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تحليل العلاقة بين بعض المؤشرات الاقتصادية ومؤشر الارهاب في العراق والتنبؤ بالإرهاب باستخدام نموذج ARMA

Analysis of the relationship between some economic indicators and the terrorism index in Iraq and predicting terrorism using the ARMA model

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الكلمات الرئيسية: العراق، المؤشرات الاقتصادية، مؤشر الارهاب، متوسط النمو، التنبؤ، نموذج ARMA.
Keywords: Iraq, Economic indicators, Terrorism Index, average growth, forecasting ARMA model.

المستخلص:

تتناول هذه الدراسة تأثير معدلات نمو بعض المؤشرات الاقتصادية في العراق كالناتج المحلي الإجمالي والتضخم والبطالة وعدم المساواة في الدخل ومؤشر الاستقرار السياسي، مع التغيرات الحلصلة في مؤشر الإرهاب TI في فترة السنوات2000-2020. ومن ثم التنبؤ بمؤشر الإرهاب السنوي للعراق باستخدام نموذج ARAM. وأظهرت النتائج أن الإرهاب زاد بنسبة 60٪ في عام2003مما تسبب في انخفاض الناتج المحلي الإجمالي إلى36.7٪. وازدادت التهديدات الإرهابية في العراق بعد عام 2014 مما تسبب في زيادة معدل البطالة بنسبة 20٪ في عام 2017 وعدم المساواة في الدخل بنسبة 12٪. وشهد الاستقرار السياسي أدنى مستوى له في عام2011بانخفاض قدره17.4٪. وبشكل عام زاد متوسط نمو الإرهاب بنسبة 3.6٪ مما تسبب في تقلبات في المعدلات المتوسطة للناتج المحلي الإجمالي والتضخم وعدم المساواة في الدخل وزيادة معدل البطالة. وفقًا لنموذج ARMA المقدر، وجد أن تأخر عام واحد في مؤشر الإرهاب، AR(1)، له أهمية معنوية عند المستوى 1%. وهذا يعني أنه كلما زاد تأخر عام واحد في مؤشر الإرهاب، زاد مؤشر الإرهاب بمقدار 0.93 نقطة، مع بقاء العوامل الأخرى على حالها. ومن المتوقع أن ينخفض مؤشر الإرهاب ببطء خلال السنوات الثماني التالية بعد عام 2020.

Abstract:

This study deals with the impact of growth rates of some economic indicators in Iraq such as GDP, inflation, unemployment, income inequality and political stability index, with the changes in the terrorism index TI during the period 2000-2020. Then, predict the annual terrorism index for Iraq using the ARAM model. The results showed that terrorism increased by 60% in 2003, causing the GDP to decrease to 36.7%. Terrorist threats in Iraq increased after 2014, causing the unemployment rate to increase by 20% in 2017 and income inequality to increase by 12%. Political stability reached its lowest point in 2011, with a decrease of 17.4%. Overall, the average growth of terrorism increased by 3.6%, causing fluctuations in the average rates of GDP, inflation, income inequality, and unemployment to increase. According to the estimated ARMA model the one-year lag of the terrorism index, AR (1), is found to be significant at the 1% level. This means that the longer the one-year lag of the terrorism index, the higher the terrorism index by 0.93 points, with other factors remaining constant. The terrorism

index is expected to slowly decline over the next eight years after 2020.

1.1 Introduction:

Iraq's economy has been impacted by an array of economic, psychological sociological, and political shocks as a result of civil war and terrorism. Indeed, as the threats of so called the Islamic State of Iraq and Syria (ISIS) has risen in power, Iraq has faced an increasingly difficult terrorist situation since 2013. In this perspective, it is particularly relevant to comprehend a picture of terrorism in Iraq before and after the creation of ISIS, as well as the consequences for the country's economy. As a result, we used a survey dataset from 2000 to 2020 to investigate the effects of terrorism in Iraq over those two time periods. Most of the analytical and empirical studies of terrorism involve time-series econometrics in order to identify trends and frequencies in terrorist attacks, such as, (Enders et al.,1992; Enders and Sandler,1999, 2000,2002, 2005, 2006; Barros and Proença, 2005). In this study, we use the Terrorism Index TI as a measurement that captures the severity of terrorism in a country based on specific weights given to some humanitarian and economic costs(Global Terrorism Index GTI, 2020 Chawsheen and Qader, 2024, pp.6-7)These costs encompass; the total number of terrorism incidents, the total number of fatalities, the total number of injuries, and the property damages. This index is scaled from 0(no terrorism) to 10(severe terrorism). Iraq’s terrorism index has been quite high during the past decade, particularly after the ISIS attacks in 2014 till the time being.

1.2 The Study Problem: The problem of frequent events of terrorist attacks causes chronic uncertainty and instability in the country’s economic growth. Several studies such as (Li and Schaub, 2004; Li, 2005 Enders, 2007) discuss the causes and problems that terrorism creates in the country's economy and give an overview of it. In order to assess the consequences of terrorism on Iraq’s economy the researchers attempt to answer the following research questions:

1.2.1 How would be the annual growth rates in GDP, inflation unemployment, income inequality, and political stability index with the changes arise in the Terrorism Index?

1.2.2 How would change the figures of Iraq terrorism indices in the short and long run future forecasting trend?

1.3 Importance of the study: The importance of this sort of research cannot be undervalued, considering that the mechanisms by which terrorism affects a society are yet unknown. In order to gain insight into the short- and long-term trends of the Terrorism Index in Iraq, as well as how to deal with terrorism via its consequences on the Iraqi economy.

1.4 The Objectives:

1.4.1 To explore annual and the average growth rates of Iraq's GDP inflation, unemployment, income inequality, and political stability index associated with changes in Terrorism Index growth rates.

1.4.2 Forecasting the annual terrorism index in Iraq using ARAM model.

1.5 The Hypotheses

1.5.1 There is no stability or quasi-stability in the rise and fall of the rate of growth of the GDP, the rates of prices inflation, unemployment rates, and the variation in peoples' incomes, due to the presence and continuation of terrorist operations in Iraq.

