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Drivers of Indonesia's Foreign Exchange Reserves and Their Linkage to USD Liquidity: Evidence From A Macro-Financial Ols Model

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Abstract
Indonesia's foreign exchange reserves are an important shield to maintain currency stability and protect the country's financial system. In recent years, changes in global interest rates, commodity prices, capital movements, and local financial conditions have made it difficult to manage these reserves. These changes create important questions for policymakers about which macro-financial factors have the strongest impact on Indonesia's foreign exchange reserves and how they relate to the USD's liquidity in the domestic interbank market. This study was conducted on the assumption that foreign exchange reserves and interbank USD liquidity respond simultaneously to domestic financial conditions and global financial macro turmoil. Based on the international financial literature, this study develops the proposition that domestic market yields, global dollar strength, financial stress indicators, commodity cycles, and external sector performance together determine the monthly dynamics of Indonesia's foreign exchange reserves and USD liquidity. The analysis applied multivariate Ordinary Least Squares to monthly macrofinancial data from 2010 to 2024, preceded by stationarity testing, multicollinearity diagnostics, and residual evaluation. The results show that Indonesia's foreign exchange reserves are heavily influenced by long-term domestic yields, global USD indices, interbank liquidity conditions, export performance, US inflation, and global dollar funding stress. Interbank USD liquidity is attributed to trade balances, domestic and global yields, consumer confidence, retail activity, MSCI equity performance, global commodity cycles, and United States corporate credit conditions. This research provides a data-driven starting point that can support the development of more responsive policy instruments to protect Indonesia's external stability.

INTRODUCTION

Indonesia’s external stability is becoming more important because global financial conditions, commodity prices, and the local market now change faster than before (Anas et al., 2022; Rozi et al., 2023; Wihardja et al., 2025). Foreign exchange reserves play a big role for countries like Indonesia because they help protect the currency from large swings and make sure the country can meet its obligations to the world. According to the International Monetary Fund, countries that have stronger FX reserves are usually more stable when there are global shocks, like the 2013 Taper Tantrum or the 2022 U.S. interest rate hikes (IMF, 2023). Since Indonesia’s economy depends a lot on global commodity markets and international capital flows, having enough FX reserves is very important for keeping policy trust and maintaining financial stability.

The business environment in which Indonesia manages its foreign exchange reserves has evolved rapidly in the period after 2010. Global interest rate cycles have become more volatile, and the dominance of the United States dollar in global trade and finance continues to shape liquidity conditions in emerging markets. Research by the Bank for International Settlements

shows that changes in United States monetary policy have deep effects on capital flows, exchange rates, and sovereign yields in emerging economies (BIS, 2021). Indonesia has experienced similar pressures. During the 2022 Federal Reserve tightening cycle, the United States dollar index appreciated sharply and emerging market currencies, including the rupiah, faced depreciation pressures greater than 9 percent at the peak of volatility (TradingEconomics, 2023). These episodes highlight the sensitivity of Indonesia's external position to global financial shifts.

Indonesia faces complex challenges in managing external stability amid an increasingly integrated and volatile global financial system. The country's foreign exchange reserves and the liquidity of the United States dollar in the domestic market are the two main pillars that determine the ability of the Indonesian economy to survive external turmoil. Foreign exchange reserves serve as a national buffer against exchange rate pressures and investor confidence, while the liquidity of the USD in the domestic interbank market reflects the health of the financial system in meeting short-term funding needs. These two indicators are interrelated but react differently to changes in global and domestic macro-financial conditions.

In the past decade, the dynamics of Indonesia's foreign exchange reserves have shown a pattern that reflects high sensitivity to changes in global financial conditions. Indonesia's foreign exchange reserves have grown gradually from about one hundred billion dollars in the early 2010s to more than one hundred and forty billion dollars in 2021. However, this growth does not take place in a linear manner and often experiences sharp fluctuations in certain periods. Bank Indonesia noted that foreign exchange reserves fell from $144.9 billion in 2021 to $137.2 billion at the end of 2022 as the United States Federal Reserve raised interest rates aggressively and global risk sentiment deteriorated. This decline shows that although Indonesia's foreign exchange reserves are quite large in aggregate, the position remains vulnerable to global turmoil, commodity cycles, and changes in domestic market behavior.

The sensitivity of Indonesia's foreign exchange reserves to global conditions is strengthened by several major episodes that occurred between 2010 and 2024. The first episode was the eurozone crisis that lasted between 2010 and 2012, which triggered capital flight from emerging markets and depressed the exchange rates of emerging market countries including Indonesia. The second episode was the collapse of the commodity super cycle between 2013 and 2015, which had a significant impact on Indonesia's export performance given the country's dependence on the export of commodities such as coal, nickel, copper, and palm oil. The third episode was the COVID-19 pandemic which triggered unprecedented global financial market volatility and prompted monetary and fiscal policy interventions around the world. The fourth episode was the global monetary tightening cycle in 2022 to 2023, when the world's major central banks raised interest rates to control inflation, which then led to a strengthening of the United States dollar and capital outflows from emerging markets.

In the same period, the global dollar strength index measured through the Dollar Index or DXY experienced significant movements reflecting the change in the direction of US monetary policy and global risk sentiment. The index showed a sharp strengthening trend in 2022, reaching its highest level in two decades, putting great pressure on emerging market currencies including the rupiah. The strengthening of the dollar coincided with an increase in US bond yields, which attracted capital outflows from emerging market assets and increased funding costs in dollars for Indonesian companies and banks.

Meanwhile, Indonesia's domestic financial landscape has also undergone significant structural changes. The role of digital investment platforms increased sharply in the wake of the pandemic, allowing retail investors to access global assets with unprecedented ease. The Financial Services Authority reported that retail investor growth exceeded forty percent per year between 2020 and 2023, with a substantial increase in demand for foreign securities requiring settlement in United States dollars. These structural changes increase the importance of USD liquidity conditions in the domestic market. When the demand for USD increases sharply, the USD liquidity market between Indonesian banks becomes an important channel to stabilize exchange rate pressures. Bank Indonesia noted that Foreign Exchange Interbank Money Market transactions or Foreign Exchange PUAB have grown in importance as a mechanism for banks to manage short-term USD needs, especially during periods of high volatility.

This development illustrates a broader business issue. Indonesia's foreign exchange reserves and USD liquidity are influenced not only by traditional macroeconomic fundamentals but also by a broader set of macro-financial drivers. These include long-term domestic yields, the strength of the global dollar, global risk appetite, commodity price cycles, and sentiment indicators in the domestic economy. A study from the World Bank emphasizes that emerging economies increasingly face multi-channel transmission of global turmoil through portfolio flows, commodity prices, and financial condition indices. For Indonesia, which relies heavily on exports of commodities such as coal, nickel, copper, and palm oil, fluctuations in global commodity prices can quickly affect trade performance and indirectly affect foreign exchange reserves.

This issue is particularly relevant for the period from 2010 to 2024, a time marked by major global episodes including the eurozone crisis, the collapse of the commodity super cycle in 2013 to 2015, the global pandemic, and the tightening cycle in 2022 to 2023. Each of these episodes introduces significant volatility into Indonesia's external environment. The Organization for Economic Co-operation and Development notes that emerging market policymakers are increasingly required to strengthen coordination between reserve management and domestic liquidity operations to contain the effects of global volatility. This underscores the importance of understanding the drivers of Indonesia's foreign exchange reserves and their relationship to USD liquidity in the domestic market.

