COVID-19 Crisis: Forecasting the Arab World Economy Performance Using the ARIMA Model

Ahmed N. K. Alfarra, and Ahmed Hagag, *Member, IAENG*

***Abstract*— This paper predicts Coronavirus Disease (COVID-19)'s potential influence on the Arab country's economy by using the Autoregressive Integrated Moving Average (ARIMA) model. The world bank offers data of the Arab countries' Gross Domestic Product (GDP) over the period 1960-2019. As we show up at the pinnacle of the COVID-19 pandemic, quite possibly the most critical inquiry going up against us is: what is the potential impact of the progressing crisis on the Arab countries' economic improvement rate? The results have shown that the GDP growth is approximately -3.8% to 1.5% for 2021 and 2022, respectively. The referenced outcomes show that pandemic status significantly affects the Arab world economy special after the energy demand decline, which prompts a fall in oil price. In spite of the fact that the Arab world's financial development is growing again, it is not most likely going to re-visitation of business as usual for quite a while to come.**

***Index Terms*—COVID-19, Forecasting, Time series analysis, GDP, ARIMA Model.**

I. Introduction

Coronavirus caused a worldwide downturn whose profundity was outperformed simply by the two World Wars and the Great Depression over the previous century and a half [1]. Thus, ensuring the stability of the world economy is an urgent necessity for regulators and economists [2, 3]. The quest for stable economic growth is quickly turning into a practical issue among governments, global foundations, and partners interested in investigating the impact of the recent crisis COVID-19 on world economic growth [2]. This follows the realization that the pandemic has caused a severe death toll, is tipping millions into extraordinary neediness and is relied upon to dispense enduring scars that push movement and pay well underneath their pre-pandemic pattern for a drawn-out period [3].

The spread of COVID-19 is anticipated to achieve a broad slowdown of economic activities. As shown by an early assessment of the International Monetary Fund (2020 a), the overall economy would diminish by around 3 percent in 2020. The choking depends on an unmistakably more important size than that of the 2008-2009 Global Financial Crisis. Regardless, in its latest update (June 2020), the International Monetary Fund (2020b) reevaluated the assessment to 4.9 percent will diminish in 2020. The report alludes to the going with clarifications behind the invigorated figure: i) more unmistakable energy in social, isolating activities; ii) lower activity during lockdowns; iii) more great decline in effectiveness among firms which have opened up for business; and iv) more critical vulnerability[1]. The economy-related repercussions will be wide-running and uncertain, with different effects on the work markets, creation of deftly chains, financial business sectors, and the World economy [1, 3]. The adverse economic effects may transmit by the strength of the social, isolating measures (e.g., lockdowns and related courses of action), its length of execution, and the degree of acquiescence [3].

Similarly, as with past economic crises, the pandemic is expected to leave long-lasting adverse impacts on the world economic movement and per capita incomes [3-6]. As a result of the recent epidemic, the reduction in energy consumption or the shortage of its supply has severe implications for the income of the countries in general and the oil countries in particular because the growth of the global economy depends heavily on energy-intensive [5, 7]. The production and consumption of oil and natural gas are among the leading economic growth engines for most Arab countries. Therefore, the Arab world is considered one of the developing economies that produce oil [3, 4]. Thus, this paper investigates the impact of the covid-19 epidemic in the Arab world economic growth? To address this inquiry, this exploration utilized the ARIMA model to gauge the Arab global economic growth. The result has been shown that the Arab world economy will grow approximately -3.8% to 1.5% for the years 2021 and 2022, respectively. Besides, one of the critical lessons of the recent crisis is that the main objective of reforms to strengthen the global economy is building a foundation for sustainable economic growth depending on the digital economy [8-10].

The remainder of the paper is coordinated as follows. Section II highlights the ARIMA model. Section III presents the showing, measuring, and documents the rule results, while Section IV concludes the paper.

II. Methodology

A. ARIMA Model

In econometric, an autoregressive integrated moving average (ARIMA) model is one of the best models for time series

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[1] World Bank (2020) forecasts a 5.2 percent contraction in global GDP. Similarly, OECD (2020) forecasts a fall in global GDP by 6 percent to 7.6 percent, depending on the emergence of a second wave of COVID-19.

