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ABSTRACT

Foreign exchange (FX) trading volume is a key factor in exchange rate volatility. Given the important role of volatility in economic growth and stability, this paper investigates the dynamic nature of exchange trading volume on exchange rate volatility using hourly high-frequency data. The estimation results from ordinary least squares, fixed effects and the general autoregressive conditional heteroskedasticity model point to a significant impact of third-party foreign exchange trade volumes on the FX volatilities of original currency pairs. The United States dollar (USD), as the dominant currency, exerts sizeable effect through this third-party channel and the magnitude of the foreign exchange trading volume turns out to be a crucial factor to this effect. However, third-party currency pairs without USD linkages also exert non-negligible impact, calling for renewed attention to the effectiveness of regional financial cooperation in mitigating exchange rate volatility as compared with major foreign exchange trading partners, not only through direct transaction mechanisms but through third party currency channels.

Keywords: FX volatility, third party channel, GARCH model

JEL codes: F31, G15, G18

I. Introduction

The impact of exchange rate movement on economic growth, development, and stability is well-documented. Much of the literature posits that exchange rates affect international trade performance, including through export/import competitiveness, volumes, and prices, as well as businesses' external financing costs. Consequently, changes in exchange rates affect foreign and domestic consumption, productivity, and investment. Given these significant impacts, private and public entities alike must carefully monitor and prepare for exchange rate movements.

The literature has shown the impact of exchange rates on multiple development and macroeconomic indicators. Eichengreen (2007) frames foreign exchange rates as a vital facilitating condition for economic growth. Development experiences in high-growth economies, such as in East Asia, and developing economies demonstrate that competitive exchange rates are critical in jumpstarting growth. An efficient exchange rate mechanism encourages efficient redeployment of resources to productive sectors, thus unlocking gains in productivity. Studies covering multiple economies across the globe affirm this, particularly that undervaluation of a currency against foreign counterparts is often accompanied by gross domestic product (GDP) growth (Rodrik 2008, Seraj and Coskuner 2021). In a study focusing on India, Shaik and Rao (2020) state that the depreciation of the Indian rupee is associated with an increase in the country's foreign exchange reserves and in real GDP. Zhao (2020) shows that exchange rates have a direct effect on the prices and costs of commodities, also impacting exports to foreign markets. Further research shows that exchange rates impact productivity and foreign tourism. Fluctuations in the exchange rate may influence economic policy, particularly in economies adopting inflation-targeting regimes, while harming economic growth.

Exchange rates have significant impact on international trade, as noted. Exchange rates have a sizable effect on the import and export costs of products. When an economy's currency is valued higher, products from foreign markets become cheaper, thus encouraging greater importation. Conversely, undervalued currencies facilitate lower prices for an economy's commodities and lead to greater product exportation. Thus, movements in the exchange rate also affect an economy's trade balance; a higher exchange rate moves towards a negative trade account balance, while a lower exchange rate leads to a positive balance, although the growing complexities associated with deepening global value chains tend to compound this linear relationship. The strength of this relationship has been widely studied in the literature, with varying results. Research on developed and developing countries (Kang 2016) after the global financial crisis show that the effect of currency devaluation on export growth post- crisis has not been as strong as before the crisis. Further research posits that an increase in the number of economies that engage in deeper currency devaluation may lead to sluggish growth in international trade.

Thus, great importance has been placed in understanding exchange rate movements, particularly through the concept of exchange rate volatility. Exchange rate volatility is defined as the risk associated with unexpected movements in exchange rates (Ozturk 2006). The representative indicator of exchange rate volatility is the degree of variance in an exchange rate over a certain period. Price movements originate from an events-based approach, such as political-economic news and announcements, that informs decisions of economic actors, both public and private. Other factors like comparative inflation and interest rate differentials between economies likewise lead to exchange rate volatility.

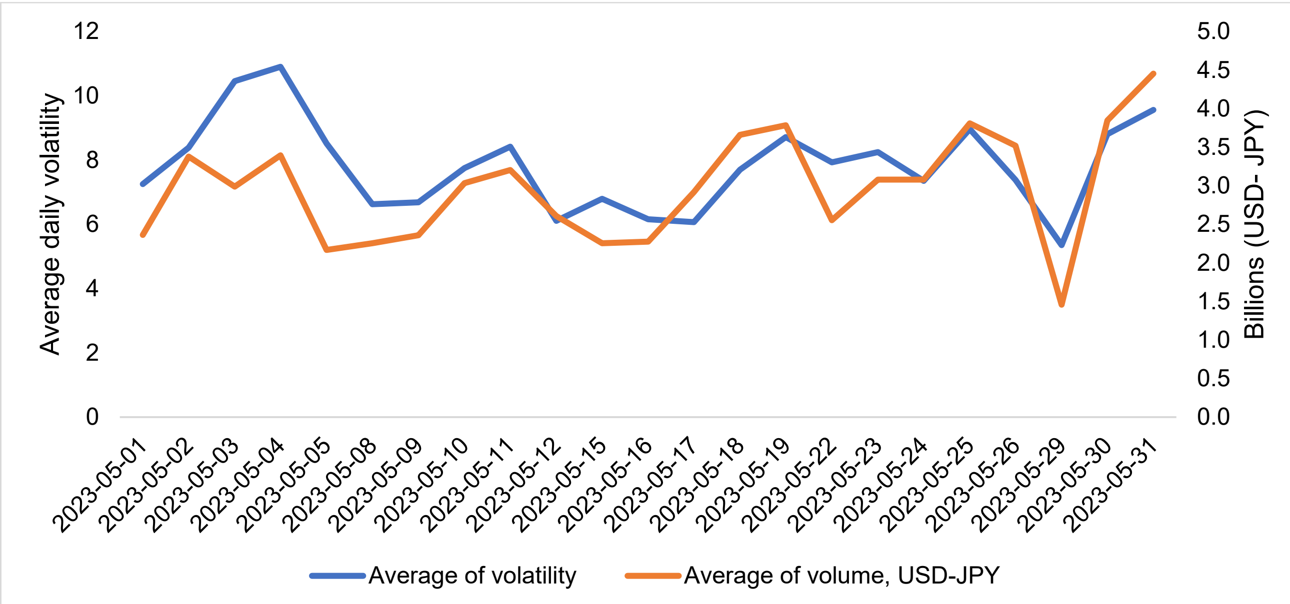
Aside from macroeconomics and international trade, exchange rate volatility is consequential for firms and traders, which could be exposed to sizeable exchange rate risks in their financing costs and financial management. Volatile foreign exchange markets lead to greater market uncertainty, which impacts costs and revenues for firms and in turn informs hedging and investment strategies. Furthermore, a volatile exchange rate increases uncertainty in the foreign exchange market and discourages risk-averse traders from engaging in investments, leading to changes in investor portfolio flows (Flores-Sosa, Aviles-Ochoa, and Merigo 2023).

Given the influence of exchange rates on economic growth and trade, maintaining a stable and predictable exchange rate has been a constant priority of sovereign financial authorities across the globe. Both the sources and implications of exchange rate volatility have been key areas of economic research. Findings generally show that higher exchange rate volatility leads to higher costs for risk-averse traders, as well as lower foreign trade. This is due to changes in the value of the exchange rate upon the agreement of a contract versus its actual payment and implementation. When exchange rates become volatile, uncertainty rises in predicting the costs and thereby the profits from transactions, which disincentivizes trade (Hooper and Kolhagen 1978). Despite this, other researchers have been less definite about the impact of exchange rate volatility on international trade. De Grauwe (1988), for example, posits that dominance of income effects over substitution effects may lead to a positive relationship between volatility and trade. In this theory, an increase in exchange rate volatility could raise the marginal utility of export revenue in the eyes of sufficiently risk-averse exporters and could induce increased exports. De Grauwe thus suggests that the effect of exchange rate volatility depends on the degree of risk aversion of market players.

Numerous efforts have been made to study exchange rate volatility. As it is not a directly observable phenomenon, extensive research has been carried out to predict movements in the exchange rates, as well as to identify causes, and possible indicators of exchange rate volatility. The literature identifies economic fundamentals, such as inflation, interest rates, and balance of payments as sources of exchange rate volatility, especially as these factors themselves have become more volatile since the 1980s. Furthermore, factors such as capital account liberalization, technological innovation, and currency speculation all contribute to increased cross-border flows and trade volumes, adding to exchange rate volatility (Hook and Boon 2000). One of the key factors affecting exchange rate volatility is foreign exchange trading volume, which is used as a measure of the state of the foreign exchange market. Foreign exchange trading is essential to engaging in international trade as it allows traders and firms alike to convert domestic currency into foreign currency and vice versa to be able to transact with external markets. Traders often study movement in the forex market and carry out trades based on their valuation of various currencies to make a profit. Thus, fluctuations in forex trading volume are also used to study and predicate the degree of foreign exchange volatility between currencies. This places a clear impetus in understanding the relationship between foreign exchange volatility and trading volumes. Foreign exchange trades can also be influenced by the firm's motives to minimize losses from exchange rate volatility in determining the timing of exchanges for foreign borrowing or repayment, and the incentives to hedge against exchange rate volatility risks.

