Oil Price and Stock Market Interaction in the USA

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ABSTRACT

This thesis focuses on analyzing empirical relationship between oil prices and stock market movements in the case of United States by employing an annual data from 1970 to 2010. Dow Jones industrial stock price index (industrial weighted average) has been selected to proxy for stock markets while real income and real industrial value added are added to analyses as control variables as advised in the literature. Results of this thesis show that oil prices do have significant impact on stock markets both in economic long and short terms; these impacts are negative as expected. Stock markets approach to their long term equilibrium path by 50.92% speed of adjustment every year significantly through the channels of oil prices and aggregate economic activity. Final finding this research study is that there also exists long term unidirectional causality that runs from oil prices and economic activity to stock prices in United States. This reveals that a change in oil prices will precede changes in stock market movements.

Keywords: Stock Price, GDP, Industrial Production, USA.

ÖZ

Bu tez çalışması, Amerika Birleşik Devletleri'nde petrol fiyatları ile hisse senedi piyasası arasındaki ilişkiyi ortaya çıkarmayı hedeflemektedir. Çalışma 1970-2010 dönemi yıllık verilerini kapsamakta olup, hisse senedi piyasası için Dow Jones Sanayi indeksi seçilmiştir. Literatür çalışmalarına paralel olarak, reel gelir ve sanayi üretimi de kontrol değişkenleri olarak dahil edilmiştir. Sonuçlar, petrol fiyatları ile hisse senedi piyasası arasında ekonometrik bağlamda bir denge ilişkisi olduğunu ortaya koymaktadır. Petrol fiyatları, hisse senedi fiyatları üzerinde hem kısa dönemde hem de uzun dönemde istatistiki olarak anlamlı fakat olumsuz bir etkiye sahiptir. Hisse senedi fiyatları uzun dönem denge düzeyine, petrol fiyatları ve ekonomik faaliyet aracılığı ile 50.92%'lik hız ile yaklaşmaktadır. Son olarak, petrol fiyatlarında ve ekonomik faaliyette meydana gelebilecek bir değişikliğin, hisse senedi piyasalarında da bir değişikliğe yol açacağı, nedensellik testleri ile ortaya konmuştur.

Anahtar Kelimeler: Hisse Senedi; Petrol; GSYİH; Sanayi Üretimi; ABD.

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I owe extremely to my family who allowed me to travel all the way from Kazakhstan to Turkish Republic of Northern Cyprus and supported me all throughout my studies. I would like to dedicate this study to them as an indication of their significance in this study as well as in my life.

To my lovely mother

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ARDL……………………………………………………Autoregressive Distributed Lag

ECM………………………………………..………………..Error Correction Model

GDP…………………………………………….………..Gross Domestic Product

IND………………………………………….……………..Industry Production

OIL………………………………………………………………………..Oil Price

SP…………………………………………………………………….…Stock Price

Chapter 1

INTRODUCTION

1.1 Importance of Oil and Stock Markets, and Macroeconomy

Throughout history of "Oil" existence, the oil has been considered as one of the most significant commodities. The role of oil price volatility in the general economy and financial markets is important to investigate in the literature. Therefore, searching the impact of oil price volatility not only on the economy as a whole but also on financial markets deserves attention from researchers. Peters and De Mello (2010), in their work, search the relationship between oil prices and economic aggregates using some macroeconomic variables and come up with findings that there is a long term interaction between oil volatility and macroeconomic variables such as interest rates, industrial production, and exchange rates. There are direct and negative effects of oil prices on the other indicators because it increases production costs (Peters and De Mello, 2010). Furthermore, there are some other valuable articles that are written as well regarding this issue. Generally speaking, the association with oil does not end with just petroleum that we use for transport sector; the use of oil is more than we could have ever thought nowadays in such modern civilization. In other words, oil is the most valuable raw material, which improves standard of living. Especially, in the United States of America (USA) like in the others, the oil plays a vital role that contributes to the economy a lot. On one hand, the economic downturn of USA reacts to changes in oil price ups and downs over many years. However, the USA is not the only country that is being influenced by the instability of oil markets especially apart from oil shock crisis in 1973, which firstly started in the USA. As also written by Martin (2007), meetings were held between members of the Organization of Petroleum Exporting Countries (OPEC) and Western oil companies after the oil crisis in 1973 in order to develop strategies and policies to deal with oil crisis and to stabilize the economies. Fixed exchange rate regime of Bretton Woods Agreement was also ended in 1973 oil crisis when countries like USA started to allow their currencies to be flexible. Members of OPEC from Arabian countries increased the price of crude oil by 70% in 1973 (October) and placed an embargo on exports to the U.S. and Israel allies. OPEC continued to use oil as a power. Global oil price in 1974 was higher than (4 times) before the crisis (Martin, 2007; Merrill, 1973; Licklider, 1988). Furthermore, following oil crisis in 1973, the 1979 Iranian revolution took place, which caused oil prices to go up again in the early 1980s; there have been done adjustments in oil prices even after 2000s until 2008s in the globe. The global economic crisis that started in 2008 is also mainly because of oil markets that exerted great influences in all of the sectors in countries around the globe. On the other hand, Chang and Wong (2003) argue that following the collapse of oil prices in 1986, oil and macroeconomic interaction has weakened. In fact, this argument needs to be investigated in further researches. In the works of Hooker (1999, 1996) and Lee et al. (1995), it is also argued that the fundamental oil price and macroeconomic relationship identified in earlier studies had eroded (See also Chang and Wong, 2003).

Since oil markets are essential for macroeconomic wealth and sustained growth in the countries, investigation of their impacts on the global economies will always deserve attention from researchers. There have been done many researches with this respect.

Sadorsky (1999), for example, studied effects of oil prices' volatility over stock returns and found that oil price itself exerted essential influence on stock returns. Sadorsky (1999) also found that variations in oil price affect the economy while changes in the economy have lower effects on oil price. Chang and Wong (2003) study how oil price fluctuations have influence for the economy in the case of Singapore which is an important oil producer and exporter country and suggest that the effect of oil price variation on the Singapore economy need not be evaluated negligible even though it is small.

