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The impact of Oil Price Changes on Economic Growth in Arab oil-exporting countries: Econometric study using the Panel data for the period (2000-2021)

أثر تغيرات أسعار النفط على النمو الاقتصادي في الدول العربية المصدرة للنفط:

دراسة قياسية باستخدام بيانات البانل للفترة (2000–2021)

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Abstract

The aim of this study is to examine the impact of oil price changes on economic growth in Arab oil-exporting countries using the panel data for the period (2000-2021).

The results of the estimation of random effects model (REM) revealed that there is a statistical significance between oil price changes and the Gross Domestic Product (GDP) of the countries under study, as a 1% change in oil price causes a 0.82% change in GDP in the same direction, meaning that any increase or decrease in oil price will have a direct impact on economic growth of these countries, which indicates the weakness and fragility of their economies.

Keywords: Oil price, Economic growth, Arab oil-exporting countries, Panel data.

ملخص

تهدف هذه الدراسة إلى اختبار تأثير التغيرات في سعر النفط على النمو الاقتصادي في الدول العربية المصدرة له باستخدام بيانات البانل (2000–2021).

أظهرت نتائج تقدير (REM) وجود دلالة إحصائية بين متغيرات الدراسة، حيث يؤدي التغير بنسبة 1% في سعر النفط إلى تغير بنسبة 0.82% في ن.م.إ في نفس الاتجاه، مما يؤثر بشكل مباشر على النمو الاقتصادي لهذه الدول.

الكلمات المفتاحية: أسعار النفط، نمو اقتصادي، دول عربية مصدرة للنفط، بيانات بانل.

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1. INTRODUCTION

Oil is one of the most important sources of energy in the world and the hub of all industrial and agricultural production in various countries. It has become a vital element of everyday life and no other substance has captured as much commercial and economic importance as it has.

Oil prices are subject to many changes and fluctuations, and the effects of these fluctuations differ greatly from one country to another, whether a country is an oil importer or exporter.

Arab oil-exporting countries rely heavily on the revenues of the hydrocarbon sector in setting their economic policy, such as Algeria, Libya, Kuwait and Saudi Arabia, which makes any change in oil prices directly affect the economy of these countries, and thus their economic growth.

In this regard, we have raised the following problematic:

What is the impact of oil price changes on economic growth in the Arab oil-exporting countries during the period (2000-2021)?

To answer this problem, we have formulated the following hypothesis: The increase of oil price has a positive impact on economic growth of Arab oil-exporting.

The significance of the study is to help determine the kind of relationship that exists between oil price changes and economic progress and its particular influence on Arab oil-exporting economies.

In order to address the main problem, we have adopted the descriptive approach to describe and analyse the evolution of oil price and the GDP of the Arab oil-exporting countries under study, namely Algeria, Libya, Kuwait and Saudi Arabia. We have also adopted the econometric approach using the Panel data for the period (2000-2021) to determine the impact of oil price changes on economic growth of these countries.

2. Literature review

Farhani (2012) studied the causality between oil price increases and economic growth in U.S., using the simple linear regression model (SLRM), dynamic regression model (DRM) and VAR model. The results indicated a strong weakness on the relation between oil price increases and economic growth, which resulted a low significant effect between the two variables.

Ftiti et al. (2016) examined the relationship between oil prices and

economic activity growth in selected OPEC countries (United Arab Emirates, Kuwait, Saudi Arabia, and Venezuela) during the period (3rd September 2000 – 3rd December 2010), using the cointegration procedure developed by Engle and Granger (1987). The results showed that oil price shocks in period of fluctuations in the global business cycle (downturn or expansion) or financial turmoil affect the relationship between the two variables under study in these countries, where aggregate demand-side oil price shocks (eg: the housing market boom, Chinese economic growth and the global financial crisis) cause a significant correlation between real activity and oil prices, whereas important precautionary oil price shocks (such as the second war in Iraq and terrorist attacks) lead to less cohesion.