The relationship between foreign exchange volatility and foreign exchange trading volumes has been explored in the literature. Foreign exchange trading volume is regarded as a proxy for unobservable market conditions, such as relative liquidity and privately informed trading (Gargano, Riddiough, and Sarno 2018). Volatility tends to move in conjunction with trading volumes, in that a steep increase in trading volumes often coincides with more volatile foreign exchange currencies (Figure on page 4). Various theoretical explanations aim to explain this. Copeland (1976, 1997) presented the model of "sequential information arrival," wherein trading participants react to information on the financial market individually. Their reaction to the arrival of the news thereby shifts their demand curve for a particular currency. These trades then act as a proxy for traders' changing demand for a particular currency, and thus coincide with increased volatility in the foreign exchange market. Another explanation for this phenomenon is the "mixture of distributions hypothesis" proposed by Clark (1973). Under this theory, volatility and volume are determined by a common, unobservable factor that reflects the arrival of new information in the foreign exchange trading market. How traders internalize this information changes the pricing of a particular currency, thus encouraging a higher number of trades. These trades therefore signify disagreements between traders on the pricing of a particular foreign exchange currency and more volatile price movement.

Figure: USD-JPY Volatility and Trading Volumes for May 2023



USD-JPY = US dollar-Japanese yen currency pair.
Notes: Values above are the daily average of the hourly volatility rates. The hourly volatility rates are calculated as the absolute sum of the 5-minute interval price change of a currency pair within an hour, reflected as a percentage of the exchange rate.
Sources: Asian Development Bank calculations using data from Bloomberg and the CLS FX databases.

Sensoy and Serdengecty (2019) explore the viability of the Mixed Distribution hypothesis by investigating the relationship between USD-TRY (Turkish lira) volatility and foreign exchange trade volumes by currency trade and counterpart. Their results used a generalized method of moments framework to establish a positive contemporaneous relationship between USD-TRY exchange volatility and trade volumes in the spot market. The research further showed that the dispersion of trader beliefs on the future USD-TRY exchange rate significantly increases the positive relationship between volatility and trading volume, strengthening the hypothesis that the joint movement of two variables are explained by trade uncertainty and disagreement in foreign exchange rate predictions. Galati (2000) likewise explores the effect of local currencies in developing economies using ordinary least squares (OLS) regression with a general autoregressive conditional heteroskedasticity (GARCH) component, distinguishing expected and unexpected changes in trade volume. The results showed a positive significant relationship between foreign exchange volatility and volumes for four out of the six currencies examined.

In Asia, monitoring and managing exchange rate volatility lies at the core of economic policy objectives of finance and central bank authorities, given its deep and broad economy-wide impacts. An important instrument that accompanies trade transactions is the currency used in invoicing international trade deals. Research has shown that in this regard, some currencies leverage a much stronger effect than others in affecting international trade and, consequently, exchange rate volatility. Mercado, Jacildo, and Basu Das (2022) explore this by assessing the covariation between global value chains and multinationals' activities based on the US dollar share in trade invoicing for economies in Asia and the Pacific. The paper emphasizes the presence of the US dollar as the dominant "vehicle currency" in international trade transactions, constituting about 40% of all international trade invoicing (and 80% in the Asian region). The presence of a US dollar-led dominant currency paradigm has several implications. First, a depreciation in a local economy's currency will have a more muted impact on lowering import prices and demand. This is attributed to the local currency prices of trading partners remaining unchanged because of a steady exchange rate with the US dollar. By the same logic, the depreciation of domestic currency under such a paradigm weakens trade effects such as lower imports and higher exports. Second, under a US dollar-led dominant currency paradigm, more exchange rate movement would be necessary to significantly affect near-term external adjustments in trade, particularly for importing economies. This would lead to higher inflation alongside the possible tightening of macroeconomic policies in the economy. These implications are particularly important in the Asian region, as the research shows that economies within the region that have higher global value chain participation also have a higher share of exports and imports invoiced in US dollars compared to nonregional economies. This finding highlights the need to strengthen regional trade and exposure and cooperation among economies in Asia and the Pacific. This brings home significant implications, as not only are Asian economies more susceptible to disruptions in the US financial system, they also have to endeavor more to influence trade to curb greater exchange rate volatility. A study by Park et al. (2022) that investigated the impact of US policy uncertainty using a news-based monetary policy uncertainty indicator supports the notion that higher US monetary policy uncertainty had a significant effect on the exchange rate volatility of various economies in Asia and the Pacific. Against this background, there is a need to strengthen regional cooperation in trade and financial policy to better mitigate exchange rate volatility.

While it is acknowledged that the US dollar, as the world's reserve currency, is the dominant currency in the foreign exchange market, Asian cross-currency trade volumes may also have a hand in affecting foreign exchange volatility within the region amid progress in deepening economic integration and interdependency across the region. This has vital implications in that if foreign exchange trading volumes between Asian economies correlate with a volatile foreign exchange market in the region, it gives a strong rationale for economic authorities in Asia to engage in greater cooperation to stabilize their foreign exchange volatilities.

However, it is worth noting that there are gaps in the literature exploring the relationship between foreign exchange volatility and trading volumes. One is the limited number of studies that use high-frequency data, as papers that cover the topic generally only had access to daily data for the prominently used currencies. Another key gap is the lack of studies that examine the effect of a third-party currency in a tripartite relationship of three economies. The latter gap is of interest as this is instrumental in determining whether the exchange rate volatility of a particular domestic economy can still be affected by a third-party currency, despite the impact of a dominant currency such as the US dollar.

This paper adds to the body of knowledge on foreign exchange volatility and trade volumes by investigating whether other third-party currency trades, through their respective trade volumes, can have a tangible effect on a domestic economy's exchange rate beyond what is exerted by the US dollar. The paper hypothesizes that third-party trade volumes also have a significant effect on foreign exchange volatility, if not stronger than the US dollar. Testing this hypothesis can provide useful information to underpin deeper and more meaningful exchanges of information and market interventions among the Asian economies.

This research fills the gap in existing discussions on foreign exchange volatility and trade volumes by investigating the effect of third-party currencies and by using high-frequency, hourly data on foreign exchange trading volumes. This enriches the discourse on the topic, which tends to cover the effect of trading volumes on each country's own foreign exchange currency pair. As an example, Khemiri (2012) employs a series of GARCH models and Markov switching GARCH models to estimate the relationship of volume and volatility in the USD-DEM (Deutsche mark) market using a limited dealer dataset. Mougoue and Aggarwal (2011) likewise explore the dynamics between volume and volatility using daily trading volume returns and FX prices from 1977–2009 for the USD-GBP (pound sterling), USD-JPY (yen), and USD-CAD (Canadian dollar) currency pairs using both linear and nonlinear Granger causality tests. To our knowledge, however, little has been done in investigating the impact of third-currency channels on exchange rate volatility using high frequency data.

Section II presents data and estimation methodology used for the analysis. Section III discusses the results of the analysis and section IV concludes by discussing the implications for policy makers.

II. Data and Empirical Methodology

2.1 Data

One of the difficulties of studying foreign exchange volume data is that the foreign exchange market is highly decentralized across several platforms and markets in the world. Furthermore, high-frequency foreign exchange data is often considered proprietary, emphasizing the need to find a database that can sufficiently proxy for global foreign exchange trading operations. This paper uses data on hourly foreign exchange trade volume from the CLS database. This database is the largest source of executed foreign exchange data available in the market and covers over 3 billion foreign exchange trades from 2011, which accounts for over 50% of total trades in the CLS settlement platform. Trade volume data is matched with the hourly foreign exchange volatility data collected from the Bloomberg database to explore the relationship between exchange rate volatility and trade volume under a high frequency framework.

The paper examines the dynamics between two tripartite relationships, the USD-JPY-AUD and the USD-JPY-NZD.[1] These were chosen as they are Asia and Pacific (Oceanic) economies that have complete documentation of foreign exchange trade volumes from the CLS database.

Table 1 summarizes the statistics of hourly foreign exchange volatilities, from 1 May to 31 May 2023. The hourly volatility rates are calculated as the absolute sum of the 5-minute interval price change of a currency pair within an hour, reflected as a percentage of the exchange rate. Thus, the foreign exchange rate volatility describes the percent change of the exchange rate around an hourly price average. The two currency pairs with the highest foreign exchange volatilities are NZD-JPY and JPY-AUD, respectively. These are followed by NZD-USD, AUD-USD, and USD-JPY respectively. It is of note that currency pairs that included the USD were relatively more stable than those that did not.

