DERIVATIVES QUARTERLY REPORT

Jan-Mar 2024

RESEARCH DEPARTMENT

CCIL

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1. Developments in Derivatives Market

Indian Markets

RBI Directions on Currency Derivatives

- The Reserve Bank of India (RBI) comprehensively reviewed the regulatory framework governing the hedging of foreign exchange risks. In a circular issued on January 5, 2024 the RBI stated that stock exchanges may offer forex derivative contracts involving the rupee to users for the purpose of hedging contracted exposure. This meant that proprietary traders and retail investors would be required to demonstrate contracted or prospective currency exposure to participate in the currency derivatives segments. The new rule, which was supposed to come into effect on April 5, was deferred to May 3.

ClearCorp's FX Clear and FX Swap Merger

- The FX-Clear and FX-Swap platforms of the Clearcorp Dealing Systems (India) Ltd are being integrated and launched as a new version of the FX-Clear Platform to provide for a comprehensive Forex platform for trading in Spot, Swaps and Forward instruments.

Portfolio Compression

- An 86.88% compression was achieved in the 33rd Portfolio Compression cycle run by CCIL for IRS (MIBOR Benchmark) in February 2024.

- A 71.31% compression was achieved in the 16th Portfolio Compression cycle run by CCIL for Forex Forward market in March 2024.

ISDA Publishes Whitepaper on India's OTC Derivatives Market

- The International Swaps and Derivatives Association (ISDA) published a whitepaper on the growth of India's financial market, focusing on over-the-counter (OTC) derivatives market. The report emphasizes broadening product development, innovation, and diversification by developing standardized term benchmarks, expanding the credit derivatives market, and enabling onshore OTC commodity and equity derivatives.
  https://www.isda.org/a/MWsgE/ISDA-Publishes-Whitepaper-Charting-the-Next-Phase-of-Indias-OTC-Derivatives-Market.pdf

Global Markets

Regulations

- ISDA, in collaboration with SIFMA, responded to the US Basel III endgame notice of proposed rulemaking, warning of significant capital increases for bank trading activities. The proposal would adversely affect derivatives end users, including commercial end users, corporate and banking organizations, resulting in negative effects on investors. To avoid these significant impacts to derivative end users, as well as knock-on consequences to consumers, the agencies should enhance the risk sensitivity of the capital framework in the proposal.

- The Australian Securities and Investments Commission (ASIC) has finalized minor and technical updates to the reporting rules for over-the-counter (OTC) derivatives, effective March 13, 2024. These updates include the addition of seven new data elements, clarifications, and administrative updates to existing data elements, changes to the reporting requirements and updates to the references for definitions in the Corporations Act 2001, reflecting recent legislative amendments.

- The Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO) released a discussion paper about improving the process for variation margin (VM) in centrally cleared markets. The paper outlines eight effective practices, including how often and when VM calls should be made during the day, handling extra collateral, passing VM through by central counterparties (CCPs), and increasing transparency between CCPs, clearing members, and their clients.

Product Launches & Technology Advancements

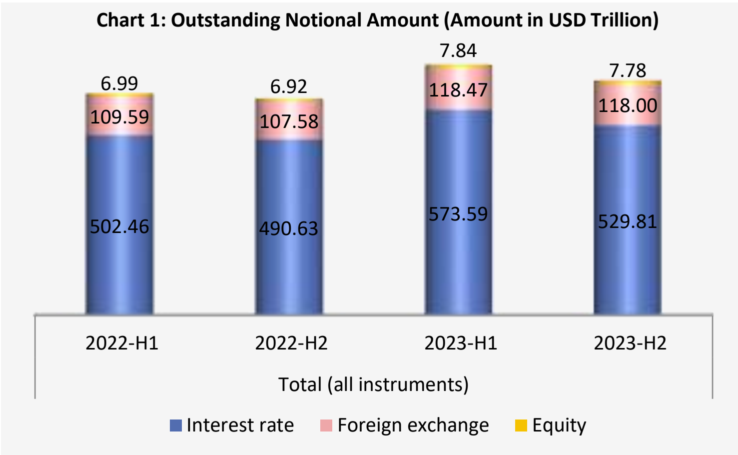
- Singapore Exchange (SGX Group) is set to launch short-term interest rate futures linked to the Singapore Overnight Rate Average (SORA) and Tokyo Overnight Average Rate (TONA) in the second half of this year, pending regulatory approval. These three-month SORA and TONA futures contracts aim to provide global investors with cost-effective tools for hedging and trading interest rate fluctuations.

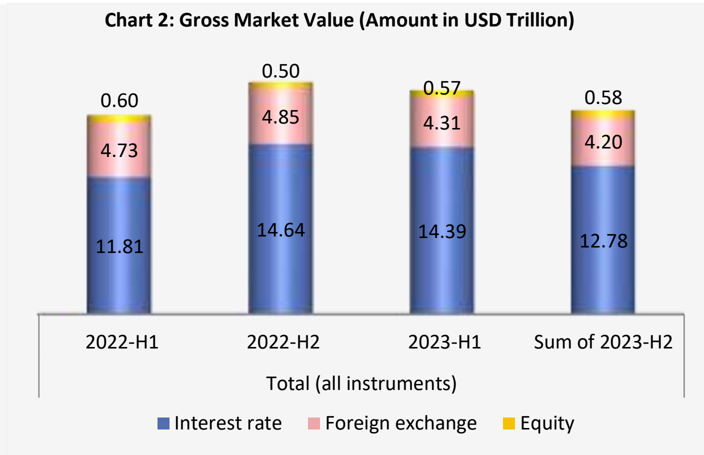
- BGC Group, Inc. a global brokerage company announced that its FMX Futures Exchange received approval from the CFTC to operate an exchange for U.S. Treasury and SOFR futures. BGC will integrate their Fenics UST cash Treasury platform with FMX to operate within the CME's U.S. interest rate system. FMX has a clearing agreement with LCH SwapClear, which holds interest rate collateral. This agreement will allow for portfolio margining across different rates, providing margin efficiencies and effective risk management.

- Intercontinental Exchange, Inc. (ICE) has introduced MSCI Index Total Return Futures (TRFs), expanding its equity derivatives complex. These new TRF contracts provide a capital-efficient and transparent method for investors to gain exposure to key MSCI indices, such as the MSCI EAFE, MSCI Emerging Markets, MSCI USA, and MSCI World indices. By using the U.S. Secured Overnight Financing Rate (SOFR) as the underlying funding rate, the TRFs serve as a listed alternative to over-the-counter swaps, with contracts available for trading up to 2033 and various expiry dates.

2.1. Outstanding Notional Amount and GMV in Global OTC Derivatives Market

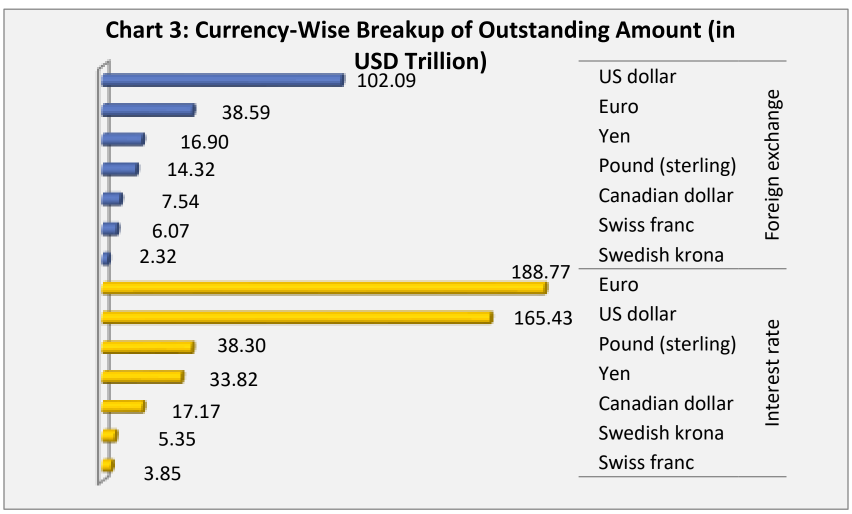
According to BIS data, the notional amount of global derivatives market fell to USD 667 trillion in the second half of 2023, compared to USD 712.88 trillion in first half of 2023. Interest rate derivatives market accounted for USD 529.81 trillion of the total outstanding notional amount followed by a foreign exchange derivatives contracts and equity derivatives market amounting to USD 118 trillion and USD 7.78 trillion respectively.





Source: BIS

2.2. Currency Wise Breakup of Outstanding Amount in the Global OTC Derivatives Market



Source: BIS

A currency wise analysis of outstanding amount for the global derivatives markets indicates that US dollar denominated foreign exchange derivatives account for a predominant share of market (USD 102.09 trillion) followed by Euro denominated foreign exchange contracts (USD 38.59 trillion) for the second half year of 2023.

In case of Interest rates derivatives, Euro and US denominated contracts accounted for USD 188.77 trillion and USD 165.43 trillion of the total global outstanding volumes for the second half year of 2023.

2.3. Instrument-Wise Breakup of Outstanding Amount in Global OTC Market

An instrument wise breakup of the global derivatives outstanding position in the OTC space in the second half of 2023 reveals that FX derivatives market are largely dominated by trades in the outright forwards and FX swap contracts (USD 67.80 trillion). This is followed by currency swaps and FX options. In case of interest rate derivatives, the market participants hold the largest outstanding position in interest rate swaps (USD 425.28 trillion) followed by Forward rate agreements (USD 56.02 trillion). The outstanding Equity derivatives products included positions in Equity Options (USD 3.95 trillion) and Equity forwards and swaps (USD 3.83 trillion).

Chart 4: Instrument-Wise FX Derivatives (USD Trillion)

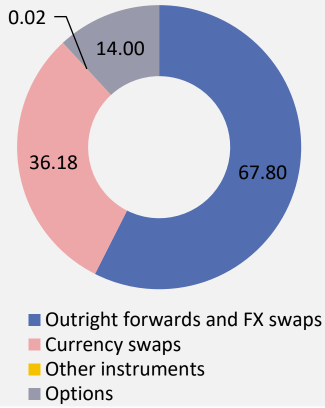


Chart 5: Instrument-Wise Interest Rate Derivatives (USD Trillion)

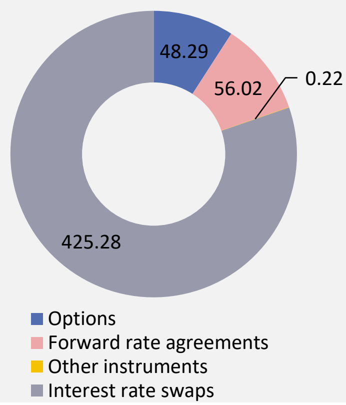
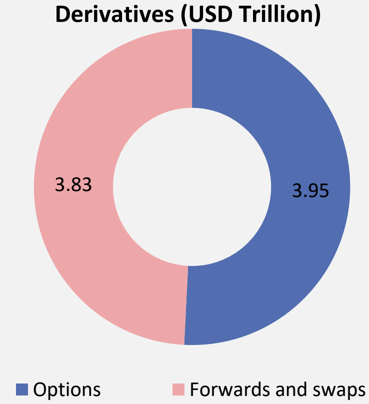


Chart 6: Instrument-Wise Equity Derivatives (USD Trillion)



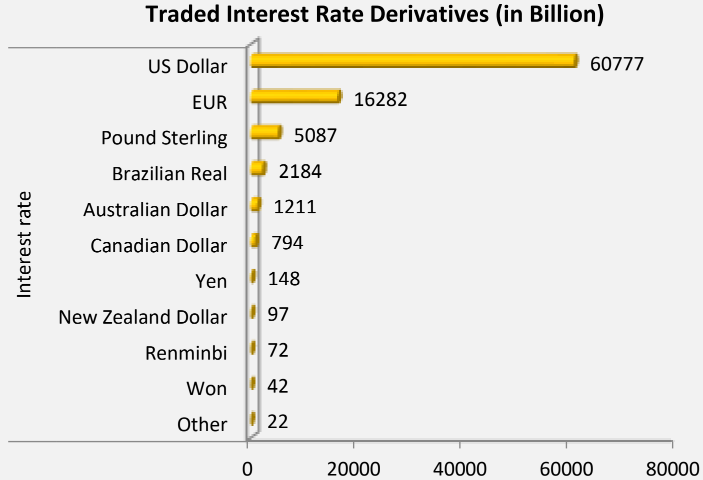
2.4. *Global Exchange Traded Derivatives*

Table 1: Market Wise Open Interest of Exchange Traded Derivatives (in billions)			
	Foreign exchange	**Interest rate**	
Product		**Short-term**	**Long-term**
Futures	342	33643	3350
Options	113	49202	520
Source: BIS			

The global exchange traded derivatives market has observed trading activity in interest rate derivatives, particularly for short term tenors. The Open interest (OI in billions) for Interest rate futures and options in the short term stood at 33643 and 49202 respectively for Oct-Dec 2023. Likewise, futures and options for tenors greater than 1 year had an OI of 3350 and 520 billion respectively during the quarter. Currency wise, exchange traded derivatives are primarily denominated in USD dollars and the Euro. While the Open Interest of US dollar Interest rate derivatives stood at 436 billion, that of the USD FX derivatives stood at 60777 billion in the Oct-Dec 2023.

