Global Review of Accounting and Finance
Vol. 7. No. 1. March 2016 Issue. Pp. 43 – 61

Impact of Oil and Gas Price Shocks on Stock Market: The Case of Egypt

Nizar Atrissi[1] and Georges Stephan[2]

The main objective of this paper is to determine the effect of the oil and natural gas price volatility on the equity market of an energy producing country under uncertainty. Our study was conducted on Egypt, a main producer and supplier of energy, and a country facing political uncertainty. We aimed at highlighting the effect that the Arab spring had on the Egyptian equities market by dividing our initial period that spanned from June 2005 to May 2014 into two distinct periods. The results showed that prior to the start of the Arab spring the Egyptian stock market exhibited the same reaction as the US equity market in case of an oil shock. During post December 2010, the Egyptian stock market exhibits an irregular reaction. On the other hand, prior to December 2010, the natural gas price shock had a prolonged positive effect on the Egypt stock market whereas, during post December 2010, it left the Egyptian stock market shadowed.

JEL Classification : G17, E44, Q43

1. Introduction

Recent literature is in line with the conclusions that positive shocks on oil prices create a weaker economic condition (Prajitno 2011). However, most researchers who tried to identify the effects of energy price shocks on stock market conducted their studies solely on oil, and limited their scope to only cover developed countries. In this study, we conducted an analysis on natural gas and crude oil while trying to determine their effect on the state of the economy of a developing energy supplying country, in this case, Egypt.

When it comes to the price of crude oil, the U.S. Energy Information Administration states that there are several key factors that affect crude oil price, mainly: production, global oil inventories, financial markets and demand. Most significant and large shifts were not caused by any of the above factors. Most of these variations were mainly due to political instability in oil producing countries, better yet, in oil-producing countries located in the Middle East and North Africa (MENA) region. Here, we make mention of the October 1973 oil shock that was caused by the embargo proclaimed by the members of Organization of Arab Petroleum Exporting Countries (OAPEC). The second oil shock occurred between November 1979 - December 1979 during the wake of the Iranian Revolution. In addition, the 1990 oil price spike aroused in response to the Iraqi invasion of Kuwait.

[1] Corresponding author: Professor Nizar Atrissi, Université Saint-Joseph de Beyrouth, Campus des sciences sociales - B.P. 17-5208, Mar Mikhaël, Beirut, 1104 2020 – Lebanon, email: nizar.atrissi@gmail.com
[2] Université Saint-Joseph de Beyrouth, Lebanon

When it comes to natural gas prices, the U.S. Energy Information Administration states that they are a function of supply and demand. Due to the fact that there are too little alternatives for natural gas consumption or production in the short term, a little change in supply or demand over a brief period can result in large price fluctuations. Harsh weather conditions can highly affect residential and commercial demand and can disrupt production. Economic growth can also highly affect natural gas demand and prices. Unlike crude oil prices, natural gas tends to have large shifts due to less complex changes in the economy.

The main motivation behind this paper is to understand and to explore the dynamic relationship between energy prices and the economic state of Egypt as a main player in the energy-supplying countries, and more specifically, to discover the consequence of the shock in energy prices on the stock market. This topic becomes more relevant when put into the recent context of turmoil that Egypt and the MENA region are facing.

Why the Middle East? According to the International Energy Agency, 34.49% of countries supplying oil are located in the MENA region. Throughout history, these countries have faced political turbulence that caused severe oil shocks. These shocks had severe repercussion, including high volatility in oil price, imbalance in supply and demand of oil, economic recession and so on. Those countries are currently involved in the Arab spring. The Arab spring is a revolutionary wave of protests and demonstrations, riots, and civil wars in the Arab world that began on 17 December 2010.

The findings of this paper shall prove to be beneficial, especially for researchers and analysts looking at the equity market as it provides an insight on what changes to expect that come with the volatility of the price of a major component of local economies, namely energy. There is little or no prior information on this matter, as there have been no prior study specific to this subject, especially one that takes into consideration the effect of political instability on energy prices, and subsequently, on local equities markets.

Why Egypt? According to the International Energy Agency, Egypt produces 680,500 barrels of oil per day, that is, almost 1% of the total oil production. When it comes to natural gas, Egypt is one of the biggest countries with natural gas reserves reaching 2.0 trillion m^3. It supplies natural gas to Jordan, Kuwait, Lebanon, Syria, Turkey and Iraq. In addition, its supply of natural gas for Israel has been halted. Moreover, Egypt rulers had been forced-out twice from power.

This empirical paper is constructed as follows: At first, we present a briefing of past works regarding oil price volatility. Later on, we describe the data and the methodology that was used. Then, we use VAR’s variance decompositions and impulse responses to determine the dynamic relationships between the available economic variables. Finally, we discuss all the results of the analysis.

2. Theoretical Framework

After the interesting work of Hamilton (1983) that concluded that positive oil price shocks are an important cause for economic recession in the US, many researchers began to analyze the importance of oil price volatility to economic activities. Furthermore, several researches were conducted in order to study the effect of oil price shocks on the stock market.

A research conducted by Burbidge and Harrison (1984) investigated the effect of the sharp increase in oil price in the 1970s on the economies of five Organization for Economic Cooperation and Development (OECD) countries, namely the US, Japan, Germany, England and Canada. The impulse responses analysis revealed that positive shocks on oil price had a major effect on the price level in the US and Canada, and on the industrial output of England and the US. They also divided their timeline into two periods that generated different results: the first period going from 1973 to 1974, where oil price shocks generated a significant effect on all five countries; while the second period going from 1979 to 1980, where an increase in oil left a significant effect only on Japan.

Bernanke (1983) found that during period of high volatility in oil price, firms found that waiting for new information is the best line of action. Even though waiting can result in opportunity cost, it is still the best action to be made. Inspired by Bernanke (1983), Heriques and Sadorsky (2011) tried to find a relation between oil price volatility and investment. They concluded that there exists a U-shape relationship between oil price and investment.

Jones and Kaul (1996) tested the reaction of international stock markets to oil shocks. They found that Canada and the US stock markets are rational: the reaction of stock prices to oil shocks can be entirely accounted for by their impact on current and projected future real cash flows alone. On the other hand, The United Kingdom and Japan oil price shock cause larger changes in stock prices than can't be justified by consequent changes in cash flows. The work that was conducted by Sadorsky (1999) concluded that increase in oil price is followed by declining stock returns. Papapetrou (2001) and Park and Ratti (2008) had the same conclusion when it came to Greece and some European countries.

In addition, Guo and Kliesen (2005) stated that oil price uncertainty had a negative impact on economic activity especially when they included oil price variation. Furthermore, Dias (2013) stated that positive oil price shock had a depressive impact on the level of GDP in the long run and on employment in the private sector. Additionally, Cong and Shen (2013) investigated the interactive relationships among China energy price shocks, stock market and the macro economy. They stated that the shocks in energy price have an important effect on the stock market. In addition, they acknowledged that investors should not only consider interest rates but energy price as well. Cong et al. (2008) noted that some major shocks to oil prices do have a negative impact on the stock market. While the work done by Huang et al. (1996) came up with a different conclusion: oil future prices do not have any impact on stock returns.

