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Estimating Autocorrelation In Slowed Time Lags Using Autoregressive Models

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Abstract

Autoregressive models, also known as AR models, are statistical models that make predictions about future values of a time series by analyzing its past values. These models employ a linear combination of previous observations of the series as predictors, with the coefficients determined through data fitting. One key aspect of autoregressive models is their ability to consider the temporal relationships among observations. This allows them to detect patterns and trends in the data that might go unnoticed by simpler models. In the realm of finance, autoregressive models find practical applications in modeling and forecasting stock prices, exchange rates, and other financial time series. By fitting an autoregressive model to a historical time series of prices or returns, analysts can estimate the probable future behavior of the series and leverage this insight for making investment decisions. In my study, I used Autoregressive models to develop a structural model using advanced statistical analysis techniques (confirmatory factor analysis) and to highlight the role and importance of the mediating variable (inflation rate) in determining economic growth rate, exchange rate, and unemployment rate in Iraq. There are statistically significant differences between the effect of the exchange rate on growth and its impact on the official growth of the Iraqi dinar. The effect of the exchange rate on growth and market growth depends mainly on the level of demand in the local market and the availability of currency through sale to the Central Bank of Iraq. These spreads have increased, especially with regard to the selling price. In addition to that, there is no specific indicator of the exchange rate of the Iraqi dinar against foreign currencies, due to the lack of a market for the foreign market [1]. In summary, autoregressive models are a powerful tool for estimating slowed time lags and predicting the future behavior of time series data

Keywords: *Autoregressive models, inflation rate, economic growth rate, exchange rate, unemployment rate.*

Introduction

Unemployment poses a pressing challenge for the Iraqi economy, carrying substantial economic, societal, and political implications alongside negative consequences for the human element. Neglecting to address this issue can result in deficiencies within social and political structures. This underscores the fragility of the state's development and its capacity to fulfill its duties to its populace. Furthermore, elevated levels of joblessness foster an environment that promotes terrorism and extremism[2].

[1] Mostafa Kazemi Najaf Abadi and M M Ali Thajeel Yousef al-Tamimi, "COORDINATION BETWEEN FISCAL AND MONETARY POLICIES AND THEIR ACTIVATION MECHANISMS TO ADDRESS ECONOMIC SHOCKS IN IRAQ FOR THE PERIOD 2004-2017," n.d.

[2] Viktor Koziuk, "Independence of Central Banks in Commodity Economies," *Visnyk of the National Bank of Ukraine*, no. 235 (2016): 6–25.

The state's strategy of absorbing labor within state establishments, particularly within the security sector, has yielded unfavorable outcomes, leading to concealed unemployment within the public sector. This form of unemployment presents difficulties in combating due to its adverse returns. To diminish joblessness and tackle the issue comprehensively, concerted efforts are necessary, encompassing labor market reforms and reforms within sectors that absorb labor, particularly in productive industries, agriculture, and the private sector [3].

The Iraqi economy has endured significant devastation as a result of its involvement in three conflicts and subsequent acts of terrorism. Additionally, it has undergone certain changes since April 2003, including unregulated openness, which triggered a surge in imports and inadequate domestic supplies. Moreover, production nearly halted. Consequently, there has been a decline in exports (excluding oil), with oil exports leading to the so-called Dutch disease, where agricultural products lose their competitiveness against imported goods. Presently, the country heavily relies on imports, resulting in widespread unemployment, deteriorating security records, a high population growth rate, and a declining education system [4].

Due to these factors, the unemployment problem in Iraq is considered one of the most complex challenges with far-reaching economic impacts [5]. As a result, institutions must find innovative methods that are compatible with their changing environment and adapt accordingly, so implementing these practices should be included in planning, recruitment, training, job design, job analysis, performance evaluation, and stimulus [6].

Cointegration using the autoregressive distributed lag model ARDL

The ARDL methodology was first developed by Pesaran, et al., [7], It has gained widespread usage in recent years due to its versatility and ability to handle time series data that are not of the same order. This means that the variables being studied can be static in the same degree (i.e., in the first level), in differences, or a combination of both. However, the time series should not be stationary in the second differences.

The distributed lag autoregressive model (ARDL) has several characteristics that distinguish it from other models. Firstly, it allows for the inclusion of explanatory variables with different time lag periods, which is not possible in other models. Secondly,

[3] Yusra Salim Nayyf, Zena Tariq Ali, and Bilal Abdulhaq Abdul Kareem, "ESTIMATING THE IMPACT OF FINANCIAL SECTOR DEVELOPMENT IN REDUCING UNEMPLOYMENT IN CHILE (1991-2017)," *Academy of Entrepreneurship Journal* 27 (2021): 1–11.

