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Forecasting the Non – Oil GDP in the United Arab Emirates by Using ARIMA Models

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United Arab Emirates economy keeps exceeding the most optimistic expectations, and even in times of political or economic crises, it was able to absorb all shocks and bounce back, and it's becoming one of the star performers of the Middle East. This study aimed to forecast the non-oil GDP (Gross Domestic Product) in the United Arab Emirates by using Autoregressive Integrated Moving Average (ARIMA) models. We shall study the non-oil industry representing the GDP cost prices during the period (1970-2006), which will form a basis to predict future performance of the economy by finding the GDP estimations up to year 2020. This will include the contributions of the different economic sectors other than the oil industry. The main objective of this study is to define the most important sectors in the United Arab Emirates non-oil economy. The outcomes of this study will help in better planning of future strategies, and give an insight of the expected performance of the economy in the next upcoming fifteen years. SPSS v.15, Minitab v.14, and Forecast Pro statistical software packages have been used to calculate the data and analyze results. This study is conducted to study the economy future potentials, as there is a lack of such professional studies.

Field of Research: Statistical forecasting and analysis and economic development.

1. Introduction

The economic development in the United Arab Emirates can be divided into three eras: before 1962 oil exports, after the union establishment and oil prices boost of 1973, and late nineties up to current days. In the first period, all the revenues were coming from pearl production, herding, agriculture and fishing. However, the second period was dominated by oil industry especially after the rise of oil prices in 1973. But this didn't persist for a long time, and some other factors played a vital rule in pushing forward the country's economy growth. Since 1973, the UAE has undergone a profound transformation from an impoverished region of small desert principalities to a modern state with a high standard of living. In recent years, the UAE has undertaken several projects to diversify its economy and to reduce its dependence on oil and natural gas revenues. But it's still expected that oil and gas reserves should last for over 100 years, at the current production rates.

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The UAE has enjoyed almost a decade of uninterrupted growth and development that has transformed the character and prospects of the federation and its people. It has the second largest economy in the region, and is the second largest exporter of goods and services in the Middle East. Its ports and airports are known across the world. Oil and gas is the key to the UAE's evident prosperity.

The United Arab Emirates have been spent fostering unified and stable political structures capable of adapting to dramatic social change; building diversified economy which is less dependent on fluctuating oil revenues; raising from the desert sands a comprehensive infrastructure of cities, houses, schools, hospitals highways, and telecommunication facilities; successfully mounting a green revolution in terms of agriculture, tree-planting and general landscaping, as well as providing world-class education, health and social services to a burgeoning population. Leisure and sporting facilities have also developed apace, allowing the country's residents to enjoy their newfound prosperity to the full.

UAE's economy is going ahead in leaps and bounds, and it's one of the star performers of the Middle East. That's because it did not depend on oil exports only, but it was amplified by a booming private sector, and a variety of industries and investments. UAE's oil revenues are accounting for less than third of the national Gross Domestic Product these days. The role of the oil economy is now clearly about one-third even during periods of oil price booms, as compared to more than one-third during the late eighties and early nineties, and almost one half during the seventies.

The non-oil sectors of the UAE's economy presently contribute around 70 percent of the UAE's total GDP, and about 30 percent of its total exports. The federal government has invested heavily in sectors other than gas and oil, such as aluminum-related products manufacturing, aviation, re-export commerce, telecommunications, and recently High-class tourism and international finance. As part of its strategy to further expand its tourism industry, the UAE is building new hotels, restaurants and shopping centers, and expanding airports and duty-free zones. Meanwhile, non-oil economy continues to expand at a steady rate, and is strengthened by the growth of the oil economy. A measure of the expansion in the non-oil economy can be made from the increase in the working population, which has been increasing at roughly the same rate as GDP. The leading employment sectors now are services like tourism, hotels and trading rather than construction. The rise in population also leads to greater demand for the non-oil economy. Manufacturing is the leading non-oil sector. While hotels, tourism and transport have recorded high growth rates in recent years, they started from a rather small base and consequently while they are important, they are not yet as large. The government sector still remains relatively important, both as a contributor to GDP as well as an employer. Construction and real estate both have been in particular boom as the economy has opened up property to the expatriates and because of the steadily rising population.

One of the most important measures of the size of a country's economy is the Gross Domestic Product (GDP). GDP is simply the total value of goods and services produced by a country over a certain amount of time. It can be calculated by summing these

components: consumption, investment, spending, and net exports (exports minus imports).

The oil industry represented the most important source of income for the United Arab Emirates, and played a major rule in its development. So will this economic sector continue to play this rule in future? Or other sectors will take the lead positions?

1.1 Objectives:

The main objective of this study is to define the most important sectors in the United Arab Emirates (UAE) non-oil economy. Then we will try to estimate the effect of the Oil Sector on the non-oil economy using ARIMA models. In addition to that, we will show the results of forecasting the non-oil Gross Domestic Product (GDP) up to year 2020 by using Autoregressive Integrated Moving Average (ARIMA) models. And by studying the current situation of UAE's economy for the period (1970 to 2006), we will form a basis from which to proceed to determine the requirements of the future, and identify the key variables that control UAE's GDP. UAE's Gross Domestic Product for the year 2020 is going to be estimated by using the aid of SPSS, Minitab and Forecast Pro statistical software packages. The time frame and the geographical scope for this study revolve around the different UAE economic sectors for the period (1970 to 2006).

1.2 Research Questions:

- Can we build a measurable statistical model to forecast UAE's GDP?
- Do UAE's economic sectors really affect the development of the non-oil GDP?
- What's the most influential economic sector on the non-oil GDP?
- What's the expected non-oil GDP for the year 2020?

