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Exploring The Dynamics of Inflation, Interest Rates, and Us Dollar Exchange Rates: A Comprehensive Quantitative Analysis From 2013 To 2023

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Abstract. *This study examines the relationships between inflation, interest rates, and US dollar exchange rates from 2013 to 2023. The main objective is to evaluate the value of the US dollar (USD) and understand how key economic indicators interact. Using advanced quantitative analysis, we identify patterns that define these variables. A macro model incorporating the natural logarithms of the USD Index (USDX), Federal Funds Rate (FFR), and Consumer Price Index (CPI) addresses time-related and growth factors. By tracking inflation, interest rates, and dollar fluctuations, we gain insights into the factors influencing the US economy. The findings highlight the slow adjustment of inflation towards long-term stability and reveal significant causal relationships among the variables. As global financial conditions evolve, this study offers relevant insights for policymakers, economists, and market participants on navigating the dynamics of inflation, interest rates, and exchange rates in today's economic landscape.*

Keywords: *Inflation; exchange rate; the United States; fed; fed funds rate*

1. Introduction

Recent market dynamics have shifted significantly due to global events such as the COVID-19 pandemic, the Russo-Ukrainian War, the Israel-Palestine conflict, and subsequent economic recovery efforts. These external factors, combined with fluctuations in inflation and interest rates, emphasize the need for a comprehensive understanding of the factors influencing the value of the USD. The global economy operates in a dynamic environment where inflation is critical to stability (Gourinchas, 2022). Inflation, defined as the gradual increase in prices over time, reduces the purchasing power of money (Fernando, 2023). While research has extensively explored inflation's effects on various aspects of the economy, its impact on current values and interest rates requires closer examination.

Exchange rates are central to international trade, investment, and capital flows, measuring a country's competitiveness and cross-border transactions. Understanding the dynamics of exchange rates is vital for making informed decisions and managing the risks associated with currency fluctuations (Twin, 2023). The US operates under a floating rate system, where supply and demand determine currency value (Murray, 2000). Multiple factors, including economic indicators, monetary policy, trade balances, investor sentiment, and geopolitical developments, influence the USD's exchange rate. This system reflects the nation's commitment to market-based exchange rate determination (Jamil et al., 2023).

Interest rates are critical to economic activity, affecting borrowing costs, investment

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decisions, and overall economic growth. In the US, the Federal Reserve (the Fed) primarily implements monetary policy through the FFR, influencing other interest rates, such as mortgages and business loans (Svensson,2020). The Fed adjusts rates based on economic conditions, inflation, and desired economic growth and stability.

This study explores the complex relationship between inflation, interest rates, and exchange rates in the United States, focusing on how these variables influence each other and affect the value of the USD. While inflation erodes the USD's purchasing power, the Federal Reserve adjusts interest rates to manage inflation and stabilize the economy. However, the effects of these adjustments on the USD's global value remain unclear. This research addresses two key questions: how inflation and interest rates impact the USD individually and collectively and how these variables interact over time.

Through empirical analysis, this research provides insights into these relationships with practical implications for various stakeholders. Policymakers and central banks can use the findings to craft more effective monetary and fiscal policies, ensuring currency stability and inflation control (Amanda et al., 2023). Investors benefit by understanding the linkages between interest and exchange rates (Akbar et al., 2019), improving their investment strategies. Businesses engaged in cross-border trade can apply these findings to make more informed decisions. The study covers the period from January 2013 to October 2023, exploring the dynamic interplay between the USD, inflation rates (CPI), and interest rates (FFR). While existing literature provides valuable insights, a gap exists in understanding the evolving dynamics between these variables, particularly in light of recent global economic shifts.

The study relies on available historical data, which may contain inaccuracies, particularly during periods of economic volatility. External factors, such as geopolitical events and changes in global economic conditions, may influence currency values, although the focus remains on internal factors.

Hypothesis Development

The literature review offers valuable insight into the relationship between interest rates, inflation, and the US exchange rate. Building on existing theoretical frameworks and empirical evidence, this subsection formulates specific hypotheses to guide the research and test the effects of inflation expectations on currency values.

H1: Rising inflation, coupled with higher interest rates, weakens the value of the USD, indicating a negative correlation between inflation, elevated interest rates, and the currency's strength.