[4] Naser M Al-Tamimi, *China-Saudi Arabia Relations, 1990-2012: Marriage of Convenience or Strategic Alliance?* (Routledge, 2013).

[5] Sjoerd Beugelsdijk, Steven Brakman, and Harry Garretsen, *International Economics and Business: Nations and Firms in the Global Economy* (Cambridge University Press, 2013).

[6] Anca Elena Nucu, "The Relationship between Exchange Rate and Key Macroeconomic Indicators. Case Study: Romania," *The Romanian Economic Journal* 41 (2011): 127–45.

[7] M Hashem Pesaran, Yongcheol Shin, and Richard J Smith, "Bounds Testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics* 16, no. 3 (2001): 289–326.

the ARDL test is particularly useful when the sample size is small and helps to prevent the occurrence of self-correlation. Additionally, the estimates resulting from the ARDL test are efficient and unbiased.

The ARDL model is useful in capturing both short-term and long-term dynamics of the relationships between variables. It is particularly useful in analyzing time series data in economics and finance, where the variables often have different orders of integration. The ARDL model can be estimated using the ordinary least squares (OLS) method, making it easy to implement and interpret. Overall, the ARDL methodology is a powerful tool for analyzing time series data and has become increasingly popular in recent years

One of the key advantages of the ARDL test is that it does not require the time series being studied to be static in the same order. This means that the variables can be stationary in different orders, and the test can still be applied. Another advantage of the ARDL model is that it allows for the estimation of short-term and long-term effects simultaneously in a single equation. This is particularly useful in analyzing the dynamics of the relationships between variables over time [8].

The ARDL model has several notable features that distinguish it from other standard models. Firstly, it allows for the inclusion of explanatory variables with different time lag periods, which is not possible in other models. Secondly, the ARDL test is particularly useful when the sample size is small and helps to prevent the occurrence of self-correlation. Additionally, the estimates resulting from the ARDL test are efficient and unbiased [9].

The ARDL model has the advantage of being simple to estimate the cointegration of time series using the ordinary least squares (OLS) method, once the optimal maximum time lag durations have been determined. The ARDL model combines two models: the distributed lag model (Lag-Distributed) and the autoregressive model. It is used when the dependent variable (yt) is influenced by changes in the explanatory variable (xt) and decelerating values from previous time periods (xt-r), where the effect of the explanatory variable extends beyond the current time period (t) and into multiple previous time periods (tr) [10]. Mathematically, the ARDL model can be represented as follows:

$$yt = \beta 0 + \beta 1xt + \beta 2xt\text{-}1 + \ldots + \beta pxt\text{-}p + \beta p+1yt\text{-}1 + \beta p+2yt\text{-}2 + \ldots + \beta qyt\text{-}q + \varepsilon t \quad (1)$$

where:

yt is the dependent variable at time t

xt is the explanatory variable at time t

xt-r represents the explanatory variable at time t-r

[8] Beugelsdijk, Brakman, and Garretsen, *International Economics and Business: Nations and Firms in the Global Economy*.

[9] Tetyana Vasylieva et al., "THE IMPACT OF GOVERNANCE QuALITY ON CENTRAL BANK'S INDEPENDENCE," 2023.

[10] Nucu, "The Relationship between Exchange Rate and Key Macroeconomic Indicators. Case Study: Romania."

β0 is the constant term

β1...βp are the coefficients of the lagged explanatory variables

βp+1...βq are the coefficients of the lagged dependent variables

εt is the error term at time t

The ARDL model is useful for analyzing the dynamic relationship between variables over time, and can be used to estimate short-term and long-term effects simultaneously. It is widely used in econometrics, finance, and other fields where time series analysis is important [11]

The dynamic or kinetic behavior of the dependent variable, yt, can be expressed through its previous values. This means that the same dependent variable can act as an explanatory variable, but with a time lag for a previous period [12]. This represents the autoregressive model, which can be expressed mathematically as follows:

$$yt=\lambda 1yt\text{-}1+\lambda 2yt\text{-}2+\cdots+\lambda pyt-p+ut \quad (2)$$

Hypothesis of study

1. Null Hypothesis: S1 has a unit root

H_0: S1 has a unit root

Exogenous: None

Lag Length: 0 (Auto. based on SIC, max lag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.227185	0.0000
Test critical values:	0.01 level	-2.641672	
	0.05 level	-1.952066	
	10% level	-1.610400	

*Mackinnon (1996) one-sided p-values [13].