One of the few works done on developing countries was accomplished by Rafiq et al. (2009) for Thailand. The conclusion was that oil price volatility had an influence on the short run and it had a major impact on investment and unemployment rate.

Moreover, Narayan and Narayan (2007) argued that the work regarding the modeling of oil price volatility was not sufficient. Data was not collected for the research on a daily basis. Via using EGARCH model, they modeled the daily data of crude oil prices and came up with the conclusion that oil shocks influence volatility on the short run and asymmetrically over a long term period.

Given the above-mentioned studies, we were able to identify a gap in the covered economies. The vast majority of the countries that were analyzed were developed markets. Furthermore, where a developing country was studied, it was an oil-consuming market rather than oil-producing economy. In this paper, we sought to target those past limitations and shed light on the specific case of an emerging oil-producing economy under uncertainty.

3. Empirical Framework, Data and Methodology

The main goal behind this study was to analyze the effect of uncertainty on equity markets. Egypt surfaced as an optimal candidate for our study, having gone through two consecutive uprisings while being an energy-producing country.

This empirical study used monthly data with samples covering the period from June 2005 till May 2014, that is, a total of 108 observations. The variables used are: Egypt total production index that consists of the major sectors of the Egyptian Economy compared to 2002 months', Egypt monthly deposit rates published monthly by Egypt central bank, monthly price of crude oil, monthly price of natural gas and Egypt stock index EGX 30.

In order to better portray the impact of the Arab spring, an uprising that first started on December 17 2010 with Mohamed Bouazizi's self-immolation in Tunisia, we conducted the study on two separate periods. The first one covering the pre-Arab spring phase from June 2005 till November 2010, while the second period represent the post-Arab spring phase spanning from December 2010 till May 2014.

The first thing that was done was compilation of the time series and determining if it is covariance stationary. The basic idea behind covariance stationary is that the mean and variance do not vary in time. We transformed the raw time series into covariance stationary time series. In order to do so, we tested the initial data to check if it is stationary. There are several tests made available, the most common of which are: Augmented Dickey Fuller test and Kwiatkowski-Phillips-Schmidt-Shin test. In case our original data exhibits non-stationary, we have to difference in order to obtain a covariance stationary time series.

After that, we checked if there exists cointegration among the variables. Two time series were considered as cointegrated if there exists between them a long-term financial or economic relationship in such way that they do not depart from each other without being bound in the long run. Cointegration test was conducted on non-stationary variables before proceeding. The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model was used to capture the features of volatility available in natural gas and oil prices.

The VAR model was used to determine the relationship between the variables - interest rate, oil prices, natural gas price, industrial production and stock returns. Last but not least, we extracted the variance decomposition of the Egyptian stock index that give us information about the effect of each variable on the variation of the index. Finally, we created a one-time shock on crude oil and natural gas over the three periods and studied the market reactions and results.

Previous studies on the matter did not directly target the specific case of an oil-producing emerging country under uncertainty. Information from those studies was of very limited benefit for any individual/entity looking to get a thorough understanding of such energy price impacts on stock markets. The main contribution this study meant to make was to provide tangible empirical evidence on the subject.

4. Results and Discussion

4.1 Unit Root Test

The test for unit root was done by utilizing a Schwarz Information Criterion to find out the automatic lag. The results of the Augmented Dickey Fuller (ADF) (H_0: has a unit root test) and the Kwiatkowski Philips Schmidt Shin test (KPSS) (H_0: is stationary) are presented in the table below. Table 1 below shows the test done on all variables for the whole period.

Table 1: Unit Root test- ADF and KPSS Test for the Whole period

	ADF Test		KPSS Test	
Null Hypothesis	has a unit root test		is stationary	
	In levels			
	t-statistic	critical value	test statistic	critical value
EGX 30	-2.27	-2.89	0.257	0.463
Crude Oil	-2.758	-2.88	0.587*	0.463
Egypt Industrial Production	-3.311*	-2.89	0.147	0.463
Egypt Monthly Rates	-3.78*	-2.88	0.07	0.463
Natural Gas	-2.03	-2.88	0.94*	0.463
	In first differences			
	t-statistic	critical value	test statistic	critical value
∆EGX 30	-8.27*	-2.89	0.075	0.463
∆Crude Oil	-7.874*	-2.89	0.0306	0.463
∆ Egypt Industrial Production	-10.42*	-2.89	0.210	0.463
∆ Egypt Monthly Rates	-5.03*	-2.88	0.051	0.463
∆ Natural Gas	-9.52*	-2.88	0.039	0.463

*implies the rejection of the hypothesis at the 0.05 level.

In levels, Egypt industrial production and Egypt monthly rates are stationary. In first difference, all variables are stationary. We want to work on the data that was not unit root test, that is, that is covariance stationary. Hence, we used the first difference of EGX 30, the first difference of crude oil, the first difference of natural gas and Egypt industrial production and Egypt monthly rates.

Then we conducted the ADF and KPSS tests on the period prior to December 2010. The results are made available in Table 2 below.

Table 2: Unit Root test- ADF and KPSS Test for the period prior to December 2010.

	ADF Test		KPSS Test	
Null Hypothesis	has a unit root test		is stationary	
	In levels			
	t-statistic	critical value	test statistic	critical value
EGX 30	-2.19	-2.90	0.13	0.463
Crude Oil	-2.85	-2.90	0.14	0.463
Egypt Industrial Production	-7.06*	-2.90	0.50*	0.463
Egypt Monthly Rates	-2.53	-2.90	0.137	0.463
Natural Gas	-1.82	-2.90	0.588*	0.463
	In first differences			
	t-statistic	critical value	test statistic	critical value
∆EGX 30	-5.79*	-2.90	0.09	0.463
∆ Crude Oil	-5.57*	-2.90	0.05	0.463
∆ Egypt Industrial Production	-10.93*	-2.91	0.19	0.463
∆ Egypt Monthly Rates	-5.6*	-2.90	0.09	0.463
∆ Natural Gas	-7.37*	-2.90	0.06	0.463

*implies the rejection of the hypothesis at the 0.05 level.

In first difference, all levels are stationary. Hence, we used the first difference of EGX 30, the first difference of crude oil, the first difference of natural gas, the first difference of Egypt industrial production and the first difference of Egypt monthly rates.

Then we conducted the above mentioned test on the period post December 2010. The outcomes of both tests are made available in Table 3.

Table 3: Unit Root test- ADF and KPSS Test for the period post December 2010.