Belkacem (2017) studied the impact of oil price fluctuations on the economic growth of oil-exporting countries. The results indicated that fluctuations in oil prices have a positive impact on economic growth in these countries by increasing financial returns, and thus increasing economic growth across all sectors. In addition to a negative impact caused by the decline in financial returns and the accompanying decline in economic growth rates.

Mamdouh (2020) in his study about the relationship between oil price fluctuations and economic growth in the MENA countries, using a panel quantile regression approach with other linear models such as FEM, REM and panel generalized method of moments, found that the fluctuations in oil price have an opposite effect for each oil-exporting and oil-importing countries; for the former, he concluded that changes in oil prices have a positive impact but the volatility have a negative effect. While changes in oil prices have a negative effect for the oil importing countries, and volatility have a positive effect.

Bolganbayev et al. (2021) examined the effect oil prices on the economic growth and energy security of oil-exporting countries bordering the Caspian Sea, using the panel data with the quarterly data collected between 2007 and 2021. The results showed a positive and significant relationship between the real oil price and economic growth variables in the long term.

In Algeria, Benoudjafaar and Beyad (2018) studied the relationship between oil price fluctuations and economic growth in the long and short

run during the period (1980-2016), using the methodology of integration, error correction model (ECM) and causality test. The results showed the existence of a relationship between the two variables in the long and short term, and the causality test showed a causality relationship from the GDP variable and oil prices. The results also showed that oil prices have a great impact on economic growth in Algeria.

Bekadi (2021) also studied the effect of oil price fluctuations on economic growth in exporting and importing countries (Algeria as an oil-exporting country and Morocco as an oil-importer) during the period (1990-2019), using the autoregressive distributed lag model ARDL. The results concluded the existence of a positive relationship between the two variables in the long and short term for the case of Algeria. As for Morocco, the results showed that in the short term, there is no relationship between the two variables, while in the long term, there is a positive relationship, but with a less affected level compared to Algeria.

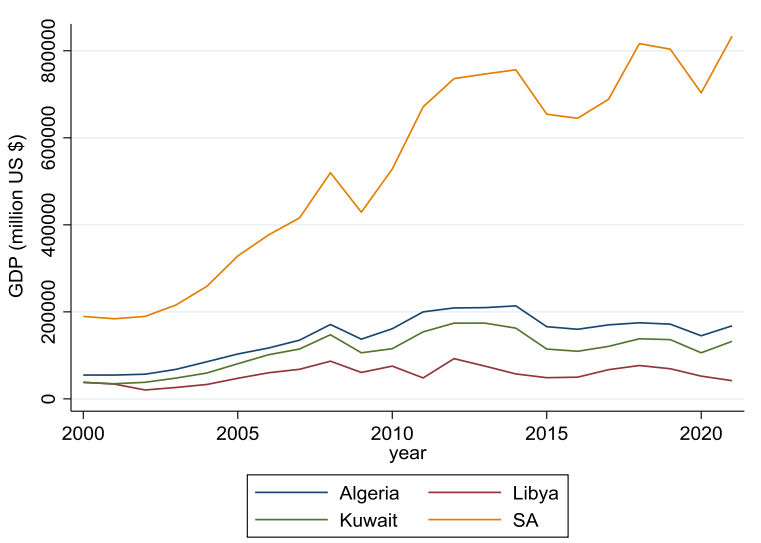
3. The Evolution of Economic Growth and Oil Prices in the Arab oil-exporting countries during (2000-2021)

Through this axis, we will discuss the evolution of the GDP and oil prices in: Algeria, Libya, Kuwait and Saudi Arabia during the period (2000-2021).

3.1. The Evolution of GDP in the Arab oil-exporting countries during (2000-2021)

The gross domestic product (GDP) of the Arab oil-exporting countries under study (Algeria, Libya, Kuwait and Saudi Arabia) has known some fluctuations during the period (2000-2021), as shown in Figure.1.

Fig.1. Evolution of GDP in the Arab oil-exporting countries during the period (2000-2021)



Source: made by the researcher based on World Bank data, using Stata 16

We note from the above figure that the GDP of Algeria, Libya, Kuwait and Saudi Arabia has varied over the period (2000-2021), but it is generally moving in the same direction.

