CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The FOREX financial market can be confirmed as the most variable and biggest market around the world.Although there are many methods and models to analyse and forecast the FOREX market. Because of the unpredictability and sensitivity of its characteristics for macroeconomic factors , it is significantly challenging to apply accurate forecasting of the futural values . However, with its intensive time-series relevance ,recently, there are developing loads of advanced techniques of ML (Machine learning) ,which erect more steadfast and precise predictive models such as LSTM(Long Short-Term Memory) and ARIMA(Autoregressive Integrated Moving Average) ,to address the accuracy issue of the FOREX predicting . Through the overall literature,it demonstrates that identifying the key features about the FOREX such as CPI(consumer price indices),interest rate and 10-year bond rate. Additionally, the project assimilates insights from EDA(exploratory data analysis) , feature engineering and results from modelling.

2.2 Macroeconomic Indicators

Macroeconomic indicators play a crucial role in foreign exchange rate movement,such as CPI,interest and 10-Year bond.There are some cases to interpret the relationship among these factors.For an instance,Kim and his mates (Kim,et al,2022) fathered the inadequacy of traditional econometric models, such as the uncovered interest parity (UIP) and purchasing power parity (PPP), which exceed the random basic models. These indicators can be confirmed as the key dataset for machine learning processing to forecast the future foreign exchange rate.

2.2.1 Interest Rate

Some studies have interpreted how interest rate movements impact on exchange rate over the time.For an instance,as the display of Yuenan(2023)'s study, while a central bank of the country increases their interest such as the Federal Reserve in the United States, it will lead to the result that rising their currency ,because international investments will benefit from high interest level,and then in the financial market, the demand of purchasing USD regularly rise.This study also declaim that because of interest highly boosting, the Chinese Yuan has devalued significantly.Through his study which discussed and implemented the impact of Federal Reserve System raising interest rate on the exchange rate of the US Dollar against the Chinese Yuan ,with the analysis of ARIMA,it illustrated that hiking the interest rate of the Federal Reserve led to the exchange rate of pairs USD/CNY steadfast increased over the time.

In addition,according to Marcin Kolasa's study(Marcin Kolasa,et,2022), they added behavioral agents to stretch the standard open economy New Keynesian framework .It conveyed a theory that the exposing to interest rate parity condition in a way and consisting with recent testing-evidence reconsidered that conducting positive monetary policy such as boosting the interest by central bank can significantly influence international output

comovement positively.Moverover,they developed the New Keynesian model with appraising an extension to successfully mitigated many problems which demonstrated the relationship between exchange rates and interest rates.Through their improvement of the model,they observed that the trending of the exchange rate under two different monetary policy statuses:Conventional Monetary Shocks and Low for Longer Policies.In the final exhibition,the result showed that during these statuses,the trending of exchange rate was intensively affected by the interest movement.

2.2.2 CPI

CPI usually can display a consumer situation of a country or place,and also is a key economic indicator of consumer price inflation. The CPI provides effective insight into how inflationary pressures may impact market patterns, company financial tables, and stakeholders. Joseph and his mate(Joseph,et 2023) researched the relationship between exchange rate and consumer price index with data context from South African.They adopt OLS (ordinary least squares) regression with the aid of Gretl econometric and statistics software to analyse the South Africa 2022 Consumer Price Index (CPI) YoY.After modeling ,they found that two-month later, there are a possible and positive movement in exchange rate while consumer price index get alteration. Furthermore, offering policies of economy and finance that may cushion the exchange rate volatility could catalyse a favourable effect on domestic prices, which is direly needed for the economic good of the citizens. They summarized their project and concluded that the oscillation of South African currency may positively and significantly impact the consumer price index,which means that there is a powerful relevance between CPI and FOREX.

There is another study to demonstrate the powerful relationship between CPI and foreign exchange rate. Through the study of Didarul and his mates (Didarul.et 2024),it is not herculean to recognise the dynamics of Uruguay's real effective exchange rate with the aid of the MundellFleming model. They analyzed crucial economic indicators and employed econometric techniques, and therefore revealed the significant insights of the determinants of Uruguay's currency. With

the analysis of the short-term real effective exchange rate in Uruguay currency,they deployed the Ordinary Least Squares(OLS) regression model.The model formula is below:

$$REER=\beta 0+\beta 1\times USLR+\beta 2\times M2+\beta 3\times CPI+\beta 4\times WIR+\varrho \quad (2.1)$$

After processing,they concluded that with maintained appropriate CPI,it will promote Uruguay currency healthily.