	ADF Test		KPSS Test	
Null Hypothesis	has a unit root test		is stationary	
	In levels			
	t-statistic	critical value	test statistic	critical value
EGX 30	-0.811	-2.93	0.43	0.463
Crude Oil	-3.19*	-2.93	0.14	0.463
Egypt Industrial Production	-7.5*	-2.93	0.10	0.463
Egypt Monthly Rates	-1.26	-2.93	0.22	0.463
Natural Gas	-1.42	-2.93	0.18	0.463
	In first differences			
	t-statistic	critical value	test statistic	critical value
∆EGX 30	-6.97*	-2.93	0.55*	0.463
∆Crude Oil	-5.18*	-2.94	0.27	0.463
∆ Egypt Industrial Production	-11.64*	-2.93	0.299	0.463
∆ Egypt Monthly Rates	-6.16*	-2.93	0.29	0.463
∆ Natural Gas	-5.52*	-2.93	0.24	0.463

*implies the rejection of the hypothesis at the 0.05 level.

In levels, crude oil and Egypt industrial production are stationary. While in first differences, all data, but EGX30 are stationary. Hence, we tested if the second difference of EGX 30 was stationary. The results are shown in Table 4.

Table 4: ADF and KPSS test on the second difference of EGX 30 for the period post December 2010.

	ADF Test		KPSS Test	
Null Hypothesis	has a unit root test		is stationary	
	t-statistic	Critical value	Test statistic	Critical value
EGX 30 second difference	-8.36	-2.94	0.255	0.463

We worked on the data that was not unit root, that is, covariance stationary. We used the second difference of EGX 30, crude oil, Egypt industrial production, the first difference of Egypt monthly rates and the first difference of natural gas.

Furthermore, cointegration test was done on non-stationary data to ensure that there was no cointegration before using the VAR test. According to the tables above, the cointegration test was conducted on crude oil and natural gas over the entire period.

4.2 Cointegration Test

Two time series are considered as cointegrated if there exists between them a long term financial or economic relationship in such a way that they do not depart from each other without being bound in the long run. Cointegration test was conducted on time series that have unit roots to see if they share a common trend. We used Johansen Cointegration test (H_0: there is no cointegration).

Table 5: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.106905	13.70295	15.49471	0.0915
At most 1	0.026409	2.622886	3.841466	0.1053

Table 6: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.106905	11.08006	14.26460	0.1502
At most 1	0.026409	2.622886	3.841466	0.1053

H_0: there is no cointegration among the two variables. (For both tests same null hypothesis)
For p-value less than 5%, we rejected the null hypothesis. For p-value more than 5%, we accepted the hypothesis: there is no cointegration.

The tables above show that both trace test and maximum Eigenvalue indicated no cointegration. Our variables, natural gas and crude oil are not correlated in the long run. This implies that VAR model can be conducted on all the variables.

4.3 GARCH Model

The most common type of error in any financial data is heteroskedasticity, meaning that the variance of the errors differs across observations. This can lead to mistakes in drawing conclusions. Hence, the outcome of our model would be unreliable. Thus, corrections were made for conditional heteroskedasticity.

In our empirical paper, we employed the GARCH (1, 1) model in order to capture the features of volatility available in natural gas and oil prices. GARCH time series models are widely used in econometrics and finance because it best models the non constant volatility.

Let us consider a GARCH (1, 1) model:

$$\text{Log}_{t} = C + C_1 \log_{t-1} + \epsilon$$
$$\sigma_t\text{\^{}}2 = \alpha_0 + \alpha_1\, \varepsilon_{t-1}\text{\^{}}2 + \alpha_2\, \sigma\text{\^{}}2_{t-1}$$
$$\text{GARCH} = C_3 + C_4{*}\text{RESID}_{-1}\text{\^{}}2 + C_5{*}\text{GARCH}_{-1}$$

Our GARCH equation is technically the equation of variance, here the dependent variable. It represents the volatility of crude oil price or natural gas price.

The GARCH model is at its best when it meets the three following conditions:

1. There is no serial correlation. We want to make sure that there is no relationship between a given variable and itself over various time intervals.

2. The residuals are normally distributed. This test is made available via the Jarque-Bera test. It is used to see if the sample has the skewness and kurtosis matching a normal distribution.
3. The residuals have no ARCH effect. It can be done by regressing the squared residuals of our time series.

The GARCH model for oil covering the whole period meets two of the three conditions. Hence, its results aren't that credible. While for the periods prior and post the start of the Arab spring taken separately all three conditions have been met.

4.4 VAR (Vector AutoRegressive) Model

An unrestricted VAR is generated to discover the relationship between the variables, that is, interest rates, crude oil prices, natural gas prices, industrial production and equity index price. We extracted three tables, one for each period. In VAR, the order in which the variables are placed and the right length of the lag are very important. Using the Choleski factorization, the interest rates are placed first followed by crude oil prices, natural gas prices, industrial production, and index price. The lag order is four as recommended by Akaike Information Criterion.

We should first start with the VAR for the whole period:

D(EGX 30)= C + β_1 Egypt rates$_{t-1}$+β_2 Egypt rates$_{t-2}$+ β_3 Egypt rates$_{t-3}$+ β_4 Egypt rates$_{t-4}$ + β_5 D(crude oil)$_{t-1}$ + β_6 D(crude oil)$_{t-2}$ + β_7 D(crude oil)$_{t-3}$ + β_8 D(crude oil)$_{t-4}$+ β_9 D(natural gas)$_{t-1}$+ β_{10} D(natural gas)$_{t-2}$+ β_{11} D(Natural gas)$_{t-3}$+ β_{12} D(natural gas)$_{t-4}$ + β_{13} D(EGX 30)$_{t-1}$ + β_{14} D(EGX 30)$_{t-2}$ + β_{15} D(EGX 30)$_{t-3}$ + β_{16} D(EGX 30)$_{t-4}$ + β_{17} (Industrial Production)$_{t-1}$ + β_{18} (Industrial Production)$_{t-2}$+ β_{19} (Industrial Production)$_{t-3}$+ β_{20} (Industrial Production)$_{t-4}$.

