Relationship Between the Commodity Prices and Stock Prices in the Petroleum Industry

Petrol Endüstrisinde Hisse Fiyatları ile Ürün Fiyatları Arasındaki İlişki

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2) Hisse Fiyatı	2) Stock Price
3) Varlığa Dayalı Getiri Modeli	3) CAPM
4) Risk	4) Risk
5) Beklenen Getiri	5) Expected Return

SUMMARY

This study focuses on the valuation of petroleum stocks and its relationship with the product prices. Despite the importance of oil to the global economy, there has been little published research on the relationship between energy prices and stock prices. We use Intertemporal Capital Asset Pricing Model (ICAPM) proposed by Merton (1973) with oil price as an independent source of risk to identify the importance of oil price on investors decision in the petroleum industry stocks. Within this framework, excess returns for stocks are explained by the sum of a market risk premium and an oil price risk premium. The data is from the petroleum industry for S&P500 over the period 1987 to 2004 and ISE over the the period 1997 to 2004. Our empirical results indicate that, for selected US companies, oil price is important in explaining excess returns on the financial assets under consideration over the entire period. On the other hand, stock returns are less sensitive to oil price for selected Turkish companies over the entire period. Sub-periods are determined based on oil price and market indices trend changes to investigate further relationship. The results from sub-periods show similar pattern with the entire period.

ÖZET

Bu çalışmada petrol hisselerinin değerlemesi ile ürün fiyatları arasındaki ilişki araştırılmıştır. Petrolün global ekonomideki önemine rağmen, enerji fiyatları ile hisse fiyatları arasındaki ilişkiyi araştıran az sayıda araştırma yapılmıştır. Çalışmada yatırımcıların petrol endüstrisindeki hisseleri alırken, petrol fiyatını nasıl bir risk olarak algıladıklarını bulabilmek için Merton'un (1973) geliştirdiği Intertemporal Finansal Varlık Değerleme Modeli kullanılmıştır. Hisselerin getirisi market riski ve petrol fiyatı riski gözönüne alınarak açıklanmıştır. Standard and Poor's ve İstanbul Menkul Kıymetler Borsasında bulunan petrol endüstrisindeki hisseler incelenmiştir. Amerikan hisseleri 1987-2004 arasındaki, Türkiye hisseleri 1997-2004 aralığındaki bilgiler baz alınarak incelenmiştir. Çalışmamız sonucunda, seçilen zaman aralığı içinde Amerikan şirketleri için petrol fiyatının hisselerin getirisinde rol oynadığı bulunmuştur. Bununla birlikte, seçilen zaman aralığı içinde Türk şirketleri için petrol fiyatının hisselerin getirisinde daha az rol oynadığı görülmüştür. Ayrıca incelemeyi derinleştirmek için zaman aralığı petrol fiyatı ve market endekslerindeki trend değişikliklerine gore alt zaman aralıklarına bölünmüştür. Alt zaman aralıklarında incelenen hisseler, bütün zaman aralığındaki sonuçlara benzer özellikler göstermiştir.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The crude oil market is the largest commodity market in the world. Total world consumption equals around 70-80 million barrels a day. Crude oil prices today are heavily influenced by producers, consumers, and traders buying and selling oil contracts or related financial instruments in various markets for crude oil. Higher oil prices, by affecting economic activity, corporate earnings and inflation, would also have major implications for financial markets. The sharp increases in oil prices in the 1970s had significant adverse effects on the world economy, putting upward pressure on inflation rates and lowering economic growth. These price increases were "supply shocks", where the effects on activity arise because higher oil prices increase the costs of production across the economy, representing a reduction in the aggregate supply of goods and services that can be sustained at any given price level.

Stock prices change everyday by market forces. This means that share prices change because of four factors; new information, uncertainty, psychological factors, supply and demand. The price of a stock doesn't only reflect a company's current value, it also reflects the growth that investors expect in the future. Investors who buy an asset expect to make a return over the time horizon that they will hold the asset. The actual return that they make over this holding period may be very different from the expected return, and this is where the risk comes in. The expected return is a function of securities risk and would be based on the models of risk and return. For expected returns, the capital asset pricing model (CAPM) is an equilibrium model. The CAPM was developed to explain the differences in risk premium across assets. According to the CAPM, these differences are due to differences in the riskiness of the returns on the assets.

The general objective of this study is to investigate the relationship between oil price and stock prices in the petroleum industry over the period 1987-2004. The oil companies has identified some risk factors such as oil price risk, foreign currency exchange rate risk, interest rate risk, natural gas price risk, politic risk, natural hazards risk, etc. The investors will take care these risks to buy and sell the oil stocks in the petroleum industry. We use oil risk as an additional variable into Intertemporal CAPM model which is constructed by Merton (1973). We start the analysis by investigating an oil factor effect from the models over the entire period. We analyse the effect of oil factor from the model over the entire period and then evaluate the models over different sub-periods obtained by splitting the initial sample based on trend changes in oil price and market indexes.

Very few attempts have been made to analyze the factors affecting oil company stocks and their relations. Some deal with the time series properties of the US exchange rate and oil prices, while others refer specifically to the exposure of firms to various risk factors. These studies examine several companies and periods, taking into consideration different risk factors, and focus on the short run impacts or long run exposure. The sensitivity of London quoted oil company stocks to oil prices is investigated by Manning (1991). A cointegration procedure is adopted to assess market efficiency. The absence of cointegrating relations between oil company stock values, market index values and oil prices are established, in accordance with the efficient market hypothesis. The estimated short-run dynamic models support the hypothesis of positive oil price effects on the returns of oil companies, and the magnitude of the estimated coefficients is larger for the firms involved in exploration than for integrated oil companies. Huang et al. (1996) focus on the relationship between daily oil futures returns and daily US stock returns. Using a vector autoregression (VAR) approach, they find that oil futures returns do lead some individual oil company stock returns but oil futures returns do not have much impact on broad based market indices like the S&P500. They also find that oil futures volatility leads the petroleum stock index volatility. Sadorsky (1999) uses a VAR model to study the relationship between oil prices changes and real stock returns in the United States. He finds that oil price changes and oil price volatility both play important roles in affecting real stock returns. There is also evidence that oil price volatility shocks have asymmetric effects on the economy. Sadorsky (2001) examines Canadian oil and gas industry stock returns. Using monthly data and a multifactor market model, which includes returns on market index, oil price, interest rate and exchange rate, he finds that stock price returns are sensitive to all these factors. Stock price returns show a positive relationship with the market and oil price factors, and a negative relationship with the interest rate and exchange rate returns. First, an increase in the ratio between future and spot prices corresponds to an increase in the company market value. Intuitively, we expect this situation to hold for a company which is focused on upstream activities. Conversely, a company whose business is mainly downstream could be penalized by a future increase in oil prices, if it is not able to transfer the rise in oil prices to the price of refined products. This result is linked to the speed of price adjustments to the oil price increase.

Merton (1973) shows that consumer-investors who solve an intertemporal utility maximization problem will hedge their portfolios against potential changes in the set of investment opportunities. Accordingly, they would demand more of those assets whose returns are positively correlated with changes in certain state variables that are expected to result in less consumption. Chen et al. (1986) show empirically that standard macroeconomic variables such as interest rate spreads, output and inflation growth indeed explain some of the cross-sectional variation of stock returns. They construct a set of twelve state variables for which they investigate empirically the impact on stock portfolio returns in a cross-sectional asset pricing test. These variables comprise the monthly growth rate of industrial production, the annual growth in industrial production, the expected inflation as computed by Fama and Gibbons (1984), the unexpected inflation, the real short-term interest rate, the change in expected inflation, the risk premium as the return differential of low-grade corporate bonds and long-term government bonds, and the term structure as the return differential of long-term government bonds and the treasury bill rate, further the value-weighted and the equally-weighted NYSE index, the growth rate of real aggregate consumption, and an oil price index. They find that neither the change in real per capita consumption nor the oil price index show a significant impact on the size-sorted stock returns. Chen et al. conclude from their findings that stock returns are indeed subject to different sources of systematic risk which can be proxied for by the innovations to some standard macroeconomic variables.

The first section of this work will focus on the establishment of detailed research procedures that will provide the framework for the development of this thesis. The remaining sections are outlined as follows; the second section will provide an extensive review of literature on the previous works. Section three concentrates on the fundamentals of commodity prices, stock prices and oil prices. Section four will introduce the empirical results obtained from the research. The final section will provide conclusions and implications of the research.

2. LITERATURE REVIEW

The behaviour of commodity prices is a subject that has received considerable attention from academics; it is also a major concern for producers and consumers. Indeed, many producer countries depend on revenue from their commodity exports to support their growth and industrialization, whereas consumer countries depend on commodity imports to fuel their production. Since the pioneering work of Prebisch and Singer (1950), which drew international attention to the declining trends in primary commodity prices, economists and policy makers have been intrigued by the causes and consequences of commodity price developments. Reinhart and Wickham (1994), Borensztein and Reinhart (1994) adopt a structural model to identify the key fundamentals behind commodity prices, and more importantly to quantify the relative contributions of demand and supply shocks. On the demand side, they find that the real US dollar effective exchange rate and the state of the business cycle in industrial countries are closely linked to the cyclical movement of world commodity prices. On the supply side, strong productivity growth of commodity sectors relative to the rest of the economy and the increased commodity supply relative to the rest of the economy are the primary causes of the downward trend of commodity prices. Variability in commodity prices arises as a direct consequence of shocks in underlying demand and supply conditions, and is affected significantly by policy measures implemented at the national level. For storable commodities, Deaton and Laroque (1992) characterize the nature of price shocks depending on prevailing market conditions. In tight markets, a sudden increase to consumption induces a sharp rise in prices which are temporal in nature, while in slack markets, the impact of a shock induces the release of stocks and other policy measures that dampen price increases but render them persistent. Cuddington (1992); Reinhart and Wickham (1994); and Cashin, Liang, and McDermott (2000) find that shocks, which drive cycles in commodity prices, can exhibit different degrees of persistence across commodities.

Shiller (1981) examines stock price movements are consistent with market rationality and concludes that stock prices are too volatile to be accounted for by the present value of future dividends. Some authors (Mehra and Prescott (1985), Cochrane (1991), Campbell and Shiller (1989) and Epsein and Zin (1991)) argue that stock price movements can be rationalised by fluctuations in discount rates, while others find evidence that earnings expectations may partly explain stock price volatility (Marsh and Merton (1987), Lee (1996) and Bulkley and Harris (1997)).