2. Methodology:

The methodology of this study based on combining:

- The theoretical analysis, by trying to form a common ground of concepts and scientific theories concerning the Time Series analysis methods.
- UAE's economic sectors relative importance.
- The quantitative analysis of non-oil GDP development, and future forecasting of UAE's economic till year 2020 by using different models of time series.
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2.1 Study Resources and Statistical Methods Used:

This study depends on the books, periodicals, and studies available in public libraries and establishments, such as Ministry of Planning, National Accounts for UAE, and Economic & Social Development in UAE periodicals. This study highlighted the statistical analytical aspects without going through pure economic analysis. Statistical

methods used are limited to: Time Series analysis, Hypothesis testing, statistical estimation, in addition to using different forecasting methods such as Box-Jenkins' to analyze ARIMA.

3. Review of Literature:

There is a great interest among researches, on the economic sectors performance analysis, based on comparison between different historic time intervals. But there is just a few number of studies that dealt with GDP affect on the UAE's economy from a statistical point of view.

Mohamed Shihab conducted a study in (1999) to analyze the current situation of UAE in the late 1990s after 20 years of oil discovery. He concluded that huge structural changes in UAE economy and an enormous increase in quality of services offered by the government led to a fast development in fields of life. And UAE has achieved impressive improvements in many social and economic development indicators during the past three decades. *Fathi M. Othman* conducted another study in order to understand the mechanism of generating data in different oil fields and to use this knowledge in predicting future production in Libya. Fathi's approach basically starts with developing models on the basis of the past behavior of the production data generated by each oil field under study. The researcher found that most of oil fields under study have been adequately and efficiently described by ARIMA(1,1,1). In *"Trends in Human and Economic Development across Countries", Edward Nissan* tried to test the convergence of the Human Development Index (HDI) and per capita income between 1975 and 1998 using a yearly adjustment model. The results indicated convergence for HDI and divergence for income. The aim was to make evident that examination by a one dimensional measure between and within countries, usually income, is not an accurate representation of quality of life. By use of a multimeasure such as the HDI, a better picture is produced. *Al-Abdulrazag Bashier & Bataineh Talal* attempted to build a univariate time series model to forecast the FDI inflows into Jordan in the future. The study employed Box-Jenkins methodology of building ARIMA (Autoregressive Integrated Moving Average) model to achieve the goals of the study. The forecasting results revealed an increasing pattern of FDI over the forecasted period. In light of the forecasted results, policy-makers should gain insight into more appropriate investment promotion strategy and meat the needs of such inflow in terms of infrastructure and skilled labor.

4. Building a Statistical Model using Box-Jenkins:

We shall present some methods of forecasting and we used the Box-Jenkins methodology of time series analysis. Box-Jenkins methodology, named after the statisticians George Box and Gwilym Jenkins, applies autoregressive integrated moving average ARIMA models to find the best fit of a time series to past values of this time series, in order to make forecasts[i]. The Box-Jenkins model assumes that the time series is stationary. Box and Jenkins recommend differencing non-stationary series one or more times to achieve stationarity. Doing so produces an ARIMA model. The underlying

strategy of Box and Jenkins is applicable to a wide variety of statistical modeling situations. It provides a convenient framework which allows an analyst to think about the data, and to find an appropriate statistical model which can be used to help answer relevant questions about the data

The traditional approach begins with lengthy detailed discussion of the theoretical properties of the many models used by the Box-Jenkins methodology and then progresses to a discussion of how the models are used. We begin by combining discussion of the properties of this model related to the steps that were taken in building and then forecasting with an appropriate Box-Jenkins model.

We then proceed to a full discussion of the Box-Jenkins model. The most popular strategy in building a model is the one developed by Box and Jenkins who defined three major stages to model building:

1. Identification
2. Estimation
3. Diagnostic Checking

4.1 Identifying the Tentative Models:

First of all, we will form a time series of the UAE's non-oil GDP for the period (1970 to 2006), which will be the basis to predict future values. By examining Figure (1) and the estimated Autocorrelation Function (ACF) in Figure (2) of the series, we can determine whether the series is stationary or not.

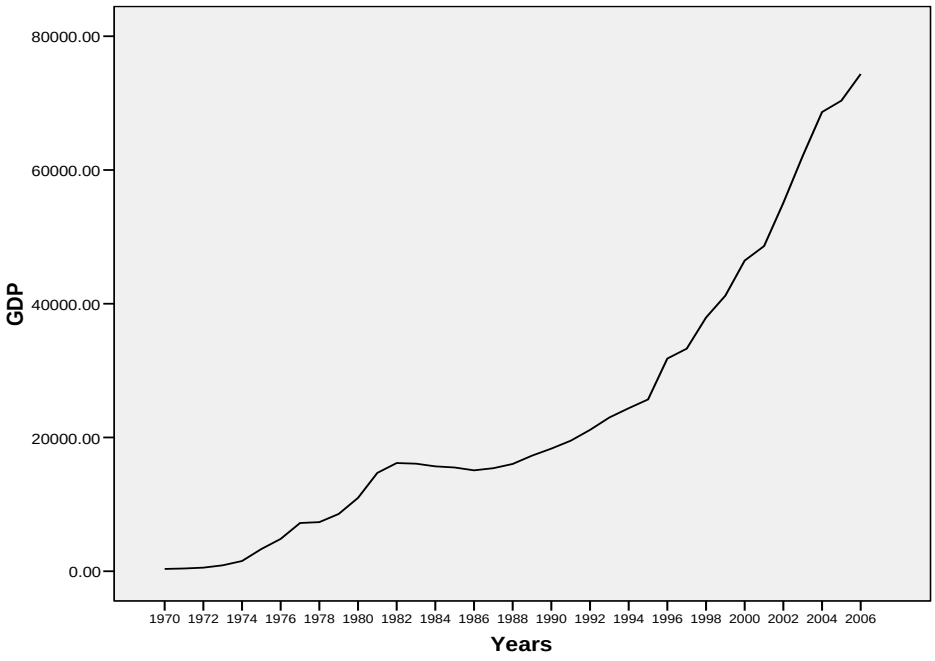

Figure 1: Plot of UAE's non-oil GDP in Millions of USD

From the plot, we see that the production varies considerably. The series wanders tell us that it is not stationary. In other words, the short term mean level is not constant but varies over the course of the series. It has also been observed from the plot that short-term variation also increases or decreases with time. So it is a non-stationary series.