Table 7: VAR Estimates for the whole period.

	egypt_rates	D(crude_oil)	D(nat_gas)	D(EGX_30)	ind_prod
egypt_rates(-1)	1.046379	-2.004566	0.138619	-486.3454	0.410012
egypt_rates(-2)	-0.003709	-1.423069	-0.736284	176.5047	5.166908
egypt_rates(-3)	0.186721	0.937857	0.530708	-125.4854	-12.19878
egypt_rates(-4)	-0.292526	1.561987	-0.114071	385.3770	5.470823
D(crude_oil(-1))	0.000437	0.138501	-0.020938	**-8.87218**	-0.025738
D(crude_oil(-2))	-0.000383	-0.064358	-0.012284	**5.003542**	-0.059979
D(crude_oil(-3))	0.001579	-0.028247	0.003434	**-1.891551**	-0.021245
D(crude_oil(-4))	0.004738	-0.082753	0.006086	**-12.23321**	-0.354859
D(nat_gas(-1))	0.086029	0.267295	-0.028341	**85.98410**	-1.000304
D(nat_gas(-2))	-0.006395	0.978280	-0.059387	**136.1630**	0.173635
D(nat_gas(-3))	0.053909	0.595652	0.038778	**72.10151**	-0.149029
D(nat_gas(-4))	-0.030907	0.586107	0.012909	**124.2255**	1.206349
D(EGX_30(-1))	-6.85E-05	0.000213	5.19E-06	0.161953	0.001696
D(EGX_30(-2))	-9.45E-07	0.001128	0.000255	-0.230217	0.000416
D(EGX_30(-3))	-6.34E-05	0.001179	0.000204	0.172520	-0.001026
D(EGX_30(-4))	2.34E-05	0.000357	5.92E-05	-0.08886	0.004557
ind_prod(-1)	-0.004037	0.068814	-0.017677	12.24468	-0.21486
ind_prod (-2)	0.008068	0.007402	-0.006336	-10.72147	-0.124193
ind_prod(-3)	0.001265	0.082883	-0.002212	12.47661	-0.294597
ind_prod(-4)	0.004178	-0.016962	0.016317	-6.537369	-0.202671
C	0.563140	8.643711	1.538887	483.5687	11.62650

The results in the table above indicate a positive relation between changes in natural gas and variation in the Egyptian stock index over the four time lags. While the relation between the Egyptian stock market and the remaining variables fluctuate over the four time lags that are presented.

Now, we move to the VAR model prior to the Arab spring:

D(EGX 30)= C + β_1 D(Egypt rates)$_{t-1}$+β_2 D(Egypt rates)$_{t-2}$+ β_3 D(Egypt rates)$_{t-3}$+ β_4 D(Egypt rates)$_{t-4}$ + β_5 D(crude oil)$_{t-1}$ + β_6 D(crude oil)$_{t-2}$ + β_7 D(crude oil)$_{t-3}$ + β_8 D(crude oil)$_{t-4}$+ β_9 D(natural gas)$_{t-1}$+ β_{10} D(natural gas)$_{t-2}$+ β_{11} D(Natural gas)$_{t-3}$+ β_{12} D(natural gas)$_{t-4}$ + β_{13} D(EGX 30)$_{t-1}$ + β_{14} D(EGX 30)$_{t-2}$ + β_{15} D(EGX 30)$_{t-3}$ + β_{16} D(EGX 30)$_{t-4}$ + β_{17} (Industrial Production)$_{t-1}$ + β_{18} (Industrial Production)$_{t-2}$+ β_{19} (Industrial Production)$_{t-3}$+ β_{20} (Industrial Production)$_{t-4}$.

Table 8 : VAR Estimates for the period prior to the Arab spring

	D(egypt_rates)	D(crude_oil)	D(natural_gas)	D(ind_prod)	D(EGX_30)
D(egypt_rates(-1))	0.031198	0.418917	0.566956	0.620400	-255.0882
D(egypt_rates(-2))	0.004390	-1.807735	-0.358039	3.374415	-563.147
D(egypt_rates(-3))	0.367520	-5.496601	0.272142	-9.598051	-578.5931
D(egypt_rates(-4))	0.274291	-1.879223	-0.808811	2.521425	19.38841
D(crude_oil(-1))	-0.001006	0.073153	-0.038139	-0.010488	**-22.79039**
D(crude_oil(-2))	-0.00068	-0.068166	-0.011967	-0.080856	**2.046161**
D(crude_oil(-3))	0.005991	0.031563	-0.00541	-0.153587	**0.006084**
D(crude_oil(-4))	0.009482	-0.239095	0.009558	-0.275408	**-16.27112**
D(natural_gas(-1))	0.087367	0.536067	-0.003286	-0.908589	**171.3088**
D(natural_gas(-2))	0.009738	0.855687	-0.09209	0.839744	**177.0946**
D(natural_gas(-3))	0.040205	0.366831	0.086180	0.781403	**107.5132**
D(natural_gas(-4))	-0.050634	0.898573	0.000850	1.919939	**145.5467**
ind_prod(-1))	-0.003048	0.007067	-0.037684	-0.82783	5.773934
ind_prod(-2))	-0.004142	-0.027322	-0.033903	-0.454978	4.053182
ind_prod(-3))	-0.002522	0.030168	-0.026662	-0.656823	30.22645
ind_prod(-4))	0.003988	-0.02661	-0.001655	-0.491728	12.20862
D(EGX_30(-1))	-0.0000257	0.000360	4.58E-05	1.62E-05	0.243532
D(EGX_30(-2))	2.03E-05	0.003170	0.000327	-0.000876	-0.192602
D(EGX_30(-3))	-0.0000176	0.001318	0.000430	-0.001289	0.145067
D(EGX_30(-4))	6.21E-05	0.001430	5.55E-05	0.003861	0.011260
C	0.004473	0.379991	-0.160938	0.276570	66.46907

The results in the table above indicate a positive relation between changes in natural gas and variation in the Egyptian stock index over the four time lags. In addition, we have a positive relation between the Egyptian stock index and the Egyptian industrial production while the relation between changes in the Egyptian stock market and the remaining variables fluctuate over the four time lags that are presented.

We now finally move to the VAR for the period post December 2010:

D(EGX 30,2)= C + β_1 D(Egypt rates)$_{t-1}$+β_2 D(Egypt rates)$_{t-2}$+ β_3 D(Egypt rates)$_{t-3}$+ β_4 D(Egypt rates)$_{t-4}$+ β_5 D(crude oil)$_{t-1}$ + β_6 (crude oil)$_{t-2}$ + β_7 (crude oil)$_{t-3}$ + β_8 (crude oil)$_{t-4}$+ β_9 D(natural gas)$_{t-1}$+ β_{10} D(natural gas)$_{t-2}$+ β_{11} D(Natural gas)$_{t-3}$+ β_{12} D(natural gas)$_{t-4}$+ β_{13} D(EGX 30,2)$_{t-1}$ + β_{14} D(EGX 30,2)$_{t-2}$ + β_{15} D(EGX 30,2)$_{t-3}$ + β_{16} D(EGX 30,2)$_{t-4}$ + β_{17} (Industrial Production)$_{t-1}$ + β_{18} (Industrial Production)$_{t-2}$+ β_{19} (Industrial Production)$_{t-3}$+ β_{20} (Industrial Production)$_{t-4}$.

Table 9: VAR Estimates from December 2010 till May 2014.