1.2 Aim of the Study

There is considerable number of literature studies that forecasted the effect of oil markets on economic indicators as mentioned in the previous section; however, this cannot be said for association among oil price and stock variables. There are rare researches on the interactions among oil price and stock variables; among the others are Sadorsky (1999) and Ozbay (2008). Therefore, this thesis aims to estimate how oil prices affect stock prices in the case of the USA, which is one of the most important countries that shape global macroeconomic performance over the years.

Determinants of stocks and their returns have been extensively studied in the literature using various approaches: Capital Asset Pricing and Arbitrage Pricing Theory are only two of them. The Arbitrage Pricing Theory, for example, was firstly proposed by Ross (1976) and is one of the asset-pricing models in the relevant literature that attempts to describe how individual risky assets are priced. But this thesis as parallel to Sadorsky (1999) will investigate macroeconomic determinants of stock movements which are mainly oil prices, real income, and real industrial production.

It is suggested that oil prices might influence economic activity and stock markets directly and indirectly through the other channels (See Sadorsky, 1999; Ozbay, 2008). We have also studied several articles in which the authors evaluated empirically how GDP and Industry production exert influence on stock price. For example, Ozbay (2008) investigated the relationship between stock movements and economic aggregates in Turkey such as: interest rate, money supply, production index inflation rate and exchange rate. In this working paper, he found that there is positive association between stock prices in Turkey and foreign investments, but negative relationship with interest rate. However, the relationship between money supply, industrial production is not statistically significant in his study. Based on the suggestions from the literature (Chen, 2007), GDP and industrial value added in the USA will be added to association between oil prices and stock performances as control variables.

The latest econometric techniques will be adapted to this study in order to investigate the role of oil markets in stock movements in the USA; among them are unit root tests to investigate integration level of variables under consideration, bounds tests to long run association between variables, conditional error correction models and Granger causality approach under the conditional autoregressive distributed lag (ARDL) system which allows alternative lag systems at various structures for dependent and independent variables unlike the classical Johansen methodology. Contemporary econometric approaches were also used by Duca (2005) to forecast about the relationship between stock market and GDP. Variables inspected in this work are real GDP, financial market indicator, and stock prices. He found unidirectional causality between GDP and stock prices; that is to say stock prices Granger causes GDP.

Since the USA is a major force on the globe and oil markets are important for stock markets, results from this thesis are expected to be interesting for researchers and policy makers.

1.3 Structure of the Study

The current study is planned as followings: The background review of oil market and its history are touched in chapter 2. Chapter 3 reviews the results from previous published articles. Theoretical setting is discussed in Chapter 4. Chapter 5 and Chapter 6 give information about Data & Methodology and empirical results respectively. Conclusions and some policy implications on how to apply our findings to stimulate development in economy of a country are provided in chapter 7.

Chapter 2

BACKGROUND REVIEW IN BRIEF

United States of America is the one of the most powerful countries in terms of economy and military force. Even though the USA is still one of the most excellent industrial powers whereas manufacturing sectors no longer play significant role in contributing to its economy. During the period from 1979 to 1998, employment in production sector fell from 20.9 million to 18.7 million, or from 21.8% to 14.8% of national employment (World Bank, 2012). During 1960s, real sector production constituted about 29% of income; during 1987, the ratio was lower at about 19% (World Bank, 2012). Manufacturing showed a decline in 2002 owing to the recession that began in 2001 (March).[1] As can also be seen from Figure 2.1 growth industrial production in the USA is highly volatile and industrial value added is in downturn in the last years.[2]

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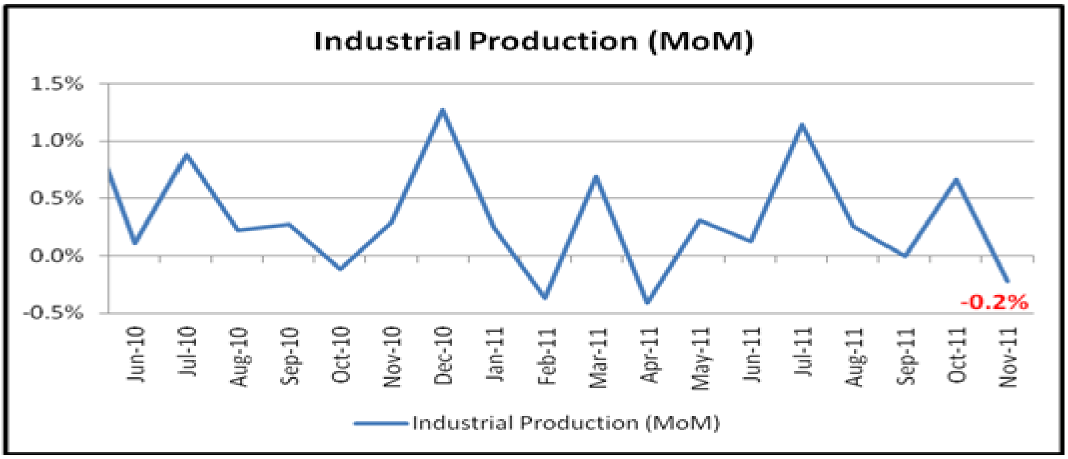
[1] Nations Encyclopedia (2012).

[2] Trang Nguyen (2012).



Graph 2.1 U.S. Industrial Production, Monthly Change: June 2010 to Present
Source: Federal Reserve (2012).

Oil is being used in all sectors; transportation sector is one of them among the others. The USA is the largest consumer of oil in the world that it imports about 2/3 of oil that it used (World Bank, 2012). The American economy needs oil for energy production and for fuel. Oil is the most important source of power in the USA. About forty percent of the total energy consumed in the United States every year comes from just oil which provides about 97 percent of the fuel used by American vehicles, including ships, trains, planes and automobiles (World Bank, 2012). Oil is also a source of important chemicals for a number of industries such as the plastics and textile industries.