1.5.2 Given a long run stationarity of terrorism index in Iraq, the researchers assume the lag of terrorism index has a significant impact on the current and future years values, so, we assume that its t-statistic is significant at 5% level.

1.5.3 Depending on the annual data collected for this study, terrorism index recorded very high values, particularly since 2014 till 2020 therefore we presume that terrorism index will sustain recording high indices during the forecasted period 2020 to 2028, as well.

1.6 The Methodology: In this study the researchers attempt to do analytical explanation for the economic variables with the presence of terrorism in Iraq though annual change in their growth rates. Also, the Ordinary Least Square OLS of Autoregressive Moving Average ARMA modeling approach is adopted.

1.7 Data Sources: The following Table 1 shows data sources, description and measurements.

Table(1) Data Sources and Description

Acronym	Description	Measurement	Data Source
TI	Terrorism Index	Ranges from 0 to 10	The Institute for Economics and Peace (IEP). Annual GTD reports. https://www.economicsandpeace.org/?s=terrorism
INF	Inflation rate	% Rate	World Bank; https://data.worldbank.org/indicator/FP.CPI.TOTL .ZG?end=2021&locations=IQ&start=2001
GDPG	Annual GDP growth	% Rate	World Bank; https://data.worldbank.org/indicator/NY.GDP locations=IQ MKTP.KD.ZG?
GINI	Income inequality index	Ranges from 0 to 1	1) https://tradingeconomics.com/iraq/gini-index-world-bank-estimate-wb-data.html 2) https://www.statista.com/forecasts/1165124/gini-index-forecast-in-iraq
UEMP	Unemployment	% Rate	World Bank: https://data.worldbank.org/indicator/SL.UEM.TOTL. NE.ZS?locations=IQ and; https://www.macrotrends.net/countries/IRQ/iraq/unemployment-rate#
PS	Political Stability index	Ranges from -2.5 (weak); to 2.5 (strong)	https://www.theglobaleconomy.com/Iraq/wb_political_stability/

Source: prepared by the researchers, 2020.

And the annual raw data collected during2000to2020, which illustrated in Table2

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Table 2 The Raw Data

Years	TI	GDPG	INF	GINI	UEMP	PS
2000	3.7	16.9	5	0.57	8.727	-1.74
2001	4	1.7	16.4	0.58	8.807	-1.68
2002	4.09	-8.2	19.3	0.59	8.852	-1.61
2003	6.56	-36.66	33.6	0.35	8.819	-2.39
2004	8.03	53.39	27	0.41	8.608	-3.18
2005	8.65	1.67	37	0.42	8.706	-2.69
2006	9.1	5.65	53.2	0.38	8.652	-2.83
2007	9.45	1.89	-10.1	0.31	8.65	-2.77
2008	9.33	8.23	12.7	0.31	8.484	-2.47
2009	9.33	3.38	6.9	0.32	8.393	-2.18
2010	9.22	6.4	2.9	0.32	8.251	-2.24
2011	9.11	7.55	5.8	0.31	8.122	-1.85
2012	9.56	14	6.1	0.29	7.96	-1.93
2013	9.01	7.62	1.9	0.27	9.264	-2.01
2014	10	0.2	2.2	0.25	10.59	-2.48
2015	10	4.72	1.4	0.23	10.725	-2.26
2016	9.96	13.79	0.6	0.24	10.82	-2.31
2017	10	-1.82	0.2	0.27	13.02	-2.31
2018	9.75	2.63	0.4	0.29	12.966	-2.53
2019	8.68	5.96	-0.2	0.31	12.863	-2.6
2020	8.682	-15.67	0.6	0.3	14.088	-2.53

Source: prepared by the researchers depending on the sources referred in Table 1, 2020.

2.1 Terrorism Index of Iraq: A terrorist assault, according to Global Terrorism Database GTD, is defined as the threat or use of violence in order to achieve a political, economic, religious, or social aim through intimidation or pressure by an actor other than the state. To be more explicit, for an incident to be classified as terrorism:

i. The offenders must be acting on purpose.

ii. The perpetrators must use threat or violence against individuals or property.

iii. The perpetrators cannot be legitimate state agents.

In addition, ideally two of the three conditions listed below must be met:

iv. The offenders' acts are motivated by a political, economic, religious, or social goals.

v. The activities are intended to intimidate or pressure more than the immediate victims. and

vi. The actions target civilians.

The Global Terrorism Index GTI index is designed to calculate the degree of terrorism's humanitarian and economic costs for a given country. These costs include total number of terrorism incidents, total number of fatalities total number of injuries, and property damages. This index is scaled from 0 (no terrorism) to 10 (severe terrorism). GTI has been utilized in several empirical research, including those by Abadie (2006), Gries et al. (2011), Enders and Sandler (2012), and others. Global Terrorism Database GTD determines this index by simple mathematical calculations. Iraq’s terrorism index, which denoted by (TI) in this study, recorded extremely high scores starting from

year 2004 to 2020. Besides, Iraq being the most affected 14 times in comparison to the other countries, during 2000 to 2018(Bardwell and Iqbal 2021). This index reached to 10 during the period of 4 years from2014to2017due to ISIS group extensive attacks. The direct costs were significantly high, such as the number of deaths due to terrorism attacks.

2.2Iraq Terrorist Attacks, Deaths, and Terrorism Index During 2000-2020: Number of terrorist attacks started to increase significantly since year 2003, with102 attacks, which caused391deaths. And the terrorism index was 6.56, started to increase significantly since2003. Associated with attacks increments till reached to3933attacks in2014, which caused14095deaths, with the highest terrorism index(TI)=10, seeTable3.