From a business policy perspective, Bank Indonesia's ability to stabilize the rupiah and maintain adequate USD liquidity depends on a clear understanding of which macro-financial variables exert the strongest and most consistent influence on interbank reserves and liquidity. With global markets becoming more interconnected and digital financial behaviors becoming more influential, challenges are growing in scale and complexity. Identifying the measurable determinants of USD's foreign exchange reserves and liquidity is therefore a strategic need to maintain Indonesia's external resilience in an increasingly unpredictable global environment. This research aims to develop an analytical framework that integrates global and domestic macrofinancial indicators to provide a more comprehensive understanding of how foreign exchange reserves and USD liquidity move together in the face of external turmoil and structural changes in domestic financial markets.

METHOD

Types of Research

This study adopted an explanatory quantitative research design based on time series data that focuses on estimating the linear relationship between macrofinancial variables with two dependent outcomes, namely the growth of monthly foreign exchange reserves and the growth of USD liquidity in the interbank market or Foreign Exchange PUAB. The Ordinary Least Squares or OLS approach was chosen based on theoretical considerations and empirical evidence from the current macrofinancial literature. The OLS method is widely used in macroeconomic analysis when the goal is to measure the marginal effects of changes in interest rates, volatility, liquidity conditions, and global turmoil on key policy variables. Modern empirical studies show that OLS remains precise and efficient when variables are stationary and when the goal is a direct estimate of elasticity rather than dynamic simulations. Many recent works examining foreign exchange reserve drivers, exchange rate pressures, and liquidity conditions use multivariate OLS regression due to its interpretability in a policy context. This design is in line with the nature of Indonesia's financial markets where USD liquidity pressures and reserve fluctuations often respond to contemporary changes in interest rate differentials, risk sentiment, global commodity cycles, and cross-border capital flows. This relationship is inherently contemporary rather than lag-driven, making OLS well-suited for isolating marginal effects of macro variables on monthly frequency.

Population and Sample

The population in this study includes all Indonesian macroeconomic and financial data relevant to external stability, especially those related to foreign exchange reserves and domestic USD liquidity conditions (Aizenman et al., 2021; Bussière et al., 2020). The research sample used monthly data from January 2010 to December 2024, reflecting the frequency with which macroeconomic and policy-relevant indicators were monitored in Indonesia (Hirata & Kaminsky, 2021; Jongwanich & Park, 2022). This period includes various global financial episodes including the eurozone debt crisis, the decline in commodity prices from 2013 to 2015, the turmoil of the COVID-19 pandemic, and the global monetary tightening cycle of 2022 to 2023 (Rey, 2022). This extended time horizon provides the rich set of macrofinancial fluctuations necessary to identify a stable relationship between Indonesia’s external buffer and the global environment (Cheng et al., 2021). The monthly frequency was chosen to match the policy monitoring rhythm of institutions such as Bank Indonesia and to ensure that the macro-financial indicators used in the study can be meaningfully compared over time (Fouquau et al., 2020). All variables are transformed into monthly growth rates, percentage changes, or logarithmic differences to ensure comparability and reduce scale differences (Kwiatkowski et al., 1992; Phillips & Perron, 1988). The date format follows a monthly structure defined in the dataset with month and COVID-19 dummy indicators to control for structural and seasonal changes in accordance with macroeconomic empirical standards (Pesaran, 2021).

Data Collection Techniques

The research data is sourced from trusted institutions that consistently provide high-quality macroeconomic and financial information. The main data sources include Bank Indonesia for foreign exchange reserves and PUAB Foreign Exchange liquidity data, Federal Reserve Economic Data or FRED for United States financial variables such as Federal Reserve interest rates, dollar indexes, financial stress indexes, and various US bond yields, as well as

Investing.com, Yahoo Financial, and TradingEconomics for trade data, commodity prices, stock market performance, and domestic sentiment indicators. The variables collected include domestic indicators such as changes in the yield of ten-year Indonesian government bonds, changes in interbank interest rates, growth in Indonesia's exports, JCI returns, changes in the consumer confidence index, and changes in retail sales, as well as global indicators such as changes in the global USD cycle index, the growth of the broad real dollar index, changes in the Federal Reserve's financial stress index, changes in the yield of various tenors of United States bonds, the growth of inflation in the United States, the growth of Brent crude oil prices, the return of the MSCI emerging market stock market, and the growth of the global commodity price index. Additional control variables include a month dummy to capture seasonal effects and a COVID-19 dummy to capture structural changes due to the pandemic. The preparation of this structured data ensures that the resulting dataset is suitable for OLS estimation with valid statistical properties and meets the standards of high-frequency macroeconometric research.

Data Analysis Techniques

The core analytical framework relies on multivariate Ordinary Least Squares or OLS supported by standard econometric diagnostic procedures to ensure the reliability, consistency, and validity of the inference. The OLS model is specified with dependent variables in the form of foreign exchange reserves or USD liquidity, independent variables in the form of macro-financial indicators, and control variables in the form of month dummy and COVID dummy with coefficients estimated through OLS and term error. The structure of this model is consistent with empirical research examining the determinants of reserve adequacy and liquidity pressure of USD in emerging markets. Before running OLS, all variables undergo root unit testing using Augmented Dickey-Fuller and Phillips-Perron tests because OLS requires a stationary series to avoid false regression. Monthly financial variables such as bond yields, global USD cyclical indices, exports, and foreign exchange reserves typically show stationarity in first differences as documented in the emerging market foreign exchange literature. Variance Inflation Factors or VIF is used to assess multicollinearity given that macrofinancial datasets often contain correlated indicators and VIF thresholds guide the retention or transformation of variables following best practices in empirical macroeconomics. To ensure valid inferences, the Breusch-Pagan test is used for heteroscedasticity and the Breusch-Godfrey test for serial correlation because macro series of emerging markets often display heteroscedasticity due to the transmission of global turmoil and when problems arise, the HAC or Newey-West robust error standard is used to correct the inference. The inclusion of the month dummy controls for seasonality which is highly relevant for variables such as Indonesia's exports and retail sales while the COVID dummy captures structural regime shifts consistent with methodological approaches in the study of economic turmoil. The final stage interprets each coefficient as a marginal effect in line with the analytical framework used in Bank for International Settlements, International Monetary Fund, and academic studies of reserve adequacy and the global liquidity cycle.

RESULT AND DISCUSSION

Analysis

This chapter presents the empirical results of the macro financial models developed to examine the drivers of Indonesia's foreign exchange reserves and their linkage to USD liquidity in the domestic interbank market. The analysis builds upon the OLS-based methodological framework described in Chapter 3 and evaluates both the FX reserve model and the USD liquidity model using monthly data from 2010 to 2024. All variables met the stationarity requirement based on Augmented Dickey–Fuller (ADF) tests, and diagnostic procedures were employed to validate model suitability. The results are interpreted within the conceptual framework established earlier, emphasizing the interaction between domestic conditions, global financial cycles, and Indonesia's external stability.

