

## **Macroeconomic Effects for**

### **Liberalizing Natural Gas and Petroleum Products Prices in Egypt**

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#### **Abstract**

This study investigates the macroeconomic effects for liberalizing Natural Gas and Petroleum products' prices in Egypt. The study uses annual data for the period 1988 to 2021 and econometric model VAR with three dependent variables which are GDP growth rate, inflation rate and interest rate. The independent variable was an index for Natural Gas and Petroleum products' prices.

The results indicate that there is a static long-run relationship between the variables. Coefficients of the variables GDPGR, INFLRAT, and INTEREST are all positive reflecting positive relationships. The relationships were assured also in the short-run using VECM model.

The study finds that increasing Natural Gas and Petroleum products' prices by 10% will cause GDP growth rate to increase by 0.16%, 4% increase in inflation rate, and 0.8% increase in Interest Rate.

Finally, it is recommended for the Egyptian government to continue the program for liberalizing energy products' prices since it increases efficiency in production and save energy and other valuable economic resources.

**Keywords:** Liberalizing Natural Gas and Petroleum Products Prices, Egypt, VECM, Macroeconomic Effects.

## **Introduction:**

Since 2014, the Egyptian government started to initiate an economic reform program in all economic fronts. This reform program tackled several economic problems that the Egyptian economy suffered in the last 40 years.

One of the most important problems that has been tackled was the issue of subsidies. It was noted that subsidies in the Egyptian societies were suffering from misallocation since Egyptian governments were applying a methodology of subsidies that was based on open subsidies, where subsidies were available for all. The strategy of open subsidies for all covered both supplying commodities and energy products. As a result, subsidies directed for energy products have reached to historical records exceeding 100 billion LE during the fiscal year 2013-2014. Moreover, this heavy cost for energy products subsidies was misallocated since the rich segmentations in the Egyptian society were gaining benefits more than the poor segmentations. This was because of the methodology of open subsidies for all and the economic fact that higher purchasing power for the rich segmentations compared to the poor classes in the Egyptian society.

Consequently, the Egyptian government put solving this problem of energy subsidies misallocation of the top of its agenda for economic reform, since the election of the president Sisi in 2014. As a result, the Egyptian government started an energy subsidies reform program that has been applied gradually across number of years. The main aim of the program was to get rid of this heavy burden of energy products subsidies and correcting the misallocation of energy subsidies spent in the Egyptian economy. Therefore, the program was based on liberalizing energy products prices across a number of years in order to reach to the full liberalization of the energy products prices.

Based on that, the program of liberalizing the energy products prices raised several questions facing the Egyptian government with regard to macroeconomic implications for this program. This question attracted several economists inside and outside Egypt to study the economic situation and the implications.

Noting that, liberalizing energy products prices can be separated into two main files; the first is liberalizing electricity prices and the second is liberalizing natural gas and petroleum products prices. Therefore, this paper will focus only on the process of liberalizing natural gas and petroleum products prices. Since these products are acquiring the lion chair in energy products subsidies.

Studying the effects of liberalizing the prices of Natural Gas and Petroleum Products in Egypt on macroeconomic indicators has become an important topic that has to be researched and analysed. It is important to investigate the impact of

these prices increases on GDP growth rate, inflation rate, interest rate, budget deficit, and exchange rate in order to submit recommendations to the Egyptian government regarding these challenges.

This study is a trial to investigate the macroeconomic implications resulted from liberalizing the prices of Natural Gas and Petroleum Products in Egypt. Also, the study will provide recommendations for the Egyptian policy makers to achieve the maximum benefits from this liberalization program. This paper is trying to shed the light on several economic questions regarding this issue such as;

- Why did the Egyptian government start applying a reform program to liberalize natural gas and petroleum products prices in this time?
- What were the solutions available for the Egyptian government to solve this problem?
- What is the optimal solution that the Egyptian government should apply based on the international experience and pervious international reforms with regard to liberalizing natural gas and petroleum prices.

### **Literature Review:**

In recent 20 years, several research studies were conducted domestically and internationally to analyse the process of liberalizing energy products price. For Egypt, it is found the review paper (Al-Ayouty and Abdel-Raouf, 2015) was tackling two crucial different topics. First and foremost, the liberalizing energy prices in Egypt and what are the impacts on the Households. The second topic is the different scenarios for Egypt's energy mix. The paper also reviewed what the government reforms that have been taken and how to reduce energy insecurity. They also viewed that in one of the conferences that Egypt would adopt a cost-based pricing regime in which prices are determined based on the actual cost of delivering energy. Also, the shifting of renewable source of energy. It is also discussed that subsidies are phased-out, so we have to ensure that 30 to 50% of saving realized from the subsidy phasing out are earmarked to cash transfers.