Chart 7: Currency Wise Open Interest Exchange Traded FX Derivatives (in Billion)

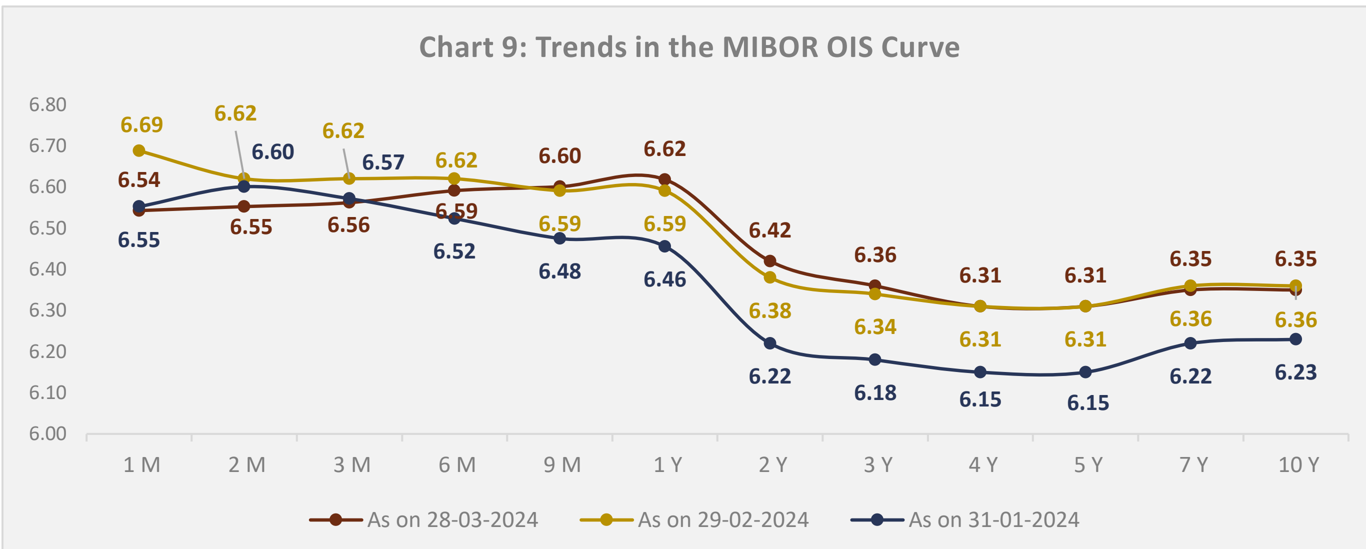
Chart 8: Currency Wise Open Interest Exchange Traded Interest Rate Derivatives (in Billion)



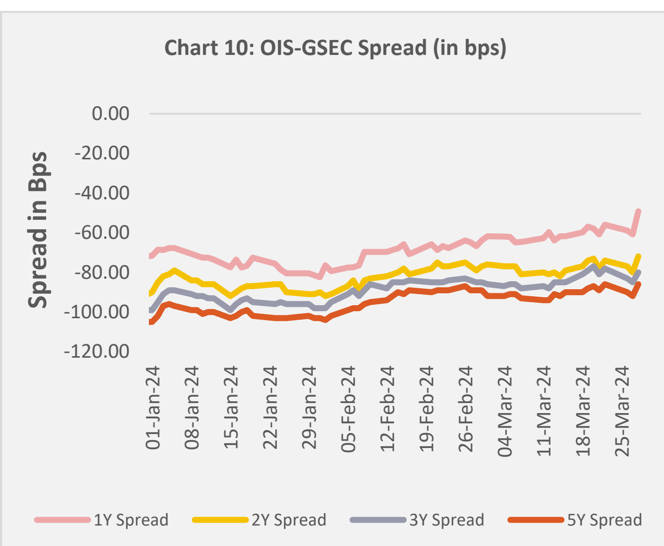
3.1. Indian OTC Interest Rate Derivatives Market

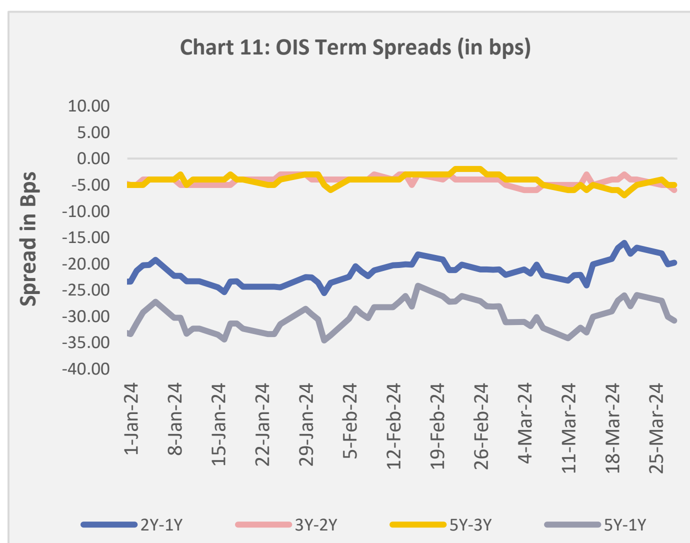
3.1.1 MIBOR OIS Market - Curve & Spreads

MIBOR OIS rates moved higher during the Jan-Mar quarter as interest rate expectations hardened in view of the delay in rate cut scenarios by central banks around the world. While the prospects of a rate cut have brightened compared to the previous quarter, the timing of it remains uncertain for some advanced economies, such as the US and the UK. In India, interest rate expectations have hardened over the course of the quarter due to sticky inflation and rising energy prices.



Data Source: Annualized OIS Rates, Refinitiv





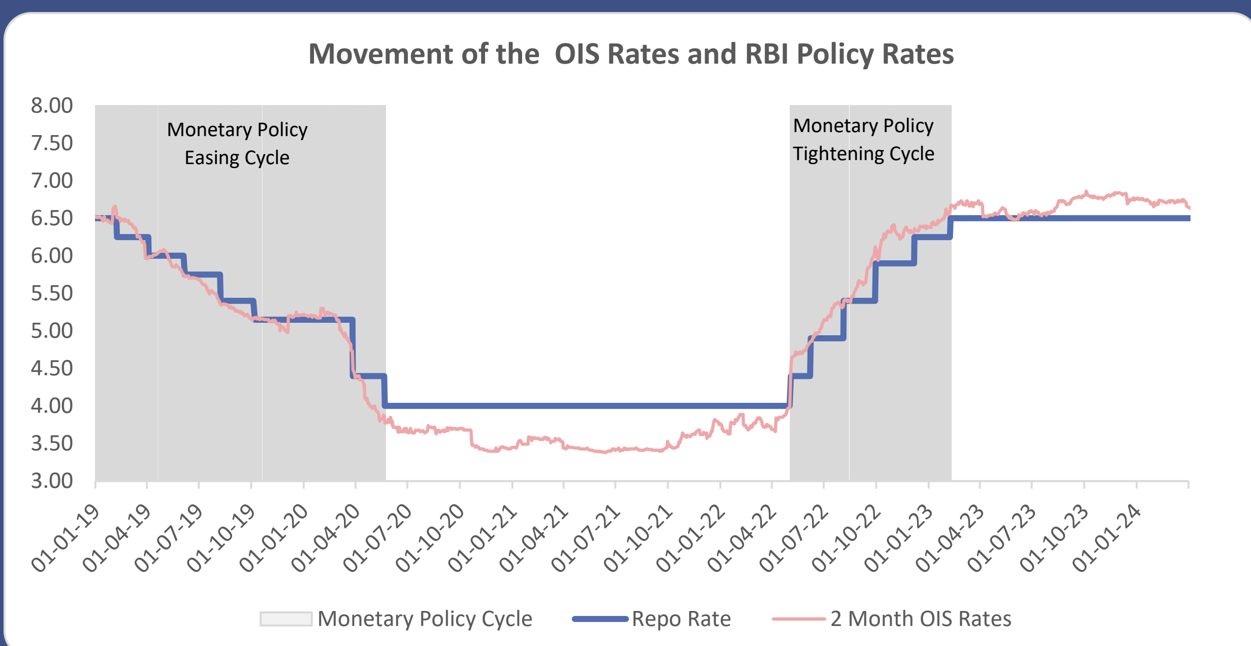
Data Source: Annualized OIS Rates, Refinitiv and G-Sec Par Rates, FBIL.

OIS G-Sec spreads for respective tenors indicated that the spreads gradually became narrower, as the interest view hardened for market participants, especially in the near term. The release of the Government borrowing calendar for the first half of the new fiscal (FY25) indicated that the Government intended to borrow less than market expectations. This led to a fall in yields, particularly in the 1Y yield, which fell by 10 basis points (bps) overnight. This led to a sharp drop in the spread at the end of the quarter, whereby other g-sec yields also moved down, albeit by a lesser magnitude.

Adjacent tenor OIS spreads moved in a narrow band (particularly 3Y-2Y and 5Y-3Y) while 5Y-1Y and 2Y-1Y spreads exhibited comparatively more volatile movements.

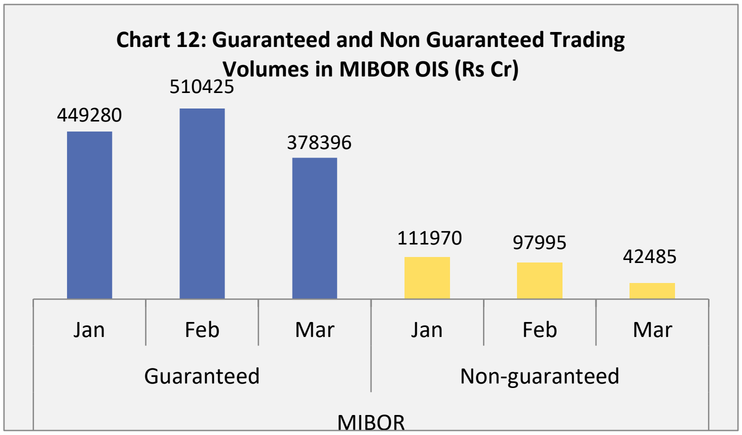
Policy Rate and OIS Rates: Connecting the Dots…

The MIBOR OIS market is often closely monitored to gauge expectations regarding the direction and magnitude of changes in the Central Bank policy rate. The short end of the MIBOR OIS curve, specifically the 2-month rates have been seen to capture the monetary policy cycles over the years (*John et. al, 2023*). During the Monetary policy easing cycle from Feb 2019-May 2020, the 2-month OIS rate was observed to moderate prior to policy announcements as market participants expected a rate cut in the upcoming monetary policy meetings. Likewise, the hardening of OIS rate preceded monetary policy tightening during May 2022 to Feb 2023. Since March 2023, the 2 Month OIS rate has remained largely range bound.