H2: A decrease in USD demand lowers its value, prompting the Fed to raise interest rates to attract capital, thereby strengthening the USD.

H3: *Higher interest rates in the US will slow domestic inflation.*

2. Literature Review / Hypothesis Development

Exchange Rates and Inflation – Purchasing Power Parity (PPP)

PPP posits that exchange rates adjust to equalize the prices of identical goods across countries. According to PPP theory, changes in inflation differentials between nations should reflect the exchange rate movements. Meese and Rogoff (1983) assessed this relationship using post-Bretton Woods data, revealing that deviations from PPP could be explained by inflation differentials, suggesting inflation drives exchange rate movements. Recent studies, such as Jamil et al. (2023), revisited these findings in light of global economic shifts, reaffirming the role of inflation differentials while highlighting the impact of global supply chain disruptions, particularly after the COVID-19 pandemic.

The Balassa-Samuelson effect provides another perspective on long-term exchange rate movements. This theory suggests that differences in productivity growth between tradable and non-tradable sectors can lead to persistent exchange rate appreciation in countries with higher productivity growth. As a result, inflation differentials caused by varying productivity levels influence exchange rates (Couharde et al., 2019).

Interest Rate and Inflation – The Fisher Effect
The Fisher Effect posits a direct relationship between nominal interest rates, actual interest rates, and expected inflation. The theory suggests that an increase in nominal interest rates, holding accurate rates constant, should correspond to expected inflation (Shobande & Shodipe, 2021).

Research on the United States provides insights into the relationship between interest rates and inflation. Taylor (2018) demonstrated a positive correlation between changes in US interest and inflation rates, suggesting that interest rate shifts influence inflation expectations and broader economic conditions. The Federal Reserve, with its dual mandate of price stability and maximum employment, plays a pivotal role in shaping interest rate and inflation policies. Bernanke (2020) explored the effectiveness of monetary policy tools in achieving these objectives, while Svensson (2020) expanded the analysis, examining post-pandemic inflationary trends and highlighting stronger correlations between interest rate adjustments and inflation control driven by supply chain challenges and rising energy prices.

Interest Rate and Currency Value of USD
The relationship between interest rates and exchange rates is critical for global trade, investment, and monetary policy. Theoretical models, such as Interest Rate Parity, suggest that exchange and interest rates move together. Higher interest rates attract foreign investment, strengthening the local currency, while lower rates may weaken it as investors seek better returns elsewhere. Smith (2021) found a statistically significant positive correlation between US interest rate changes and USD exchange rate fluctuations. However, Brown (2011) reported conflicting findings, suggesting that factors such as economic growth and geopolitical events may substantially influence the USD, highlighting the complexity of this relationship and the need for a nuanced understanding of contributing factors.

Exchange Rate Management
Policymakers have long struggled with managing exchange rates in the face of global inflation. Buffie et al. (2017) explored the difficulties of maintaining exchange rate stability while mitigating potential disruptions to currency markets. Ocampo et al. (2007) examined the effectiveness of exchange rate interventions, noting their impact on inflation rates and macroeconomic conditions. However, the success of such interventions remains debated, and further research is needed to understand their outcomes in various economic environments.

While extensive research has been conducted on the relationship between inflation, interest rates, and exchange rates through the lenses of PPP, the Fisher Effect, and Interest Rate Parity, there is a notable gap in understanding how these relationships evolve amid unprecedented global disruptions, such as the COVID-19 pandemic, geopolitical tensions, and supply chain constraints.

3. Methodology

Data and Methodology
This study utilizes monthly data from January 2013 to October 2023, including inflation (CPI), the FFR, and the USD value (measured by the US Dollar Index, USDX). Data on the FFR is sourced from the Federal Reserve Bank of St Louis, inflation data from the US Bureau of Labor Statistics, and the USDX from Investing.com.

Due to the complexity of measuring the USD's value against multiple significant currencies, the USDX is used as a proxy. As explained by Chen (2022), the USDX has measured the value of the USD against a basket of foreign currencies—including the Euro, Japanese Yen, British Pound, Canadian Dollar, Swedish Krona, and Swiss Franc—since 1973.