The non-stationary behavior of the series is also confirmed by the estimated ACF of the series. We find that the ACF dies out slowly confirming the earlier observation that it's non-stationary. To reach stationary we have taken differencing, as practiced, in developing ARIMA model.

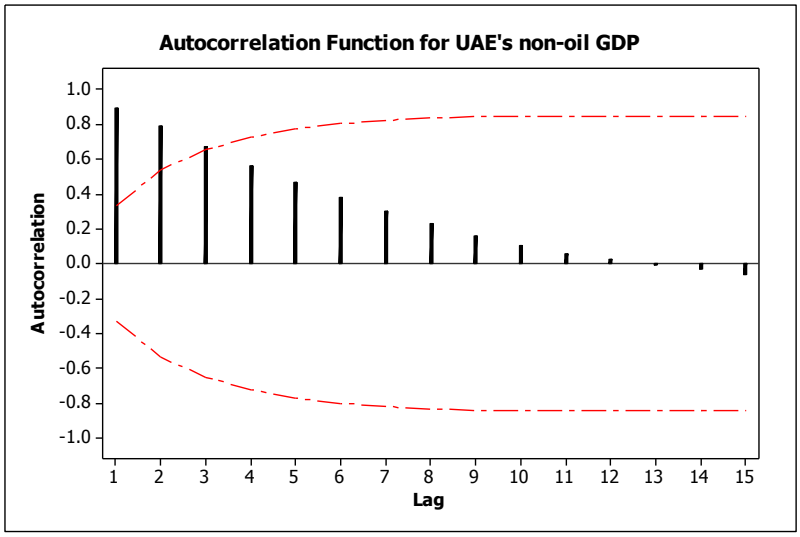

Figure 2: ACF for non-oil GDP

From the plot Figure (3) of the difference series in the estimation period, we see that the mean and variance do not remain constant throughout the production periods indicating the non-stationary of the production series.

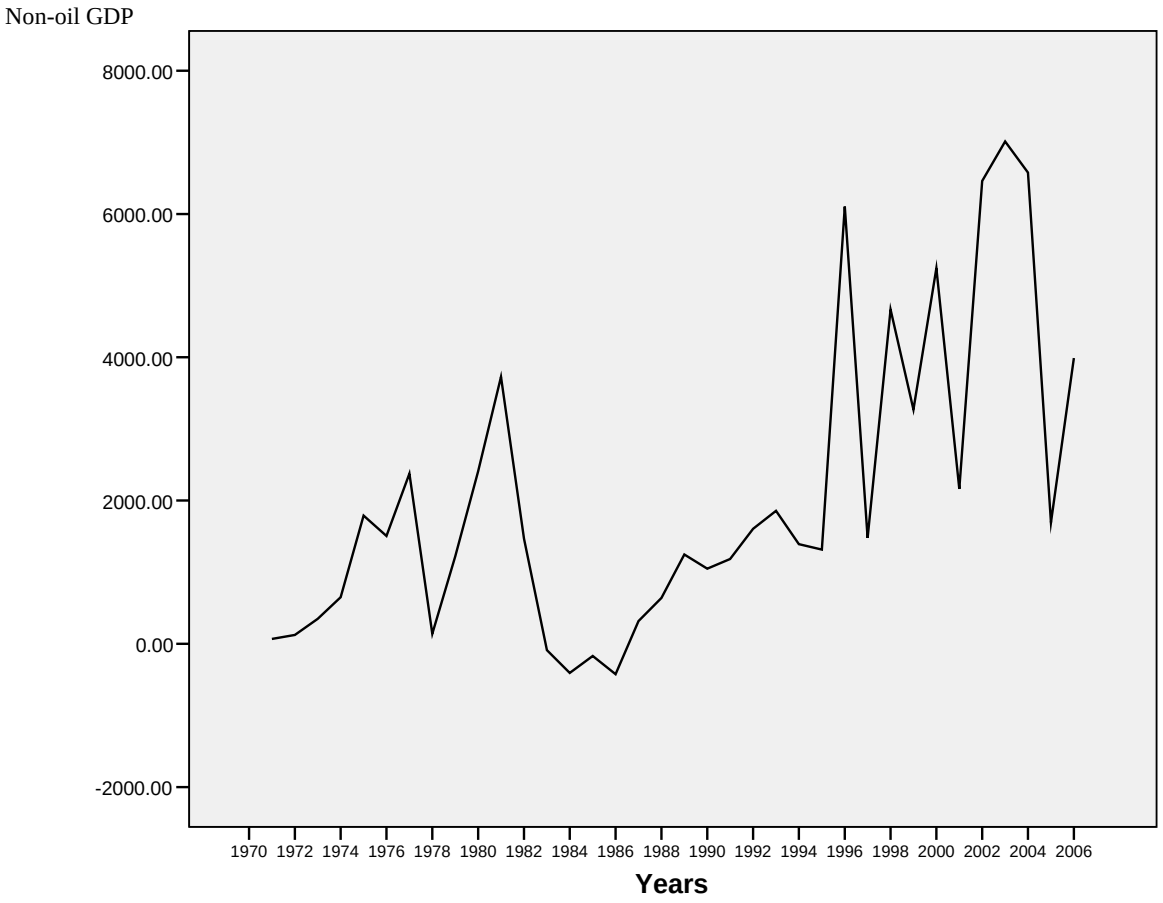

Figure 3: non-GDP Plot after taking the 1st Difference

This is also supported by ACF of the series Figure (4).