1. Descriptive Statistics

This chapter starts by giving a simple descriptive overview of all the variables used in the FX reserve model and the USD liquidity model. Descriptive statistics help give a first look at how each variable behaves, including its average value, how much it moves over time, and whether the data is spread out or clustered in certain periods. Since this research uses monthly data from 2010 to 2024, looking at the basic pattern of each variable is important so the model results in the next sections can be understood correctly. From this descriptive output, we can see which variables move a lot, which ones look more stable, and whether extreme values appear during times of global or domestic financial stress. This also helps show differences between groups of variables, such as global financial indicators, domestic sentiment indicators, and external sector variables.

To support the analysis later in the chapter, this descriptive section also helps explain why some variables show stronger reactions in certain years, such as during global tightening cycles or the pandemic period. By understanding these early patterns, the interpretation of the regression results becomes clearer and more aligned with Indonesia's real macro financial conditions.

Reserve Growth

	Percentiles	Smallest		
1%	-7.541402	-8.481576		
5%	-3.631319	-7.541402		
10%	-3.02296	-6.94365	Obs	180
25%	-1.036538	-5.688134	Sum of wgt.	180
50%	.4411717		Mean	.4476143
		Largest	Std. dev.	2.688179
75%	2.035136	5.933974		
90%	3.622888	6.237199	Variance	7.226304
95%	5.398997	7.387626	Skewness	-.1897815
99%	7.387626	8.994461	Kurtosis	3.994816

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	Percentiles	Smallest		
1%	-197.8971	-234.8324		
5%	-96.72155	-197.8971		
10%	-72.17915	-188.971	Obs	180
25%	-28.35131	-149.2473	Sum of wgt.	180
50%	-.4149481		Mean	.6661302
		Largest	Std. dev.	62.05886
75%	31.15209	138.18		
90%	70.27605	139.362	Variance	3851.303
95%	89.98984	188.0037	Skewness	-.0007206
99%	188.0037	271.9746	Kurtosis	6.201792

10Y Bond Yield

	Percentiles	Smallest		
1%	-66.61857	-66.85672		
5%	-52.19717	-66.61857		
10%	-43.7016	-64.464	Obs	180
25%	-20.98463	-60.45205	Sum of wgt.	180
50%	-3.449702		Mean	-1.531966
		Largest	Std. dev.	30.97389
75%	16.07316	82.54389		
90%	34.51481	87.3632	Variance	959.3322
95%	52.70848	91.18176	Skewness	.5513683
99%	91.18176	118.4226	Kurtosis	4.114999

USD Global Cycle (index)

	Percentiles	Smallest		
1%	-2.620033	-2.939201		
5%	-2.03727	-2.620033		
10%	-1.556965	-2.615097	Obs	180
25%	-.706913	-2.533478	Sum of wgt.	180
50%	.1705971		Mean	.1965206
		Largest	Std. dev.	1.335668
75%	1.015781	2.891556		
90%	1.868004	3.103142	Variance	1.784089
95%	2.485516	3.273712	Skewness	.1367635
99%	3.273712	4.319061	Kurtosis	2.875206

Export from Indonesia

Percentiles	Smallest		
1% -23.91928	-31.37741		
5% -15.24578	-23.91928		
10% -11.91164	-22.63822	Obs	180
25% -5.929415	-22.4451	Sum of wgt.	180
50% .0297988		Mean	.3915843
	Largest	Std. dev.	9.673613
75% 6.540416	22.97695		
90% 12.15951	25.79478	Variance	93.5788
95% 15.437	25.88307	Skewness	-.0732642
99% 25.88307	27.89322	Kurtosis	3.564842

USD Consumer Price Index

Percentiles	Smallest		
1% -.6390714	-.7951584		
5% -.1782593	-.6390714		
10% -.0612207	-.4538775	Obs	180
25% .0504796	-.3089389	Sum of wgt.	180
50% .2102842		Mean	.2183658
	Largest	Std. dev.	.264789
75% .3348752	.9370993		
90% .5035411	.9395782	Variance	.0701132
95% .6670517	1.028701	Skewness	.3023775
99% 1.028701	1.286909	Kurtosis	5.923013

Real Broad Dollar Index

Percentiles	Smallest		
1% -2.334875	-2.874984		
5% -1.759799	-2.334875		
10% -1.350887	-2.157967	Obs	180
25% -.6581638	-2.113996	Sum of wgt.	180
50% .1307863		Mean	.1594085
	Largest	Std. dev.	1.179649
75% 1.007603	2.853877		
90% 1.589669	2.919884	Variance	1.391573
95% 2.064287	3.148999	Skewness	.1168619
99% 3.148999	3.563077	Kurtosis	2.781574

Fed Financial Stress Index

Percentiles	Smallest		
1% -1.4431	-1.7601		
5% -.38935	-1.4431		
10% -.267	-.5623	Obs	180
25% -.1591	-.491	Sum of wgt.	180
50% -.013		Mean	-.0019867
	Largest	Std. dev.	.4213594
75% .18215	.5992		
90% .26145	1.0248	Variance	.1775438
95% .36855	1.0655	Skewness	4.932888
99% 1.0655	4.1555	Kurtosis	56.32835

US 2Y Bond Yield

Percentiles	Smallest		
1% -.53	-.88		
5% -.23	-.53		
10% -.16	-.42	Obs	180
25% -.055	-.4	Sum of wgt.	180
50% .02		Mean	.0183333
	Largest	Std. dev.	.1756154
75% .08	.51		
90% .18	.52	Variance	.0308408
95% .31	.61	Skewness	-.2090744
99% .61	.63	Kurtosis	8.316915

90 day AA Financial Commercial Paper Interest Rate

Percentiles	Smallest		
1% -.24	-.26		
5% -.185	-.24		
10% -.06	-.24	Obs	180
25% -.02	-.19	Sum of wgt.	180
50% 0		Mean	.0383333
	Largest	Std. dev.	.1278437
75% .045	.54		
90% .135	.61	Variance	.016344
95% .25	.63	Skewness	2.375962
99% .63	.64	Kurtosis	11.6396

Fed Change

Percentiles	Smallest		
1% -.6	-.93		
5% -.125	-.6		
10% -.02	-.3	Obs	180
25% 0	-.28	Sum of wgt.	180
50% 0		Mean	.0242778
	Largest	Std. dev.	.1504557
75% .02	.47		
90% .13	.52	Variance	.0226369
95% .235	.65	Skewness	-.3987844
99% .65	.7	Kurtosis	17.10069

IHSG Return

Percentiles	Smallest		
1% -10.31042	-11.17132		
5% -5.530598	-10.31042		
10% -2.984248	-7.973307	Obs	180
25% -.7885208	-7.123828	Sum of wgt.	180
50% .8195155		Mean	.8291581
	Largest	Std. dev.	3.263401
75% 2.984712	6.165134		
90% 4.584485	7.178926	Variance	10.64978
95% 5.690879	8.59828	Skewness	-.665358
99% 8.59828	9.832262	Kurtosis	4.448666