The selected period (2013-2023) captures key economic events such as the recovery from the 2008 financial crisis, the COVID-19 pandemic, and significant shifts in US monetary policies. This time frame allows for an analysis of how inflation, interest rates, and the value of the USD respond to internal and external pressures, providing valuable insights into the relationships between these variables during global economic change.

For Hypothesis 1, the Johansen Cointegration Test is used to identify long-term relationships between inflation, interest rates, and the USD's value. The Vector Error Correction Model (VECM) helps assess how these variables adjust over time, determining whether increases in inflation and interest rates result in a decline in the USD's value. Impulse Response Functions (IRF) are used to observe how short-term shocks in inflation or interest rates impact the USD.

For Hypothesis 2, the Granger Causality Test is employed to determine whether changes in USD demand influence interest rates. This test evaluates whether declines in USD demand lead to higher interest rates, supporting the hypothesis that the Federal Reserve raises interest rates in response to shifts in the USD's value.

For Hypothesis 3, the VECM is applied again to analyze whether rising interest rates slow down inflation. Variance decompositions are used to quantify the influence of interest rates on inflation trends.

Unit Root and Cointegration Tests

The Augmented Dickey-Fuller (ADF) test determines whether the variables (inflation, interest rates, and the US Dollar Index) are stable over time. The ADF results showed the data is non-stationary in its original form but becomes stable after first differencing, ensuring stability for further analysis. The optimal lags are selected using the Schwarz Information Criterion (SIC) (Schwarz, 1978). The Johansen Cointegration Test is then used to examine long-term relationships between inflation, interest rates, and the USD. The results confirm a long-term connection, suggesting that changes in one variable eventually affect the others, and they return to a balanced state over time.

The long-run relationship between the variables can be examined using Johansen. The VAR of order p can be shown as:

$yt = \mu + A1yt-1 + \cdots + Apyt-p + \varepsilon t$ *(1)*

$\Delta yt = \mu + \pi yt-1+i=1p-1iyt-i+t$ (2)

Where:

$\pi=i=1pAi-I$ and $i = j=i+1pAj$ (3)

If the coefficient matrix π has a reduced rank r < n, where n is the number of variables, then there exist nxr matrices α and β, each with rank r. The number of co-integrating relationships is denoted by r, α represents the adjustment parameters in the VECM, and β represents the co-integrating vector. The VECM explores how inflation, interest rates, and the USD react when they are temporarily out of balance. For example, if inflation suddenly rises, VECM helps us understand how long it will take for inflation to return to its balanced state. It also shows how interest rates and the dollar might respond to this change in the short-term.

Johansen proposes two test statistics to test for cointegration: the trace test and the maximum eigenvalue test.

The maximum eigenvalue test is represented as:

Jtrace(r, r+1)=-Tln(1-λr+1) (4)

Moreover, the null hypothesis of r co-integrating vectors versus the alternative of r+1 co-integrating vectors is examined through testing (Johansen, 2000). The maximum eigenvalue test is preferred because it furnishes outcomes specifically for the exact number of r vectors in co-integrating.

Pairwise Granger Causality Test

The Pairwise Granger Causality test is used to determine whether one variable can predict another in a time-series analysis (Eric, 2021). This study examines whether past inflation values can predict future exchange rate movements, indicating a causal relationship between inflation and exchange rates. To conduct the Granger Causality Test, collect the data on inflation, interest rates, and the USD over the specified period. Then, apply the test to assess whether the values of inflation have significant predictive power for future exchange rate movements. If inflation Granger-cause exchange rate changes, it supports the idea that inflation significantly influences USD values. If not, the absence of Granger causality suggests other factors may drive exchange rate fluctuations.

IRF

While the Pairwise Granger Causality test shows causality between variables, it does not capture their overall interaction. The IRF evaluates how a shock in one variable affects others in the system over time (Enders, 2014). The IRF, represented by yi, reflects the response of variable i to shock j at time horizon t. The vector moving average (VMA) framework is employed under the covariance stationarity, where:

yt=μ+t + E1t-1+E2t-2+… (5)

yt=i=0Eit-i+μ (6)

This VMA representation helps us describe how the system responds (yi) when there is an external influence or shock (εj)

yt+n = i=0Eit+n-i (7) Eni,j = yi,t+nj,t (8)

represents the derivative of yi concerning εj for all j≥0 (Enders, 2014). The representation of vector moving averages enhances empirical causal analysis and facilitates the examination of policy effectiveness, particularly when investigating specific economic issues (Lütkepohl, 2008) instead of using the VAR model. It is crucial to acknowledge that the IRF operates, assuming all other shocks remain constant. Consequently, meaningful shocks require specific structural information for accurate identification. In this context, the Cholesky decomposition by Hatemi (2014) proves valuable for pinpointing the fundamental shock.