Overall, the GDP recorded an increase from 2002 to 2008 at varying rates in the four aforementioned countries, but the highest was in Saudi Arabia, where the GDP was about 520 billion dollars in 2008, while in Algeria it was 171 billion dollars, in Kuwait about 147 billion dollars, and in Libya about 87 billion dollars in the same year.

In 2009, the Gross Domestic Product (GDP) of the four countries decreased, and the reason for this was due to the repercussions of the global financial crisis of 2008, which caused a slowdown in the growth of the global economy, then rise again from 2010 to 2014, when the world knew another crisis known as the Oil crisis in the second half of 2014, as this crisis led to a decline in oil revenues for oil-exporting countries, which affected the value of the GDP of these countries in 2015.

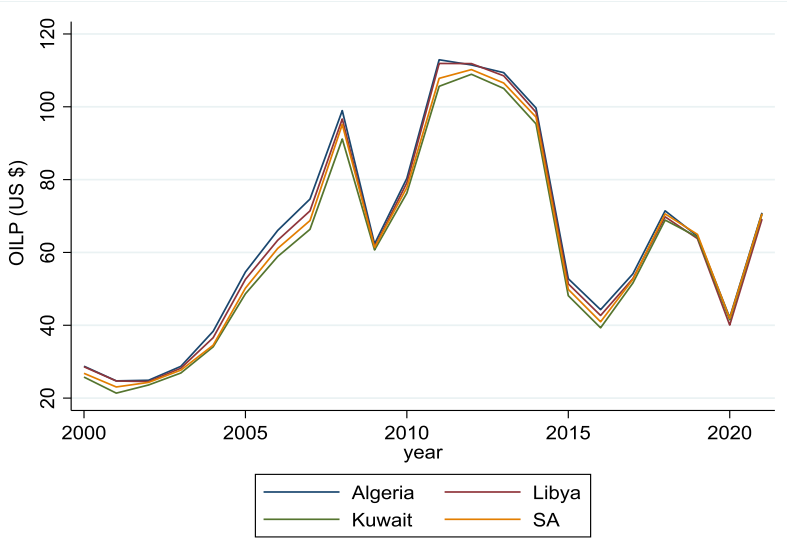
Starting from 2017, the GDP returned to rise again until 2020, when it witnessed a decline due to the repercussions of the Covid 19 pandemic on the local economy of these countries, to rise again in the year 2021 for Saudi Arabia, Algeria and Kuwait, except in Libya, where the decline continued during the same year, due to its political and security conditions during this

period.

3.2. The Evolution of oil prices in the Arab oil-exporting countries during the period (2000-2021)

The oil price of the Arab oil-exporting countries under study has known great fluctuations during the period (2000-2021); especially after the year 2014, as shown in Figure.2.

Fig.2. Evolution of Oil Prices in the Arab oil-exporting countries during the period (2000-2021)



Source: made by the researcher based on OPEC data, using Stata 16

From the above figure, we notice that the prices of Algerian (Saharan Blend), Libyan (Ess Sider), Kuwaiti (Kuwait Export) and Saudi (Arab Light) oil have risen from 2002 to 2008 to reach about $95 per barrel, then dropped dramatically to reach about $60 per barrel in 2009, due to the global financial crisis of 2008, which caused a significant decline in the global oil demand.

From 2010, the prices rose again until 2014, where we can notice a sharp decline, as the average price per barrel for the four countries amounted to about 50 dollars in 2015, then it fell below fifty (50) dollars (about 41 dollars) in 2016, and this sharp decline was due to the abundance of supply in the oil markets, especially from outside the oil-exporting countries (OPEC), where the world witnessed the so-called “shale oil boom”

in the United States of America, which enabled it to rely heavily on its domestic production and thus dispense with imported oil from abroad. Its production reached about 6 million barrels per day in 2012, then rose to more than 9,5 million barrels per day in 2014 (Álvarez & Di Nino, 2017), which led to a decrease in global demand for oil, as the United States is the largest consumer of oil in the world.