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analysis [11, 12]. This model is considered suitable for time-series data to forecast future points in the series. The ARIMA demonstrating approach has three phases; model distinctive evidence, boundary evaluation, and suggest checking of the model [11-14]. The autocorrelation function (ACF) and partial autocorrelation (PACF) plots of the differenced series are used to identify the numbers of autoregressive (AR) and/or moving average (MA) terms that are needed. These plots are in like manner helps to see if all coefficients are significant and all of the pattern has been explained [11-13]. A non-seasonal ARIMA model can be summarized by three parameters *p*, *d*, and *q*, which refers to the number of autoregressive terms, nonseasonal differences (i.e., the number of differencing required to make the time series stationary), and moving average terms, respectively. The model with the previous parameters is called ARIMA *(p, d, q)* model [11, 12]. In addition, all these parameters (i.e., *p*, *d*, and *q*) are both integrated and non-negative numbers [12, 14]. Parameter assessment of the properly chosen model is made by most extreme probability, which is a regularly utilized technique for assessment. At last, the general adequacy of the model is checked so that no further modeling of time series is required. Let $\{y_t\}$ with $t = 1, 2, \ldots, n$ be a classical time series. The ARIMA *(p, d, q)* model is given by the following equation:

$$\Delta^d y_t = \mu + \sum_{i=1}^{p} \emptyset_i y_{t-i} + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} \qquad (1)$$

where Δ^d represents the d order difference, μ is constant, $\sum_{i=1}^{p} \emptyset_i y_{t-i}$ is the AR(p) model (i.e., lagged values of y), and $\sum_{j=1}^{q} \theta_j \varepsilon_{t-j}$ is the MA(q) model (i.e., lagged errors).

B. Description of Data

The most essential and primary indicator of general economic matters is the Gross Domestic Product (GDP) to assess the general economic condition. It reflects the country's monetary quality; help plan and market scale. The World Bank offers GDP information for several nations, including the Arab world over the period 1960-2019. This paper has been used the GDP data as a proxy to investigate the impact of COVID-19 on the Arab world economy during the period. Figure 1a shows that the Jarque – Bera Test: p < 0.05; Does not follow the normal distribution. In addition, the mean of GDP over the period 1965 to 2019 is 922e+11, moreover the median is 483e+11. Furthermore, the results shown the maximum value is 2.89e+11, and the minimum value is 259e+11, moreover the stander deviation value is 949e+11, as well as the Skewness value is 1.036697, which is indicates to right side Skewness with Kurtosis factor 2.522790. Figure 1b illustrates the AGDP data during 1960 to 2019 after taking the natural logarithm. The Jarque – Bera Test: p < 0.05; Normal distribution. In addition, the mean of GDP over the period 1965 to 2019 is 26.89361, moreover the median is 26.90347. Furthermore, the results shown the maximum value are 28.69325, and the minimum value are 23.97719, moreover the stander deviation value is 1.315892, as well as the Skewness value is -0.510186, which is indicates to right side Skewness with Kurtosis factor 2.641017.

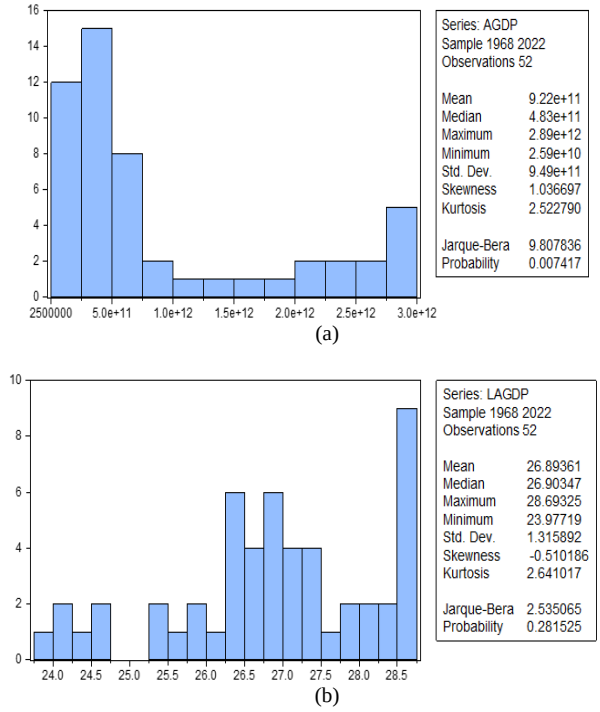

Fig. 1. The AGDP over the period 1960-2019. (a) Before Taking the Natural Logarithm. (b) After Taking the Natural Logarithm.