Variance Decompositions

Variance decomposition breaks down changes in a dependent variable to explain the impact of random shocks within the system. Using Cholesky decomposition, the analysis isolates the effects of these shocks on the variables. This method offers a clearer understanding of the relationships between inflation, interest rates, and exchange rates.

$$A = LL^T \qquad (9)$$

When considering L as the Cholesky factor of A, both A and L can be partitioned as follows:

$$\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ a_{31} & a_{32} & \cdots & a_{3n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} l_{11} & 0 & \cdots & 0 \\ l_{21} & l_{22} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ l_{n1} & l_{n2} & \cdots & l_{nn} \end{bmatrix} \begin{bmatrix} l_{11} & l_{21} & \cdots & l_{n1} \\ 0 & l_{22} & \cdots & l_{n2} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & l_{nn} \end{bmatrix}$$

(10)

Simply, Cholesky decomposition breaks down a square matrix into a triangular form, multiplied by its transpose, providing valuable insights in certain analyses.

4. Findings and Discussion

This study uses a macro model to evaluate the USD's value from January 2013 to October 2023. The analysis includes the USDX, the FFR, and the inflation rate, represented by the CPI.

Figure 1 presents the trends in these macroeconomic variables over time, with natural logarithms applied to solve time and growth issues. Over the ten years, both the USDX and CPI display upward trends, while the FFR, which had been rising gradually since 2013, was significantly adjusted in 2020 due to the COVID-19 pandemic when the government lowered rates to stimulate the economy. Post-pandemic, interest rates increased rapidly.

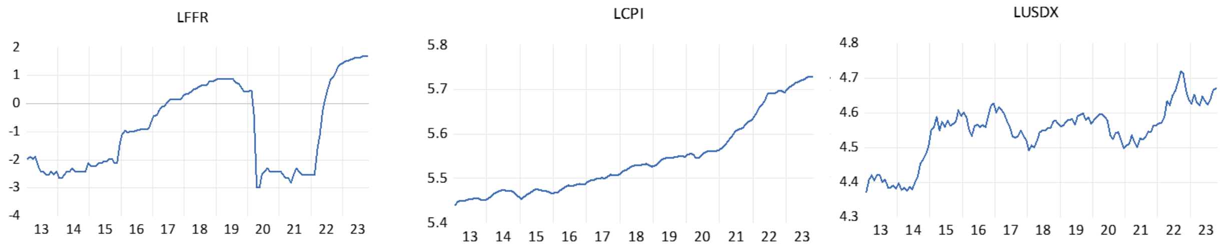

Figure 1.
Natural Logarithm Chart
Source: US Bureau of Labor Statistics, Economic Research Federal Reserve Bank of St Louis, Investing.com; Notes: LFFR = natural logarithm of US Fed Funds Rate, LCPI = natural logarithm of CPI, LUSDX = natural logarithm of USD Index

Table 1 presents the descriptive statistics for the variables, including the mean, median, maximum, and minimum values, confirming the accuracy and consistency of the data. Although the variables are not normally distributed, skewness and kurtosis metrics confirm that this is typical for time-series data. The sample size of n = 130 for each variable is adequate for time-series analysis.

Table 1.
Data Properties

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Observations
LUSDX	4.5459	4.5614	4.7195	4.3721	0.0791	-0.6279	2.9868	130
LFFR	-0.8813	-0.9809	1.6733	-2.9957	1.5028	0.2259	1.4936	130
LCPI	5.5421	5.5270	5.7294	5.4392	0.0832	0.9106	2.6783	130

Table 2
Unit Root Test

	Unit Root Test: ADF t-stat					
Series	**Level**	**5% level**	**Lag**	**1st Diff**	**5% Level**	**Lag**
LCPI	1.82	2.88	1	6.07	2.88	0
LFFR	1.32	2.88	1	7.59	2.88	0
LUSDX	1.82	2.88	0	10.93	2.88	0

The ADF test reveals that at the 5% significance level, all variables (LCPI, LFEDFUNDRATE, LUSDX) are non-stationary at their levels but become stationary after first differencing, meeting the criteria for cointegration analysis, which requires variables to be integrated at order one (I(1)).