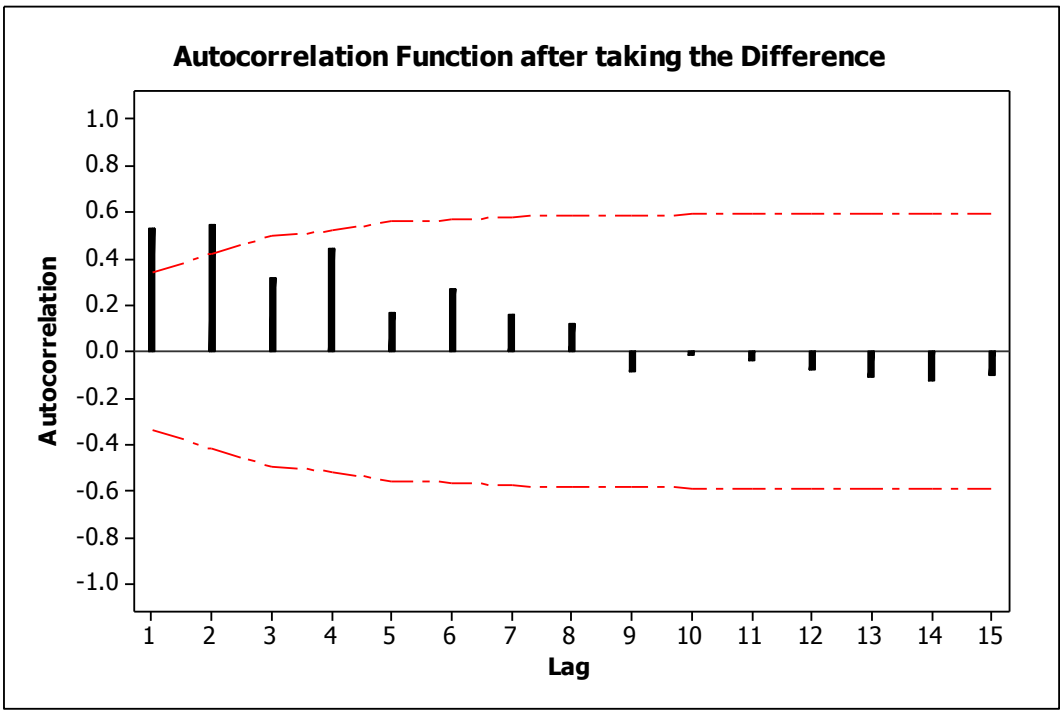

Figure 4: ACF for non-oil GDP after taking the 1st Difference

From the plot Figure (5) of the differenced series in the estimation period, we see that the mean of the differenced series is about zero from the beginning to the end and the variance does not noticeably change indicating that the series has attained the stationary. The ACF of the differenced series figure (6) also confirms this. So the value of the parameter d of the ARIMA model has been determined and equal to two.

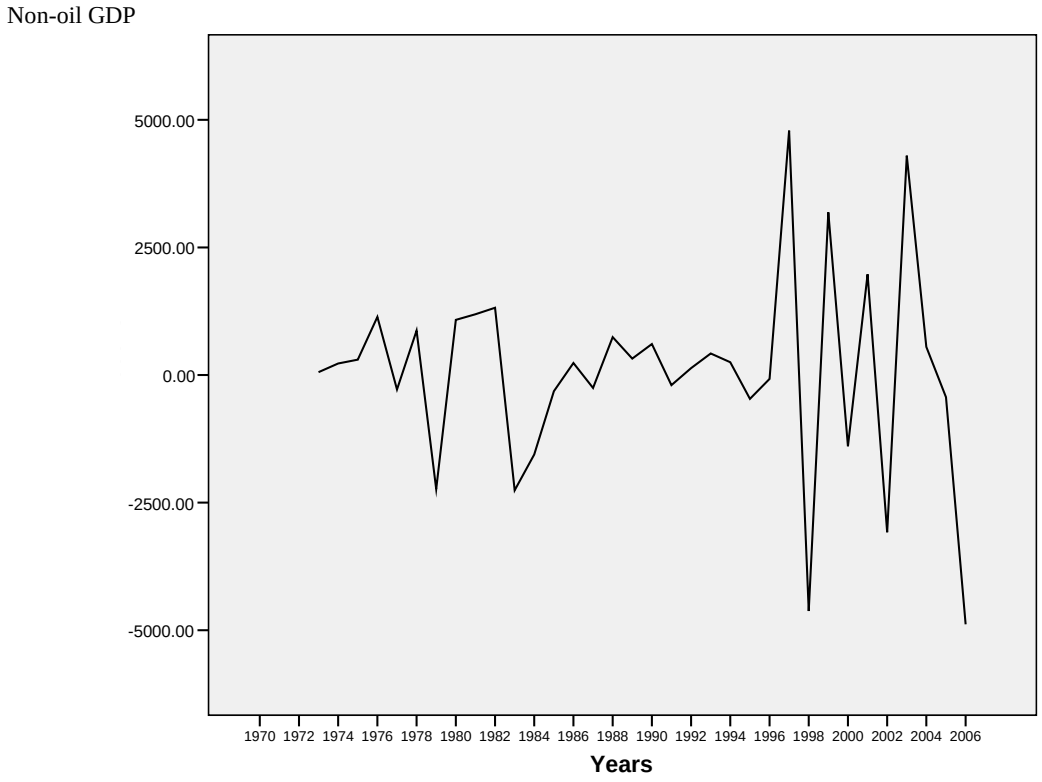

Figure 5: non-GDP Plot after taking the 2nd Difference

Now to fix the value of p and q of the ARIMA model, we have to study the shape of the ACF and PACF (partial ACF) of the difference of the series. From the plots Figure (6) and (7), and we can see that in the ACF.