[11] Nucu.

[12] Beugelsdijk, Brakman, and Garretsen, *International Economics and Business: Nations and Firms in the Global Economy*.

[13] James G MacKinnon, "Numerical Distribution Functions for Unit Root and Cointegration Tests," *Journal of Applied Econometrics* 11, no. 6 (1996): 601–18.

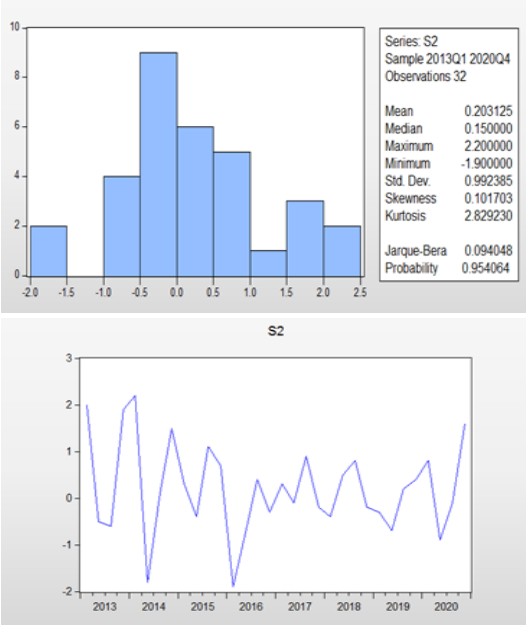

Figure 1. expanded Dickey-Fowler test

It is noted from the above figure that the variable does not suffer from heterogeneity in the data and there is no general trend in the series according to the Jarque-Bira test, as it is noted from the above figure that the probability value of the Jarque-Bira test of0.564724 is greater than the level of significance of 5%, thus accepting the null hypothesis that there is no difference between the distribution of variable data and the normal distribution.

The following table shows the expanded Dickey-Fowler test to detect the general trend of the series, as follows:

Table 1.

Method	df	Value	Probability
Bartlett	3	0.978771	0.8064
Levene	(3.28)	1.052627	0.3848
Brown-Forsythe	(3.28)	0.965559	0.4228

It is noted from the above table that the probability value of the expanded Dickey-Fowler test is0.000 is less than the significance level of 0.05, thus rejecting the null hypothesis that the series has a unit root, that is, the series is stable at the level of the series. That is, the economic growth rate variable is stable in consistency and direction. That is, the series is integral of zero degree. We conclude that the variable economic growth rate is stable and homogeneous.

2. Null Hypothesis: S2 has a unit root

H_0: S2 has a unit root
Exogenous: None
Lag Length: 1 (Auto. based on SIC, max lag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.932420	0.0000
Test critical values:	0.01 level	-2.644320	
	0.05 level	-1.952473	
	10%level	-1.610211	

*Mackinnon (1996) one-sided p-values [14].

It is noted from the above table that the probability value of the expanded Dickey-Fowler test is0.000 is less than the significance level of 0.05, thus rejecting the null hypothesis that the series has a unit root, that is, the series is stable in the direction. That is, the series is integral of zero degree.

It is noted from the above table that the probability values of the tests are greater than the level of significance (0.05) and thus accepting the null hypothesis that the variances are homogeneous. We conclude that the variable rate of inflation is stable and homogeneous. And the Statistical characteristics of the unemployment rate variable is:

[14] MacKinnon.