Johansen Cointegration and Long-Run Estimation

The Johansen Cointegration Test (Table 3) rejects the null hypothesis of no co-integrating vector, confirming at least one co-integrating vector among the variables. The normalized co-integrating equation demonstrates a long-term equilibrium relationship between USDX, CPI, and FFR. The estimation shows that CPI has a significant positive long-term effect on the value of the USD (coefficient = 4.65), while FFR has a smaller, negative impact (coefficient = -0.15). Both coefficients are statistically significant at the 1% level.

Table 3
Cointegration Tests

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.18	25.20	22.30	0.02
At most 1	0.06	8.04	15.89	0.54
At most 2	0.01	1.69	9.16	0.84

Table 4
Lag used Table

Lag	LogL	LR	FPE	AIC	SC	HQ
0	112.8864	NA	3.31e-05	-1.801417	-1.732465	-1.773411
1	822.5265	1372.746	3.40e-10	-13.28732	-13.01151	-13.17530
2	850.9738	53.63022*	2.48e-10*	-13.60613*	-13.12347*	-13.41009*
3	856.8371	10.76536	2.61e-10	-13.55471	-12.86519	-13.27465
4	865.7283	15.88763	2.62e-10	-13.55292	-12.65656	-13.18885
5	871.5625	10.13812	2.76e-10	-13.50102	-12.39780	-13.05293
6	875.4263	6.524057	3.01e-10	-13.41682	-12.10675	-12.88471
7	883.8692	13.84094	3.05e-10	-13.40769	-11.89076	-12.79156
8	891.1523	11.58118	3.16e-10	-13.37955	-11.65576	-12.67940

The normalized co-integrating equation is formed by dividing each co-integrating vector by the corresponding negative co-integrating vector of Y. Consequently, there is a noteworthy long-term correlation between USDX, CPI, and FFR. The long-term estimation and corresponding coefficients are shown below:

$$USDX = 4.65CPI^{*} - 0.15FFR^{*} + 20.87^{*} \quad (11)$$
$$(2.32) \quad (3.64) \quad (2.95)$$

The normalized cointegration equation clearly suggests a noteworthy positive long-term influence of the CPI on the USD value. The impact is larger (coefficient = 4.65) than the FFR (coefficient = -0.15), which is having a negative impact on the USDX, on average, ceteris paribus. The coefficients are statistically significant at the 1% level.

VECM and Causality

In Table 5, VECM shows that only the DLCPI equation of ECT is significant (-4.86), suggesting the CPI bears the most in short-term adjustment towards long-run equilibrium. Approximately 0.2955% of the imbalance is corrected monthly, suggesting slow adjustments, taking roughly 28 years to fully resolve disturbances. A 1% change in USDX corresponds to a 2.55% decrease in CPI in the short-term, while a 1% change in FFR is linked to a 0.05% rise in USDX.

The Granger Causality Test reveals that USDX Granger caused both FFR and CPI at a 5% significance level. However, there is no evidence that FFR Granger causes USDX, indicating a unidirectional causal effect from USDX to FFR. This challenges traditional views and suggests a need to rethink which variables drive the dynamics within the model.

Table 5
Vector Error Correction Model

Error Correction:	D(LUSDX)	D(LFFR)	D(LCPI)
CointEq1	-0.004923	-0.036119	-0.002955
	(0.00413)	(0.06130)	(0.00061)
	[-1.19196]	[-0.58922]	[-4.86079]
D(LUSDX(-1))	0.026103	1.478647	-0.025548
	(0.09041)	(1.34178)	(0.01330)
	[0.28873]	[1.10200]	[-1.92018]
D(LUSDX(-2))	0.109087	0.107226	1.55E-05
	(0.09149)	(1.35778)	(0.01346)
	[1.19239]	[0.07897]	[0.00115]
D(LFFR(-1))	0.005515	0.408064	0.000515
	(0.00643)	(0.09548)	(0.00095)
	[0.85725]	[4.27385]	[0.54386]
D(LFFR(-2))	0.001436	-0.157414	-0.000206
	(0.00644)	(0.09565)	(0.00095)
	[0.22280]	[-1.64575]	[-0.21695]
D(LCPI(-1))	0.373962	3.677357	0.555504
	(0.64534)	(9.57785)	(0.09497)
	[0.57948]	[0.38394]	[5.84911]
D(LCPI(-2))	-0.611859	2.147982	-0.198134
	(0.62827)	(9.32444)	(0.09246)
	[-0.97388]	[0.23036]	[-2.14293]