Consumer Confidence Index

Percentiles	Smallest		
1% -27.2	-29		
5% -6.75	-27.2		
10% -4.149998	-15.1	Obs	180
25% -1.849995	-11.6	Sum of wgt.	180
50% .2000008		Mean	.1166667
	Largest	Std. dev.	5.183628
75% 2.600002	13		
90% 4.450001	15.8	Variance	26.87
95% 5.899998	17.9	Skewness	-1.352199
99% 17.9	18.2	Kurtosis	13.22598

Indonesia Retail Sales MoM

Percentiles	Smallest		
1% -33.4	-41.5		
5% -17.25	-33.4		
10% -12.35	-26.1	Obs	180
25% -4.35	-22.5	Sum of wgt.	180
50% 2.15		Mean	.8533333
	Largest	Std. dev.	9.26698
75% 6.1	15.8		
90% 8.85	17.3	Variance	85.87692
95% 10.8	20	Skewness	-1.153581
99% 20	21.8	Kurtosis	5.478068

MSCI Emerging Markets

Percentiles	Smallest		
1% -13.84213	-17.28459		
5% -8.439317	-13.84213		
10% -5.422734	-12.54214	Obs	180
25% -2.9772	-11.75762	Sum of wgt.	180
50% .1311599		Mean	.2266723
	Largest	Std. dev.	5.043099
75% 3.193441	10.2258		
90% 6.756135	12.40303	Variance	25.43285
95% 8.562389	13.3743	Skewness	-.1649467
99% 13.3743	14.40107	Kurtosis	3.807239

Global Price Index of All Commodities

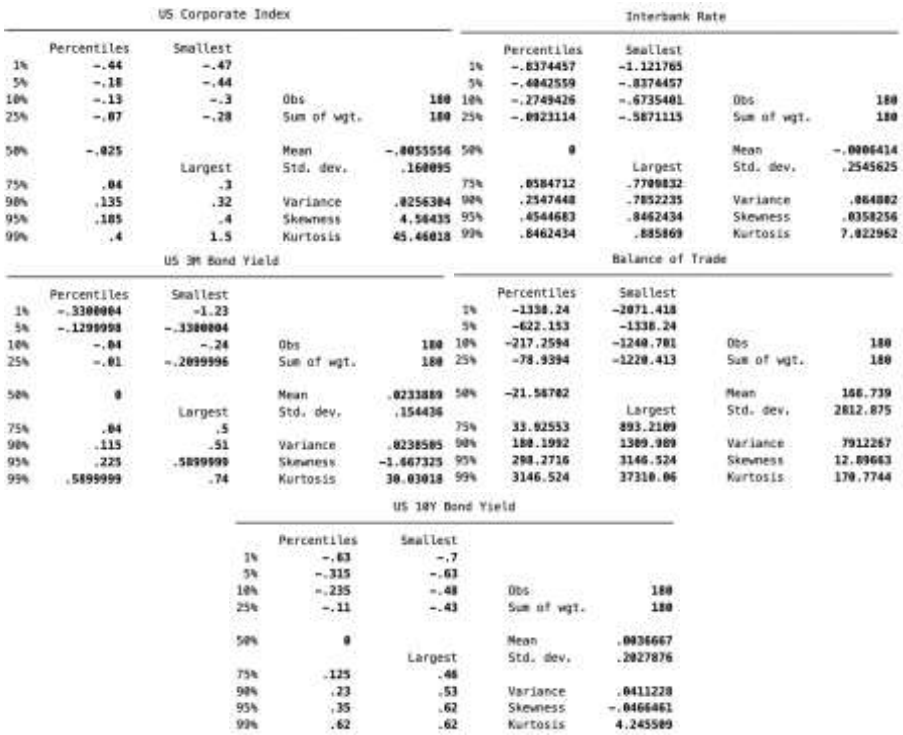
Percentiles	Smallest		
1% -.1395227	-.1672993		
5% -.0710186	-.1395227		
10% -.0565325	-.0997272	Obs	180
25% -.0194076	-.0996244	Sum of wgt.	180
50% .0038398		Mean	.0009739
	Largest	Std. dev.	.0429683
75% .0277548	.0853784		
90% .0473164	.0893401	Variance	.0018463
95% .0566018	.1098978	Skewness	-.3866109
99% .1098978	.1643693	Kurtosis	5.136057

Fed National Financial Conditions Index

Percentiles	Smallest		
1% -.24121	-.37804		
5% -.08717	-.24121		
10% -.058435	-.15867	Obs	180
25% -.035435	-.13834	Sum of wgt.	180
50% -.008435		Mean	-.0015775
	Largest	Std. dev.	.0779917
75% .022695	.17573		
90% .069105	.23522	Variance	.0060827
95% .09713	.25619	Skewness	1.738553
99% .25619	.55763	Kurtosis	20.11453

Global price of Brent Crude

Percentiles	Smallest		
1% -25.11526	-49.50101		
5% -14.11078	-25.11526		
10% -9.745084	-23.45935	Obs	180
25% -4.666661	-23.07404	Sum of wgt.	180
50% 1.004059		Mean	-.02503
	Largest	Std. dev.	8.666546
75% 5.287197	17.43571		
90% 8.481892	17.62886	Variance	75.10902
95% 11.83104	18.8634	Skewness	-1.278864
99% 18.8634	23.13137	Kurtosis	8.622994



US Corporate Index

	Percentiles	Smallest		
1%	-.44	-.47		
5%	-.18	-.44		
10%	-.13	-.3	Obs	180
25%	-.07	-.28	Sum of wgt.	180
50%	-.025		Mean	-.0055556
		Largest	Std. dev.	.160095
75%	.04	.3		
90%	.135	.32	Variance	.0256304
95%	.185	.4	Skewness	4.56435
99%	.4	1.5	Kurtosis	45.46018

Interbank Rate

	Percentiles	Smallest		
1%	-.8374457	-1.121765		
5%	-.4042559	-.8374457		
10%	-.2749426	-.6735401	Obs	180
25%	-.0923114	-.5871115	Sum of wgt.	180
50%	0		Mean	-.0006414
		Largest	Std. dev.	.2545625
75%	.0584712	.7709832		
90%	.2547448	.7852235	Variance	.064802
95%	.4544683	.8462434	Skewness	.0358256
99%	.8462434	.885869	Kurtosis	7.022962

US 3M Bond Yield

	Percentiles	Smallest		
1%	-.3300004	-1.23		
5%	-.1299998	-.3300004		
10%	-.04	-.24	Obs	180
25%	-.01	-.2099996	Sum of wgt.	180
50%	0		Mean	.0233889
		Largest	Std. dev.	.154436
75%	.04	.5		
90%	.115	.51	Variance	.0238585
95%	.225	.5899999	Skewness	-1.667325
99%	.5899999	.74	Kurtosis	30.03018

Balance of Trade

	Percentiles	Smallest		
1%	-1338.24	-2071.418		
5%	-622.153	-1338.24		
10%	-217.2594	-1240.701	Obs	180
25%	-78.9394	-1220.413	Sum of wgt.	180
50%	-21.56702		Mean	168.739
		Largest	Std. dev.	2812.875
75%	33.02553	893.2109		
90%	180.1992	1309.989	Variance	7912267
95%	298.2716	3146.524	Skewness	12.89663
99%	3146.524	37310.06	Kurtosis	170.7744

