Research on the Prediction of Euro Pound Exchange Rate Based on ARIMA Model

Yaojun Yang*

School of Nanjing foreign, Nanjing, China

*Corresponding author: 100564@yzpc.edu.cn

Abstract. There have been many changes in the macroeconomy in recent years, both in the UK and in Europe. With the different global situations, the Pounds against euro is constantly being affected. This paper uses the ARIMA model as the main model to forecast the Euro Pound exchange rate for the next eight years. The results shows that it fluctuates slightly from 2022 to 2026, rises from 2026, reaches a peak of about 0.9 in the middle of the same year for the next eight years and then gradually declines, before suddenly and sharply falling to about 0.76 in 2030.This result is informative and helpful to users of both the Euro and the Pound to some extent. In turn, it is of great significance to the country in stabilising the foreign exchange market and preventing potential financial risks arising from a significant reduction in foreign exchange rates.

Keywords: Exchange rate, ARIMA, Python

1. Introduction

In financial markets, the exchange rate is known as the exchange rate at which one currency is exchanged for another. In most cases, currencies are national currencies, but they can also be currencies of national federations, such as the Euro which is the currency used by the European Union, or sub-national currencies, such as the Hong Kong dollar in Hong Kong.

Of course, the value of one country's currency relative to another currency is also considered to be the exchange rate. For example, a bank pound to Korean Won exchange rate means that one pound will be convertible to 1588 Korean Won, or that 1588 Korean Won is equivalent in value to one pound. In this case, it could be said that 1 GBP is 1588 relative to the KRW, or that 1 KRW is 1/1588 relative to the GBP. The retail currency exchange market will see a wide range of buy and sell prices offered by currency dealers. The majority of transactions are made and received in local money. The price at which a currency trader will purchase foreign currency is known as the "buy rate," and the price at which they will sell it is known as the "sale rate." The dealer's margin (or profit), which can be recouped by commissions or other methods, will be included in the advertised rate. Cash, documented operations, and wire transfers may all have varying rates. Documentary transactions have a higher rate since clearing them takes more time and money; cash, on the other hand, can be sold right once but has security, storage, and transit charges, considering the cost of investing capital in a stock of notes (bills).

In 2022, the Euro and Pound Sterling exchange rate, although reaching a low in January at about 0.83, has since recovered steadily and remained stable.

Exchange rate forecasting is very important for countries to better secure their interests in international trade, to attract foreign investment, to safeguard the value of their currency and exchange rates in their favour, etc.

As a result, there is a rich body of literature on exchange rates, focusing on foreign exchange risks and policies to prevent them, and the impact of exchange rates on foreign-owned enterprises. Of which, in terms of the Euro exchange rate, The Financial Times (2022) examines the impact on the euro exchange rate by comparing European gas price movements with energy supply shortages, and finds that the euro is likely to fall further to 0.90 against the dollar in the coming months, weighed down by Europe's growing energy crisis and the risk of recession. In the short term, if the flow of the two Nord Stream-1 gas pipelines does not return to normal levels after the end of the maintenance period on 21 July, the euro will face a rapid decline in the exchange rate. In the medium to long term

In the medium to long term, if the eurozone falls into recession, the currency markets will experience the extreme chaos of the past since the end of the Bretton Woods system in 1971, and the euro is likely to fall further. The euro is likely to fall further to a conclusion of $0.95 to $0.97.

This paper will therefore look at the recent exchange rate of the euro against the pound, a study that will contribute to the unfolding of trade and monetary policy reforms between EU countries and the UK.

A number of studies have been carried out on prediction methods,for example, Cao (2022) uses LSTM-ELM to prediction exchange rate between dollar and yuan in 2022,the results were obtained for a significant fluctuation in the US dollar over the next 120 days [1]. Lu (2022) used GARCH-ELMAN model, predicting the exchange rate between RMB and dollar and got that comparing the MSEs of the models on the training and test sets shows that purely linear models are less effective in predicting the series, such as GARCH and EGARCH and ELMAN neural network models have larger mean squared errors in predicting the series compared to the GARCH-ELMAN and EGARCH-ELMAN models, which leads to the conclusion that the USD-RMB series contains complex information and that the exchange rate is on the one hand The series is affected by the monetary policies of the two countries on the one hand, and by a series of factors such as import and export trade and foreign exchange transactions of the two countries on the other [2].

