International Journal of Maritime, Trade & Economic Issues *pp. 49-58*
Volume I, Issue (1), 2013

The Oil Price Effects in the Greek Stock Market

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Abstract:
This paper investigates the effects between the Greek stock market returns and the oil price during a period in which the oil prices have been increasing. We employ a VAR model in conjunction with Granger-causality tests and we investigate the interactions among the stock market returns, the volatility of the stock market price index, the oil returns and the volatility of oil prices. The empirical evidence supports the existence of significant causal effects running from oil price returns and volatility of oil prices towards the stock market.

Key Words:
Stock market, oil price effects

***JEL Classification**: C50, L16*

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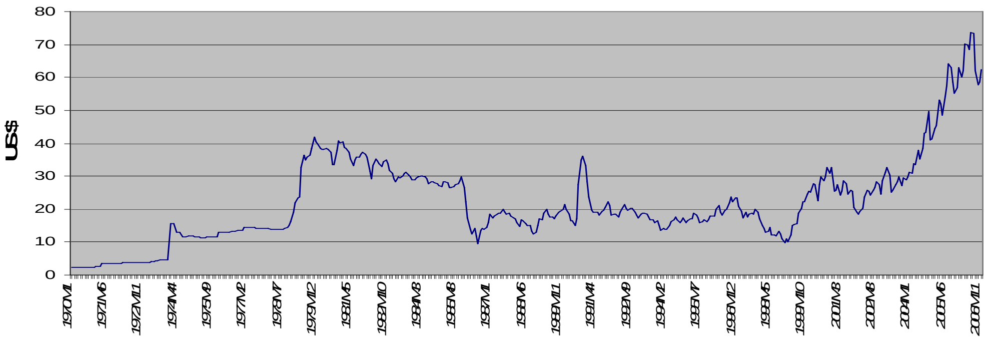
1. Introduction

Throughout the past decades, oil prices have had a prominent role in modulating the economic and political situation in the developed countries. A considerable part of the international literature has been devoted to the study of energy and more particularly to the effects of oil prices on stock markets.

The oil price crises of the 1970's have created major aggregate supply shocks in the world economy. Indeed, the price per barrel increased from US$ 2.45 in 1972 to US$ 11.25 in 1974 and it reached 31.5 dollars in 1980 (Figure 1).

Figure 1: Oil price per barrel from 1970 until 2007 (expressed in US $)



The respective international literature, primarily, has attempted to identify the effects of changes in international oil prices on certain macroeconomic variables, such as, GDP growth rates, inflation and exchange rates (Hamilton, 1983; Mork, 1989 among others). Fewer researchers have attempted to focus on the effects of oil-price changes on asset prices, such as stock prices or stock returns and cover regional economies. In this paper, we intend to cover this gap and contribute further to the economic literature as the paper by shedding light on the relationship between the above mentioned variables. It also focuses on the Greek stock market, which has not been covered sufficiently in the existing literature. The majority of the literature finds evidence of negative relationship between the oil price returns, the oil price volatility, the stock market returns volatility and the stock market returns. Nonetheless, it is interesting to examine how the above mentioned variables react within the frame of the Greek economy. The fact that the Greek stock index is heavily composed of oil related companies or oil holding companies produce results that differ from the majority of the literature and indicate different policy implications. The nature of the stock market returns and its volatility are likely to reveal positive relationship with the oil price returns and its volatility.

The rest of the paper is organized as follows: In the next section we present the literature review that deals with the relationship between the oil prices index and the stock market performance. In the section that follows we present the data, the empirical methodology and the results that have been obtained. Finally, in the last section we present the concluding remarks.

