

Forecasting the Exchange Rates of the Iraqi Dinar against the US Dollar using the Time Series model (ARIMA)

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ABSTRACT

Estimating the exchange rate is considered a key tool for economic planning and reaching economic stability. This study aims to reach the best model for predicting exchange rates of Iraqi Dinar against the U.S. dollar in the period (2008-2017). For this purpose the following methods have been adopted: - Time-series analysis using the Box – Jenkins approach.

Forecasts obtained from the two models were compared using both mean of the absolute values of the errors (MAE) and the square root of the mean square error (RMSE). The ARIMA (1,1,1) model produced the best forecasts and it can be used as a reliable method of estimating the exchange rate of any foreign currency.

Keywords— Currency Exchange Rate, Iraqi Dinar, US Dollar, Time Series, Foreign Exchange

I. INTRODUCTION

An exchange rate is defined as the number of units of certain currencies exchanged for one unit of another currency, a standard procedure or method by which all prices can be translated from a foreign language into a local language (Brigham & Gapenski, 1996).

Or "the value earned by the two currencies" through their relationship. The Iraqi dinar is the Iraqi currency on which the national economy depends on its domestic dealings. The dollar also plays an important role in the Iraqi economy, whether at the local level or the level of international relations because of its link to the exchange rate of the dinar. The exchange rate is affected by some important variables including ((interest rate, inflation, the balance of payments (balance of foreign trade, the balance of current transactions)). (Gitman, 2000)

Time series analysis is an interesting statistical method that has evolved a lot and can be used for forecasting in the future. The time series analysis method is based on tracking the phenomenon (or variable) over a certain period (for example several years), then predicting the future.

The researchers try to find a reliable statistic method to predict the exchange rate of the Iraqi dinar

against the US dollar in the future based on the historical data of the exchange rate of the US dollar in Iraq during a period by using the time series. This statistic method can be used to predict the exchange rate of any foreign currency by using the historic date of the exchange rate of the local currency against the foreign one.

II. RESEARCH PROBLEM

The fluctuations in the exchange rate, especially the unexpected ones, are a factor that negatively affects the national economy of any country. The exchange rate of the Iraqi dinar against the dollar deteriorated significantly during (the 1990s) due to the depletion of foreign currency reserves and the freezing of Iraq's assets abroad. Therefore, forecasting the exchange rate is considered as important and influential in the economic life of the state as its survival at the lower levels leads to the high competitiveness of the export sector and the protection of the domestic market from external competition and high purchasing power of wages and low level of inflation.

Therefore, the problem of research is to read the future and predict its changes and value of these changes by building a statistical model to predict exchange rates in Iraq.

III. RESEARCH OBJECTIVES

- 1- The research aims to build time series models to predict the exchange rates in Iraq.
- 2-To differentiate between the estimation models and choose the most suitable model for forecasting.
- 3- It's a try to make a fixed model forecast the exchange rate of the Iraqi Dinar against USD.
- 4-The model we suggest can be used to predict any exchange rate of foreign currency based on the historic date of the exchange rate of the same currency.

IV. THE IMPORTANCE OF RESEARCH

The economic and practical importance of the research in building a statistical model to predict exchange

rates in Iraq to meet the fluctuations in the exchange rate, which is considered as an aid in stabilizing the Iraqi economy through its impact on reducing inflation and the optimal use of economic resources and the equitable distribution of income between local groups or sectors, and thus achieve the objectives Macroeconomic balance of internal and external.

V. DATA COLLECTION

The research is based on the data published in the reports and periodicals issued by the Central Bank of Iraq, which included daily data on the exchange rate of the Iraqi dinar against the US dollar from (2008) to (2017). And analyzing the data by Mat lab.

VI. THE RESEARCH FILED

The field of research is mainly focused on the exchange rates of the dinar against foreign currency (dollar). Where the time limits for the research period extend from (1st January 2008) to the end of (December 2016) were limited to the stage of estimating the statistical model. Then data for the following three months that period, i.e. (1st January 2017) until the end of (March 2017) is used to test the quality of the estimated model. The spatial research limits will be at the national level of the State of Iraq.