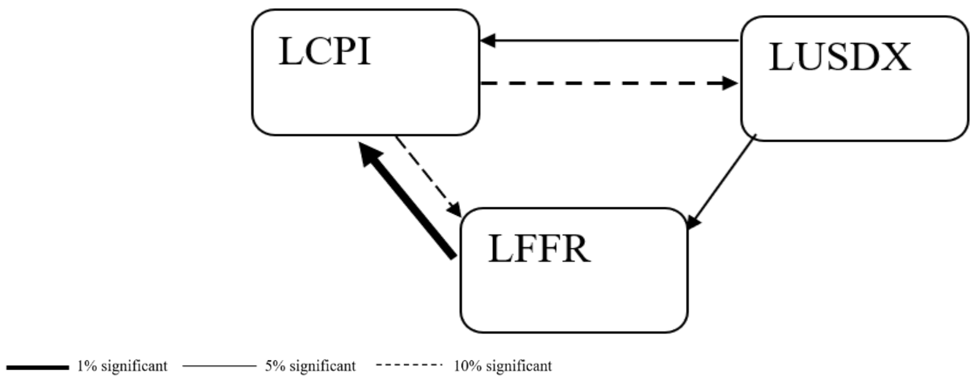

Figure 2.
Causal Effects within the VECM

IRF

The IRF, depicted in Figures 3, 4, and 5, illustrates how the variables respond to one standard deviation (SD) shocks in USDX, FFR, and CPI. An increase in CPI leads to a positive reaction in both USDX and FFR, which intensifies over time. Conversely, a positive shock to USDX has a persistent positive effect on itself but a negative impact on both FFR and CPI. An increase in FFR causes an immediate positive reaction in USDX but has a mixed impact on CPI, starting positive but turning negative over time.

