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FX Swap Liquidity in India's Domestic and International Front: Exploring Spill over Across Exchange Rate Regimes

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FX Swap Liquidity in India's Domestic and International Front: Exploring Spill over Across Exchange Rate Regimes

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This paper examines the integration of the Indian FX Swap market, highlighting liquidity risk that can spill from international to domestic markets and may affect the liquidity across different tenors of the FX Swap segment. This paper argues that even under a managed float exchange rate or pegged exchange rate, the real economy faces systemic risks linked to the forex interbank segment's liquidity exposure, despite the central bank's efforts for the stability of the exchange rate. Using ARDL model, the study finds that the domestic FX Swap market is significantly integrated, especially in the 1-month tenor, where banks use swaps to hedge client positions regularly. The 6-month tenor is crucial for establishing derivative contract reference rates, while the 12-month tenor serves as a key market benchmark influenced by interest rate differentials between India and US Treasury rates. Furthermore, the FX swap market demonstrates integration with some Asian economies and the US, particularly between India's managed float and Singapore's pegged exchange rate. Overall, the liquidity in the interbank segment of the FX Swap markets fosters global connectivity, which may impact the liquidity of the banking sector. Despite supervisory efforts by the Basel Committee, the self-regulated nature of the interbank market means that individual banks' risk appetites dictate overall exposure levels.

JEL: F10, F31, F50, G15.

Keywords: Foreign Exchange Market and Funding liquidity, FX Swap, Interbank Forex Market, Integration

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1. Introduction

In the post-liberalization era, the integration of global financial markets has made it possible for financial crises to spread from the countries where they originate to the rest of the world. A sudden shock in the financial market or the real economy can set off a chain reaction, leading to capital flight that undermines corporate asset values and diminishes firms' creditworthiness, thereby increasing exchange rate volatility. When corporate asset values decline, it can erode confidence in the banking sector, causing banks to hesitate in extending loans, which may trigger a credit crunch and ultimately reduce production and employment levels. Additionally, any instability in the financial sector can adversely affect bank assets, given how closely the banking industry is tied to the financial market. This was particularly evident during the United States (US) financial crisis of 2007-08.

The rapid increase in the use of foreign exchange (FX) swaps has emerged not only as a significant source of funding but also a critical hedging mechanism; and has drawn considerable attention during the 2007-08 financial crisis. According to the Bank for International Settlement (BIS) Triennial Report in 2022, the market has a staggering daily trading volume of $3.8 trillion. It may be noted that commercial banks across the world are the main players in this market, as FX Swap is purely an interbank[1] product. This product is primarily used by banks for obtaining forex funding to cover their exchange rate risk[2] due to their open position on behalf of the corporate or merchant, or for trading in the interbank market as a proprietary trader. In a nutshell, it is extensively used for the cover operation of NOSTRO liquidity for different value dates, for example, cash, tom, and forward. So, we can say that except for spot, all interbank merchant deals cover operation and proprietary trading require the engagement of FOREX swap (Sanati, 2021).

The FX swap market also faced reverberation with severe instability in the international money markets that started in the latter half of 2007 and continued in 2008. With the shortage of liquidity in the FX swap market during the crisis, the concern grew regarding the capacity of banks to successfully roll over their funding obligations and effectively manage their liquidity risks in this challenging environment. At the onset of the turmoil in the forex swap markets, the primary issue was a severe shortage of U.S. dollar funding among non-U.S. financial institutions. These entities urgently needed U.S. dollars to keep their operations running, but participants in the interbank market, who usually provided this currency, were retaining liquidity to meet their own funding needs. As a result, many non-U.S. financial institutions turned to the forex swap markets to secure the necessary U.S. dollar liquidity. This surge in demand made the forex swap market increasingly lopsided, resulting in a notable shift in market dynamics. Subsequently, concerns about overall economic and financial stability began to emerge. This was primarily because forex

[1] Forex market has two segments: Retail or Merchant segment and Wholesale or Interbank segment. While retail segment associates transaction between bank and the merchant, interbank segment represent the transactions between two banks.

[2] In FX market there are four value dates; Cash, Spot, Tom and Forward. Other than spot segment of the market, banks are allowed to cover their exchange rate risk in the interbank segment of the market by using FX swap. The details of the market and the product is discussed in the appendix.

swaps were widely used by banks to raise funds and manage their forex risk exposures. Additionally, the upheaval raised pressing questions about banks' ongoing ability to provide credit to the local economies they serve and highlighted the potential external financing gaps that could arise as a consequence of these liquidity challenges (Barkbu and Ong, 2010).

In light of such risks to the real economy, many central banks opt for a managed float approach to mitigate the effects of exchange rate volatility. Developing countries often implement volatility management systems to set foreign exchange rates. It may be noted that India's FX market often experiences interventions from the central bank on account of volatility of the rates. Countries like Singapore manage the Singapore dollar against a basket of currencies along a typically appreciating path or crawl within a policy band. In this backdrop, we argue that even if the central bank manages the FX rate, the country may be subject to liquidity risk through the FX Swap market. The liquidity of the Indian FX swap market is highly linked with the liquidity availability in the other FX swap markets internationally and domestically across different maturities. We aim to empirically estimate the linkages between the liquidity of the Indian FX swap market and the global market, which will help us to get a better understanding of the potential liquidity risks which may disrupt the liquidity in the banking sector and thereby the economy.
This paper examines the integration in the FX swap market through the availability of liquidity in the domestic and international markets. Specifically, the objective of the paper is two-fold: 1) We examine the integration of liquidity in the FX Swap market for USD/INR currency at different tenors, 2) We also test the integration of the liquidity in the domestic FX swap market with the liquidity in the international FX swap markets. Furthermore, this paper also talks about the microstructure of the FX market, parlances used in the dealing room operations, transactions of FX Swap product in the interbank segment, while emphasizing the importance of FX swaps for managing liquidity risk of NOSTRO account[3] and hedging of the open position.

The rest of the chapter is organized as follows. In Section 2, we present a comprehensive review of the studies that have examined the interlinkages of real sector growth, contribution of finance, and how the banking channel has become important in connecting the exchange rate channel and the real sector growth. In section 3 we present the microstructure of the Global FX Market and a brief on the interbank cover operations for an import merchant deal. Section 4 represents some stylized facts of the domestic and international FX Swap markets. It also preludes the study by presenting some descriptive statistics. Section 5 provides a brief background on the database and methodology. We summarise our findings in Section 6. In conclusion, Section 7 offers some policy implications.

[3] NOSTRO account is the account a bank in India may hold in another country in it's local currency. For example, if SBI in Mumbai holds an account with Citi bank New York in USD and Deutsche bank, Frankfurt in EUR, then these accounts are NOSTRO account of SBI

2. Literature Review

Financial market integration can be classified into two types: horizontal and vertical (Sanati, 2010). Horizontal integration takes place within the domestic financial markets and relies on intermediaries' efficient and growing participation. The integration of the domestic markets plays a significant role in indicating the interest rate, which is based on a fundamental reference rate. Vertical integration, on the other hand, happens within the international financial markets and is a result of the capital account's openness and liberalization of the stock market. The integration of international finance makes the financial system more competitive by creating more opportunities for better investment projects, maintaining a suitable balance of liquidity across different markets, and unifying rates of return. These factors influence international investment decisions and risk-sharing (Lane and Milesi-Ferretti, 2003).

The coupling among financial markets is expected to offer valuable insights that aid in comprehending how transmission occurs from one market to another, where returns or asset prices hold a significant influence in shaping saving and investment behaviour. In the context of financial market prices, Taylor (1995) highlights the significance of three types of prices - exchange rates, long-term interest rates, and short-term interest rates - when examining the impact of monetary policy changes on the real gross domestic product. It is important to note that the financial markets channel has become stronger over time and has a multiplicative impact on the real sector economy through the banking channel (Sanati, 2013).

Several macroeconomic and financial channels play a major role in reaping the benefits of financial integration. While it is well established that finance matters for the growth of the economy (Robinson, 1952), the coupling of financial markets and the real sector economy may also lead to systemic risk. Four interconnected channels are predominant in establishing the connection between finance and the real sector economic growth: a) Credit based channel, b) Interest rate channel, c) Exchange rate channel, and d) Asset Price channel. While each of these channels has its significance, in the recent past we have observed that exchange rate channels played a significant role in financial market turmoil. While Keynesian economics stressed the interest rate channel, Taylor (1995) emphasized that both the interest rate and the exchange rate channels are interdependent. Innovations in the international financial markets have led to significant improvements in efficiency. These innovations have widened and made the range of instruments available for borrowing and hedging interest rate and exchange rate exposures more flexible. In recent times, these advancements have helped banks and their customers manage the challenges caused by the increased volatility of exchange and interest rates, proving to be invaluable. (BIS, 1986).