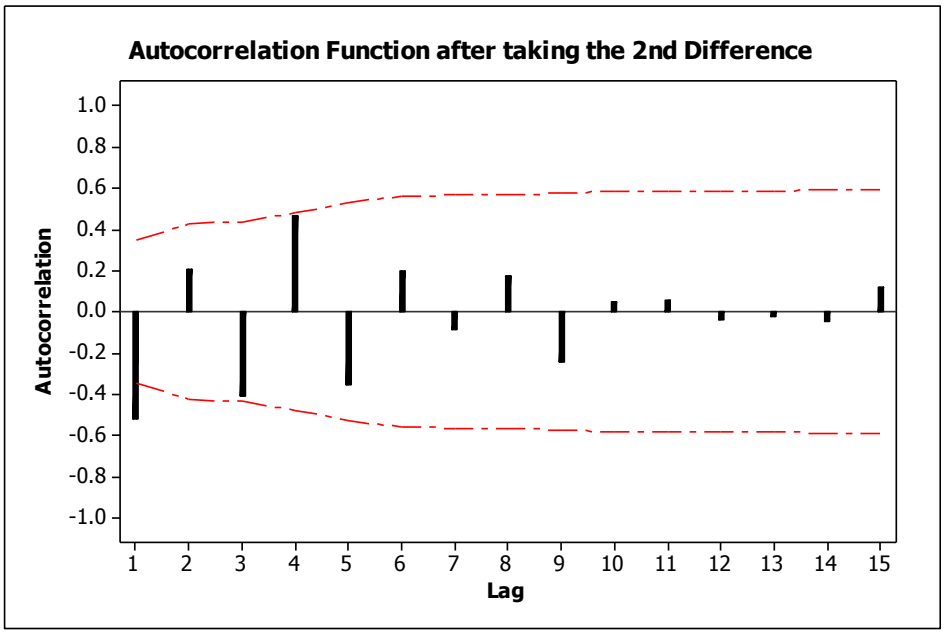

Figure 6: ACF for non-oil GDP after taking the 2nd Difference

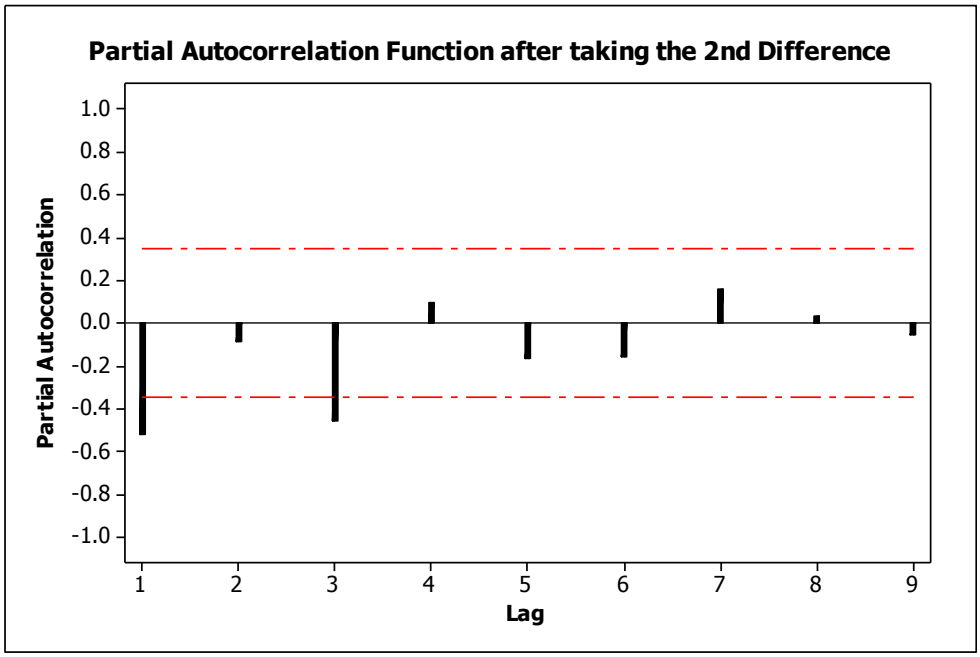

Figure 7: PACF for non-oil GDP after taking the 2nd Difference

From Figure: (6), we also notice that the ACF of the differenced series now dies out quickly confirming that the stationary of the series has been obtained and hence provides us the value of the parameter d = 2 of ARIMA model.

Next to identify the value of the other two parameters p and q of ARIMA model, we study the appearance of the ACF and PACF of the differenced series and Comparing the two plots given in Figure (6) and (7) we see that there is an unexpected peak in both the ACF and PACF at lag 1 which can not be explained properly. Aside from the peak both AR and MA components. Since the series has been differenced for the ACF and PACF so a mixed ARIMA (0,2,1) for the series may be recommended.

Since the estimated ACF and PACF of the differenced series are quite complex and identification of ARIMA (0,2,1) is not straight forward and certain so well as, the ARIMA (0,2,1), there fore we have also fitted other models such as ARIMA (1,2,1), ARIMA (1,2,0) and compared than with each other before finally accepting any model for the production series.

4.2 Estimating the Models:

Table (1) shows the estimation of the above-mentioned models selected for the series. Comparing the results we see that among all fitted models the value R^2 of ARIMA (0,2,1) is the highest ($R^2 = 0.98$). It is very important to increase confidence of accepted model andadj R^2=0.97. This model is explains 97% percentage of the variables of GDP non-oil. This affected spread values of GDP and sequence forecasting .

