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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.

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	0.16	1.3	1.7	0.0483
INFLRAT	4.18	0.7	0.11	0.0164
INTEREST	0.81	0.4	-3.5	0.0006
C	-0.87	4.67	-0.12	0.0164
R-squared	0.58	Mean dependent var		0.86
Adjusted R-squared	0.54	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)

2 Decomposition Matrix: Log likelihood -185.3

Normalized Decomposition Matrix (standard error in parentheses)

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

		Log	
3 Decomposition Matrix:		likelihood	-455.40
Normalized Decomposition Matrix (standard error in parentheses)			
GDPGR	INFLRAT	INTEREST	ENERGYIN
1.000000	0.000000	-0.65 (0.12)	-0.59 (0.069)
0.000000	1.000000	-0.06 (0.78)	0.70 (0.40)
Adjustment coefficients (standard error in parentheses)			
D(ENERGYIN)	-0.092 (0.04)	-0.002 (0.003)	0.04 (0.02)
D(GDPGR)	-1.01 (1.65)	-0.69 (0.13)	0.80 (0.75)
D(INFLRAT)	-0.105 (0.07)	-0.001 (0.005)	0.078 (0.02)
D(INTEREST)	0.20 (0.16)	0.006 (0.01)	-0.12 (0.07)

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 () & t-statistics in []

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

	[-3.01]	[-0.90]
D(INFLRAT (-2))	-0.03	1.7
	(0.03)	(0.76)
	[-1.1]	[2.3]
<hr/>		
R-squared	0.55	0.45
Adj. R-squared	0.51	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.

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.

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The Relation between Gender Inequality and Wages in Egypt

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Abstract

This study tests the relation between gender inequality and Wages in the Egyptian Economy during the period 1998 to 2021. The study uses econometric co-integration model and OLS estimates to estimate the effect of gender inequality on Wages in Egypt during the period 1988 until 2021. The study finds that Female to Male Wage rate through this era is significantly positively affected by the Gender Parity Index (which is the proxy to gender inequality) with coefficients equal to 0.53. The analysis proved the existence of short-run and long-run relation between the two variables. This finding means that 1% enhancement in gender inequality raises Female to Male Wage rate by around 0.53%. This result reflects the positive impact of decreasing inequality and discrimination against female in the Egyptian Economy that appears in higher wages for female. Finally, the study recommends that the Egyptian government remove obstacles facing Egyptian female participation in labour force through expanding education opportunities for female and stopping discrimination against female in job opportunities.

Keywords: Gender Inequality, Wages, Egypt, Labour Market.

Introduction:

Gender inequality remains a major barrier to human development. Girls and women have made major strides since 1990, but they have not yet gained gender equity. The disadvantages facing women and girls are a major source of inequality. All too often, women and girls are discriminated against in health, education, political representation, labour market, etc.—with negative consequences for development of their capabilities and their freedom of choice.

When seeing the statistics about gender inequality worldwide we find that 62 million girls are denied an education all over the world. In 2016, just 57 percent world's working-age women are in the labour force, compared to 70 percent of working-age men. In 2016, just 57 percent world's working-age women are in the labour force, compared to 70 percent of working-age men. African-American women earn 64 cents and Latina women earn 56 cents for every dollar earned by a Caucasian man (makers, 2018)

Gender inequality is not only take one form as education but it have been shaped so it can be seen in different form like physical or sexual violence by their partner. Women in Saudi Arabia weren't allowed to drive and are still discouraged from working jobs that would put them in contact with men. The unemployment rate for women is 33 percent for women, 7 percent for men (khera, 2018)

In all Western societies women earn lower wages on average than men. The gender wage gap has existed for many years, although there have been some important changes over time (Blau, 2010).

According to a recent statistics published by the BBC 74% of firms pay higher rates to their male staff. Just 15% of businesses with more than 250 employees pay more to women. As many as 11% of firms said there is no difference between the rates paid to either gender.(BBC , 2018).

The size of the gender pay gap is commonly viewed as an indicator of the progress made by women towards achieving equity with men in the labour market. This study examines the nature and sources of change in the gender earnings gap in Egypt between 1998 and 2018, a period in which the relative earnings of females were rising. The importance of this study that to assess the relationship between gender inequality and its impact on wages in Egypt

The aim of the study, understand the relationship between gender inequality and wages in Egypt and how can the Government Issue policies that will aim to reduce the percentage of gender inequality. Gender inequality have a significant impact on wages of women in the labor market the paper aim to answer the following question;

What is the relationship between Gender inequality and wages in Egypt between 1998 to 2021?