[1] *John et. al., Reading the Market's Mind: Decoding Monetary Policy Expectations from Financial Data, November 2023.*

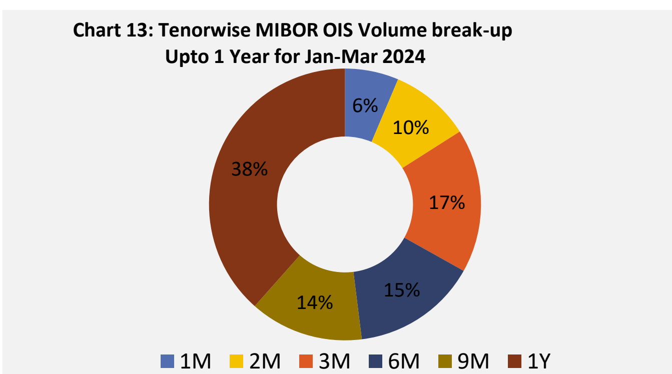
3.1.2 MIBOR OIS – Trading and Settlement Pattern

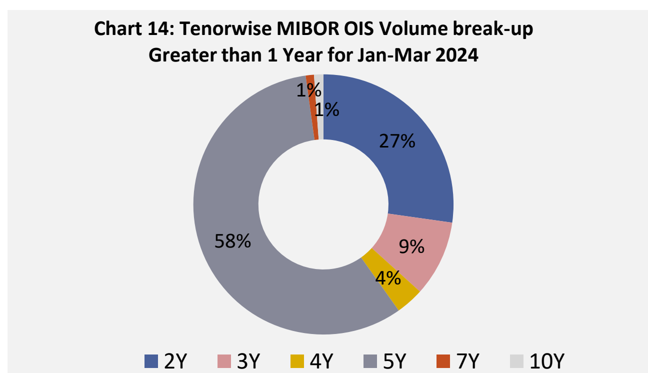


In the MIBOR OIS segment, guaranteed settlement (GS) notional traded volumes continued to dominate the segment, while the volume in non-guaranteed settlement (NGS) decreased sharply in comparison. Notional volume in the GS segment decreased by 15% over the quarter to Rs 3, 78, 396 crores in March 2024, while volumes declined by over 62% in the NGS segment to Rs 42, 485 crores.

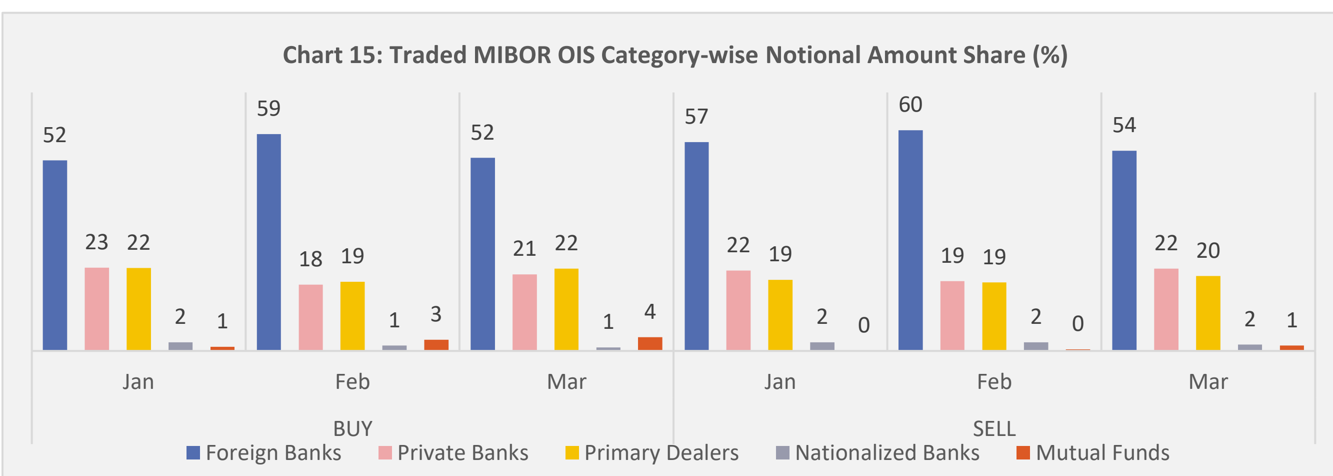
Data Source: CCIL

1-year OIS trades continued to dominate trading in the short-term segment (up to 1 year) with a share of 38%, followed by trades in 3-month and 6-month tenor, respectively. For tenors greater than 1 year, the 5 year OIS captured a market share of 58% in terms of traded volume, followed by 2 year and 3 year, respectively. In terms of market participants, foreign banks remained the dominant category as both buyers (52% in March) and sellers (54% in March), with private banks and primary dealers making up the majority of the remaining volume.

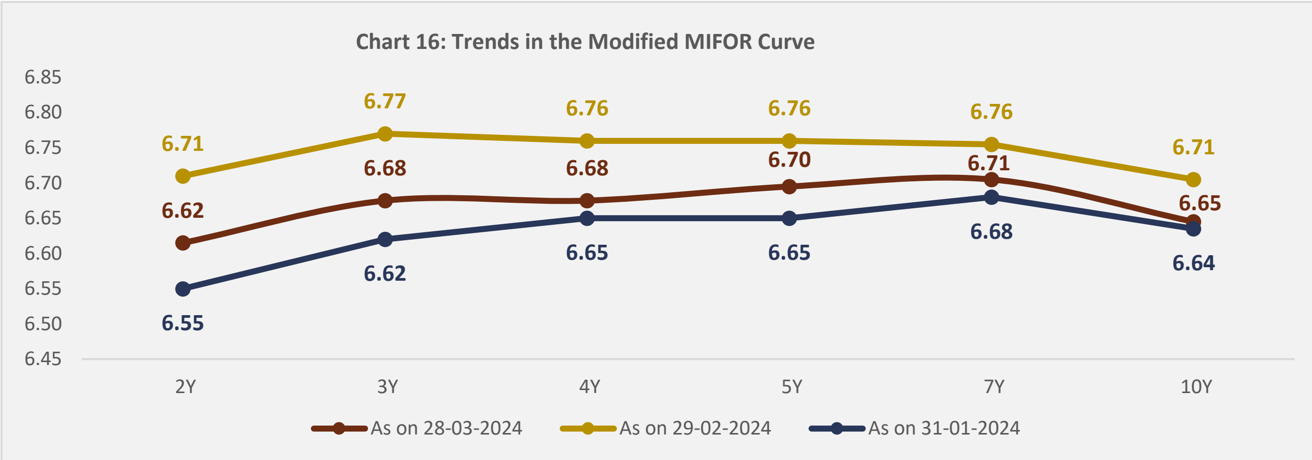




Data Source: CCIL



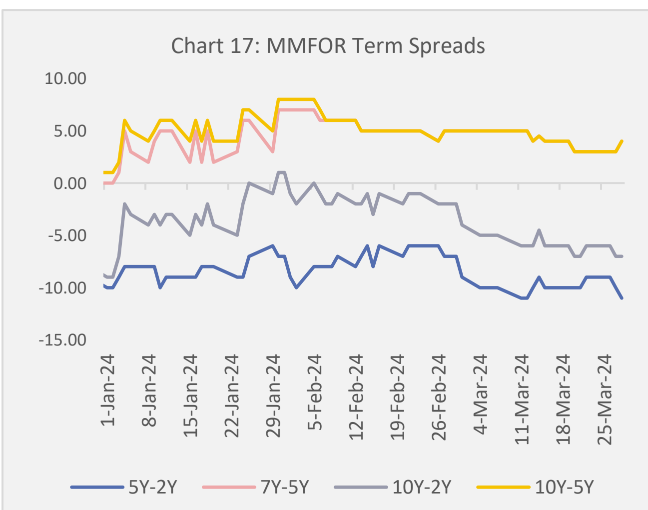
3.1.3 Modified MIFOR Market - Curve & Spreads

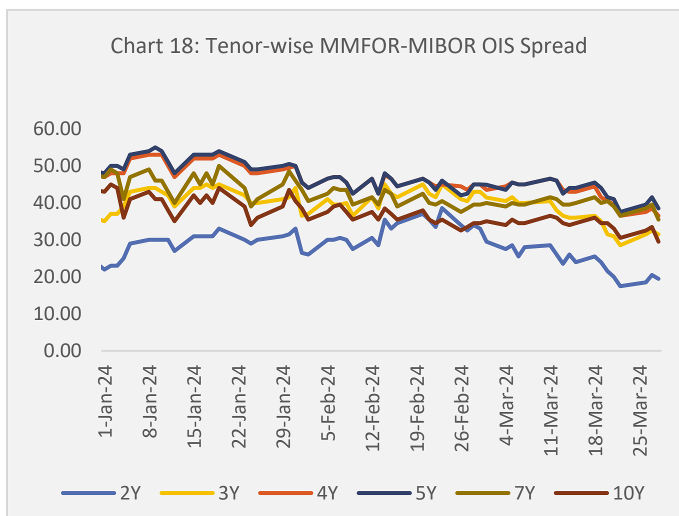


Data Source: Refinitiv

The modified MIFOR curve indicated a downward shift across tenors in March, after a brief rise in February 2024. The 2 year Modified MIFOR rate moved in a range (High-Low) of 31 bps between January and March 2024. The corresponding range for the 3Y rate was 30 bps.

Modified MIFOR term spreads indicated that spreads experienced bouts of volatility in January 2024, before stabilizing in the middle of February. The term spreads for all tenors subsequently moved downwards, with the exception of the 10Y-5Y spread which showed an upward movement at the end of March. MMFOR-MIBOR OIS spreads for the respective tenors also moved in a tight band and exhibited downward movement as the quarter progressed.

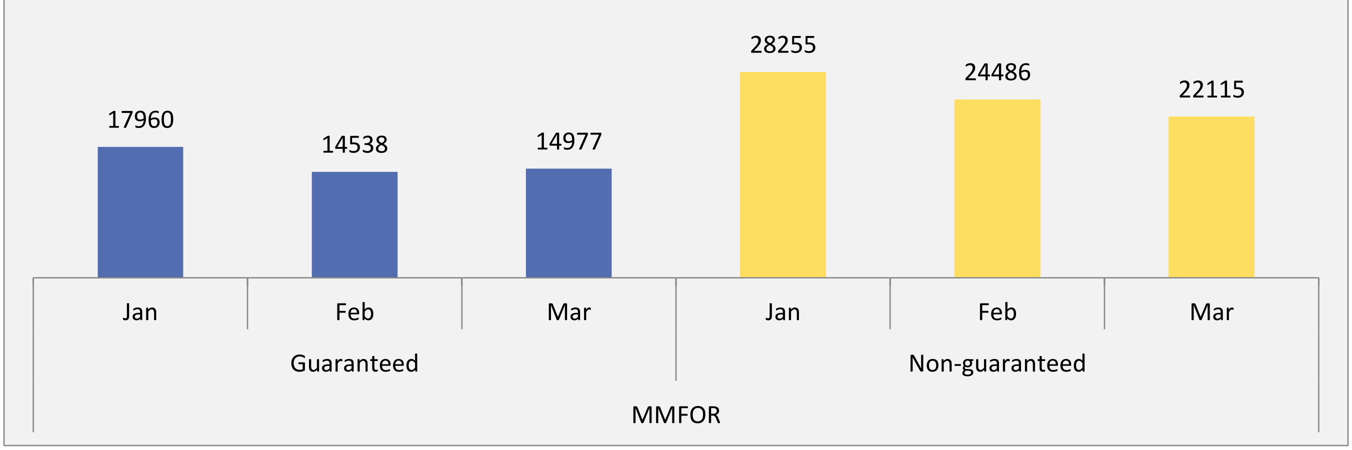




Data Source: Refinitiv

3.1.4 Modified MIFOR –Trading and Settlement Pattern

Chart 19: Guaranteed and Non Guaranteed Trading Volumes in MMFOR (Rs Cr)



Data Source: CCIL

The trading volumes in both the guaranteed and the non-guaranteed segments of Modified MIFOR declined over the course of the quarter. The volume in the non-guaranteed segment remained higher in absolute value terms, compared to the guaranteed settlement segment, which is still in its nascent stages. Foreign banks were by far the most active participants in the MMFOR markets as both buyers and sellers, followed by moderate trading activity by the private banks. Volumes were highest in the 2 year tenor, followed by 3 year and 5 year tenors.