VII. HYPOTHESIS

The research is based on the following hypothesis:

By using the time series models we can build a reliable prediction method to forecast the exchange rate of foreign currencies against the local currency by using historical exchange rate data.

VIII. RESULTS AND DISCUSSION

Time series analysis is an interesting statistical method that has evolved a lot and can be used for forecasting in the future. The time series analysis method is based on tracking the phenomenon (or variable) over a certain period (for example several years), then predicting the future. Based on the different values that have emerged in the time series and the pattern of change in values, it surpasses the traditional method, which calculates the difference of values between only two time series and builds the future forecast based on them without taking into account the general pattern of the series (the highest and lowest). It happens to the values of the time series related (Vande, 1992). The Box and Jenkins method is one of the most important methods used to predict in time series

because it differs from other methods of prediction since it does not assume that there is any particular pattern of historical data of the time series that we predict. Thus, we obtain the appropriate data model when the differences (residues) between the estimated values and historical data are very small and are distributed naturally and independently of each other.

With the constant need for more accurate predictions of different phenomena, researchers are trying to use more than one model to find the best model.

IX. PREVIOUS STUDIES

Some previous studies have dealt with the use of time series methods in forecasting, such as:

1- Hamad Abdullah Al-Ghannam (2003). This study aimed to analyze the general index of stock prices in Saudi Arabia using the Box and Jenkins methodology. Stocks in the Kingdom in the period from (March 1985) to (June 2002) and the time series was unstable and the first difference was taken to the logarithm of the index has been built five models of which are two models are the best models to predict the Saudi stock index in accordance with the accuracy of prediction criteria have been used to predict the rest of the index. The study showed eased that the general stock price index is affected significantly the value of the index in the previous period also showed that the index is not affected by seasonal changes significantly.

2- The Manshir al-Dhafiri (2004) study aimed at comparing both multiple regression analysis and time series analysis and neural networks.

In the study of Aamal Saied Mubarak (2006), which aimed to build a model to predict the general index of the Egyptian Stock Exchange, which takes into account the problem of the instability of the average and variability of the time series in addition to the study of the elemental seasonality and characterization in this model, so the researcher examined the linear and non-linear models of conditional variation and test the existence of these models, the general bases in the estimation process and how to estimate conditional variance models in addition to the most appropriate estimation method in the presence of extreme values in the time series. The study also discussed how to use these models to obtain predictions of conditional volatility and evaluate those predictions. Two sets of data were applied, daily data and monthly data for the general index of stock exchange transactions in Cairo and Alexandria.

X. TIME SERIES ANALYSIS USING THE BOX AND JENKINS METHOD

The Box and Jenkins Iterative technique is a common method for building heterogeneous time series

models and consists of four stages: Model Identification, Parameter Estimation, Model Diagnostics, and Forecasting. The Box and Jenkins stages of (ARIMA) model construction were implemented from the first week of 2008 to the third week of January 2017 in the estimation phase, and the following ten weeks data were used in the estimated model quality testing phase, as shown below:

Phase I: Identify the Model

The aim of this stage is to identify one or more (ARIMA) models, where the exchange rate data of the Iraqi dinar for the US dollar was drawn (480) weeks, and Figure (1) shows an upward trend at the beginning and end of the exchange rate chain, which indicates that the mean does not still. This requires the taking of non-seasonal differences in the first stage, and it is clear from the figure the stillness of the variance, which does not need to take a suitable shunt (logarithmic shunt, square root shunt).

Figure (2) shows the non-seasonal differences of the first stage of the time series of the exchange rate of the Iraqi dinar against the US dollar, and it is clear from the figure to limit the general trend and the approach of values to the mean, which indicates the stillness of the series.