Bagehot (1873) and Schumpeter (1912) believed that banks were relatively more efficient institutions in identifying and funding more productive investments, which, in turn, spurred innovative growth. It is widely acknowledged that banks play an essential role in financing development, especially in developing countries, as they facilitate the strategic allocation of savings (Gerschenkron, 1962). Stiglitz (1985) and Singh (1997) suggested that the banking sector is a better-organized institution in addressing the agency problem and overcoming the many shortcomings of a market-based system. Moreover, since banks operate in the long run, they can effectively monitor and play an important role in corporate governance (Bhide, 1993). Moore et al. (2016) have opined that Forex trading has become increasingly relationship-driven, even though in an electronic form. According to them, the changes in market

participants and their trading patterns may significantly impact market functioning and forex spot market liquidity resilience in the future.

While there is a range of literature examining the exchange rate channel, there is a notable opportunity for further exploration of this market in the context of liquidity in the FX Swap market. The foundational work by Barkbu and Ong (2010) underscores the importance of the FX Swap market for maintaining economic and financial stability. Their findings suggest that disruptions in this market can adversely affect the banking sector's ability to fund and hedge, potentially limiting its capacity to lend to the real economy. The paper by Krone and Sushko (2022) shows that Bid-ask spreads in spot and FX swaps are highly correlated, showing a strong link between market liquidity in both. Additionally, a decline in FX funding liquidity, measured by the forward discount or deviations from covered interest parity (CIP), leads to widening bid-ask spreads in both FX swaps and the spot market. Also, they concluded that the linkage between FX market and FX funding liquidity conditions has strengthened significantly since about mid-2014. Another paper by Saeidinezhad (2022) shows prime brokerage firms are replacing traditional market makers in the FX swap market. FX dealers are adjusting their cost structures to account for higher required returns from shareholders, moving beyond just market-making costs. Additionally, US banks are reducing their lending in the Eurodollar market, with US money market funds now providing most direct dollar funding. These trends could destabilize global liquidity and limit central banks' ability to manage systemic risk from the FX derivatives market during financial crises.

In the context of the Indian FX Swap market, Sanati (2021) offers valuable insights into the integration of the Indian FX swap market with the Spot Market for USD/INR and foreign currencies. This research reveals a long-run equilibrium among India, JPY, the US, and the UK in forex swap liquidity, opening avenues for further analysis and understanding of these dynamics. Furthermore, the study of Sanati (2024) shows that many countries may be affected if there is a liquidity shock in the FX Swap segments in the global economy, irrespective of the fact if the central bank follows a market-determined exchange rate, managed float, or pegged exchange rate.

In the backdrop, this study attempts to provide the micro structure of the FX swap market and an operational perspective of the FX dealing room. Also, it adds to the existing literature by contributing an analysis of Indian FX Swap market integration on the domestic front by examining the liquidity segment of USD/INR at different maturities, and in the international front, it discusses the spillover impact of liquidity shocks with the causality impact. To the best of our knowledge, this study adds to the literature by contributing a different dynamics of the FX market operations.

3. Micro-Structure of the FX Swap Market

An FX Swap is a form of over-the-counter (OTC) foreign exchange derivative contract that entails the exchange of two currencies—specifically the principal amount—on a designated near date (referred to as the near leg). This is followed by a reverse exchange of the same two currencies at a later date (known as the far leg). So, an FX swap involves the simultaneous buy-sell or sell-buy of the same currency of the same amount at the two different maturity date with a mutually agreed premium or discount. For example, if JP Morgan hits the market as a taker for booking a buy/sell swap for 3 million Euro against USD between cash/spot and market quotes for C/S EUR/USD is 0.0002/0.0003 (forward points or swap points) , which is at premium, then JP Morgan buys 3 million Euro and sells simultaneously 3 million Euro between

cash over spot market and as the market is in the premium, JP Morgan (as a taker) receives 0.0002 pips USD per Euro as a difference between buy and sell of Euro. So, the total receive amount of JP Morgan is 3x0.0002 million USD.

FX swaps are generally classified based on their maturity. Near-Maturity Swaps are short-term instruments with maturities ranging from one day to two business days, which encompass Cash-Tom swaps, Tom-Spot swaps, and Cash-Spot swaps. For longer duration, Spot-Forward swaps are widely utilized. These involve one leg at the spot date (T+2) and another at a forward date, usually aligned with month-end maturities. They are particularly advantageous for institutions aiming to manage currency risks at the end of financial periods. The details of the interbank parlance are given in Appendix Box 1A.

The FX swaps market operates in a two-tier structure, consisting of the interbank segment, which is run for proprietary trading, and the interbank segment, which covers merchant deals. So, if there is a merchant who books a 1-month or 3-month forward contract, the exchange rate risk is transferred from the merchant to the banking book. To cover the risk of exchange rate fluctuation, the interbank trader has to book the interbank cover operations by using both the spot leg and FX swap leg. FX Swaps may also be needed if an early delivery of forward contracts is requested by the customer. An operational structure of FX Swap transactions for a merchant deal covering cash over spot is described below:

I. Suppose the USD/INR spot rate is 84.50/52 and C/S: 0.03/0.04. If there is a customer who wants to cover his import payment on value cash (same day as the deal date) bank provides him the rate as 84.52-0.03 (as per the market convention of exchange arithmetic (Sanati, 2024) adding the exchange margin, say, 2 paise. Once this deal is booked by the import customer with the bank, the risk of exchange rate movement shifts to the banking book. As to sell the required USD to the customer bank needs to buy the USD from the interbank market. Bank covers its exchange risk position through the interbank spot and swap segments, as bank is not allowed to buy USD outright in the cash segment of the interbank market. The details of the transaction is given below. As a taker Bank Buys USD value spot in interbank at 84.52. With this transaction, the exchange position and fund position in USD become as follows:

II. The requirement of USD by the customer on value today and bank's purchase deal of USD value spot creates a maturity mismatch in the NOSTRO account of USD. Bank is oversold in Cash and overbought in USD. To cover the maturity gap (oversold in cash and overbought in spot) the bank has to do a buy/sell swap in USD/INR cash over spot.
   a) Buy USD / Sell INR value cash
   b) Sell USD / Buy INR value spot,

	Purchase	Sale		Credit	Debit
Customer		-1	Cash	Buy	-1
Interbank	+1		Spot	1	Sell

Interbank Cover rate 84.52 - 0.03 = 84.49

By this transaction, the bank is able to buy USD from the interbank market at the rate of 86.49 INR per USD. At the same time, the bank has sold USD to the import customer at 86.51 (2 paise is the bank's profit, generated from the exchange margin)

FX swap is an important instrument to manage liquidity in the domestic front and manage further depreciation of the local currency. Suppose the market experiences continuous USD appreciation against INR. In this event, RBI sells USD in the interbank market at the spot value in support of the Rupee. In other words, to combat the USD liquidity shortage and to stop INR from depreciating further, the RBI injects more USD liquidity into the system by selling USD spot and buying INR spot. However, it creates pressure on INR liquidity in the domestic market. This may increase the interbank lending rate. So, to maintain the INR liquidity intact within the banking sector, the RBI also does FX Swap (in this case buy/sell in particular) transactions for any maturity, such as spot over one month, spot over three months, etc. This buy/sell swap of USD/INR spot over one month forward (or three months forward) helps the central bank to manage the domestic liquidity issue in the short run.

FX Swaps are invaluable for institutions seeking to manage liquidity in both domestic and foreign currencies. For instance, an FX Swap can be executed to adjust a cash position in a specific currency and address liquidity mismatches on their balance sheets. Furthermore, banks may also resort to FX Swaps when they find themselves overbought in certain maturities and oversold in others within a currency.

4. Some Stylized Facts of FX Swaps Market on the Domestic and International Front

The global financial system relies heavily on the FX market, which is a crucial component. As key dealers and users of FX instruments, banks have an essential role to play in this market. They also serve as anchors for financial stability and economic activity. So, banks' exposure to the liquidity risk that originates in the international market may be a threat to the domestic market. It has already been discussed that amid the recent crisis in the United States, concerns arose in some countries about their banks' ability to meet funding needs due to stress in the FX swap market. This situation could impact credit provision and balance of payments financing. In this backdrop, we empirically examine the coupling of the Indian Forex swap market with a few Asian economies and the US market. In the post-Covid era, it has been observed that JPY has experienced almost 37% depreciation against USD. On the other hand, the depreciation of the INR is one-third of the Japanese YEN. (Table 1). The same trend has been observed even during the COVID time. While YEN was depreciated against USD by 6.48%, the INR was depreciated only 2.66%.