This question will be answered through answering the following

- What are the form of gender inequality in Egypt?
- What are the reasons behind Wages Gap between men and women in Egypt?
- What are the impact Gender inequality on wages in Egypt?
- What are the steps that the government should take to reduce the Gap of wages of men and women?

Literature Review

Andrew M. Penner, , Harold J. Toro-Tulla, uses a survey of 2,000 small businesses to examine how gender differences in wages vary among establishments with male and female owners. We find no systematic differences between the levels of gender wage inequality in female owned small business and male owned small businesses.(Penner & Tulla , 2010)

Giovanni Ferro Luzzi, Jacques Silber found that gender wage inequality differences in Switzerland is due to differences in the distributions of unobservable characteristics, while human capital tends to compensate slightly for this effect.(Ferro & Jacques , 1998)

Stephen Machin argue that higher wage inequality takes on an added significance if real wages of the typical worker are not growing, and showing that inequality rises and real wage slowdowns have gone hand-in-hand with one another due to wages decoupling from productivity in the United States and United Kingdom. The lack of growth of real wages at the median in the United States is also shown to be linked to the declining influence of trade unions. (Machin, 2016)

Maria J. Perez-Villadoniga, Ana Rodriguez-Alvarez examine the gender wage gap not only in gross wages, but also focusing on a specific salary component, the base wage, he find a significant wage differential between men and women. A detailed analysis of this result points to the existence of occupational segregation in the labor market. Within each occupational category, females tend to be concentrated in the lower ranking jobs, which entail lower wages. This result is consistent with the existence of a sticky floors phenomenon.(Villadoniga & Alvarez , 2017)

Miguel Angel Ropero_analyze the effects on the gender wage gap of women's access to supervisory jobs within each establishment in the Spanish labor market. He found that an increase in the proportion of women among supervisors within each establishment significantly widens the wage difference between genders. This study shows that the impact of an increase in women's power within establishments may well be more limited than other empirical studies suggest (Ropero , 2018).

Gender Inequality in Egypt According to Gender Parity Index:

Egypt ranks low in gender equity compared to other countries worldwide. The 2015 Global Gender Gap Index, which measures disparities between men and women across countries, ranks Egypt at 136 out of 145 countries worldwide. Women have significantly lower participation in the labor force than men (26% vs 79%) and lower literacy (65% literacy for women vs 82% of males). The Organization for Economic Cooperation and Development's Social Institutions and Gender Index 2014, which measures legislation, practices, and attitudes that restrict women's rights and opportunities, classifies Egypt to be among the countries 'very high' in gender discrimination together with others in Africa and the Middle East.

Research Methodology:

The study will use qualitative and quantitative research method through understanding the relationship between gender inequality and wages in Egypt in the period between 1988 to 2021. Then will evaluate the role of government toward reducing gender inequality. Multiple regression models of earnings are widely used in labour economics to measure the influence of human capital characteristics on wages, and are one of the main tools used in empirical studies of the gender wage gap. A basic objective of these studies is to estimate how much of the female shortfall in pay is due to women's lower average levels of labor market skills. This is accomplished by taking a sample of male and female employees, estimating wage equations separately for men and women, and using the coefficients thus estimated in a decomposition of mean effects. In the simplest versions of this work, the portion of the wage gap that is found to be attributable to differences between men and women in productivity-related attributes is treated as nondiscriminatory. The residual or remaining part of the wage gap is regarded as the difference in wages that is partly or wholly due to wage discrimination.

Hypothesis

H0: Gender inequality have a negative relationship with wages

H1: The role of the government have a negative relationship in decreasing gender inequality

Data Collection Methods and Variables:

Data used in this study will be collected from Household Expenditure Survey done in Egypt by CAPMAS every five years. The last one was conducted in 2018. The data for the variable Gender Parity Index (GPI) is collected from the World Bank data base “World Development Indicators” (WDI).