	D(egypt_rates)	crude_oil	D(nat_gas)	ind_product	D(EGX_30,2)
D(egypt_rates(-1))	0.022135	-4.84509	-0.719251	-12.01657	-575.682
D(egypt_rates(-2))	-0.053089	1.948392	-0.299729	1.472610	996.6362
D(egypt_rates(-3))	0.169948	7.481093	-0.580044	-9.054182	103.6929
D(egypt_rates(-4))	-0.022465	-3.228858	-0.139281	-6.56761	-269.8932
crude_oil(-1)	-0.01538	0.925687	-0.023374	-0.046098	**26.91244**
crude_oil(-2)	0.003432	-0.334109	-0.007526	-0.072354	**-23.22139**
crude_oil(-3)	-0.010466	-0.091113	0.017991	-0.01211	**-12.83778**
crude_oil(-4)	-0.002024	0.082239	-0.02142	-0.276177	**16.31813**
D(natural_gas(-1))	0.114133	-3.110842	-0.009355	-7.271812	**-222.0767**
D(natural_gas(-2))	-0.296274	2.662244	-0.144298	4.426370	**137.8002**
D(natural_gas(-3))	0.162396	-3.661271	-0.295484	-4.17594	**-1.545344**
D(natural_gas(-4))	-0.266513	3.351097	0.119173	-2.637243	**-208.1373**
ind_prod(-1))	-0.007473	0.205103	-0.002586	-0.034289	23.13211
ind_prod(-2))	0.016874	0.089281	-0.013281	0.039991	-22.43775
ind_prod(-3))	0.001482	-0.028632	0.017422	-0.026598	1.241047
ind_prod(-4))	0.004024	-0.081455	-7.91E-05	-0.016159	-13.05929
D(EGX_30(-1),2)	-4.89E-05	-0.000626	0.000208	-0.001092	-0.710552
D(EGX_30(-2),2)	2.44E-05	-0.000809	7.01E-05	-0.002956	-0.685931
D(EGX_30(-3),2)	-3.20E-05	0.001426	0.000191	-0.003791	-0.310188
D(EGX_30(-4),2)	3.94E-06	-0.00122	0.000103	0.003242	-0.198512
C	2.338155	40.12830	3.277325	39.94578	-645.2238

The relation between the second difference in the Egyptian stock market and the remaining variables fluctuate over the four time lags that are presented.

Table 10: Relationship Between the EGX and all the variables over the three time periods

	NG	Oil	Industrial Production	Other Variables
Whole Period	+	Fluctuates	Fluctuates	Fluctuates
Prior to the Arab Spring	+	Fluctuates	+	Fluctuates
Post the Arab Spring	Fluctuates	Fluctuates	Fluctuates	Fluctuates

4.5 Variance Decomposition

The variance decomposition provides information about the relative importance of each random in affecting the variables in the VAR. We mainly tried to determine the main variables that affect the variation of EGX 30 in the VAR model over the three periods.

Table 11: Variance Decomposition of D(EGX_30) for the entire period.

Period	egypt_rates	D(crude_oil)	D(natural_gas)	egypt_industrial_product	D(egx_30)
1	6.786940	9.848016	0.082260	0.094545	83.18824
2	10.48854	8.918105	2.130218	2.561549	75.90158
3	10.86474	8.453228	3.065794	4.485685	73.13055
4	13.12237	8.074882	3.489308	4.684436	70.62900
5	14.98390	9.280289	3.570562	5.452782	66.71247
6	14.83881	9.966514	3.511197	5.821355	65.86212
7	15.59026	9.872197	3.690767	5.752818	65.09396
8	15.69134	9.894701	3.728927	5.733577	64.95145
9	15.70576	9.885720	3.722569	5.742096	64.94386
10	15.67465	9.871876	3.768457	5.751982	64.93304
Cholesky Ordering: egypt_rates D(crude_oil) D(natural_gas) egypt_industrial_product D(egx_30)					

According to the variance decomposition in Table 11, we can state that: in period one, shock to difference in EGX 30 cause 83.19% fluctuations in the difference in EGX 30, while shocks in crude oil accounts for 9.8% for fluctuations in the difference in EGX 30. In period 7 for instance, shock to difference in EGX 30 cause 65.09% fluctuations in the difference in EGX 30, while shocks in crude oil accounts for 9.87% for fluctuations in the difference in EGX 30. The analysis done for the whole period shows that the EGX 30 own shocks explain most of the fluctuations in the EGX 30 itself.

Table 12: Variance Decomposition of D(EGX_30) prior to the Arab spring

Period	D(egypt_rates)	D(crude_oil)	D(natural_gas)	D(egypt_industrial_product)	D(egx_30)
1	16.25039	18.35684	0.005473	2.583367	62.80393
2	16.17370	15.95359	7.916085	3.095582	56.86105
3	15.90156	14.51222	14.15616	3.250254	52.17981
4	19.58795	13.07552	13.37469	7.447859	46.51398
5	19.06183	14.65197	13.17121	7.485348	45.62964
6	18.88636	15.10174	13.24203	7.719387	45.05049
7	22.16850	15.15751	12.43429	7.567492	42.67221
8	22.02173	15.67843	12.38522	7.726452	42.18816
9	21.64435	15.43364	12.73948	8.749542	41.43299
10	21.26588	15.24086	13.51735	8.879742	41.09616
Cholesky Ordering: D(egypt_rates) D(crude_oil) D(natural_gas) D(egypt_industrial_product) D(egx_30)					

According to the variance decomposition in table 12, we can state that: in period one, shock to difference in EGX 30 cause 62.80% fluctuations in the difference in EGX 30, while shocks in crude oil accounts for 18.35% for fluctuations in the difference in EGX 30. In period 7 for instance, shock to difference in EGX 30 cause 42.67% fluctuations in the difference in EGX 30, while shocks in crude oil accounts for 15.16% for fluctuations in the difference in EGX 30 and shocks in natural gas accounts for 12.43% for fluctuations in the difference in EGX 30.

The analysis done on the period prior to the start of the Arab spring shows that the effect of the EGX 30 on its own variation has decreased and shed the light on the importance of other variables namely crude oil, natural gas and Egypt monthly rates on the variation of the EGX 30.

Table 13: Variance Decomposition of D(EGX_30,2) from December 2010 till May 2014.

Period	D(Egypt rates)	Crude oil	D(natural_gas)	Egypt industrial product	D(egx_30,2)
1	0.778166	15.80698	2.373503	0.453875	80.58747
2	1.224810	9.421862	5.861819	14.35507	69.13644
3	10.96521	6.623770	4.207534	29.19373	49.00976
4	8.954890	10.99853	15.23182	23.80147	41.01329
5	15.21013	8.884963	23.94977	18.64745	33.30769
6	19.11001	9.039880	23.36741	17.75024	30.73245
7	18.82078	8.897712	23.41207	17.67249	31.19695
8	18.42476	9.884450	23.67466	17.41917	30.59696
9	18.53900	9.833083	23.94767	17.33683	30.34341
10	18.56812	9.845689	24.32349	17.04090	30.22179
Cholesky Ordering: D(egypt_rates) crude_oil D(natural_gas) egypt_industrial_product D(egx_30,2)					

According to the variance decomposition in Table 13, we can state that: in period one, shock to difference in EGX 30 cause 80.59% fluctuations in the difference in EGX 30, while shocks in crude oil accounts for 15.80% for fluctuations in the difference in EGX 30. In period 7 for instance, shock to difference in EGX 30 cause 31.20% fluctuations in the difference in EGX 30, while shocks in crude oil accounts for 8.89%% for fluctuations in the difference in EGX 30 and shocks in natural gas accounts for 23.41% for fluctuations in the difference in EGX 30. The analysis for the period ranging from December 2010 till May 2014 stresses on the importance of the effect of natural gas on the fluctuations of the EGX 30.