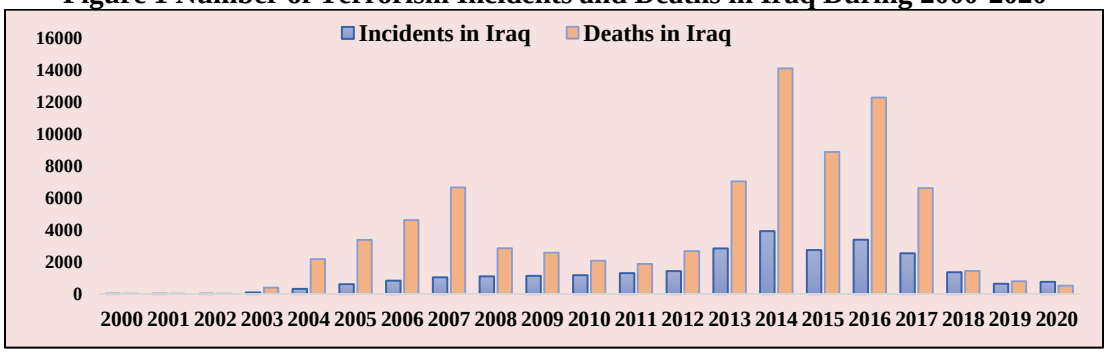
Table 3 Number of Terrorist Attacks and Deaths in Iraq During 2000-2020

Years	No. of Attacks	No. of Deaths	TI
2000	10	10	3.7
2001	3	9	4
2002	6	10	4.09
2003	102	391	6.56
2004	323	2171	8.03
2005	617	3384	8.65
2006	838	4612	9.1
2007	1047	6665	9.45
2008	1106	2864	9.33
2009	1137	2585	9.33
2010	1179	2074	9.22
2011	1308	1870	9.11
2012	1437	2679	9.56
2013	2852	7042	9.01
2014	3933	14095	10
2015	2751	8885	10
2016	3360	12276	9.96
2017	2466	6619	10
2018	1956	1432	9.75
2019	1131	799	9.241
2020	495	525	8.682

Source: GTD annual reports.

The highest number of deaths was14095 in year 2014, which is corresponding to the highest number of terrorist incidents 3934, in the same year, as shown in Figure 1The ratio of Iraqi deaths to worldwide deaths due to terrorism was0.23% in year2000, then this ratio increased significantly to reach31.57% in year 201(GTI, 2016).

Figure 1 Number of Terrorism Incidents and Deaths in Iraq During 2000-2020



Source: plotted by the researchers based on; GTD, START, and (Herre, 2023b).

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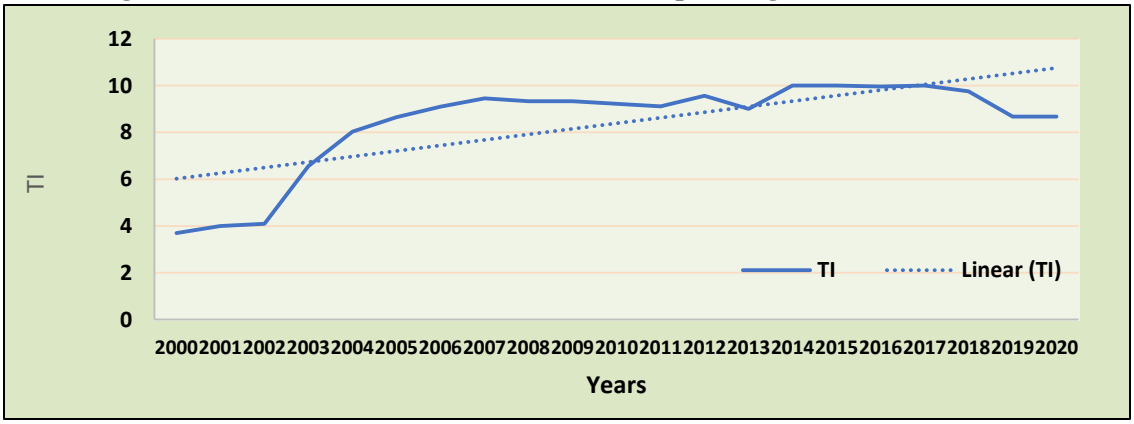
Sinjar massacre was Iraq's most serious humanitarian disaster. This was the world's second-costliest occurrence in terms of deaths and injuries from 2000 to2018, with an economic loss of $US4.3billion due to ISIL attacks as they claimed the responsibility for an attack on Yazidi people in Sinjar Nineveh, Iraq. Consequently, at least 953 individuals were killed in this attack, and5350were kidnapped. However, the collective cost of31terrorist incidences in Iraq estimated to be $US31billion in lost GDP due to fatalities and injuries(Bardwell and Iqbal, 2021) Annual terrorism index TI had recorded the highest figure, close to 10, during 2014 to 2018. Note that Iraq terrorism index has an upward trend for the period under investigation with mean of 8.4 for the entire series under study, see Figure 2.

Figure 2 The Trend of Terrorism Index in Iraq During the Years 2000-2020



Source: plotted by the researchers depending on table 2.

Figure 2 shows that Iraq terrorism index recorded more than 6 during the period years 2004 till 2020, particularly during the years 2014 to 2018 where it was at peak, rather close to 10.

2.3 Annual and Average Growth Rate of The Economic Indicators Related to Terrorism: Annual growth rates of the variables are calculated depending on the raw data from Table 1. The following formula calculates the percentage change from one period to the next:

$$\boldsymbol{PR} = \frac{(\boldsymbol{V\,pr} - \boldsymbol{V\,pa})}{\boldsymbol{V\,pa}} \times \mathbf{100} \quad \ldots\ldots (\mathbf{1})$$

, Where: PR=Percent Rate, V Pr=Present or Future Value, V Pa=Past or Present Value Through looking at Figure 2, we can detect a structural break(date) in the curve of terrorism index in year 2003. This also found throughout the structural break stationarity test for TI in Table 5. Accordingly, we divide the status of average growth rate for each indicator of this study into two time periods; period(1)2000-2002 and period(2)2003-2020 as exhibited in Table 4.