On the same track, the PhD thesis (Kamal, 2011) expressed in the paper that a great increase in petroleum products and natural gas subsidies in Egypt has appeared, in addition to increase in Egyptian budget deficit has been noticed. Therefore, the Egyptian cabinet tends to reduce petroleum products and natural gas subsidies to restructure the public expenditures to cope with the natural priorities. This dissertation aimed to study effects of liberalizing petroleum products and natural gas prices on main macroeconomic indicators in Egypt through a gradual program that lasts for five years.

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With regard to international experience, the paper (Hope and Singh, 1999) shows that six case studies show that raising energy prices to eliminate subsidies does not harm the poor, growth, inflation, or industrial competitiveness. Using six case studies, Hope and Singh investigate the effect of energy price increases on the poor, inflation, growth, public revenues, and industrial competitiveness. The effect on households in various income classes depends on the energy commodity's share in the household budget and the price elasticity of demand.

### **Research Methodology:**

This study assumes that liberalizing the prices of Natural Gas and Petroleum Products in Egypt has positive effects on macroeconomic indicators.

In the paper (Al-Ayouty and Abdel-Raouf, 2015), a descriptive methodology was used in order to investigate the effects of liberalizing energy sector prices to deal with energy subsidies. In paper (kamal, 2011), it used VAR model to perform the macroeconomic analysis to end up with the macroeconomic effects of liberalizing these products' prices on the main macroeconomic indicators in Egypt. Also, the study recommends the Egyptian policy makers to deal with the negative effects to reduce their harmful effects on the poor.

In the paper (Hope and Singh, 1999) used a descriptive methodology to illustrate the experience of liberalizing energy products prices in a group of six countries. This study draws on the recent experience of countries that have implemented domestic energy price increases and analyses the economic consequences. A sample of six countries, which implemented significant increases in prices of different fuels and electricity during the 1980s, was identified for detailed analysis: Malaysia, Indonesia, Ghana, Zimbabwe, Colombia and Turkey. The choice of countries was guided by factors such as income level, economic structure geographic dispersion, and export or import of oil. In this paper VAR econometric model will be used to conduct the analysis and investigate the results.

This study uses an econometric VAR model in order to investigate the macroeconomic effects for liberalizing Natural Gas and Petroleum products' prices. The study will use the same methodology used in (Kamal, 2011) for estimating the variables, especially for the index of prices of Natural Gas and Petroleum products.

### **Data and Econometric Model:**

Data will be collected annually through the period 1988 until 2018 from the Financial Monthly report published by the Egyptian Ministry of Finance. Also,

some data will be collected from official websites of the Central Bank of Egypt, Egyptian Ministry of Petroleum and the Egyptian Ministry of Planning. In addition, the study will use data published in (Kamal, 2011) for several variables. The study uses an econometric model, Vector Auto-regression (VAR) model, in order to investigate the relationships between the GDP growth rate, Inflation rate, and Interest rate as dependent variables and the independent variable which is index constructed by (Kamal, 2011) for Natural Gas and Petroleum products' prices.

### **Testing Augmented Dickey – Fuller (ADF) for all Variables:**

Following (Engle and Granger, 1987) the study uses the Augmented Dickey – Fuller (ADF) test provided in (Dickey and Fuller, 1981) in order to determine order of integration. Therefore, this study takes the first and second differences for the variables included in the analysis in order to reach to stationarity. All variables data being tested have to be stationary. Therefore, the study used unit root tests for every variable on its original data. To reach stationarity, every data set has been first differenced and second differenced. After using the ADF, the problem of the possibility of autocorrelation in the error process is solved since the test reduces autocorrelation of the residuals. The study finds these variables are integrated from second order I (2). Results for this test are explained in the following table 1.