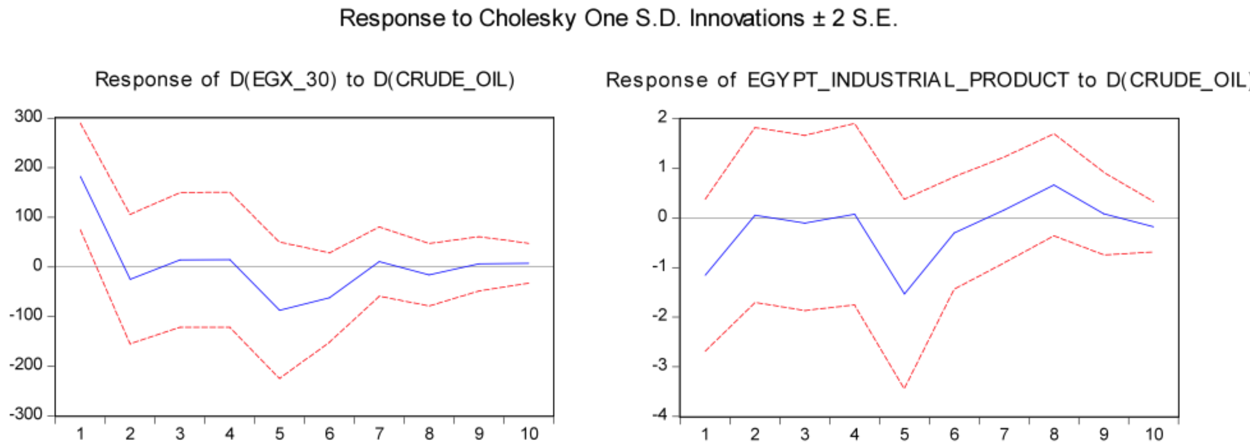
4.6 Impulse Responses

A shock to oil and natural gas will not only directly affect commodities prices, but will also be transmitted to all of our endogenous variables through the dynamic structure of the VAR. An impulse response function traces the effect of a onetime shock on the current and future values of the variables. First, we conducted a one-time positive oil and gas shocks on the whole range and checked the results. Later on, we stimulated those shocks on the two timelines, that is, prior and post Arab spring.

Figure 1 presents the response for oil price shocks on our entire timeline. The graph shows that shocks on oil prices have a positive impact on the Egyptian stock index for the first 45 days. The index shows a small positive return on the 3rd month. Afterwards, the returns are genuinely negative.

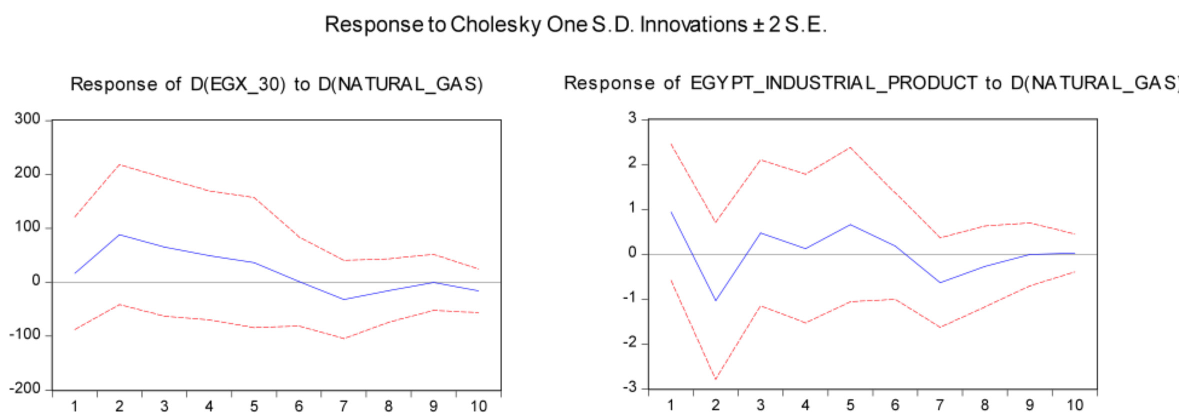
While oil price shocks have a negative impact on the industrial production of Egypt for the first six month, this result is in line with the work done by Uri (1996). He found that positive oil shocks lowers industrial production due to the increase of production costs. This observation is true for all the remaining periods.

Figure 1: Crude Oil shock over the entire period



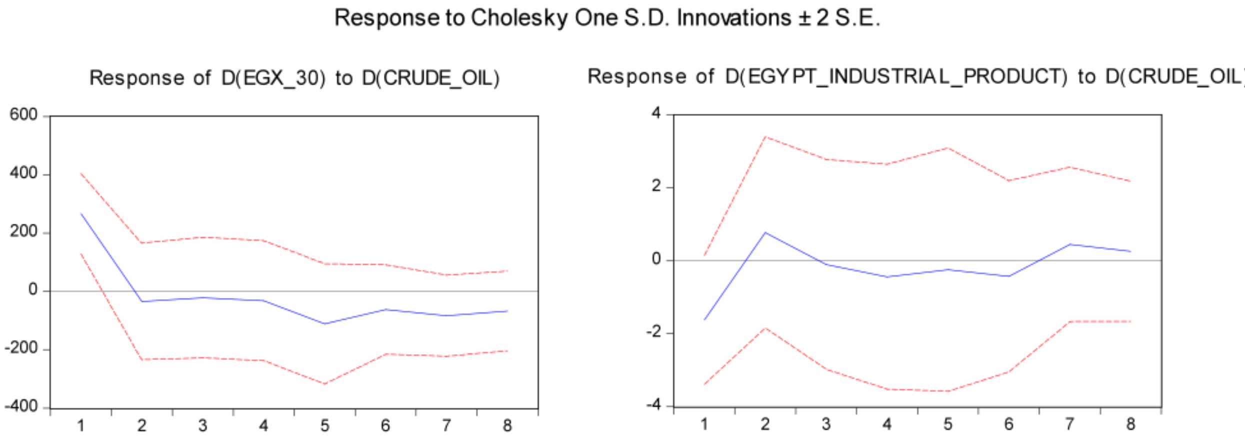
We then stimulated a one-time shock of natural gas given the entire period. Figure 2 presents the response of that shock. The graph shows that these shocks have a positive impact on the Egyptian stock index for the first five months. Afterwards, the returns are negative. It should be noted that this one-time shock has a choppy reaction over the industrial production.