Table 4 Annual Growth Rate for Terrorism Index and The Economic Indicators

Year	TI % Δ	GDPG %Δ	INF %Δ	UEMP %Δ	GINI %Δ	PS %Δ
2000	-	-	-	-	-	-
2001	8.11	1.76	228	0.92	1.75	-3.45
2002	2.25	-8.19	17.68	0.51	1.72	-4.17
2003	60.39	-36.65	74.09	-0.37	-40.68	48.45
2004	22.41	53.38	-19.64	-2.39	17.14	33.05
2005	7.72	1.67	37.04	1.14	2.44	-15.41
2006	5.20	5.64	43.78	-0.62	-9.52	5.20
2007	3.85	1.88	-118.98	-0.02	-18.42	-2.12
2008	-1.27	8.22	-225.74	-1.92	0	-10.83
2009	0	3.37	-45.67	-1.07	3.23	-11.74
2010	-1.18	6.40	-57.97	-1.69	0	2.75
2011	-1.19	7.54	100	-1.56	-3.13	-17.41
2012	4.94	13.93	5.17	-1.99	-6.45	4.32
2013	-5.75	7.62	-68.85	16.38	-6.90	4.15
2014	10.99	0.19	15.79	14.31	-7.41	23.38
2015	0	4.72	-36.36	1.27	-8	-8.87
2016	-0.40	13.78	-57.14	0.89	4.35	2.21
2017	0.40	-1.81	-66.67	20.33	12.50	0
2018	-2.50	2.63	100	-0.41	7.41	9.52
2019	-10.97	5.95	-150	-0.79	6.90	2.77
2020	0.02	-15.67	-400	9.52	-3.23	-2.69
The Indicator Rate of Growth %						
Period (1) 2000-2002	5	-3.4	13.8	0.7	1.7	1.1
Period (2) 2003-2020	1	6	-2.8	3	-2.2	0.6
Entire Time 2000-2020	3.6	4.7	-2.4	2.2	-3.6	-0.2

Source: Calculated by the researchers using EViews13.

Annual growth rates are fluctuating for each indicator comparing to its previous year figure. Considering TI, we see that in year 2003 terrorism increased by 60%. Iraq's GDP dropped to 36.7% in the same year. In 2017 after the emergence of ISIS attacks, unemployment increased by 20%, and income inequality raised by 12% for the same year. And price inflation raised to 100% in 2018. Political stability experienced its lowest level in 2011, reduced by 17.4%. The average rate of growth for each series is calculated using exponential growth rate model, for the two above-mentioned periods separately, and also for the entire time frame of the collected dataset, as the following:

$Y= e^{a+bT}$, or $LogY= a+bT$……. (2), (Panik, 2014, p.33). Where; Y represents the series of concern, a is the constant, b the rate of growth in unit time, T Refers to time variable i.e., years under study that starts from 2000 until and 2020. Terrorism average rate of growth was increasing in period(1)and period(2), by 5% and 1%, respectively, and for the entire time frame by 3.6%. comparing the rise in TI in the two periods, we see that in period(1)was more 5%. This caused a significant decrease in Iraq's GDP by 3.4%, and raised the average rate of each of; inflation by 13.8 unemployment rate by 0.7, income inequality by 1.7%. While the average growth rate of political stability index was growing by about 1% in period (1), i.e., pre-ISIS attacks, political stability in Iraq experienced a bit of

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growth, but it was deteriorating by 0.2% for the entire period. As for period(2)during 2003-2020, terrorism was growing with annual average rate of 1%, this increase was associated with annual growth in GDP by6% decrease in inflation by2.8%, rise in unemployment by3%, reduction in income inequality by2.2, and a slight growth in political stability0.6%, but this index reduced by0.4% comparing with the first period. This reduction in PS might be due to increase in violence and terrorism during the second period. The consequences of terrorism in Iraq in the entire period of the study2000-2020, where TI growth rate was3.6%, associated with4.7% increase in GDP growth, 2.4%decrease in inflation, 2.2%increase in unemployment, 3.6% reduction in the rate of income inequality, and0.2% reduction in political stability.

3.1 The Econometrics Segment: The following steps consider the process of developing an ARAM model for forecasting terrorism in Iraq with all necessary statistical tests.

3.1.1 What is the ARMA model?

An ARMA model, also known as an autoregressive moving average model, is a forecasting model that forecasts future values based on previous values. The simplicity of ARMA models is a significant advantage. They just require a minimal dataset to generate a prediction and they are very accurate for short predictions, and operate with data that does not have a known trend. The ARMA model was initially presented in Peter Whittle's1951 thesis, which merged mathematical analysis of Laurent series and Fourier analysis, as well as statistical inference. A1970 book by George E. P. Box and Jenkins popularized ARMA models by explaining an iterative Box-Jenkins approach for selecting and estimating them. This technique worked well for polynomials of degree no more than three (Hannan and Deistler 1988, p. 227). The ARMA model is just a white noise infinite impulse response filter with some additional interpretation attached to it. The notation ARMA(p,d,q) refers to a model containing p autoregressive terms, d the dependent variable's integration level, and q moving-average terms(Shumway and Stoffer 2000). Because d is integrated at level I(0), d=0 and our ARMA model is expressed as ARMA(p,q). In this study the autoregressive model for Iraq terrorism index of order p would be as:

$TI_t = \sum_{i=1}^{p} \varphi i \;\; TIt - i + \varepsilon$ ……. 4.3

Where; TI_t represents terrorism index in year t, TI_{t-i} is ith year lag of terrorism index, and ε_t is the error term. The moving average MA(q)

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model, which is a linear combination of error terms occurring contemporaneously and at various times in the past, is:

$$TI_t = \mu + \varepsilon_t + \sum_{i=1}^{q} \theta i \ \varepsilon t - i \quad \ldots\ldots\ldots\ldots 4.4$$

Where; $\theta 1. \ldots, \theta q$ are the parameters of the model, μ is the expectation of TI (often assumed to equal 0), and the εt, …., εt − i, are i.i.d white noise error terms that are commonly normal random variables.