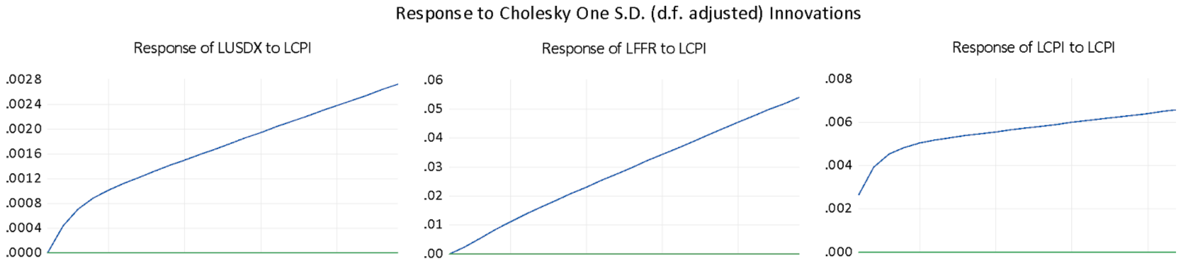

Figure 3
Impulse Response to LCPI

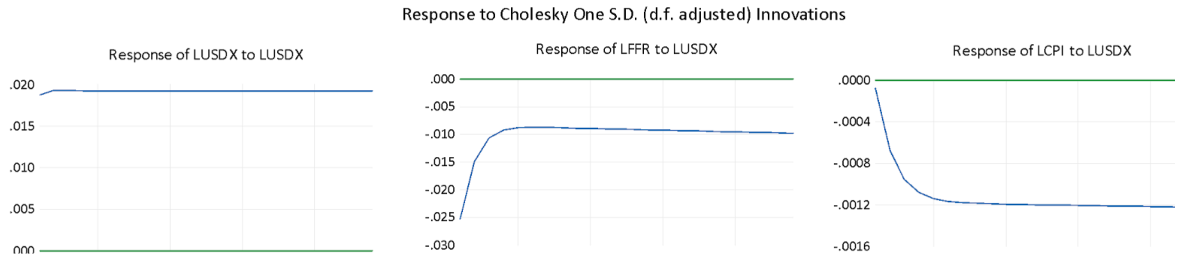

Figure 4
Impulse Response to LUSDX

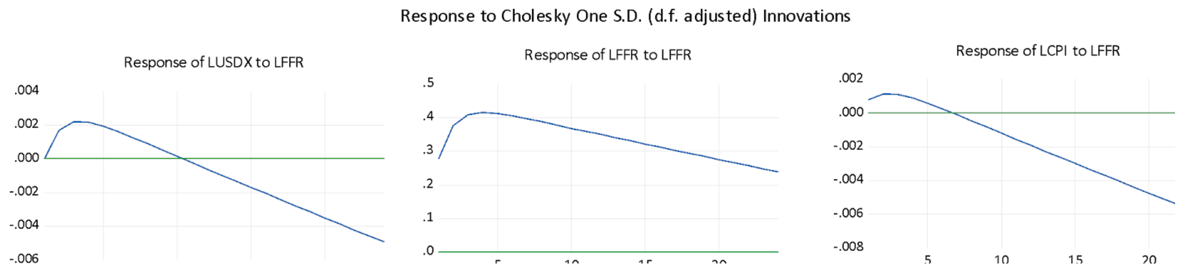

Figure 5
Impulse Response to LFFR

LUSDX (US Dollar Index): The response of LUSDX to the shock in LCPI is observed in subsequent periods. Initially, there was no response (as expected for the first period). As time advances, the response becomes positive and increases. This indicates that an increase in the CPI leads to a positive reaction in the US Dollar Index, and this effect becomes more pronounced over time.

LFFR (FFR): Like LUSDX, LFFR shows no immediate response in the first period. As time progresses, the response of LFFR becomes positive and grows. This suggests that an increase in the CPI leads to a positive reaction in the FFR, and this effect amplifies over time.

LCPI (CPI): The impulse response for LCPI starts at 0.002666 in the first period. As time progresses, the response of LCPI to its own shock increases. This suggests that the CPI reacts positively to the shock, and the effect accumulates over time.

LUSDX (US Dollar Index): The impulse response for LUSDX starts at 0.018784 in the first period. As time progresses, the response of LUSDX to its own shock remains positive and fairly stable. This suggests that a positive shock to the US Dollar Index leads to a persistent positive effect on itself.

LFFR (FFR): The response of LFFR to the shock in LUSDX is observed in subsequent periods. Initially, there is a negative response, indicating that an increase in the US Dollar Index is associated with a decrease in the FFR. This negative response diminishes over time but remains negative throughout the period.

LCPI (CPI): LCPI also shows a negative response to the shock in LUSDX. Initially, the response is negative, suggesting that an increase in the US Dollar Index is associated with a decrease in the CPI. This negative response becomes less pronounced over time.

LUSDX (US Dollar Index): The response of LUSDX to the shock in LFFR is observed in subsequent periods. Initially, there is no immediate response (as expected for the first period). As time advances, the response becomes positive and increases. This indicates that an increase in the FFR is associated with a positive reaction in the US Dollar Index, and this effect becomes more pronounced over time.

LFFR (FFR): The impulse response for LFFR starts at 0.277107 in the first period. As time progresses, the response of LFFR to its own shock remains positive and relatively stable. This suggests that a positive shock to the FFR has a persistent positive effect on itself.

LCPI (CPI): LCPI shows a mixed response to the shock in LFFR. Initially, the response is positive, suggesting that an increase in the FFR is associated with an increase in the CPI. However, this positive response diminishes over time and eventually turns negative, indicating a reversal in the relationship.

Variance Decompositions

Variance decomposition, presented in Table 6, breaks down the variance in one variable due to shocks in other variables. USDX remains the primary contributor to its own variance but is increasingly influenced by FFR and CPI over time. FFR primarily drives its own variance, while both USDX and FFR influence CPI as time progresses.