A market with prices fully reflecting all available information is called efficient. All the efficient market hypotheses assert that the investors will not be able to achieve an abnormal or excess return. Following the seminal work of Fama (1970), a number of studies documented that the stock markets in the developed countries are either weak or semi-strong form efficient. There is recent interest on the market efficiency of emerging capital markets. Researchers have focused on whether these markets are informationally efficient or whether anomalies exist. El-Erian and Kumar (1995) use indices of prices for the stock markets of Turkey and Jordan. Using the serial correlation and the parametric run techniques, they find both markets to be inefficient. Antoniou and Ergul (1997) study the Istanbul Stock Exchange and find it to be inefficient in the early times and efficiency improves as the country starts liberalization and deregulation.The efficient market hypothesis can be divided into three forms of market efficiency. There is weak-form efficiency, semi strong-form efficiency and strong form efficiency. In the weak-form efficient market it is impossible to make abnormal profits by using historical share prices or other financial data as only guidance. In the semi strong-form efficient market it is impossible to make abnormal profits by studying publicly available information. In the strong-form efficient market it is impossible to make profits from analyzing by using any information available, both private and public information. If this were true it would not be possible to earn an abnormal profit by using insider information. The abnormal return(AR) can also be measured by the market model,

$$AR = R - (\alpha + \beta R_m)$$

In weak form efficiency, fully incorporates the information in past stock prices, it would not be able to generate profits if weak form efficiency holds. Weak form efficiency is represented as,

$$P_t = P_{t-1} + E[R_t] + \varepsilon_t \qquad (2.1)$$

The price today is equal to the sum of the last observed price plus the expected return on the stock plus a random component occurring over the interval. Last observed price could have occurred yesterday, last week, or last month, depending on once's sampling interval. The expected return is a function of securities risk and would be based on the models of risk and return. The random component is due to new information on the stock. It could be either positive or negative and has an expectation of zero. The random component in any one period is unrelated to random component in any past period. This component is not predictable from past prices. If stock prices follow equation (2.1), it follows a random walk.

Investors who buy an asset expect to make a return over the time horizon that they will hold the asset. The actual return that they make over this holding period may be very different from the expected return and this is where the risk comes in. In addition to the expected return, an investor now has to consider the following. First, the spread of the actual returns around the expected return is captured by the variance or standard deviation of the distribution; the greater the deviation of the actual returns from expected returns, the greater the variance. Second, the bias towards positive or negative returns is captured by the skewness of the distribution. The distribution above is positively skewed, since there is a greater likelihood of large positive returns than large negative returns. Third, the shape of the tails of the distribution is measured by the kurtosis of the distribution; fatter tails lead to higher kurtosis.

In the more general case, where distributions are neither symmetric nor normal, it is still conceivable, though unlikely, that investors still choose between investments on the basis of only the expected return and the variance, if they possess utility functions that allow them to do so. A utility function is a way of summarizing investor preferences into a generic term called "utility" on the basis of some choice variables. In this case, for instance, investor utility or satisfaction is stated as a function of wealth. It is far more likely, however, that they prefer positive skewed distributions to negatively skewed ones, and distributions with a lower likelihood of jumps (lower kurtosis) to those with a higher likelihood of jumps (higher kurtosis). Investors will trade off the good (higher expected returns and more positive skewness) against the bad (higher variance and kurtosis) in making investments. Among the risk and return models, the capital asset pricing model (CAPM) explicitly requires that choices be made only in terms of expected returns and variances. While it does ignore the skewness and kurtosis, it is not clear how much of a factor these additional moments of the distribution are in determining expected returns.

CAPM developed by Sharpe (1964), Lintner (1965) and Black (1972), predict that the expected asset return is a linear function of the risk, where the risk is measured by the covariance between its return and that of a market portfolio. The empirical evidence on the

CAPM is mixed. Black, Jensen and Scholes (1972), Fama and MacBeth (1973) and Blume and Friend (1973) find support for CAPM whereas Basu (1977) and Banz (1981), Fama and French (1992, 1993), DeBondt and Thaler (1985) and Jegadeesh and Titman (1993) find evidence against the CAPM. The mixed evidence naturally leads to consideration of multifactor asset pricing models. The CAPM is an equilibrium model for expected returns and relies on a set of rather strict assumptions. The CAPM was developed, at least in part, to explain the differences in risk premium across assets. According to the CAPM, these differences are due to differences in the riskiness of the returns on the assets. The model asserts that the correct measure of riskiness is its measure- known as beta- and that the risk premium per unit of riskiness is the same across all assets. Given the risk-free rate and the beta of an asset, the CAPM predicts the expected risk premium for that asset. CAPM assumptions are as follows:

1. Risk aversion, rational and utility maximizing behavior of investors.
2. All securities (or financial assets) are marketable, so they can be sold and bought on the market.
3. Assets are infinitely divisible.
4. There are no transaction costs.
5. The absence of personal income tax, i.e. the taxes and legal regulations has no influence on investor preferences.
6. An individual cannot influence the price of a stock by his selling or buying action.
7. Investors are expected to make decisions solely in terms of expected values and standard deviations of the returns on their portfolios.
8. Assumption of unlimited lending and borrowing at the risk-free rate.
9. Homogeneity of expectation. Investors have identical expectations with respect to the assets.

CAPM relationship can be expressed in the following way:

$$R_{it} = r_f + \beta_{i,M}\left(R_{Mt} - r_f\right) + \varepsilon_{it}$$

One of the important problems of financial economics is the quantification of the tradeoff between risk and expected return. Although common sense suggests that risky investment such as the stock market will generally yield higher returns than investment free of risk, it was only with the development of the CAPM that economists were able to quantify risk and the reward for bearing it. The CAPM implies that the expected return of an asset must be linearly related to the covariance of its return with the return of the market portfolio. The risk of any asset to an investor is the risk added on by that asset to the investor's overall portfolio. Erdogan (1996) investigates bunker and freight risk for maritime firms. In CAPM, the risk of an individual asset to an investor will be the risk that this asset adds on to the market portfolio. Intuitively, assets that move more with the market portfolio will tend to be riskier than assets that move less, since the movements that are unrelated to the market portfolio will not affect the overall value of the portfolio when an asset is added on to the portfolio. Statistically, this added risk is measured by the covariance of the asset with the market portfolio.

Since the covariance of the market portfolio with itself is its variance, the beta of the market portfolio, and by extension, the average asset in it, is one. Assets that are riskier than average (using this measure of risk) will have betas that exceed one and assets that are safer than average will have betas that are lower than one . The riskless asset will have a beta of zero.

According to the CAPM, the extra return earned by any risky asset comes from bearing market risk only. There is now considerable evidence against the CAPM, suggesting that variables other than the rate of return on a market portfolio proxy command significant risk premia. The intertemporal CAPM (ICAPM) theory (Merton 1973) suggests that the premium on any risky asset is related to the market risk premium as well as to the risk premia on additional variables. Economic risk premia represent the compensation for holding assets that are exposed to prespecified sources of economic risk. Merton does not explicitly identify these additional sources of risk but shows that variables affecting a representative investor's risk-return trade-off should also command significant risk premia. Since Merton (1973), financial economists have begun to realize that factors, state variables or sources of priced risk, beyond movements in the market portfolio should be considered as explanations of why some average returns are higher than others. Investors' marginal value of wealth is affected not only by how the stock market performs but also by how their earnings, bonuses, real estate property, and numerous other sources of income or wealth change over time. Hence, investors would be more willing to hold stock and bond market assets if these represented a good hedge against the possibility of negative developments. In other words, investors would be willing to pay a higher price for those assets that best hedge against macroeconomic as well as financial risk. The ICAPM uses a time series multiple regression to measure the exposure of asset i to the set of risk factors M, A and so on.

$$R_{it}-r_f=\alpha_i+\beta_{iM}(R_{Mt}-r_f)+\beta_{iA}(R_{At}-r_f)+...+\varepsilon_{it}$$

for t = 1, 2, . . . , T and i = 1, 2, . . . , N, where F_M, F_A, etc., represent multiple risk factors and the βs represent the factor loadings. The risk premium on asset i is given by

$$ER_{it}-r_f=\alpha_i+\beta_{iM}\lambda_M+\beta_{iA}\lambda_A+...$$

for i = 1, . . . , N, where λ_M, $\lambda_{A,}$ . . . represent the conditional market risk premium and the conditional premiums on the additional sources of economic risk, respectively.

Some authors argue that multifactor models such as the ICAPM perform better than the CAPM in explaining expected excess returns. In the ICAPM, the market portfolio serves as one factor and the state variables, F_A, . . . , serve as additional factors. The additional factors arise from investors' demand to hedge uncertainty about future investment opportunities. Factors do not need to be traded portfolios of assets. Proposed factors include macroeconomic variables such as innovations in gross domestic product (GDP), changes in bond yields, unanticipated inflation, and so forth.

3. OVERVIEW OF THE PETROLEUM INDUSTRY

Petroleum is a complex mixture of liquid hydrocarbon, chemical compounds containing hydrogen and carbon, occurring naturally within the earth.

3.1. Petroleum Products

Although petroleum provides many useful products, the most notable are motor gasoline and heating fuel. Petroleum is used in the transportation sector include fuel for automobiles, trucks, agricultural and industrial machinery, trains, ships, and aircraft. Petroleum is used to heat homes, offices, and factories and is used to grow, process, package, distribute, refrigerate, and cook food. Petroleum is also the source of synthetic fabric for cloths as well as detergents and dry cleaning solvent to clean them. Moreover, petroleum provides a chemical base for cosmetics and pharmaceutical products as well as for many plastic products from toys to building materials.

Some petroleum products are as follows:

- Motor gasoline is chiefly used to fuel automobiles and light trucks for highway use.

- Distillate fuel oil includes diesel oil, heating oils, and industrial oils. It is used to power diesel engines in buses, trucks, trains, automobiles, and other machinery. It is also used to heat residential and commercial buildings and to fire industrial and electric utility boilers.

- Liquefied petroleum gases (LPG's) are used as inputs (feedstocks) for petrochemical production processes. This is their major nonfuel use. LPG's are also used as fuel for domestic heating and cooking, farming operations, and as an alternative to gasoline for use in internal combustion engines.

- Most jet fuel is a kerosene-based fuel primarily used in commercial airlines. It requires a higher temperature to ignite and is safer for commercial use than naphtha-based fuel.

- Naphtha jet fuel meets the specifications required for certain military aircraft. It has a lower freezing point than commercial fuel and a lower flash (ignition) point.

- Kerosene is used for residential and commercial space heating. It is also used in water heaters, as a cooking fuel, and in lamps. Kerosene falls within the light distillate range of refinery output that includes some diesel fuel, jet fuel, and other light fuel oils.

- Petroleum coke can be used as a relatively low-ash solid fuel for power plants and industrial use (marketable coke) if its sulfur content is low enough, or used in nonfuel applications (catalyst coke), such as in refinery operations.

- Nonfuel use of petroleum is small compared with fuel use. Solvents such as those used in paints, lacquers, and printing inks;. Lubricating oils and greases for automobile engines and other machinery; Petroleum (or paraffin) wax used in candy making, packaging, candles, matches, and polishes; Asphalt used to pave roads and airfields, to surface canals and reservoirs, and to make roofing materials and floor coverings; Petroleum Feedstocks used as chemical feedstock derived from petroleum principally for the manufacture of chemicals, synthetic rubber, and a variety of plastics.

Unlike crude oil, which is mostly consumed by only one kind of final user, refined petroleum products are ultimately sold to a variety of users in the transportation, residential, industrial, commercial, and electric utility sectors of the economy (EIA, 1999).