Thus, the ARMA model for terrorism in Iraq would be developed through combining both models 4.3 and 4.4, which yields:

$$TI_t = C + \sum_{i=1}^{p} \varphi i \ TIt - i + \sum_{i=1}^{q} \theta i \ \varepsilon t - i \quad \ldots\ldots\ldots\ldots\ldots 4.5$$

it is quite likely that TI has characteristics of both AR and MA and is therefore ARMA(p,q). Thus, TI_t follows an ARMA(1, 1) process if it can be written as:

$$TI_t = C + \varphi_1 TI_{t-1} + \theta_0 \varepsilon_t + \theta_1 \varepsilon_{t-1} \ldots\ldots\ldots\ldots\ldots 4.6$$

So, there is one autoregressive term, and one moving average term (Gujarati 2004, 839). Where, C represents a constant term. In general, in an ARMA(p, q)modeling, there will be p autoregressive and q moving average terms (Hallin, and Puri, 1988).

3.1.2 Pre-Diagnostic Test of TI Stationarity: Unit root test shows the stationarity status for each data series. Therefore, before running ARMA model for time series data, each variable data has to be stationary at its original level of integration I(0), or at its first difference of integration I(1). The approaches of Augmented Dicky Fuller ADF, Philips- Peron, and Peron (1997) which accounts for structural breaks, are adopted to show the results of unit root test. The hypotheses of these tests are:

H0: the series has a unit root (not stationary).

H1: the series hasn't a unit root (stationary).

Table 5 shows the results of unit root test at the original level I(0)level, and at first differences I(1)of integration at10%and 5% alpha significance level.

Table 5 ADF, PP, Structural Break Unit Root Test

Unit Root Test	Level		First Difference	
	Intercept	Intercept and trend	Intercept	Intercept and trend
ADF	-2.9516 0.0571*	-1.1867 0.8857	-2.9422 0.0591 *	-4.1410 0.0211 **
PP	-2.8719 0.0665 *	-1.0809 0.9072	-2.9202 0.0616 *	-4.1393 0.0211 **
Structural Break	-4.6828 ** (2003)	-3.0390 (2003)	-4.5222 ** (2006)	-5.1920 ** (2013)

* Significant at %10 level. ** significant at %5 level. *** significant at %1 level.

Source: prepared by the researchers using EViews 13.

The ADF and PP unit root tests have a well-known defect in that they might misinterpret breaks in the series as evidence of non-stationarity. In other

words, if the series has a structural break as shown in Figure 2, where the series is having structural break points in different years and they might fail to reject the unit root hypothesis(Perron1989; Perron1997, 358). Therefore, we added another unit root test of structural break unit root test. And the results revile stationarity at I(0), and I(1)at 5%significant level. Thus, we can reject H0, and determine that TI series is stationary, i.e., doesn't have a unit root.

3.1.3 Selecting The Appropriate Rank for ARMA(p, q): At this juncture we deal with two essential concepts autocorrelation and partial autocorrelation, they are measurements of relationship between current and previous series values that reveal which previous series values are most beneficial in forecasting future values. This information is used to identify the order of processes in an ARMA model. To be more specific, ACF stands for autocorrelation function. This is the correlation between series values that are k gaps apart at lag k. while PAF stands for partial autocorrelation function. This is the correlation between series values that are k intervals apart at lag k, taking into consideration the values of the intervals between(IBM Documentation, n. d.)Through plotting TI partial autocorrelation for an estimate of p, and also using the autocorrelation functions for an estimate of q, we can decide that ARMA(1,1)is a suitable model for the forecasting process, as shown in the following correlogram Table6. Here we can observe that partial correlation p=1, and Autocorrelation q=1because p and q are spiked out of the dashed range of significance. Therefore, ARMA(1,1)is the appropriate model rank for TI forecasting process. We also could, and in fact applied ARMA(1,2), but the results and post estimation tests were unreliable, therefore we settled on ARMA(1,1) model. Eventually this technique is somewhat dependent on the analyst's subjective assessment(Gooijer, Abraham, Gould, and Robinson1985, p. 301).

Table 6 TI Series Correlogram

Sample (adjusted): 2000 2020
Included observations: 21 after adjustments

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.79...	0.79...	15.19...	9.71...
		2	0.54...	-0.2...	22.80...	1.11...
		3	0.25...	-0.2...	24.59...	1.87...
		4	0.08...	0.13...	24.79...	5.53...
		5	-0.0...	0.03...	24.79...	0.00...
		6	-0.0...	-0.1...	24.90...	0.00...
		7	-0.0...	-0.0...	25.12...	0.00...
		8	-0.0...	0.06...	25.33...	0.00...
		9	-0.0...	-0.0...	25.63...	0.00...
		10	-0.1...	-0.0...	26.14...	0.00...
		11	-0.1...	-0.0...	27.03...	0.00...
		12	-0.2...	-0.1...	29.26...	0.00...

Source: found by the researcher using EViews 13.

Finding appropriate values of p and q in the ARMA(p,q) model can be simplified by:

1. Finding the model that residuals are white nose, through (Ljung-Box Q statistics) H0: residuals are white noise. Which means the variables are independently and identically distributed (i.i.d) with a mean of zero. This implies that all variables have the similar variance (sigma2) and each has a zero correlation with all other values in the series.
2. The ARMA model is covariance stationary (AR roots should lie inside the unit circle).
3. MA roots should lie inside unit circle. If these three conditions are satisfied then forecasting process could be achieved appropriately.

3.1.4 The Estimated ARAM Model: Table7 includes the estimated ARAM(1,1) model for terrorism index in Iraq during the period 2000-2020 with related statistics.

Table 7 Iraq TI ARMA Model

Dependent Variable: TI				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Sample: 2000 2020				
Included observations: 21				
Convergence achieved after 35 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	**7.1287**	**1.91633**	**3.7199**	**0.0017**
AR(1)	**0.9313**	**0.1109**	**8.3908**	**0.0000**
MA(1)	**0.2948**	**0.2452**	**1.2022**	**0.2457**
SIGMASQ	**0.5102**	**0.1319**	**3.8673**	**0.0012**
R-squared	**0.8691**	**Mean dependent var**		**8.3910**
Adjusted R-squared	**0.84611**	**S.D. dependent var**		**2.0238**
S.E. of regression	**0.7939**	**Akaike info criterion**		**2.6696**
Sum squared resid.	**10.7153**	**Schwarz criterion**		**2.8685**
Log likelihood	**-24.0310**	**Hannan-Quinn criter.**		**2.7128**
F-statistic	**37.6554**	**Durbin-Watson stat**		**1.8306**
Prob(F-statistic)	**0.0000**			

Source: developed by the researcher using EViews 13.