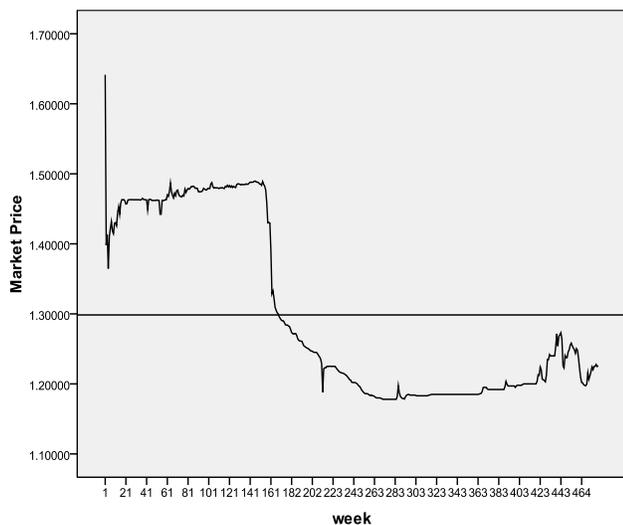


Figure (1) Time series of the exchange rate of the Iraqi dinar against the US dollar by researchers

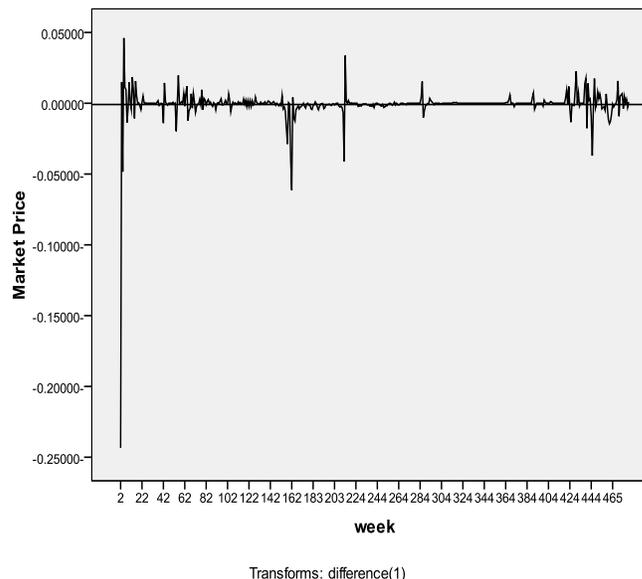


Figure (2) non-seasonal differences of the first stage for the time series of the exchange rate of the Iraqi dinar against the US dollar by researchers

Figure (3) shows the (ACF) and (PACF) for the non-seasonal differences of the first stage of the exchange rate data of the Iraqi dinar relative to the US dollar. The correlation coefficient was not significant in the first period ($k = 1$), and the correlation coefficient was significant in the second period. ($k = 2$), and then the rapid decline at the fourth period, i.e., it is approaching zero rapidly, which indicates the stillness of the series, which indicates the presence of a moving averages parameter in the model of the first order, and given the partial self-correlation function we note the irrelevance of the coefficients. At the first period ($k = 1$) and significant coefficient Partial self-correlation at the second period ($k = 2$) indicating the presence of two first-order autistic regression parameters in the proposed model.

From the above, ARIMA (1, 1, 1) can be filtered to represent data, and another set of models can be proposed, such as ARIMA (1, 1, 2) and ARIMA (2, 1, 1).

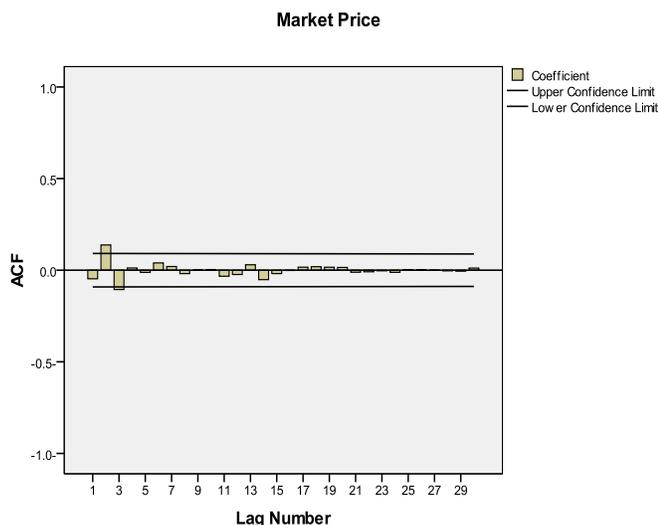


Figure (3): Self-correlation function and partial self-correlation function for non-seasonal differences of the first stage of exchange rate data of the Iraqi dinar by researchers