In 2017, oil prices returned to rise, reaching about $70 per barrel in 2018, and then declining again in 2019 and 2020 to reach about $41 per barrel in 2020. This decline could be explained by the repercussions of the COVID-19 pandemic, which started in this year, and caused the world economy to shrink, and thus the demand for petroleum products fell (Bolganbayev, Myrzabekkyzy, Baimaganbetov, & Kelesbayev, 2021, p. 433).

In the year 2021, oil prices witnessed a significant increase, as the average price of a barrel of "Algerian, Libyan, Kuwaiti and Saudi oil" reached about $70 per barrel.

4. The econometric study of the impact of oil price changes on economic growth in Arab oil-exporting countries (2000-2021)

Oil revenues make a significant contribution to the economic performance of oil-exporting countries in general; and Arab oil-exporting countries in particular, by providing financial resources for investments. Therefore, price changes have dramatic effects on their economic growth.

In this axis will study the impact of oil price changes on economic growth in Arab oil-exporting countries, using the panel data for the period (2000-2021)

4.1. Introduction to Panel data models

Panel data, also known as "longitudinal" data, is a dataset in which the behaviours of individual micro-units are observed across time (Hill, Griffiths, & Lim, 2018, p. 9). The individual units are usually represented in economic and finance applications by single individuals, firms, industries, regions, or countries (Pesaran, 2015, p. 633).

There are three types of models in the panel data: the pooled model, the fixed effects model and the random model.

- **Pooled Regression Model (PRM):** the pooled model is the simplest cross-sectional time series model, in which all coefficients $\propto and\ \grave{\beta}$ are

constant for all time periods. The usual assumptions for cross-sectional analysis (Pesaran, 2015, p. 636):

$$y_{it} = \propto + \grave{\beta} x_{it} + u_{it}$$

With:

i = 1, 2, ..., N and t = 1, 2, ..., T.

Where N = Number of individuals or cross section and T is the number of time periods.

- **Fixed Effects Model (FEM)**

The FEM allows the individual-specific effects $\propto_i$ to be correlated with regressors x.

The regression equation of fixed effects model panel data is as follows (Hsiao , 2014, p. 37):

$$y_{it} = \propto_i + \grave{\beta} x_{it} + u_{it}$$

With:

i = 1, 2, ..., N and t = 1, 2, ..., T.

Where N = Number of individuals or cross section and T is the number of time periods.

- **Random Effects Model (REM)**

The random effects model assumes that the unobserved entity-specific heterogeneity is random (Das, 2019, p. 505), and its regression equation is as follows (Zulfikar, 2018):

$$y_{it} = \propto + \grave{\beta} x_{it} + u_i + \varepsilon_{it}$$

With:

i = 1,2, ..., N and t = 1,2, ..., T. Where: N = number of individuals or cross section T = the number of time periods.

ε_{it} = is the residual as a whole where the residual is a combination of cross section and time series. u_i = is the individual residual which is the random characteristic of unit observation the i^{th} and remains at all times.

4.2. Data source

The study uses annual data of a panel of 4 Arab oil-exporting countries, which include: Algeria, Libya, Kuwait and Saudi Arabia. The sample span covers the period (2000–2021). The data series were collected from the database of the World Bank and the Organization of Petroleum Exporting Countries (OPEC). The data set includes the growth in the Real

Gross Domestic Product (Current US $) and oil barrel price (US $) for each country.

Logarithmic transformations are applied to the variables and the model can be formulated as follows:

$$LogGDP = \propto_i + \grave{\beta} LogOilP + u_{it}$$

4.3. Estimation results of panel data models

According to the analysis of the results of panel data, the three longitudinal data models were estimated: PRM, FEM and REM, and the table below shows the results of the estimation using STATA 16.

Table 1. Estimation results

Variables	PRM	FEM	REM
LogOilP	0.8031653 0.000***	0.8178942 0.000***	0.817861 0.000***
Constant	8.568864 0.000	8.509547 0.000	8.509681 0.000
N. of Obs	88	88	88
F-Statistic	18.24	218.89	221.29
Prob (F-statistic)	0.0001	0.0000	0.0000

"Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level".