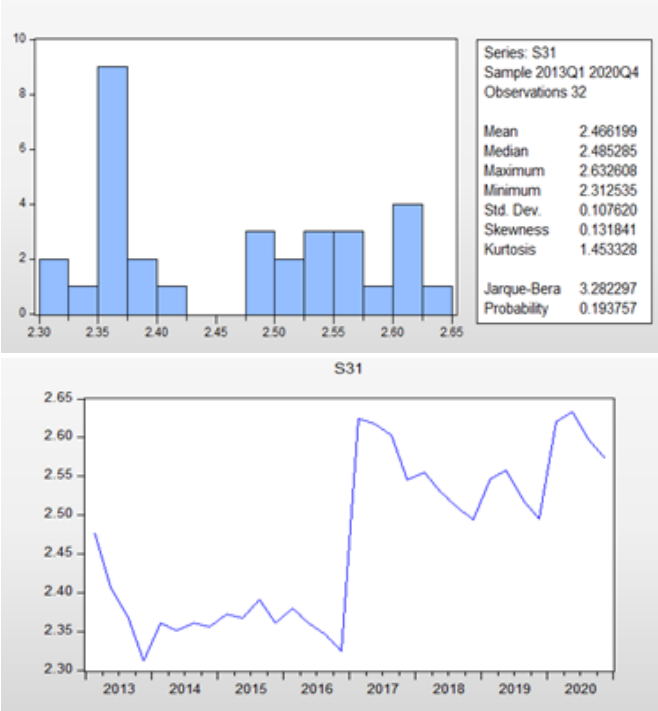

Fig 2: probability value of the Jarqua-Peira test

It is noted from the above figure that the probability value of the Jarqua-Peira test is0.193757 is greater than the level of significance 0.05, and thus accepting the null hypothesis that the data distribution does not differ from the normal distribution.

The following table also shows the extended Dickie Fuller test for the general trend test, as follows:

Table 2.

Method	df	Value	Probability
Bartlett	4	2.158444	0.7066
Levene	(4.27)	0.997033	0.4262
Brown-Forsythe	(4.27)	0.967240	0.6005

3. Null Hypothesis: D(S31) has a unit root

H_0: D(S31) has a unit root

Exogenous: None

Lag Length: 1 (Auto.based on SIC, max lag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.837781	0.0000
Test critical values:	0.01 level	-2.644320	
	0.05 level	-1.952473	
	10% level	-1.610211	

*Mackinnon (1996) one-sided p-values [15].

The significance level of 0.05, thus rejecting the null hypothesis that the first difference of the series has a unit root, that is, the first difference of the series is stable in the direction. That is, it is integrated of the first order. The following table shows the homogeneity test for variance

Table 3: Test for Equality of Variances of S31 Categorized by values of S31Sample: 20observation: 32

Method	df	Value	Probability
Bartlett	3	6.302922	0.0978
Levene	(3.28)	2.049485	0.1297
Brown-Forsythe	(3.28)	1.083192	0.3723

It is noted from the above table that the probability values of the test are greater than the level of significance5%, thus accepting the null hypothesis that the unemployment rate series is homogeneous.

The following figure shows the graph of the exchange rate variable:

[15] MacKinnon.

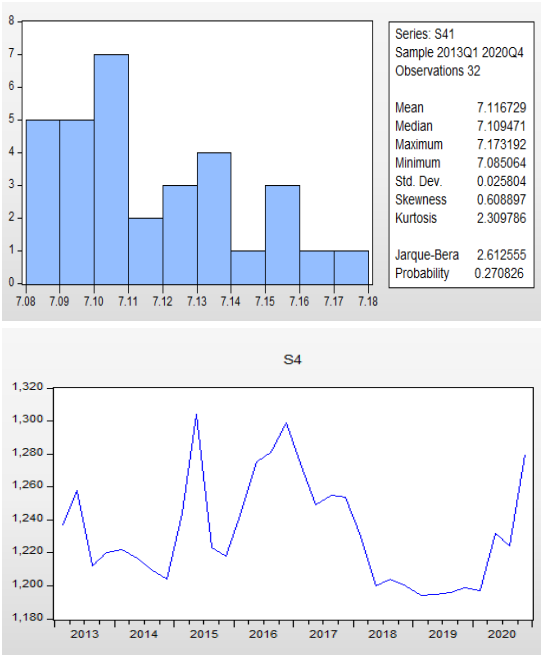

Fig 3: Exchange rate variable

It is noted from the above figure that the inflation rate series suffers from heterogeneity in variance, and to verify this, the following tests were used.

Conclusion

The results that i reached from this study are the need to find platforms for currency trading based on a series of currencies with the Iraqi dinar, and to ben this HP allots whether in Iraq's market and stock papers Mother Central Bank of Iraq. Also, the necessity of calculating a special indicator of the exchange rate and its impact on growth and its impact on the growth of the Iraqi dinar against foreign currencies, and it is calculated on the basis of the daily trading of the foreign exchange market. In addition to that not to prejudice the independence of the Central Bank of Iraq, and this is according to the law, provided that the goals of the Central Bank are integrated with the general goals of Iraqi state and situation frame work General for the integration of monetary tools of the central bank with financial toadstool fiscal policy in order to create price stability Cashing Iraqi dinar finally, it's important to adopting a flexible exchange policy by the Central Bank of Iraq, as fellowman and the nature of the Iraqi economy and fluctuations in oil prices global prices.

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