**Table 1**  
**ADF unit root test results for Dependent and Independent variables**

ADF statistics			
Variables	Levels form	First differenced	Second Differenced
GDPGR	3.2	2.5	-4.4
INFLRAT	4.3	1.81	-6.9
INTEREST	7.9	2.82	-5.6
ENERGYIN	2.5	0.11	-3.4

From table 1, it is noted that integration of orders zero and one are not existed for these four variables. Therefore, first and second differences have been taken in order to reach stationarity for these variables. This means that the alternative hypothesis is rejected which indicates that these variables are integrated of order higher than one. Consequently, when second differences were taken for these

variables, the null hypothesis that  $\alpha_1 = 1$  is rejected for all of them which indicates that these variables are integrated of order two I (2).

Consequently, the second step in this econometric analysis is conducting the VAR model analysis for this group of four variables. This VAR model analysis is shown in the table 2;

**Table 2**  
**VAR Model Test**

Diagnostic Test	VAR Model	
	Test Statistic	P-value
Residual Serial Correlation LM Test	8.63	0.025
Residual Heteroskedasticity Tests	40.21	0.041
Stability Test	VAR test satisfies stability conditions	No root lies outside the unit circle
Residual Normality Tests	2.63	0.32

According to table 2, results of testing for VAR model among the variables are presented. For the estimation of the VAR model, only one lag was included based on the Akaike information criterion. Diagnostic tests were applied to ensure the validity of the results. Autocorrelation, heteroscedasticity, normality, and stability tests were conducted. The results of these tests confirm that the model does not suffer any autocorrelation, heteroscedasticity, normality or stability problems. The results of these tests are presented in the table 2.

The results of this VAR model can be interpreted using two main analytic tools, impulse response functions (IRFs) and variance decompositions (VDs). These two analytical tools are used to investigate the response of GDP growth rates to shocks or changes in the independent variable and to describe the main effects of the independent variable on the three dependent variables in Egypt.

**Table 3****OLS Estimates between Dependent and Independent Variables**

Dependent Variables: GDPGR INFLRAT INTEREST

Method: Least Squares (OLS)

Date: 05/07/19 Time: 13:13

Sample: 1 120

Included observations: 120

Dep. Var.	Coefficient	Std. Error	t-Statistic	Prob.
GDPGR	<b>0.16</b>	1.3	1.7	<b>0.0483</b>
INFLRAT	<b>4.18</b>	0.7	0.11	<b>0.0164</b>
INTEREST	<b>0.81</b>	0.4	-3.5	<b>0.0006</b>
C	<b>-0.87</b>	4.67	-0.12	<b>0.0164</b>
R-squared	<b>0.58</b>	Mean dependent var		0.86
Adjusted R-squared	<b>0.54</b>	S.D. dependent var		6.35
S.E. of regression	7.1	Akaike info criterion		3.36
Sum squared resid	129.9	Schwarz criterion		5.8
Log likelihood	-350.04	Hannan-Quinn criter.		4.8
F-statistic	4.1	Durbin-Watson stat		2.5
Prob (F-statistic)	0.002			

Table 3 describes the Ordinary Least Squares (OLS) estimates between variables where the GDP growth rate, Inflation rate, and Interest rate as dependent variables and the independent variable which is index constructed by (Kamal, 2011) for Natural Gas and Petroleum products' prices.

The results indicate that there is a static long-run relationship between the variables. Coefficients of the variables GDPGR, INFLRAT, and INTEREST are all positive reflecting positive relationships. Therefore, 10% increase in Natural

Gas and Petroleum products' prices causes GDP growth rate to increase by 0.16%, 4% increase in inflation rate, and 0.8% increase in Interest Rate. The last column that represents the probabilities for these coefficients are all less than 0.05 and R-squared and Adjusted R-squared are 0.58 and 0.54 respectively which means that the long-run relationship between these four variables is highly significant.

**Table 4**  
**Impulse Response Functions (IRFs)**

Included observations: 120

Trend assumption: Linear deterministic trend

Series: GDPGR INFLRAT INTEREST ENERGYIN

Lags interval (in second differences): 1 to 4

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.11	23.06	36.2	0.0002
At most 1 *	0.13	11.40	18.7	0.0223
At most 2	0.01	2.7	9.4	0.3161
At most 3	0.0006	0.026	2.8	0.2137

\* denotes rejection of the hypothesis at the 0.05 level

\*\* Akaike information criterion p-values

Unrestricted Adjustment Coefficients (alpha):

D(ENERGYIN)	0.02	0.006	0.020	0.001
D(GDPGR)	1.4	2.20	-0.139	-0.011
D(INFLRAT)	0.08	-0.029	-0.002	0.003
D(INTEREST)	-0.1	0.016	-0.018	0.005