3.2. Oil Industry Structure

Petroleum companies are a mix of large integrated companies known often as "major oil companies and smaller "independents". Integrated oil companies own and operate establishments in many facets of the industry, from exploration through marketing. The independent companies, although greater in number than the majors, own a smaller share of the industry. These companies usually specialize in one particular activity of the oil industry, such as production or marketing (as independent drilling or exploration contractors or independent service station operators). The petroleum market can be thought of as two separate but interdependent markets for crude oil and products in which the majors, independents, and a host of traders and marketers cooperate in transferring ownership from producers to consumers. Crude oil ownership is transferred from producers to refiners by transactions in the crude oil market. Products refined from crude oil are sold to final consumers in the petroleum products market, where price movements are similar, but not entirely parallel, to those in the crude oil market (EIA, 1999).

A recent study asserted that a total of over 2,600 merger transactions took place in the oil industry from 1991 through 2000. These mergers fell into two main classes: asset mergers and corporate mergers. Asset mergers accounted for approximately 80% of the total, and the remaining 20% were corporate mergers. Asset mergers are defined as one company purchasing a part, or a specific asset from another company. For example, Tosco Petroleum's acquisition of Unocal's refining and marketing assets on the West Coast in 1997 was an asset merger. Corporate mergers are defined as those in which one company acquires the other company's total assets, resulting in one company. Examples include Exxon-Mobil and Chevron-Texaco, which produced two of the super major oil companies. A possible outcome of mergers and acquisitions is that the resulting companies, larger and more capable of exerting market power, raise prices to the detriment of consumers. An econometric analysis on a set of these mergers and found that mergers and the resulting higher concentration ratios observed in the oil industry resulted in wholesale price increases of about 2 cents per gallon in six of the eight specific cases it examined (Pirog, 2004).

3.3. Oil Markets

Crude oil purchases and exchanges can be accomplished by long-term contracts or through spot market acquisitions. Long-term contracts specify the volumes to be delivered and fix the price for a period of time. Since the middle 1980's, more and more crude oil has been bought and sold on the spot market, where single cargoes of oil are purchased for more immediate delivery. Buyers and sellers agree on a price at the same time of sale, which is much closer to the actual delivery date. Therefore, the "spot" prices are usually a better indicator of current market conditions than long-term contract prices.

Unlike contract and spot markets, the futures market is a paper market where contracts for crude oil and some petroleum products are bought and sold. Successful futures trading began in 1978 when futures contracts for No. 2 heating oil were first offered on the New York Mercantile Exchange (NYMEX). NYMEX remains the leader in energy futures trading. Petroleum futures contracts are also traded at the International Petroleum Exchange in London and at the Singapore International Monetary Exchange (SIMEX). A "futures contract" is an agreement between a seller to deliver and a buyer to accept a commodity on a designated date in the future for a specified price. The contract defines a standard quantity and quality of the product and the point of delivery. On the NYMEX, for example, all crude oil contracts specify 1,000 barrels of West Texas Intermediate crude oil to be delivered at Cushing, Oklahoma, as a standard. The price is settled by negotiation when the contract is sold. An "options contract" gives the trader the right to buy or sell a futures contract at a later date for a specified price. It is not, however, an obligation to buy or sell. The right to buy is known as a "call" option and the right to sell as a "put" option. The option may or may not be exercised depending on how futures prices change. If an option is not exercised, the buyer loses a premium paid to the seller. The futures market succeeds because of contract liquidity and price uncertainty, which has dominated the oil market since the early 1970's. Some traders use the futures market for speculating on price changes. More often, however, the futures market is used by producers and consumers to hedge against uncertainty in price or supply. A hedge is designed to protect a trader against losses when the price changes to his/her disadvantage. It can be accomplished because a hedger makes counterbalancing (opposite) transactions in the futures market and the cash market (where physical goods are traded). Options contracts can also be used to protect against adverse price changes (EIA, 1999).

While oil markets may behave like other commodity markets much of the time, the oil market does have unique features. First, few commodity markets have an institution like the Organization of Petroleum Exporting Countries (OPEC). Since its creation in 1960, OPEC has had a variable influence on the price of oil through its member nation quota system. Second, oil has been subject to supply disruption due to political instability as well as technical factors. Third, psychological or expectations effects, tied to real or perceived probabilities of market disruption, may lead to price volatility. Finally, world oil transactions are settled in US dollars, which affects the value of the dollar in world currency markets, as well as the magnitude of international reserves held by petroleum importing and exporting nations around the world (Pirog, 2004).

3.4 Oil Industry Risk

The ICAPM suggests that the premium on any risky asset is related to the market risk premium as well as to the risk premia on additional variables. Investors who buy and sell an asset will use risk factors in making investment decision. Risk factors in oil industry are as follows:

There is strong competition, both within the oil industry and with other industries, in supplying the fuel needs of commerce, industry and the home. The oil industry is particularly subject to regulation and intervention by governments throughout the world in such matters as the award of exploration and production interests, the imposition of specific drilling obligations, environmental protection controls, control over the development and decommissioning of a field (including restrictions on production) and, possibly, nationalization, expropriation or cancellation of contract rights. The oil industry is also subject to the payment of royalties and taxation, which tend to be high compared with those payable in respect of other commercial activities. Exploration and production require high levels of investment and have particular economic risks and opportunities. They are subject to natural hazards and other uncertainties including those relating to the physical characteristics of an oil or natural gas field. Oil prices are subject to international supply and demand. Political developments (especially in the Middle East) and the outcome of meetings of OPEC can particularly affect world oil supply and oil prices. Natural gas prices are subject to regional supply and demand. Prices can fluctuate significantly. Refining profitability can be volatile with both oversupply and periodic supply tightness in various regional markets. The marketing of petroleum and related products, especially to retail customers, can be affected by intense competition. Crude oil prices are generally set in dollars while sales of refined products may be in a variety of currencies. Fluctuation in exchange rates can therefore give rise to foreign exchange exposures. Sectors of the chemicals industry are also subject to fluctuations in supply and demand within the chemicals market, with consequent effect on prices and profitability, and to governmental regulation and intervention in such matters as safety and environmental controls.

3.5. OPEC

OPEC was formed in 1960 with five founding members Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. By the end of 1971 six other nations had joined the group: Qatar, Indonesia, Libya, United Arab Emirates, Algeria and Nigeria. OPEC seeks to create favorable oil prices for its members by assigning production quotas to its member nations with the goal of limiting the supply of crude oil available on the world market. The ability of the quota system to control price has been questioned because of the well known propensity for OPEC members to produce beyond their assigned production levels (Pirog, 2004). OPEC has used production quotas since 1983 as a way of managing the market, but has not always been successful in defending targeted price levels because of lack of discipline by some member states in abiding by quota and due to miscalculations by OPEC over the call on its production. OPEC has influenced conditions in the oil market as buyers and sellers await decisions taken at OPEC meetings, and monitor the institution's behavior (IEA, 2002).

3.6. Oil Benchmark

The crude oil market is the largest commodity market in the world. Total world consumption equals around 70-80 million barrels a day of which the United States consume approximately 25 percent. Several times total consumption is traded daily on crude oil, spot, futures and over-the-counter markets at Exchanges in New York (NYMEX) and London (IPE). Prices of three types of oil – Brent, West Texas Intermediate(WTI) and Dubai - serve as a benchmark for other types of crude oil. Processing costs and therefore prices of oil depend on two important characteristics: sulphur content and density. Oil that has a low sulphur content ("sweet") and a low density ("light") is cheaper to process than oil that has a high sulphur content ("sour") and high density ("heavy"). For instance the price of WTI is generally higher than Brent oil as it is sweeter and lighter than Brent oil (Driesprong et. al, 2003).

The three "benchmark" grades of crude oil are:

- Brent: Brent is a light, sweet crude oil produced in the North Sea within the territorial waters of the United Kingdom. Because Brent is slightly heavier and has slightly more sulfur than WTI, which is also a light, sweet crude oil, it normally costs less than WTI. More crude oil is priced in relation to Brent than to any other type of crude oil. Brent serves as the benchmark for approximately 40-50 million barrels of crude oil produced daily. Most of the crude oil priced off Brent is purchased in Europe. About one- fifth of the 10 million barrels of crude oil imported daily into the United States are priced off Brent. The Brent-based imports come from west Africa and northwest Europe.

- West Texas Intermediate (WTI): WTI is the benchmark for approximately 12 to 15 million barrels of crude oil produced or sold each day in the Western Hemisphere. Except for crude oil produced in Alaska, nearly all of the crude oil produced in the United

States is priced off WTI. About 80 percent of the crude oil imported into the United States is priced off WTI. Although more crude oil worldwide is priced off Brent than WTI, the standard NYMEX WTI contract is the most widely traded commodity futures contract in the world. Approximately 150,000 contracts for WTI are traded daily on the NYMEX, representing a volume of crude oil equal to nearly twice the world's daily production. WTI is actually a blend of crude oils produced in oil fields in Texas, New Mexico, Oklahoma, and Kansas. These crude oils all have relatively low sulfur levels and are relatively low in density. Like Brent, the production of WTI is dwindling. Ten years ago, around 750,000 barrels of WTI were produced daily; presently, around 400,000 barrels of WTI are produced daily. Future production is expected to decline.

- Dubai: Generally, crude oil purchased in Asia, most of which originates in the Middle East, is priced off the Dubai benchmark. This benchmark price is calculated from the price of crude oils produced in both Dubai and Oman. Approximately 10-15 million barrels per day of crude oil are priced off the Dubai benchmark. Only a small fraction of US crude oil imports are linked to the price of Dubai oil. Initially, the Dubai benchmark price was calculated solely on the basis of the price of crude oil produced in Dubai. However, as production declined from around 350,000 barrels per day ten years ago to around 200,000 barrels per day in recent years, the Dubai market became volatile and susceptible to manipulation.

Just as crude oil purchasers located in the United States use the difference between the price of Brent and the price of WTI as a major factor in determining whether to import crudes from Europe and West Africa, purchasers in Asia use the difference between the price of Brent and the price of Dubai as a major factor in determining whether to export European and West African crudes to Asia. Hence, the price of Brent is a critical component of the entire global crude oil trade, and the relative price of the three benchmarks are a major factor determining the global flow of crude oil.

3.7. Oil Reserves

The Middle East, and especially Saudi Arabia, continue to be the largest holders of reserves in the world. Some of the other regional changes in the data reflect changing national and political borders as well as oil positions. European reserves are now dominated by members of the former Soviet bloc, including Azerbaijan, Kazakhstan, Romania, and others.

The long term ability of the oil market to meet demand depends on the magnitude of available reserves. An important category of reserves are proved reserves. Proved reserves are those quantities that geological and engineering analysis suggest can be recovered with high probability under existing technological and economic conditions. Proved reserves can be augmented through exploration and development of new discoveries, through technological improvements, as well as through the existence of more favorable economic conditions. Whether the proved reserve base grows over time or not depends in part on the level of production. As production proceeds, the level of proved reserves declines. As new oil discoveries are made, recovery technologies improve, or as the price of oil rises, the stock of proved reserves increases. A standard measure of the potential availability of oil over time is the reserve to production ratio (R/P). The R/P can be interpreted as the number of years that the existing reserve base can sustain the current level of production. Since both proved reserves and production can change year-to-year, the value of the R/P is more descriptive as a measure of potential market viability when considered over time. Table 1 shows the R/P over the past 20 years for the world as well as various regions.