Table 1: FOREX Spot Rate Movement

Description	USD/EUR	USD/JPY	USD/SGD	USD/INR
% Change from February 2020 to December 2021	3.11	6.48	(-)3.15	2.66
% Change from January 2022 to May 2024	3.82	37.11	1.19	12.09
Standard Deviation (Volatility between May 2019 to May 2024) in %	0.05	17.46	0.02	4.65
Source: Reuters Database				

Therefore, it can be claimed that the market-driven exchange rate is more sensitive to global shocks. Though Indian central bank interventions are mainly to keep the market volatility moderate, the highly liquid and connected FX swap market raises concerns related to the

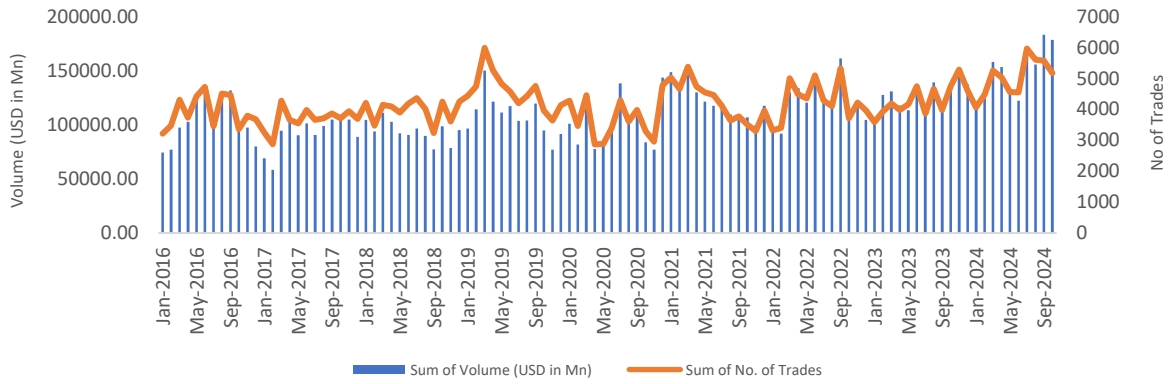
stability of the financial market. This means that liquidity shocks or shortage in one market can spill over to the rest of the FX markets with a multiplier effect in the banking sector. On the outbreak of any financial instability on the international front, there may be capital flight out of the country, the sell/buy swap of USD/INR by central bank helps in managing the excess demand for dollar and excess supply of INR liquidity. Interestingly, the interbank transactions are completely self-regulated except the fact that the banks' treasury mid-office can play the role of certain limits, like VAR (value-at-risk) limit, stop loss limit, daylight limit, or overnight limit for carrying a position. Therefore, the important challenge for future banking is that liquidity may be affected due to global shock and the central bank of any country has to be prepared for such shock in the system.

As the popularity of FX swaps continues to rise, these markets have the potential to connect global Forex markets even more. Policymakers have long been aware of the risks associated with banks' foreign exchange activities, particularly during times of increased volatility in exchange rates. The Basel Committee on Banking Supervision (BCBS) observed that banks can suffer significant losses in a short amount of time due to their participation in foreign exchange transactions. It was further stated by the BCBS that regulators must remain watchful to prevent forex-related risks from ever becoming so extensive that they jeopardize the banks' solvency and liquidity, as well as the overall health and stability of the banking system4 (Barkbu and Ong, 2010).

4.1. Trends of USD/INR FX-Swap Market in Near Maturities

The trend in trading volumes and the number of trades for near-maturity FX swaps from 2016 to 2024 in the OTC interbank market is provided in Figure 1. It can be observed that banks have increased the use of FX swaps in the short-term, with both volumes and trade counts steadily rising over the years. Significantly, September 2024 marked a record peak in trading activity for these instruments.

Figure 1- Trends in Traded Value (USD Mio) and No. of Trades of FX Swaps Near Maturity Tenors



Source: Author's Compilation - CCIL database

[5] International standards and regulations have been established to address the risks associated with Forex instruments and promote more transparency in their disclosure. These regulations encompass the Basel Accords (Basel I and Basel II), as well as the International Financial Reporting Standards (IFRS). When participating in the over-the-counter (OTC) Forex derivatives market or using other derivatives instruments, parties typically enter into standardized contracts issued by the International Swaps and Derivatives Association (ISDA) with their counterparties. These contracts usually include provisions aimed at reducing credit risk.

Figure 2 and Figure 3 provide a breakdown of near-maturity FX Swap (Cash-Tom, Cash-Spot, and Tom-Spot) trading activity. To manage their overnight liquidity mismatches, banks often resort to using Cash-Tom swaps, as evident from both trading volume and trade frequency. It accounts for over 50% of all trades throughout the period in the near maturity segment. Depending on their need, banks also manage their liquidity using Cash-Spot and Tom-Spot instruments.

The overnight USD/INR FX swap rates are often influenced by the demand for dollar (relative to the rupee) in the system. During periods of a dollar crunch, the immediate need for dollars, pushes up its demand in the FX swap market, which, in turn, causes the overnight rates to rise. Figure 4 depicts the trend in Weighted Average Rate (WAR) for near-maturity FX Swap instruments along with the descriptive statistics in *Table 2.*

Figure 2- Near Maturity Tenor-wsie Distribution of FX Swap Traded Volume (USD Mio)

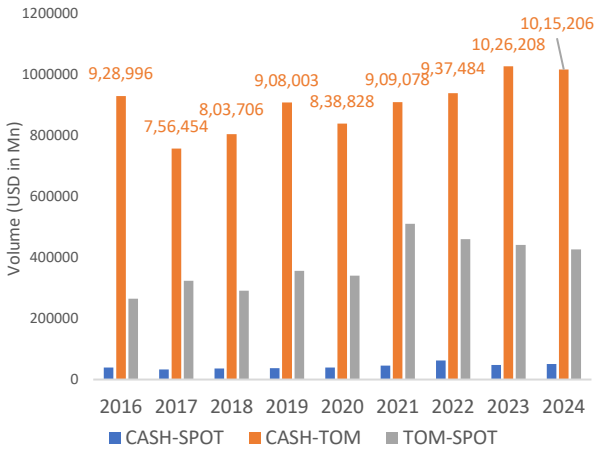


Figure 3- Near Maturity Tenor-wsie Distribution of FX Swap No. of Trades (USD Mio)

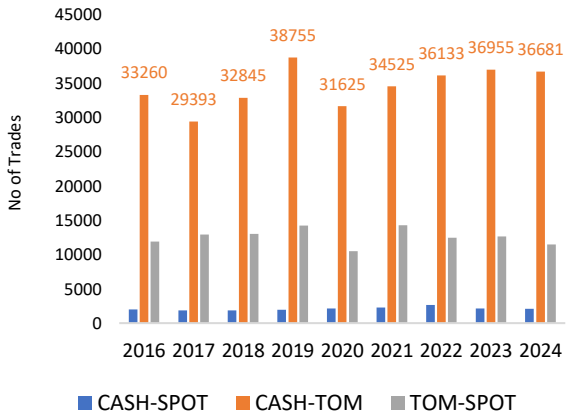
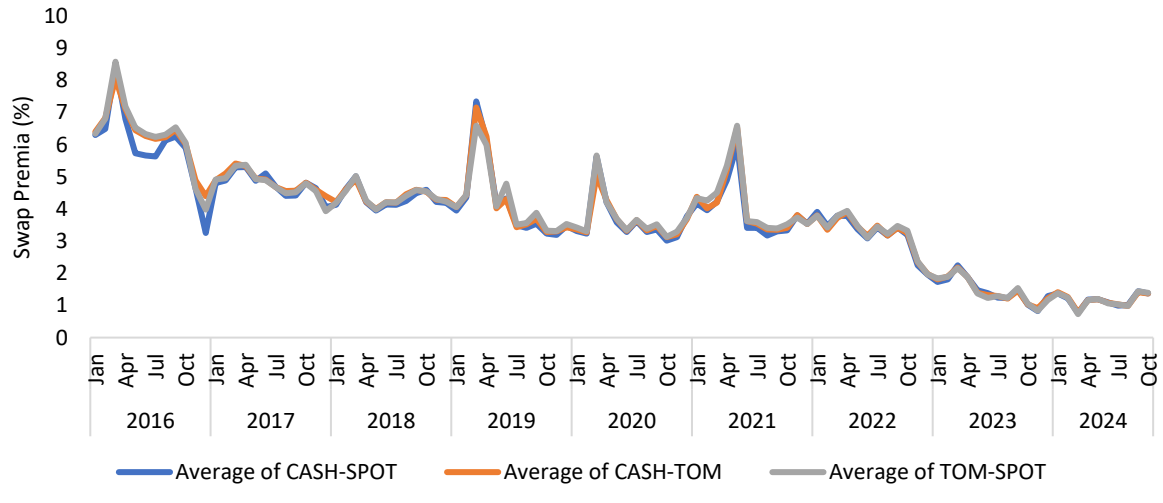


Figure 4: Monthly Average Rates of Near Maturity FX Swap Premia



Source: Authors' Compilation -CCIL Database

Overall, the rates for all three instruments have been decreasing. The monthly average rates reached a peak of approximately 8.6% in March 2016, and since then, they have steadily declined, settling between 1.39% and 1.5% in October 2024. However, the data exhibits a

relatively high kurtosis with positive skewness (as indicated by the daily (WAR%)) suggesting the presence of outliers. These outliers are likely associated with year-end effects. Specifically, notable spikes are observed mostly around the end of the financial year, i.e. the last few days of March and the first few days of April. This spike in rates during year-ends is attributed to heightened demand for US dollars by Indian firms to fulfil year-end dollar-denominated liabilities, exerting significant pressure on FX swap pricing[5].