Adjustment coefficients (standard error in parentheses)

D(ENERGYIN)	-0.03	(0.02)
D(GDPGR)	-1.9	(0.61)
D(INFLRAT)	-0.11	(0.02)
D(INTEREST)	0.15	(0.06)

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2 Decomposition Matrix:	Log likelihood	-185.3
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Normalized Decomposition Matrix (standard error in parentheses)

GDPGR	INFLRAT	INTEREST	ENERGYIN
1.000000	0.000000	-0.61 (0.12)	-0.56 (0.06)
0.000000	1.000000	-0.06 (0.75)	0.71 (0.41)

Adjustment coefficients (standard error in parentheses)

D(ENERGYIN)	-0.03	-0.00
	(0.01)	(0.003)
D(GDPGR)	-1.42	-0.69
	(0.68)	(0.13)

D(INFLRAT)	-0.11	-0.001
	(0.02)	(0.005)
D(INTEREST)	0.15	0.007
	(0.06)	(0.01)

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3 Decomposition Matrix:	Log likelihood	-455.40
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Normalized Decomposition Matrix (standard error in parentheses)

GDPGR	INFLRAT	INTEREST	ENERGYIN
1.000000	0.000000	-0.65	-0.59
		(0.12)	(0.069)
0.000000	1.000000	-0.06	0.70
		(0.78)	(0.40)

Adjustment coefficients (standard error in parentheses)

D(ENERGYIN)	-0.092	-0.002	0.04
	(0.04)	(0.003)	(0.02)
D(GDPGR)	-1.01	-0.69	0.80
	(1.65)	(0.13)	(0.75)
D(INFLRAT)	-0.105	-0.001	0.078
	(0.07)	(0.005)	(0.02)
D(INTEREST)	0.20	0.006	-0.12
	(0.16)	(0.01)	(0.07)

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Table 4 is investigating impulse response functions (IRFs) among the four variables in the analysis. In the first period following increasing the prices of Natural Gas and Petroleum products (ENERGYIN), the results show that ENERGYIN responds positively to itself which means that expectations about the increase in energy prices seemed to play an important role, as ENERGYIN rate responds positively to a shock in itself.

**Table 5****Variance Decomposition (VD) for EGR**

## Variance Decomposition Estimates

Date: 05/07/19 Time: 18:28

Sample (adjusted): 4 120

Included observations: 120

Standard errors in ( ) &amp; t-statistics in [ ]

Variance Decomposition	Estimates	
ENERGYIN (-2)	2.4	
	(0.38)	
	[ 6.11]	
C	-14.67	
D(GDPGR (-2))	<b>-0.059</b>	0.53
	<b>(0.03)</b>	(2.08)
	[-0.69]	[ 0.24]
D(INTEREST (-2))	<b>-0.02</b>	-0.49
	<b>(0.02)</b>	(2.15)
	[-0.29]	[-0.18]
C	<b>-0.37</b>	-2.8
	<b>(0.12)</b>	(3.01)

	[-3.01]	[-0.90]
D(INFLRAT (-2))	<b>-0.03</b>	1.7
	<b>(0.03)</b>	(0.76)
	[-1.1]	[ 2.3]
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R-squared	<b>0.55</b>	0.45
Adj. R-squared	<b>0.51</b>	0.43
Sum sq. resids	9.56	404.63
S.E. equation	0.27	6.38
F-statistic	5.51	17.50
Log likelihood	-4.51	-123.9
Akaike AIC	0.16	6.59
Schwarz SC	0.32	6.75
Mean dependent	0.04	-0.20
S.D. dependent	0.28	8.46

### **Conclusion:**

This study investigates the macroeconomic effects for liberalizing Natural Gas and Petroleum products' prices in Egypt. The study uses annual data for the period 1988 to 2018 and econometric model VAR with three dependent variables which are GDP growth rate, inflation rate and interest rate. The independent variable was an index for Natural Gas and Petroleum products' prices.

The results indicate that there is a static long-run relationship between the variables. Coefficients of the variables GDPGR, INFLRAT, and INTEREST are all positive reflecting positive relationships. The relationships were assured also in the short-run using VECM model.

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The study finds that increasing Natural Gas and Petroleum products' prices by 10% will cause GDP growth rate to increase by 0.16%, 4% increase in inflation rate, and 0.8% increase in Interest Rate.

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