It is therefore impossible to predict accurately using only a single linear or non-linear model. The EGARCH-ELMAN model has the best prediction results in terms of relative and absolute accuracy of the series fit and is an important guide to actual exchange rate forecasting. Therefore, this paper uses ARIMA to forecast the Euro to Pound Sterling exchange rate based on considerations of personal competence, content of the research project, data smoothness and forecasting effectiveness.[2]

2. Data and Method

2.1 Data

The data source of the data that used to prediction is from Kaggle (https://www.kaggle.com).The data is from the euro daily hist from 1999 to 2022.In this paper, all data are saved and read as csv files, and four years of exchange rate data from 1999-2003 are extracted as the training set (as shown by the blue line 'y_true' in Figure 1.

2.2 Method

An auto regressive integrated moving average model is a generalization of an autoregressive moving average (ARMA) model which is widely applied in statistics and econometrics, particularly in time series analysis. These two similar models are both used to time series data for the sake of either better aware the data or predict future points in the series (forecasting).In some situations where data demonstrate evidence of mean non-stationarity (but not variance or autocovariance), ARIMA models are used, and to eliminate the–anti of the mean function, an earlier differencing check can be used once or more (i.e., the trend). Seasonal-differencing can be used to eliminate the seasonal component from a time series when it shows signs of seasonality [3]. The Wold's decomposition theorem states that the ARMA model is theoretically sufficient to represent a regular (also known as simply nondeterministic) wide-sense linear system, which is why we are driven to make fixed a non-stationary time series before utilizing it. In the event that the time series includes a predictable sub-process, take note (a.k.a. pure sine or complex) [4,5].

The formula for non-seasonal ARIMA models is commonly stated as ARIMA(p,d,q), where p denotes the order of the moving-average model, d is the grade of differencing, and q refers tothe priority of the autoregressive model (the number of time lags).The standard abbreviation for seasonal ARIMA models is ARIMA(p,d,q)(P,D,Q)m, where m stands for the number of periods in each season and the capital P, D, and Q stand for the auto-regressive, differencing, and exponential smoothing terms, respectively, for the seasonal component of the ARIMA model [4].

Given time series data X_t represents real numbers, an AR IMA(p’,q)model is given by

$$X_t - a_1 X_t - 1 - \ldots - ap' X_t - p' = \varepsilon_t + \theta_1 \varepsilon_t - 1 + \ldots + \theta_q \varepsilon_t - q \quad (1)$$

Or can be represented by:

$$\left(1 - \sum_{i=1}^{p} \phi_i L^i\right)(1-L)^d X_t = \left(1 + \sum_{i=1}^{q} \theta_i L^i\right) \varepsilon_t \quad (2)$$

2.3 Steps

1. Acquisition of time series: Time series can be generated by experimental research or by employing statistical information from relevant domains. The acquired data should be reviewed for abrupt points and examined for proof of human error or other factors. The first step to developing an appropriate model and ensuring that the proper analysis is performed is to ensure the validity of the information obtained.

2. Pre-processing of the time series: Two tests—the smoothness test and the white noise test—are part of the time sequence' pre-processing. A time sequence must meet the requirement of being a smooth, non-white noise sequence in order to be studied and predicted by the ARMA model. An essential stage in time sequence analysis is determining the smoothness of the data, which is typically done using time sequence plots and correlation plots. Autocorrelation plots, such as autocorrelation and partial autocorrelation function plots, are more complex but more accurate than time-series plots, which are distinguished by their intuitive simplicity but substantial mistakes. In this study, we first make an intuitive determination using the time series chart, and then we further examine our hypothesis using the correlation chart.For non-stationary time sequence, if there is an increasing or decreasing trend, then a differencing process is required and then a smoothness test is performed until smoothness is achieved. The model ARIMA's order is influenced by the quantity of differences (p,d,q). Philosophically, the extraction of non-stationary predetermined relevant data from the time series would be more effective with a greater number of differences. However, theoretically, more differences are not necessarily better because each difference functionality will result in the loss of relevant information, so excessive differences should be managed to avoid.

3. Model identification: The choice of a model from a pool of well-known models that best fits the specified time period activity is known as model identification. The Box-Jenkins model identification approach is just one of numerous model identification techniques.

4. Model order: The BIC criterion approach can be used to determine the ranking of the model after the model's type has been established.

5. Parameter estimation: Most frequently, correlation moment overestimation, least squares estimation, and maximum likelihood estimation are used to estimate a model's parameters.

6. Model validation: The model is validated to ensure that it fits the data. If the model effectively or totally explains the significance of the system data, then the model's noise series is white noise, and the model's validation also serves as a test of the noise series' independence. Barlett's theorem can be used to test the statistic Q and develop the Baybody test. The model should be modified till it can pass the self-noise test if the resulting model fails the test.

3. Results

This paper uses python to build ARIMA for exchange rate forecasting. Python is a general-purpose, high-level, interpreted computer language. Its design philosophy prioritizes code readability and employs a lot of punctuation [6-8]. In addition,it is one of the most widely used computer tools[9,10].

