Exchange Rate Trading Strategy

1. PROJECT OBJECTIVE

The objective of this project is to develop and evaluate an exchange rate trading strategy using a macroeconomic fundamental as an indicator. The evaluation of the strategy will be based on 10+ metrics and compared with the HFRI Macro Currency index.

For the purpose of our paper, we are utilizing the 3-month Interbank Rates and employing a directional forecast for the DEXUSAL–the U.S. Dollars to Australian Dollar Spot Exchange Rate.

2. STRATEGY DESCRIPTION

2.1 Kalman Filter

The strategy involves utilizing the interest rate differential between two countries to predict the future movement of the exchange rate. By setting specific parameters, the strategy determines when a trading action should be taken based on the degree of movement observed. This allows for an understanding of the direction in which the exchange rate is likely to move and aids in forecasting future market trends..

2.2 Rules for Trading

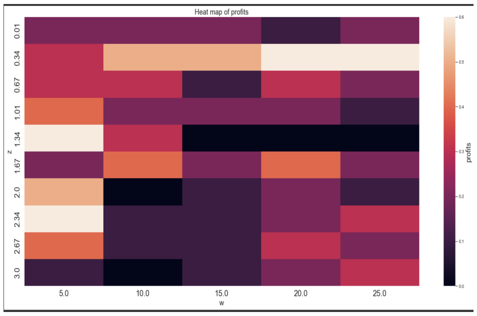
A. We go long (buy) when the signal equals 1 and we go short (sell) when the signal equals -1. The signals are generated based on the condition that the absolute difference between the filtered interest rates and their moving average is greater than ‘z’ times the rolling standard deviation of the filtered error.
B. The exit strategy is based on the holding period defined by the parameter 'h'. The positions are held for 'h' periods after a signal is generated. For example, if a long signal is generated at time 't', then we go long and hold the position for 'h' periods, i.e., until time 't+h'. At time 't+h', we exit the position. Similarly, if a short signal is generated at time 't', then we go short and hold the position for 'h' periods, i.e., until time 't+h', and exit the position at time 't+h'.

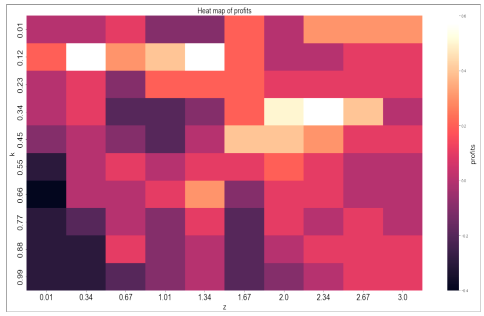
3. MODEL SELECTION

We are using 4 parameters k,w,h,z:

A. K is a hyperparameter that determines the weight given to the most recent data in the exponentially weighted moving average (EWMA) filter.
B. W is the window size for calculating the standard deviation using a rolling window.
C. H is the number of periods the strategy takes a position for after a signal is generated.
D. Z is the number of standard deviations used to calculate the upper and lower bounds of the signal based on the mean and standard deviation.

To conclude the optimal hyperparamters, we create heatmaps and get the following results:





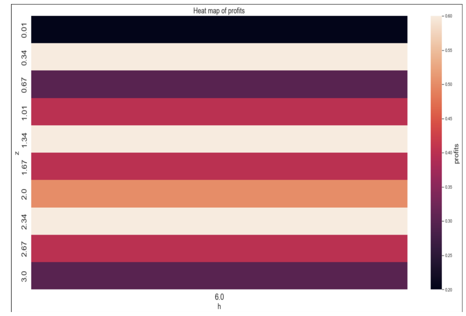


Fig 1. w & z **Fig 2. k & z** **Fig 3. h & z**

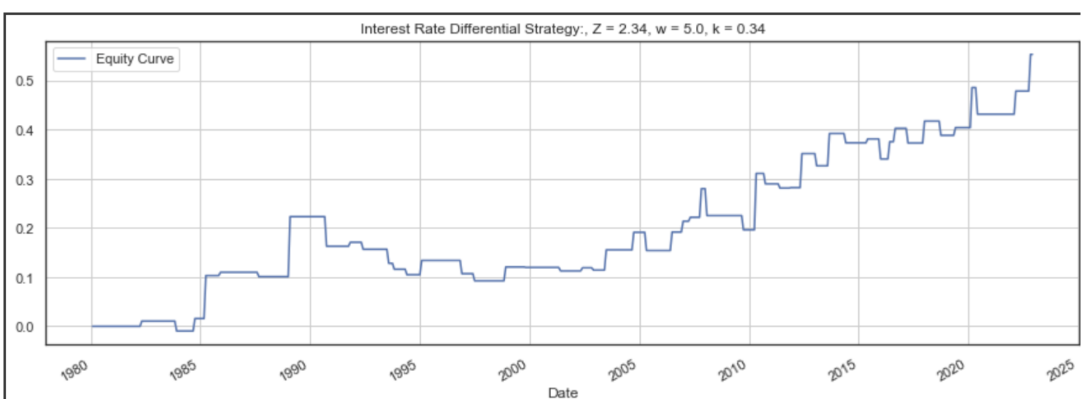
Analyzing the three heatmaps, the optimal values of parameters that we chose are:
k = 0.34, z = 2.34, w = 5.0 and h = 6.0.

The values have been chosen in a way that will maximize the profits from our trading strategy in a sustainable way, that is, it is not only showing a singular peak in profits but rather an area of light-toned spaces.. The final values are a combination of the optimal points from all 3 graphs.

Reasoning for not tuning 'h' :
When the holding period is short (e.g., hs = 1, 2, 3, or 4), the strategy generates frequent signals, and profits depend mainly on the accuracy and frequency of these signals, and less on the holding period. So, profits do not change much with different holding periods. However, when the holding period is longer (e.g., hs = 100), market movements have a greater impact on profits. Therefore, the optimal value for "h" may be larger than those tested in the code.