The USA imports most of its oil from the Arab World especially Saudi Arabia. Although oil has many advantages for the economies, it may affect an economy so terribly because of volatility in oil prices; therefore, changes in the price of the oil, which are produced by Arab countries are likely to threat the USA economy. The effects of the 1973 oil crisis were long lasting and significant not only in the USA but also in the other countries. Another serious crisis in the USA happened after 2005s when shortage in oil production was experienced.[3] From one year to another year oil consumption has increased in the USA especially for crude imported oil, which is also presented in Figure 2.1. It is seen that national oil output peaked in the 1970s, consumption continued to grow at break-neck speed. In 2025, the USA is suggested to consume 28.3 million barrels a day, which means 44 percent more oil than they consume today. It is stated that national oil output meets only 30 percent of total oil consumption in the USA (Energy Information Administration, 2004).[4]

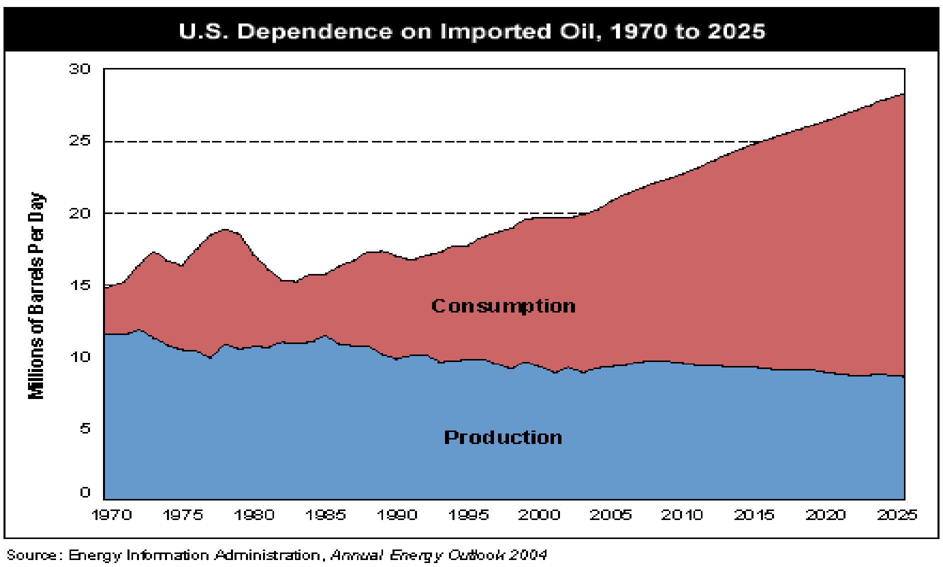


Figure 2.1 US Dependence on Imported Oil, 1970 to 2025.

3 Arab-American Business (2011).
4 NRDC (2012).

Chapter 3

LITERATURE REVIEW

The relationship between oil prices and various macroeconomic indicators has been investigated in the related literature as mentioned previously. Among them which are not cited in the previous chapter are Sari and Soytas (2006), Toru and Alper (2008), Boyer and Filion (2007), Trung (2009), Huang et al. (1996), Hamilton (1983), Hammoudeh et al. (2010), Choi and Hammoudeh (2010), Gisser and Goodwin (1986), Basher and Haug (2008), McSweeney and Worthington (2008), Driesprong et al. (2008), Hammoudeh and Aleisa (2002), Hooker (1996), and Miller and Ratti (2009). In this chapter, a brief summary of major findings of those researches will be provided.

Sari and Soytas (2006) find that oil price fluctuations and its shocks do not seem to affect the real stock returns significantly in the case of Turkey. This finding is interesting due to the fact that Turkey is oil-import dependent country and has developing stock market since 1986; this finding is also different from the others that were obtained for OECD and other developing countries. Sari and Soytas (2006) justifies this finding by macroeconomic policies of Turkish government that put high tax rate on oil by thinking that that the fluctuations in world oil prices may be absorbed by changes in the tax rate; by this policy minimization of the bad impact of world oil price increases on the stock returns or the general price level is targeted.

Toru and Alper (2008) find that FED (Federal Reserve Bank of the USA) funds rate and the Turkish overnight interest rate respond positively to oil price increases but there is no significant relationship between oil price changes and the implied volatility in stock indices. Toru and Alper (2008) also conclude that the inclusion of the global liquidity conditions in the relationship between aggregate economic activity and oil price changes is an important issue for a small open economy such as Turkey and show that Turkey has small open economy; therefore, oil price movements are less likely to have significant effects on stock performances in the money markets.

Hamilton (1983) found that oil price increases reduced the USA output growth from 1948 to 1980. Hammoudeh et al. (2010) estimate relationship between world stock returns, oil prices, federal funds rate, and sector specific variables. Standard GARCH methodology has been used in his study. They find that a rise in oil prices reduces the volatility in most sectors and also oil related sectors. Choi and Hammoudeh (2010) evaluate interactions between 5 commodities' market (copper, gold, silver, Brent oil, and West Texas Intermediate oil) and US stock market. Their results propose that there is low probability of low regimes for all the markets.

Gisser and Goodwin (1986) find that oil price didn't lose its prospective to expect gross national income growth. Moreover, Gisser and Goodwin (1986) mentioned two important results for the relationship between oil price swing and macroeconomic variables: Firstly, monetary and fiscal policy cannot measures oil price effect in macroeconomics after market. Secondly, oil price on USA economy did not change after OPEC times start since 1971.

Also Hooker (1996) confirmed Hamilton's (1983) results and did study for period between (1948-1972) and mentioned that the oil price level and its changes do exert influence on GDP growth and macroeconomic variables. His findings suggest that due to a 10 percent increase in oil prices 0.6 percent GDP growth is estimated, which is lower in the third and fourth quarters after assigning an oil shock.

Miller and Ratti (2009) study on the relationship between oil prices and stock markets of whose results suggest no long run relationship between stock market and crude oil prices. The sign of coefficient for crude oil prices is negative, against what Miller and Ratti (2009) expected, and they based this negative result to uncertainty about the magnitude and also long-run change in crude oil price are accompanied by long-run change in the stock in the stock price by same way and same direction.

Basher and Haug (2008) show that stock prices from emerging markets and foreign exchange rates put a pressure on oil prices to rise. They also find positive association between oil prices, stock prices, and exchange rates in emerging markets. Trung (2009) examines the impact of oil price on Vietnam's macroeconomic economic activity such as inflation and effective exchange rates by using autoregressive models. His findings suggest that both oil prices and effective exchange rates have strong impact on the economy of Vietnam. Simply to say, an increase in oil prices enhances the economic growth. And inflation has effect on economy but it is not statistically significant.