In order to ensure that the data can be used,this study performs a smoothness test of the data and the results of pacf test and acf test are separately shown in figure 2 and figure 3. If graph 'pacf' is trailing, graph 'acf' is also trailing, so it is a smooth series. This study also conduct the white noise

test or the data, it is concluded that the data is not white noise. Therefore the ARIMA model should be used most appropriately.

The exchange rate forecast results are shown in figure 1. The orange line 'y_pred' in the graph 'exchange rate'. It fluctuates slightly from 2022 to 2026, rises from 2026, reaches a peak of about 0.9 in the middle of the same year for the next eight years and then gradually declines, before suddenly and sharply falling to about 0.76 in 2030.

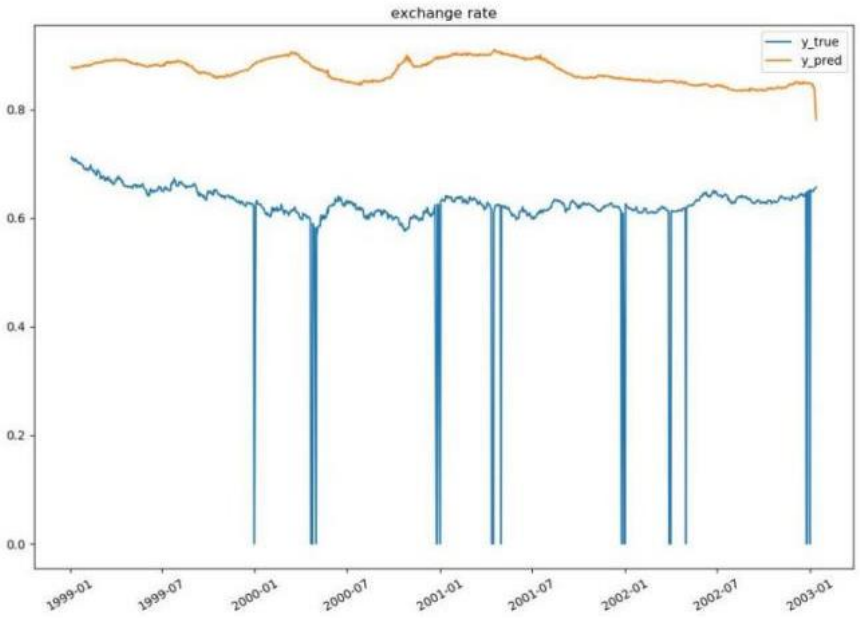

Fig 1. prediction and test diagram

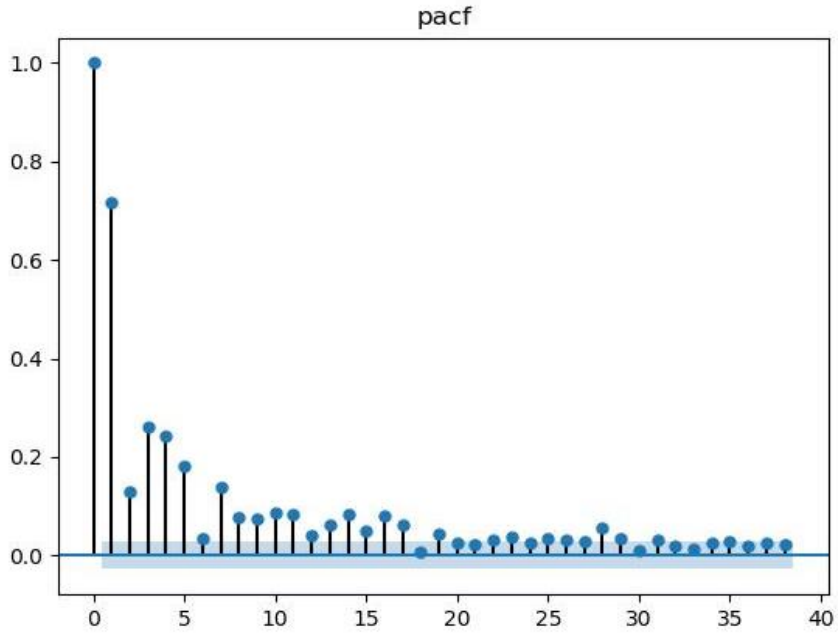

Fig 2. pacf diagram

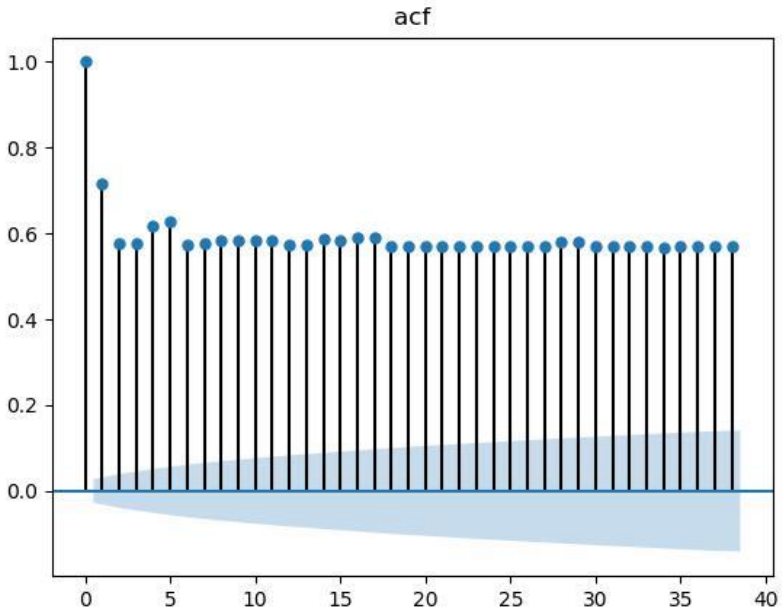

Fig 3. acf diagram

4. Discussion

4.1 Government intervention to stabilise the exchange rate

The foreign exchange reserve ratio is used to regulate the currency derivative capacity, except that it regulates the liquidity of domestic foreign exchange. If the percentage of foreign exchange deposit reserves is lowered, it will release the frozen foreign exchange quota of commercial banks and increase the foreign exchange deposit derivative capacity, thus boosting the demand for foreign exchange settlement and relieving the pressure of pound depreciation. Conversely, an increase in the Bank of England's ratio of foreign exchange deposit reserves would help ease the pressure on the appreciation of the pound.

4.2 Forming a management mechanism to prevent exchange rate risks

Exchange rate movements are uncontrollable factors, but the risks and opportunities of exchange rate movements coexist. The risks to enterprises arising from exchange rate movements can be prevented by forecasting them. Enterprises can set up a special organisation to forecast and analyse exchange rates. Form an exchange rate risk control department to make thematic assessments of the exchange rate risk of the enterprise for the purpose of taking targeted preventive measures

5. Conclusion