US 10Y Bond Yield

	Percentiles	Smallest		
1%	-.63	-.7		
5%	-.315	-.63		
10%	-.235	-.48	Obs	180
25%	-.11	-.43	Sum of wgt.	180
50%	0		Mean	.0036667
		Largest	Std. dev.	.2027876
75%	.125	.46		
90%	.23	.53	Variance	.0411228
95%	.35	.62	Skewness	-.0466461
99%	.62	.62	Kurtosis	4.245509

Figure 6 Descriptive Statistics for Key Macroeconomic and Financial Variables

The FX reserve growth variable shows relatively moderate variation, with a mean of 0.447 and a standard deviation of 2.69, as documented in the descriptive output on page 1 of the PDF . The distribution exhibits mild negative skewness and a kurtosis close to 4, suggesting occasional episodes of sharp reserve drawdowns such as during global tightening cycles. In contrast, USD liquidity growth in PUAB Valas displays extreme volatility, with a standard deviation exceeding 62 and kurtosis above 6, indicating the presence of large liquidity shocks within the period. These characteristics align with the behavioral differences observed later in the regression models, where reserve growth responds more structurally while liquidity growth is driven by short horizon sentiment and funding pressures.

Global financial variables also exhibit distinct statistical patterns. The USD global cycle index records a mean of 0.19 with moderate volatility and near-symmetric distribution. The Real Broad Dollar Index shows a similar behavior, with relatively balanced skewness and kurtosis, reflecting the cyclical but less erratic nature of broad dollar movements. The Fed Financial Stress Index, however, shows very high kurtosis, exceeding 56 on page 2 of the descriptive results , indicating that financial stress events are rare but extremely large when they occur. U.S. yield variables follow similar patterns. The U.S. 3M bond yield exhibits negative skewness and significant kurtosis around 30, while the U.S. 2Y yield shows long right-tail events, reflecting global monetary policy cycles over the sample period. These attributes are consistent with the literature on global financial cycle dynamics, which suggests that major U.S. monetary shocks create fat-tailed behavior in yield series.

Domestic financial indicators present different levels of variability. The interbank rate changes have a near-zero mean and low standard deviation, indicating stable short-term liquidity conditions in normal periods, but the kurtosis above 7 suggests abrupt shifts during tightening episodes. The 10-year Indonesian government bond yield exhibits a substantially

higher dispersion, with a standard deviation exceeding 30 and positive skewness. This reflects Indonesia's sensitivity to capital flow reversals and external financing shifts, particularly during high-volatility periods such as the taper tantrum and early pandemic episodes. The IHSG return displays typical equity market dynamics with moderate positive mean, negative skewness, and kurtosis above 4, capturing both bull market periods and sharp corrections.

External sector variables such as Indonesia's export growth show moderate variation with a mean around 0.39 and kurtosis near 3.5, indicating a distribution closer to normal compared to financial variables. The trade balance, however, shows extremely heavy-tailed behavior with kurtosis above 170, as noted on page 3 of the descriptive tables . This reflects episodes of exceptionally large surpluses and deficits driven by global commodity cycles. Commodity price variables show a wide range of behavior. The global price of Brent crude has a mean near zero but significant standard deviation and high kurtosis, reflecting oil price shocks. The Global Price Index of All Commodities exhibits a more stable profile with lower variance and moderate tails, aligning with its broader composition.

Sentiment-driven domestic variables such as the Consumer Confidence Index and Retail Sales show distribution patterns associated with consumption cycles. Both variables have meaningful skewness and kurtosis, suggesting asymmetric responses during contractions and expansions. For instance, retail sales exhibit negative skewness and kurtosis above 5, indicating sharper declines during downturns compared to the pace of recovery. The MSCI Emerging Markets Index displays positive mean returns but substantial tail risk, consistent with emerging market vulnerability during global risk-off periods.

The descriptive results show a simple but clear pattern in how the variables behave. Many global financial variables have very heavy tails, which means they often show sudden large movements during global shocks or stress periods. Domestic bond yields and stock returns also move a lot, mostly because they are sensitive to capital flow changes. External sector variables tend to show extreme values during commodity up and down cycles, while sentiment indicators move in an uneven way when the economy goes through transitions. These patterns help explain why some variables in the next regression sections end up having strong and significant effects on FX reserves and USD liquidity. Understanding how the data behaves at this early stage makes it easier to interpret the later results and see how global conditions, domestic behavior, and external sector dynamics all influence Indonesia's external stability.

2. FX Reserve Model

a) Model Estimation and Spesification

The FX reserve model adopts a multivariate Ordinary Least Squares (OLS) approach, as diagnostic tests indicate the absence of heteroskedasticity (Breusch–Pagan p = 0.3967) and serial correlation (Breusch–Godfrey p = 0.1869). The dependent variable is the monthly growth rate of Indonesia's FX reserves (dlr_res). Independent variables include domestic financial conditions, global dollar indicators, global funding stress, U.S. money market rates, export performance, and control variables for seasonality and the COVID period. The estimated regression equation derived from the Stata output is expressed as:

Table 2 summarizes the overall fit and diagnostic indicators of the FX reserve model estimated using Ordinary Least Squares. The F-statistic, R-squared, adjusted R-squared, and Root Mean Squared Error demonstrate the model's explanatory strength and confirm that a

substantial proportion of monthly reserve fluctuations can be explained by macro-financial variables. These statistics help assess whether the model captures systematic patterns and whether the included variables collectively hold predictive content, consistent with econometric standards for macro-financial regression modelling (Ghosh & Ostry, 2023).

Table 1 FX Reserve Model Statistics

Statistic	Value
Number of Observations	180
F-statistic (22, 157)	8.35
Prob > F	0
R-squared	0.5392
Adjusted R-squared	0.4746
Root MSE	1.9485

Source: Processed data from Bank Indonesia, Federal Reserve Economic Data, TradingEconomics, and Yahoo Finance

The model yields an R-squared of 0.5392, indicating that approximately 54 percent of the monthly variation in FX reserves is explained by the included macro financial variables. This level of explanatory power is substantial for a high-frequency macroeconomic model and aligns with prior literature highlighting the importance of global liquidity and domestic macro fundamentals in shaping reserve dynamics (Obstfeld, Shambaugh, & Taylor, 2010; IMF, 2023).

b) Intrepetation of Key Coefficients

Table 3 shows the estimated coefficients for all variables used in the FX reserve model. Each number in the table explains how much monthly reserve growth changes when one variable moves by one unit while the others stay the same. The significance levels help identify which variables have the strongest and most reliable effect on Indonesia's reserves. This table acts as the starting point for the economic interpretation that follows, where each important coefficient is linked to ideas from earlier studies, such as global liquidity cycles, interest rate gaps, and domestic liquidity conditions (Obstfeld, Shambaugh, & Taylor, 2010).