Chart 20: Tenor wise share MMFOR Volume breakup for Jan-Mar 2024

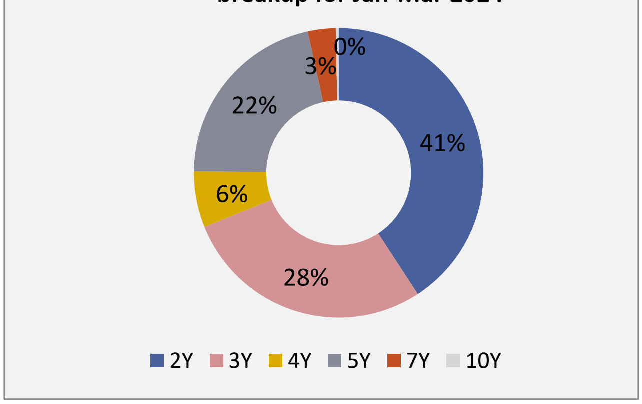
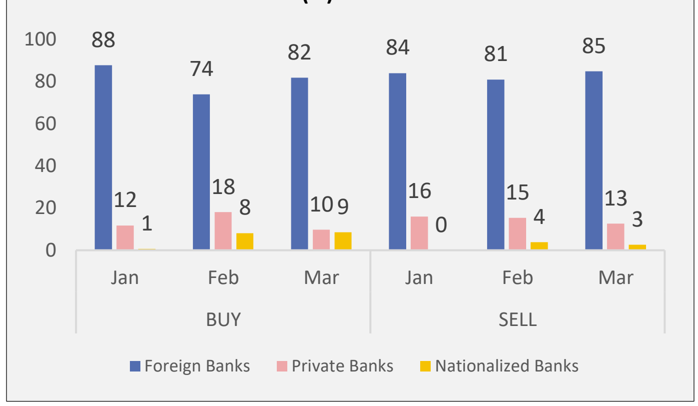


Chart 21: MMFOR Category-wise Traded (Notional) Amt Share (%) for Jan-Mar 2024



Data Source: CCIL

3.2. Indian OTC Forex Derivatives Market

3.2.1. Trends across OTC Interbank FCY-INR Forwards

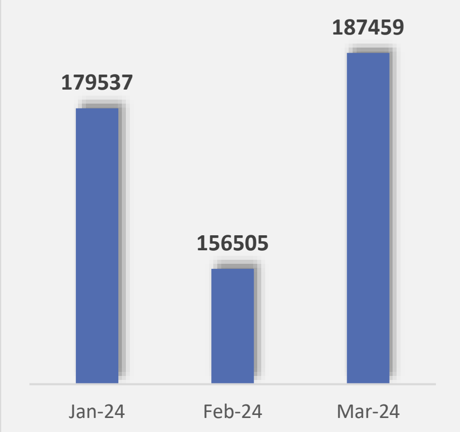


Chart 22: Traded volume for OTC Interbank FCY-INR Forwards (US$Mn)

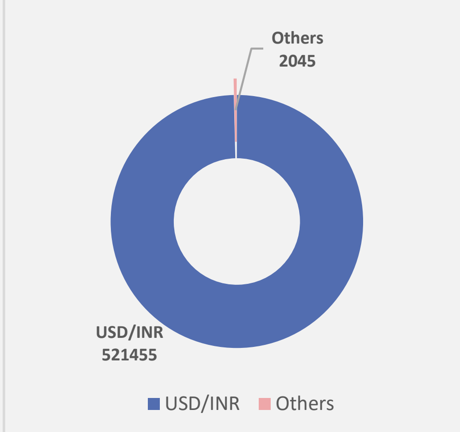


Chart 23: Breakup of Currency Pairs for OTC Interbank FCY-INR Forwards (US$Mn)

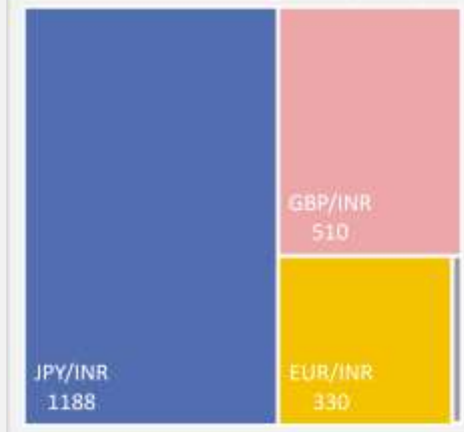


Chart 24: Break up of Other Currency Pairs for OTC Interbank FCY-INR Forwards (US$Mn)

Data Source: CCIL. All values converted to USD Millions from Base Currency.

The trading volume in Interbank FCY-INR Forwards peaked in March 2024 at USD 187 billion, following lower turnover reported in the first two months of the quarter. The dominance of the dollar was evident, as USD/INR accounted for 99% of the total trading activity, while other currencies such as JPY/INR, GBP/INR, and EUR/INR made up the remainder.

An analysis of USD-INR Interbank Forward transactions undertaken through Spot-Forward swaps revealed that near-term contracts of one month accounted for more than 25% of the share in all three months. This was followed by 12-month tenors, which showed the second-highest trading activity share for all three months of the quarter.

Table 2: Tenor-wise Share of USD-INR Interbank Forward transaction undertaken through swaps (Spot-Forward)

	Month End Spot-Forward Currency Swaps											
	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Jan-24	19%	15%	13%	8%	3%	9%	2%	1%	4%	2%	2%	23%
Feb-24	24%	18%	7%	4%	4%	4%	5%	2%	2%	1%	3%	26%
Mar-24	25%	17%	8%	6%	4%	5%	8%	2%	1%	3%	3%	18%

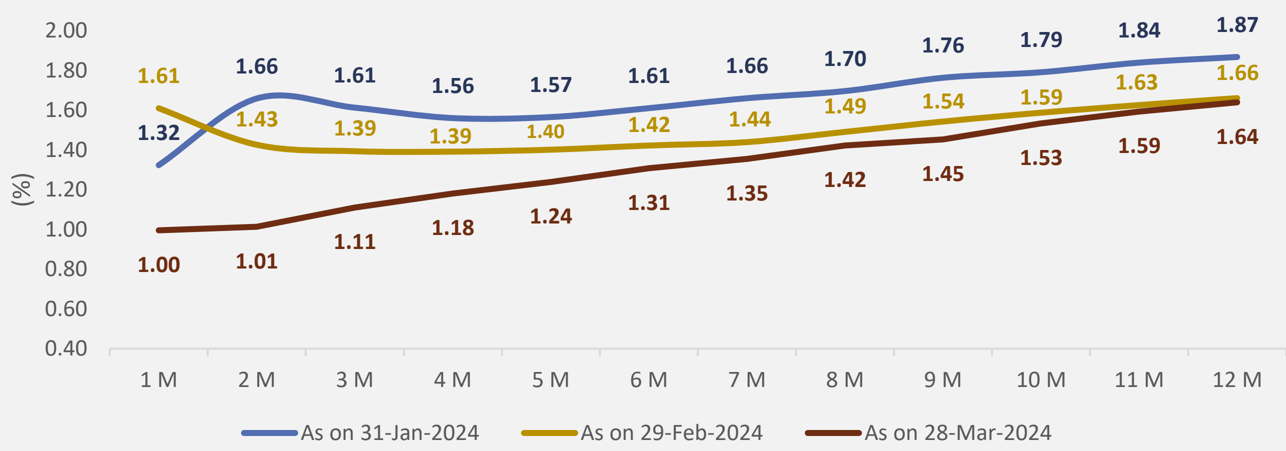
3.2.2. *USD/INR Forward Premia Curve Movement*

Compared to December levels, the USD-INR forward premia rates increased by an average of 9.6 bps across tenors upto 1 Year, in January 2024. During the month of January, an anticipation of a rate cut by US Federal Reserve dragged treasury yields down, widening the spread between India and US Treasury yields. The USD/INR Forward premia rates began to increase, mirroring the increasing interest rate differential between the two countries.

On January 31, 2024 the FMOC announced that it would maintain its policy rate in a range of 5.25% to 5.5%. It also noted there were no plans to cut rates with the inflation print above the Federal Reserve's target. This led to hardening of US treasury rates in February, putting a downward pressure on the USD/INR forward premia rates. The 1 Year forward premia rates fell from to 1.66% as on February 29, 2024 vis-à-vis 1.87% on the last day of the previous month.

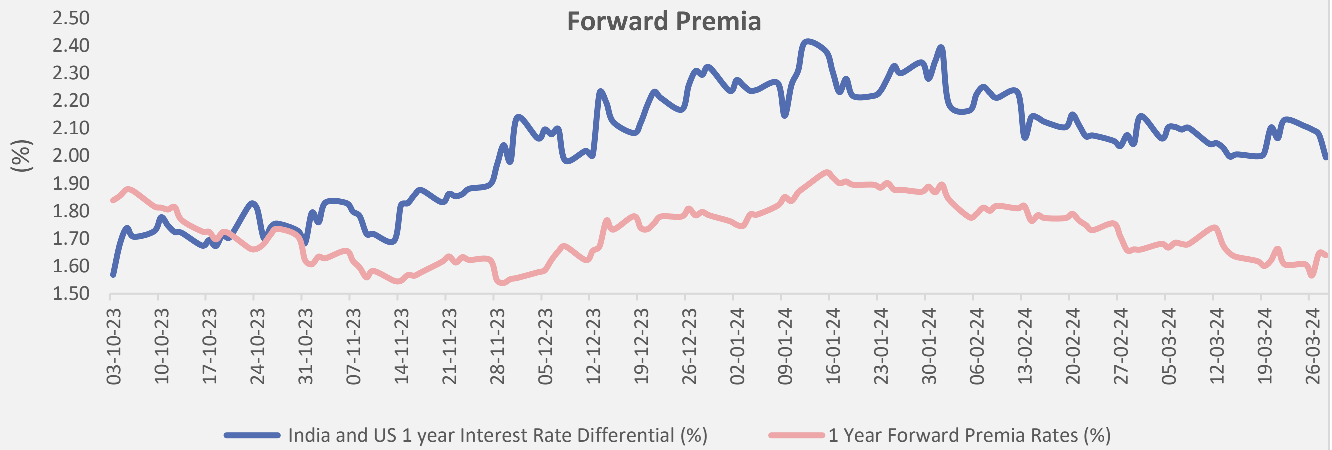
Continuing its policy stance in the month of March, the FMOC held its policy rate steady, citing elevated inflation levels. The 1Year month USD/INR forward premia rates further fell to 1.64% from 1.66%.