2.2.3 10-Year Bond

10-year government bonds play a significant role in affecting FOREX markets,Oscillations of these bonds have a great impact on currency valuations through various factors such as interest rate differentials,capital flows and stakeholders risk.Recently,there are some academic studies to elucidate these facts.Usually,10-Year bond indirectly impact FOREX market by directly influenced interest rate.Although it can not directly affect FOREX market,it still can be confirmed as a significant factor in short time.

As the study of Rosnawintang and his mates(2019),they analyzed the relationship between Indonesian currency and bond yield.According to their study ,it is a crucial theory that domestic interest rate is the sum of international interest rate and expectation of depreciation (or appreciation) of domestic currency exchange rate against foreign currency .Through their VAR(Vector autoregression) model,they collected the data of IDR/USD exchange rate and bond yield from January 2006 to December 2018 with monthly time series.After the feature engineering,they concluded that it is effective that the causal relationship between the government bond yield and paires IDR and USD exchange rate during the short-term relationship.They also declaimed that in the first three months, the response of the government bond yield against the exchange rate between IDR and USD was very strong (significant 1%).

2.3 FOREX prediction model

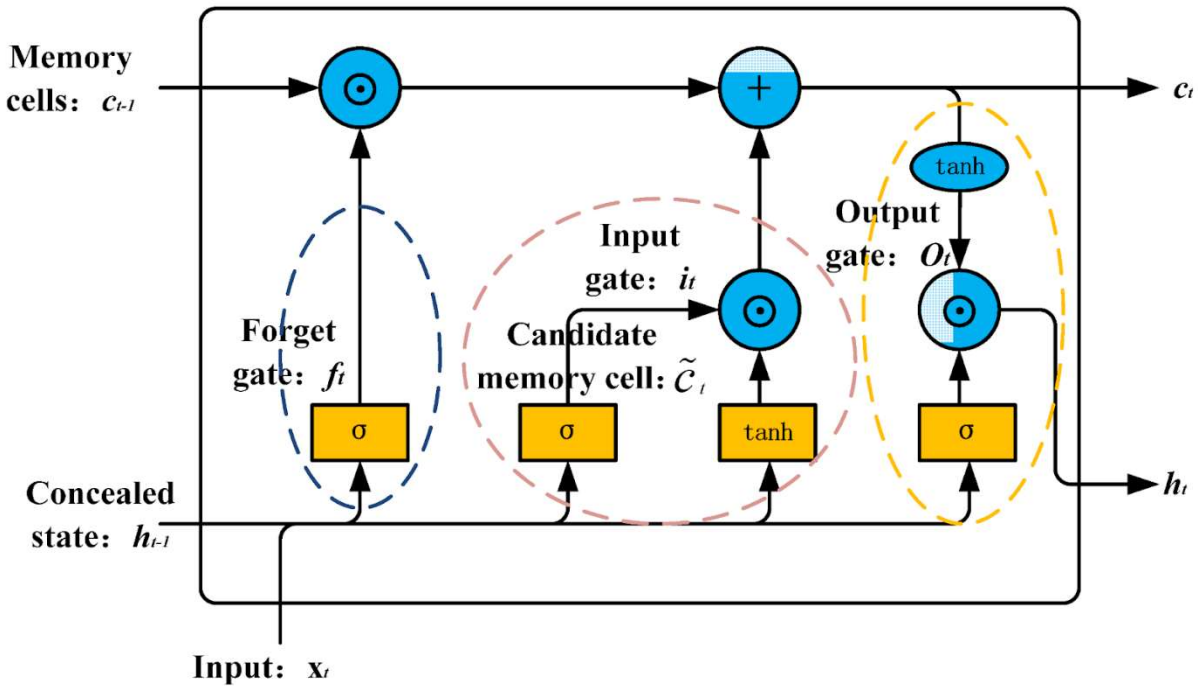
There is a famous deep learning technique which is called “long short-term