Table 2 FX Reserve Model Result

Label	Parm	Estimate	Stderr	t	p	min95	max95
90 day AA Financial Commercial Paper Interest Rate	cpf3m_change	5.2663	2.5459	2.0686	0.0402	0.2377	10.2949
Export from Indonesia	export_growth	0.0374	0.0181	2.0716	0.0399	0.0017	0.0731
Interbank Rate	interbank_change	1.6438	0.6632	2.4786	0.0142	0.3339	2.9538
Real Broad Dollar Index	rbdi_growth	-4.7127	0.8905	-5.2924	0.0000	-6.4715	-2.9538
Fed Financial Stress Index	stlfsi4_change	-2.2741	0.5394	-4.2157	0.0000	-3.3395	-1.2086
USD Consumer Price Index	us_cpi_growth	2.5686	0.7987	3.2161	0.0016	0.9911	4.1461

US 2Y Bond Yield	usd2y_change	-3.1089	1.2486	-2.4899	0.0138	-5.5751	-0.6426
USD Global Cycle (index)	usd_idx_chg	3.8837	0.8073	4.8105	0.0000	2.2890	5.4783
US 3M Bond Yield	usdm3_change	-6.8093	2.3012	-2.9590	0.0036	-11.3545	-2.2640
10Y Bond Yield	y10_change	-0.0299	0.0057	-5.2130	0.0000	-0.0412	-0.0186
Months Dummy	1b.month	0.0000	0.0000			0.0000	0.0000
	2.month	1.0144	0.7250	1.3992	0.1637	-0.4176	2.4464
	3.month	-0.2921	0.8229	-0.3550	0.7231	-1.9175	1.3333
	4.month	1.0708	0.7251	1.4767	0.1418	-0.3615	2.5031
	5.month	-0.3176	0.7576	-0.4192	0.6756	-1.8139	1.1788
	6.month	0.0409	0.7390	0.0554	0.9559	-1.4187	1.5006
	7.month	0.0834	0.7439	0.1121	0.9109	-1.3860	1.5528
	8.month	1.3295	0.7470	1.7797	0.0771	-0.1461	2.8050
	9.month	0.1895	0.7295	0.2598	0.7953	-1.2513	1.6304
	10.month	-0.3183	0.7585	-0.4196	0.6753	-1.8165	1.1799
	11.month	0.5071	0.7428	0.6826	0.4959	-0.9601	1.9743
	12.month	2.4978	0.7460	3.3481	0.0010	1.0242	3.9713
COVID-19 period	covid	-0.3852	0.4338	-0.8879	0.3759	-1.2421	0.4717
	_cons	-0.5230	0.5539	-0.9441	0.3466	-1.6171	0.5712

Source: Author's calculation using the OLS method based on macro-financial data

The result for the Indonesian 10-year sovereign yield (y10_change) shows a negative and significant coefficient. This means that when domestic yields go up, Indonesia's FX reserves often face more pressure. Situations like this usually happen when capital starts to leave the country or when risk levels increase, which forces Bank Indonesia to use its reserves to help keep the exchange rate stable. This pattern agrees with the global financial cycle theory, which explains that tighter monetary policy in advanced countries can push yields higher in emerging markets and make them more likely to experience capital outflows (Rey, 2015).

Global dollar strength, measured through changes in the USD Index (usd_idx_chg), exhibits a strong positive and highly significant coefficient. This result indicates a counterintuitive but policy-consistent mechanism: during periods of global dollar appreciation, BI often undertakes stabilizing interventions that, in the Indonesian context, correlate with reserve accumulation during specific windows, especially when supported by export inflows.

Interbank liquidity contributes positively to reserve growth, highlighting the stabilizing role of domestic money market conditions. When domestic liquidity is ample, the need for FX conversion declines, easing pressure on BI's reserves. Export growth also exerts a positive influence, consistent with the traditional external balance view that strong export performance reinforces reserve accumulation (World Bank, 2022).

U.S. inflation (us_cpi_growth) is positively associated with reserve growth, reflecting the relative attractiveness of emerging market assets when U.S. real returns decline. At the same time, global dollar funding stress, measured through rbdi_growth, exerts a negative effect on reserves, confirming that tighter global USD conditions reduce reserve buffers. Likewise,

higher global financial stress (stlfsi4_change) and changes in U.S. money-supply-related or money market rates (usdm3_change, usd2y_change, cpf3m_change) demonstrate statistically significant relationships with reserve movements, capturing broader liquidity cycle dynamics (BIS, 2024).

c) Summary of the FX Reserve Model

The FX reserve model shows that Indonesia's reserves are affected by a mix of domestic and global financial factors. Global factors related to USD strength and global funding pressure have the biggest impact. At the same time, domestic liquidity conditions and export performance help give more stability to the reserves. The results of the model suggest that Indonesia needs to monitor both global and domestic indicators together so that changes in FX reserves can be predicted better.

3. USD Liquidity Model (INNER VASE)

a) Model Estimation and Spesification

The USD liquidity model, with puab_valas_growth_adj as the dependent variable, initially exhibited serial correlation, prompting the use of Newey–West heteroskedasticity and autocorrelation consistent (HAC) standard errors with a lag structure of 12 months. This adjustment aligns with best practices in high-frequency macro financial modelling where residual autocorrelation is prevalent. The estimated regression equation, incorporating the Newey–West standard errors, is expressed as:

$$\begin{aligned}\Delta USDliq_t = {} & 21.4601 - 0.00417\, bot\_growth_t - 0.3697\, y10\_change_t + 3.6208\, ihsg\_geo\_ret_t \\ & - 2.2038\, consconf\_change_t - 1.8413\, retail\_mom\_change_t - 3.5252\, msci\_ret_t \\ & + 54.5107\, usdy10\_change_t - 39.8973\, us\_cpi\_growth_t - 6.7991\, rbdi\_growth_t \\ & - 502.162\, pallf\_growth_t - 323.4746\, nfci\_change_t + 4.5357\, brent\_crude\_price\_growth_t \\ & + 246.0996\, us\_corporate\_index\_change_t + \gamma_i\, Month_i + \delta\, Covid_t + u_t\end{aligned}$$

Table **4** presents the statistical summary of the USD liquidity model estimated with Newey–West heteroskedasticity and autocorrelation-consistent standard errors. The model's R-squared and adjusted R-squared show its ability to capture short-run liquidity fluctuations, while the F-statistic confirms joint significance of the explanatory variables. Because USD liquidity is influenced by market microstructure and institutional behavior, these statistics provide important context for interpreting the model's moderate explanatory power, which is consistent with empirical findings in USD funding market studies (BIS, 2024).

Table 3 USD Liquidity Model Statistics

Statistic	Value
Number of Observations	180
F-statistic (26, 153)	59.68
Prob > F	0
R-squared	0.4276
Adjusted R-squared	0.3303
Root MSE	50.784

Source: OLS estimation results, processed by the author from macroeconomic datasets.

The adjusted R squared value of 0.3303 shows that the model can explain some of the changes in USD liquidity, but it also suggests that there are other factors affecting USD liquidity that the model does not capture. These factors are usually related to how the market works in practice, for example the way dealers behave, certain regulations, or differences between onshore and offshore FX markets. This is similar to the view of the BIS, which explains that USD liquidity in emerging markets is not influenced only by macro numbers but also by market structure and institutional conditions (BIS, 2024).

b) Interpretation of Key Coefficients

Table X displays the estimated coefficients of the USD liquidity model, capturing the marginal impact of domestic sentiment, global risk indicators, commodity prices, and U.S. financial conditions on monthly changes in PUAB Valas liquidity. The coefficient signs and significance levels reveal how short-term USD funding pressures arise from both global shocks and domestic economic activity. The structure of the table allows for a clear evaluation of which variables exert the largest liquidity effects, consistent with the risk-taking and global financial cycle literature (Bruno & Shin, 2015; Rey, 2015).