Table 2: Descriptive Statistics of Near Maturity FX Swap Premia and Value Traded (2016-2024)

Parameters	**Daily**			**Monthly**		
	CASH-TOM	**CASH-SPOT**	**TOM-SPOT**	**CASH-TOM**	**CASH-SPOT**	**TOM-SPOT**
Panel A: Descriptive Statistics WAR (%)						
Mean	3.7447	3.6415	3.7525	3.7513	3.6771	3.7644
Median	3.7071	3.6114	3.7353	3.7055	3.6977	3.7566
Stdev.	1.9361	1.9222	1.8840	1.6289	1.5890	1.6419
Kurtosis	64.2154	41.3433	20.0334	-0.2597	-0.0084	-0.0983
Skewness	4.1182	3.4566	2.2599	0.0698	0.1199	0.0928
Range	39.2001	33.6099	26.3426	7.2739	7.7098	7.8468
Minimum	0.3174	0.0730	-0.5878	0.7791	0.7646	0.7299
Maximum	39.5175	33.6099	25.7548	8.0531	8.4744	8.5767
Count	1965	1866	2039	106	106	106
Panel B: Descriptive Statistics of Value (USD Mio)						
Mean	4134.333	210.913	1673.772	76641.17	3712.86	32196.42
Median	3966.55	15.5	1535.5	74220.21	3802.47	30882.00
Stdev.	1179.175	943.1463	788.2005	16725.58	3013.65	9956.29
Kurtosis	2.047778	45.99823	2.182595	0.93	0.14	-0.75
Skewness	1.013696	6.170381	1.150814	0.67	0.71	0.37
Range	11421.2	13032.88	6376	92672.02	13419.64	40950.80
Minimum	682	0.0224	200	38774.24	103.87	13988.50
Maximum	12103.2	13032.9	6576	131446.26	13523.50	54939.30
Count	1965	1866	2039	106	106	106
Source: CCIL Database						

Table 3 shows the correlation of the WAR and value (USD million) for near-maturity swaps. The positive and significant correlation between CASH-SPOT, CASH-TOM, and TOM-SPOT indicates a linear relationship and a highlighted interconnectedness within the FX swap market for such tenors. It is also observed that the correlation of the WAR(%) across tenors are higher than that of the value traded.

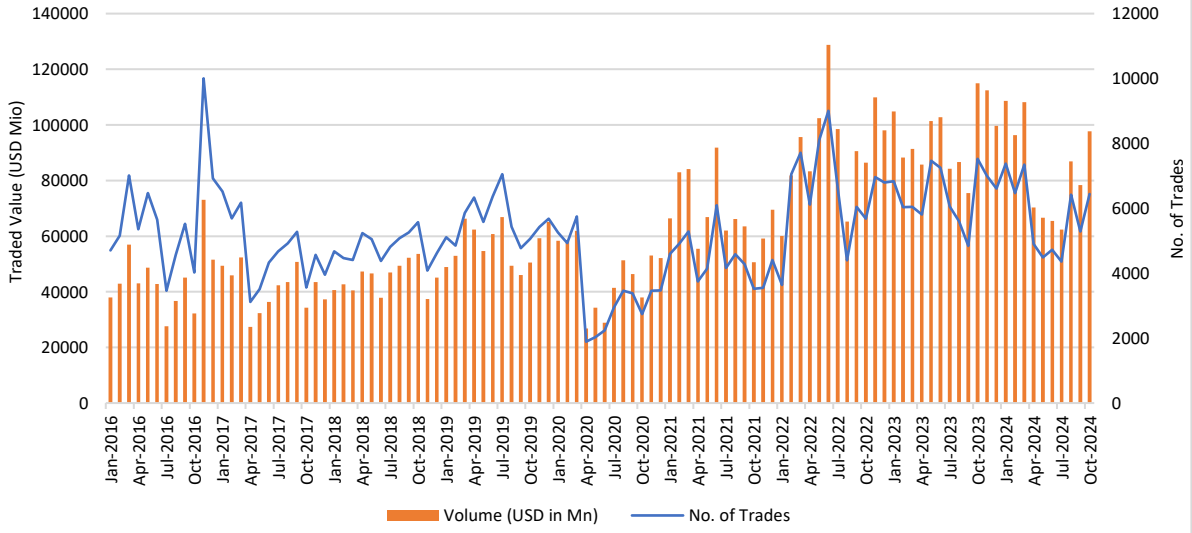
[6] https://www.cmegroup.com/articles/2022/2022-year-end-fx-turn.html

Table 3: Correlation of Daily Near Maturity Swap			
Correlation of WAR (%) of Near Maturity Contracts			
	CASH-SPOT	*CASH-TOM*	*TOM-SPOT*
CASH-SPOT	1		
CASH-TOM	0.9427***	1	
TOM-SPOT	0.9109***	0.8522***	1
Correlation of Value (USD Million) of Near Maturity Contracts			
CASH-SPOT	1		
CASH-TOM	0.1111***	1	
TOM-SPOT	0.1936***	0.4879***	1
Note: All the value are statistically significant (***) at 1% level. Source: CCIL Database			

4.2. Trends of USD/INR FX-Swap Market for Month End Tenors

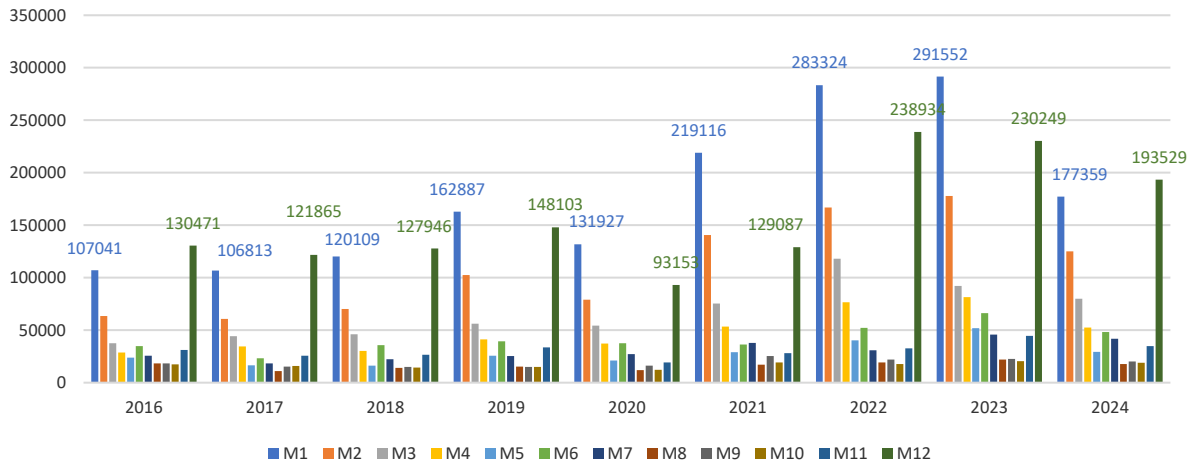
Figure 5 highlights a significant surge in trading activity for month-end tenor FX swaps. The Covid-19 pandemic initially disrupted trading volumes in early 2020, causing a decline in activity due to heightened uncertainty and a slowdown in economic activity. However, this was followed by a sharp recovery in the aftermath. There was a rebound across both trading volumes and the number of trades executed.

Figure 5: Trends in Traded Value (USD Mio) and No. of Trades of FX Swaps



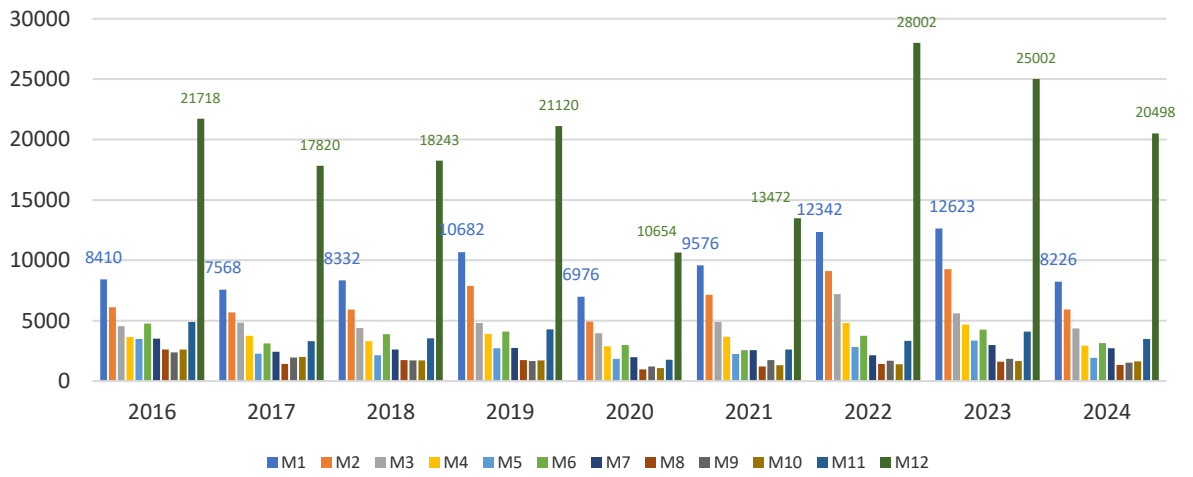
Source: Authors' Compilation - CCIL Database

Figure 6: Tenor-wsie Distribution of FX Swap Traded Volume (USD Mio)