Figure 2: Natural Gas shock over the entire period



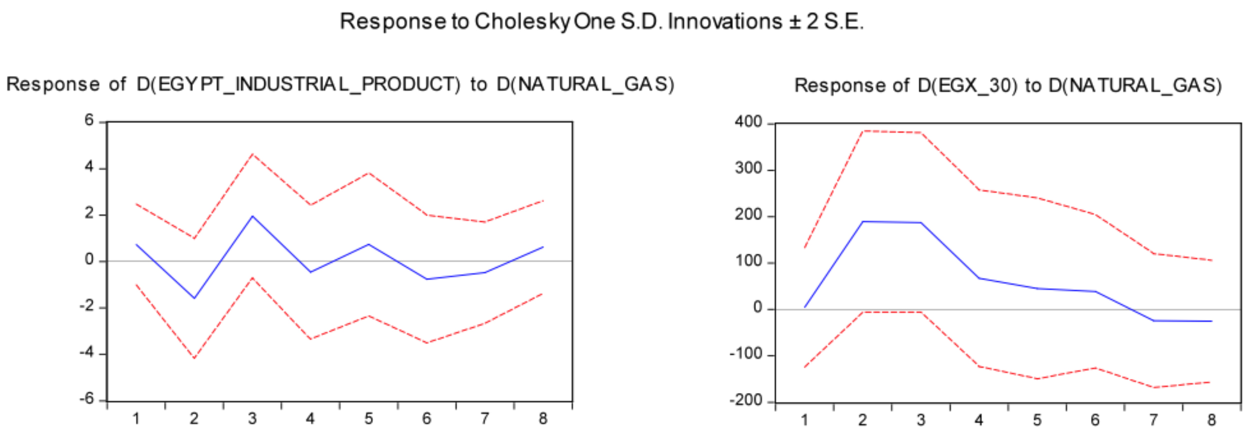
After that, we applied both shocks over the period prior to the start of the Arab spring. Figure 3 presents the response for oil price shocks on the timeline going from June 2005 till December 2010. Our graph shows that shocks on oil prices have a positive impact on the Egyptian stock index for the first 45 days. Afterwards, the returns are negative. This is in line with the work of Parjitno (2011) who obtained similar response in the US equity market given an oil price shock.

Figure 3: Crude Oil shock prior to December 2010.



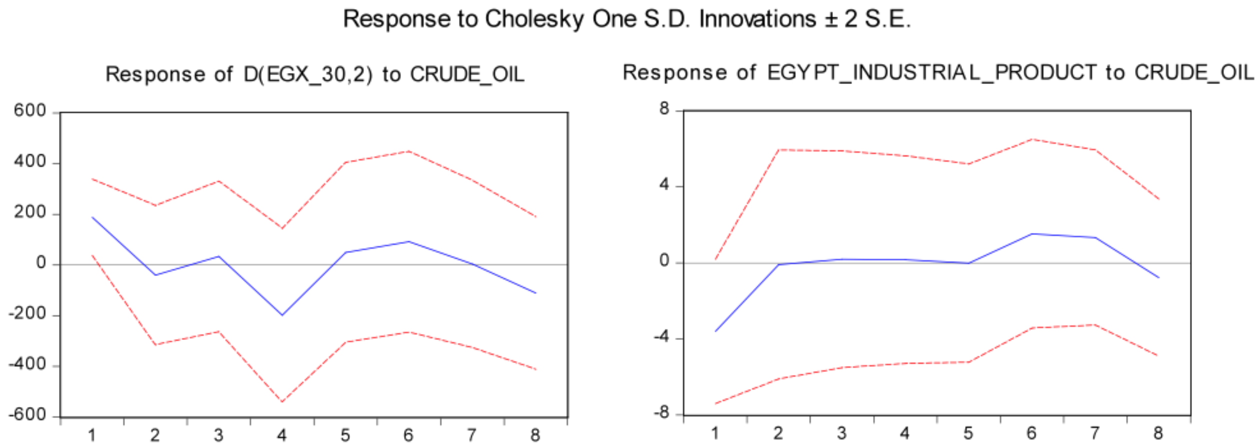
As shown in figure 4, shocks in natural gas have a positive impact on the Egyptian stock market. This positive effect endures for a period of six months. Later on, the market exhibits a negative performance. The natural gas shock has a choppy effect on the variation of Egypt industrial production.

Figure 4: Natural Gas shock prior to December 2010.



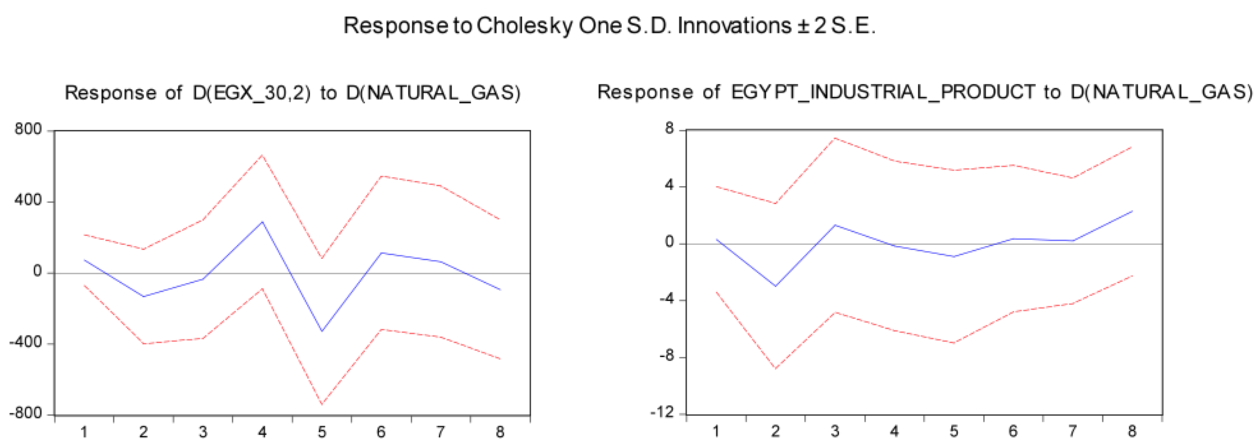
Then we applied these one-time price shocks for the period that starts in December 2010.
The stock market performance due to that positive oil shock is choppy. The index exhibits a positive return for the first 45 days, a negative return over a period of 15 days, a positive return for a period of 15 days, a negative return for a period of 2 months, a positive return for a period of three months and finally, a negative return during the last month.