Table 3.1. Oil reserve / production ratios, selected years.

	1983	1993	2003
World	31.6	42.5	41.0
U.S.	7.0	7.7	11.3
North America	14.6	17.9	12.2
South and Central America	25.5	42.9	41.5
Europe and Euroasia	Incomplete	16.2	17.1
Middle East	76.4	92.3	88.1
Africa	32.9	23.8	33.2
Asia Pacific	21.4	18.6	16.6

Source: For 2003 and 1993, *BP Statistical Review of World Energy, June 2004.* pp. 4, 6; and for 1983, U.S. Energy Information Administration. *International Energy Annual 1983.* Tables 14, 30. pp. 30, 84.

The reserve portion of the ratio shows that the world had access to more reserves in 2003 than in 1993 or 1983. Reserves in 2003 totaled 1.147 trillion barrels. Reserves in 1993 were 1.023 trillion barrels, and in 1983 were 723 billion barrels. These data represent over a 12% increase in reserves for the decade since 1993, and a 36% increase compared to 1983. Similarly, world production is greater in 2003, at 76.7 million barrels per day (b/d), than in 1993 when production was 66 million b/d, or 1983 when production was 57.9 million b/d. This represents an increase in production of over 32% compared to 1983. Another conclusion that might be drawn from the R/P data is that it provides little support for the escalated prices of the first quarter of 2004. Since little has changed in the long term balance between reserves and production, it is unlikely that the R/P has been the source of upward price pressures. Long term oil prices might be affected by reserve and production positions in the future, but R/P ratios do not appear to be a major cause of recent oil price increases.

The world R/P has stayed roughly constant over the past 2 decades because investments have been made in exploration, development, and production. The International Energy Agency estimates that over $3 trillion, or $103 billion per year will need to be invested in the oil sector through 2030 if its projections for increased demand materialize. It estimates that 70% of this total will be spent on exploration and development, with the remainder in refining, transportation and the development of non-conventional oil sources (Pirog, 2004).

3.8. Oil Consumption

There has been considerable focus on the record rise in global oil consumption in 2004, driven by sharp increases in China and other nations in Asia. The International Energy Agency (IEA) estimates that global consumption will be up by 2.6 million barrels per day (mmb/d) in 2004 to 82.2 mmb/d. That jump of 3.3% would be more than double the average annual increase of the past ten years (1.6%). This growth is being driven by rapidly rising consumption in China and the rest of Asia, not including Japan. Demand growth in the rest of the world is estimated at 2.1% for 2004 (O'neill, 2004).

Table 3.2. Oil consumption in the world.

	2001	2002	2003	2004
OECD CONSUMPTION				
North America	24.0	24.1	24.6	25.1
Europe	15.3	15.3	15.5	15.7
Pacific	8.7	8.6	8.8	8.7
Total OECD	48.0	48.0	48.9	49.5
NON-OECD CONSUMPTION				
FSU	3.7	3.5	3.6	3.7
Europe	0.7	0.7	0.7	0.7
China	4.7	5.0	5.5	6.4
Other Asia	7.6	7.9	8.1	8.5
Latin America	4.9	4.8	4.7	4.9
Middle East	5.2	5.4	5.6	5.9
Africa	2.6	2.7	2.7	2.8
Total NON-OECD	29.4	30.0	30.9	32.9
Total Consumption	77.4	78.0	79.8	82.4

Source: International Energy Agency, Monthly Oil Market Report, October 2004, p:40.

4. FUNDAMENTALS OF PETROLEUM AND STOCK PRICES

4.1. Commodity Prices

Commodity is a homogeneous product. Many products are not perfectly homogeneous, but are sufficiently so to be viewed as commodities; crude oil and oil products are examples. About 25 percent of world merchandise trade consists of primary commodities, and many developing countries depend on one or a few commodities for the majority of their export earnings (Cashin and Pattillo, 2000). Both sharp fluctuations and long-run trend movements in commodity prices present serious challenges for many developing countries, owing to their large impacts on real output, the balance of payments, and government budgetary positions, and because of the consequent difficult problems they pose for the conduct of macroeconomic policy. The behaviour of commodity prices is a subject that has received considerable attention from academics; it is also a major concern for producers and consumers. Indeed, many producer countries depend on revenue from their commodity exports to support their growth and industrialization, whereas consumer countries depend on commodity imports to fuel their production. Moreover, one has only to look at the history of the formation of stockpiles and other schemes that attempt to stabilize prices, as well as the rise and fall of cartels and producer organizations that attempt to increase prices, to realize that the stakes are high. It is therefore not surprising that economists have devised and tested models that explain how commodity - price distributions - means and variances - are determined. Most commodity markets are distinguished by the fact that there is a spot market in which the physical product is sold - the real market - as well as a futures market in which contracts for future delivery of the product are sold -the financial market (Slade and Thille, 2003).

A commodity is a fixed physical substance that investors buy or sell, usually via future contracts at the Commodities Exchange Center (CEC). A commodity future contract is a commitment or agreement to buy or sell a specified quantity of a commodity at a specifie price in a stipulated future date. The original goal of the future commodity market was to guarantee producers the price of goods or raw material used in production; that is, to act as a hedge for price volatility. However, it became also a scenario for speculators with the aim to capitalize on the volatility of the contracts themselves. These two quite different kinds of participants, hedgers and speculators, make it difficult to predict market behavior (Levy-Carciente et. al).

Primary commodities still loom large in international trade. The importance of commodities in total trade has been declining over time, and that of manufactures has been rising. Despite the decline, primary commodities are still sufficiently important to have a substantial impact on the world economy. Changes in the prices of commodities are known to have strong repercussions, for instance on global inflation rates, or on the exchange rates and levels of economic activity of the raw materials exporting countries (Radetzki, 1990). A number of analyst have emphasized that the strong link between movements in the (nominal and real) dollar exchange rate and the relative price of commodities in terms of manufactures. Gilbert(1989) argues convincingly that the appropriate definition of the effective exchange rate is critical in getting meaningful results when studying the impact of exchange rate changes on world commodity prices. International macroeconomists and policy makers have been interested in the impact of alternative exchange arrangements on international trade and financial flows. It has been argued that under flexible exchange rate regimes, export and import prices become more volatile, thereby adding additional risk to export and import transactions. The increased sophistication of firms in hedging exchage rate induced price risks (Cuddington and Liang, 2000).

In a competitive commodity market, inventories can be used to reduce costs of varying production (when marginal cost is increasing), and to reduce marketing costs by facilitating production and delivery scheduling and avoiding stockouts. In a competitive commodity market subject to stochastic fluctuations in production and/or consumption, producers (and to a lesser extent, consumers and third parties) will hold inventories. Producers hold them to reduce costs of adjusting production over time, and also to reduce marketing costs by facilitating production and delivery scheduling and avoiding stockouts. If marginal production costs are increasing with the rate of output and if demand is fluctuating, producers can reduce costs over time by selling out of inventory during high-demand periods, and replenishing inventories during low-demand periods. Inventories also serve as a "lubricant" to facilitate scheduling and reduce marketing costs. Industrial consumers of a commodity also hold inventories, to facilitate their own production processes. To the extent that inventories can reduce production and marketing costs in the face of changing demand conditions, they will reduce the magnitude of short-run price fluctuations. Also, because it is costly for firms to reduce inventory holdings beyond some minimal level, price volatility tends to be greater during periods when inventories are low. When inventory holdings can change, the market-clearing price is determined not only by current production and consumption, but also by inventories. Thus, we must account for equilibrium in both the cash and storage markets (Pindyck, 2001).

In markets for storable commodities such as oil, inventories play a crucial role in price formation. As in manufacturing industries, inventories are used to reduce costs of changing production in response to fluctuations (predictable or otherwise) in demand, and to reduce marketing costs by helping to ensure timely deliveries and avoid stockouts. Producers must determine their production levels jointly with their expected inventory. These decisions are made in light of two prices - a spot price for sale of the commodity itself, and a price for storage. Thus there are two interrelated markets for a commodity: the cash market for immediate, or "spot" purchase and sale, and the storage market for inventories held by both producers and consumers of the commodity (Pindyck, 2001a). In the cash market, purchases and sales of the commodity for immediate delivery occur at a price that we will refer to as the "spot price". Because inventory holdings can change, the spot price does not equate production and consumption. Instead, we can characterize the cash market as a relationship between the spot price and "net demand",i.e., the difference between production and consumption (Pindyck, 2001) .

Many developing countries depend on one or a few commodities for the majority of their export earnings.The Prebisch-Singer hypothesis states that owing to the low income elasticity of demand for commodities and because total factor productivity increases have been smaller for manufactured goods than for primary commodities, the price of commodities relative to manufactured goods should decrease over time. If this hypothesis were true, then the long-term outlook for commodity-exporting countries would be quite unfavorable (Cashin and Mcdermott, 2002).

The markets for oil products, natural gas, and many other commodities are characterized by high levels of volatility. Prices and inventory levels fluctuate considerably from week to week, in part predictably (e.g., due to seasonal shifts in demand) and in part unpredictably. Furthermore, levels of volatility themselves vary over time. Because commodity markets are volatile, producers and consumers often seek ways of hedging and trading risk. In response to this need, markets for commodity risk trading arose, and their use has become increasingly widespread. Instruments traded in these markets include futures and forward contracts, options, swaps, and other derivatives. Futures contracts are among the most important of these instruments, and provide important information about cash and storage markets. Understanding the behavior and role of volatility is important in its own right. Price volatility drives the demand for hedging, whether it is done via financial instruments such as futures contracts or options, or via physical instruments such as inventories. Volatility is a key determinant of the values of commodity-based contingent claims, such as futures contracts, options on futures, and commodity production facilities, such as oil wells, refineries, and pipelines. (Indeed, such production facilities can usefully be viewed as call options on the commodity itself.) Furthermore, volatility plays an important role in driving short-run commodity cash and storage market dynamics (Pindyck, 2001a).

Liberalization of trading markets and development of transaction tools such as derivatives and information technology (IT) intensify volatility. There are more and more people intervening markets at the same time, and reforms of financial and commodity markets and development of IT enable those increasing number of markets' participants to make transactions not only across commodities/stocks within the concerned market, but also across several markets, with greater mobility. The subsequent increasing transactions in turn cause additional volatility. Thus, price fluctuation and volatility are an integral part of open and market-based economies.

In fact, many roots of volatility can be listed: economic factors such as production/ consumption balance and transportation costs; political factors such as market regulation, cartels, taxes, and environmental regulation; geographical factors such as shipping availability, weather, and seasonality; and comparative factors such as quality of commodities, market preference and existence of alternative commodities (IEA, 2002).