Huang et al. (1996) study for the relationship between daily USA stock returns and oil-futures returns; they conclude that oil futures returns do not exert long term impact on various stock indices in industry sector. Boyer and Filion (2007) study those factors that explain the association between oil and gas company returns in Canada. They find that if there are interest rates, production volume and depreciation of Canadian dollar against USD dollar pass on negative effects on stock returns.

And finally, Hammoudeh and Aleisa (2002), employing monthly figures from the years from 1991 to 2000 and using the GARCH models, obtained mean spillovers from oils to stocks in Bahrain, Indonesia, Mexico, and Venezuela. This is hardly surprising since some of these countries are major oil exporters and their economies are heavily dependent on oil. However, it would be interesting to see if the relationship between stock returns and oil price returns also exists between second moments.

Chapter 4

THEORETICAL SETTING

This thesis aims to estimate the impact of oil prices on stock performances in the USA. GDP and industrial value added are added as control variables to this relationship as advised in the literature (See Sadorsky, 1999). Therefore, the following mathematical function can be proposed in the current research study:

$$S_t = f\ (Y_t, I_t, O_t) \qquad (1)$$

The variable of "S" in equation (1) stands for stock performance in period t, "Y" for gross domestic product in period t, "I" for industrial production in period t, and "O" for oil prices in period t.

Mathematical function in equation (1) can be written in linear and double logarithmic system in order to estimate elasticity coefficients of each explanatory variable in order to obtain growth effects as also suggested by Katircioglu (2010):

$$\log S_t = b_0 + b_1\left(\log Y_t\right) + b_2\left(\log I_t\right) + b_3\left(\log O_t\right) + e_t \qquad (2)$$

In equation (2), the terms "log" stands for the natural logarithm of each variable while ε_t stands for white noise error term of this long run model.

Econometric methodology under "Classical Linear Regressions Models" assumes that series in equation (2) are stationary that have fixed mean, variance, and covariance over time (Gujarati, 2003). If anyone of these fixed parameters is violated, this causes series to be nonstationary, which this situation likely to result in spurious estimations in regressions. This time it is essential to deal with time series econometric methodology in order to overcome such possibility in the estimations. Differencing those variables which are not stationary is observed as solution to the problem; however, there is an assumption that dependent variable may not adjust to its long term path given a shock in its regressors. So, the following error correction model has been offered in the econometrics literature in order to estimate for short term coefficients plus how fast dependent variable is expected to adjust to its long term path through the channel of its regressors (Gujarati, 2003; Enders, 1995):

$$\Delta \ln S_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \ln S_{t-j} + \sum_{i=0}^{n} \beta_2 \Delta \ln Y_{t-j} + \sum_{i=0}^{n} \beta_3 \Delta \ln I_{t-j} + \sum_{i=0}^{n} \beta_4 \Delta \ln O_{t-j} + \beta_5 \varepsilon_{t-1} + u_t \qquad (3)$$

where Δ stands for a change (difference) in lnS, lnY, lnI, and lnO and ε_{t-1} is the lagged error correction term (ECT) which is derived from equation (2). The coefficient of ECT in equation (3) suggests how fast the difference between the short-run and the long-run values of lnS is eliminated each period (Katircioglu, 2010). The expected sign of coefficient for ECT is negative by expectation (Katircioglu, 2010; Gujarati, 2003; Enders, 1995).

Chapter 5

DATA AND METHODOLOGY

5.1 Data

The time series data analysis was applied in the empirical work of this research in order to conduct econometric analysis on these numbers covering the period between the years of 1970 and 2010. The variables used in the study are Dow Jones industrial stock price index in the USA (S), gross domestic product of the USA at constant 2000 USD prices (Y), industrial production of the USA at constant 2000 USD prices (I), and oil prices in the USA (O). Oil prices are computed by deflating Dubai crude oil prices in USD (which are available from BP Statistical Review of World Energy report, 2012) to consumer price index (2000 = 100) of the USA as advised in the literature (Chang and Wong, 2003). The variables of GDP and I have been obtained from World Bank Development Indicators (WB, 2012), oil prices have been obtained from World Energy report (BP, 2012), and Dow Jones industrial average has been obtained from Datastream (2012).

Real GDP and real industrial production have been used to approximate for business activity in parallel to the work of Chen (2007). This is due to the fact that these economic aggregates significantly result from economic activity in the countries. It is business activity that plays major role in industrial production of countries. Since industrial production is a very important element of income in, specially, developed countries, business activity also is a major determinant of income. Therefore, both industrial value added and real income (GDP) can easily be used to proxy for business conditions in the countries (See Chen, 2007 for more details).

5.2 Unit Root Tests for Stationary

Series in equation (1) are assumed to be stationary as mentioned earlier in the previous chapter. In order to test whether our data is stationary or not we employed two types of unit root tests, which are the augmented Dickey-Fuller (ADF) and Phillips & Perron approaches (Dickey and Fuller 1981; Phillips and Perron 1988). It is argued that PP unit root tests are superior to ADF tests because of minimizing for autorcorrelation problems (Katircioglu, 2010); therefore, final decision in this thesis will be given based on the results from PP tests for unit roots. ADF tests for unit roots are employed in the thesis for comparison purposes. Furthermore, all of the unit root tests will be carried out starting from the most general model including deterministic trend and intercept towards the most restricted model which is without trend and intercept as also suggested by Enders (1995).

5.3 Tests for Long Term Relationships

As general case, econometric estimation is always based on the long term movements. Analyses are passed out to see whether variables have relationship in the long run (LR). Coefficients in the models where variables are stationary at their levels are interpreted for the LR period. However, for non-stationary variables this cannot be done since those variables are differenced. Once variables are differenced, existence of LR movements needs to be investigated.