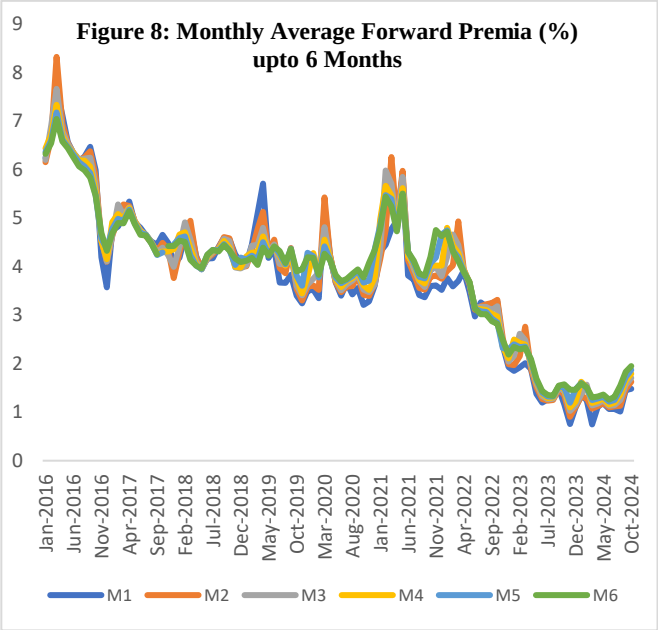
Source: Authors' Compilation - CCIL Database

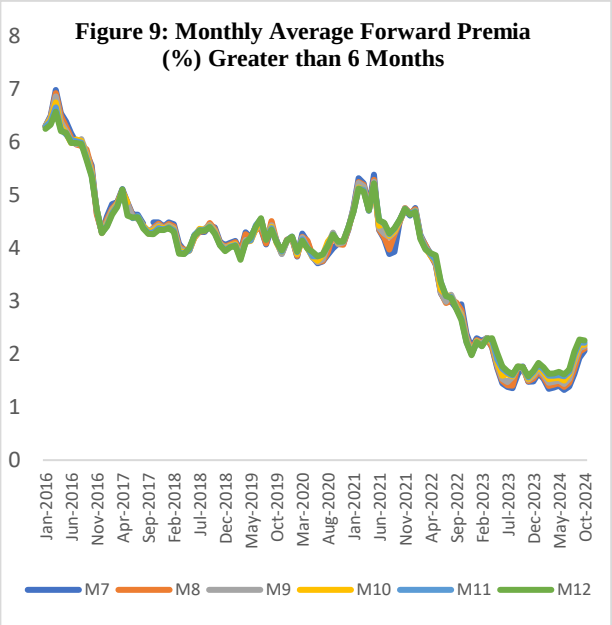
Figure 7: Tenor-wsie Distribution of FX Swap No. of Trades



Source: Authors' Compilation - CCIL Database

Figures 6 and 7 present a tenor-wise analysis of the volume and trades of month-end FX swaps. Among the various tenors, the highest trading activity was observed in the 1-month and 12-month tenors. The 1-month tenor is particularly active, as such FX swaps are commonly used by banks to hedge client positions, with contracts rolled over from one month to the next. Market participants typically take a short-term view of exchange rates, opting to lock in rates for shorter durations to better manage currency risk.

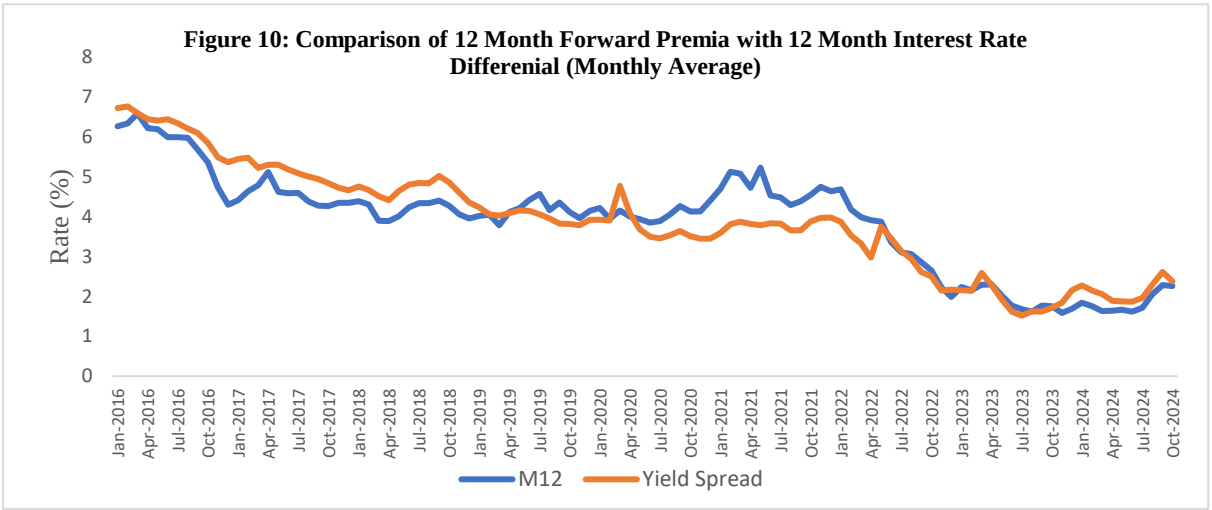




Source: Authors' Compilation - CCIL Database

Figures 8 and 9 illustrate the tenor-wise movement of forward premia rates, which exhibit a downward trend, similar to the patterns observed in near-maturity swaps. Notably, there was greater volatility in these rates for tenors of less than 6 months, especially during the Covid-19 pandemic, when rates spiked due to increased uncertainty and significant market disruptions.

In general, the movement of forward premia closely tracks the interest rate differential between India and the US, reflecting the relative economic conditions and monetary policy stances of the two countries. Figure 10 compares the 12-month forward premia with the difference between the 1-year domestic treasury yield in India and the US Treasury yield. This comparison highlights the close co-movement between the forward premia rates and the interest rate differential, particularly in more recent periods, where the two have largely aligned, as the market is increasingly sensitive to interest rate expectations and changes in the economic landscape of both countries.



Source: Authors' Compilation - CCIL Database

Table 4 : Descriptive Statistics of Month End FX SWAP Forward Premia and Value Traded (2016-2024)										
	Daily Value					Monthly				
	M1	*M3*	*M6*	*M9*	*M12*	*M1*	*M3*	*M6*	*M9*	*M12*
Panel A: Descriptive Statistics of WAR (%)										
Mean	3.6847	3.8026	3.8298	3.8746	3.8505	3.7032	3.8183	3.8448	3.8648	3.8724
Median	3.7857	3.9578	4.1218	4.1744	4.1624	3.7201	3.9975	4.1439	4.1836	4.1544
Stdev	1.5927	1.5111	1.4094	1.3489	1.2716	1.5639	1.5047	1.4027	1.3278	1.2674
Kurtosis	0.0522	-0.2477	-0.4229	-0.4448	-0.4901	-0.2629	-0.2111	-0.3467	-0.3739	-0.4324
Skewness	0.0915	-0.0975	-0.2632	-0.2850	-0.2919	-0.0549	-0.1461	-0.3015	-0.3280	-0.3326
Range	10.1609	7.3490	6.1742	5.7931	5.2588	6.9043	6.6409	5.7880	5.4318	4.9974
Minimum	0.2446	0.9015	1.1867	1.3472	1.5334	0.7484	1.0266	1.2600	1.4389	1.5847
Maximum	10.4055	8.2505	7.3609	7.1403	6.7922	7.6526	7.6675	7.0480	6.8706	6.5822
Count	2112	2109	2054	1868	2062	106	106	105	106	106
Panel B: Descriptive Statistics of Value (USD Mio)										
Mean	757.64	286.34	182.05	91.03	685.42	15095.54	5697.16	3561.23	1604.13	13333.36
Median	599.22	219.50	125.35	51.00	599.00	12936.72	4845.83	3310.84	1270.41	12232.93
Stdev	579.12	256.18	189.97	121.33	445.82	6857.02	2723.63	1698.91	1150.01	5650.88
Kurtosis	3.91	11.08	13.60	24.82	2.98	0.26	0.25	1.52	7.95	-0.03
Skewness	1.67	2.38	2.87	3.75	1.34	0.91	0.97	1.17	2.37	0.37
Range	4259.90	3030.65	1822.10	1645.99	3304.90	32507.50	12261.73	8771.85	7707.37	26788.68
Minimum	5.00	0.08	0.10	0.01	0.10	4821.10	1725.16	1042.70	2.00	8.00
Maximum	4264.90	3030.73	1822.20	1646.00	3305.00	37328.60	13986.89	9814.55	7709.37	26796.68
Count	2112	2109	2054	1868	2062	106	106	105	106	106
Source: Authors' Compilation – CCIL Database										

Table 5 shows the correlation of the WAR for month end-maturity swaps. The high positive and significant correlation between M1, M3, M6, M9 and M12 indicates a strong linear relationship and a highlighted interconnectedness within the FX swap market for such tenors. The correlation between the rates is more prominent compared to that of the values (in USD).