memory" (LSTM).It is known as very efficient in many time-series forecasting problems, to navigate direction predictions in the FOREX market. Going through recent studies,for predicting the future exchange rate,it is certain that many researchers prefer the LSTM model to complete the forecasting work.A study by (Deniz et al.,2021)stated that the single LSTM models were vaguely better than ME_TI_LSTM in profit_accuracy, which was less than 1% during the one-day size.However,in three-day scale, the individual LSTM models outperformed the ME_TI_LSTM in profit_accuracy by 5.81%.In the five days ahead forecation, they found that in the profit_accuracy results,it illustrated the similar relevance of individual LSTMs and the ME_TI_LSTM .

2.3.1 Long Short Term Memory Model (LSTM)

Long Short-Term Memory (LSTM) networks, a type of Recurrent Neural Network(RNN), were designed to resolve issues present in traditional RNNs, such as the vanishing and exploding gradient problems (Y. Bengio,1994). LSTM has three key characteristics :memory cells,gates mechanism and cell state.In terms of memory cells ,it is for storing and managing information around the time series,ensuring maintenance of relevant data while dropping irrelevant data.As for gates mechanism,usually,there are three different gates in the LTSM for regulating the flow of information.First one is called Forget Gate,which determining what data from cell state will be dropped .The second one is named Input Gate,storing the effective data in the cell state.The third one is called Output Gate ,picking the valued output to export at each step.The cells state can be imagined by a pathway,which engaged through the whole sequence, supporting data to flow with minimal modification unless regulated by the gates.The flow of LSTM details shows below Figure 2.1.

Figure 2.1 the work flow of LSTM



Based on the framework of LSTM, nowaday,researchers implement a series of applications. For example,because of an intensive allergy to time series,it is effective to predict the trending of the stock prices, weather, future FOREX rates and so on.It can not be ignored that LSTM plays an important role in processing data with its advantage.Speaking about advantages,contrasting to the traditional RNNs,LSTMs can deal with learning dependencies over long sequences well.Moreover,it also can accept the various length of sequences and convey a suitable data to tasks with irregular time series.

It performs well in alleviating the vanishing gradient problem,ensuring training operation stably around the processing.

2.3.2 Case Studies

Because of the importance of the FOREX,it is obvious to see more and more researchers involving detecting the future trending of exchange rate.By the paper (Ling Qi et al.,2020),they applied LSTM model in predicting the price of exchange rate with using technical indicators as the feature.Firstly,they collected

the data including four major currency pairings : GBP/USD, EUR/GBP, AUD/USD and CAD/CHF and 15 minutes interval data through Jan 2005 to Sep 2017 for training and testing data from Oct 2017 to Sep 2020 .Secondly,they set a sets of standard regression metrics which are mean square error, root mean squared error,mean absolute error and mean absolute percentage error.Then they select cleaned data for entering the LSTM model .At the final phrase of the experiment,they found that the performing of LSTM and GRU models substantially exceed th RNN model for three currency pairs – EUR/GBP, AUD/USD and CAD/CHF.In addition,they identified that concerning different time series,currency pairings perform the difference simultaneously.

Another study also highlighted the effectiveness of the LSTM in applying FOREX prediction.According to the research (Hasnaet al.,2020),they gathered EUR/USD historical data from 4 May 2010 to 19 October 2020 with 2718 records of daily time frame data and 64897 records of 1-hour timeframe data.For getting the best hyperparameters to process in the LSTM model ,they stored the RMSE test data from 02 January to 19 October 2020. After examining the daily timeframe,1-hour timeframe and comparing the previous years basing on 2020 prediction ,they found that the best hyperparameters were 2 hidden layers and 10 neurons with a dropout layer (0,1 rate) and the RMSE result which meant 0,624 × 10 in in the daily timeframe.In addition,as for 1-hour timeframe,it was 1 hidden layer and 5 neurons without a dropout layer and the RMSE result which meant 0,135 × 10 .They concluded that LSTM model process more accurate and effective than with chaos and turbulence such as 2020 COVID-19.