Phase II: Estimation

At this stage, it is estimated the parameters of the candidate models to match the weekly data of the Iraqi dinar exchange rate for the US dollar, namely:

- 1- ARIMA (1, 1, 1)
- 2- ARIMA (2, 1, 1)
- 3- ARIMA (1, 1, 2)

Table (1) shows the point estimator values of the model parameters and the t (t- ratio) of the test of the significance of each parameter at the (5%) level of significance.

Models		$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\theta}_1$	$\hat{\theta}_2$	BIC
1	B	-0.972		-0.690		-8.275
	T-Ratio	-110.32*		-16.184		
2	B	-0.551	0.416	-0.468		-8.162
	T-Ratio	-8.892*	6.988*	-7.800*		
3	B	-0.969		-0.865	-0.337	-8.149
	T-Ratio	-118.04*		-18.260*	-7.061*	

*Significant statistic at level 5%

** Significant statistic at level 10%

Table (1) results of estimating candidate models for estimation by researchers

Phase III: Diagnostic Tests for the Estimated Models

1- Research of Static and Reflection

By reviewing Table (1), we note that all the parameters of the estimated models are significant and

satisfy the static and reflection conditions since all the parameters are significant, the calculated (t) value for each of them separately is greater than (2), and check the static condition where the values of the absolute autistic regression parameters are less than one. And check the reflection condition and the values of the absolute moving averages parameters less than one.

2- Statistical Standards

From Table (1), it is clear that the (BIC) values for the estimated models are lower for the first model.

3- Analysis of Remains

From the above, we can choose the first model to fit the data under study, and we are now conducting another test by drawing the autocorrelation function for the remainder of the first model and examine whether they are purely random changes or not? By analyzing the residues of the first model, by plotting the correlation function of the residues of the model as shown in Figure (4), we notice that most of the correlation coefficients are not significant (the occurrence of the correlation coefficients of the residuals is within the confidence interval 2σ), except the first period and this is acceptable in practice. The ratio of transactions beyond the confidence interval, indicating that the overflow of the estimated model changes purely random.

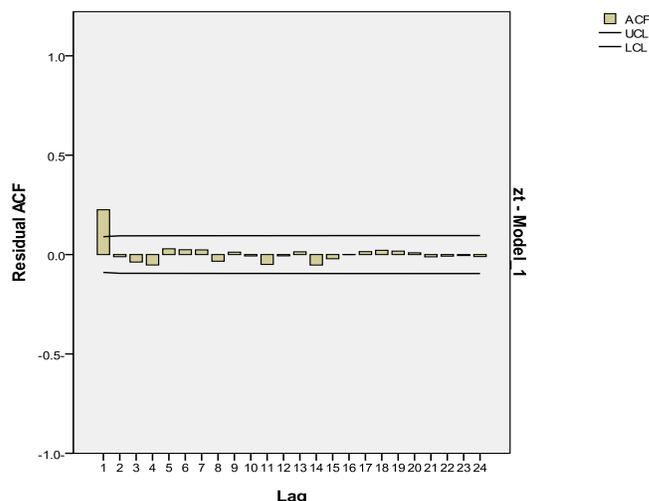


Figure 4: Self-autocorrelation function of the first model by researchers

After estimating the model and conducting diagnostic tests and ensuring that the (ARIMA) model (1, 1, 1) is appropriate to represent the series data, the model was used to predict the future values of the Iraqi dinar exchange rate relative to the US dollar.