The estimates of MAD, MAPE, BIC, RMSE and forecast error are the smallest. The estimated coefficients of parameters of ARIMA (0,2,1) are found statistically significant but the estimated coefficients of parameters of the other mentioned models are non-significant. It is also observed that adding more parameter to ARIMA (1,2,3),(1,2,0) manifests itself in non-significant coefficient and larger MAPE and BIC values indicate overfitting of the model. So these over fitted models have been dropped from analysis. So ARIMA (0,2,1) has been identified as the best production model.

ARIMA	0,2,1	1,2,3	1,2,0
R^2	0,98	0,98	0,97
Durbin-Watson	2.014	1.994	1.854
Forecast error	1347	1348	1402
MAPE	0.09635	0.1177	0.09967
MAD	807.5	832.1	892.7
Standard Deviation	9332	9332	9332
Adjust R^2	0.98	0.97	0.97
Ljuny-Box (18)	12.44	12.41	12.16
BIC	1404	1442	1461
RMSE	1323	1380	1376

Table 1: Estimation of the three models

4.3 Diagnosing the Final Model: (The Residual Analysis)

The universal rule for residuals generated by an appropriate model should be randomly distributed without any pattern (white noise). The plot Figure (8) of residuals created by ARIMA (0,2,1) show no pattern indicating the appropriateness of the model although a large outliner is still present.

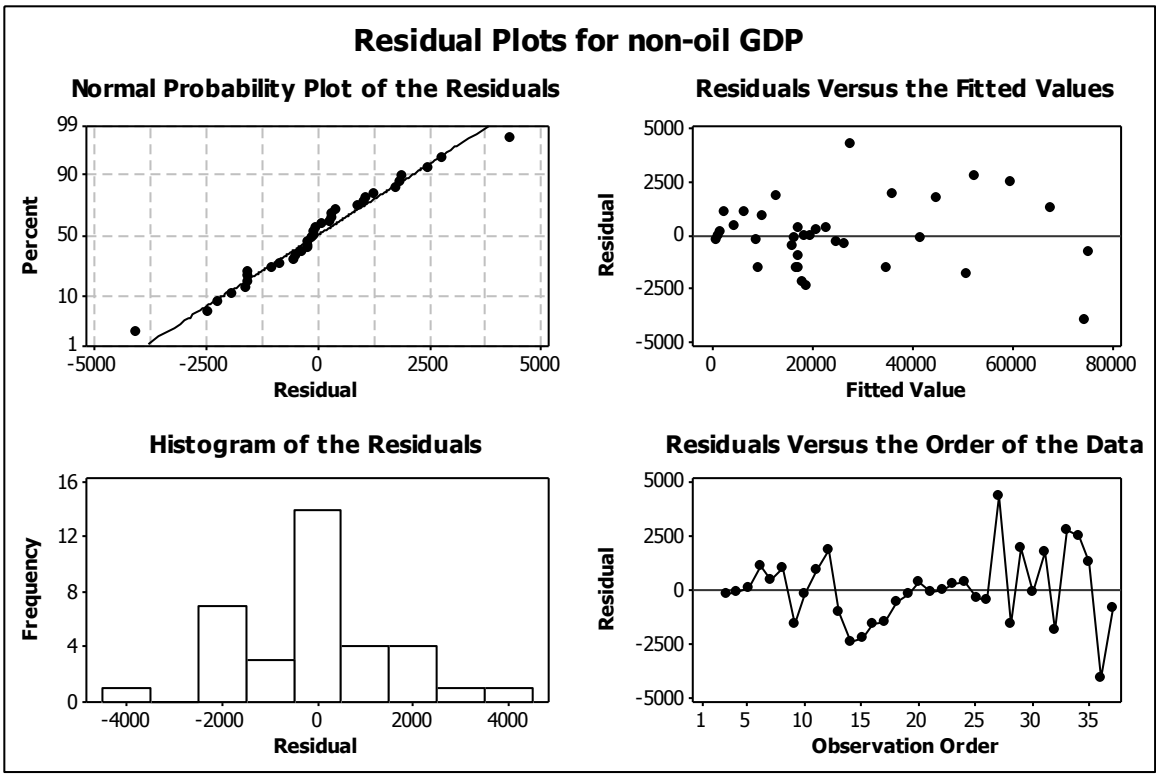

Figure 8: Plot of ARIMA Model (0,2,1) Residuals

From the ACF and PACF plots of residuals figure (9), (10) we observe that the ACF and PACF are randomly distributed. All the Box-Ljung Q statistics for the ACF are not statistically significant at any lag. All these findings further confirm that the residuals are white noise.