Chart 25.1: FBIL Forward Premia Curve (%)



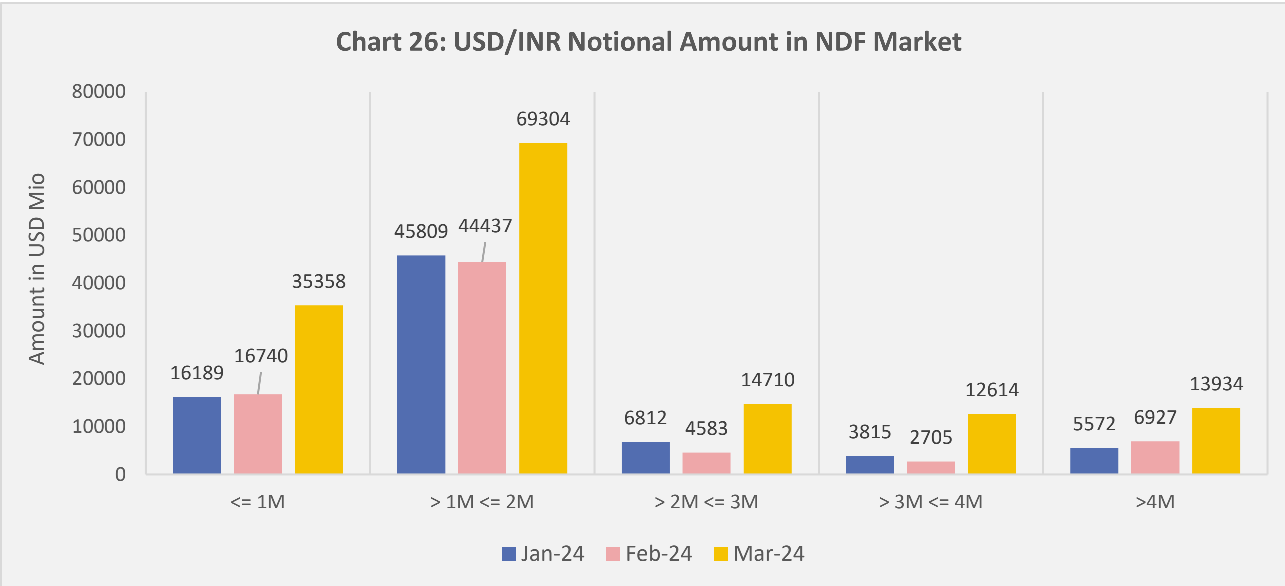
Data Source: FBIL

Chart 25.2. Differential in 1 Year Treasury Yields (India-US) and 1 Year USD/INR Forward Premia



Data Source: FBIL, CCIL and Investing.com

3.2.3. *Interbank NDF Volumes and Tenor-wise Breakup*



Data Source: CCIL

Non-deliverable forwards (NDFs), which are offshore dollar-settled currency forwards used by investors with limited onshore market access to hedge their exposure, experienced moderate turnover in the first two months of the quarter, followed by a steep surge in March. In March 2024, the notional interbank volume surged to USD 145,919 million, nearly reaching the combined volumes registered in the first two months of the quarter. Notably, the executed trades were primarily for maturities of less than one month and between one and two months.

3.2.4. Trends across OTC Interbank FCY-INR Options

Chart 27: Traded volume for OTC Interbank FCY-INR Options (US$Mn)

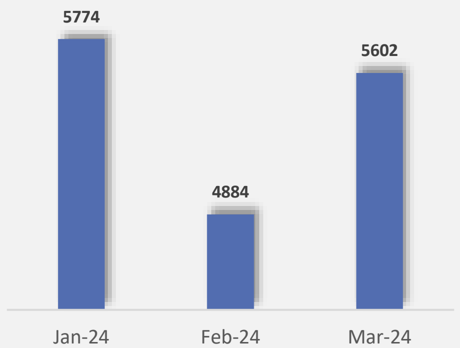


Chart 28: Breakup of Currency Pairs for OTC Interbank FCY-INR Options (US$Mn)

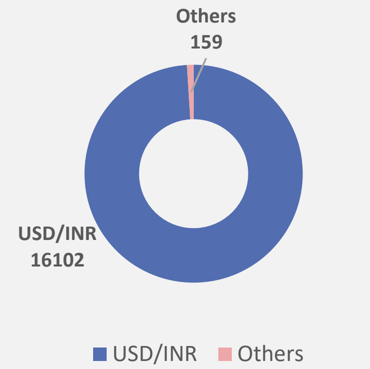
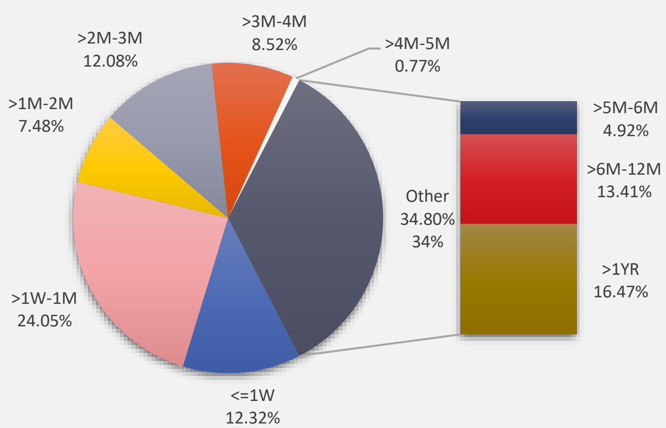


Chart 29: Break up of Other Currency Pairs for OTC Interbank FCY-INR Options (US$Mn)

Data Source: CCIL. All values converted to USD Millions from Base Currency.

Chart 30: Share of Traded Tenors in Interbank Options Jan-Mar 2024



The OTC Interbank FCY-INR Options turnover remained range-bound in Q4 FY24. Volume peaked at USD 5774 million in the first month of the quarter, then dropped to USD 4884 million, before ending the quarter at USD 5602 million. The USD/INR currency pair dominated the market, representing a significant proportion of the total volume. Specifically, USD/INR options accounted for USD 16102 million in volume, while options involving other currencies totaled USD 159 million.

An analysis of traded tenors shows that market participants preferred FCY-INR options with short term maturities (less than 1 week and between 1 week to 1 month) accounting for 36% of total trades.

The Distribution Map showing Average IV of Options displayed wider dispersion in Call Option for 1 to 3 year tenors as compared to Put Option.

Chart 31: Distribution of Average IV of Call Options

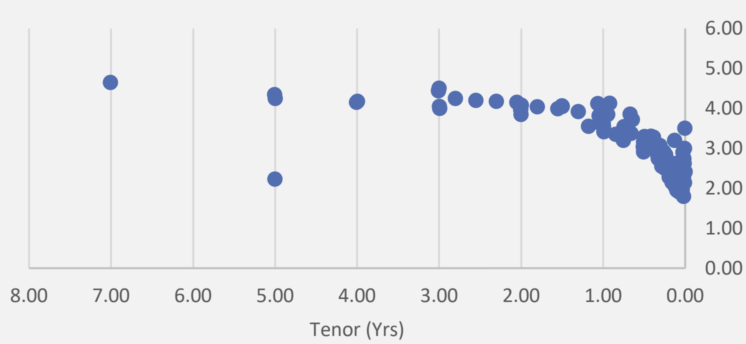
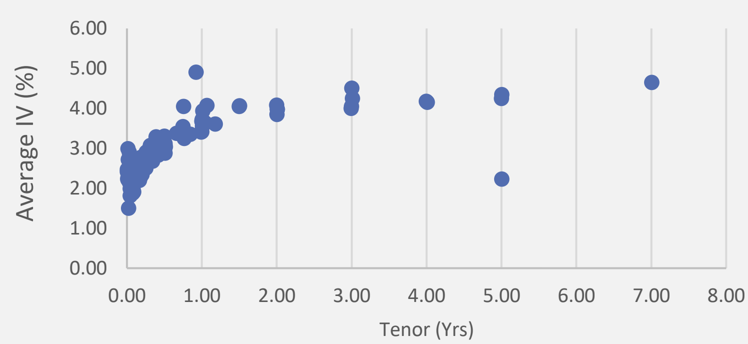
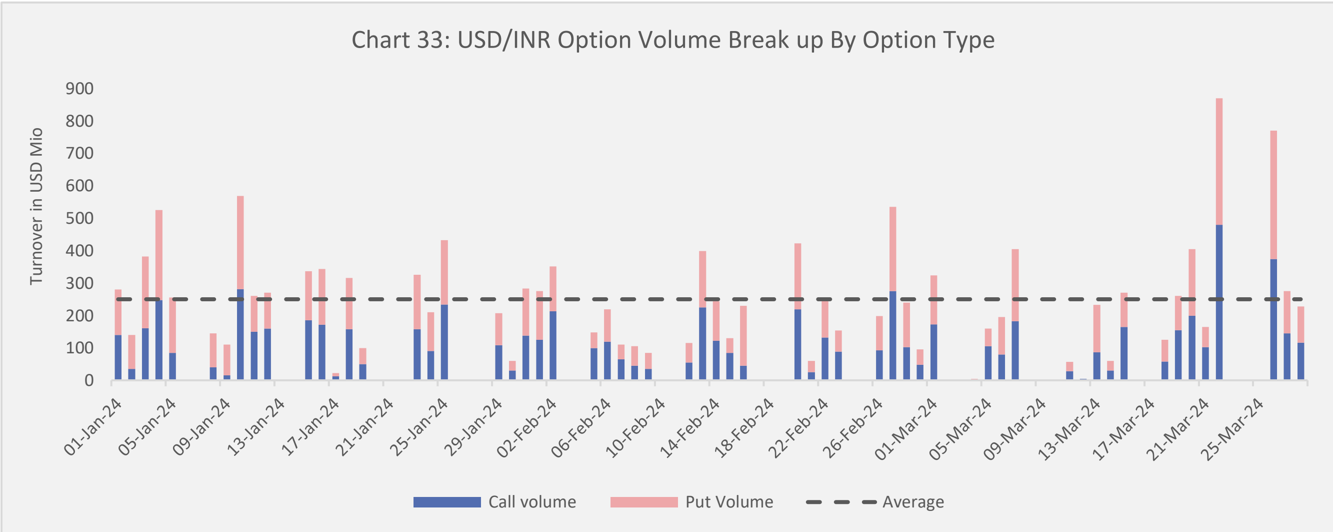


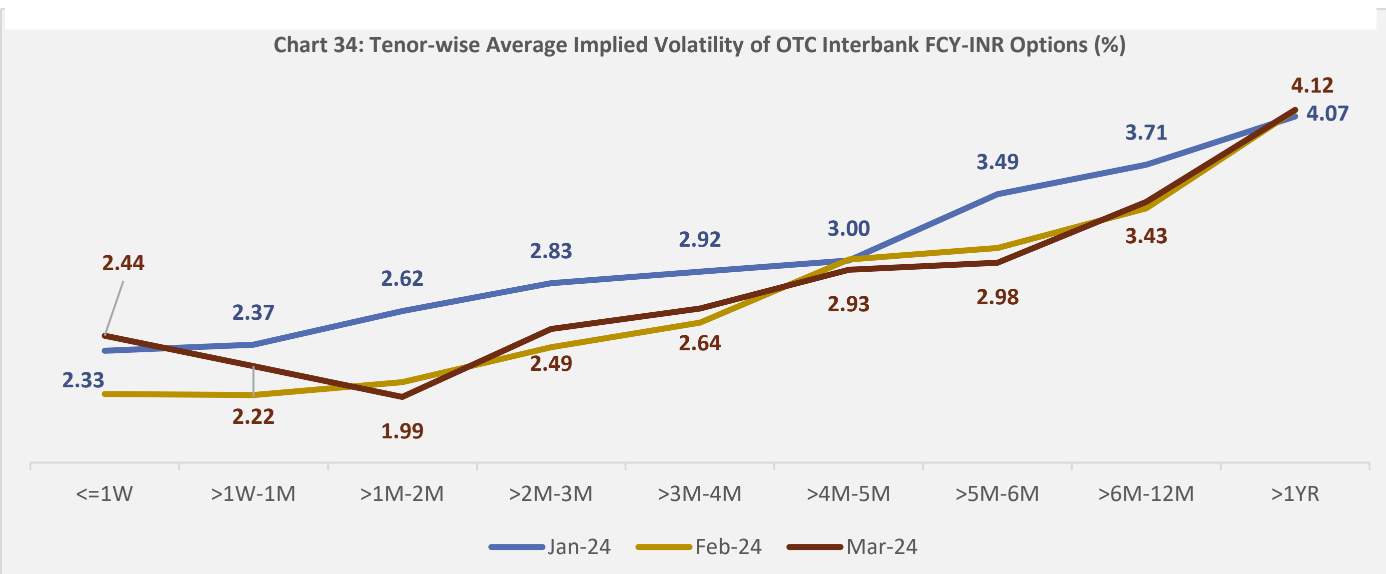
Chart 32: Distribution of Average IV of Put Options