Table 4 USD Liquidity Model Result

Label	Param	Estimate	Stderr	t	p	min95	max95
Balance of Trade	bot_growth	-0.0042	0.0010	-4.1585	0.0001	-0.0062	-0.0022
Global price of Brent Crude	brent_crude_price_growth	4.5357	1.3885	3.2667	0.0013	1.7927	7.2787
Consumer Confidence Index	consconf_change	-2.2038	1.0102	-2.1815	0.0307	-4.1995	-0.2080
COVID-19 period	covid	11.9737	13.3524	0.8967	0.3713	-14.4052	38.3525
Fed Change	fed_growth	-33.9437	26.6788	-1.2723	0.2052	-86.6500	18.7626
IHSG Return	ihsg_geo_ret	3.6208	1.6168	2.2395	0.0266	0.4267	6.8148
MSCI Emerging Markets	msci_ret	-3.5252	0.8409	-4.1920	0.0000	-5.1866	-1.8639
Fed National Financial Conditions Index	nfci_change	-323.4746	110.9451	-2.9156	0.0041	-542.6568	-104.2924
Global Price Index of All Commodities	pallf_growth	-502.1620	216.6950	-2.3174	0.0218	-930.2625	-74.0614
Real Broad Dollar Index	rbdi_growth	-6.7991	3.3774	-2.0132	0.0459	-13.4714	-0.1269
Indonesia Retail Sales MoM	retail_mom_change	-1.8413	0.3944	-4.6693	0.0000	-2.6204	-1.0622
US Corporate Index	us_corporate_index_change	246.0996	54.2807	4.5338	0.0000	138.8631	353.3361

USD Consumer Price Index	us_cpi_growth	-39.8973	25.3908	-1.5713	0.1182	-90.0592	10.2646
US 10Y Bond Yield	usdy10_change	54.5107	16.9478	3.2164	0.0016	21.0289	87.9926
10Y Bond Yield	y10_change	-0.3697	0.1192	-3.1013	0.0023	-0.6052	-0.1342
Months Dummy	1b.month	0.0000	0.0000			0.0000	0.0000
	2.month	-28.8924	30.3250	-0.9528	0.3422	-88.8021	31.0173
	3.month	15.2213	30.5254	0.4986	0.6187	-45.0843	75.5269
	4.month	-12.7734	27.6484	-0.4620	0.6447	-67.3953	41.8485
	5.month	-15.5856	26.4203	-0.5899	0.5561	-67.7813	36.6102
	6.month	-32.8630	28.4418	-1.1554	0.2497	-89.0523	23.3263
	7.month	0.8937	25.5677	0.0350	0.9722	-49.6176	51.4050
	8.month	-23.5920	26.7802	-0.8809	0.3797	-76.4987	29.3147
	9.month	-57.2325	24.5519	-2.3311	0.0211	-105.7370	-8.7280
	10.month	3.9867	24.0603	0.1657	0.8686	-43.5466	51.5200
	11.month	15.0863	31.4693	0.4794	0.6323	-47.0842	77.2568
	12.month	-22.7155	39.0846	-0.5812	0.5620	-99.9307	54.4998
	_cons	21.4601	26.1644	0.8202	0.4134	-30.2300	73.1502

Source: Author's calculation using the Newey-West (HAC) model.

The negative and significant coefficient on the trade balance (bot_growth) suggests that when export earnings are strong, banks demand less USD from the interbank market, easing liquidity pressures. The negative effect of the domestic yield (y10_change) indicates that tighter domestic monetary conditions reduce USD liquidity availability, consistent with capital outflow pressures.

Domestic sentiment variables, including consumer confidence and retail activity, exert significant negative effects, reflecting increased USD settlement demand during periods of heightened domestic economic activity.

The negative coefficient on global equity performance (msci_ret) demonstrates the contraction of USD liquidity during global risk-off episodes, while the positive coefficient on domestic equity returns (ihsg_geo_ret) indicates that stronger domestic markets attract capital inflows, easing onshore USD conditions.

Global financial stress indicators, including RBDI and NFCI, significantly reduce USD liquidity, reinforcing the sensitivity of Indonesia's money markets to global financial conditions (IMF, 2023). Commodity variables also play a central role, with pallf_growth (global price index of all commodities) showing a large negative effect, highlighting the asymmetric impact of broad commodity cycles on USD demand. Brent crude price growth exerts a positive impact, consistent with Indonesia's partial importer exposure to energy commodities.

Finally, the positive coefficient on the U.S. corporate bond index (us_corporate_index_change) indicates that improved U.S. credit conditions translate into better global USD liquidity, benefiting emerging markets such as Indonesia.

c) Summary of the USD Liquidity Model

The Newey West results show that USD liquidity in Indonesia is mostly affected by domestic sentiment, global risk conditions, movements in commodity prices, and financial factors coming from the United States. These findings suggest that USD liquidity pressure can come from many directions at the same time. The results also show that global financial cycles still have a strong impact on Indonesia's USD liquidity even though there are local factors that try to keep the market stable.

d) Integrated Model Interpretation

When the FX reserve model and the USD liquidity model are looked at together, they give a clearer picture of how strong Indonesia is against external shocks. Both models show that global financial factors, like the strength of the USD, global stress indicators, and U.S. bond yields, have a big impact on Indonesia. This supports the idea that Indonesia is heavily influenced by global liquidity conditions, which limits how much independence domestic policy can have.

Domestic liquidity helps stabilize FX reserves, but it affects USD liquidity in a different way. When people and businesses feel more confident and economic activity increases, the demand for USD in the interbank market also rises. Export performance helps build up FX reserves while at the same time reducing the need for banks to borrow USD, showing that the external sector can support reserves and lower USD pressure at once.

Commodity cycles also play an important role because they affect both FX reserves and USD liquidity. This matches Indonesia's economic structure, where exports and imports of commodities strongly influence FX inflows, outflows, and the overall demand for USD in the domestic market.

4. Summary of Findings

The empirical analysis yields several key findings central to understanding Indonesia's external stability. First, FX reserves are strongly driven by global liquidity conditions, including USD strength, global funding stress, and U.S. monetary variables, with domestic liquidity and export performance acting as stabilizing forces. Second, USD interbank liquidity responds strongly to domestic sentiment, global equity performance, U.S. financial conditions, and commodity cycles, highlighting its nature as a short-term, demand-sensitive channel. Third, the global financial cycle remains the dominant external force affecting Indonesia's reserve buffers and USD liquidity conditions. Fourth, the results underscore the need for an integrated macro financial monitoring system capable of synthesizing global and domestic

indicators to anticipate liquidity pressures and guide policy responses. These findings establish the empirical foundation for the strategic recommendations presented in Chapter 5.