[1] AUD = Australian dollar and NZD = New Zealand dollar.

Table 1: Summary Statistics of Hourly Foreign Exchange Volatility from 1–31 May 2023
(% of exchange rate price)

Currency Pair	Observations	Mean (%)	Minimum (%)	Maximum (%)
AUD-USD	552	8.82	1.07	56.66
JPY-AUD	552	9.62	3.04	37.80
NZD-JPY	552	10.02	2.26	76.13
NZD-USD	552	9.32	1.33	76.82
USD-JPY	552	7.83	1.42	41.15

Source: Authors' calculations using the Bloomberg database.

Table 2 shows the data on hourly foreign exchange trade volume from the same date range as the previous figures. On average, the currency pairs with the largest hourly trade volume are USD-JPY, followed by AUD-USD, and NZD-USD. The data seems to follow a distinct pattern, in that currency pairs with a greater trade volume have relatively less volatile foreign exchange rates.

Table 2: Summary Statistics of Hourly Trade Volume from 1–31 May 2023

Currency Pair	Observations	Mean	Minimum	Maximum
AUDUSD	552	1.01e+09	2.44e+07	5.32e+09
JPYAUD	552	1.24e+08	221109.3	8.82e+08
NZDJPY	552	2.91e+07	0	2.47e+08
NZDUSD	552	4.52e+08	3003438	4.06e+09
USDJPY	552	2.98e+09	7907000	1.73e+10

Note: 0 minimum value in NZD-JPY is uniformly found on hour 1 of every Monday of the sample
Source: Authors' calculations using the CLS Database.

Tables 3 and 4 depict the correlation matrixes between the volatilities and trading volumes for each of the trilateral relationship. The case of the USD-AUD-JPY trilateral shows that all the currency volatilities move together with foreign exchange trading volumes. AUD-USD volatility has the highest correlation with AUD-USD trading volumes, followed by JPY-AUD and USD-JPY volumes. JPY-AUD volatility likewise corresponds the strongest with JPY-AUD trading volumes but is followed more closely by trading volumes of AUD-USD and USD-JPY. The foreign exchange volatility of USD-JPY, on the other hand, correlates strongly with USD-JPY trading volumes, which have a relatively stronger effect than trading volumes of AUD-USD and JPY-AUD.

The correlation matrix for the USD-NZD-JPY trilateral broadly follows the same trend, in that all currency volatilities also correlate positively with trading volumes. USD-JPY volatility exhibits the strongest positive correlation with USD-JPY trading volumes, trailed significantly by NZD-USD and NZD-JPY trading volumes. Likewise, NZD-USD volatility correlates strongly with NZD-USD trading volumes, though correlations with NZD-JPY and USD-JPY are not far behind. The only divergent case is NZD-JPY volatility, wherein the strongest correlation is with NZD-USD trading volumes, followed closely by that of NZD-JPY and USD-JPY.

Initial insights from these matrixes demonstrate a strong positive correlation between foreign exchange volatilities and trading volumes. For the most part, a currency pair's volatility correlates strongest with its own trading volumes. Initial evidence also suggests that the size of the currency pair's trading market determines the strength of correlation compared to trading volumes of other currency pairs. As an example, the correlation coefficients of NZD-JPY volatility are more closely clustered together compared to that of USD-JPY volatility. Appendix 1 depicts a visualization of these various correlations.

Table 3: Correlation Matrix for USD-AUD-JPY Volatility and Trading Volumes

	Volatility AUDUSD	Volatility JPYAUD	Volatility USDJPY	Volume AUDJPY	Volume AUDUSD	Volume USDJPY
Volatility AUDUSD	1					
Volatility JPYAUD	0.83	1				
Volatility USDJPY	0.65	0.74	1			
Volume AUDJPY	0.65	0.69	0.49	1		
Volume AUDUSD	0.73	0.67	0.57	0.64	1	
Volume USDJPY	0.64	0.67	0.78	0.58	0.76	1

Sources: Authors' calculations using the CLS Database and Bloomberg database.

Table 4: Correlation Matrix for USD-NZD-JPY Volatility and Trading Volumes

	Volatility NZDJPY	Volatility NZDUSD	Volatility USDJPY	Volume NZDJPY	Volume NZDUSD	Volume USDJPY
Volatility NZDJPY	1					
Volatility NZDUSD	0.85	1				
Volatility USDJPY	0.57	0.52	1			
Volume NZDJPY	0.56	0.52	0.35	1		
Volume NZDUSD	0.61	0.59	0.40	0.53	1	
Volume USDJPY	0.52	0.50	0.78	0.45	0.51	1

Sources: Authors' calculations using the CLS Database and Bloomberg database.

This research builds on previous research that investigated the relationship between foreign exchange volatility and trade volumes, mostly based on two currency cases, by adding a third currency case to the analysis. In this manner, the paper investigates whether a local currency's trade volume with the third currency also influences the former's foreign exchange volatility as compared with its direct exchange trading partner. Within each tripartite relationship, every possible foreign exchange volatility pairing is separately utilized as the dependent variable, wherein all trade volume pairs within the tripartite relationship are examined and considered as the factor to impact bilateral exchange rates. Specifically, our analysis uses a (i) simple OLS regression with lagged variables and weekday dummies, (ii) fixed effect OLS regression with lagged variables and weekday dummies, and (iii) a GARCH model analysis.

2.2 Methodology

Building upon the approach of Galati (2000), we use an OLS regression to initially investigate any relationship between foreign exchange volatility and trading volumes within tripartite relations. The analysis adds a third currency to the traditional bilateral two-currency analysis, by adding two new trading volume pairs to the estimation. Lagged values of the dependent variable are included to control for immediate autocorrelation, while dummies are made for each trading day in the week to control for the effect of a traditionally busy trading session.

$$\ln\_volatility_{i1} = \beta_o + \beta_1 \ln\_volume_{i1t} + \beta_2 \ln\_volume_{i2t} + \beta_3 \ln\_volume_{i3t} + \beta_4 lagged_{volatility}{}_{i1t-1} + \beta_5 lagged_{volatility}{}_{i1t-2} + \beta_6 tuesday + \beta_7 wednesday + \beta_8 thursday + \beta_9 friday + \varepsilon_{it}$$

where *i* and *t* correspond to the currency pair and hour, respectively.

We then use a fixed effects model, wherein the hour of each trading day has an unobserved effect on its respective foreign exchange volatility. This model is used to observe the relationship between volatility and trading volume considering any effects brought about by the hours within a trading day.

$$\ln\_volatility_{it} = \beta_o + \beta_1 \ln\_volume_{i1t} + \beta_2 \ln\_volume_{i2t} + \beta_3 \ln\_volume_{i3t} + \beta_4 lagged\_volatility_{i1t-1} + \beta_5 lagged\_volatility_{i1t-2} + \beta_6 tuesday + \beta_7 wednesday + \beta_8 thursday + \beta_9 friday + \beta_{10} hour_t + \varepsilon_t$$

where *i* and *t* correspond to the currency pair and hour, respectively.

We further adopt the model by Epaphra (2017), wherein the ARCH and GARCH models are used to identify volatility clustered in foreign exchange rates. It is well-established in the literature that foreign exchange rates tend to behave like financial data, and thus are also examinable by models that aim to account for time-related effects in volatility. For this analysis, the adopted GARCH model employs the following estimation procedure.

First, volatility and trade volumes are log-differenced to satisfy the condition of non-stationarity, as confirmed by the Augmented Dickey Fuller-Test. Second, the basic regression equation is fitted as follows for each currency pair:

$$dln\_volatility_{it} = \beta_o + \beta_2 \mathrm{dln\_tradevol}_{i1t} + \beta_3 \mathrm{dln\_tradevol}_{i2t} + \beta_4 \mathrm{dln\_tradevol}_{i3t} + \varepsilon_{it}$$

where *i* and *t* correspond to the currency pair and hour, respectively.

The model consists of the log-differenced trade volumes within each tripartite relationship as regressors. Following the Box-Jenkins method for specifying models, the correlogram, Autocorrelation (ACF) and Partial Autocorrelation (PACF) of the basic regressions are tested to identify the appropriate amount of Autoregressive (AR) and Moving Average (MA) components to add to the equation. The following tests are vital to ensure that there is no serial autocorrelation in the time series data, that is, that there are no correlations between the error terms of different periods within the time series. Autoregressive Moving Average (ARMA) components are added and removed based on repeated testing of the ACF and PACF of the model. When the ARMA model is satisfied, the Autoregressive Conditional Heteroskedasticity (ARCH) test is applied on the squared residuals of the model to see if there are ARCH effects in the data. The presence of an ARCH effect in the ARMA model would show that there is a tendency for the data to exhibit periods of high volatility, then followed by even higher levels of volatility, and vice-versa. This means that the model also needs to be controlled for its conditional variance. For this analysis, the GARCH (general ARCH) model is utilized to capture this conditional variance. The GARCH model is an extension of the ARCH model, which models the conditional variance of time series data as a linear function of past squared observations. GARCH builds upon this by allowing more flexibility by modelling the conditional variance as a linear function of past squared observations, as well as past conditional variances. Thus, the GARCH model adds in both short-term and long-term memory in the volatility analysis.