Commodity prices are known to be very difficult to predict (Adams, 2003). Early studies in this area assumed that they followed a 'random walk' described by Brownian motion, and this stochastic behavior plays a central role in the models for valuing their contingent claims and in methods for evaluating investments for their generation (Brennan and Schwartz, 1985; Schwartz, 1997, Schwartz and Smith, 2000). Reinhart and Wickham (1994) point out that "there is a sustained and sharp increase in the variance of commodity prices. The increase is evident in all the indices but is most pronounced in the all nonfuel commodities and food groupings". Not only has commodity prices volatility risen over time, commodity prices have consistently exhibited greater volatility than the prices of manufactured goods (Cuddington and Liang, 2000).

4. 2. Stock Prices

Financial theorists define stock price as the present value of all future earnings expectations for the company, divided by its number of shares outstanding. Even companies that lose money today can have a high share price because price is based on the future earnings of the company. No enterprise is in business to lose money, so the expectation is that every business will make money some day. So long as there is the potential for future revenue streams to shareholders, there will be a price that someone is willing to pay for the shares. The earnings that a company could make in the future, the growth that the company could realize and the time to the realization of those goals are all factors which affect the estimate that the market makes on the earnings potential of the company.

There are four factors that cause movements in stock price:

a) New information: Information is key, as it gives the market a reason to value a stock at a particular price level. The market will price a stock based on all information that the public is aware of. As new information comes into the public realm, the market will adjust prices up or down based on how the market perceives the information will effect the future earnings capacity of the company.

b) Uncertainty: What a company will make in the future is far from certain. The uncertain future of the company will bring some volatility in share prices even during a period in which there is no new information.

c) Psychological Factors: Human characteristics are also factors in how share prices move. Understanding human psychology is extremely valuable when evaluating investment opportunities because human psychology creates and accentuates many of the opportunities that investors can capitalize on.

d) Supply and Demand: The majority of stocks do not have liquidity. As a result, stocks that trade smaller volumes of shares are subject to fluctuations because of supply and demand. If more people want to buy a stock (demand) than sell it (supply), then the price moves up. Conversely, if more people wanted to sell a stock than buy it, there would be greater supply than demand, and the price would fall. What is difficult to comprehend is what makes people like a particular stock and dislike another stock (Bolhorn, 2005).

The behavior of stock market prices in one of three possible ways:

a) Market efficiency: Stock prices equal the present value of the rational expectation future cash flows;

b) Irrationality: Stock prices reflect psychological waves of unjustified optimism and pessimism;

c) Conventional consistency: Stock prices reflect a market sentiment regarding future cash flows (i.e., a general sense of directions of business affairs and of market liquidity resulting from heterogeneous investors) and a discount factor (a long-term nominal interest rate) at which expected cash flows are discounted (Terzi and Vega, 2002).

Prior to 1981, much of the finance literature viewed the present value of dividends to be the principal determinant of the level of stock prices. However, Leroy and Porter (1981) and Shiller (1981) found that, under the assumption of a constant discount factor, stock prices were too volatile to be consistent with movements in future dividends. This conclusion, known as the excess volatility hypothesis, argues that stock prices exhibit too much volatility to be justified by fundamental variables. Most academicians believe that dividend policy does not affect the current value of a stock. However, dividend policy greatly affects the future value of a stock (Balke and Wohar, 2002).

4.3. Oil Price

Oil is one of the most heavily traded commodities in the world. Fluctuating prices have important effects for oil producers/exporters and many countries that remain dependent on oil as a key input in their energy, manufacturing and service industries (Tutor2u, 2005). Crude oil prices today are heavily influenced by producers, consumers, and traders buying and selling oil contracts or related financial instruments in various markets for crude oil. The development of a market-based system for determining the price of crude oil is a relatively recent advance in the petroleum industry. Prior to the mid-1970s, crude oil prices were largely determined by fiat by a few large oil companies dubbed the "Seven Sisters." Following the nationalization of many of the Middle Eastern oil fields owned by these companies and the rise in power of the Organization of the Petroleum Exporting Countries (OPEC) cartel, crude oil pricing shifted from private companies to OPEC, which effectively controlled global prices from the mid-1970s until the mid-1980s. Most of the world's crude oil is located within the boundaries of the countries belonging to OPEC, and OPEC has nearly all of the world's estimated excess production capacity. OPEC attempts to set an average global price for crude oil by establishing production quotas for its members and meets regularly to adjust these quotas in consideration of the global balance between supply and demand. Because of its market power, OPEC decisions about the supply of oil significantly affect world oil prices.

The reasons that behind the increase of oil prices in recent years are:

1. A strong recovery in global GDP growth: Fuelling an increase in the demand for many essential raw materials and energy products including oil. A significant influence has been fast growth in the emerging market economies notably China.

2. Speculative demand for oil: Oil inventories (stocks) are low, investors are buying up stocks when they become available and thus driving the price higher. Fear about the future supply of oil given the political crisis in the Middle East is also causing higher prices. Major consumers of oil are desperate to guarantee their supplies and are buying forward contracts.

3. Production limits: The decision by OPEC to hold back on oil production at the start of 2004 – although there is now pressure on OPEC to expand their output quotas. However, the OPEC producers are quite close to their short run production limits.

Higher oil demand matched against an inelastic short run supply of oil invariably drives market prices higher. An increase in demand causes a fall in oil stocks at the major international refineries and pushes prices higher. This acts as a signal to suppliers to expand production. However there are time lags between a change in price and extra supplies coming on stream. The demand for oil is also price inelastic. This combination of an inelastic demand and supply helps to explain some of the volatility in world oil prices (Tutor2u, 2005).

Markets do respond to high prices. Both supply and consumption adjust to changing prices, although in the oil market this sometimes takes quite a while. Nevertheless, high prices are stimulating investment in new oil producing capacity in OPEC and elsewhere. And, if sustained, high prices would lead households and businesses to take steps to reduce consumption of oil-based products. Newly emerging risks, such as the possibility of labour strikes and increasing rebel insurgency in Nigeria, could push prices even higher during the next few months, particularly with the approach of the winter heating season. However, over the medium- to longer-term, oil prices are not likely to be sustained at current levels. This note examines current oil market conditions in an historical context and assesses the likely direction of factors which have forced prices well above normal (O'neill 2004).

Another factor that some feel might be influencing the price of oil is the influence of financial investors and financial instruments. At the time of the first oil shock in 1973/1974, the primary market for oil price formation was the Rotterdam spot market, where physical cargoes of oil for near term delivery were bought and sold, generally by traders who had a real commodity interest in the market. Today, the primary market in price formation may be the NYMEX, supplemented by the International Petroleum Exchange (IPE). In these markets, the focus is not on physical supply for current delivery, but on the open interest in a financial contract, generally a future or options contract, that will expire in the near month, generally the month after the current month. The goal of financial traders is to make a profit on the contract, which may necessitate the price of the contract rising or falling depending on the trader's position in the market and current prices. The implication of this is that financial traders may have an interest in the price moving either up or down, almost without regard to the underlying fundamentals of the market (Pirog 2004).

4.3.1. Exceptional Events

These are a set of factors that may exert an influence on oil prices, but seem to be more in the nature of a "one time" event rather than a trend or cyclic factor. The effect of each of these factors tends to be made more important by the general tightness of the market. In some cases, there is an interactive relationship between two or more of these factors, again possibly increasing the over-all effect on price. The war in Iraq has contributed to high oil prices in different ways as events have progressed. The predominant effect of the conflict on oil prices has been an increase in uncertainty. The concern the market has shown regarding supply disruption has been borne out by events. Political unrest and strikes have disrupted oil exports from both Nigeria and Venezuela. Indonesian oil production has been declining, leaving it unable to meet its OPEC quota. The legal conflict between Yukos, the major Russian oil company and the Russian government over back tax obligations threatens to bankrupt the company, or force the sale of producing assets. Markets are concerned that bankruptcy, or significant asset sales, might lead to an oil supply cutoff, or reduction, of exports from Russia, the world's largest non-OPEC producer.

4.3.2. Oil Price Chronology

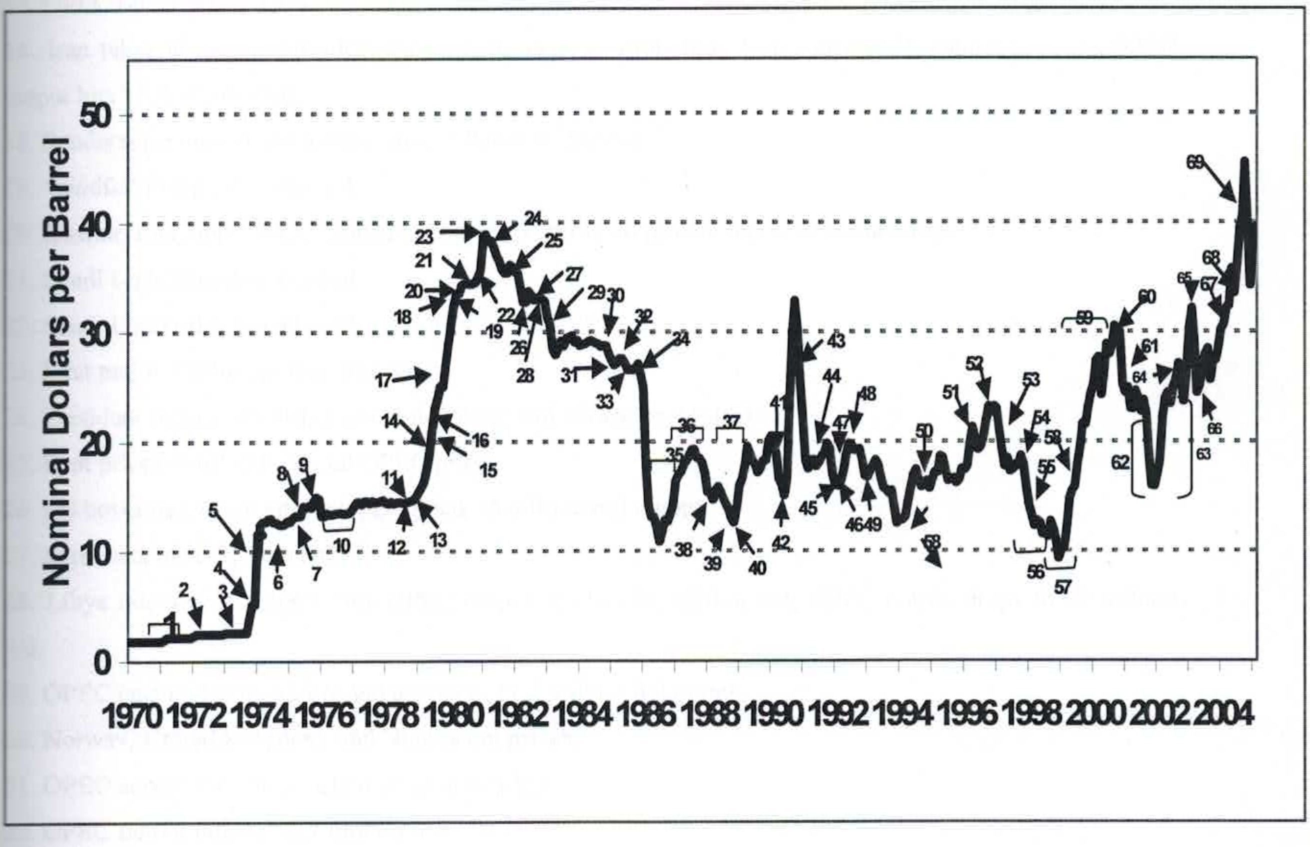

Figure 4.1. World Oil Price Chronology: 1970-2005.