Gender Parity Index (GPI):

The Gender Parity Index (GPI) is a socioeconomic index usually designed to measure the relative access to education of males and females. This index is released by UNESCO. In its simplest form, it is calculated as the number of females divided by the number of males enrolled in a given stage of education (primary, secondary, etc.). A GPI equal to one signifies equality between males and females. A GPI less than one is an indication that gender parity favors males while a GPI greater than one indicates gender parity that favors females. The closer a GPI is to one, the closer a country is to achieving equality between males and females. It is used by international organizations, particularly in measuring the progress of developing countries. The Institute for Statistics of UNESCO also uses a more general definition of GPI: for any development indicator one can define the GPI relative to this indicator by dividing its value for females by its value for males

In completing the study we will depend on statistical data retrieved from secondary resources like central bank of Egypt and reports of the Human development report analyze the impact of Gender inequality on wages. In

addition we will conduct a survey that will try to point out the reasons behind gender inequality and the role of government toward reducing it.

The study will conduct a regression equation through OLS econometric model where the Gender Parity Index will be the independent variable and Female to Male Wage ratio is the dependent variable. GPI will be used as a proxy for gender inequality in the Egyptian society.

Econometric Analysis and Results:

The first step in this econometric analysis is to conduct Dickey Fuller test for the group of variables in this study in order to reach to stability and determine the level of integration among these variables.

Dickey Fuller Test of Unit Root to Test the Stability of Examined Variables:

In Dickey Fuller test, H0 and H1 are formulated as follows:

H0: the variable is not stable.

H1: the variable is stable.

Table 1

ADF unit root test results for Female to Male Wage Rate and The Independent Variable GPI

ADF statistics			
Variables	Levels form	First differenced	Second Differenced
Female to Male Wage Ratio	6.67	1.65	-8.97
Gender Parity Index	2.861	0.62	-8.14

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

Table 2
Co-integration Analysis between the Two Variables

Sample (adjusted): 6 40

Included observations: 40

Trend assumption: Linear deterministic trend

Series: FEM_MAL_WR GENDER_INDEX

Lags interval (in second differences): 1 to 4

Unrestricted Co-integration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.15	44.07	84.8	0.0002
At most 1 *	0.14	31.40	31.1	0.03
At most 2	0.021	2.83	12.42	0.81
At most 3	0.00025	0.041	3.89	0.85

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integrating Coefficients (normalized by $b'S11*b=I$):

	GENDER_I	
FEM_MAL_WR	INDEX	
	-1.39	-0.12

0.27	-0.29
-7.032	0.058
0.55	-0.032

Unrestricted Adjustment Coefficients (alpha):

D(FEM_MAL_W R)	0.021	0.006
D(GENDER_IND EX)	1.49	2.20

	Log	
1 Co-integrating Equation(s):	likelihood	-98.0883

Normalized co-integrating coefficients (standard error in parentheses)

	GENDER_I
FEM_MAL_WR	NDEX
1.000000	0.076348
	(0.03389)

Adjustment coefficients (standard error in parentheses)

D(FEM_MAL_W R)	-0.032807
	(0.01916)
D(GENDER_IND EX)	-1.954358
	(0.72467)

	Log	
2 Cointegrating Equation(s):	likelihood	-98.21

Normalized cointegrating coefficients (standard error in parentheses)

	GENDER_I	
FEM_MAL_WR	NDEX	
1.000000	0.000000	
0.000000	1.000000	

Adjustment coefficients (standard error in parentheses)

D(FEM_MAL_W R)	-0.03 (0.019)	-0.004 (0.003)
D(GENDER_IND EX)	-1.38 (0.70)	-0.55 (0.13262)

3 Cointegrating Equation(s):	Log likelihood	-86.51
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Normalized cointegrating coefficients (standard error in parentheses)

	GENDER_I	
FEM_MAL_WR	NDEX	
1.000000	0.000000	
0.000000	1.000000	
0.000000	0.000000	

Adjustment coefficients (standard error in parentheses)

D(FEM_MAL_W R)	-0.092705 (0.04658)	-0.002928 (0.00380)	0.045222 (0.02113)
D(GENDER_IND EX)	-1.001147 (1.65862)	-0.697811 (0.13541)	0.808401 (0.75237)

In table 2, results of testing for co-integration relationships between the variables are presented. It is the first stage of (Engle and Granger, 1987) two-stage procedure which is the static long-run regressions. The results from the ADF unit root tests on the residuals in every bivariate static long-run equation showed in Table 2 indicate that residuals in all static long-run equations are integrated of order two. This means that the variables in every bivariate equation are co-integrated. Therefore, there is a long-run relationship between these variables that is assured by results shown in Table 3.