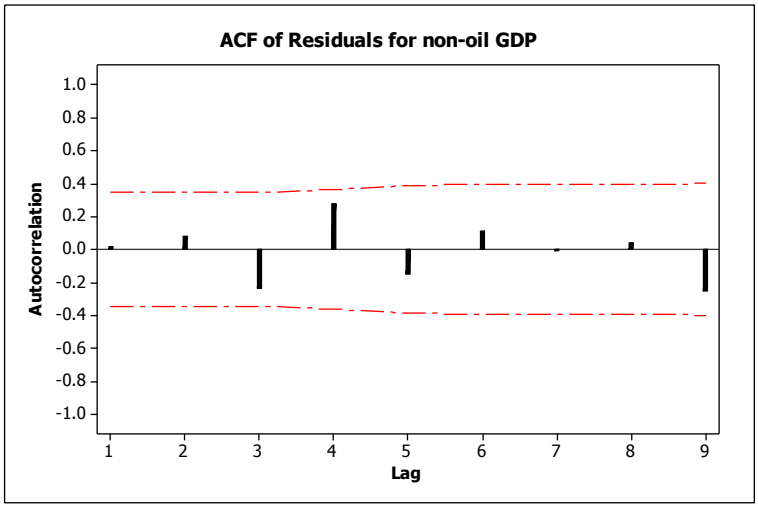

Figure 9: ACF of ARIMA Model (0,2,1) Residuals

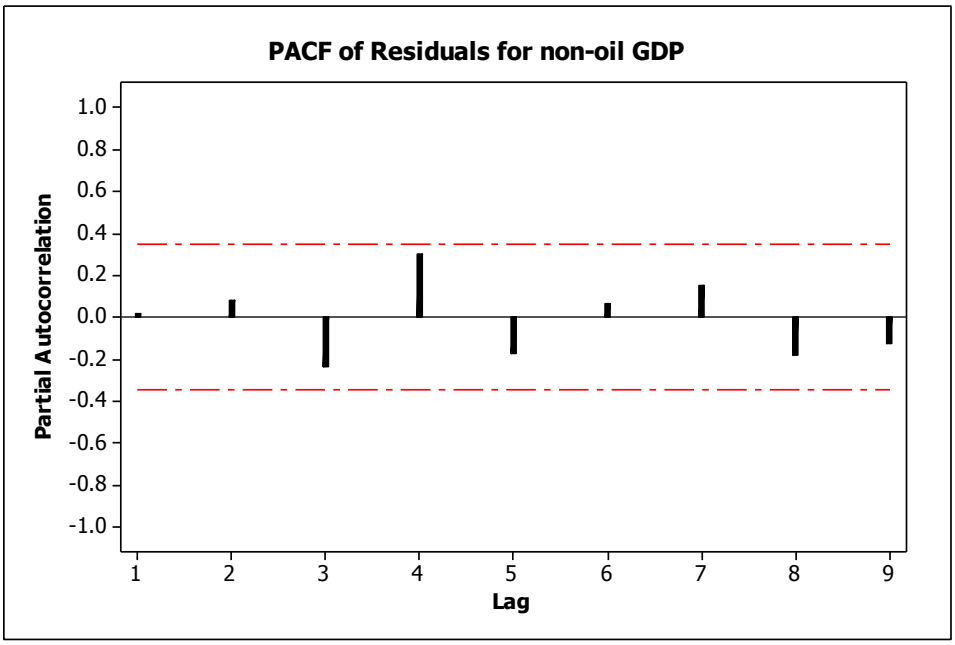

Figure 10: PACF of ARIMA Model (0,2,1) Residuals

The value of DW statistic is 2.014, which also indicates the absence of first order auto correlation in the residuals. Moreover from table (2). We also observe that in both the estimation and predict periods the RMS for residuals created by ARIMA (0,2,1) are the smallest compared to RMS for residuals created by any other attempted model. This indicates that the ARIMA (0,2,1) not only fits the data better than any other model but also reveals that the forecasts based on the model are more accurate. Again, the normal probability plot Figure (11) of residuals generated by ARIMA (0,2,1) shows that residuals are approximately follow normal distribution.

So ARIMA (0,2,1) is the appropriate model.

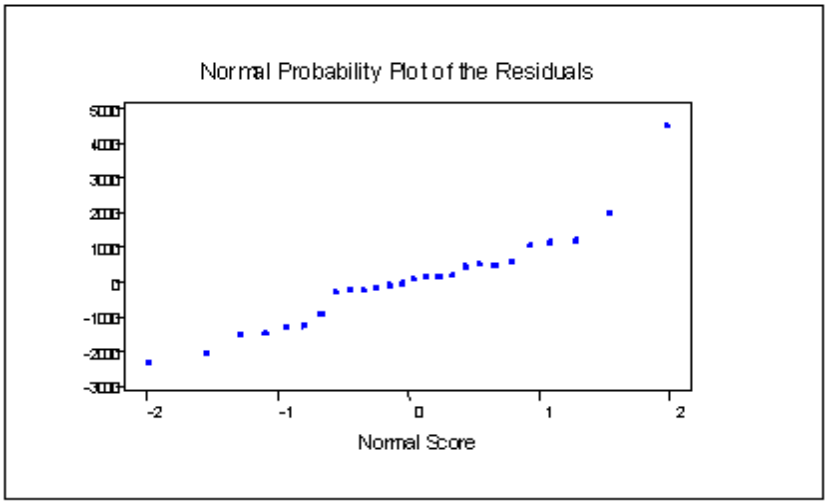

Figure 12: The normal probability of residuals

Comparing Box-Jenkins method ARIMA (0, 2, 1) with exponential smoothing and moving Average methods:

If we examine Figure (1), we can see that the series is too short to be considered for Box-Jenkins (ARIMA) classical. Now we compare Box-junkies method with exponential smoothing and moving average methods.

Methods	Box-junkies ARIMA (0,2,1)	Moving Average	Exponential smoothing
R^2	0,98	0.9621	0.979
Durbin-Watson	2.014	0.7316	1.873
Forecast error	1347	1753	1378
MAPE	0.09635	0.1408	0.1517
MAD	807.5	1254	932.5
Standard deviation	9332	9332	9332
Adjust R^2	0.98	0.9647	0.9782
Ljuny-Box (18)	12.44	7.15	12.28
BIC	1404	1681	1496
RMSE	1323	1784	1328

Table 2

From Table (1), we can see that the value of adj. R^2 of ARIMA (0,2,1) is the highest (R^2 = 0.98), and it is very important to increase confidence of accepted model.

The estimates of MAD, MAPE, BIC, RMSE and forecast errors are the smallest. The value of DW statistic is 2.014, which also indicate the absence of first order auto correlation in the residuals. Moreover, from table (2) we also observe that the value of RMS (the root mean square error) for residuals created by ARIMA (0,2,1) is the smallest than RMS for residuals created by any other attempted methods. This indicates that the ARIMA (0,2,1) is better than any other methods So ARIMA (0,2,1) is the appropriate model.