In Table 7 we can observe the coefficient of one year TI lag AR(1) is significant at 1% significance level. Implying that, one year lag of TI has a significant positive effect on the present year TI. As one year lag of TI increases by one point, TI increases by 0.93 points, ceteris paribus. While the coefficient of one year lag of the moving average hasn't any effect on TI, ceteris paribus. Though it has, jointly with rest variables, as the F statistic is significant at 1% level. The R squared and adjusted R squared are relatively close to each other, 87%, and 85%, respectively. indicating

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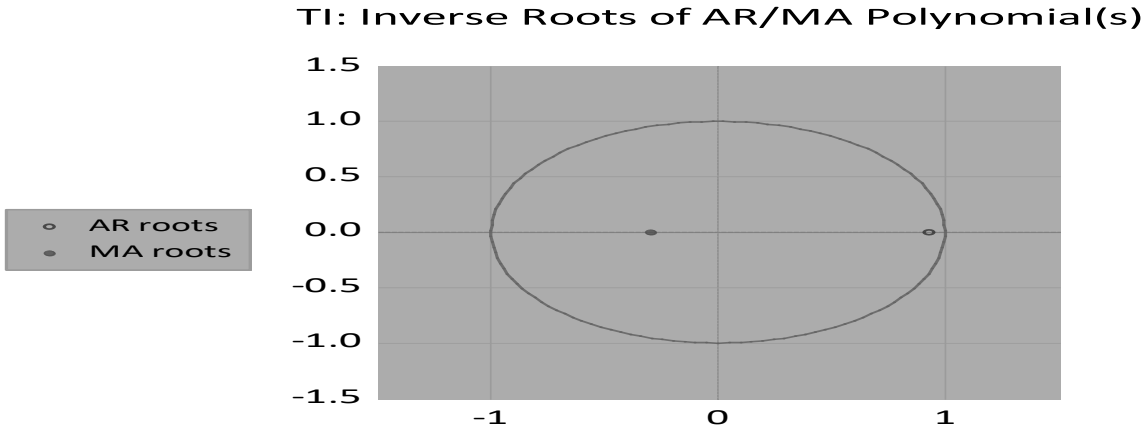
that 85% of the variations that might TI experience are due to the independent variables. Akaike and Schwarz criterions are 2.6, and 2.8 respectively. Durbin- Watson statistic is 1.83, which is close to 2, might be a sign of no serial correlation.

3.1.5 The Diagnostic Tests of the Estimated ARMA Model: The estimated model would be reliable, through the diagnostic tests, which are shown in Figure 3, and Tables 8, and 9.

Figure 3 AR and MA Roots of Terrorism ARMA Model



Source: Plotted by the researcher using EViews 13.

From Figure 3 we can settle on the ARMA model is covariance stationary because autoregressive roots AR roots are locating inside the unit circle. Also, the moving average MA roots are inside the unit circle. And conclude the residuals are white nose, through (Ljung-Box Q statistics) and we accept H0, which says residuals are white noise.

Table 8 Ljung-Box Q Statistics of Iraq Terrorism ARMA Model

Sample (adjusted): 2000 2020
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.0...	-0.0...	0.122...	
		2	0.15...	0.15...	0.743...	
		3	-0.2...	-0.2...	2.158...	0.14...
		4	-0.0...	-0.1...	2.335...	0.31...
		5	-0.1...	-0.1...	3.274...	0.35...
		6	0.01...	-0.0...	3.282...	0.51...
		7	-0.0...	-0.1...	3.601...	0.60...
		8	0.05...	-0.0...	3.709...	0.71...
		9	0.09...	0.09...	4.045...	0.77...
		10	-0.0...	-0.1...	4.410...	0.81...
		11	0.27...	0.25...	8.174...	0.51...
		12	-0.1...	-0.1...	10.14...	0.42...

Source: calculated by the researcher using EViews 13.

Since the residual's values of partial correlation, and autocorrelation coefficients are not spiking out of their significance boundaries in Table8 and their probabilities are greater than 5%, so H0 is accepted. Therefore we can confirm that the residuals of the estimated ARM (1,0,1)are white noise.

Table 9 Ramsey RESET Test for the Estimated ARMA Model

Ramsey RESET Test			
Omitted Variables: Squares of fitted values, Specification: TI C AR (1) MA (1)			
	Value	df	Probability
t-statistic	1.1478	16	0.2679
F-statistic	1.3175	(1, 16)	0.2679
Likelihood ratio	2.87519	1	0.0899

Source: calculated by the researcher using EViews 13.

Looking at Table 9, since the p-value of F-statistics is0.26, which is greater than0.05 we can decide the estimated ARMA model isn't mis-specified and could be relied for the purpose of forecasting terrorism in Iraq.

3.1.6 Forecasting Iraq Terrorism Index TI: Now we are reassured to forecast TI values for the years 2021 to 2028 as shown in Table 10.