Table 5 : Correlation of Daily WAR (%) and Value Across FX Swap Month End Tenors					
Correlation of Daily WAR (%)					
	M1	M3	M6	M9	M12
M1	1				
M3	0.9805***	1			
M6	0.9626***	0.9837***	1		
M9	0.9505***	0.9735***	0.9957***	1	
M12	0.9418***	0.9659***	0.9918***	0.9982***	1
Correlation of Daily Value (in USD)					
	M1	M3	M6	M9	M12
M1	1				
M3	0.4009***	1			
M6	0.2954***	0.2791***	1		
M9	0.0901***	0.0903***	0.1617***	1	
M12	0.1998***	0.2266***	0.1809***	0.2006***	1
Note: All the value are statistically significant (***) at 1% level. Source: Author's Compilation; CCIL Database					

4.3 FX Swap in International Markets

This section describes the primary analysis with respect to India's FX swap liquidity in the global context. Table 6 shows the descriptive statistics. It is worth noting that the USA and Japan have a negative kurtosis value, which suggests that there is no tail-risk associated with their respective distributions. In contrast, Singapore has a kurtosis (kurt) value that is almost zero, indicating a relatively low likelihood of extreme events. India, on the other hand, has a positive kurtosis value, which implies that the distribution of its data has fatter tails and is more prone to extreme outcomes. Also, negative skewness (skew) values for the USA and Japan imply that the probability is high that these two market segments generate higher-value transactions while the positive skewness for India and Singapore indicates that the probability is high that there is lower value transaction. The coefficient of variation (CV) indicates the risk per unit of return in Forex swap transactions for USA Japan is almost the same. However, India experiences a relatively higher risk per unit of return compared to the USA and Japan. In Singapore market, the risk per unit of return in Forex swap transactions is almost two-fold of the USA and Japan.

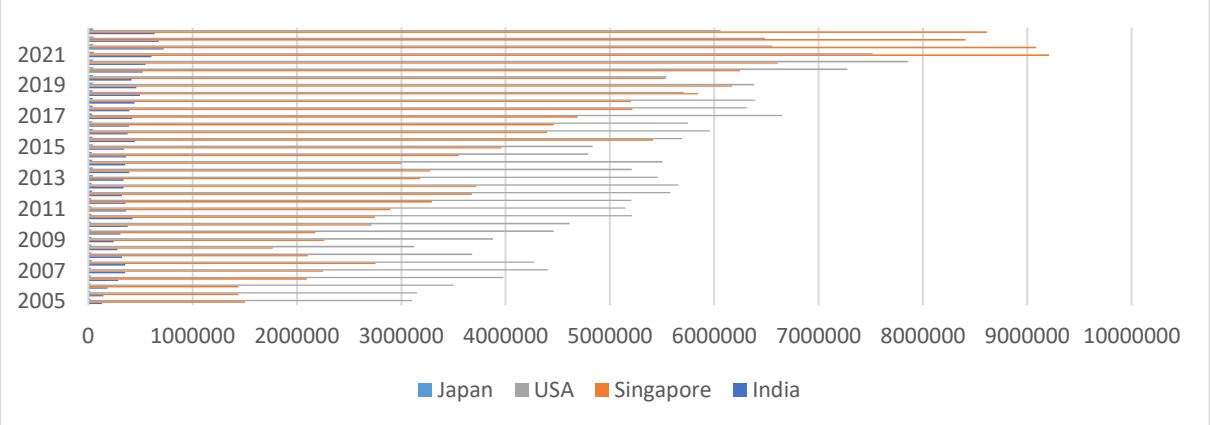
Table 6: Descriptive Statistics

	India	***Singapore***	***USA***	***Japan***
Mean	392582.74	4191336.5	5302259.3	36253
SD	131798.44	2207314.3	1228510.4	9121.63
CV	33.572142	52.663734	23.2	25.1608
Kurt	0.7338998	0.002353	-0.462320	-1.0803
Skew	0.5260174	0.8832465	-0.055522	-0.2152

Source: Author's Compilation: CCIL Database

The figure presented below (Figure 11) displays the liquidity and trends in the four market segments of India, Japan, Singapore, and the USA. Upon analysis, it is evident that the US market is unparalleled when it comes to Forex swap transactions. Among the three Asian countries, Singapore's market stands out as the most advanced in terms of Forex swap transactions. Despite Japan's highly developed market, it has significantly lower liquidity compared to Singapore. In contrast, India's market is increasingly demonstrating advancements in its trend.

Figure11: Forex Swap Transactions: Liquidity and Trend (Millions of USD)



Source: Author's Compilation from respective Central Bank Databases. Note: Japan represents Hundred Millions of USD as per market convention

According to the correlation analysis conducted (Table 7), there exists a positive and significant correlation between various market segments. The analysis further reveals that the Singapore market demonstrates a relatively stronger linear relationship with all the other markets. However, it can undoubtedly be claimed that the USA, Japan, India and Singapore market, all show a very strong correlation with each other. Additionally, the Indian market exhibits a relatively high significant linear relationship with the Singapore market.

Table 7: Correlation Analysis

	India	***Singapore***	***USA***	***Japan***
India	1			
Singapore	0.93***	1		
USA	0.81***	0.84***	1	
Japan	0.79***	0.85***	0.81***	1

Source: Author's Estimation. Note: *** indicates statistical significance at 1% level.

Given this background, we endeavour to examine if the Indian market is exposed to external shocks by testing if the most liquid segment of the markets is coupled with the other significant Asian markets and the US market. It has been noted that USD is appreciated against many currencies in the post-COVID era while volatility in USD/INR was well managed with a very slow appreciation. Considering trade balance and real sector growth, exchange rate stability is one of the desired conditions. However, it raises an important question if the well-managed exchange rate makes India protected or if there exists some other channels through which the risk can be spilled over across countries. We argue that liquidity in the Forex swap market can pose a probable threat to the availability of bank liquidity, irrespective of managed, pegged, or market-determined exchange rate. We examine India's Forex swap market integration with other major Forex markets such as the US, Japan, and Singapore, and observe if the liquidity crisis of one market may spill over to the others. Our analysis sheds light on risk spill over through the liquidity of the forex swap market.

5. Data and Methodology

The domestic interbank USD/INR FX-swap market data, reported to The Clearing Corporation of India (CCIL) Trade Repository (TR), has been extracted from the CCIL website. This dataset includes a number of trades, transaction value (in USD million) and the weighted average forward premia rates for both near-maturity and month-end tenor-wise contracts. We used the data from January 2016 to October 2024 as available in the CCIL Database.

Among the available month-end tenors, key tenors such as 1-month, 3-month, 6-month, 9-month, and 12-month have been selected for econometric analysis. The 1-month tenor is particularly active, reflecting its frequent use by banks to hedge client positions, with contracts typically rolled over on a monthly basis. The 6-month tenor is also significant, as it plays a crucial role in determining reference rates for derivative contracts, including Modified MIFOR swaps, directly influencing pricing mechanisms for such instruments. The 12-month tenor, being the most liquid among all, serves as a market benchmark and is used in the pricing of longer-dated tenor.

We have extracted forex swap turnover data from the respective countries' central bank websites. For example, Forex swap turnover data of the USA is downloaded from the Foreign Exchange Committee (FOREXC) which is sponsored by *Federal Reserve Bank of New York.* In October 2004, the Survey of North American Foreign Exchange Volume was introduced to offer the market frequent updates on the size and structure of foreign exchange activity in North America. This survey provides valuable information regarding the volume and nature of foreign exchange transactions taking place in the region.

The FOREXC and the Foreign Exchange Joint Standing Committee in London collaborated to collect data on foreign exchange turnover. The data included customer, product, currency pair, and execution data, and was collected in April and October for one month[6]. The most recent survey effort included participation from twenty-one leading institutions that are active in the North American market. The data pertaining to Forex swaps in the Singapore market has been collected from the *Singapore Foreign Exchange Market Committee* (SFEMC)[7] to promote the growth and development of Singapore as a leading global financial center in Asia. SFEMC has a specific focus on foreign exchange, money markets, fixed income, and derivatives markets. For data relating to Forex swap transactions in YEN is collected from *The Tokyo Foreign Exchange Market Committee (TFEMC)*[8] releases the results of its Turnover Survey of the Tokyo Foreign Exchange Market covering transactions on a regular frequency. The TFEMC surveys to provide market participants with developments in the Tokyo foreign exchange market in an appropriate and timely manner, thereby contributing to the sound growth of the market. In conducting the survey, the Financial Markets Department of the Bank of Japan provides technical assistance in collecting and processing the data of respective respondents. On the other hand, Forex swap turnover data has been collected from the RBI database. For each of the countries, we have taken bi-annual data from October 2005 to April 2023.[9]

As we deal in time series econometrics we first checked the non-stationarity of all the variables by using Augmented Dickey-Fuller (ADF) test (1979, 1981). In ADF test (Equation 1) the null hypothesis is the presence of unit root or the level variables are non-stationary. The null and alternative hypotheses may be written as $H_0: \gamma = 0$ or the presence of unit root.