Source: http://www.eia.doe.gov/cabs/chron.html

Notes on data,

The price data graphed above are in nominal terms, i.e., they are in "dollars-of-the-day" and have not been adjusted for inflation.

1. OPEC begins to assert power; raises tax rate & posted prices.

2. OPEC begins nationalization process; raises prices in response to falling US dollar.

3. Negotiations for gradual transfer of ownership of western assets in OPEC countries . Oil embargo begins (October 19-20, 1973).

4. OPEC freezes posted prices; US begins mandatory oil allocation.

5. Oil embargo ends (March 18, 1974).

6. Saudis increase tax rates and royalties.
7. US crude oil entitlements program begins.
8. OPEC announces 15% revenue increase effective October 1, 1975.
9. Official Saudi Light price held constant for 1976.
10. Iranian oil production hits a 27-year low.
11. OPEC decides on 14.5% price increase for 1979.
12. Iranian revolution; Shah deposed.
13. OPEC raises prices 14.5% on April 1, 1979.
14. US phased price decontrol begins.
15. OPEC raises prices 15%.
16. Iran takes hostages; President Carter halts imports from Iran; Iran cancels US contracts; Non-OPEC output hits 17.0 million b/d.
18. Saudis raise marker crude price from 19$/bbl to 26$/bbl.
19. Windfall Profits Tax enacted.
20. Kuwait, Iran, and Libya production cuts drop OPEC oil production to 27 million b/d.
21. Saudi Light raised to $28/bbl.
22. Saudi Light raised to $34/bbl.
23. First major fighting in Iran-Iraq War.
24. President Reagan abolishes remaining price and allocation controls.
25. Spot prices dominate official OPEC prices.
26. US boycotts Libyan crude; OPEC plans 18 million b/d output.
27. Syria cuts off Iraqi pipeline.
28. Libya initiates discounts; Non-OPEC output reaches 20 million b/d; OPEC output drops to 15 million b/d.
29. OPEC cuts prices by $5/bbl and agrees to 17.5 million b/d output.
30. Norway, United Kingdom, and Nigeria cut prices.
31. OPEC accord cuts Saudi Light price to $28/bbl.
32. OPEC output falls to 13.7 million b/d.
33. Saudis link to spot price and begin to raise output.
34. OPEC output reaches 18 million b/d.
35. Wide use of netback pricing.
36. Wide use of fixed prices.
37. Wide use of formula pricing.
38. OPEC/Non-OPEC meeting failure.
39. OPEC production accord; Fulmar/Brent production outages in the North Sea.
40. Exxon's Valdez tanker spills 11 million gallons of crude oil.
41. OPEC raises production ceiling to 19.5 million b/d.
42. Iraq invades Kuwait.
43. Operation Desert Storm begins; 17.3 million barrels of SPR crude oil sales is awarded.
44. Persian Gulf war ends.

45. Dissolution of Soviet Union; Last Kuwaiti oil fire is extinguished on November 6, 1991.

46. UN sanctions threatened against Libya.

47. Saudi Arabia agrees to support OPEC price increase.

48. OPEC production reaches 25.3 million b/d, the highest in over a decade.

49. Kuwait boosts production by 560,000 b/d in defiance of OPEC quota.

50. Nigerian oil workers' strike.

51. Extremely cold weather in the US and Europe.

52. US launches cruise missile attacks into southern Iraq following an Iraqi-supported invasion of Kurdish safe haven areas in northern Iraq.

53. Iraq begins exporting oil under United Nations Security Council Resolution 986.

54. Prices rise as Iraq's refusal to allow United Nations weapons inspectors into "sensitive" sites raises tensions in the oil-rich Middle East.

55. OPEC raises its production ceiling by 2.5 million barrels per day to 27.5 million barrels per day. This is the first increase in 4 years.

56. World oil supply increases by 2.25 million barrels per day in 1997, the largest annual increase since 1988.

57. Oil prices continue to plummet as increased production from Iraq coincides with no growth in Asian oil demand due to the Asian economic crisis and increases in world oil inventories following two unusually warm winters.

58. OPEC pledges additional production cuts for the third time since March 1998. Total pledged cuts amount to about 4.3 million barrels per day.

59. Oil prices triple between January 1999 and September 2000 due to strong world oil demand, OPEC oil production cutbacks, and other factors, including weather and low oil stock levels.

60. President Clinton authorizes the release of 30 million barrels of oil from the Strategic Petroleum Reserve (SPR) over 30 days to bolster oil supplies, particularly heating oil in the Northeast.

61. Oil prices fall due to weak world demand (largely as a result of economic recession in the United States) and OPEC overproduction.

62. Oil prices decline sharply following the September 11, 2001 terrorist attacks on the United States, largely on increased fears of a sharper worldwide economic downturn (and therefore sharply lower oil demand). Prices then increase on oil production cuts by OPEC and non- OPEC at the beginning of 2002, plus unrest in the Middle East and the possibility of renewed conflict with Iraq.

63. OPEC oil production cuts, unrest in Venezuela, and rising tension in the Middle East contribute to a significant increase in oil prices between January and June.

64. A general strike in Venezuela, concern over a possible military conflict in Iraq, and cold winter weather all contribute to a sharp decline in US oil inventories and cause oil prices to escalate further at the end of the year.

65. Continued unrest in Venezuela and oil traders' anticipation of imminent military action in Iraq causes prices to rise in January and February, 2003.

66. Military action commences in Iraq on March 19, 2003. Iraqi oil fields are not destroyed as had been feared. Prices fall.

67. OPEC delegates agree to lower the cartel's output ceiling by 1 million barrels per day, to 23.5 million barrels per day, effective April 2004.

68. OPEC agrees to raise its crude oil production target by 500,000 barrels (2% of current OPEC production) by August 1—in an effort to moderate high crude oil prices.

69. Hurricane Ivan causes lasting damage to the energy infrastructure in the Gulf of Mexico and interrupts oil and natural gas supplies to the United States. US Secretary of Energy Spencer Abraham agrees to release 1.7 million barrels of oil in the form of a loan from the Strategic Petroleum Reserve (EIA, 2005).

4.3.3. Oil Price Volatility

There is an increasing concern about price volatility in energy markets, particularly oil markets. One of the most common indicator of price volatility is to measure dispersion of daily price changes over a certain period. The analysis of daily Brent price indicates that oil prices have been more volatile during the last several years. This change in oil price movement can be attributed to a change in OPEC's production policy. However, a number of other factors such as the decline in spare crude oil production capacity in the oil producing countries, and lower level of desired inventories and rapid decline in surplus capacity in the global refining industry also enhanced this transformation to a period of more volatility. The resulting tightly balanced market has become more sensitive to actual or threatened supply disruptions, and swings in demand are increasingly met by price changes rather than delivery from storage. Liberalization of trading markets and development of transaction tools such as derivatives and information technology seem to intensify volatility. Since changes in prices affect market variable such as production and inventories, sharp and unpredictable swings in energy prices complicate economic management and lead to ineffective policy and inefficient allocation of capital.

Whatever the adverse effects of oil price volatility, it seems likely that oil prices will remain highly volatile in the foreseeable future. The growing dependence on oil imports from Middle East OPEC producers and their increased market power suggests that oil prices will continue to fluctuate in the mid- and long-term according to changes in OPEC production policies, quota discipline and market perceptions and expectations. Unless significant amount of surplus capacity in crude oil production and refining emerges, markets will also remain sensitive to actual or feared disruptions in supply whether of a political or technical nature, which will most likely keep prices highly volatile in the short-term. A failure to improve oil market transparency through more reliable, timely and accurate data may exacerbate this situation. The volatile energy markets can distort the mid- and long-term development path of the industry. Better stock provision and the availability of alternative energy supplies can soften the impacts of price volatility (IEA, 2002).

4.3.4. Effects of Oil Demand on Price

Demand patterns for world oil and oil products show significant diversity by country, region, and product groupings. As a result of this diversity it is not possible to attach blame for the current level of price to any one nation, region, or product segment. The view that the oil market is international in scope and tightly interrelated is enhanced by the demand data (Pirog, 2004).

The demand of crude oil is affected by a series of different factors:

1. Cyclical demand: There is a strong link between the demand for oil and the rate of global economic growth because oil is an essential input into many industries – when the economy is expanding, the demand for oil rises. The best recent example of this is the extreme growth of the Chinese economy. Fast growth of national output in energy-intensive sectors has led to a surge in demand for crude oil into the Chinese economy. China's burgeoning economy guzzled about 6m barrels per day in the first quarter of 2004, 15% more than a year ago. China now accounts for 7.1% of world oil demand and a third of the increase in global oil demand in 2003 is due to the growth in the Chinese economy.

2. Prices of substitutes: Demand also affected by the relative prices of oil substitutes (e.g. the market price of gas). If in the longer term, reliable and relatively cheaper substitutes for oil can be developed, then we might expect to see a shift in demand away from crude oil towards the emerging substitutes.

3. Changes in climate: Affecting the demand for heating oil. It is often said that if the winter in North America is particular fierce, then the price of crude is almost certain to rise as the USA and Canadian economies raise their demand for oil to fuel household heating systems and workplaces.

4. Market speculation: There is also a speculative demand for oil (i.e. purchasers hoping for a rise in prices on world markets). Indeed one of the features of the most recent spike in oil prices (through the spring of 2004) has been the very high level of speculative demand by hedge funds and other investors pouring in the international petroleum

exchanges to buy up any surplus oil futures contracts. They hope that by the time the contracts are ready to be fulfilled, they will have made a large profit (Tutor2u, 2005).

Although global supply capacity has also expanded in recent years, this has not occurred at the same rate as global demand. Historically, OPEC has had significant excess capacity and has adjusted its supply to reduce swings in market prices. However, OPEC now accounts for less than 40 per cent of global supply, down from more than 50 per cent in the mid 1970s. Also, OPEC is currently producing very close to its capacity: in August, OPEC–10 (OPEC excluding Iraq) produced 27.5 million bpd, only 0.3 million bpd short of its estimated sustainable capacity of 27.8 million bpd. Global primary oil demand is projected to grow by 1.6 per cent per year, reaching 121 mb/d in 2030. Demand will continue to grow most quickly in developing countries. Most of the increase in world oil demand will come from the transport sector (Dickman and Holloway, 2004).