2. Literature review

Despite the fact that most empirical studies focus on the relation between economic activity and oil price index changes, it is staggering that only few studies have been conducted on the relationship between financial markets and oil price shocks. If oil prices affect real GNP, it will affect earnings of companies for which oil is a direct or indirect operational cost. Thus, an increase in oil prices will cause expected earnings to decline, and this will bring about an immediate decrease in stock prices if the stock market efficiently capitalizes the cash flow implications of the oil price increase. Jones and Kaul (1992) examine the effect of oil prices on stock prices. They detect significant effect of oil prices on aggregate real stock returns, including a lagged effect, for the period 1947 to 1991. Their paper has a macroeconomic focus, using quarterly data and employing the Producer Price Index for fuels to proxy the oil price index. Jones and Kaul (1996) use quarterly data to test whether the reaction of international stock markets to oil shocks can be justified by current and future changes in real cash flows and hence the changes in expected returns. Using a standard cash-flow dividend valuation model they find that the reaction of Canadian and U.S. stock prices to oil price shocks can be completely accounted for the impact of these shocks on the real cash flows. The results for Japan and the UK are, however, not as strong. Papapetrou (2001) attempts to shed light into the dynamic relationship among oil prices, real stock prices, interest rates, real economic activity and employment in Greece, by employing a multivariate vector autoregression (VAR) approach. The empirical evidence suggests that oil price changes affect real economic activity and employment while stock returns do not lead to changes in real activity and employment. Oil prices are important in explaining stock price movements. The results show that a positive oil price shock depresses real stock returns. Sadorsky (1999) suggests that there is an interaction between oil prices, oil price volatility and stock market returns. He shows that oil price movements are important in explaining movements in the stock returns in the U.S. market. Huang, Masulis and Stoll (1996) investigate the impact of oil price shocks on the U.S. equity market from a financial markets perspective. Within the framework of a vector autoregression (VAR) model, they examine dynamic interactions between daily oil futures returns and stock returns. Thalassinos and Politis (2012) have analyzed USD currency and oil prices using (VAR) model. Moreover, a study by Maghyereh (2004) reveals that oil prices shocks have no important significance on stock index returns. He examines the dynamic linkages between crude oil price shocks and stock market returns in 22 emerging economies. The vector autoregression (VAR) analysis is carried out by using daily data covering the period between 1/1/1998 and 31/4/2004. Inconsistent with prior research on developed economies, the findings imply that oil shocks have no significant impact on stock index returns in emerging economies. The results also suggest that stock market returns in these economies do not rationally signal shocks in the crude oil market. Some studies have also dealt with the lead-lag relationship between spot and futures for the oil market. Bopp and Sitzer (1987) tested the hypothesis that futures prices are good predictors of spot prices in the heating oil market, and found that, even when crude oil prices, inventory levels, weather, and other important variables were accounted for, futures prices still have a significant positive contribution in describing past price changes. Concerning the oil price volatility, most studies have attempted to model the oil price shocks by using GARCH models. Hwang, Yang, Huang and Ohta (2004), after modelling the oil price volatility with the aid of a GARCH model; they constructed a VAR model and examined the Granger Causal effects between oil price volatility, exchange rates, stock market returns, inflation and industrial production. They focus on Canada, Italy, Germany, the U.S, the U.K. and Japan. They concluded that the volatility of oil price changes leads to negative stock returns in three out of six cases while it affects the industrial production in just two cases.

Hamilton (1983) argues that oil price shocks were responsible, at least partly, for every U.S. recession in the post-World War II period. Many other studies, such as Loungani (1986), Gisser and Goodwin (1986), Mork (1989) and Lee, Ni and Ratti (1995), report similar conclusions, using different data and econometric approaches. Mork, Olsen and Mysen (1994) extend these findings to six other industrialized countries: Japan, Germany, Canada, France, the U.S. and Norway. They show that oil price shocks affect the GDP in all these countries, although the effects are stronger for the U. S. Japan and Norway.

The arising interest for the relationship between financial markets and oil price movements is revealed from both the investigation of the relationship between oil price movements and stocks returns and between spot and futures prices. However, only little attention has been paid on the causal relationship between oil spot prices and the Greek Stock Market Index movements. This paper attempts to fill this gap by examining the causal relationship between oil spot prices and the ASE General Index movements.

3. Methodology

3.1 Sample and data collection

For the empirical analysis we use daily data from Bloomberg covering the period between 2004 and 2006. In particular, we use the General Index of the ASE and the crude oil price index. Both are used in logarithmic form and are denoted as LSP and LOP respectively. Numerous studies have provided evidence that the variance of the stock and oil price returns are time varying and heteroscedastic (Mandelbort, 1963; Fama, 1965; Bollesev, Chou and Kroner, 1992). This implies that if one ignores the time dependent nature of volatility then any inference regarding the impact on volatility may be misleading. Thus, the first step in the empirical analysis is modelling the volatility of the stock market returns and the oil price index returns. A particularly important preliminary problem is the choice of the appropriate methodology to estimate the market volatility since estimates are highly sensitive to the measure of volatility adopted. The ARCH/GARCH modelling techniques are used by the majority of the researchers as the most adequate measure of volatility and hence the same methodology is adopted in this study.