There are considerable numbers of cointegration tests in order to investigate the existence of LR relationship among variables. Pesaran et al. (2001) have suggested newer approach in addition to previous ones including Johansen methodology to test for long run association between the variables. The advantage of employing bounds tests as offered by Pesaran et al. (2001) is that independent variables can be at mixed order of integration while dependent variable should be again at first order. The following equation can then be proposed in this thesis in order to test for long term association between stock prices and its regressors via bounds test:

$$\Delta \ln S_t = a_0 + \sum_{i=1}^{n} b_i \Delta \ln S_{t-i} + \sum_{i=0}^{n} c_i \Delta \ln Y_{t-i} + \sum_{i=0}^{n} d_i \Delta \ln I_{t-i} + \sum_{i=0}^{n} e_i \Delta \ln O_{t-i}$$

$$+ \sigma_1 \ln S_{t-i} + \sigma_2 \ln Y_{t-i} + \sigma_3 \ln I_{t-1} + \sigma_4 \ln O_{t-i} + \varepsilon_{1t} \quad (4)$$

Bounds test will be again carried out using double logarithmic system since the main focus in the study is to have growth impacts of variables on another. The above model is carried out under distributed lag system including dependent variable as well. Pesaran et al. (2001) suggest that if F statistic of the model is statistically significant, then there exists long term association between stock prices and its regressors. Critical values used in this respect are not classical ones but they are special critical values with lower and upper bounds proposed in the study of Pesaran et al. (2001). If computed F value is above upper bound value, the null hypothesis of H_0: $\sigma_1 = \sigma_{2=} \sigma_3 = \sigma 4 = 0$ (no level association) is rejected; if F value falls between lower and upper bounds values, then test is inconclusive; and if F value is less than lower bounds value, the above null hypothesis is accepted that denotes no level relationship. Finally, three scenarios as suggested by Pesaran et al. (2001) will be used in this work that consider different combinations of trend and intercept factors, which are with different combinations of trends and intercept. F_{III} scenario is the model with intercept which is not restricted one and without time trend; F_{IV} scenario is the model with intercept which is not restricted one and with time trend; and finally, F_V scenario is the model with intercept which is not restricted one again and also with trend (Pesaran et al., 2001).

5.4 Long Run Model and Error Correction Model for Short Run Coefficients

In econometrics, when long term relationship is obtained via econometric tests like bounds approach, then, long run and short run models can be estimated. In this study, both models will be again estimated by using distributed lag system. Short run model need to be estimated under conditional error correction mechanism in order to estimate error correction term as well (See Pesaran et al. 2001). Then, conditional error correction model under the ARDL approach can be written as follows:

$$\Delta \ln S_t = \Delta\beta_0 + \sum_{j=1}^{p-1}\phi_j \Delta \ln S_{t-i} + \sum_{i=1}^{k}\beta_1 \Delta \ln Y_{it} + \sum_{i=1}^{k}\beta_2 \Delta \ln I_{it} + \sum_{i=1}^{k}\beta_3 \Delta \ln O_{it} + + \beta_4 ECT_{t-1} + u_t \qquad (5)$$

Equation (5) is also known as the short run model with error correction term. The coefficient of error correction term will denote how much discrepancy between long run and short run values of dependent variable (S) can be eliminated at the end of each period in percent terms.

5.5 Granger Causality Tests

In the final stage, Granger causality tests will be implemented in this work in order to observe the direction of causality among variables both in long and short runs. This test was firstly proposed by Granger (1969). Later, it has been developed and extended by the other authors. In this work, Granger causality techniques will be carried out again under distributed lag system and error correction mechanism as advised in the econometrics literature (Enders, 1995). Therefore, equation (6) will be estimated in this thesis with that respect in parallel to the work of Katircioglu (2007):

$$\ln S_t = a + \sum_{i=1}^{p} \alpha_i \ln S_{t-i} + \sum_{j=1}^{q} \beta_j \ln Y_{t-j} + \sum_{j=1}^{r} \beta_j \ln I_{t-j} + \sum_{j=1}^{s} \beta_j \ln O_{t-j} + \mu_t \qquad (6)$$

Econometrics methodology reveals that having significant *t ratios* for ECT_{t-1} in equation (6) would be enough to validate long-run causations and significant F ratios would be enough for short term causations among the series (Katircioglu, 2010). The terms “L” denotes distributed lag structures in the model to be determined by standard lag length criteria such as Akaike and Schwartz approaches. In this thesis, optimum lag structure will be determined based on Schwartz criterion.

Chapter 6

EMPRICAL ANALYSIS AND RESULTS

6.1 Unit Root Test Results

The variables of this study have been tested for unit root tests to show whether they are stationary at their levels or the first level difference. We employed the ADF and PP tests to determine the availability of unit roots as mentioned earlier. Unit root test results are summarized in Table 6.1. Detailed unit root test results are not presented here since actually there isn't any need to run unit root tests as long as dependent variable is non-stationary variable at its level form but becomes stationary only at its first difference. As mentioned earlier, this is also because of the reality that bounds testing procedures allow independent variables to be of mixed order of integration; they might be I (0) or I (1) but not I (2). Having a stationary feature at a second difference of a variable is not allowed in bounds testing procedure (Pesaran et al., 2001).

Unit root test results of this thesis suggest that lnS and lnY for the USA are not stationary at levels but become stationary at their first difference; therefore, they are said to be integrated of order one, I (1). On the other hand, lnI and lnO seem to be stationary at their levels; therefore, they are said to be integrated of order zero, I (0). To summarize, results of unit root tests reveal that stock prices and real GDP in the USA are integrated of order one, I (1), while real industrial value added and oil prices are integrated of order zero, I (0).

Table 6.1. Unit Root Test Results

Variable	Integration
lnS	I (1)
lnY	I (1)
lnI	I (0)
lnO	I (0)

Note: Detailed results of ADF and PP unit root tests are available upon request.

Unit root tests gave mixed results for the order of integration of variables. However, dependent variable in equation (1) is integrated of order one, I (1). Therefore, this satisfies that condition of Pesaran et al. (2001) in order to proceed with bounds test for level relationship, which is carried out under the ARDL approach.

6.2 Bounds Test Results

In this step, bounds testing results will be presented and discussed. Results have been based on three different scenarios as mentioned earlier. These scenarios are the ones which have been offered in the original work of Pesaran et al. (2001). Optimum lag in ARDL models for bounds testing has been estimated to be one according to Schwartz criterion. But, we present results of bounds tests in Table 6.2 till lag 4 as also mentioned by Pindcyk and Rubinfeld (1991) that estimations should be compared across different lag structures in order to see whether results are robust or not. This is also because cointegration issue is very sensitive to the lag selection (Pindcyk and Rubinfeld, 1991).