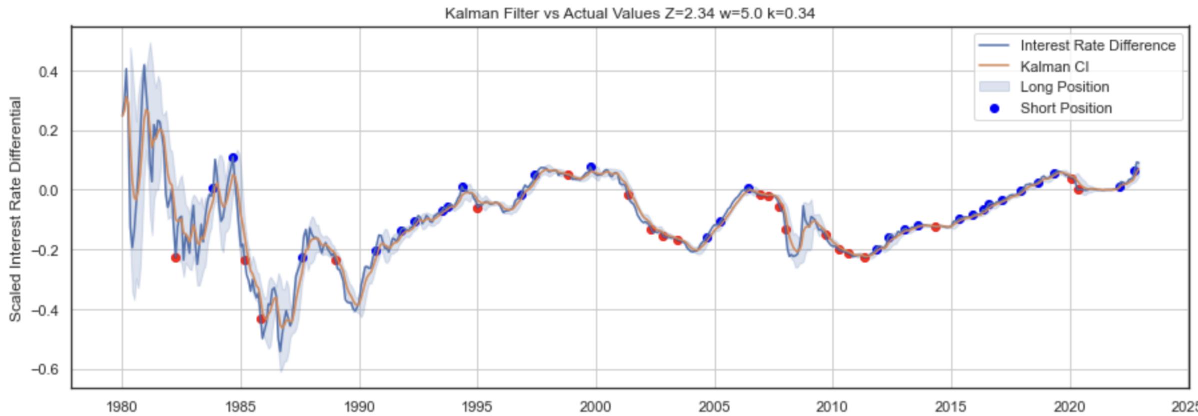
4. PERFORMANCE AND EVALUATION

4.1 a) Equity Curve

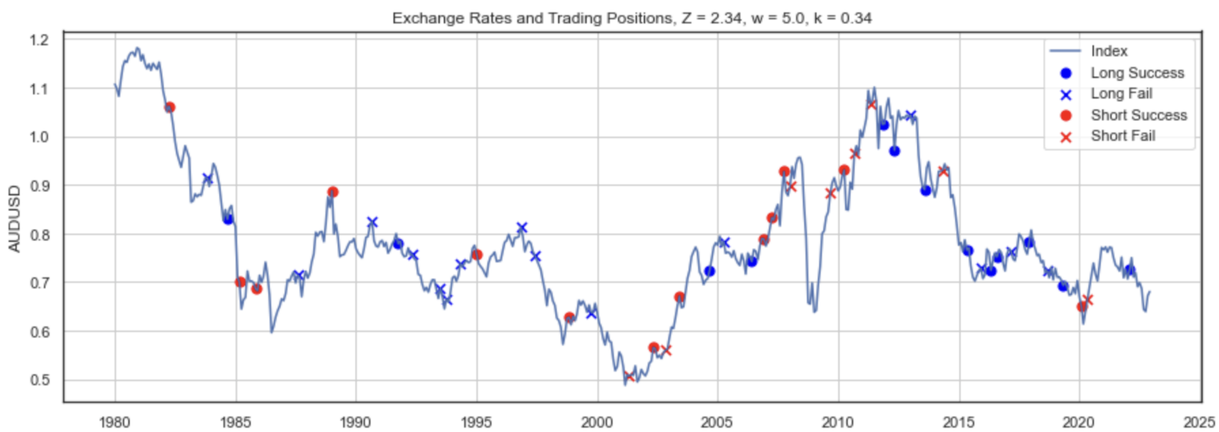


The equity curve here shows the performance of the strategy over time, indicating the returns generated by the strategy's trades. Although the performance often fluctuates, the overall trend can be categorized as increasing.

b) Kalman Filter vs Actual Values



c) Exchange Rates and Trading Positions



4.2 Binomial Test

The Binomial Test is a test of Statistical Significance for Directional Forecasts. The null hypothesis for this test is that our directional forecasts are uncorrelated with the realized directional changes, while the alternative hypothesis of the one-sided test is that it is positively correlated with the realizations.

Our test statistic is **-0.71509,** which is smaller than critical values from standard normal distribution, we fail to reject the null hypothesis. This suggests that our directional forecasts were unable to successfully capture the realized appreciation or depreciation of exchange rates.

4.3 Performance Table – A Comparison with HFRI Metrics

Risk/Return

Type	Our model	HFRI
Geo Average Monthly	0.0008	0.74
Std. Deviation	0.010824	1.99
High Month	0.105185 (on 1989-02-01)	7.88
Low Month	-0.0504 (on 1990-10-01)	-6.4
Annualized Return	1.03148	9.28
Annualized STD	0.89991	6.88
Risk Free Rate	2.98	2.59
Sharpe Ratio	-0.24420	0.95
% of Winning Mo	5.24271	62.31
Max Drawdown	-1.9026	10.7

Regression

Type	Our Model	HFRI
Alpha	-0.002	0.64
Beta	0.0057	0.14
Mnt. R-Squared	0.001	0.09
Correlation	0.02320	0.3
Up Alpha	0.0322	0.88
Up Beta	0.0461	0.09
Up R-Squared	0.004	0.01

Down Alpha	0.0045	0.17
Down Beta	0.0072	0.06
Down R-Squared	0.003	0.01

Major conclusions from the comparison table:

A. Our model's Sharpe ratio of -0.24420 is lower than the HFRI index's 0.95, indicating a lower risk-adjusted return.
B. The maximum drawdown of our model at -1.9026 is higher than the HFRI index's 10.7, showing a larger decline during its worst period.
C. The low correlation of 0.02320 between our model and the market suggests relative independence.
D. Our model's negative alpha of -0.002 underperformed the HFRI index's positive 0.64 on a risk-adjusted basis. The low beta of our model at 0.0057 indicates low sensitivity to market changes.
E. The up alpha, up beta, and up R-squared are positive, indicating better performance during positive market conditions, while the down alpha, down beta, and down R-squared are relatively low, suggesting weaker performance during negative market conditions.

Overall, while our model may have had a higher annualized return than the HFRI index, it also had a higher level of risk and lower risk-adjusted return. Additionally, our model's performance during negative market conditions was not as strong as during positive conditions.

Given more time, we would like to improve this strategy with more hyperparameter tuning and by exploring other macroeconomic fundamentals that can be used as indicators for movements in exchange rates. We could also explore strategy building with more than one indicator variable and using the combination of such fundamentals to capture more changes in the interconnected global economy.

5. CONCLUSION

The objective of this project was to develop a directional forecast strategy for exchange rates using various macroeconomic indicators. The procedure entailed employing a Kalman Filter and fine-tuning the hyperparameters to achieve maximum profits. Afterwards, performance and efficiency of the model were evaluated using metrics such as Binomial Test, Sharpe Ratio etc. Ultimately, we compared our outcomes with the HFRI Macro Currency Index to comprehensively evaluate the efficacy of our strategy. Engaging in this project facilitated our comprehension of possible modifications that can be made with more time to create a more effective trading strategy.