Data Source: CCIL

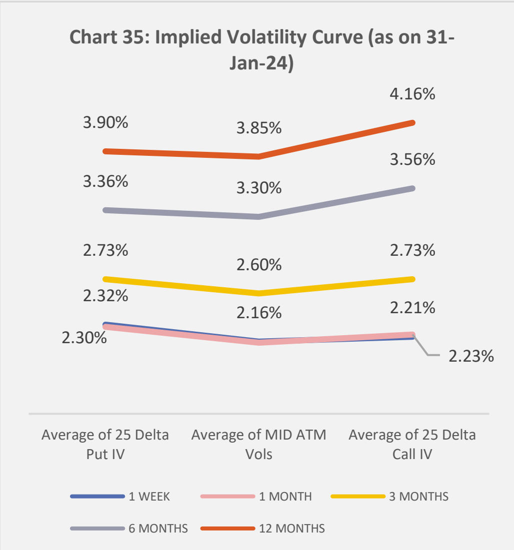


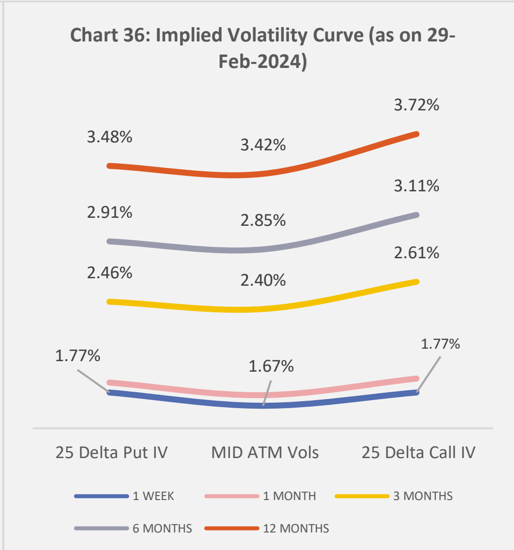
The volumes in USD/INR options remained range-bound for most of the quarter before experiencing a final surge towards the end of the quarter and the financial year ending March 2024. The daily average volume for USD/INR Options for the quarter stood at USD 250 million.

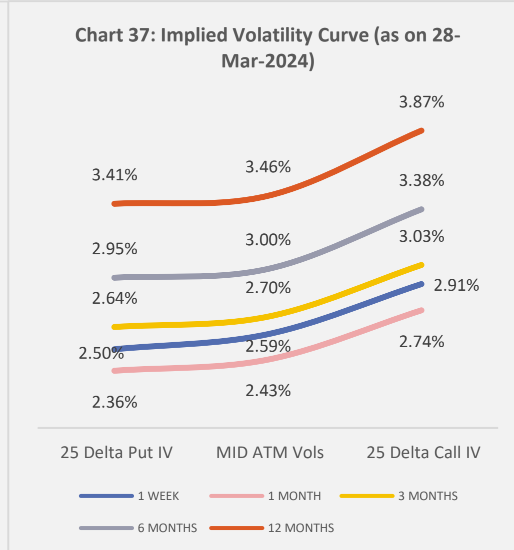


A month-wise distribution reveals that the tenor-wise implied volatility curve was higher at the start of the quarter but shifted downward in February and remained at that level until March. This downward shift in implied volatility occurred against the backdrop of the Indian Rupee strengthening, supported by strong foreign capital inflows into the Indian debt market.

3.2.5. Volatility Smile across tenors in OTC Interbank FCY-INR Options



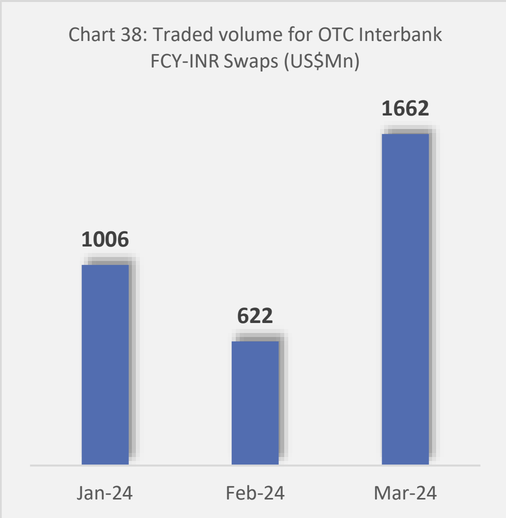


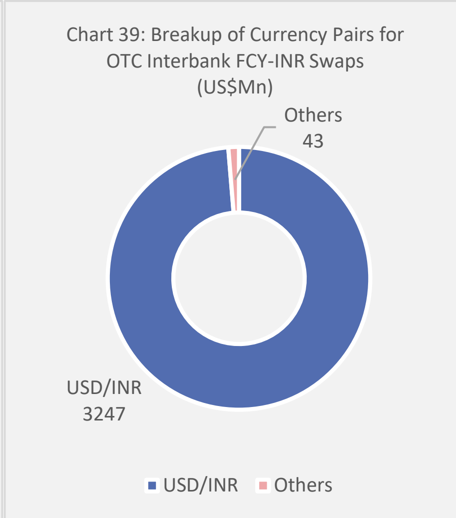


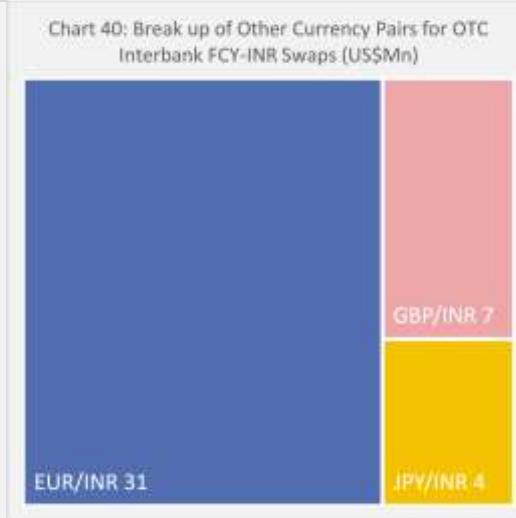
Data Source: ATM Vol. RR and STR from FBIL. Charts based authors' Calculations

At the beginning of the quarter, the volatility smile, which represents implied volatilities across strikes, exhibited a flatter profile. However, towards the end, it turned steeper. The steepness of the volatility smile indicates increased concern among market participants regarding extreme price movements. RR, defined as the difference between the 25-delta call implied volatility (IV) and the 25-delta put implied volatility, expanded from negative 11 basis points in the 1-week tenor at the beginning of the month to 41 basis points towards the end of the quarter. A similar trend was observed in the 12-month tenor, where RR increased from 26 basis points at the start of the quarter to 46 basis points by the end. This change was evident for all tenors in the last month of the quarter. A rise in RR signals the market's expectation of greater volatility on the upside.

3.2.6. Trends across OTC Interbank FCY-INR Cross Currency Swap







Data Source: CCIL. All values converted to USD Millions from Base Currency

The Interbank OTC FCY-INR cross currency swap volumes, which remained subdued in the first two months of the quarter, sharply rose to USD 1662 million in March. The FCY-INR cross currency swap volume for the Jan-Mar 2024 quarter amounted to USD 3290 million, significantly higher than the previous quarter's volume of USD 1438 million. The majority of the trades involved the USD/INR swaps, accounting for USD 3247 million. Other currencies, represented by EUR/INR and JPY/INR, contributed only USD 43 million to the total volume.

3.2.7. OTC Interbank FCY-FCY Forex Derivatives

A product wise analysis of OTC Interbank FCY-FCY Forex Derivatives is provided below.

Chart 41: Traded volume for OTC Interbank FCY-FCY Forwards (US$Mn)

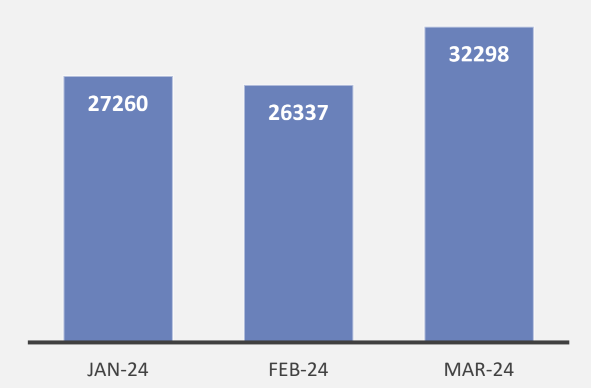


Chart 42: Traded volume for OTC Interbank FCY-FCY Options (US$Mn)

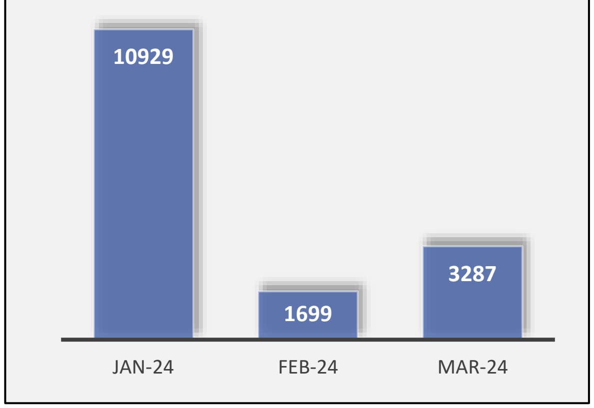


Chart 43: Traded volume for OTC Interbank FCY-FCY Swaps (US$Mn)

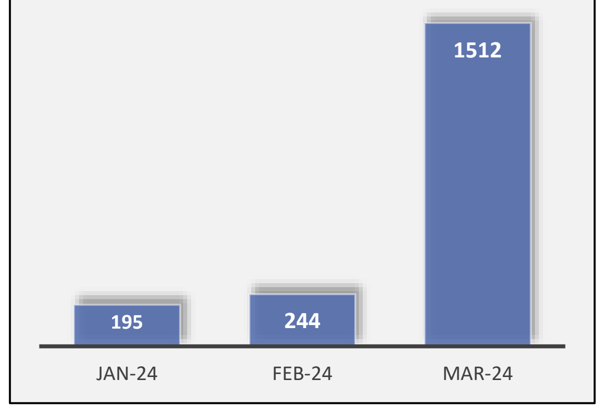


Chart 44: Break up of Currency Pairs for OTC Interbank FCY-FCY Forwards (US$Mn)

Chart 45: Break up of Currency Pairs for OTC Interbank FCY-FCY Options (US$Mn)