Business Solution

The results of the analysis show that Indonesia's FX reserves and USD interbank liquidity are affected by different but still connected macro financial factors. FX reserves are mainly influenced by global dollar movement, global funding pressure, and the condition of domestic liquidity. On the other hand, USD liquidity in the interbank market is more affected by domestic sentiment, global risk preference, and changes in commodity markets. These findings suggest that Bank Indonesia needs a more coordinated policy approach that allows it to prepare for external pressure early, instead of waiting until the market becomes volatile

A first solution is the development of a Macro-Financial Early Warning System (MFEWS) that integrates the statistically significant variables identified in the FX reserve model, including USD Index movements, RBDI, global financial stress indicators, and U.S. yield curve dynamics. The system would function as a daily monitoring platform operated by BI's Monetary Management and Macroprudential Policy Departments. Its purpose is to identify early signs of pressure on reserves and guide pre-emptive FX intervention strategies. This framework is consistent with BIS (2024) and IMF recommendations emphasizing the value of real-time monitoring for emerging economies operating within the global financial cycle.

The second solution focuses on strengthening the resilience of the USD interbank market through a Pre-emptive USD Liquidity Operations Framework. Since domestic sentiment indicators such as consumer confidence and retail sales significantly reduce USD liquidity, these variables should be incorporated into BI's liquidity-forecasting models. When indicators reveal rising domestic USD demand, BI can activate USD liquidity lines, swap facilities, or targeted auctions to stabilize market depth. This approach aligns with the international literature on the risk-taking and liquidity channels in emerging markets (Bruno & Shin, 2015).

A third solution is the enhancement of external-sector stabilization through an expanded Trade-Linked FX Smoothing Mechanism. Because export growth increases reserves and improvements in the trade balance reduce USD borrowing needs, BI can encourage exporters to hedge via domestic non-deliverable forwards (DNDF). This reduces the volatility of FX inflows and supports sustained reserve accumulation, consistent with evidence on the stabilizing role of trade-based FX flows in commodity-linked economies (Aizenman & Sun, 2012; World Bank, 2022).

A fourth solution involves adopting a Commodity-Responsive Reserve Buffer Strategy. Given that global commodity indices significantly influence both reserves and USD liquidity, BI can adjust its target reserve buffers based on projected commodity cycles. During favorable commodity periods, reserving additional buffers enhances resilience against future downturns; during adverse cycles, controlled drawdowns paired with enhanced market operations help preserve stability.

Taken together, these solutions form an Integrated External Stability Framework that strengthens Indonesia's capacity to manage reserve dynamics and domestic USD liquidity in a synchronized manner. The framework operationalizes the empirical insights from this study by linking macro-financial signals to actionable policy instruments, improving the central bank's

ability to maintain external stability in the face of global shocks and domestic shifts in USD demand.

Implementation Plan and Justification

Effective implementation of the recommended policy framework requires a structured and coordinated approach within Bank Indonesia that integrates macro-financial monitoring, liquidity operations, and external sector engagement. The proposed implementation plan is designed to transition BI from a reactive posture to a more anticipatory regime, supported by empirical evidence from the FX reserve and USD liquidity models. The timing of implementation should align with BI's monthly and quarterly policy cycles, allowing the institutionalization of new monitoring tools and operational adjustments within existing governance structures.

The adoption of a Macro-Financial Early Warning System can be initiated within BI's Monetary Management Department, leveraging the statistical sensitivities identified in the FX reserve model. The system would be embedded within BI's daily market surveillance processes and integrated into decision rooms that support FX interventions. Its establishment is justified by the finding that global variables such as the USD Index, RBDI, and financial stress indicators exert large and statistically significant impacts on reserve movements, consistent with global financial cycle theory (Rey, 2015; IMF, 2023). The monitoring infrastructure can be implemented within a single quarter, utilizing existing Bloomberg, FRED, and SEKI data feeds already accessible to BI analysts.

For USD liquidity resilience, the introduction of a Pre-emptive Liquidity Operations Framework can be anchored in BI's Financial Market Operations Department. This framework should run continuously and be activated whenever domestic sentiment indicators or global stress signals surpass predefined thresholds. Empirical results show that consumer confidence, retail momentum, global equity performance, and U.S. yield curve shifts are all statistically significant predictors of USD liquidity tightness. These insights justify embedding sentiment-driven triggers within BI's liquidity forecasting models. Over time, the framework can expand into structured liquidity auctions or swap line activations during periods of anticipated stress, consistent with emerging market best practices (Bruno & Shin, 2015).

Implementation of trade-linked FX smoothing can be coordinated with Indonesia's export-facing institutions, particularly in partnership with banks offering DNDF products. BI's role involves adjusting DNDF parameters and communicating hedging incentives during exporter briefings and industry forums. This initiative should be aligned with BI's quarterly external sector assessments, as export growth and trade balance improvements were shown to significantly influence FX reserves. The timing allows exporters to integrate hedging strategies into their production and shipment cycles. The justification follows from the literature on trade-linked reserve stabilization in commodity-dependent economies (Aizenman & Sun, 2012; World Bank, 2022).

A commodity-responsive reserve buffer strategy can be embedded in BI's Reserve Management Division. Reserve targets would be recalibrated semi-annually using commodity price forecasts. The regression results show that the global commodity index and Brent crude prices substantially affect both FX reserves and USD liquidity, validating the need for commodity-sensitive reserve planning. This approach enhances BI's ability to accumulate

buffers during commodity upswings and manage drawdowns more strategically during downturns, consistent with IMF guidance on commodity-linked economies (IMF, 2023).

The final component, integrating global credit-cycle indicators into liquidity forecasting, can be implemented within BI's stress-testing and research units. Regular simulation exercises incorporating U.S. corporate credit metrics and Treasury yield movements should feed into BI's monthly liquidity reports. The strong empirical influence of U.S. credit conditions on Indonesia's USD liquidity justifies the inclusion of credit-cycle signals in operational planning. This enhances BI's ability to identify vulnerabilities arising from fluctuations in offshore USD supply, consistent with BIS (2024).

Putting these solutions into practice will help strengthen BI's overall framework for maintaining external stability. It allows BI to make decisions based on clear risk indicators, actual data patterns, and movements in global financial conditions. These proposals can work inside the current BI structure and do not need major regulatory changes. They also use data and tools that BI staff already understand. When these steps become part of BI's daily work, Indonesia will be in a better position to predict potential stress, keep FX reserves at a safe level, and support USD liquidity in the market.

CONCLUSION

This study aims to identify the macro-financial factors that affect the movement of Indonesia's foreign exchange reserves and their relationship with the liquidity condition of the USD in the interbank forex money market. Using the OLS model for foreign exchange reserves and the Newey-West model for USD liquidity, the results show that both variables are influenced by a combination of global and domestic factors, albeit with different response characters. Foreign exchange reserves are more sensitive to global liquidity cycles, USD movements, United States financial indicators, as well as global funding pressures, while USD liquidity reacts more quickly to domestic sentiment, short-term economic activity, and commodity market dynamics. These findings confirm that foreign exchange reserves are not always able to reflect short-term vulnerability, so USD liquidity analysis is an important complement in assessing external stability. Therefore, this study recommends an integrated monitoring approach between foreign exchange reserves and USD liquidity so that Bank Indonesia can detect pressures earlier, respond to global shocks more effectively, and strengthen Indonesia's external resilience in an increasingly complex global financial system.

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