Source: made by the researcher based on appendix.1

The p-value is less than 0.05 in the three models, which means that the independent variable (LogOilP) has a significant impact on the dependent variable (LogGDP). We have also a positive coefficient of the independent variable (LogOilP) in the three models, which means that there is a positive impact of OilP on GDP.

4.4. Selection of the appropriate Panel model

4.4.1. Lagrange multiplier test (LM): is a test to determine whether Random Effect model (REM) is better than Pooled Regression Model (PRM).

If Result:

$\begin{cases} H_0: \text{Select PRM } (\text{p} - \text{value} > 0.05) \\ H_1: \text{Select REM } (\text{p} - \text{value} < 0.05) \end{cases}$

Table 2. Breusch and Pagan Lagrangian multiplier test

Test Summary	Chi-Sq Statistic	Prob
Result	769.90	0.0000

Source: made by the researcher based on appendix.2

After performing the Lagrange multiplier test, we obtained a probability value of 0.0000 less than 0.05, that is, we reject the null hypothesis and accept the alternative hypothesis, which means that the Pooled Regression Model is not suitable for analyzing the series data. Therefore, the appropriate model is either the Fixed Effects Model or the Random Effects Model.

4.4.2. Hausman test: is a test to select whether the most appropriate model is the Fixed Effect Model (FEM) or Random Effect model (REM).

If Result:

$\begin{cases} H_0: \text{Select REM } (\text{p} - \text{value} > 0.05) \\ H_1: \text{Select FEM } (\text{p} - \text{value} < 0.05) \end{cases}$

Table 3. Hausman test

Test Summary	Chi-Sq Statistic	Prob
Result	0.00	0.9954

Source: made by the researcher based on appendix.3

Through the results of the table above, we note that the probability value was estimated at 0.9954 greater than the statistical significance of 0.05, that is, we accept the null hypothesis and we reject the alternative one. Thus, the appropriate model is the **Random Effects Model**.

The model obtained can be illustrated as follows:

$$\boldsymbol{Log\ GDP} = 8.509681 + 0.817861\ Log\ OilP$$

4.5. Diagnostic tests of the estimated model

Table 3. Diagnostic tests of the estimated model

Test	Jarque-Bera	White test

Result	0.0864	0.8722

Source: made by the researcher based on appendix.4

- **Normality test**: the Chi-squ probability of Jarque-Bera test is 0.0864> 0.05. Hence, we accept the null hypothesis of the normality which means that our data is normally distributed.
- **Homoskedasticity**: The p-value of white test is 0.8722 > 0.05. Thus, we accept the null hypothesis of the homoskedasticity, which means that there is no heteroscedastic factor in our model.

5. RESULTS AND DISCUSSION

After it turns out that the appropriate model is the random effect model "REM", we noted that there is a direct relationship between the oil prices and GDP of the Arab oil exporting countries, meaning that the increase in oil prices by 1 percent leads to the rise in GDP by 0.817861 percent at a level of significance of 0.01. This can be explained by the fact that the economies of the Arab oil-exporting countries, especially the countries under study: Algeria, Libya, Kuwait and Saudi Arabia, are closely related to oil export revenues, which means that any increase or decrease in oil prices will directly affect the economic growth of these countries.

6. CONCLUSION

Oil prices are undergoing major changes in the international market, which affects the economies of oil-producing countries greatly, especially those that depend mainly on oil revenues to advance their economy, similar to the Arab oil-exporting countries such as Algeria, Libya, Kuwait and Saudi Arabia.

The period from 2005 to 2013 was might the best in terms of the continued rise in oil prices, which enabled these countries to build huge foreign exchange reserves, but the period from mid-2014 to 2020 was difficult for their economies, as the surplus turned into a deficit in their budgets, which affected the economic growth of these countries significantly.