The standard GARCH (1,1) model is then fitted to the equation, and the ARMA components are modified until the residuals are not autocorrelated through the ACF and PACF test. The final equation for the model is as follows:

(1) $dln_{volatility_{it}} = \beta_o + \beta_2 \mathrm{dln}_{\mathbf{tradevol}_{i1t}} + \beta_3 \mathrm{dln}_{\mathbf{tradevol}_{i2t}} + \beta_4 \mathrm{dln}_{\mathbf{tradevol}_{i3t}} + ARdln_{volatility_{it-x}} + MA\varepsilon_{it-x} + \varepsilon_{it}$

(2) $\epsilon_{it} = \sigma_{it} z_{it}$

(3) $\sigma_{it}^2 = \alpha_0 + ARCH\epsilon_{it-1}^2 + \mathrm{GARCH}\sigma_{it-1}^2$

where *i* and *t* respectively correspond to the currency pair and hour, *x* refers to the number of lags, *z* refers to a white noise process with mean zero and variance 1, and α_0 refers to the constant in the variance.

III. Estimation Results

3.1. OLS estimation

The OLS estimation firmly establishes the significant positive impact of a currency pair's trade volumes on the currency pair's foreign exchange volatility. The model also demonstrates the potency of USD-related trade volume as a determinant of volatility across multiple currency pairs.

Table 5 models foreign exchange volatility in the USD-JPY-AUD trilateral, which shows that bilateral exchange rate volatility is significantly affected by the trading volume of corresponding currency pairs. A 1% increase in AUD-USD trading volume leads to a 0.3% increase in AUD-USD exchange rate volatility, the same in AUD-JPY trading volumes leads to a 0.09% increase in the volatility of corresponding currency exchange rate, and the same in USD-JPY leads to a 0.33% increase in USD-JPY exchange rate volatility. AUD-JPY volatility, however, is also affected by trades of non-corresponding currencies, i.e., the trading volumes of AUD-USD and USD-JPY. Interestingly, AUD-JPY volatility is more strongly influenced by AUD-USD trading volume. These phenomena attest to the crucial role of USD in affecting the exchange volatility of non-USD related currency pairs. While the 1 hour lagged dependent variable shows significant, positive impact on exchange rate volatility, the 2-hour lagged dependent variable has negative impact, indicating short-lived persistency in exchange rate volatility.

Table 6 likewise models the volatility in the USD-JPY-NZD trilateral. This model also presents significant and positive impacts of corresponding trading volumes on the exchange rate volatility of currency pairs similar to the results for USD-JPY-AUD trilateral. In this case, the impact of trades of non-corresponding currency pairs turns out to be even stronger, through USD linked trade channels. For example, NZD-JPY volatility is more strongly affected by USD-JPY trading volume than the trading volume of its own corresponding currency pair (0.14% vs. 0.09%). In both trilaterals, non-USD-related currency pair volatilities are more affected by the trades of third currency pairs, in particular USD-related ones.

Table 5: Regressions Results for Volatility, Trilateral Relationship (USD-JPY-AUD)

Regressors	**Volatility**					
	AUDUSD		AUDJPY		USDJPY	
Constant	-5.60	***	-3.22	***	-5.42	***
Volume (AUDUSD)	0.30	***	0.10	**	-0.02	
Volume (AUDJPY)	0.06		0.09	**	0.03	
Volume (USDJPY)	0.01		0.07	**	0.33	***
Tuesday	0.01		0.04		-0.01	
Wednesday	0.04		0.05		-0.01	
Thursday	0.07	*	0.16	***	0.04	
Friday	0.01		0.03		-0.02	
Lagged Dependent Variable (1 hour)	0.20	***	0.21	***	0.29	***
Lagged Dependent Variable (2 hours)	-0.09	***	-0.11	***	-0.11	***
R-squared	0.60		0.51		0.58	

Notes: * for significance below 10%; ** for significance below 5%; *** for significance below 1%.

Sources: Authors' calculations using data from the Bloomberg and CLS FX Database

Table 6: Regressions for Volatility, by Trilateral Relationship (USD-JPY-NZD)

Regressors	Volatility					
	NZDJPY		NZDUSD		USDJPY	
Constant	-4.36	***	-6.58	***	-6.86	***
Volume (NZDJPY)	0.09	***	0.12	***	0.10	
Volume (NZDUSD)	0.09	***	0.15	***	0.03	
Volume (USDJPY)	0.14	***	0.14	***	0.37	***
Tuesday	0.04		0.02		0.01	
Wednesday	0.1	**	0.11		-0.00	
Thursday	0.15	***	0.88	**	0.05	
Friday	0.04		0.05		-0.22	
Lagged Dependent Variable (1 hour)	0.15	***	0.10	**	0.20	***
Lagged Dependent Variable (2 hours)	-0.11	***	-0.08	***	-0.12	***
R-squared	0.58		0.58		0.61	

Notes: * for significance below 10%; ** for significance below 5%; *** for significance below 1%
Sources: Authors' calculations using data from Bloomberg and CLS FX Database.

The OLS models from the two trilateral relationships affirm the strength of the USD-related trade flows in influencing foreign exchange volatilities, and show the possibility of a third regional currency impacting exchange rate volatility. Another point worth noting is that the size of the foreign exchange trading market, especially in comparison to other currency pairs within each trilateral relationship, could drive the strength of the effect of a particular currency trading volume. As an example, the USD-JPY trading market is significantly larger than NZD-JPY and NZD-USD markets, which leads to the USD-JPY trading volume having the strongest effect on currency pair volatilities among the three bilateral pairs. The fact that non-USD currency pairs AUD-JPY and NZD-JPY show different dynamics, in that the former is affected strongest by USD-AUD trades while the latter is affected strongest by USD-JPY trades, also partly reflects the relatively bigger size of the USD-AUD exchange market than the USD-NZD.

3.2. Fixed effect estimation

The above findings are further supported by the time-fixed effect model estimations for both trilateral relationships. Table 7 summarizes the impact of trading volumes on the USD-JPY-AUD trilateral (see Appendix 2 for the full model). The results show that the volatility of each currency pair is affected significantly by the trading volume of corresponding currency pairs. The increase in USD-JPY trading volume accounts for a 0.29% increase in USD-JPY exchange rate volatility. At the same time, however, the volatility of country pair exchange rates is also significantly affected by the trade of non-corresponding country pairs. This third currency trading channel works strongly for the AUD-JPY volatility, which is more strongly affected by USD-AUD trading volume than by its own corresponding trading volume. This result is consistent with OLS estimation results. Moreover, the inclusion of the time-fixed effect variable broadly establishes a significant relationship between volatility and specific hours within the trading day, although this is not as prevalent in the case of USD-JPY volatility. Furthermore, the 2-hour lagged volatility turns out to be no longer significant while the positive impact of 1-hour lagged volatility is largely maintained, and the impact of trading in the middle of the week is only significant in one of the three currency pairs.

Table 7: Fixed-Effect Regressions on USD-JPY-AUD Trilateral

Currency	**Trading Volumes**		
	USDJPY (Major Pair)	USDAUD (Major Pair)	AUDJPY (Minor Pair)
USDJPY	0.29%***	0.08%**	0.01%
USDAUD	0.06%***	0.33%***	0.03%
AUDJPY	0.11%***	0.17%***	0.09%***

Notes: * for significance below 10%; ** for significance below 5%; *** for significance below 1%.
Major pair refers to currency pairs involving widely used currencies paired with the USD. Minor pairs refer to widely used currencies, excluding USD.
Sources: Authors' calculations using data from Bloomberg and CLS FX Database.

Somewhat different results are estimated for the case of USD-JPY-NZD, as illustrated by Table 8 (see Appendix 3 for the full model). Exchange rate volatility is affected by the corresponding currency pairs significantly. However, the magnitude of impact turns out to be strongest from the non-corresponding currency pairs except for USD-JPY volatility. Consistent with OLS estimation results, NZD-JPY volatility seems to be more strongly affected through the USD-linked third currency trading channel, i.e., USD-JPY in our model. Different from OLS estimation results, USD-NZD volatility is also more strongly affected by the USD-linked third currency trading channel, i.e., USD-JPY instead of its own corresponding pair. USD-JPY exchange rate volatility is still affected by USD-JPY trading volume the most, with 1% increase in USD-JPY trading volumes leading to 0.43% increase in USD-JPY exchange rate volatility. In the case of USD-JPY volatility, this direct effect is dominant, and the indirect impact of other currency pairs turn out to be insignificant. The time-fixed effect variable in the USD-JPY-NZD trilateral are mostly significantly correlated with volatility, although it is worth noting that not all hours have a significant effect on USD-JPY volatility. The inclusion of the time-fixed effect also renders the 2-hour lagged volatility as insignificant, while in trading day variables, Wednesdays and Thursdays are significant for NZD-JPY volatility, and Wednesdays for NZD-USD volatility.