III. Modeling And Forecasting

A. Stationarity Test

ARIMA Model recommended that the factors utilized in the model must be fixed. The variables associated with our model have the time series attributes. It is seen that the mean of the intrigued factors is not fixed after some time. To make them consistent the regular logarithm was taken. It very well may be seen the conduct of GDP information when taking the characteristic logarithm of the information in Figures 2 and 3. Moreover, Table I shows that the ADF = 1.116678 is greater than the critical values of 1%, 5%, and 10% significance levels. Moreover, the P-value is exceeding 0.05. Therefore, the original AGDP sequence is non-stationary. Subsequently, taking the normal logarithm of the AGDP data to exclude it is unstable and obtain the LAGDP sequence. It can be seen that the ADF and P-value are greater than 0.05 (critical value). Which implies the GDP connection cannot reject the null hypothesis. Accordingly, the variance of first-order is accomplished, and a DAGDP succession is found.

The ADF test results for the DAGDP sequence are provided in Table II. The ADF = -5.113698 less than the critical values and, the P-value = 0.0001< 0.05. Which indicates that the series is fixed after changing the logarithmic and taking the variance of the first-order.

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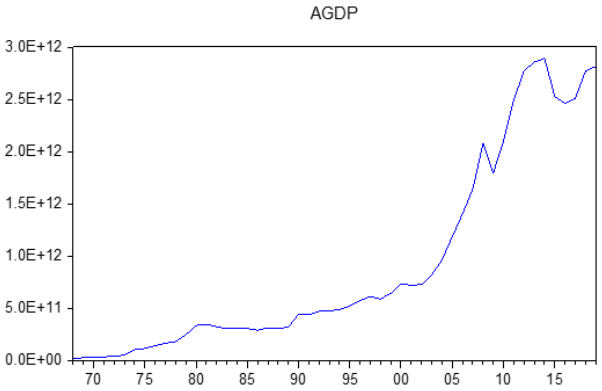

Fig. 2. The AGDP over the period 1960-2019.

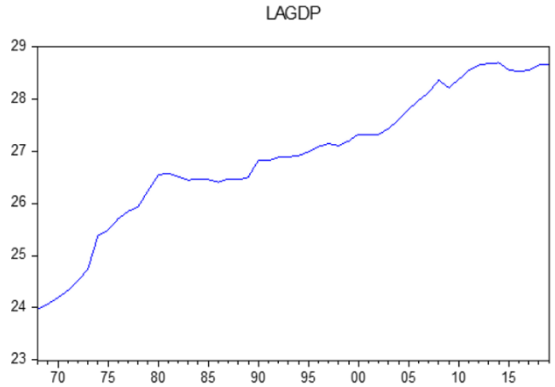

Fig. 3. The LAGDP over the period 1960-2019.

TABLE I

AGDP UNIT ROOT TEST.

Null Hypothesis: AGDP has a unit root				
			t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic			1.116678	0.9972
Test critical values:	1% level		-3.565430	
	5% level		-2.919952	
	10% level		-2.597905	

*MacKinnon (1996) one-sided p-values.

TABLE II

D(LAGDP) UNIT ROOT TEST.

Null Hypothesis: D(LAGDP) has a unit root				
			t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic			-5.113698	0.0001
Test critical values:	1% level		-3.568308	
	5% level		-2.921175	
	10% level		-2.598551	

*MacKinnon (1996) one-sided p-values.

B. Model Identification

The autocorrelation coefficient of the LAGDP in Table III shows progression is essentially non-zero when the slack demand is one.

TABLE III

THE BEST SELECTED (p, q) SPECIFICATIONS.

Autocorrelation	**Partial Correlation**		**AC**	**PAC**	**Q-Stat**	**Prob**
. |*******	. |*******	1	0.941	0.941	48.730	0.000
. |******	.*| .	2	0.876	-0.078	91.831	0.000
. |******	. | .	3	0.817	0.017	130.08	0.000
. |*****	. | .	4	0.758	-0.040	163.66	0.000
. |*****	.*| .	5	0.692	-0.084	192.30	0.000
. |****	.*| .	6	0.608	-0.199	214.88	0.000
. |****	.*| .	7	0.518	-0.107	231.59	0.000
. |***	.*| .	8	0.426	-0.084	243.18	0.000
. |**	. | .	9	0.344	0.011	250.90	0.000
. |**	. |*.	10	0.279	0.111	256.10	0.000
. |**	. |*.	11	0.226	0.089	259.60	0.000
. |*.	.*| .	12	0.159	-0.136	261.37	0.000

Besides, the parameter q can be seen as one because the requested lag is more critical than one. The halfway autocorrelation coefficient is nonzero when the slack request is equivalent to one, it is additionally unique according to zero when the lag order is two, along these lines $p = 1$ or $p = 2$ can be assumed of. To set up a more rigorous model, the extent of valuations of number of autoregressive terms and moving average terms (i.e., p and q) is properly loose, besides divergent ARIMA (p, d, q) models are demonstrated. Table IV illustrates the ARIMA test consequences of several p and q parameters and d equal one.