Therefore, through this study, we measured the impact of oil price changes on the economic growth of the aforementioned countries, and we

reached the following results:

- After studying the three models under the Panel data, which are the Pooled Regression Model, the Fixed Effects Model and the Random Effects model, the Hausman test and the Lagrange multiplier test (LM) indicated that the Random Effects Model is the most appropriate model for our study;
- The study proved the existence of a direct relationship between the oil price changes and the economic growth in the Arab oil-exporting countries under study;
- The study proved that a 1% change in oil prices causes a 0.817861% change in GDP in the same direction; at a level of significance of 1%, this means that any increase or decrease in oil prices will have a direct impact on economic growth, which indicates the fragility and weakness of the economies of the countries under study.

In order to reduce the impact of Oil Price changes on Economic Growth in The Arab oil-exporting countries, the following steps are needed:

- The necessity of taking advantage of the high oil prices at the present time in order to establish investment projects that stimulate productivity in various sectors in these countries;
- The need to diversify exports outside hydrocarbons in these countries in order to reduce the damage caused by the sudden drop in oil prices;
- The need to move towards the exploitation of renewable energies, as Algeria, Libya, Kuwait and Saudi Arabia have enormous energy resources that can be exploited, especially the solar and the wind energy.

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8. Appendices

Appendix.1: Estimation results of PRM, FEM and REM

```
. reg LogGDP LogOilP
```

Source	SS	df	MS	Number of obs	=	88
				F(1, 86)	=	18.24
Model	13.1708858	1	13.1708858	Prob > F	=	0.0001
Residual	62.1128765	86	.72224275	R-squared	=	0.1749
				Adj R-squared	=	0.1654
Total	75.2837624	87	.865330602	Root MSE	=	.84985

LogGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LogOilP	.8031653	.1880784	4.27	0.000	.4292777	1.177053
_cons	8.568864	.7628445	11.23	0.000	7.05238	10.08535

```
. xtreg LogGDP LogOilP, fe

Fixed-effects (within) regression               Number of obs      =        88
Group variable: i                               Number of groups   =         4

R-sq:                                           Obs per group:
     within  = 0.7251                                         min =        22
     between = 0.0208                                         avg =      22.0
     overall = 0.1749                                         max =        22

                                                F(1,83)            =    218.89
corr(u_i, Xb)  = -0.0088                        Prob > F           =    0.0000
```

LogGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LogOilP	.8178942	.0552825	14.79	0.000	.7079396	.9278488
_cons	8.509547	.2242209	37.95	0.000	8.06358	8.955513
sigma_u	.9289309					
sigma_e	.24945901					
rho	.9327349	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(3, 83) = 305.04                     Prob > F = 0.0000
```

```
. xtreg LogGDP LogOilP, re

Random-effects GLS regression                   Number of obs      =        88
Group variable: i                               Number of groups   =         4

R-sq:                                           Obs per group:
     within  = 0.7251                                         min =        22
     between = 0.0208                                         avg =      22.0
     overall = 0.1749                                         max =        22

                                                Wald chi2(1)       =    221.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

LogGDP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LogOilP	.817861	.054979	14.88	0.000	.7101041	.9256178
_cons	8.509681	.5999289	14.18	0.000	7.333842	9.68552
sigma_u	1.1200391					
sigma_e	.24945901					
rho	.95273869	(fraction of variance due to u_i)				

Appendix.2: Breusch and Pagan Lagrangian multiplier test

```
. predict residuals
(option xb assumed; fitted values)

. jb residual
Jarque-Bera normality test:  4.898 Chi(2)  .0864
Jarque-Bera test for Ho: normality:
```

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effe

        LogGDP[i,t] = Xb + u[i] + e[i,t]

        Estimated results:
                             Var     sd = sqrt(Var)
                    -------------------------------
                LogGDP    .8653306        .9302315
                     e    .0622298         .249459
                     u    1.254488        1.120039

        Test:   Var(u) = 0
                                 chibar2(01) =   769.90
                              Prob > chibar2 =   0.0000
```

Appendix.3: Hausman test

Appendix.4: Jarque-Bera and White test

```
. imtest, white

White's test for Ho: homoskedasticity
        against Ha: unrestricted heteroskedasticity
```

```
. hausman model_fe model_re
```

	Coefficients (b) model_fe	(B) model_re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
LogOilP	.8178942	.817861	.0000332	.0057845

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 0.00
Prob>chi2 = 0.9954