Table 8: Fixed-Effect Regression on USD-JPY-NZD Trilateral

Currency	Trading Volumes		
	USDJPY (Major Pair)	USDNZD (Major Pair)	NZDJPY (Minor Pair)
USDJPY	0.43%***	0.01%	0.002%
USDNZD	0.17%***	0.13***	0.10***
NZDJPY	0.22%***	0.09***	0.08%***

Notes: * for significance below 10%; ** for significance below 5%; *** for significance below 1%
Sources: Authors' calculations using data from Bloomberg and CLS FX Database.

Overall, the weaker influence of NZD-related trades on the volatility of their own corresponding currency pair may be attributed to the AUD-USD and AUD-JPY trading markets being larger than the NZD-JPY and NZD-USD markets. AUD-USD volume, for example, is second only to USD-JPY trading volumes in terms of size. Regardless, the fixed effect models show that third currency pair trading volumes can have an impact on exchange rate volatility. While this third-party currency pair channel is stronger through USD related trades, non-USD related third party currency trade can also exert significant impact on the exchange volatility, as the estimation results indicate.

3.3. GARCH estimation

GARCH analysis is used to further explore the effects of trading volumes on foreign exchange volatility, controlling for time-specific components.

The differenced time series are then converted into log variables and fitted with their respective log-differenced trading volumes for each tripartite relationship, as well as an ARMA component to control for time-specific properties. An ARCH test is then performed to investigate possible heteroskedasticity within each time series. Table 9 summarizes the results of the ARCH test on each currency volatility. The test shows that foreign exchange volatilities for the AUD-USD, AUD-JPY and NZD-JPY ARMA models show heteroskedasticity, and thus necessitate the addition of an ARCH component to capture further time effects. In contrast, NZD-USD and USD-JPY for both AUS and NZD tripartite ARMA models are already sufficiently explained by the ARMA model, and do not necessarily need an additional ARCH component. Nevertheless, to analyze the models on a uniform ground, the GARCH (1,1) component is adopted all models.

Table 9: ARCH Test on Currency Volatilities (24 lags)

Volatility	F statistic	Obs R^2	Prob F(24,478)	Prob Chi^2 (24)
AUDUSD	3.56	76.21	0	0
AUDJPY	2.71	60.35	0	0
NZDUSD	0.56	13.78	0.96	0.95
NZDJPY	1.65	38.32	0.03	0.03
USDJPY (AUD)	0.69	17	0.86	0.85
USDJPY (NZD)	0.68	16.6	0.87	0.86

Sources: Authors' calculations using data from Bloomberg and CLS FX Database.

The individual GARCH (1,1) models for each currency pair all show that most currency trade volumes exert a positive significant effect on the respective currency volatilities. The time-specific effects vary per model.

Results from the USD-JPY-AUD tripartite analysis (see Table 10) show that USD-AUD and AUD-JPY volatilities all have positive correlations with the various currency pair trading volumes. In the case of AUD-USD, the trading volume with the strongest effect is its own pair (0.33), followed by USD-JPY (0.10) and AUD-JPY (0.05). Likewise, AUD-JPY volatility is most influenced by USD-JPY (0.19), followed by AUD-JPY (0.11) and USD-AUD (0.08). In contrast with these currency pairs, USD-JPY volatility is only influenced by the USD-JPY trading volume (0.38). It is noteworthy that these relationships hold even with the inclusion of time series variables in the model. All three of the volatility pairs are positively correlated with the 24-hour AR component at similar levels, which suggest that volatility values tend to be above the mean volatility if its 24-hour lagged value was also above the mean. Since the coefficients register at around 0.33–0.34, the past value's influence on present values, though significant, are not very strong. The 1-hour MA component for all three volatilities are significant, large and negatively correlated with present volatility values. The MA (1) coefficients for AUD-USD and AUD-JPY are both higher in magnitude than in the USD-JPY; this means that the error terms of 1-hour lagged values tend to exert a stronger influence on the preceding two currency pairs. A negative correlation suggests that a higher error term or shock from the previous hour tends to pull current volatility value lower (and vice versa). The MA (2) components are also negatively correlated with current volatility values, though the magnitude of their coefficients is much lower. This implies that the shocks or error terms from 1-hour lagged values have a stronger influence over current volatility than 2-hour lagged values. The MA (2) coefficient magnitude of USD-JPY volatility is also marginally higher than the other pairs, suggesting that the USD-JPY currency is more influenced by its past 2-hour error terms. The ARCH and GARCH components of the model offer an idea of whether volatility values are more influenced by short-term or long-term shocks. The ARCH (1) coefficients of USD-JPY and AUD-USD are both insignificant, while the magnitude of AUD-JPY's, though significant, is very small. This suggests that that short-term shocks do not have a persistent effect on current volatility values for all currency pairs. Meanwhile, GARCH (1) components are all significant and large in magnitude across all currency pairs, which implies that older volatility values have a more long-term and persistent effect on current volatility.

Table 10: GARCH Model Estimations for USD-JPY-AUD

Regressors	Volatility					
	AUDUSD		AUDJPY		USDJPY	
Constant	-0.00	***	-0.00	***	-0.00	**
Volume (AUDUSD)	0.33	***	0.08	***	0.02	
Volume (AUDJPY)	0.05	***	0.11	***	0.03	
Volume (USDJPY)	0.10	***	0.19	***	0.38	***
AR (24)	0.35	***	0.34	***	0.34	***
MA (1)	-0.75	***	-0.76	***	-0.68	***
MA (2)	-0.19	***	-0.14	***	-0.29	***
ARCH (1)	-0.02		-0.01	*	0.00	
GARCH (1)	0.85	***	0.87	***	0.92	***
R-squared	0.53		0.47		0.56	
Aike info criterion	-0.03		-0.19		0.13	

Notes: 24-hour lagged volatility values are in logarithmic form, while all trade volume variables are in logarithmic form, differenced by 1 hour. The ARMA model of ARMA-GARCH model of AR (24) MA (1) MA (2) ARCH (1) GARCH (1) are used for all models.
Sources: Authors' calculations using data from Bloomberg and CLS FX Database.

Results from the USD-JPY-NZD triparty (see Table 11) reflect varied patterns from the previous tripartite analysis. NZD-USD volatility is affected by all trading volumes. The magnitude of the values is more even than the currencies in the previous analysis, wherein NZD-USD volatility is most affected by its own volume (0.16), followed by USD-JPY (0.14), and NZD-JPY (0.10). NZD-JPY volatility is also influenced by all trading volumes, with the largest influence from USD-JPY (0.21), followed by USD-NZD (0.10), and NZD-JPY (0.06). USD-JPY volatility is heavily influenced by its own trading volume (0.31), then distantly followed by NZD-JPY (0.05). The AR (1) component of NZD-JPY is positively significant at a low magnitude (0.24), which means that its volatility is mildly influenced by its 1-hour lagged value. The AR (24) coefficients for all volatilities are likewise positively significant, wherein USD-JPY (0.31) and USD-NZD (0.35) have higher magnitude than NZD-JPY (0.24). This would show that the 24-hour lagged volatilities of the preceding currencies have a slightly larger impact on current values. The MA (1) coefficients of all three currencies are negatively significant. The analysis shows that the MA (1) component of

NZD-JPY is highest (-0.99), followed by NZD-USD (-0.89), and USD-JPY (-0.61). This would imply that current volatility values are variedly influenced by immediate past error terms and shocks. The MA (2) components are also negatively correlated for USD-NZD and USD-JPY but have vastly different magnitudes. The analysis would show that shocks from a 2-hour window still have a strong effect on USD-NZD but have significantly tapered for USD-JPY. The ARCH and GARCH components are both significant for NZD-USD, with a larger magnitude for the GARCH coefficient implying that much previous volatility values have a more persistent effect on current values. In comparison, only the ARCH coefficient is significant for USD-JPY and NZD-JPY, which means that these volatility values are more influenced by recent shocks.