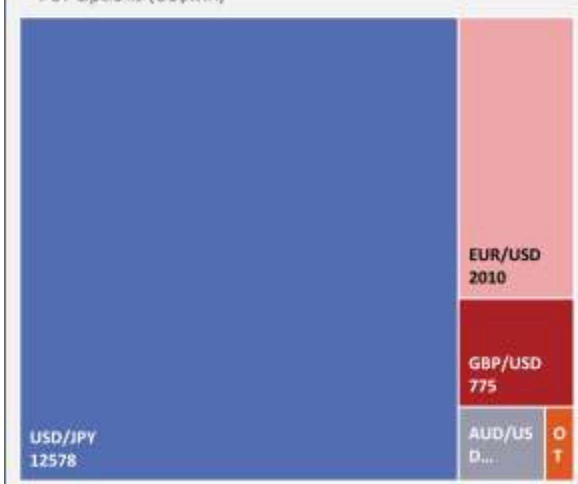


Chart 46: Break up of Currency Pairs for OTC Interbank FCY-FCY Swaps (US$Mn)

Data Source: CCIL. All values converted to USD Millions from Base Currency

3.2.8. OTC FCY-INR and FCY-FCY Client Forex Derivatives

A snapshot of OTC Client Forex Derivatives is highlighted below:

Chart 47: Traded volume for OTC Client FCY-INR Forwards (US$Mn)

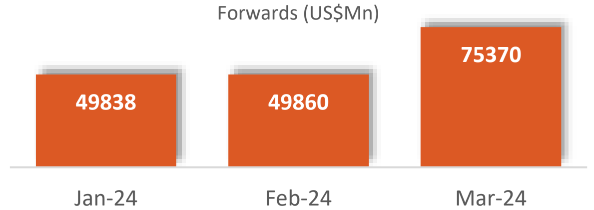


Chart 48: Traded volume for OTC Client FCY-INR Options (US$Mn)

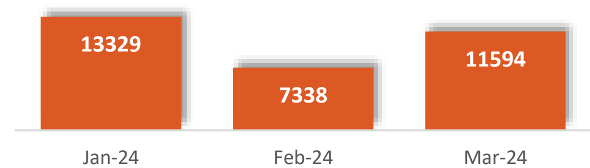


Chart 49: Traded volume for OTC Client FCY-INR Swaps (US$Mn)

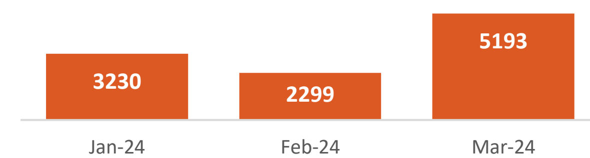


Chart 50: Breakup of Currency Pairs for OTC Client FCY-INR Forwards (US$Mn)

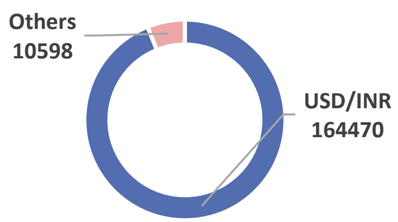


Chart 51: Breakup of Currency Pairs for OTC Client FCY-INR Options (US$Mn)

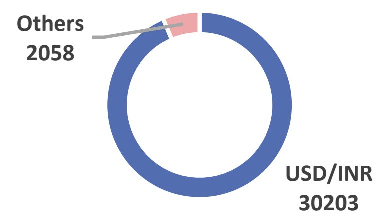


Chart 52: Breakup of Currency Pairs for OTC Client FCY-INR Swaps (US$Mn)

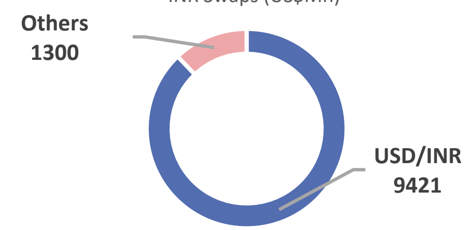


Chart 53: Traded volume for OTC Client FCY-FCY Forwards (US$Mn)

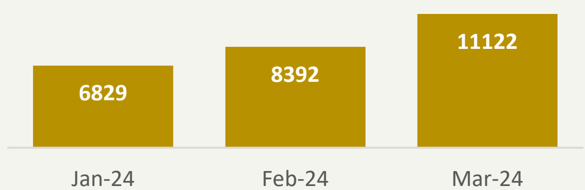


Chart 54: Traded volume for OTC Client FCY-FCY Options (US$Mn)

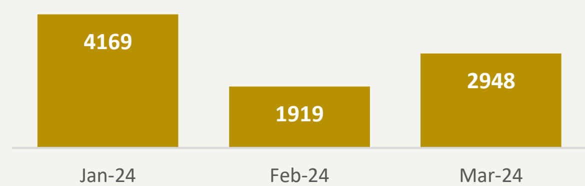


Chart 55: Traded volume for OTC Client FCY-FCY Swaps (US$Mn)

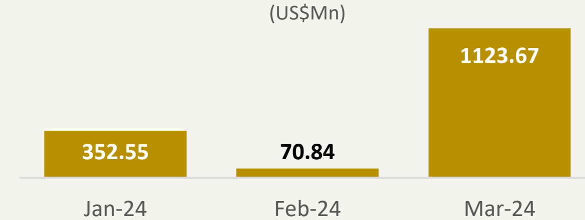


Chart 56: Breakup of Currency Pairs for OTC Client FCY-FCY Forwards (US$Mn)

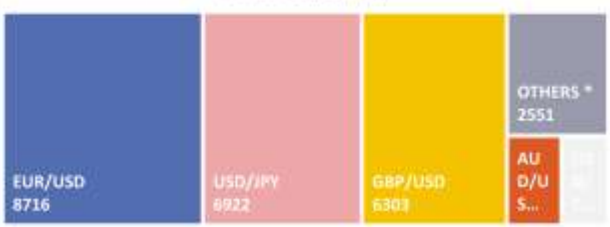


Chart 57: Break up of Other Currency Pairs for OTC Client FCY-FCY Options (US$Mn)

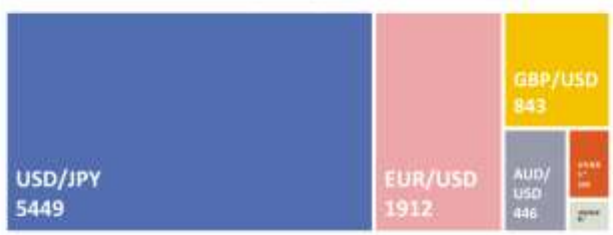
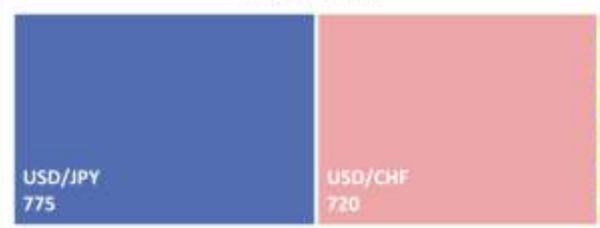


Chart 58: Breakup of Currency Pairs for OTC Client FCY-FCY Swaps (US$Mn)



Data Source: CCIL. All values converted to USD Millions from Base Currency

3.3. Indian Exchange Traded Derivatives Market

In the exchange-traded currency derivatives market, volumes in currency futures increased in the first month of the quarter and saw a decline, partly due to uncertainty regarding regulation-permitting exchanges to offer forex derivative contracts for hedging contracted exposure.

The same trend persisted in the Currency Options market, where turnover decreased after peaking out in Jan-24.

In the exchange-traded interest rate derivatives market, turnover surged in the last two months of the quarter. February saw a volume of Rs 9,844 crore, while March witnessed a staggering volume of Rs 12,931 crore, significantly greater than the average trend. The total traded volume in the in the Jan-Mar 2024 quarter was at Rs 28,445 crore as compared Oct-Dec 2023 quarter volume which stood at Rs 15,297 crore. Meanwhile, open interest witnessed a declining trend, falling to its six-month low.

Chart 59: Exchange Traded Currency Futures Volume and Open Interest

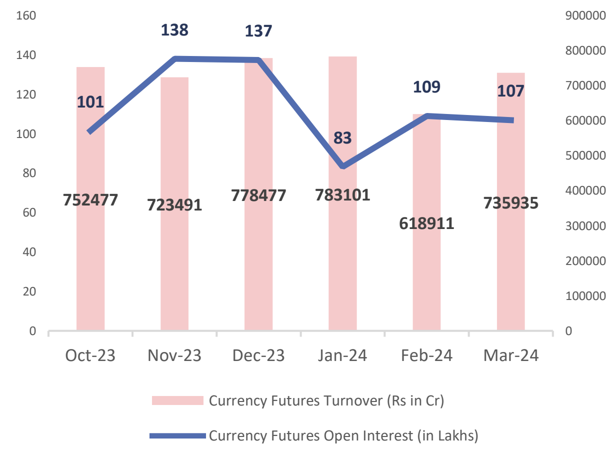


Chart 60: Exchange Traded Currency Options Volume and Open Interest

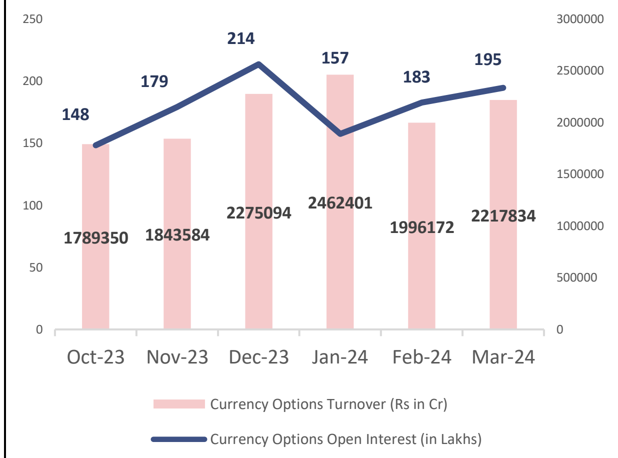
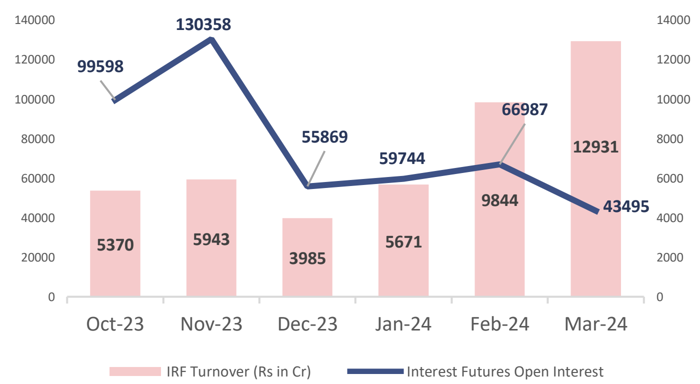


Chart 61: Exchange Traded Interest Futures Volume and Open Interest



Data Source: NSE. BSE & MSEI. Amount in Rs Cr.

Analysing the Mechanics of Barrier Options

Debjyoti Roy

Background

Options are derivative instruments which give the buyer the option to purchase or sell the underlying asset for a given price at a particular time in the future. The underlying asset can be financial, such as asset prices, interest rates, commodity prices, exchange rates, or it can be non-financial such as weather or livestock prices. Options are traded both on the exchanges and in over-the-counter (OTC) market. The key difference between futures and options contracts is that while the holder of the futures contract is obligated to buy or sell the underlying asset, the holder of the option has a choice to exercise his/her right to buy or sell the underlying. Another key difference is that while there is no cost to enter into a futures contract, there is a cost to acquiring an option, known as the option premium.