In conclusion. the exchange rate between the pound and the euro has been in a relatively flat state and has fluctuated slightly at high frequencies between 0.8 and 1 over the next eight years, but has generally shown a flat trend. The results of this study provide a generalised forecast of the exchange rate of the euro against the pound over the next eight years, which is an important reference for governmentmaingain exchange rate and risk aversion decisions. It also has implications for multinational companies in terms of enhanced foreign currency liquidity management, long-term investment analysis and long-term financing decisions.

The limitation of the study in this paper is that it is not possible to predict contingencies. For example, political changes, natural disasters, wars, etc. In addition, the arrival of the new British Prime Minister, Ms. Truss, has also created uncertainty in the exchange rate of the pound.

References

[1] Cao, Xintong, Reaserch on Exchange Rate Forecast Based on LSTM-ELM Hybrid Model, Changchun University of Technology, 2022.

[2] Lu, Yuanyuan, Prediction of RMB exchange rate based on garch-elman model, Financial View, 2022(13):5

[3] O'Sullivan, Arthur; Steven M. Sheffrin. Economics: Principles in action. Upper Saddle River, New Jersey 07458: Prentice Hall. 2002, 458

[4] Hyndman, Rob J; Athanasopoulos, George. 8.9 Seasonal ARIMA models. Forecasting: principles and practice. O texts. 19 May 2015. Available at: https://otexts.com/fpp2/seasonal-arima.html

[5] Hamilton, James. Time Series Analysis. Princeton University Press, 1994.

[6] Triacca, Umberto (19 Feb 2021). The Wold Decomposition Theorem

[7] SAS Institute, Notation for ARIMA Models. Time Series Forecasting System. Retrieved 19 May2015.

[8] Kuhlman, Dave. A Python Book: Beginning Python, Advanced Python, and Python Exercises. Retrieved 23 June 2012. Available at: http://www.davekuhlman.org/python_book_01.html

[9] JetBrains: Developer Tools for Professionals and Teams. The State of Developer Ecosystem in 2020 Infographic. Archived from the original on 1 March 2021. Retrieved 5 March 2021. Available at: https://www.jetbrains.com/lp/devecosystem-2021/

[10] Stack Overflow, Stack Overflow Developer Survey 2020. Retrieved 5 March 2021. Available at: https://insights.stackoverflow.com/survey/2021