Table 6.2: Bounds F- and t-statistics for the Existence of a Levels Relationship

		Without Determintic Trends				
				p-val		
p	F_iii	p-val F_iii*	t_iii	t_iii*		
1	5.75959*	0.0013	-2.2147	0.034		
2	2.892198	0.041	-2.103	0.0449		
3	4.493559	0.0083	-2.6213	0.0156		
4	5.717633*	0.0042	-3.0826	0.0068		
		With Determintic Trends				
				p-val		p-val
p	F_iv	p-val F_iv*	F_v	F_v*	t_v	t_v*
1	4.706452*	0.0026	3.80999	0.0124	-1	0.2029
2	2.233231	0.0811	2.20388	0.0964	-2	0.1097
3	3.431994	0.0201	3.48763	0.0247	-2	0.0513
4	4.329671	0.0111	4.73312	0.0103	-3	0.0231

*Note: * implies to reject the null hypothesis of no level relationship.*

As can be seen from Table 6.2, there are lag levels (especially optimum lag) where computed F statistics are higher than critical values as provided by Pesaran et al. (2001) and Narayan (2005). F_V scenario is the only exception. Since the null hypothesis of H_0:

$\sigma_1 = \sigma_{2=}\ \sigma_3 = \sigma 4 = 0$ (no level association) can be rejected and its alternative of H_0: $\sigma_1 \neq \sigma_2 \neq \sigma_3 \neq \sigma 4 \neq 0$ (level association) can be accepted instead, we hereby confirm that industrial stock markets (prices) are said to be in long term association or movement with real income, industrial production, and oil prices in the case of the USA. This is also to say that business conditions (real GDP and industrial value added) and oil markets are long term determinants of industrial stock markets in the USA. This is also what expected from the theory of macroeconomics.

6.3 Results of Level Equation and Error Correction Model

Bounds testing procedure have supported evidence of long term association between industrial stock market and its regressors which are GDP, industrial value added, and oil prices. The next procedure is to obtain long run and short run coefficients plus error correction coefficient. Econometric theory states that error correction term or coefficient should be statistically significant and negative in the case of cointegrated models (Enders, 1995). Table 5.2.1 gives results with this respect. In parallel to the suggestion of Pindyck and Rubinfeld (1991) again, alternative lags have been used rather than using optimum lags only. Panel (a) gives estimation of error correction model which includes short term coefficients and error correction term; Panel (b) gives estimation of level equation which presents long term coefficients of independent variables with respect to industrial stock market variable.

Table 6.3: Level Equation Model and ECM

Panel (a). Error Correction Model: Dependent Variable: lnS					Panel (b). Level Equation for Long Run Coefficients: Dependent Variable: lnS				
Variable	Coefficient	Std. Error	t-Statistic	Prob.Values	Variable	Coefficient	Std. Error	t-Statistic	Prob.Value
ΔlnY	7.0287	1.4137	4.97189	0.000	lnY	0.31747	2.46059	0.12902	0.89800
ΔlnY_{t-1}	3.1833	1.2523	2.542	0.017	lnI	8.1941	1.52105	5.38713	0.00000
ΔlnI	-3.1806	0.8463	-3.758	0.000	lnO	-2.8007	0.29695	-9.4313	0.00000
ΔlnI_{t-1}	1.0763	0.844	1.27527	0.213	C	248.811	46.3191	5.37166	0.00000
ΔlnI_{t-2}	3.4121	0.6601	5.16897	0.000					
ΔlnI_{t-3}	2.2704	0.5574	4.07339	0.000					
ΔlnI_{t-4}	2.3873	0.5842	4.08603	0.000					
ΔlnO	-2.6649	0.2821	-9.4475	0.000					
C	-0.0166	0.0334	-0.4962	0.623					
ECT_{t-1}	-0.5092	0.0641	-7.9433	0.000					
Adjusted R-squared	0.8493	S.D. dependent var		0.2079					
F-statistic	22.9151	Durbin-Watsonstat		2.416					
Prob(Fstat)	0.0000								

Results in Panel (b) of Table 6.3 show that real GDP depicts positive but statistically insignificant long term impact on Dow Jones Industry average stock index in the USA. This is because t-statistic for lnY (0.12902) is less than critical values or its related t-prob value (0.89800) is higher than α (alpha) values at 0.01, 0.05, and 0.10 levels. On the other hand, industrial production exerts positive and statistically significant impact on Dow Jones Industry average. This is because t-statistic of lnI is greater than the related critical values or its t-prob value is less than $\alpha = 0.01$ level (t-prob value is zero). Long term elasticity coefficient of lnI suggests that 1 percent change in industrial production in the USA would lead to 8.194 percent change in Dow Jones Industry average in the same direction. This finding of the thesis is quite reasonable. Finally, oil prices, on the other hand, exert negative and statistically significant impact on Dow Jones Industry average. This is because t-statistic of lnO is greater than the related critical values or its t-prob value is less than $\alpha = 0.01$ level (t-prob value is zero). Long term elasticity coefficient of lnO suggests that 1 percent change in industrial production in the USA would lead to 2.800 percent change in Dow Jones Industry average in opposite direction. This finding is also reasonable.

Panel (a) of Table 6.3 presents error correction model that includes error correction estimate and short term coefficients. Firstly, error correction term is -0.5092, which is negative as expected and statistically significant. This is because t-statistic is greater than critical values or its prob value is zero; this coefficient reveals that disequilibria between long term and short term values of Dow Jones Industry average are eliminated every year by 50.92 percent speed of adjustment through the channels of real output, industrial production, and oil prices. This also suggests that Dow Jones Industry average in the USA converges to its long term path by 50.92 percent speed of adjustment through the channels of business conditions and oil markets. This is a major finding of this thesis that 50.92 percent is a high, negative, and statistically significant coefficient. Contribution of business conditions and oil markets to enable industrial stock markets in the USA to reach their long term path is higher than 50 percent. Secondly, when short term coefficients are considered, it is seen that they are again statistically significant except intercept (-0.0166) and one year lagged coefficient of lnI (1.0763). Real GDP exerts positive and statistically significant short term impact on Dow Jones Industry average; industrial value added has negative impact without lagged structure but positive impact with lagged structure on industrial stock market of Dow Jones. Finally, oil prices again have negative and statistically significant impact on Dow Jones Industry average in the short term period.

