Temporal Dynamics and Volatility Analysis of the PHP–USD Exchange Rate

Baul, K.L., Cañete, M.C., Galario, A., Lapad, G.M., Panilag, A.J., Ramirez, G.M.
Department of Data Science
University of Science and Technology of Southern Philippines – CDO

Abstract

This study analyzes the behavior, volatility, and structural shifts of the PHP–USD exchange rate from 2018 to 2025. The exchange rate is treated as a dynamic indicator of broader macroeconomic conditions rather than an isolated variable. The analysis integrates inflation and interest rate differentials between the Philippines and the United States, along with trade balance measures, oil prices, and Overseas Filipino Worker (OFW) remittances. Daily USD–PHP closing prices serve as the primary dataset, while monthly macroeconomic indicators are temporally aligned through resampling and feature engineering.

Descriptive statistics, rolling-window measures, and visual time-series techniques are employed to examine trends, volatility patterns, and co-movements without imposing strict econometric assumptions. The results identify distinct phases of exchange rate behavior marked by stability, heightened volatility, and sharp directional changes. Comparative inflation analysis reveals higher variance, faster mean reversion, and weaker persistence in Philippine inflation relative to the smoother and more stable U.S. inflation process. Overall, the findings underscore the sensitivity of the PHP–USD exchange rate to relative macroeconomic pressures and structural dynamics, offering insights relevant to macroeconomic monitoring and risk analysis.

1 Introduction

1.1 Background and Significance

The PHP–USD exchange rate is a preeminent macroeconomic indicator for the Philippines, a small, open economy heavily reliant on remittances and imports. Fluctuations in the exchange rate directly affect domestic inflation—particularly through the cost of imported commodities such as oil—fiscal stability via US dollar–denominated debt servicing, and the welfare of remittance-receiving households.

Given these critical implications, understanding exchange rate dynamics requires moving beyond a univariate time-series perspective. Classical currency valuation theories, notably

Purchasing Power Parity (PPP) and Interest Rate Parity (IRP), posit that exchange rates are fundamentally influenced by cross-country differentials in inflation and interest rates. Consistent with these frameworks, this study incorporates Philippine inflation, US inflation, and the US Federal Funds Rate (DFF) to examine their relationship with the PHP–USD exchange rate.

The 2018–2025 period is particularly salient, as it encompasses extreme macro-financial shocks, including the COVID-19 pandemic (2020) and the aggressive US Federal Reserve interest rate tightening cycle (2022–2023). These events generated pronounced monetary policy divergence, significantly shaping capital flows and exchange rate volatility. Using a multivariate exploratory data analysis (EDA), this study investigates co-movement patterns and volatility dynamics among these variables, providing empirical insights relevant to exchange rate policy and financial risk management.

1.2 Statement of the Problem

From 2018 to 2025, the USD–PHP exchange rate experienced significant fluctuations driven by major global and domestic events, including the COVID-19 pandemic, shifts in interest rates and inflation, oil price instability, and geopolitical tensions such as the Russia–Ukraine war. These events likely affected currency behavior, but the extent, patterns, and timing of their influence remain unclear. This project aims to conduct exploratory data analysis (EDA) to examine how the USD–PHP exchange rate behaved during this period, identify potential seasonal trends, measure changes in volatility before and after the pandemic, and assess whether major events or macroeconomic factors contributed to notable movements in the exchange rate. Understanding these patterns can provide insights into currency sensitivity to shocks and support more informed economic analysis.

2 Methodology

2.1