TABLE IV

THE MODEL RESULTS.

(*p*, *d*, *q*)	**Adjusted R-squared**	**Akaike info criterion**	**Schwarz criterion**	**Standard error of regression**
(0,1,1)	0.047704	-1.238153	-1.162395	0.127808
(0,1,2)	0.021562	-1.211072	-1.135314	0.129550
(1,1,0)	0.065128	-1.235668	-1.159187	0.127919
(1,1,1)	0.019286	-1.167252	-1.090035	0.132318
(1,1,2)	0.143862	-1.304699	-1.189978	0.122414
(2,1,0)	0.056157	-1.207171	-1.092450	0.128531
(2,1,1)	0.053341	-1.183284	-1.067458	0.130001
(2,1,2)*	**0.244115**	**-1.408334**	**-1.292508**	**0.116165**

The Akaike info criterion (AIC) and the Schwarz criterion (SC) standards are utilized to decide the best model. Although, the convenient ARIMA model is typically chosen based on the result of the AIC and the SC esteem. Reduce the AIC and the SC values are insufficient to choose the best ARIMA model. Following the researchers [12, 14, 15], this work first creates a model with the minimized AIC and SC values. After that, the significance parameter and residual tests do on the assessment result. The model considered the optimal, if it passes the test. Table 4 reports the model that had success in the tests mentioned above specified via "*".

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C. Model Results

The assessed consequences of the use ARIMA model as following. The LAGDP sequence is an ARIMA (2, 1, 2) has been shown in Table V.

TABLE V
STATISTICAL RESULTS.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.054324	0.012700	4.277555	0.0001
AR(2)	0.763159	0.072711	10.49582	0.0000
MA(2)	-0.953625	0.021539	-44.27377	0.0000
R-squared	0.275610	Mean dependent var		0.091361
Adjusted R-squared	0.244115	S.D. dependent var		0.133613
S.E. of regression	0.116165	Akaike info criterion		-1.408334
Sum squared resid.	0.620742	Schwarz criterion		-1.292508
Log likelihood	37.50418	Hannan-Quinn criterion		-1.364390
F-statistic	8.750864	Durbin-Watson stat		1.700697
Prob(F-statistic)	0.000602			
Inverted AR Roots	.87	-.87		
Inverted MA Roots	.98	-.98		

In addition, the Eq. (2) illustrates the specified shape of the model. Besides, the *t* values of all the model variables are significant and the probabilities are less than 0.05. Moreover, Eq. (3) illustrates the estimated error of regression.

$$\Delta LCGDP = 0.0543240983193 + [AR(2) = 0.763158600329, MA(2) = -0.953625457432] \quad (2)$$

$$\hat{\sigma}_a = 0.116165 \quad (3)$$

Figure 4 reports that the model is utilized to suitable the DLAGDP information. The genuine information is offered through the inflexible lines, and the superior and inferior dabbed lines orchestrate to the fit, values lingering of the model. In addition, Table VI outlines the AC and PAC results that our model is satisfactory.

D. Data Forecasting

Figure 5 delineates the forecast of the Arab world GDP. The plot got with the EViews program shows the genuine GDP with strong line and the upper and lower ran line shows the anticipating deviation. Table VII reports that the CGDP deciding assessments of the years 2021 and 2022 is (2706858485000), and (2859002420000) USA Dollar, respectively. Likewise, the overall development rate 1.5 %, about the reporter for the year 2022 compared with the base year 2019.