6.4 Results of Granger Causality Tests

This study has confirmed long term impact of GDP, industrial value added, and oil price fluctuations on industrial stock movements in the USA; therefore, Granger causality tests can be also carried out using error correction mechanism as a further step. Granger causality tests in this thesis, which imply if a change in one variable precedes a change in another variable as mentioned earlier should be carried out under conditional error correction models. This is because proposed model of this thesis has been confirmed to be a long run model via ARDL approach; therefore, causality tests also need to be carried out via ARDL setting (Pesaran et al., 2001; Katircioglu, 2010). Table 6.4 gives output from Granger causality estimations. The null hypothesis of the models denotes no causation among the variables (Granger, 1969; Enders, 1995). If the null hypothesis is rejected, it implies that a change in independent variable precedes a change in dependent variable (causality). Again, alternative lags have been used in causality tests based on the suggestion of Pindyck and RubinFeld (1991).

The results show that there is one causality in the long term and one in the short term period:

Table 6.4: Granger Causality Test Results

Y / X	lnY	lnI	lnO	lnS	ECT_{t-1} (t-stat)
	With Deterministic Trend				
lnY	--	0.472740 (0.7902)	1.719450 (0.1994)	2.036166 (0.1400)	-0.95330 (0.35783)
lnI	0.106506 (0.9889)	--	0.422470 (0.8250)	1.127464 (0.3937)	0.01421 (0.98888)
lnO	2.186545 (0.1188)	1.491045 (0.2589)	--	2.177975 (0.1199)	0.45684 (0.65532)
lnS	1.944766 (0.1549)	2.619744*** (0.0751)	0.857788 (0.5341)	--	-3.37634* (0.00496)

Note: * and *** denote the rejection of null hypothesis respectively at 0.01 and 0.10 levels. Numbers in brackets are prob values of t-statistics for long term causations and of F-statistics for short term causations.

Firstly, t-statistic of ECT in the model when lnS is dependent variable and lnY, lnI, and lnO are regressors are negative (as expected) (-3.37634) and statistically significant at 0.01 level. Therefore, the null hypothesis of no causality can be rejected for this model. However, in the other models, t-statistics of ECTs are not statistically significant. Therefore, our results confirm unidirectional long run causality that runs from business conditions and oil prices towards Dow Jones Industry average. This proves the reality that Dow Jones Industry average in the USA is driven by business conditions and oil markets in the long run period.

Secondly, F-statistic of the model, when again lnS is dependent variable and only lnI is regressor, is statistically significant only at 0.10 level. So, the null hypothesis of no causality can be rejected in this case. It is concluded that there is also short term causation that runs from industrial value added towards Dow Jones Industry average in the short term of the USA economy. It is again important to note that the other F-statistics are not statistically significant; therefore, further short term causality cannot be inferred in the study.

Results of Granger causality tests prove that Dow Jones Industy average is stimulated by any change in business conditions and oil markets in the long run period while it is stimulated by a change only in industrial value added in the short run period.

Chapter 7

CONCLUSION

7.1 Summary of Major Findings

This thesis aims at estimating the impact of business conditions and oil price fluctuations on Dow Jones Industrial Stock Index in the USA. Industrial stock index has been selected due to the reason that business conditions are a part of industrial economic activity; and using time series analysis the study aimed at investigating the role of business activity for industrial stock market. Additionally oil prices have also been added to the analyses due to the fact that oil markets shape the economy especially in the last decade and are crucial for United States. This is true when dependency of USA on external oil markets (especially in the Middle East) and politics of USA in different regions including Middle East are considered. Therefore, results of this study are expected to be important for policy makers.

Time series analysis has been adapted to an annual data for the USA. Since classical linear regression models assume that series under inspection are stationary; as an initial step, unit root tests for stationary nature of variables under consideration have been carried out. ADF and PP unit root tests revealed that Dow Jones Industrial average and real GDP of United States are non-stationary variables at their levels but become stationary at first differences; therefore, they are said to be integrated of order one, I (1). On the other hand, unit root tests also revealed that real industrial value added and oil prices in the USA seem to be stationary at levels; so they are integrated of order zero, I (0).

Since unit root test results in this thesis provided mixed evidence on the order of integration for variables under inspection, cointegrating vector in the estimation of model where stock market variable is dependent while real income, real industrial value added, and real oil prices are regressors needed to be investigated as a further step. But, classical Engel and Granger (1987), and Johansen (1990) and Johansen & Juselius (1991) types of cointegration approaches were not applicable for this study. This was because these classical approaches require variables to be integrated of the same order if they are non-stationary at levels. Therefore, this thesis has adapted bounds testing procedures under the ARDL mechanism as suggested by Pesaran et al. (2001). Results of bounds tests revealed that there existed level (long run) relationship in equation (1) of this study where Dow Jones Industrial average in the USA is dependent variable while real GDP and real industrial value added as proxies for business conditions and real oil prices are independent variables.

Once long run association has been obtained between Industrial Stock Index and its regressors in equation (1), long run and short run coefficients should be estimated in addition to error correction term. So, conditional error correction models and long run regressions have been estimated via ARDL approach in the study since bounds tests confirmed the existence of long run associations in equations (1) and (2) and meant that economic long run inference could be done with this respect. Results showed that real GDP exerted positive and statistically significant impact on Dow Jones Industrial stock index in the short run while the impact of real GDP in the long run was positive but statistically insignificant. Industrial value added, on the other hand, depicted positive and statistically significant effects on Dow Jones Industrial index of the USA both in short and long runs. And oil prices depicted negative (as expected) and statistically significant effects on Dow Jones Industrial average again both in short and long runs. To summarize, business conditions exerts positive impact on Industrial Stock markets, which suggest that a change in business conditions will exert positive influence on Industrial Stock markets. On the other hand, oil price movements exert negative influence on Industrial Stock markets, which suggest that Industrial Stock markets will be negatively affected from any change in oil prices. In the last stage of error correction model, error correction term has been also estimated, which denoted that disequilibria between long term and short term values of Dow Jones Industrial Stock Index are eliminated every year by 50.92 percent speed of adjustment through the channels of business conditions and oil price movements in the USA. Dow Jones Industry average in the USA converges to its long term path by 50.92 percent speed of adjustment through the channels of business conditions and oil markets.