Nelson (1999) proposes the exponential GARCH (EGARCH) model as an extended version of the GARCH model. The EGARCH model allows for asymmetry in the responsiveness of the volatility variables to the sign of the shocks. Secondly, the EGARCH model, specified in logarithms, does not impose the non-negativity constraints on parameters. Finally, the use of logarithms hampers the effects of outliers on the estimation results. We employed log likelihood ratio tests on a EGARCH (p,q) model in order to specify the EGARCH representation of the conditional variance of the stock price returns and the oil price returns at time i as:

$$Logh_i^2 = \beta_0 + \beta_1|\varepsilon_{i-1}|/h_{i-1} + \beta_2\varepsilon_{i-1}/h_{i-1} + \beta_3 Logh_{i-1}^2 \quad (1)$$

It should be mentioned that |εi-1|/hi-1, εi-1/hi-1 and the log of the lagged value of the conditional variance (h2i) is used to explain the behaviour of the conditional variance which hereafter will be denoted by VARLS and VAROIL for the stock market returns and the oil price returns respectively.

More specifically, we constructed our volatility proxies using the conditional variance of returns, which has been retrieved from the maximum likelihood estimation of an EGARCH (0,1).

$$DLSi = \alpha0 + \sum_{i=1}^{p} \alpha iDLSi\text{-}1\ \varepsilon s,i, \qquad \varepsilon i\ |(\varepsilon i\text{-}1\ ,\varepsilon i\text{-}2\ ,\dots\ ) \sim N(0,hi\ ) \qquad (2)$$

$$DLOPi = \alpha0 + \sum_{i=1}^{p} \alpha iDLOPi\text{-}1\ \varepsilon p,i, \qquad \varepsilon i\ |(\varepsilon i\text{-}1\ ,\varepsilon i\text{-}2\ ,\dots\ ) \sim N(0,hi\ ) \qquad (3)$$

where DLS denotes the stock market returns, ε is the error term and equation (2) denotes the conditional mean equation of the returns while DLOP denotes the oil price returns, ε is the error term and equation (3) denotes the conditional mean equation of the returns.

It should also be noted that we have used daily continuing compounded returns. The calculation for the stock market and the oil price returns are presented in equation (4) and (5) respectively.

$$DLS_i = \log\left(LS_i \middle/ LS_{i-1} \right) \tag{4}$$

and

$$DLOP_i = \log\left(LOP_i \middle/ LOP_{i-1} \right) \tag{5}$$

The estimates of the above EGARCH model are presented in Table 1 and Table 2.

Table 1: E-GARCH estimation results with the oil price variable (DLOP) as dependent

Exponential GARCH(0,1) assuming a t distribution			
Dependent variable is DLOP			
Regressor	Coefficient		T-Ratio[Prob]
C	.7960E-3		[.236]
DLOP(-1)	-.050823		[.135]
DLOP(-6)	-.10948		[.002]
DLOP(-12)	.054768		[.104]
DLOP(-13)	.068625		[.038]
DLOP(-19)	.028525		[.400]
DLOP(-21)	-.073257		[.020]
DUMOIL	-.14026		
R-Squared	0.73908	R-Bar-Squared	0.72716
S.E. of Regression	0.006974	F-stat	F(9, 197) 62.0025[.000]
DW-statistic	1.8		
Parameters of the Conditional Heteroscedastic Model			
Explaining the Logarithm of H-SQ, the Conditional Variance of the Error Term			
	Coefficient		Asymptotic Standard Error
Constant	-7.8622		.18
(E/H)(- 1)	-.041930		.002
ABS(E/H)(- 1)-MEU	.064355		.015
D.F. of t-Dist.	3.4623		1.1

Table 2: E-GARCH estimation results with the stock market variable (DLSP) as dependent

Exponential GARCH(0,1) assuming a t distribution		
Regressor	Coefficient	T-Ratio[Prob]
C	.6622E-3	[.123]
DLSP(-1)	.078515	[.056]
DLSP(-13)	.088346	[.024]
DLSP(-12)	-.046848	[.185]
DLSP(-15)	.059973	[.123]
DLSP(-16)	.09181	[.024]

DLSP(-17)	-.086122		[.035]
DLSP(-18)	.070130		[.018]
DLSP(-22)	-.083464		[.036]
DUMOIL	.0030741		[.423]
R-Squared	.61196	R-Bar-Squared	.582295
S.E. of Regression	.010076	F-stat	F(11, 558) 2.1795[.014]
DW-statistic	2.387		

Parameters of the Conditional Heteroscedastic Model
Explaining the Logarithm of H-SQ, the Conditional Variance of the Error Term

	Coefficient	Asymptotic Standard Error
Constant	-9.2217	0.06373
(E/H)(- 1)	-.016907	.0060203
ABS(E/H)(- 1)-MEU	.16079	.077088

Next, we examined the dynamic relationship between stock market returns, oil market returns, stock market volatility and oil price volatility in the framework of a VAR model with only lagged values of the right-hand-side variables in each equation. The model is estimated by ordinary least squares (OLS), and executes Granger causality tests (Granger, 1969) by testing for zero restrictions on subsets of lagged parameters in each equation of the VAR in order to investigate lead-lag relationships between the variables in question (Chatrath, Ramchander and Song, 1995, 1996).