4.3.4.1. Economic Growth

Economic growth in oil consuming nations increases the demand for oil and pushes up oil prices. The world economy continued its recovery in 2003 and 2004 with gross domestic product (GDP) growth rates increasing in many regions. The strongest growth performances were in oil importing United States and China, but better performance was also observed in Japan and Russia, as well as the emerging growth nations of Asia. US growth was 3.1% in 2003, and forecast to reach 4.6% during 2004. Chinese economic growth was 7.4% in 2003 and projected to be 6.8% in 2004. In the United States, economic growth has been linked to high levels of oil consumption, of which increasing gasoline demand is an important component. In China, expanding exports have increased the industrial demand for oil, and rising consumer income has increased consumers' demand for gasoline. US oil demand increased by 1.9% in 2003 to over 20 million b/d. Chinese oil demand increased by 11.5% in 2003 to almost 6 million b/d. While the United States and China increased their demands for crude oil and petroleum products as a result of their GDP growth, Russia, an oil exporter, improved its GDP growth rate as a result of the expansion of the petroleum industry. For Russia, it is likely that expansion of the oil sector led the growth in Russian GDP. This behavior is typical of nations whose oil exporting sector is a major component of their GDP. For nations in this category, high oil prices, based on rising oil demand, create an inflow of oil derived revenue, increasing GDP growth. The danger for these nations is that if prices go too high, and stay high, GDP growth in the consuming nations might decline, reducing the demand and price of oil. An additional factor is that high prices lead to increases in exploration and development budgets around the world. As new oil is found and brought to market, supply increases and prices might be reduced, damaging the oil exporting nation's growth or high oil prices can make alternative fuels more competitive potentially reducing the demand for oil (Pirog, 2004).

4.3.4.2. Exchange Rates

Changes in the exchange rate of the US dollar can affect the level and distribution of world oil demand. The decline in the dollar's value has not been uniform against all currencies. Most of the change has been against nations in the Euro area. The Japanese and some of other Asian trading partners have intervened in the currency markets in an attempt to prevent the dollar from declining in value relative to their currencies. China maintains a fixed exchange rate against the dollar; as a result, the yuan has experienced no appreciation against the dollar. Exchange rate variations in the US dollar can affect the world price of oil because oil is priced in dollars and generally paid for in dollars. Several results may follow from this relationship. First, if the value of the dollar declines against other currencies the dollars received by oil exporting nations are worth less in terms of world purchasing power. If oil exporters are able to exert market power in setting prices, or if market conditions permit oil exporters to dictate higher prices, they have incentives to increase the money price of oil in an attempt to preserve the purchasing power they earn through selling a barrel of oil. The effect of a declining dollar on oil importing consumer nations varies with respect to how their currency has adjusted to the changing value of the dollar. For the United States, of course, any increase in the dollar price of oil is immediately felt as an increased price burden, possibly leading to decreases in demand. For the Euro area consumers, the situation is different. Since the value of the euro has increased in terms of dollars, the effect of any increase in dollar denominated oil prices is offset by the amount of euro appreciation. For example, if the euro appreciates by the same percent that the price of oil in dollars increases the two effects cancel each other. The result is that the demand for oil in the euro area is less likely to be affected by high oil prices as long as the euro appreciates (Pirog, 2004).

4.3.5. Effects of Oil Supply on Price

For the global market supply of oil, making a distinction between short-term and longer-term supply to the international markets is necessary. The short run supply curve is normally drawn on the basis of a given state of production technology and fixed capital inputs (i.e. the oil industry is supplying from a known level of oil reserves and a given stock of capital used to extract that oil). There is inevitably a short-run limit on daily oil supply and, as production gets close to capacity limits, so the short run supply of oil becomes more inelastic. One possible way of modelling this is to assume the supply curve for oil is non-linear. An alternative is to suggest that more oil can be supplied elastically at a fairly constant price until the capacity limit is reached, when the short run supply curve becomes vertical.

The short-run supply of crude oil is affected by a series of different factors:

1. Profit motive: The production decisions of OPEC and Non-OPEC countries.
2. Spare capacity: The level of spare production capacity in the oil sector.
3. Stocks: The current level of crude oil stocks (inventories) available for immediate supply from the major oil refineries – i.e. a high level of stocks means that extra oil supplies can be released onto the market quickly when demand fluctuates.
4. External shocks: The effects of production shocks (e.g. loss of output from rig closures or disruption of oil supplies due to war and terrorist attacks).

Taking a longer-term perspective, the long run world oil supply is linked to:

1. Reserves: Depletion of proven oil reserves – the faster that demand grows, the quicker the expected rate of depletion.
2. Exploration: Investment spending on exploring, identifying and then exploiting new oil reserves. When oil prices are rising and are expected to stay strong for the foreseeable future, it makes financial sense to invest more resources in exploring for new reserves, even though these may not come on stream for some years.
3. Technology: Technological change in oil extraction which affects the costs of extraction and the profitability of extracting and then refining the oil (Tutor2u, 2005).

Over the rest of the current decade non-OPEC countries are expected to contribute most of the increase in global production. High oil prices have stimulated increased development of reserves in those countries in recent years. The transition economies, West Africa and Latin America are expected to contribute most of this increase. Russian output, which has soared in the last six years, will continue to rise, but at a slower rate. In the longer term, production in OPEC countries, especially in the Middle East, will increase more rapidly because their resources are much larger and their production costs are generally lower than in other regions. OPEC crude oil supply, which is assumed to meet the portion of global oil demand not met by non-OPEC producers, will need to increase to 33 mb/d in 2010 and to 65 mb/d in 2030. These projections assume that there are no major disruptions in supply and that current high oil prices will not be sustained. The strong projected growth in OPEC production – particularly in the second half of the projection period –will boost OPEC's market share significantly. In the near term, the cartel's share, which currently stands at 36 per cent, will remain roughly stable but as oil prices return to a level closer to the average of the last two decades, incentives to raise output in non-OPEC regions will diminish, increasing the call on oil from OPEC producers.

Although the unanticipated surge in 2004 oil demand caught the market by surprise, OPEC producers did eventually respond by maximizing production. Key producers have indicated that they will increase exploration and development activity to maintain a sizeable level of spare capacity. But bringing this new capacity on line will take time and requires huge capital investments, money which could otherwise be earmarked for social and economic programs. Major expenditure programs are already required to offset depletion. International oil companies have also increased their exploration and development budgets. But years of cost-cutting have taken their toll on the service industry and constrain its ability to mobilize the rigs and manpower to meet demand. It takes ever longer to expand refinery, pipeline and related shipping infrastructure. More stringent regulations and environmental standards impose new constraints on potential investors and increase their risk.

A long-term challenge confronting the oil industry the availability of sufficient investment to turn resources into production in a timely manner. The IEA projects that global oil investment of around $3 trillion needed over the period 2003-2030, or around $105 billion per year. The openness of countries with large oil resources to foreign direct investment will be a key factor in determining how much upstream investment occurs and where. Today, three major oil producing countries – Kuwait, Mexico and Saudi Arabia – remain totally closed to outside investment. Access to many others, such as Russia and Iran, are restricted. The world is not running out of oil just yet. Most estimates of proven oil reserves are high enough to meet the cumulative world demand we project over the next three decades. But, the IEA calls on all parties to work together to devise and implement a universally-recognised, transparent, consistent and comprehensive data reporting system for oil and gas reserves. The reliability of reserves data reported by oil companies has been called into severe question. Doubts about the accuracy of reserve estimates could undermine investor confidence and slow investment (Birol, 2004).

4.3.6. Macroeconomic Implications of Oil Price

The sharp increases in oil prices in the 1970s had significant adverse effects on the world economy, putting upward pressure on inflation rates and lowering economic growth. These price increases were 'supply shocks', where the effects on activity arise because higher oil prices increase the costs of production across the economy, representing a reduction in the aggregate supply of goods and services that can be sustained at any given price level. In addition, the rise in oil prices represents a loss of real income to oil consumers, which implies that aggregate demand in net oil-consuming countries will be weaker than otherwise. This income is transferred to oil producers and if there is no equivalent boost to aggregate demand in those countries, there will be a net negative effect on world economic growth. The International Energy Agency (IEA), in collaboration with the OECD and IMF, has recently estimated that a US$10 per barrel increase in oil prices reduces global GDP by around 0.5 per cent in the following year, and boosts consumer prices by a slightly larger amount. These results do not take into account the flow-on effects of higher oil prices, for example, to other energy prices, or through reduced consumer and business confidence, nor do they take account of policy responses.

The effects of higher oil prices on different economies will vary considerably depending on the oil intensity of consumption and production and the extent to which the economies are net importers of oil. Oil intensity in aggregate has declined over time, as measured by the quantity of oil consumed per unit of real GDP, though there are significant differences across countries. In this regard, the east Asian region is likely to be more adversely affected than other regions by the latest rise in oil prices. Countries such as Korea, Taiwan, Thailand and the Philippines use oil more intensively and are also heavily reliant on oil imports. Indeed, as a result of rapid industrialisation in recent years a number of countries in the region have shown some increase in their reliance on oil. The IEA estimates that a US$10 per barrel increase in oil prices lowers GDP by around 0.3 per cent in the US, 0.4 per cent in Japan (with its relatively low oil intensity somewhat offsetting its high import dependence), 0.5 per cent in the euro area, and 0.8 per cent in Asia. For Australia, the direct effects of rising oil prices are likely to be less contractionary than for most other industrial countries and our trading partners. While Australia is a small net importer of oil, it is a substantial and growing net exporter of natural gas, the price of which is partly linked to the price of oil. Further, if the price of oil were to remain high for an extended period, it could be expected that prices for other energy sources such as coal would also increase, as has tended to occur in the past. Since Australia is a substantial net energy exporter, the overall effect of higher energy prices would be to boost Australia's terms of trade, representing a net transfer of income to Australia from abroad.

Higher prices are contributing to stubbornly high levels of unemployment and exacerbating budget-deficit problems in many OECD and other oil-importing countries. The vulnerability of oil-importing countries to higher oil prices varies markedly depending on the degree to which they are net importers and the oil intensity of their economies. According to the results of a quantitative exercise carried out by the IEA in collaboration with the OECD Economics Department and with the assistance of the International Monetary Fund Research Department, a sustained $10 per barrel increase in oil prices from $25 to $35 would result in the OECD as a whole losing 0.4% of GDP in the first and second years of higher prices. Inflation would rise by half a percentage point and unemployment would also increase. The OECD imported more than half its oil needs in 2003 at a cost of over $260 billion – 20% more than in 2001. Euro-zone countries, which are highly dependent on oil imports, would suffer most in the short term, their GDP dropping by 0.5% and inflation rising by 0.5% in 2004. The United States would suffer the least, with GDP falling by 0.3%, largely because indigenous production meets a bigger share of its oil needs. Japan's GDP would fall 0.4%, with its relatively low oil intensity compensating to some extent for its almost total dependence on imported oil. In all OECD regions, these losses start to diminish in the following three years as global trade in non-oil goods and services recovers. This analysis assumes constant exchange rates. The adverse economic impact of higher oil prices on oil-importing developing countries is generally even more severe than for OECD countries. This is because their economies are more dependent on imported oil and more energy-intensive, and because energy is used less efficiently. On average, oil-importing developing countries use more than twice as much oil to produce a unit of economic output as do OECD countries. Developing countries are also less able to weather the financial turmoil wrought by higher oil-import costs. India spent $15 billion, equivalent to 3% of its GDP, on oil imports in 2003. This is 16% higher than its 2001 oil-import bill. It is estimated that the loss of GDP averages 0.8% in Asia and 1.6% in very poor highly indebted countries in the year following a $10 oil-price increase. The loss of GDP in the Sub-Saharan African countries would be more than 3%.