Table 3 clarifies the Ordinary Least Squares (OLS) estimates between variables where FEM_MAL_WR is the dependent variable and the GPI is the independent variable. The results indicate that there is a static long-run positive relationship between the two variables. Coefficients of the independent variable is positive equal to 0.53 reflecting the positive relationship between Female to Male Wage Ratio and GPI. The last column that represents the probabilities for these coefficients are all less than 0.05 and R-squared and Adjusted R-squared are 0.84 and 0.81 respectively which means that the positive long-run relationship between these two variables is highly significant.

Table 3**OLS Estimates between Variables and Static long-run model for the effect of Independent Variable GPI on Female to Male Wage Rate**

Dependent Variable: FEM_MAL_WR

Method: Least Squares

Date: 05/08/19 Time: 19:13

Sample: 1 40

Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FEM_MAL_WR	0.085	1.33	1.71	0.0483
C	2.78	7.66	-0.11	0.0049
R-squared	0.82	Mean dependent var		0.99
Adjusted R-squared	0.78	S.D. dependent var		7.68
S.E. of regression	7.04	Akaike info criterion		6.46
Sum squared resid	1952.902	Schwarz criterion		6.82
Log likelihood	-153.02	Hannan-Quinn criter.		6.80
F-statistic	5.15	Durbin-Watson stat		1.48
Prob (F-statistic)	0.002			

Consequently, the analysis must be transferred into the second stage of (Engle and Granger, 1987) to confirm this co-integration relationship through applying the Error Correction EC models. Results for this second stage analysis are presented in the coming Table 4.

Table 4

**The EC model for the impact of
Gender Inequality on Wages**

Vector Error Correction Estimates

Date: 05/09/19 Time: 15:28

Sample (adjusted): 4 40

Included observations: 40 after adjustments

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

Cointegrating Eq: CointEq1

FEM_MAL_WR(-

1) 2.60

(0.30)

[6.4]

C -11.66

Error Correction: D(GPI) D(FEM_MAL_WR)

CointEq1 0.001004 -0.273018

(0.00179) (0.04461)

[0.56155] [-6.12002]

D(GPI (-1)) **-0.057970** 0.553122

(0.03372) (2.08961)

[-0.69244] [0.26470]

R-squared	0.82	0.45
Adj. R-squared	0.81	0.43
Sum sq. resids	9.56	1952.62
S.E. equation	0.25	6.31
F-statistic	5.51	12.50
Log likelihood	-4.51	-152.9
Akaike AIC	0.17	6.52
Schwarz SC	0.35	6.75
Mean dependent	0.04	-0.20
S.D. dependent	0.22	8.462

Diagnostic tests for the
chosen EC model

ARCH
0.158

(0.389)

As presented in Table 4, the model where Female to Male Wage Ratio is its dependent variable and the independent variable is the Gender Parity Index contains Error Correction Model ECM which is consistent with the previous results obtained for the static long-run regression and the ADF unit root tests for the residuals. Therefore, this positive relationship between the two variables is valid also in the short-run. Moreover, it is showed that the assumptions behind this EC model are supported by the diagnostic test Autoregressive Conditional Heteroscedasticity (ARCH).

Conclusion:

This study investigates the impact of gender inequality on Wages in the Egyptian society through the period 1998 to 2018. The study uses econometric analysis through co-integration model and OLS estimates to estimate the effect of gender inequality on Wages in Egypt during the period 1988 until 2018. The study finds that Female to Male Wage rate through this era is significantly positively affected by the Gender Parity Index (which is the proxy to gender inequality) with coefficients equal to 0.53. This finding means that 1% enhancement in gender inequality raises Female to Male Wage rate by around 0.53%. This result reflects the positive impact of decreasing inequality and discrimination against female in the Egyptian Economy that appears in higher wages for female.

Finally, the study recommends that the Egyptian government remove obstacles facing Egyptian female participation in labor force through expanding education opportunities for female and stopping discrimination against female in job opportunities. Empowering female and integrating them as active participants in the economy is essential to promote economic growth in Egypt. Consequently, raising the female labor force participation rate to the male level, coupled with access to employment opportunities, would increase GDP by approximately 34 percent. In partnership with the Government of Egypt and the private sector, USAID has a number of activities designed to improve the skills and participation rate of women in the workforce and remove constraints to women's economic participation in micro, small, and medium enterprises.

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