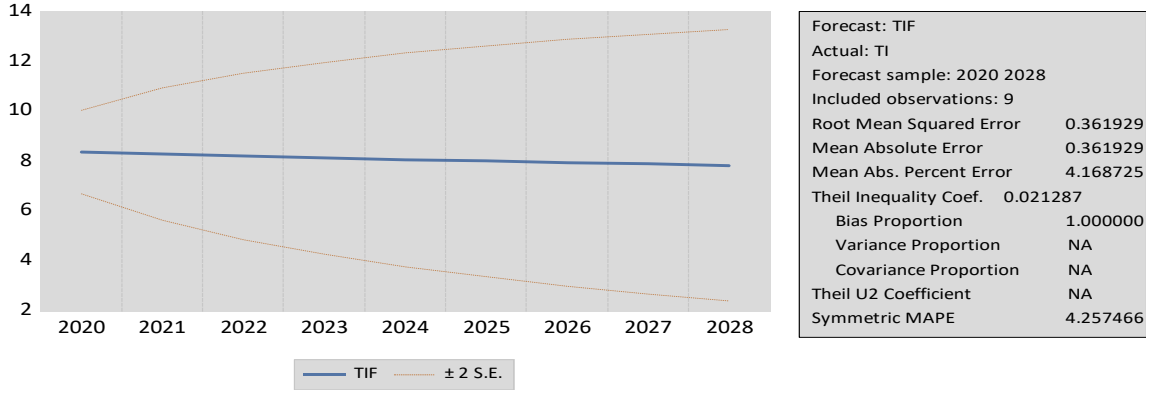
Table 10 The Forecasted Values of Iraq TI from Year 2021 to 2028

Year	Forecasted TI	Upper Bound	Lower Bound
2021	8.24	9.56	6.91
2022	8.16	9.82	6.50
2023	8.09	10.01	6.17
2024	8.03	10.16	5.89
2025	7.96	10.28	5.65
2026	7.91	10.38	5.44
2027	7.85	10.45	5.25
2028	7.80	10.52	5.09

Source: calculated by the researcher using EViews 13.

The following Figure4 shows the forecasted values of TI during the period 2020-2028Where we can observe a very slow declining in TI And Theil inequality coefficient of0.02is quite low expresses a perfect fit of forecasted model.

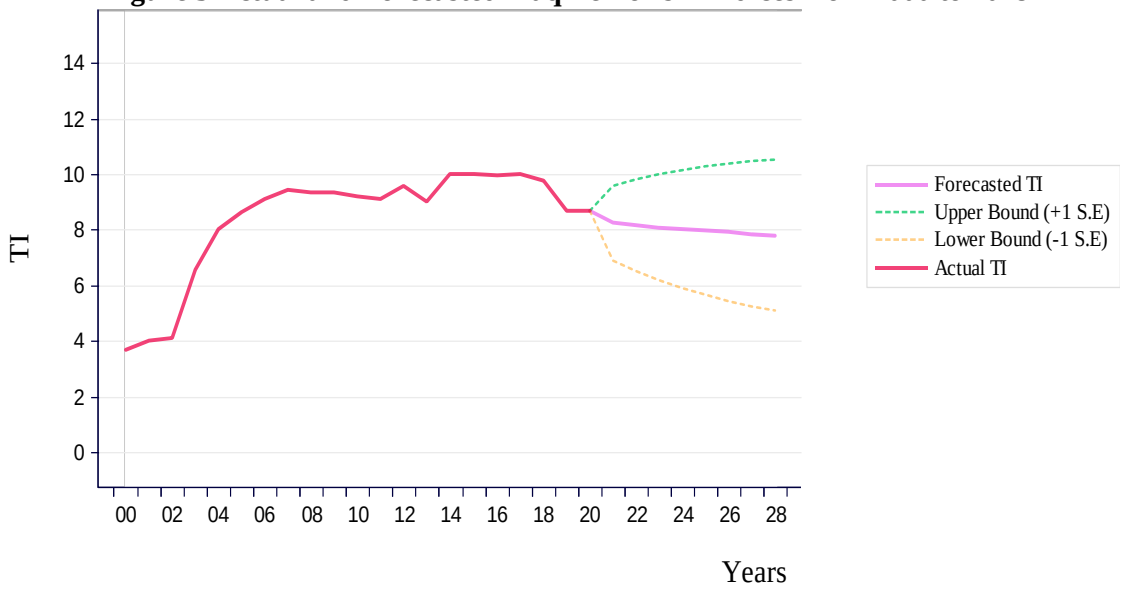
Figure 4 Trend of the Forecasted Iraq Terrorism Indices From 2020 to 2028.



Source: Plotted by the researcher using EViews 13.

As the time frame of Iraq's annual Terrorism Index is from year 2000 to 2020, the ARMA model employed to forecast this index for extra eight extended years, i.e., until year 2028. According to the forecasted values in Table 10 terrorism index of Iraq is decreasing in a slow manner. In year 2021 TI expected to be8.24, which located between the upper and lower boundaries of 9.56, and6.91, respectively. Now, while the researchers write this paper, we are in year 2023, GTI(2022)has reported Iraq's actual TI for year 2021to be 8.51, which is quite close to this study's empirical forecasting's. Considering the year 2028 TI might decline to 7.8, within the upper and lower boundaries of 10.52 and 5.09, respectively. Figure 5 shows the actual, and the forecasted values of TI along with its upper and lower boundaries.

Figure 5 Actual and Forecasted Iraq Terrorism Indices from 2000 to 2028



Source: Plotted by the researcher using EViews 13.

As illustrated in Figure 5, the red line, represents the actual TI, and the purple line is the forecasted TI from year 2021 to 2028. We can see that the actual TI started to increase in year 2003 and was at pick of 10, during the years 2014 to 2018. Then it started to decline from year 2019, but in a very slow pace. Now the results of ARMA forecasting's show a slow continuous declining in TI, where it may decline to 8 in year 2024, and keeps declining to reach 7.8 in year 2028, with ±1 standard error for upper and lower boundaries, the dotted green and yellow frontiers, respectively.