After the detailed analysis we notice that the progress of the economy in accordance with the United Arab Emirates economy during the period from (1970-2006). We have to put futuristic view that can be drowning in accordance with the economy to the year (2020), through certain limits, based on the present compared too past.

From table (3) we see the result of forecasting.

Period	Forecast	Lower	Upper
2007	83937	78699	89175
2008	88916	81713	96119
2009	94019	84777	103260
2010	99245	87870	110620
2011	104595	90983	118206
2012	110068	94116	126021
2013	115666	97269	134063
2014	121387	100444	142330
2015	127232	103645	150819
2016	133201	106874	159528
2017	139293	110134	168453
2018	145510	113426	177593
2019	151850	116754	186945
2020	158313	120119	196507

Table 3: The result of forecasting of non-oil GDP in UAE (In Millions of USD)

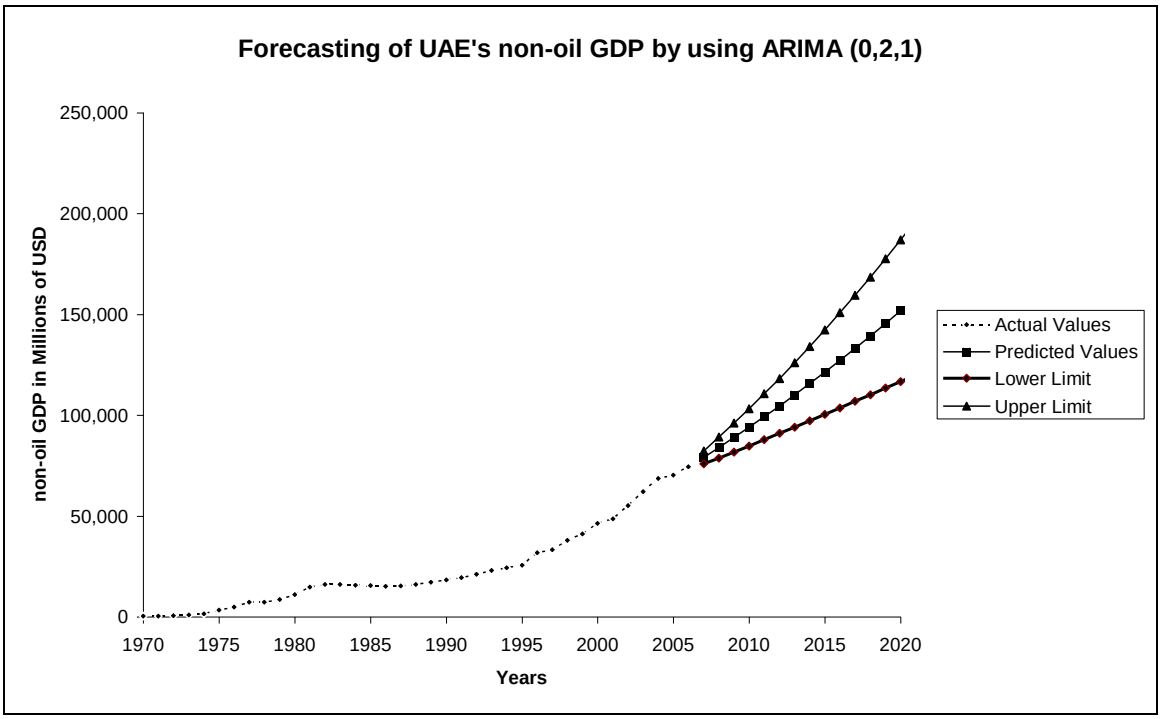

Figure 12: Predicted values of UAE's non-oil GDP using the model ARIMA (0,2,1)

From the table and figure above we have reached to the conclusion that non-oil GDP might probably reach the value of 158313 million USD in 2020 at least. The non-oil GDP in UAE ranges from a minimum of 120119 million USD limit confidence 95%. We expect a growing gape between the oil and non-oil economy, for the benefit of increasing percentage of the contribution of non-oil economy sector. The figure of the minimum rang which accordingly the non-oil GDP developed shows that in the worst circumstances the period of year 2006 and till year 2020 will not observe non-oil GDP less than 120119 million USD.

5. Recommendations:

- Emphasize more focus on the non-oil sector, and this will reduce the tendency on the oil revenue, as the oil is a depleted wealth.

- Redistribution of the labor force through the production sectors and the rebuild of the production environment for other economic sectors that leads to fall and efficient utilization of labor force.

- Reduction of foreign labor force by increasing the motivation and creating encouragement work atmosphere for the national labor force by adding specific and plant emigration policy in order to obtain administration and technology.

- We suggest that the decision-makers have to take a look at the results of this study, and they should be taken into consideration in forming economic policies.

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Appendix

UAE's non-oil GDP (from 1970 to 2006)

Year	GDP (in Millions of USD)
1970	343.60
1971	411.80
1972	535.80
1973	884.90
1974	1535.70
1975	3325.40
1976	4831.40
1977	7207.60
1978	7347.80
1979	8568.10
1980	10977.90
1981	14705.30
1982	16173.80
1983	16085.60
1984	15680.10
1985	15510.20
1986	15086.00
1987	15404.00
1988	16044.00
1989	17291.00
1990	18340.00
1991	19524.00
1992	21130.00
1993	22987.00
1994	24378.00
1995	25693.00
1996	31796.00
1997	33275.00
1998	48294.00
1999	54948.00
2000	70246.00
2001	69227.00
2002	75032.00
2003	87720.00
2004	102763.0
2005	120235.0
2006	153487.0

[i] Online Free Encyclopedia: http://en.wikipedia.org/wiki/Box-Jenkins