The model has been estimated as follows:

$$(1 + .972\beta) (1 - \beta) z_t = (1 + 0.690\beta) e_t$$

Thus, it is possible to predict the future values of the Iraqi dinar exchange rate to the US dollar. Table (2)

shows the predictive values of the Iraqi dinar exchange rate to the US dollar. Figure (5) shows the actual and estimated values using the one-time time series method. The actual values are predicted using the ARIMA model (1, 1, 1).

weeks	Forecast values	Lower	Upper limit	Observed values
481	1.22564	1.20125	1.24634	1.22580
482	1.22386	1.19525	1.25577	1.22760
483	1.22559	1.18189	1.26634	1.22840
484	1.22391	1.17874	1.27269	1.23260
485	1.22554	1.16918	1.27968	1.23900
486	1.22396	1.16684	1.28500	1.24600
487	1.22550	1.15904	1.29045	1.25300
488	1.22400	1.15707	1.29519	1.25925
489	1.22546	1.15037	1.29974	1.26200
490	1.22404	1.14861	1.30408	1.26400

Table (2) Predictive and actual values of the Iraqi dinar exchange rate for the US dollar using the one-time time series method by researchers

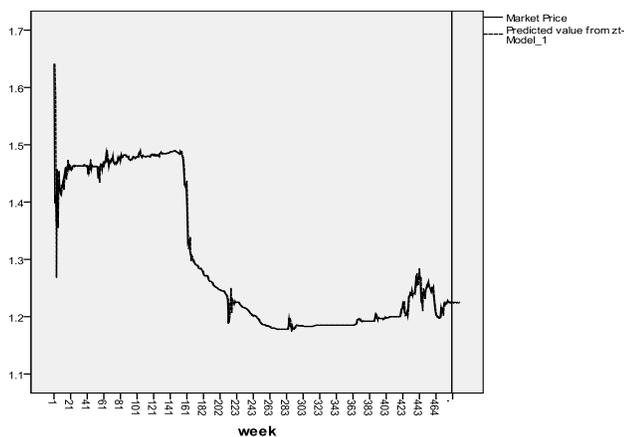


Figure (5) the Predictive and actual values of the Iraqi dinar exchange rate for the US dollar by researchers

To compare the methods used for the time series method, the following statistical criteria were adopted in the comparison:

- Average absolute values of MAE errors.
- The square root of the average RMSE error boxes.

Methods	MAE	RMSE
Time series	.004	.016

Table (3) Statistical criteria for differentiation between estimated models for forecasting the exchange rate of the Iraqi dinar against the US dollar by researchers

Table (3) shows the devaluation of both the average absolute values of (MAE) errors and the square root of the average error boxes (RMSE) for the appropriate

time series model to predict the Iraqi dinar exchange rate against the US dollar.

From the previous analyses of historical data of exchange rate of US dollar, the researches verifies the hypothesis that says (By using the time series models we can build a reliable prediction method to forecast the exchange rate of foreign currencies against the local currency by using historical exchange rate data) by using ARIMA model (1, 1, 1).

XI. CONCLUSIONS

- 1- We can predict the exchange rate of foreign currencies by using the statistic methods and its applicable anywhere and anytime.
- 2- Time series models are the best choices to build a prediction method by using the historical data, not only for estimating the currency exchange rate.
- 3- The more data used in your analysis the more accurate your estimation will be, so more historical data should be used for an accurate results.
- 4- The time series analysis (Box and Jenkins model) is an effective way of estimating the exchange rates of foreign currencies but it is also difficult and requires skill and knowledge.

RECOMMENDATIONS

- 1- To make the best results, studying the most important variables that affect the value of the exchange rate, which is useful economically in predicting the exchange rate in the light of independent variables that affect the price with the attempt to estimate other multivariate models.
- 2- Continue to use statistical models and rely on them in the estimation of fluctuations in exchange rates in the future, taking into account as much as possible from the published data, and the flexibility to use more than one statistical method to reach the best method to predict exchange rates.
- 3- To predict a future period, historical data should be considered to obtain more accurate results. We note that the more accurate the data used in the analysis, the more accurate the results. It helps to benefit from the results of studies and researches.
- 4- The time series model using residual and estimated values (ARIMA) (1,1,1) proved to be preferable to other models to predict the Iraqi dinar exchange rate against the US dollar during the study.
- 5- Box and Jenkins model is the most flexible methods in the construction of the time series model, but it needs knowledge and skill to use the model of box and Jenkins, so we may find a difference in obtaining the model between users.

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