

Vector Autoregression (VAR) and Foreign Exchange (FX) Returns

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Hypothesis

Vector Autoregression (VAR) is a statistical model used to analyze the dynamic relationships among multiple time series variables. VAR models are commonly used in econometrics, finance, and other fields to analyze and forecast multivariate time series data. We sought to investigate whether or not VAR is a valid technique for predicting returns of foreign exchange markets (such as the US/EURO exchange). Specifically, we wanted to test whether or not our time-series data satisfied certain assumptions necessary for VAR to be valid.

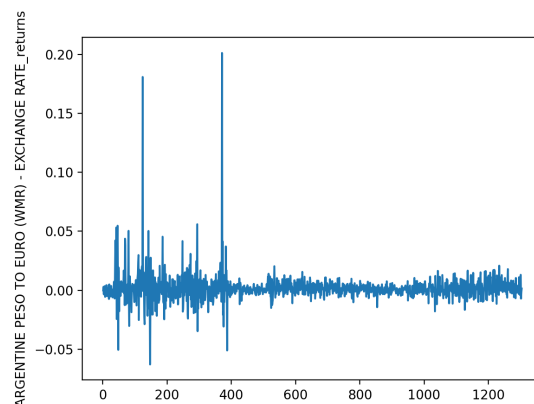
Data

We leveraged FOREX exchange rate data from Refinitiv's Eikon Datastream for the US dollar, British Pound, Swiss Franc, Mexican and Argentine Peso, Australian and Canadian dollar, Indian Rupee, Brazilian Real, Japanese Yen, and Chinese Yuan against the Euro from 3/8/18 to 3/8/23. We then created our time-series data for each exchange rate by renumbering dates into consecutive integer indices. For the few null data points, our remedy was to forward-fill these values.

Findings

Claim #1: Historical returns for foreign exchange markets are not statistically different than 0.

Support for Claim #1: Using a one-sample z-test, we failed to reject the null hypothesis, that the sample of log returns is 0, for all FX indices, except the Argentine Peso to Euro. While the z-score for this index was far higher than for all others, the graph we examined below indicated to us that this result was likely an outlier stemming from a brief period of high volatility.



Claim #2: Historical time-series data for log returns of FX indices is not likely to be affected by a unit root process that would invalidate the use of a VAR approach to forecast future returns.

Support for Claim #2: We used the Augmented Dickey-Fuller (ADF) test on each FX index to test for the presence of a unit root process that can cause issues with time series models like VAR. After converting the ADF test statistic for each of our 11 indices, we found that the largest p-value was, 9.82×10^{-15} and, thus, rejected the null hypothesis of the presence of any unit root processes for every FX index.

Claim #3: There are no significant autocorrelations in the time series of log returns for FX indices, which invalidates the use of VAR for forecasting future returns.

Support for Claim #3: We used the Ljung-Box Q-test on each FX index to test whether or not any FX index shows consistently statistically significant autocorrelations at different lags up to 15 periods. After converting the Q test statistic to a p-value for 15 lag periods for every index, we find that most indices only showed statistically significant autocorrelations for at most one lag period. We include the strength of autocorrelations for the US to Euro index as an example. Notice that only a lag of 6 periods shows any statistically significant autocorrelations. Without statistically significant autocorrelations, we are hesitant to further consider VAR for forecasting future returns.

