years near month contract wise data and used basic hedging tool to compute the efficiency of currencies. Further this study can be continued by using the higher econometric tools and consider longer period of data for the better results.

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