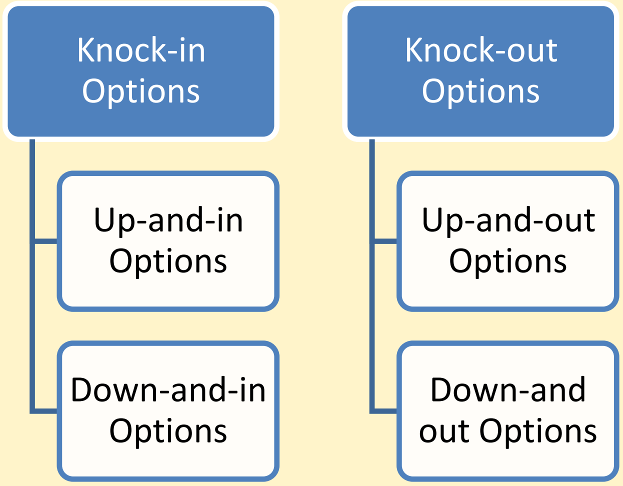
Exotic Options

European and American call and put options (also termed as plain vanilla products or vanilla options) are standardized across exchanges, well-defined characteristics and are traded actively. Their prices or implied volatilities are quoted by exchanges or inter dealer brokers on a regular basis. The OTC market however provides the opportunity to create and trade non-standardized products that have been created through financial engineering. These products are called exotic products or simply exotics. While they have a more complex payoff structure, they can also be created for a simpler purpose: meeting a genuine hedging need in the market. Options created in such a manner are called exotic options. There are various types of exotic options available in the financial markets. In this note, we focus on one such exotic option, known as the Barrier Option.

Barrier Option

Barrier Options are options where the payoffs depend on whether the underlying asset's price reaches a certain level/barrier during a certain period of time. They are attractive to the market participants because they are less expensive compared to regular options. They can be classified into *knock-in options* or *knock-out options*. A knock-out option ceases to exist when the underlying asset price reaches a certain barrier; a knock-in option comes into existence only when the underlying asset price reaches a barrier.

Figure 1: Types of Barrier Options



Knock-in and Knock-out Options can be designed as both call and put options. The following box summarizes the various sub-categories of the barrier options in terms of a call option.

Figure 2: Mechanics of a Barrier Option

Down-and-in option

- Option remain inactive until the underlying asset's price falls below the predetermined barrier level
- Option becomes activated once the barrier is breached

Down-and-out option

- Active initially but become invalid if the underlying asset's price touches or falls below the barrier level
- Option is deactivated and ceases to exist after the barrier is breached.

Up-and-in option

- Option remains inactive until the underlying asset's price reaches the predetermined barrier level
- Once the barrier is breached, the option becomes activated and behaves like a standard vanilla option

Up-and-out option

- Option is initially active but becomes invalid if the underlying asset's price touches or exceeds the barrier level
- Ceases to exist once the barrier is breached

Illustration

We shall now discuss the various categories of barrier options in more detail, in the following sections. All the examples are in terms of a European option, which can only be exercised at maturity.

Up-and-in Call Option: In this type of option, the barrier level lies above the strike price, and the option is activated only when the spot price of the underlying touches the barrier level. Assume there are two market participants party A and B. Party A has purchased an Up-and-in call option in the USDINR rate from Party B. The strike price K in the option is at 84, and the barrier level is at 86 (‘up’ from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 1: Up-and-in Call Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	Out-of-the money call option, and spot price is below the barrier level, hence option is not activated	83	0	$50000	-$50000
2	At-the-money call option, but spot price is below the barrier level, hence no payoff	84	0	$50000	-$50000
3	In-the-money call option, but below the barrier level, hence no payoff	85	0	$50000	-$50000
4	In-the-money call option, and as spot price has hit the barrier level, the option is activated and can be exercised	86	US$(86-84) mio = $2 mio	$50000	$2 mio - $50000 = $1.95 mio
5	In-the-money call option, and as spot price has hit the barrier level, the option is activated and can be exercised	87	US$(87-84) mio = $3 mio	$50000	$3 mio - $50000 = $2.95 mio

Up-and-out Call Option: In this type of auction, the barrier level lies above the strike price, and the option becomes deactivated once the spot price of the underlying touches the barrier level. In this scenario, Party A has purchased an Up-and-out call option in the USDINR rate from Party B. The strike price K in the option is at 84, and the barrier level is at 86 (‘up’ from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 2: Up-and-out Call Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	No Settlement	83	0	$50000	-$50000
2	At-the-money call option	84	0	$50000	-$50000
3	In-the-money call option	85	US$(85-84) mio = $1 mio	$50000	$1 mio - $50000 = $0.95 mio
4	As spot price has hit the barrier level, the option is deactivated	86	0	$50000	-$50000
5	As spot price has hit the barrier level, the option is deactivated	87	0	$50000	-$50000

Down-and-in Call Option: In this type of auction, the barrier level is below the strike price, and the option becomes activated once the spot price of the underlying touches the barrier level. In this scenario, Party A has purchased a down-and-in call option in the USDINR from Party B. The strike price K in the option is at 84, and the barrier level is at 82 ('down' from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 3: Down-and-in Call Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	In-the-money call option, but barrier level much below spot price, hence no payoff since option is not activated	85	0	$50000	-$50000
2	At-the-money call option, no payoff since option is not activated	84	0	$50000	-$50000
3	Out-of-the-money call option, and above the barrier level, hence no payoff	83	0	$50000	-$50000
4	Out-of-the money call option; additionally, as spot price has hit the barrier level, the option is activated, but payoff is negative, hence A will not exercise it	82	0	$50000	-$50000
5	Out-of-the-money option, as spot price has hit the barrier level, the option is activated but payoff is negative, hence A will not exercise it	81	0	$50000	-$50000

Down-and-out Call Option: In this type of auction, the barrier level is below the strike price, and the option becomes deactivated once the spot price of the underlying touches the barrier level. In this scenario, Party A has purchased a down-and-out call option in the USDINR from Party B. The strike price K in the option is at 84, and the barrier level is at 82 ('down' from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 4: Down-and-out Call Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	In-the money call option, can be exercised	85	$(85-84) = $1 mio	$50000	$1 mio -$50000 = $0.95 mio
2	At-the money call option	84	0	$50000	-$50000
3	Out-of-the money call option, will not be exercised, as payoff is negative	83	0	$50000	-$50000
4	Out-of-the money call option; additionally, as spot price has hit the barrier level, the option is deactivated, hence no payoff	82	0	$50000	-$50000
5	Out-of-the money call option; as spot price has hit the barrier level, the option is deactivated, hence no payoff	81	0	$50000	-$50000

Up-and-in Put Option: In this type of auction, the barrier level lies above the strike price, and the option becomes activated once the spot price of the underlying touches the barrier level.

In this scenario, Party A has purchased an up-and-in put option in the USDINR from Party B. The strike price K in the option is at 84, and the barrier level is at 86 ('up' from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 5: Up-and-in Put Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	In-the-money put option, but option not activated as spot price is below the barrier level, hence no payoff	83	0	$50000	-$50000
2	At-the money put option, but spot price is below the barrier level, hence option not activated, and no payoff	84	0	$50000	-$50000

3	Out-of-the money put option, and spot price is below the barrier level, hence option not activated and no payoff	85	0	$50000	-$50000
4	Out-of-the money put option; although spot price has hit the barrier level, the option is activated, but payoff is negative, hence party A will not exercise the option	86	0	$50000	-$50000
5	Out-of-the money put option; although spot price has hit the barrier level, the option is activated, but payoff is negative, hence party A will not exercise the option	87	0	$50000	-$50000

Up-and-out Put Option: In this type of auction, the barrier level lies above the strike price, and the option becomes deactivated once the spot price of the underlying touches the barrier level.

In this scenario, Party A has purchased an up-and-out put option in the USDINR from Party B. The strike price K in the option is at 84, and the barrier level is at 86 ('up' from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 6: Up-and-out Put Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	In-the money put option, option can be exercised	83	$(84-83) = $1 mio	$50000	$1 mio - $50000 = $0.95 mio
2	At-the money put option, can be exercised, but no payoff	84	0	$50000	-$50000
3	Out-of-the money put option, no payoff	85	0	$50000	-$50000
4	Out-of-the money put option, additionally as spot price has hit the barrier level, the option is deactivated	86	0	$50000	-$50000
5	Out-of-the money put option, additionally as spot price has hit the barrier level, the option is deactivated	87	0	$50000	-$50000

Down-and-in Put Option: In this type of auction, the barrier level is below the strike price, and the option becomes activated once the spot price of the underlying touches the barrier level.

In this scenario, Party A has purchased a down-and-in put option in the USDINR from Party B. The strike price K in the option is at 84, and the barrier level is at 82 ('down' from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 7: Down-and-in Put Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	Out-of-the money put option	85	0	$50000	-$50000
2	At-the money put option	84	0	$50000	-$50000
3	In-the-money put option, but spot price is above the barrier level, hence option is not activated	83	0	$50000	-$50000
4	In-the-money put option, additionally spot price has touched the barrier level, hence option is activated and can be exercised	82	$(84-82) mio = $2 mio	$50000	$2 mio -$50000 = $1.95 mio
5	In-the-money put option, additionally spot price has touched the barrier level, hence option is activated and can be exercised	81	$(84-81) mio = $3 mio	$50000	$3 mio -$50000 = $2.95 mio

Down-and-out Put Option: In this type of auction, the barrier level is below the strike price, and the option becomes deactivated once the spot price of the underlying touches the barrier level.

In this scenario, Party A has purchased a down-and-out put option in the USDINR from Party B. The strike price K in the option is at 84, and the barrier level is at 82 ('down' from the strike price). The contract is for US$1 million face value. According to the spot price movement, the potential payoff for party A can be created as per the following table:

Box 8: Down-and-out Put Option Potential Payoffs

Specifics: Strike Price (K) =84 , Barrier Level = 86 , Face Value = USD 1 million					
Sr. No	**Observation**	**Spot Price**	**Payoff**	**Option Premium**	**Net Profit/Loss**
1	Out-of-the money put option	85	0	$50000	-$50000
2	At-the money put option	84	0	$50000	-$50000
3	In-the-money put option, can be exercised	83	$(84-83) = $1 mio	$50000	$1 mio - $50000 = $0.95 mio
4	In-the-money put option, but spot price has touched the barrier level, hence option is deactivated	82	0	$50000	-$50000
5	In-the-money put option, but spot price has touched the barrier level, hence option is deactivated	81	0	$50000	-$50000

Price sensitivities of Barrier Options: Like vanilla options, price of barrier options are also sensitive to various aspects of the markets. In the case of knock-in (KI) options, the following are the factors affecting the price of the options:

Knock-In Options

a) **Barrier Level**: The nearer the barrier level to the initial spot, the more expensive the KI option would be. This is because the closer the barrier level, the higher the probability of the option coming into existence.
b) **Barrier Observation**: The higher the number of barrier observations, the higher the probability of the option being activated, the more expensive the KI option. A KI option having a quarterly monitored barrier would be cheaper than a similar KI option having a monthly monitored barrier.
c) **Volatility**: A KI option is more sensitive to volatility than a vanilla option carrying the same features. A higher volatility can benefit the holder of the option because it increases not only the probability of maturing in the money (ITM) but also the probability of reaching the barrier and being activated.

Knock-Out (KO) Options

a) **Barrier Level**: The closer the barrier level is to the initial spot, the cheaper the KO option would be. This is because the closer the barrier level, the higher the probability of the option expiring worthless.
b) **Barrier Observation**: For a KO option, the higher the number of barrier observations, the higher the probability of the option knocking out and the cheaper the KO option. A KO option having an annually monitored barrier would be more expensive than a similar KO option having a quarterly monitored barrier.
c) **Volatility**: A KO option is less sensitive to volatility than a vanilla option carrying the same features. A higher volatility increases the probability of expiring ITM but also increases the probability of reaching the barrier and ending with no value.

Uses and Benefits

Like with any other derivative products, the primary benefit of barrier options is to protect the user from any adverse movement in the price of the underlying asset. For example, in the case of the USDINR option, the transaction helps the user to hedge against adverse foreign currency movements in the future. The added feature of a barrier option is that it provides an opportunity for the investor to take additional protection or leverage, depending upon his/her risk appetite. However, it is advisable that the user understands the product completely before entering into the transaction, as it may expose him/her to loss of capital in case of unfavourable underlying asset price movement.

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