Table 6

Variance Decomposition Analysis

	Variance Decomposition of LUSDX:			
Period	S.E.	LUSDX	LFFR	LCPI
1	0.018863	100.0000	0.000000	0.000000
6	0.050444	99.33876	0.592072	0.069164
12	0.071990	99.63266	0.327134	0.040203
18	0.087269	99.54825	0.414880	0.036870
24	0.099453	98.95456	0.974723	0.070713
	Variance Decomposition of LFFR:			
Period	S.E.	LUSDX	LFFR	LCPI
1	0.279949	0.820566	99.17943	0.000000
6	0.908040	0.091333	99.28204	0.626626
12	1.253288	0.128579	98.87843	0.992996
18	1.483447	0.338846	98.25020	1.410952
24	1.651915	0.740367	97.33537	1.924268
	Variance Decomposition of LCPI:			
Period	S.E.	LUSDX	LFFR	LCPI
1	0.002776	0.256642	8.793087	90.95027
6	0.010840	7.116692	4.223233	88.66007
12	0.016751	11.91509	2.935845	85.14907
18	0.022697	15.61155	6.918439	77.47001
24	0.029286	18.24096	13.31898	68.44007
Cholesky Ordering: LUSDX LFFR LCPI				

LUSDX remains the main contributor to its own variance, but there is an increasing influence of LFFR and LCPI over longer horizons. LFFR dominates its own variance, and its influence remains over time. LCPI is primarily driven by its own shocks, with increasing contributions from LUSDX and LFFR over time.

Limitations of the Study

While this study provides valuable insights, it relies on historical data from January 2013 to October 2023, a period marked by significant economic events such as the COVID-19 pandemic and various geopolitical tensions. These events introduce unique disruptions that may not represent future conditions, limiting the study's ability to predict future trends. Additionally, the study focuses solely on the US economy, and its findings may not be fully applicable to other countries with different monetary policies or exchange rate systems. Future research could expand the analysis to other regions or explore comparative studies across different economic contexts.

5. Conclusions

The study provides crucial insights into the dynamics between the USD, FFR, and CPI from January 2013 to October 2023. The bidirectional Granger causality between USDX and FFR highlights the challenge policymakers face in balancing interest rate adjustments and the USD balue. The inability to substantiate Hypothesis 2 raises questions about the effectiveness of interest rate adjustments in strengthening the USD. The identification of a significant long-term relationship between these variables offers new perspectives, especially in the context of post-pandemic economic recovery and geopolitical tensions.

This study confirms a robust long-term influence of CPI on the USD, complementing previous research on exchange rate theories like PPP and the Fisher Effect. However, the finding that changes in interest rates have a limited short-term effect on currency values suggests a complex interaction between monetary policy and exchange rates, an area underexplored in recent literature.

The results underscore the substantial impact of CPI on the USD, suggesting that controlling inflation could serve as a strategic tool for currency stabilization. Policymakers are encouraged to explore inflation targeting to influence the USD value, especially given its role as a global reserve currency. External economic factors and geopolitical events further highlight the need for a comprehensive approach to monetary policy.

The study's recognition of linear relationships calls for future research to investigate potential nonlinearities in economic dynamics. Advanced econometric techniques can better capture these complexities. Additionally, variables that reflect global economic conditions, trade dynamics, and geopolitical events should be integrated to enhance model precision.

Policymakers can use these findings to inform more effective monetary and fiscal strategies. The significant role of inflation in shaping currency values suggests a stronger focus on inflation targeting, alongside interest rate adjustments and exchange rate management, for achieving macroeconomic stability. Future policy models should also account for external shocks, such as geopolitical events and global supply chain disruptions, to enhance economic resilience.

In conclusion, the study provides valuable insights into monetary policy interactions, global dynamics, and nonlinear relationships. It proposes future research directions, including scenario analyses in response to unexpected events, machine learning algorithms to identify hidden patterns and real-time monitoring of high-frequency data to improve model responsiveness. Furthermore, incorporating behavioral economics could offer a more holistic view of the factors influencing currency value, enriching our understanding of macroeconomic relationships and guiding future research in this area.

Declarations

Author contribution

All authors contributed equally as the main contributors of this paper. All authors read and approved the final paper.

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Competing interest

The authors declare that they have no conflicts of interest to report regarding the present study.

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