The formulation of the VAR model we used is presented below:

$$DLS_i = a + \sum_{j=1}^{p} \beta_j DLS_{i-j} + \sum_{j=1}^{p} \gamma_j DLOP_{i-j} + \sum_{j=1}^{p} \delta_j VAROIL_{i-j} \sum_{j=1}^{p} z_j VARLS_{i-j} + e_i \quad (6)$$

$$VARLS_i = a + \sum_{j=1}^{p} \beta_j DLS_{i-j} + \sum_{j=1}^{p} \gamma_j DLOP_{i-j} \sum_{j=1}^{p} \delta_j VAROIL_{i-j} + \sum_{j=1}^{p} z_j VARLS_{i-j} + e_i \quad (7)$$

where β,γ,δ and z are parameters, p is chosen on standard statistical grounds, and ei is a white noise error term.

Based on the estimates derived from equations (6) and (7), we performed Granger Causality Tests, in order to detect the possible existence and direction of the causal impacts between stock and oil markets. The results are presented in Table 3.

Table 3: P-values of Granger Causality Test Based on the SEM estimates (Wald X2)

Dependent Variable	DLSP	VARLSP	DLOP	VAROP
DLPS		0.000*	0.015*	0.016*
VARLSP	0.000*		0.302	0.002*

It should be noted that we report only equations with DLS and VARLS as endogenous variables since, by common sense, we do not expect the Greek stock market and its volatility to cause any effect of significant magnitude on the oil price index and its volatility. In short, the findings support the existence of significant causal interactions between stock market and oil market. With regard to the direction of Granger causal effects, we find evidence of strong bi-directional causal effects between stock market returns and stock market volatility. We also find significant causal effects running from oil price returns and oil price volatility towards the stock market returns. Last we detect causal impacts running from the volatility of oil price returns to stock market volatility.

The results obtained are consistent with Jones and Kaul (1996), Sadorsky (1999) and Papapetrou (2001). Our results are possibly justified by the fact that oil companies participate heavily in the calculation of the General index in the ASE. The oil price index and the Athens General Index have followed an almost parallel move from 8/2004 until 9/2006. A possible reason for this parallel movement may be the fact that two of the biggest oil companies, listed in the ASE, participate by more than 5% at the Athens General Index. It should also be noted that the strong gains presented in the balance sheets of the oil companies in Greece affect directly or indirectly the corporate returns of various banks or funds that own shares in these companies. In turn, the increase of the stock prices of these banks or funds directly affect the general index.

We also find evidence that the volatility of oil price has significant causal impacts in the stock market returns as well as on stock market volatility. This may be attributed to the fact that Greek stock market is heavily dependent on oil companies, or companies which hold shares in oil companies. The volatility of the oil price has direct impact on the gains of these companies, and this is reflected on the stock market prices and the stock market volatility.

4. Conclusion and policy implications

We have attempted to investigate the dynamic linkages between the Greek stock market returns and the oil price behaviour. We explored the interactions among stock market returns, the volatility of the stock market index, the oil returns and the oil price index volatility. The approach employed a VAR model in conjunction with Granger-causality tests. The evidence supports the existence of significant positive association between stock market and oil market. With regard to the detection of Granger causal effects, we found evidence of strong bi-directional causal effects between stock market returns and stock market volatility. We also found significant positive causal effects running from oil price index returns and oil price volatility towards the stock market returns. Last, we detected causal impacts running from the volatility of oil price returns to stock market volatility.

The period that has been covered in this study includes high oil prices. This is due to various incidents such as the Gulf war, the increased oil demand from China and India and the low oil reserves that have been reported by the U.S. government. It is likely that when these reasons cease the oil prices will fall. In such case listed companies may find it hard to fund their expansion using collateral instruments such as their own stocks. On the other hand, when oil prices increase, listed companies will benefit from the positive association between the oil prices and the subsequent increase in their capitalization since they will be in position to use their high capitalisation as collateral. In that case unlisted companies do not benefit from the high oil prices since their capitalization remains stable.

The policy maker should keep an eye on the effects of the oil price movements on the stock market volatility and intervene, whenever is required, so as to ensure the stable and unaffected operation of the stock market.

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