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad \text{..... Equation 1}$$

where $\gamma = -(1 - \sum_{i=1}^{p} a_i)$ and $\beta_i = -\sum_{j=1}^{p} a_j$

Autoregressive Distributed Lag models or ARDL models are least squares regressions that utilize lags of both the dependent variable and explanatory variables as repressors (Greene, 2008). Although the use of ARDL models in econometrics has been prevalent for decades, they have gained popularity in recent years as a tool for analysing co-integrating relationships between variables. This is largely due to the contributions made by Pesaran and Shin (1998) as well as Pesaran, Shin, and Smith (2001).

[6] https://www.newyorkfed.org/Forexc/Forex-volume-survey
[7] https://www.sfemc.org/statistics/
[8] https://www.Forexcomtky.com/survey/index_e.html#latest
[9] Some of the countries like London, or BRICS countries have not been considered due to sufficient period of data availability.

The investigation employs the Autoregressive Distributed Lag (ARDL) approach to co-integration, which was developed by Pesaran and Pearson (1997) and subsequently redeveloped into a bounds-testing approach by Pesaran, Shin, and Smith (2001). We do not employ SVAR method as the necessary condition for the SVAR is variables have to be stationary. Though it is possible to consider the non-stationary variables in the 1st difference form which is stationary in our case, it removes the trend component. The reason for choosing the ARDL approach is that it has several comparative advantages over other co-integration methods such as Engle and Granger (1987), Johansen and Juselius (1990), and Johansen (1988) approaches. These other methods require variables to be integrated at first difference order, I(1), and must assume equal lag length in the model. However, the ARDL method can be used to circumvent the requirements of same-order integration of the variables and can very well be used to test the lag relationship and long-run co-integration among the variables that are integrated into different orders (Pesaran and Pesaran, 1997). The ARDL bounds test approach is a useful method to determine the long-term relationship between variables, and it also offers a model to estimate the short-term coefficients of the variables if they are co-integrated in the long run. In the Conditional Error Correction Model specification, the joint significance test (Wald test) F-statistic is used to assess the significance of the lagged levels of the variables in the first difference regression.

Pesaran et al. (2001) developed two asymptotic sets of critical values for large sample studies and F-statistic is compared with these critical values. Depending on the existence of the deterministic trend in the model, the critical values constitute the lower bound and upper bound for I (0) and I (1) respectively. The null hypothesis of the bound test is 'no existence of long-run equilibrium. If the F-statistics falls above the upper bound, we reject the null hypothesis and the long-run level relationship is said to exist among the variables; if the F statistics falls below the lower bound, we do not reject the null hypothesis and conclude that the long-run level relationship among the variables does not exist. The decision whether there exists co-integration among the variables remains inconclusive if the F-statistics falls in between the upper and the lower bounds (Pesaran and Shin, 1999; Pesaran et al., 2001).

The assumption of uncorrelated residual is a mandatory requirement for the Conditional Error Correction Model (long-run ARDL Model). The conclusion on the serial correlation of the error term is sensitive to the appropriate selection of the lag length criteria. And (Pesaran et al., 2001. The three popular methods in selecting the optimal lag length criteria are a) Akaike Information Criterion, AIC (Akaike, 1974), b) Schwarz Bayesian (or Information) Criterion, SBC (Schwarz, 1978) and c) Hannan-Qiunn Criterion, HQC (Hannan and Quinn, 1979) methods. The lag length at which the information loss is minimum is the optimal lag (Enders, 2014).

If y_t is the dependent (autoregressive) variable, $x_{1t}, \dots, x_{kt}$ are k distributed lag explanatory variables, and $d_{1t}, \dots, d_{mt}$, are m exogenous, potentially determistic variables, the Intertemporal Dynamics representation of an ARDL (p, $q_1, \dots \dots q_k$) model is given by:

$$y_t = \sum_{j=1}^{p} \psi_j \, y_{t-j} + \sum_{1}^{k} \sum_{j=0}^{p_r} \beta_{r,j} x_{r,t-j} + \sum_{s=1}^{m} \alpha_s d_{s,t} + \varepsilon_t \text{ ----------Equation 2}$$

where ε_t are the innovations and $\alpha_s, \psi_j, \beta_{r,j}$ are the coefficients associated with the exogenous variables, p lags of y_t and p_r lags of the k distributed lag regressors x_r, respectively.

If co-integration is identified by the rejection of H_0, the long-run and short-run coefficients of the FX swap transactions are estimated in equation 3, 5, and 4, 6 respectively (Pesaran *et al., 2001).*

Domestic Market:

$$M1_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} M1_{t-i} + \sum_{i=m}^{p} \gamma_{1i} M3_{t-i} + \sum_{i=m}^{P} \delta_{1i} M6_{t-i} + \sum_{i=m}^{p} \varphi_{1i} M9_{t-i} + \sum_{i=m}^{p} \pi_{1i} M12_{t-i} + \varepsilon_{1t} \quad \text{----------Equation 3}$$

$$\Delta M1_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} \Delta M1_{t-i} + \sum_{i=m}^{p} \gamma_{2i} \Delta M3_{t-i} + \sum_{i=m}^{P} \delta_{2i} \Delta M6_{t-i} + \sum_{i=m}^{p} \varphi_{2i} \Delta M9_{t-i} + \sum_{i=m}^{p} \pi_{2i} \Delta M12_{t-i} + \varphi ECM_{t-1} + \varepsilon_{2t} \quad \text{---------- Equation 4}$$

International Market:

$$India_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} India_{t-i} + \sum_{i=m}^{p} \gamma_{1i} Japan_{t-i} + \sum_{i=m}^{P} \delta_{1i} Singapore_{t-i} + \sum_{i=m}^{p} \varphi_{1i} USA_{t-i} + \varepsilon_{1t} \quad \text{----------Equation 5}$$

$$\Delta India_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} \Delta India_{t-i} + \sum_{i=m}^{p} \gamma_{2i} \Delta Japan_{t-i} + \sum_{i=m}^{P} \delta_{2i} \Delta Singapore_{t-i} + \sum_{i=m}^{p} \varphi_{2i} \Delta USA_{t-i} + \varphi ECM_{t-1} + \varepsilon_{2t} \quad \text{----------Equation 6}$$

The coefficients of the level variables in the long run at optimal lag are represented by equation 3 and 5. Equation 4 and 6 are the ARDL short-run specification or the speed of adjustment; it is derived through the construction of an error correction model (ECM). ECM, represents the speed of adjustment that brings back equilibrium if there is any deviation as a result of shocks, thus it must be negative and significant. The ECM is therefore the error correction term and is lagged by one period to show the percentage of its speed of adjustment from a shock in the previous period to equilibrium in the current period.

6. Empirical Analysis

This section summarizes all the econometric analysis in understanding if the Indian economy is decoupled in Forex market transactions. We begin by estimating the ADF test for the overall liquidity in Forex swap for domestic and international segments of the market. For domestic segment we report the unit test results for FX Swap tenure of 1-month (M1), tenure 3-month (M3), tenure 6-month (M6), tenure 9-month (M9), tenure 12-month (M12) in the domestic segment and the US, Japan, Singapore, and India in the international segment. Table 8a shows that, in the domestic segment of the market M1 and M3 are non-stationary at level and stationary at the first difference. However, all other segment of domestic FX Swap market we find they are stationary at level. Our conclusions are restricted to the 1% level of significance. Also, for each of the tenure of FX Swap Market in the domestic segment, we allow intercept at level and no trend, no intercept at the 1st difference (Table 8a). Table 8b shows that India, Singapore, and the USA are non-stationary at the level and stationary at first difference. However, Japan was found stationary at the level at the 5 % level of significance. So, we conclude that Forex swap markets for all the countries; the US, Singapore, and India are integrated at order 1, or they are I(1), however, the Forex swap market in Japan follows a stational time path or it is I(0). Also, we have allowed trend and intercept in the level equation of the ADF test and intercept in the first difference equation.

Table 8a: Stationarity Test- Domestic FX Swap Market				
M1	Level – Intercept 1st Difference – None	Level 1st Difference	[pr=0.0289] [pr=0.0000]	Non-stationary Stationary***
M3	Level – Intercept 1st Difference – None	Level 1st Difference	[pr=0.0460] [pr=0.0000]	Non-stationary Stationary***
M6	Level – Intercept	Level	[pr=0.0004]	Stationary***
M9	Level – Intercept	Level	[pr=0.0000]	Stationary***
M12	Level – Intercept	Level	[pr=0.0004]	Stationary***
Table 8b: Stationarity Test- International FX Swap Market				
India	Level -Trend and Intercept	Level	[pr=0.2788]	Non-Stationarity
	1st Difference-Intercept	1st Difference	[pr=0.0000]	Stationary***
Japan	Level – Trend and Intercept	Level	[pr=0.01]	Stationary***
Singapore	Level – Trend and Intercept	Level	[pr=0.3625]	Non-Stationary
	1st Difference – Intercept	1st Difference	[pr=0.0000]	Stationary***
USA	Level – Trend and Intercept	Level	[pr=0.1090]	Non-Stationary
	1st Difference – Intercept	1st Difference	[pr=0.0000]	Stationary***
Note: *** indicates statistical significance at 1% level. The decision of stationary conditions have been restricted to 1% significance level Source: Author's Estimation.				