Table 11: GARCH Model Estimations for USD-JPY-NZD

Regressors	Volatility					
	NZDJPY		NZDUSD		USDJPY	
Constant	-0.00		-0.00	**	-0.00	
Volume (NZDJPY)	0.06	***	0.10	***	0.05	***
Volume (NZDUSD)	0.10	***	0.16	***	0.01	
Volume (USDJPY)	0.21	***	0.14	***	0.31	***
AR (1)	0.24	***	NA		NA	
AR (24)	0.24	***	0.35	***	0.31	***
MA (1)	-0.99	***	-0.89	***	-0.61	***
MA (2)	NA		-0.8	***	-0.34	***
ARCH Residual	0.23	**	-0.01	***	0.10	**
GARCH	-0.03		0.58	**	0.10	
R-squared	0.46		0.54		0.58	
Aike info criterion	-0.01		0.23		0.24	

Notes: 24-hour lagged volatility values are in logarithmic form, while all trade volume variables are in logarithmic form, differenced by 1 hour. NA implies that a particular ARMA component was omitted in the analysis for the currency pair. The omission of these components for particular models was done to ensure that the individual model exhibited no serial autocorrelation to provide a clearer analysis.
Sources: Authors' calculations using data from the Bloomberg and CLS FX Database.

While the GARCH analysis for both tripartite relationships shows that time-related coefficients have varying effects on each individual time-series, a pattern emerges that, for most of the currency pairs, all trading volumes have a positive and significant correlation with their trading volumes, controlling for these time elements (see Tables 12 and 13). While NZD-JPY and AUD-JPY volatility are both more influenced by USD-JPY trading volumes, other currency pairs such as USD-AUD and USD-NZD are most strongly determined by their own currency pair volatilities. In all these four cases, the third-party currency also has a significant influence on their respective volatilities. As expected, USD-JPY volatility is influenced mostly by its own trading volume; in the USD-JPY-AUD tripartite, it is in fact the sole influencer to USD-JPY volatility. The USD-JPY-NZD tripartite, however, suggests that even small currency pairs like NZD-JPY also have a significant, if minute, effect on USD-JPY volatility.

Table 12: Percentage Effects to FX volatility, by Foreign Exchange Trading Volume Pair (USD, JPY, AUD)

Currency	Trading Volumes		
	USDJPY (Major Pair)	USDAUD (Major Pair)	AUDJPY (Minor Pair)
USDJPY	0.38%***	0.02%	0.03%
USDAUD	0.10%***	0.33%***	0.05%***
AUDJPY	0.19%***	0.08%***	0.11%***

Notes: Data is taken from GARCH (1,1) regressions on matching each individual currency with trading volume pairs. *** denotes significance at 0.01, ** denotes significance at 0.05, * denotes significance at 0.10. Major pair refers to currency pairs involving widely used currencies paired with the USD. Minor pairs refer to widely used currencies, excluding USD.
Sources: Authors' calculations from data from Bloomberg and CLS Database.

Table 13: Percentage Effects to Foreign Exchange Volatility by Trading Volume Pair (USD, JPY, NZD)

Currency	Trading Volumes		
	USDJPY (Major Pair)	USDNZD (Major Pair)	NZDJPY (Minor Pair)
USDJPY	0.31%***	0.01%	0.05%***
USDNZD	0.14%***	0.16***	0.10***
NZDJPY	0.21%***	0.10***	0.06%***

Notes: Data is taken from GARCH (1,1) regressions on matching each individual currency with trading volume pairs. *** denotes significance at 0.01, ** denotes significance at 0.05, * denotes significance at 0.10
Sources: Asian Development Bank calculations from data from Bloomberg and CLS Database.

IV. Conclusions

US dollar dominance as a global reserve currency has significant implications for the impact of USD-related currency trade volumes on exchange rate volatility. This paper has investigated whether third-party foreign exchange trade volumes can have any significant effect on the foreign exchange volatilities of original currency pairs despite the crucial role of the US dollar as the dominant currency. While the study demonstrates the significant effect of exchange trade volumes on the volatility of the corresponding currency pairs, third party currency trade volumes also exert significant impact on the volatility of the corresponding currency pairs. This third party trading channel is quite strong for the USD-related currency trades. However, non-USD-related third party trades also significantly affect the volatility of corresponding currency pairs. These findings are investigated through three types of models that explore the relationship between foreign exchange volatility and trade volumes. The OLS regressions point out that, individually, most currency volatilities are affected by all currency volumes in the tripartite relationships, including the indirect, third-party currency trading channels. The time-fixed effect model adds that, even when controlling for the hours of a trading day, these effects turn out to be consistent. The model further implies that the size of trade volume transactions has a role in influencing both the significance and strength of these effects. The GARCH analysis approaches the issue using cyclical time elements and provides further evidence that the above results are robust to different model setup and the treatment of potential autocorrelation and heteroskedasticity of average and variance over time.

While the relationship between foreign exchange volatility and trading volumes of a specific country pair has been examined based on a monthly or annual timeframe (Rajbongshi and Suresh 2023), this analysis uses the higher frequency data of a 1-month window of hourly data. This research also attempts to fill the gap in literature by examining the potential impact of third-party currency pairs in delving into the dynamics between trading volume and exchange rate volatility.

While this study was only limited to studying two trilateral relationships, the analysis suggests the possibility that variances in trade volumes of third-party currency pairs can directly influence the volatility of exchange rate of target currencies. With the rapid growth of foreign exchange trade on multiple fronts and under the assumption of an efficient market without any arbitrage opportunities, the importance of this third-party currency trade link cannot be overemphasized in considering the policy responses to exchange rate volatility. Given that fluctuations in foreign exchange trade volume are often brought about by how investors and traders react to events, speculative motives, and public or private interventions, the possible connection of exchange trade volumes to currency volatility both come with risks and opportunities. While the impact of indirect trading volume channel is relatively stronger through the USD-related currency trade, the volume of third-party currency trades without involving USD could also exert influence on the exchange rate volatility.

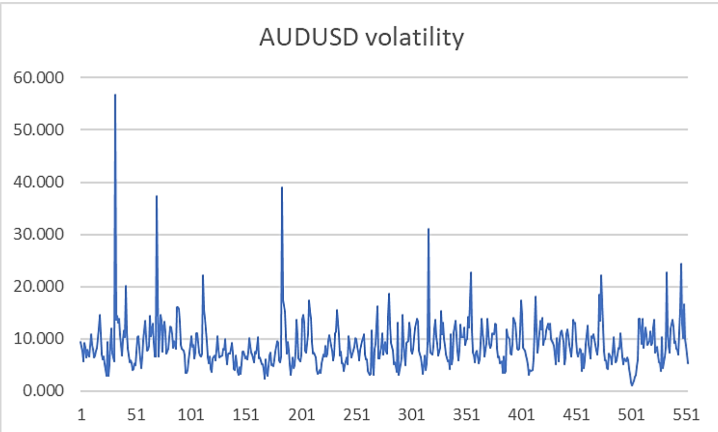
Several papers that explored the relationship of foreign exchange volatility and trading volume emphasize the need for more meticulous surveillance and better-quality financial information for traders. This is supported by the findings of Park et al. (2022) that identified the information component of monetary policy statements as the key factor in explaining variation in foreign exchange rates in response to monetary policy. Furthermore, aside from direct monetary stability measures, policy makers are also encouraged to provide policies that mitigate information asymmetries and lower speculative demand of foreign currencies. While it is acknowledged that interventions on the foreign exchange market to stabilize volatility are often matters of domestic discretion, it becomes vital that economies must establish a broad means of communication and coordination to monitor the potential indirect impact of third-party currency trades. An example of such multilateral initiatives is the European Bank Coordination “Vienna” Initiative. Originally conceived at the height of the global economic crisis in 2009, the initiative has evolved to assume a more constant role in addressing stability issues in the region’s financial sector. The Vienna Initiative brings together key stakeholders, private and public, in the EU-based cross border bank groups.[2] Another regional example is Chiang Mai Initiative Multilaterlisation (CMIM) under ASEAN+3’s initiative. While the framework is to provide balance of payment and liquidity support through multilateral swap arrangements among central banks during the financial crisis, its dialogue channel can be utilized to ensure the stability in exchange rate volatility through multilateral foreign exchange market coordination beyond unilateral market interventions.

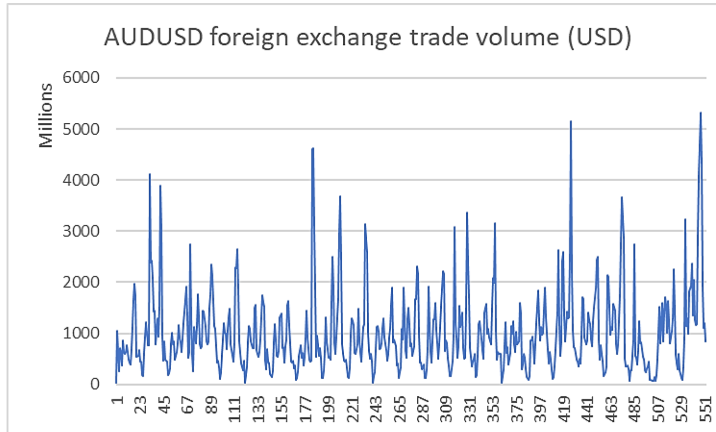
Further, a more open and free regional exchange of market information and insights, as well as a more in-sync and harmonious regional approach to controlling foreign exchange volatility, will lend more clarity in trading markets and can help the region navigate the challenges of volatile exchange rates.