In the final stage, Granger causality approach under the ARDL mechanism have been carried out to enrich results reached from error correction and long run models. Causality test results have suggested two types of causality among variables under inspection: (1) Unidirectional causality in the long term that runs from business conditions and oil price movements towards Dow Jones Industry average, and (2) unidirectional causality in the short term that runs from industrial value added towards Dow Jones Industry average. Therefore, it can be easily seen that causality test results support findings from long run, short run, and error correction models in this thesis.

The major finding of this study, therefore, is that business activity as proxied by real GDP and industrial value added and oil prices are long term and short term drivers of Industrial Stock markets in the USA. Any change in business activity will contribute to industrial stock markets positively while oil price movements will contribute to industrial stock markets negatively both in the short and long terms of the USA economy.

7.2 Policy Implications

Results of this thesis suggest that the USA administrations should manage the economy and in order to have better functioning stock markets by showing a strong emphasis on oil markets' conditions. Long term forecasting of oil prices will be essential for forecasting purposes related with its national economy and stock markets in general. Results of this research also suggest that USA probably will continue to be a major actor in oil markets especially in the Middle East region. Therefore, macroeconomic policies related with oil markets will be also a major determinant of political stability/instability in those regions where oil production is available.

7.3 Limitations of the and Further Research

During this research data availability was a major limitation for the empirical analysis throughout the study. This was true for oil price data, which was available only from 1973 for Dubai crude oil prices in USD. Oil price data was, then, deflated by consumer price index of USA in order to construct a good proxy for oil prices in the USA as advised in the literature (Chang and Wong, 2003). Similar research with larger span of data can be replicated via using similar or different methodology in the case of USA again for comparison purposes. Furthermore, similar studies can be replicated for the other countries, which are important actors of oil markets as well. Finally, the effects of oil prices on the other macroeconomic aggregates still are needed to investigate as further research topics.

REFERENCES

Boyer, M.M., Filion, D., 2007. Common and fundamental factors in stock returns of Canadian oil and gas companies. Energy Economics 29,pp.428–453.

Cait Murphy,Why Oil Prices Are So Volatile, http://moneywatch.bnet.com/economic-news/article/why-oil-prices-are-so-volatile/337483/, September 1, 2009

Chang and Wong (2003), " Oil Price Fluctuations and Macroeconomic Performances in Asian and Oceanic Economies", /www.usaee.org/usaee2011/submissions /OnlineProceedings.

Choi, K., Hammoudeh, H., 2010. Volatility Behavior of Oil, Industrial, Commodity and US stock Market, Energy Policy Journal, Volume 38, Issue 8, August 2010, pp.4388–4399.

Driesprong, G., Jacobsen, B., Maat, B., 2008. Striking oil: Another puzzle? Journal of Financial Economics 89, pp.307–327.

Gisser, M., & Goodwin, T. H. (1986). Crude oil and the macroeconomy: tests of some popular notions. Journal of Money, Credit and Banking, 18(1), pp.95−103.

Hammoudeh, S., Yuan, Y., Chiang, T., Nandha, M., 2010. Symmetric and Asymmetric US sector return volatility in the presence of oil, *Energy Policy*, 2010, vol. 38, issue 8, pp. 3922-3932

Huang, R.D., Masulis, R.W., Stoll, H.R., 1996. Energy shocks and financial markets. Journal of Futures Market 16, pp.1–27.

Hooker, A. M. (1996). What happened to the oil price–macroeconomy relationship? Journal of Monetary Economics, 38, pp.195−213.

Internet, Arab-American Business, http://www.arabamericangiving.org/the-importance-of-arab-oil-in-the-american-economy.php, 12th of Nov,2011.

Internet, Arab-American Business, http://www.arabamericangiving.org/the-importance-of-arab-oil-in-the-american-economy.php, 12th of Nov,2011

M., Gisser , & Goodwin, T. H. 1986. Crude oil and the macroeconomy: tests of some popular notions. Journal of Money, Credit and Banking, 18(1),pp. 95−103.

McSweeney, E.J., Worthington, A.C., 2008. A comparative analysis of oil as a risk factor in Australian industry stock returns, 1980–2006. Studies in Economics and Finance 25, pp.131–145.

NRDC (2012), Safe, Strong and Secure: Reducing America's Oil Dependence, http://www.nrdc.org/air/transportation/aoilpolicy2.asp, 9th of Oct, 2012.

Rong Gang Cong, Relationships between oil price shocks and stock market: An empirical analysis from China, Energy Policy Volume 36, Issue 9, September 2008, pp.3544-3553

Ross, S. (1976) *The Arbitrage Theory of Capital Asset Pricing*. Journal of Economic Theory. Vol 13, pp.314-360.

Roy Licklider, "The Power of Oil: The Arab Oil Weapon and the Netherlands, the United Kingdom, Canada, Japan, and the United States," International Studies Quarterly 32 (1988): 205-226. Karen R. Merrill, The Oil Crisis of 1973-1974: A Brief History with Documents (Bedford St. Martin's, 2007).

Sector Return Volatilities in Presence of Oil, Financial and Economic Risks. Energy Policy 38 (8), pp.3922–3932.

Stock Markets in a Regime-Switching Environment. Energy Policy 38, 4388–4399.

Trang Nguyen,U.S. Industrial Production Disappointedly Retreats; Dollar Weakens,www.dailyfx.com/forex/market_alert/2011/12/15/121511_US_Industrial_Production_November.html, 15Dec 2011

Sadorsky (1999), "Oil Price Shocks and Stock Market Activity", Energy Economics 21 _1999, pp.449-469.

Ugur Soytas The Empirical Economics Letters, 5(4): (July 2006) ISSN 1681 8997

United States Industry, http://www.nationsencyclopedia.com/Americas/United-States-INDUSTRY.html#b, visited 2nd of November, 2011.

Worthington, A.C., McSweeney, E.J. , 2008. A comparative analysis of oil as a risk factor in Australian industry stock returns, 1980–2006. Studies in Economics and Finance 25, pp.131–145.