Figure 5: Crude Oil shock for the period post December 2010.



The effect of natural gas price shocks on the period going from December 2010 till March 2014 is shown in Figure 6. The Egyptian stock market reaction is also a choppy one. The stock market exhibits several shifts from positive to negative returns.

Figure 6: Natural Gas shock for the period post December 2010.



5. Conclusions

This paper studies the effect of positive energy price shocks on the stock market of an energy producing country under uncertainty. It extends the existing literature to a new empirical framework, Egypt, a developing and energy-producing country which witnessed instability due to the political shocks created by the Arab spring uprising.

What this research did was to present direct empirical evidence on the subject, providing a reliable source of information for researchers and analysts looking to understand how equities markets are affected by energy price shocks. To do so, it took advantage of the conditions that the uprisings created to be able to apply the formulated hypothesis.

Our paper discusses the dynamic interactions among the price of crude oil, the price of natural gas, Egypt's monthly rates, Egypt's monthly industrial production and its stock index. More precisely, we studied the effect of oil price shocks and the effect of natural gas price shocks on the Egyptian stock market via using the vector autoregressive model (VAR). At first, we applied the VAR model on the timeline ranging from June 2005 till March 2014. Later on, we divided this timeline into two: one prior to the start of the Arab spring and the other post that date.

The VAR model is made more transparent via the variance decomposition analysis and the impulse responses. The variance decomposition analysis was done on the three timelines. The analysis for the whole period showed that EGX 30's own shocks explain most of the fluctuation in the EGX itself. The analysis for the period prior to the start of the Arab spring showed that the effect of the EGX on its variation has decreased and it shed some light on the importance of the other variables, that is, crude oil, natural gas and Egypt monthly rates on the EGX 30's fluctuation. The analysis for the period ranging from December 2010 onward stresses on the importance of natural gas on the fluctuations of the EGX 30.

Furthermore, the impulse responses over the separate timelines indicate that a positive oil shock leaves a negative impact on the industrial production of Egypt. Unlike positive oil shock, positive natural gas shock has a positive impact on the stock market of an energy-producing country. Dividing our timeline into two provided a clearer picture: First, prior to the start of the Arab spring, an oil price shock effect on the Egyptian stock market is similar to the reaction of a developed country's stock market, while a positive natural gas shock creates a positive reaction on the stock market of Egypt, a main supplier of natural gas. Second, post the start of the Arab spring, a positive oil or natural gas shock leaves the Egyptian stock market in a blurry performance. The Arab spring had a blurry impact on the Egyptian equity index and increased its volatility.

The findings of this paper contribute to the academic literature on the effect of energy shocks on emerging markets vis-a-vis industrial markets in the context of uncertainty. It would also help investors and conglomerates forecast and better manage their equity investments.

The main challenge encountered by this study and that acted as a limitation to this research is the fact that we were unable to source any historical data relating to Egypt's equities market. The Central Bank of Egypt, as well as other local financial authorities, does not provide historical data, specifically from previous energy price shock periods. That being said, our research had to rely entirely on the recently released data. We could have increased the robustness of our model via taking into account historical data.

Although the questions that were raised at the beginning of this paper were thoroughly analyzed and answered throughout our study, this analysis opens the door for further research, such as the study of the effect of a negative energy price shock in a deflationary environment on the economic condition of an energy-producing country.

References

Bernanke, B.S. 1983. “Irreversibility, Uncertainty and Cyclical Investment”, *Journal of Economics*, vol. 97, no. 1, pp. 85-106.

Burbidge, J. and A. Harrison. 1984. “Testing for the Effects of Oil Price Rises Using Vector Autoregressions”. *International Economic Review,* Vol. 25, No. 2, pp. 459-484.

Cong, R.G., Shen, S. 2013 “Relationships among Energy Price Shocks, Stock Market, and the Macroeconomy: Evidence from China”, The *Scientific World Journal*, Published 9 April 2013.

Cong, R.G., Yi-Ming Wei, Jian-Lin Jiao, and Ying Fan. 2008. “Relationships between Oil Price Shocks and Stock Market: An Empirical Analysis from China”. *Energy Policy*, Vol. 36, pp 3544-3553.

Dias, F.C. 2013. “Oil price shocks and their effects on economic activity and prices: an application for Portugal”. *Economic Bulletin and Financial Stability Report Articles*, Summer 2013, pp 39-48.

Ferderer, J.P. 1996. “Oil Price Volatility and the Macroeconomy”. *Journal of Macroeconomics*, vol. 18, issue 1, pp 1-26.

Guo, H. and K. L. Kliesen. 2005. “Oil Price Volatility and U.S. Macroeconomic Activity”. *Federal Reserve Bank of St. Louis Review*, vol. 87, issue 6, pp 669-683.

Hamilton, J.D. 1983. “Oil and the macroeconomy since World War II”. *Journal of Political Eonomy, vol.* 91, no. 2, pp 228-248.

Henriques, I. and P. Sadorsky. 2011. “The Effect of Oil Price Volatility on Strategic Investment”. *Energy Economics,* vol. 33, issue 1, pp 79-87.

Jones CM, Kaul G. 1996 “Oil and the stock markets.” *Journal of Finance*, vol.51, no.2, pp 463-491.

Narayan, P.K. and S. Narayan. 2010. “Modelling the Impact of Oil Prices on Vietnam’s Stock Prices”. *Applied Energy,* vol. 87, no.1, pp 356-361.

Papapetrou, E. 2001. “Oil Price Shocks, Stock Market, Economic Activity and Employment in Greece”. *Energy Economics*, vol. 23, issue 5, pp 511-532.

Park, J. and R. A. Ratti. 2008. “Oil Price Shocks and Stock Markets in the US and 13 European Countries”. *Energy Economics*, vol. 30, pp 2587-2608.

Prajitno, O., 2011. “The effect of Oil Price Volatility on the US stock market” Thesis Paper, Erasmus University, Rotterdam.

Rafiq, S., Ruhul S., and H. Bloch. 2009. “Impact of Crude Oil Price Volatility on Economic Activities: An Empirical Investigation in the Thai Economy”. *Resources Policy*, vol 34, no 3, pp 121-132.

Sadorsky, P. 1999. “Oil Price Shocks and Stock Market Activity”. *Energy Economics*, vol 21, issue 2, pp 449-469.

Uri, N.D. 1980. “Energy as a Determinant of Investment Behavior”. *Energy Economics*, vol 2, issue 3, pp 179-183.

U.S. Energy Information Administration (E.I.A), *What are the major factors affecting natural gas prices?*, viewed 6 June 2014 <http://www.eia.gov/tools/faqs/faq.cfm?id=43&t=8>.

U.S. Energy Information Administration(E.I.A), *What drives crude oil prices?*, viewed 6 June 2014 <http://www.eia.gov/finance/markets/reports_presentations/eia_what_drives_crude_oil_prices.pdf >.