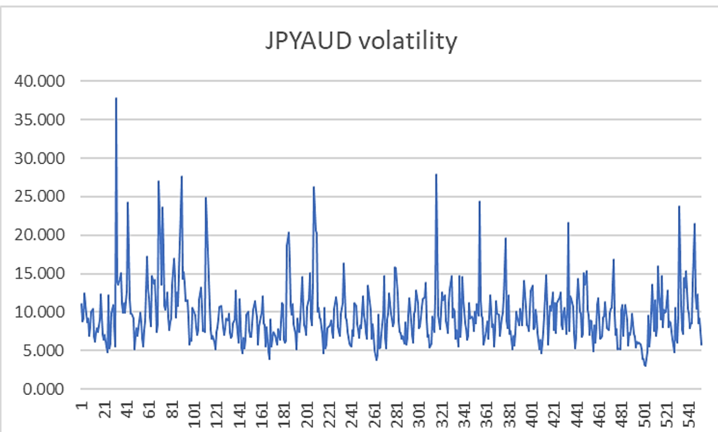
[2] Vienna Initiative. https://www.vienna-initiative.com/about/.

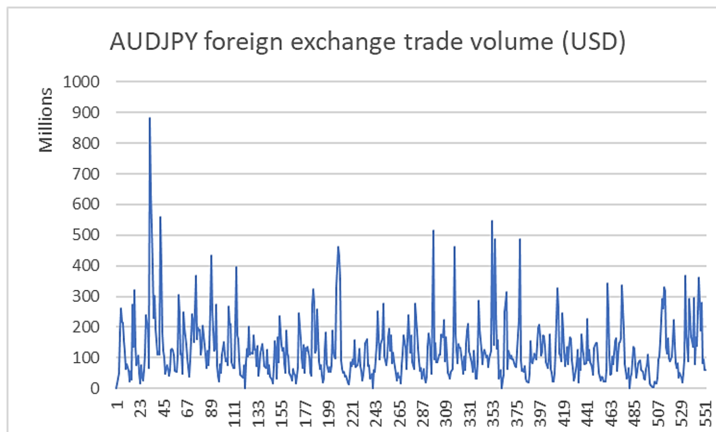
APPENDIX

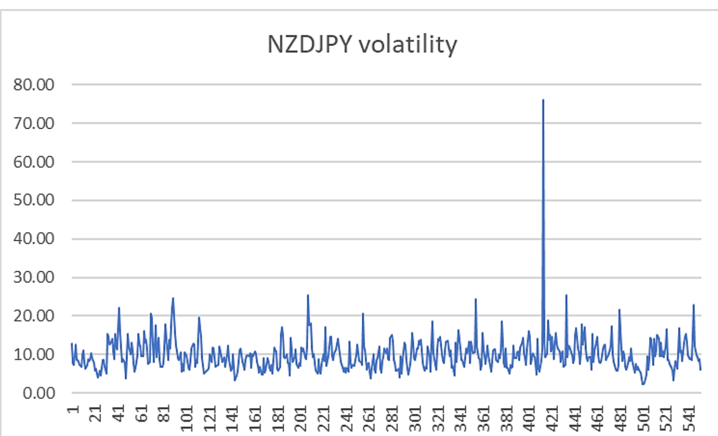
Appendix 1: Volatility and Trade Volumes, by Currency Pair

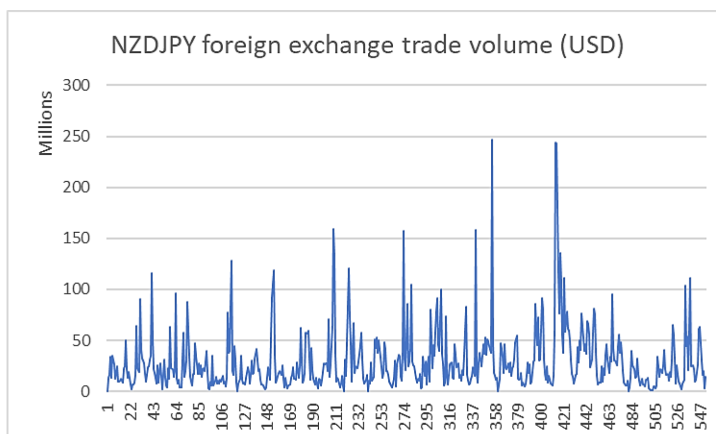












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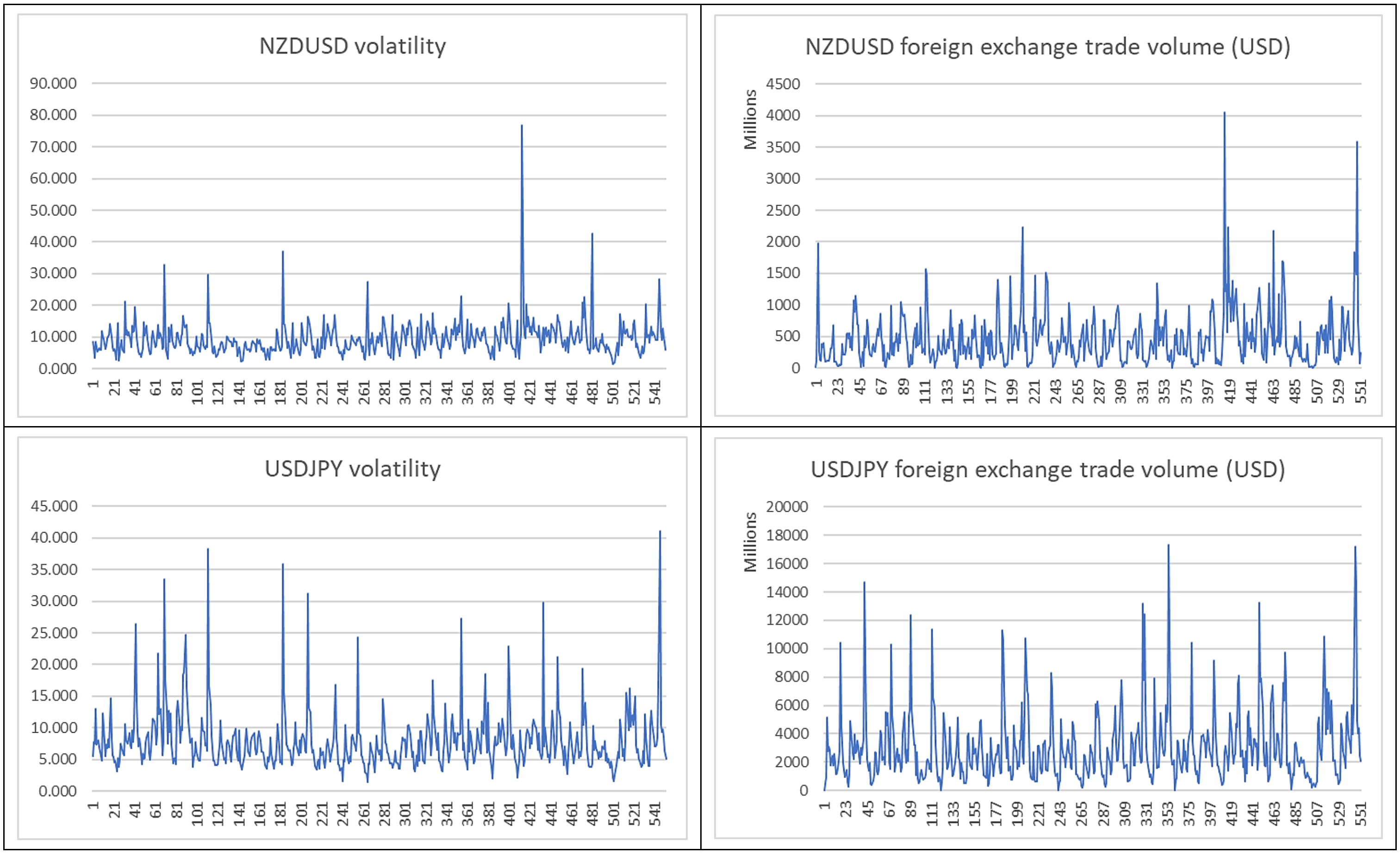

Sources: Asian Development Bank calculations using Bloomberg and CLS database.