3.1.7 **Impulse Response of TI:** An impulse response function (IRF) of a time series model, or dynamic response of the system, assesses the changes in the future responses of all variables in the system when one variable is

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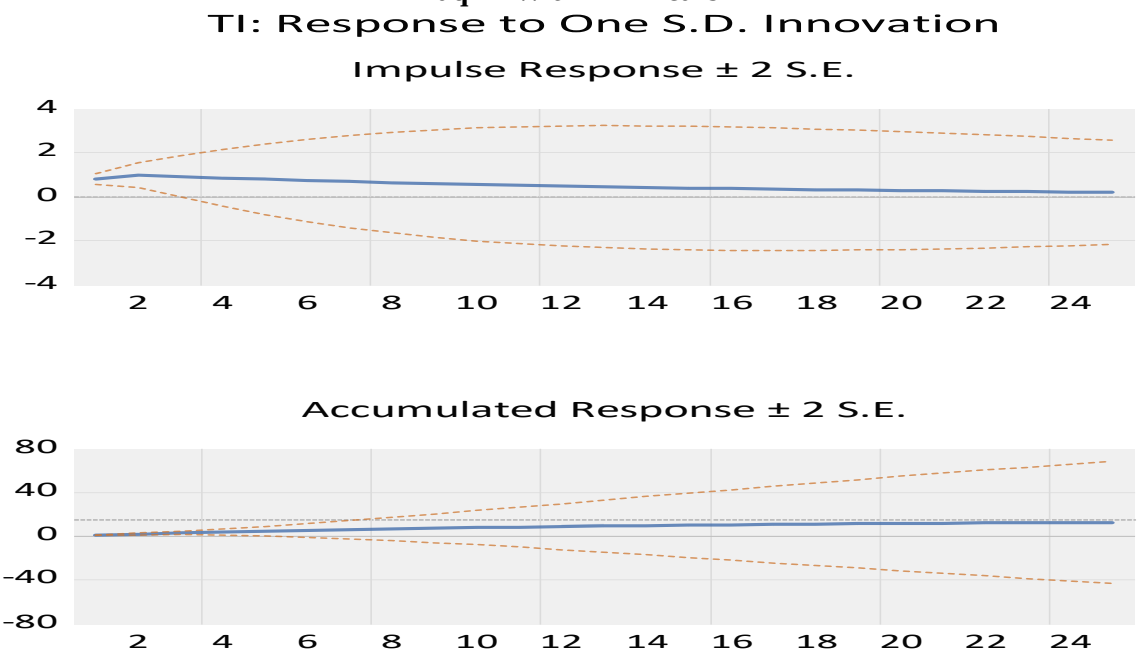
shocked by an impulse (Lütkepohl, 2007). In this study starting at period 0 to period 24, the impulse depicts the dynamic responses, during which impulse runs one shock to the innovation or change.

Figure 6 Two Panels of Impules and Accumulated Responses to One SD Innovation of Iraq TI Within 24 Years



Source: Plotted by the researcher using EViews 13.

Figure6 contains two panels that are representing impulse, and accumulates responses of one standard deviation innovation might occur to Iraq terrorism index. In these panels we note that both blue curves incur few fluctuations at the first five periods, as being relatively far from zero, i.e., not stationarity. But they get closer and closer to zero as time passes and be stationary starting from period 5 and onwards. Bothe curves are representing reliable images as they remain within the boundaries of ±2 standard errors.

4.1 Conclusions:

In this study we concluded that:

i. Annual terrorism index TI had recorded the highest figure, close to 10, during 2014 to2018Note that Iraq terrorism index has an upward trend for the period under investigation 2000-2020, with mean of8.4 for the entire series under study.

ii. Terrorism increased by 60% in 2003, causing a drop in GDP to 36.7%. In 2017, unemployment increased by 20%, income inequality rose by 12%, and price inflation rose to 100% in 2018. Political stability experienced its lowest level in 2011, with a reduction of 17.4%. Terrorism average growth increased by 5% and 1%, causing a 3.4% decrease in GDP and increasing inflation

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unemployment, and income inequality.

iii. The results show TI series is stationary at level I(0), and the rank of partial correlation p=1, and Autocorrelation q=1because p and q are spiked out of the dashed range of significance in the correlogram of TI series. Therefore, ARMA(1,0,1)is the appropriate model rank for TI forecasting process, which is frequently written as ARMA (1,1).

iv. The coefficient of one year TI lag AR(1)is significant at1% significance level. Implying that, one year lag of TI has a significant positive effect on the present year TI. As one year lag of TI increases by one point, TI increases by 0.93 points, ceteris paribus. While the coefficient of one year lag of the moving average hasn't any effect on TI, ceteris paribus. Though it has, jointly with rest variables, as the F statistic is significant at 1% level.

v. The R squared and adjusted R squared are relatively close to each other 87%, and 85%, respectively. indicating that 85% of the variations that might TI experience are due to the independent variables. Akaike and Schwarz criterions are 2.6, and 2.8 respectively. Durbin- Watson statistic is 1.83, which is close to 2, might be a sign of no serial correlation.

vi. Theil inequality coefficient of 0.02 which is quite low, expresses a perfect fit of forecasted model.

vii. According to the forecasted values in the extended eight years terrorism index of Iraq will be decreasing in a slow manner. In year 2021 TI expected to be 8.24, which located between the upper and lower boundaries of 9.56, and 6.91, respectively. Now, while the researchers write this study, as we are in year 2023, GTI(2022) has reported Iraq's actual TI for year 2021 to be 8.51, which is quite close to this study's empirical forecasting's. In year 2028 TI might decline to 7.8, within the upper and lower boundaries of 10.52 and 5.09, respectively.

viii. The impulse response curve incurs few fluctuations at the first five periods as being relatively far from zero ,i.e.,not stationarity. But they get closer and closer to zero as time passes and be stationary starting from period5and onwards.

4.2 Recommendations :

The results of forecasting's show that terrorism in Iraq Republic will decline in a quite slow pace, indicating the existence of sustainable high levels of terrorism in the long run future, to be more than7on scale of10This leads to sluggish the sustainable development, or worse, might leads to economic deficiency or depression. Therefore, the researchers are recommending the country's related agencies of counter terrorism to perform more practical steps toward speed up reducing and combating terrorism actions through:

i. Reducing the rate of unemployment by increasing job opportunities particularly for youths.
ii. Controlling the rises in prices or inflation.
iii. Increasing gross domestic product of Iraq.
iv. Decreasing the gap of income inequality among Iraqi populace.
v. Political stability is an important factor that should receive more consideration and work.
vi. Reducing the effect of media and rumors regarding spreading the spirits of revenge and violence among people.

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