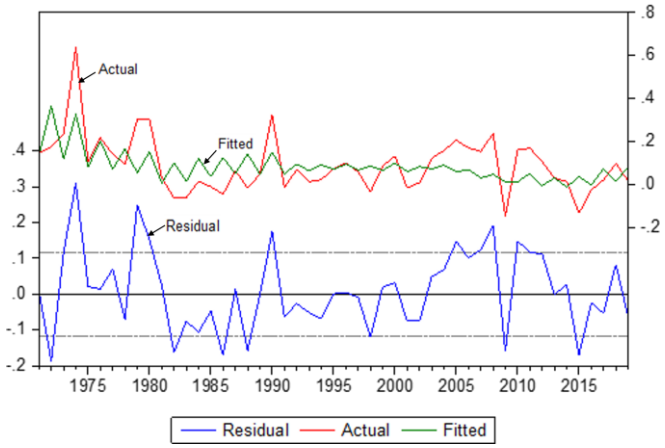
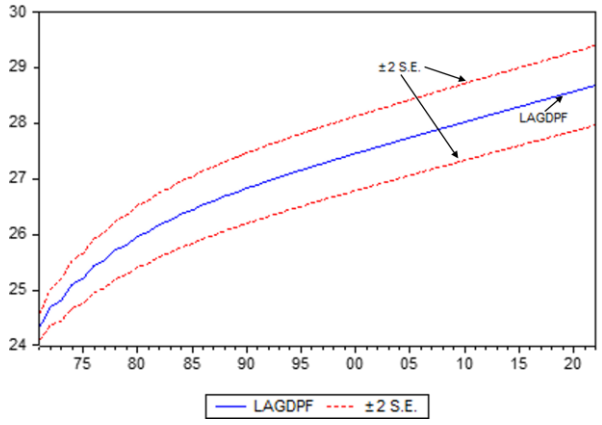


Fig. 4. The DLAGDP Sequence: Actual, Fitted, and Residual Series.

TABLE VI
THE RESIDUAL SERIES.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*. |	. |*. |	1	0.140	0.140	1.0225	
. | . |	. | . |	2	0.037	0.017	1.0943	
. | . |	. | . |	3	0.030	0.023	1.1425	0.285
. | . |	. | . |	4	0.024	0.017	1.1750	0.556
. | . |	. | . |	5	0.042	0.036	1.2772	0.735
. |*. |	. |*. |	6	0.181	0.172	3.1770	0.529
.*| . |	.*| . |	7	-0.130	-0.189	4.1761	0.524
.*| . |	.*| . |	8	-0.186	-0.163	6.2759	0.393
**| . |	**| . |	9	-0.244	-0.220	10.003	0.188
. | . |	. |*. |	10	0.030	0.112	10.062	0.261
. | . |	. | . |	11	-0.018	-0.015	10.084	0.344
.*| . |	**| . |	12	-0.174	-0.207	12.138	0.276



Forecast: LAGDPF
Actual: LAGDP
Forecast sample: 1968 2022
Adjusted sample: 1971 2022
Included observations: 49

Root Mean Squared Error	0.267588
Mean Absolute Error	0.227767
Mean Abs. Percent Error	0.836843
Theil Inequality Coefficient	0.004948
Bias Proportion	0.127444
Variance Proportion	0.026462
Covariance Proportion	0.846094

Fig. 5. LAGDP: Forecast and Actual.

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TABLE VII

ARAB WORLD GDP FORECAST IN USA DOLLAR (FROM 2019 TO 2022).

Year	Forecast Arab World GDP	variation	Growth rate
2019	2815410000000	-	-
2020	2563478486000	-251931514000	-0.089483064278382
2021	2706858485000	-108551515000	-0.038556201405834
2022	2859002420000	43592420000	0.0154835068426979

IV. CONCLUSION

The global spread of the novel Coronavirus epidemic and the preventive processes taken by countries wide-reaching to prevent it have also upset the supply and demand equilibrium of the energy sector. According to most institutions, the mean demand for oil in 2020 has dropped drastically and most sectors of the energy industry have been damaged by the pandemic. Combined with, given preventive estimates taken by the Arab world, the main endeavor has been made to assess the economy's probabilities of sway in the medium term. This paper's primary contribution is proposing a model for forecasting and examining time frames that authentic patterns become inaccurate because of the recent global epidemic. As it was referenced, the pandemic's trend shift phenomena make the entirety of the models created utilizing the historical trends useless. Thus, the techniques applied for this examination are created utilizing econometric models (ARIMA model). The energy demand decrease during the Covid-19 crisis leads to a fall in oil price, which is reflected in the Arab world GDP growth. The ARIMA model results predicted that the Arab world GDP growth is approximately -8.9%, -3.8%, 1.5% for 2020, 2021, and 2022, respectively. Which shows that the Arab world economic movement is developing once more; it is not probably going to re-visitation of business as usual for a long time to come. Since the emergency is not completely over at this stage, there is no comprehensive data to thoroughly investigate the crisis and explore its full range and multidimensional effects. Notwithstanding, there are suggestions from this examination that can be summed up as. First, the Arab world special oil-creating nations should attempt to coordinate in the emergency to forestall more critical economic cruel circumstances. Second, its container be established that the oil industry needs a new strategy to stabilize its funding support and attractiveness to Foreign Direct Investment (FDI). More strategies for decreasing the novel Coronavirus pandemic's longstanding effects on the oil industry be proposed in future research.

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