Appendix 2: Time-Fixed Effect Model for USD-JPY-AUD Trilateral

VARIABLES	(AUDUSD) Volatility	(AUDJPY) Volatility	(USDJPY) Volatility
Volume (AUDJPY)	0.0327	0.0912***	0.00991
	(0.0200)	(0.0178)	(0.0224)
Volume (AUDUSD)	0.329***	0.167***	0.0845**
	(0.0304)	(0.0263)	(0.0331)
Volume (USDJPY)	0.0555**	0.114***	0.293***
	(0.0255)	(0.0224)	(0.0292)
Lagged Dependent Variable (1 hour)	0.206***	0.157***	0.246***
	(0.0372)	(0.0372)	(0.0392)
Lagged Dependent Variable (2 hours)	0.0265	0.00101	-0.000521
	(0.0362)	(0.0361)	(0.0375)
Friday	-0.0270	-0.0276	-0.0625*
	(0.0317)	(0.0279)	(0.0354)
Thursday	0.00479	0.0801***	-0.0135
	(0.0330)	(0.0300)	(0.0369)
Tuesday	-0.0256	-0.00873	-0.0409
	(0.0297)	(0.0262)	(0.0332)
Wednesday	-0.00959	-0.0148	-0.0514
	(0.0307)	(0.0270)	(0.0342)
1.hour	-0.638***	-0.509***	0.333***
	(0.0731)	(0.0624)	(0.0768)
2.hour	-0.792***	-0.694***	-0.0871
	(0.0705)	(0.0620)	(0.0816)
3.hour	-0.676***	-0.765***	-0.0749
	(0.0866)	(0.0751)	(0.0953)
4.hour	-0.640***	-0.744***	-0.427***
	(0.0908)	(0.0781)	(0.0988)
5.hour	-0.833***	-0.903***	-0.538***
	(0.0847)	(0.0731)	(0.0928)
6.hour	-0.890***	-0.912***	-0.483***
	(0.0803)	(0.0699)	(0.0893)
7.hour	-0.832***	-0.901***	-0.362***
	(0.0772)	(0.0678)	(0.0874)
8.hour	-0.760***	-0.855***	-0.291***
	(0.0810)	(0.0717)	(0.0923)
9.hour	-0.684***	-0.781***	-0.203**
	(0.0881)	(0.0776)	(0.0993)
10.hour	-0.754***	-0.703***	-0.144
	(0.0893)	(0.0778)	(0.0990)
11.hour	-0.769***	-0.765***	-0.319***
	(0.0851)	(0.0741)	(0.0938)
12.hour	-0.828***	-0.851***	-0.281***
	(0.0810)	(0.0707)	(0.0898)
13.hour	-0.823***	-0.838***	-0.265***
	(0.0777)	(0.0680)	(0.0865)
14.hour	-0.733***	-0.819***	-0.168*
	(0.0803)	(0.0707)	(0.0901)
15.hour	-0.596***	-0.726***	0.0955
	(0.0893)	(0.0785)	(0.0998)
16.hour	-0.749***	-0.765***	-0.238**
	(0.0933)	(0.0814)	(0.104)

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VARIABLES	(AUDUSD) Volatility	(AUDJPY) Volatility	(USDJPY) Volatility
17.hour	-0.804***	-0.745***	-0.239**
	(0.0975)	(0.0853)	(0.109)
18.hour	-1.054***	-0.973***	-0.492***
	(0.0946)	(0.0827)	(0.105)
19.hour	-0.899***	-0.815***	-0.344***
	(0.0815)	(0.0712)	(0.0903)
20.hour	-0.826***	-0.735***	-0.236***
	(0.0761)	(0.0667)	(0.0850)
21.hour	-0.817***	-0.734***	-0.244***
	(0.0754)	(0.0662)	(0.0843)
22.hour	-0.919***	-0.820***	-0.340***
	(0.0741)	(0.0648)	(0.0826)
23.hour	-1.199***	-1.013***	-0.494***
	(0.0736)	(0.0647)	(0.0829)
Constant	-6.150***	-4.925***	-6.459***
	(0.470)	(0.400)	(0.521)
Observations	550	550	550
R-squared	0.773	0.714	0.726

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Sources: Asian Development Bank calculations using Bloomberg and CLS database.

Appendix 3: Time-Fixed Effect Model for USD-JPY-NZD Trilateral

VARIABLES	(NZDJPY) Volatility	(NZDUSD) Volatility	(USDJPY) Volatility
Volume (NZDJPY)	0.0782***	0.102***	0.00283
	(0.0140)	(0.0175)	(0.0150)
Volume (NZDUSD)	0.0909***	0.132***	0.0118
	(0.0151)	(0.0189)	(0.0164)
Volume (USDJPY)	0.219***	0.168***	0.433***
	(0.0238)	(0.0296)	(0.0277)
Lagged Dependent Variable (1 hour)	0.111***	0.118***	0.195***
	(0.0376)	(0.0379)	(0.0375)
Lagged Dependent Variable (2 hours)	0.0239	0.0212	0.00274
	(0.0352)	(0.0358)	(0.0351)
Friday	0.000770	0.0184	-0.0400
	(0.0317)	(0.0397)	(0.0344)
Thursday	0.0820**	0.0399	-0.00216
	(0.0324)	(0.0397)	(0.0347)
Tuesday	-0.00363	-0.00785	-0.0208
	(0.0288)	(0.0359)	(0.0314)
Wednesday	0.0509*	0.0667*	-0.0323
	(0.0300)	(0.0376)	(0.0324)
1.hour	-0.181**	-0.579***	0.476***
	(0.0721)	(0.0918)	(0.0744)
2.hour	-0.384***	-0.665***	0.0732
	(0.0703)	(0.0880)	(0.0778)
3.hour	-0.453***	-0.604***	-0.0361
	(0.0800)	(0.100)	(0.0880)
4.hour	-0.455***	-0.512***	-0.312***
	(0.0814)	(0.102)	(0.0881)
5.hour	-0.569***	-0.669***	-0.430***
	(0.0786)	(0.0993)	(0.0845)
6.hour	-0.624***	-0.737***	-0.359***
	(0.0752)	(0.0952)	(0.0809)
7.hour	-0.681***	-0.825***	-0.250***
	(0.0735)	(0.0928)	(0.0802)
8.hour	-0.578***	-0.687***	-0.181**
	(0.0742)	(0.0930)	(0.0818)
9.hour	-0.439***	-0.472***	-0.123
	(0.0802)	(0.100)	(0.0880)
10.hour	-0.387***	-0.539***	-0.0399
	(0.0813)	(0.103)	(0.0877)
11.hour	-0.405***	-0.528***	-0.222***
	(0.0807)	(0.102)	(0.0859)
12.hour	-0.544***	-0.635***	-0.163**
	(0.0775)	(0.0974)	(0.0824)
13.hour	-0.532***	-0.645***	-0.144*
	(0.0747)	(0.0943)	(0.0801)
14.hour	-0.503***	-0.529***	-0.0699
	(0.0757)	(0.0954)	(0.0823)
15.hour	-0.487***	-0.462***	0.130
	(0.0839)	(0.105)	(0.0917)

Continued on the next page

VARIABLES	(NZDJPY) Volatility	(NZDUSD) Volatility	(USDJPY) Volatility
16.hour	-0.501***	-0.568***	-0.150
	(0.0855)	(0.108)	(0.0937)
17.hour	-0.522***	-0.618***	-0.188*
	(0.0901)	(0.114)	(0.0982)
18.hour	-0.741***	-0.842***	-0.400***
	(0.0863)	(0.109)	(0.0927)
19.hour	-0.621***	-0.822***	-0.251***
	(0.0785)	(0.0992)	(0.0846)
20.hour	-0.557***	-0.729***	-0.126
	(0.0733)	(0.0923)	(0.0794)
21.hour	-0.508***	-0.638***	-0.103
	(0.0717)	(0.0899)	(0.0779)
22.hour	-0.430***	-0.602***	-0.194**
	(0.0727)	(0.0913)	(0.0786)
23.hour	-0.677***	-0.885***	-0.385***
	(0.0724)	(0.0905)	(0.0790)
Constant	-5.397***	-5.509***	-7.882***
	(0.455)	(0.569)	(0.512)
Observations	546	546	546
R-squared	0.696	0.687	0.752

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Sources: ADB calculations using Bloomberg and CLS database.

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Dynamic Impact of Foreign Exchange Trading Volume on Foreign Exchange Volatility

Foreign exchange (FX) trading volume is a key factor in volatility. This paper investigates the effect of trading volume on volatility using high-frequency data. Estimation results from econometric models reveal a significant impact of third-party trade volumes on the volatilities of original currency pairs. Though the United States dollar (USD) exerts sizeable effect through third-party channels, currency pairs without USD linkages also have impact, calling renewed attention to utilizing regional cooperation in mitigating volatility as compared with major FX trading partners.

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