For the ARDL model, as our equations 3, 4 we have considered M1 as the dependent variable and M3, M6, M9 and M12 are regressors in the domestic segments. Similarly, in the international segment, India is considered as the dependent variable while Japan, Singapore, and the USA are considered as the regressors. We have allowed a maximum of 4 lags for the dependent and regressor variables. However, using AIC we have found the optimal model of ARDL with 1 lag in M1 and zero lags for all M3, M6, M9 (1,0,0,0,0) (Table 9a). In the international front optimum lags reported as 2, 1, 0, and 4 for India, Japan, Singapore, and the USA respectively (Table 9b).

Table 9a: ARDL Test Result With ECM for Domestic Front	
M1(-1)	-0.419331***
M3	0.478521***
M6	-0.421601*
M9	-0.409193
M12	0.414102***
C	351.5463
CointegEqn	-0.419331***
Table 9b: ARDL Test Result With ECM for International Front	
INDIA(-1)	-0.74***
JAPAN(-1)	0.35
USA(-1)	-0.02
SINGAPORE**	0.046***
C	203403.1

D(INDIA(-1))	0.22
D(JAPAN)	-3.23
D(USA)	0.007
D(USA(-1))	0.009
D(USA(-2))	0.028**
D(USA(-3))	0.027**
CointegEqn	-0.74***

Notes:
1) *, **, *** indicate statistical significance at 10%, 5%, and 1% level, respectively.
2) Deterministic: Restricted constant and no trend.
3) For the Domestic front other than M1 no other lag were reported under ECM Bound test

Source: Author's Estimation.

Table 9a shows that there exists long run equilibrium among M1, M3, M6 and M12. This was expected because these key tenor points play an important role in shaping market expectations and in the pricing currency risk. The 1-month tenor is particularly active, as FX swaps are frequently used by banks to hedge client positions, with contracts rolled over monthly. This high level of liquidity in M1 and M3 segments reflects the market's focus on short-term trading positions to get the benefit of exchange premium fluctuations, especially as a market taker who takes proprietary trading positions with a short-term view on currency movements. The 6-month tenor also plays a key role, as it is involved in the fixing of reference rates for derivative contracts, such as Modified MIFOR swaps, linking it directly to pricing mechanisms of such instruments. The 12-month tenor, with the highest liquidity among all the tenors, serves as a market benchmark and is heavily influenced by the interest rate differential between India and the US Treasury rates. Its liquidity and role as a market indicator make it a critical input for longer-term market expectations.

According to the findings in Table 9b, there is a strong connection between the liquidity of the forex swap market in India and the liquidity of the forex swap of Singapore markets. The result is more interesting as the Singapore market exchange rate is pegged. So it necessarily concludes that managed or pegged foreign exchange rates may not be sufficient to control the liquidity crisis triggered by the interbank forex swap market. The study reveals that the short-run adjustment factors for 2nd and 3rd lags in the US market establish long-run equilibrium. though lagged, has a greater influence on India's forex swap liquidity. On the other hand, the impact of the Singapore market liquidity is more instantaneous. The results suggest that the Forex swap liquidity in India is highly dependent on the liquidity conditions in the Japanese and Singapore Forex swap markets. However, India's Forex swap liquidity reacts to the US market with a lag impact.

Table 10a: ARDL-ECM Model: Bound Test for USD/INR FX-Swap Market across Different Liquidity Tenor						
F-Statistics	*11.5089*					
	10%		*5%*		*1%*	
Sample Size 104	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Asymptotic	2.2	3.09	2.56	3.49	3.29	4.37
Table 10b: ARDL-ECM Model: Bound Test for FX Swap Market in International Front						
F-statistic	*6.736978*					
	10%		*5%*		1%	
Sample Size	*I(0)*	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*
30	2.676	3.586	3.272	4.306	4.614	5.966
35	2.618	3.532	3.164	4.194	4.428	5.816
Asymptotic	2.37	3.2	2.79	3.67	3.65	4.66
Source: Author's Estimation						

Tables 10a and 10b describe that at all levels of significance, that is 10%, 5% and 1% we reject the null hypothesis of 'no long-run equilibrium' or 'no cointegration'. This is because the estimated F statistics is larger than the upper bound of critical values for all the levels of significance, both for domestic and international fronts. Therefore, we conclude that long-run equilibrium exists across the FX swap segments in the domestic front and among countries like India, Japan, Singapore, and the USA. So, any liquidity crunch in one segment of the market may be rolled over to the other segments of the market. Also, ECM shows that the short-run adjustment factor is negative and significant both on the domestic front and on the international front (Table 9a and 9b).

7. Conclusion

In this paper, we examine if the Indian Forex market is integrated in the domestic and international front through its liquidity channel. We argue the liquidity risk may be spilled from one country to another and then international to domestic front through the FX Swap segment despite following a managed float in determining its exchange rate. This study argues that irrespective of the central bank's role in the exchange rate stability, the real sector economy may still be exposed to potentially far-reaching systemic risk through the liquidity exposure of the forex interbank segment to the global segment. During the US financial crisis, it became evident that banks play a crucial role as key dealers and users of Forex instruments, serving as anchors for financial stability and economic activity. Since banks are the sole participants in the Forex swap market segment, a liquidity crunch in the banking system—resulting from a one-sided dollar market (with only buyers and no sellers)—is likely to affect the real economy. The funding needs of banks can impact the supply of credit to the local economy and influence the financing of the balance of payments.

Against this backdrop, our empirical analysis finds that the domestic segment of the FX Swap market is integrated. The 1-month tenor is particularly active, as banks often utilize FX swaps to hedge client positions, rolling over contracts every month. This heightened level of liquidity in both the M1 and M3 segments highlights the market's emphasis on short-term trading strategies aimed at capitalizing on fluctuations in exchange premiums. Market participants

typically adopt a short-term perspective on currency movements when taking proprietary positions. The 6-month tenor is also significant, as it plays a crucial role in establishing reference rates for derivative contracts, including Modified MIFOR swaps, which are directly linked to the pricing mechanisms of these instruments. Among all the tenors, the 12-month tenor boasts the highest liquidity, serving as a vital market benchmark. Its liquidity is heavily swayed by the interest rate differentials between India and the US Treasury rates, influencing trading dynamics in a major way.

Also, our study confirms the integration of the forex swap market, with a few Asian economies and the US market. Most importantly, Singapore follows a pegged exchange rate and India, a managed float, the integration between these two markets persists through the liquidity channel of the interbank forex market. We argue that the forex swap market plays a vital role in promoting financial stability through cross-border investments and trade.

In conclusion, the increasing liquidity in the forex swap markets has the potential to further connect global forex markets, regardless of whether they operate under managed, pegged, or free exchange rate systems. As a result, banks are highly likely to acquire significant exposure to the global forex market through the forex swap segment. Although the Basel Committee on Banking Supervision (BCBS) has emphasized the importance of supervisory vigilance to ensure that the risks associated with banks' forex operations do not grow to the point where they threaten their solvency and liquidity, a major challenge for supervisors is that the forex swap interbank market operates as a globally self-regulated segment. Consequently, it is the individual bank's risk appetite that ultimately determines the total exposure in the market.

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Annexure 1

Box 1A: Interbank Market Parlance

Base currency – The currency which is priced. In USD/INR, USD is the base currency. In GBP/USD the base currency is GBP.

Quoting Currency or Price Currency – The currency which is used in pricing the base currency. In USD/INR quoting currency is INR and in GBP/USD the quoting currency is USD.

Bid rate – The rate at which market maker buys the base currency. If USD/INR is quoted as 66.70/72 then bid rate is 66.70. It means market maker is willing to buy USD at the rate of 66.70 INR.

Offer Rate – The rate at which market maker sells the base currency. If USD/INR is quoted as 66.70/72 then offer rate is 66.72. It means market maker is willing to sell USD at the rate of 66.72 INR.

Market Maker – The bank which quotes the rate to the taker. Some of the major market makers presently are Deutsche bank, J P Morgan, Citi bank, Barclays, and UBS etc

Marker Taker. The bank which asks for the quote and approaches interbank market for the quote.

NOSTRO Account --An account maintained in a foreign currency with a bank usually located in that country. Example – an Indian bank maintains a USD account with Citi bank, New York and maintains a euro account with Deutsche bank, Frankfurt. These accounts would be referred to as the Indian bank's USD NOSTRO account and GBP NOSTRO account respectively.

VOSTRO Account - An INR account maintained with a bank in India by a bank located abroad is referred to as a Vostro Account. Eg: Citi bank, New York maintains a rupee account with Bank of Maharashtra, Mumbai. This account will be referred to as Citi bank's VOSTRO account.

Cash value date – Settlement is at T = 0. The deal date and settlement date both are same.

Tom value date – Settlement is at T+ 1. It means the date of settlement falls due on the next working day for the non-USD centre (between USD/INR non-USD centre is INR centre). On the settlement date both the USD and Non-USD center should remain open.

Spot Date – Settlement is at T+2. 'Value spot' means the date of settlement falls due on the second working day for the non-USD centre after the date of deal. On the settlement date both the USD and Non-USD center should remain open.

Forward Value Date – Any settlement date beyond spot would be categorized as 'forward'. The rate of forward cover is arrived at after taking into consideration the current spot rate and the current forward points for the date of delivery.