World GDP would be at least half of one percent lower – equivalent to $255 billion – in the year following a $10 oil price increase. This is because the economic stimulus provided by higher oil-export earnings in OPEC and other exporting countries would be more than outweighed by the depressive effect of higher prices on economic activity in the importing countries. The transfer of income from oil importers to oil exporters in the year following the price increase would alone amount to roughly $150 billion. A loss of business and consumer confidence, inappropriate policy responses and higher gas prices would amplify these economic effects in the medium term. For as long as oil prices remain high and unstable, the economic prosperity of oil-importing countries – especially the poorest developing countries – will remain at risk. The impact of higher oil prices on economic growth in OPEC countries would depend on a variety of factors, particularly how the windfall revenues are spent. In the long term, however, OPEC oil revenues and GDP are likely to be lower, as higher prices would not compensate fully for lower production.

Naturally, the bigger the oil-price increase and the longer higher prices are sustained, the bigger the macroeconomic impact. For net oil-exporting countries, a price increase directly increases real national income through higher export earnings, though part of this gain would be later offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners.

Higher oil prices lead to inflation, increased input costs, reduced non-oil demand and lower investment in net oil importing countries. Tax revenues fall and the budget deficit increases, due to rigidities in government expenditure, which drives interest rates up. Because of resistance to real declines in wages, an oil price increase typically leads to upward pressure on nominal wage levels. Wage pressures together with reduced demand tend to lead to higher unemployment, at least in the short term. These effects are greater the more sudden and the more pronounced the price increase and are magnified by the impact of higher prices on consumer and business confidence. An oil-price increase also changes the balance of trade between countries and exchange rates. Net oil-importing countries normally experience a deterioration in their balance of payments, putting downward pressure on exchange rates. As a result, imports become more expensive and exports less valuable, leading to a drop in real national income. Without a change in central bank and government monetary policies, the dollar may tend to rise as oil-producing countries' demand for dollar-denominated international reserve assets grow.

The economic and energy-policy response to a combination of higher inflation, higher unemployment, lower exchange rates and lower real output also affects the overall impact on the economy over the longer term. Government policy cannot eliminate the adverse impacts described above but it can minimise them. Similarly, inappropriate policies can worsen them. Overly contractionary monetary and fiscal policies to contain inflationary pressures could exacerbate the recessionary income and unemployment effects. On the other hand, expansionary monetary and fiscal policies may simply delay the fall in real income necessitated by the increase in oil prices, stoke up inflationary pressures and worsen the impact of higher prices in the long run.

Similarly, the boost to economic growth in oil-exporting countries provided by higher oil prices in the past has always been less than the loss of economic growth in importing countries, such that the net effect has always been negative. This is mainly because the propensity to consume of net importing countries that lose from higher prices is generally higher than that of the exporting countries. Demand in the latter countries tends to rise only gradually in response to higher prices and export earnings, so that net global demand tends to fall in the short term.

The results of the sustained higher oil price simulation for both the OECD and non-OECD countries suggest that, as has always been the case in the past, the net effect on the global economy would be negative. That is, the economic stimulus provided by higher oil (and gas) export earnings in OPEC and other exporting countries would be outweighed by the depressive effect of higher prices on economic activity in the importing countries, at least in the first year or two following the price rise. Combining the results of all world regions yields a net fall of around 0.5% in global GDP – equivalent to $ 255 billion - in the first year of higher prices. The transfer of income from oil importers to oil exporters in the year following the $10 price increase would amount to roughly $150 billion.

Higher oil prices, by affecting economic activity, corporate earnings and inflation, would also have major implications for financial markets – notably equity values, exchange rates and government financing – even, as assumed here, if there are no changes in monetary policies:

- International capital market valuations of equity and debt in oil-importing countries would be revised downwards and those in oil-exporting countries upwards.
- Currencies would adjust to changes in trade balances. Higher oil price would lead to a rise in the value of the US dollar, to the extent that oil exporters invest part of their windfall earnings in US dollar dominated assets and that transactions demand for dollars, in which oil is priced, increases.
- Fiscal imbalances in oil-importing countries caused by lower income would be exacerbated in those developing countries, like India and Indonesia that continue to provide direct subsidies on oil products to protect poor households and domestic industry.

5. EMPIRICAL RESEARCH

With the aim of understanding the relationships between oil prices and stock market in the petroleum industry, as well as their short and long-run behavior, we analyse data on stock prices of ASH, COP, CVX, XOM, AYGAZ, PTOFS, PETKM and TUPRS with the relevant stock market indexes and crude oil prices. Oil returns are measured using return on the Brent crude oil due to it serves as the benchmark for approximately 40-50 million barrels of crude oil produced daily.

Table 5.1. Information about the selected companies.

	Market	Operations	Market Cap (B)	Revenue (B)	Average Volume (3 months)
Exxon Mobil(XOM)	S&P500	Oil and gas exploration, production, supply, transportation, and marketing.	361.57	279.14	21,670,000
Chevron(CVX)	S&P500	Oil and gas exploration, production, supply, transportation, and marketing.	114.52	142.89	9,034,150
ConocoPhillips(COP)	S&P500	Oil exploration and production, refining and marketing.	74.87	136.91	4,213,840
Ashland Inc(ASH)	S&P500	Producing various products derived from petroleum.	5.00	8.84	1,227,870
Tupraş(TUPRS)	ISE	Producing petroleum products, crude oil supply and refining.	3.53	8.60	15,345
Petkim(PETKM)	ISE	Producing various products derived from petroleum.	1.39	1.17	NA
Petrol Ofisi(PTOFS)	ISE	Producing of various products derived from petroleum, marketing of fuel and selling subsidiary refinery products.	1.09	7.72	NA
Aygaz(AYGAZ)	ISE	Purchase of liquid petroleum gas (LPG) in bulk form from domestic refineries and the overseas market and delivery to retailers.	0.48	2.88	NA

When looking at oil stocks it's necessary to understand the business each one is in. The oil industry on a whole is made up of three or four parts. First are the upstream producers. This industry consists of the oil producers that explore, drill, and lift the oil. Generally, companies that specialize in the upstream businesses are called independents. The largest companies in the industry are called the "super-independents." Second, the midstream segment of the industry specializes in transportation, processing, and storage of oil and natural gas products. The third link is the downstream industry segment. Companies specializing in this industry refine the crude oil. Refining oil turns it from just crude into marketable products like gasoline or motor oil. There is a fourth segment of the oil industry made up the integrated oil companies or "Big Oil". This segment is the more public face of the oil industry. Companies like Exxon, or ConocoPhillips are integrated oil companies. An integrated oil company combines all three of the previously mentioned segments into one company. The integrated companies have divisions that explore, drill, transport, refine, and market the oil and refined oil products. A fifth segment could possibly be defined by the oil and natural gas services companies. These companies work in all of the segments mentioned before.

5.1. Methodology and Data Description

The data was extracted from different internet sources, mostly from www.finance.yahoo.com and Istanbul Stock Exchange(ISE). All of the data are in US dollars. The S&P500 related data consists of monthly closing prices of ASH, COP, CVX, XOM, S&P500 index, 10 year bond rate and Brent oil futures between the dates June, 1987 – December, 2004, and each series consists of 211 data points. The ISE related data consists of monthly closing prices of AYGAZ, PTOFS, PETKM, TUPRS, ISE index, overnight interest rate and Brent oil futures between the dates April, 1997 – December, 2004, and each series consists of 93 data points. Table A-1 and Table A-2 provides descriptive statistics about the stocks and oil data. Table A-3 shows correlation matrix for US data. Brent has the strongest linear relationship with COP. Table A-4 shows correlation matrix for Turkish data. Brent has a negative linear relationship with Turkish stocks.

Definition for each price series p_t as follows:

$$r_t = \log(p_t) - \log(p_{t-1})$$

where r_t corresponds to continuously compounded return on a monthly basis. Note that a uniformly scaled version (returns multiplied by hundred) will be used for computations. This method was applied to generate data for all time series that used in the model.

Investors who buy assets expect to earn returns over the time horizon that they hold the asset. Their actual returns over this holding period may be very different from the expected returns and it is this difference between actual and expected returns that is source of risk. When an investor buys stock or takes an equity position in a firm, he or she is exposed to many risks. Some risks may affect only one or a few firms and it is this risk that we categorize as firm-specific risk. Within this category, we would consider a wide range of risks, starting with the risk that a firm may have misjudged the demand for a product from its customers; we call this project risk. The risk could also arise from competitors proving to be stronger or weaker than anticipated; we call this competitive risk. In fact, extending risk measures to include risks that may affect an entire sector is called sector risk. There is other risk that is much more pervasive and affects many if not all investments. This risk is market risk. There are risks that fall in a gray area, depending upon how many assets they affect.

The CAPM may be expressed as

$$ER_{it} - r_f = \beta_i(ER_{Mt} - r_f) \tag{5.1}$$

where ER_{it} is the (subjective) expected return on an asset (or a group of assets) an investor chooses to hold, ER_{Mt} is the (subjective) expected return on the mean-variance efficient market portfolio, r_f is the risk-free rate, i indexes assets or groups of assets, t indexes time, and β_i is equal to the ratio of the covariance between R_{it} and R_{Mt}, denoted by cov(R_{it}, R_{Mt}), r and the variance of R_{Mt}, denoted by σ_M^2.

To transform the relationship into observable variables for testing purposes, we introduce the following two equations relating observable returns to expected returns:

$$R_{it} = ER_{it} + V_{it}' \tag{5.2}$$

$$R_{Mt} = ER_{Mt} + V_{Mt}' \tag{5.3.}$$

where R_{it} and R_{Mt} are the observable returns, and V_{it} and V_{Mt} are random variables.

Substituting equations (5.2) and (5.3) into equation (5.1) yields

$$R_{it} - r_f = \beta_i^*(R_{Mt} - r_f) + V_{it}'$$

where

$$\beta_i^* = \beta_i \left[1 - \frac{V_{Mt}}{R_{Mt} - r_f} \right] \quad (5.4)$$

Even if the mismeasurement issue is resolved, equation (5.4) may nonetheless still be criticized insofar as important regressors are excluded. Another issue in the CAPM is whether all investors risk arising from uncertainty about the future values of faces only one asset. In all likelihood, investors face many sources of risk, as shown by Merton's (1973) intertemporal asset pricing model. In such instances, investors would supplement the market portfolio with additional positions in hedge portfolios to hedge these risks. These results in separate betas and risk premiums for every significant source of risk that investors try to hedge. Equation (5.4), therefore, should be extended to account for the effects of extra market hedging transactions on equilibrium rates of return. Such an expanded version of multidimensional nature of risk and regressors are necessarily excluded 5.2. and 5.3. A generalization of the CAPM including previously excluded trivial because the functional form equation (5.4) would recognize the thereby show that some important from equation (5.4) regressors in equation (5.4) is not of the relationship between them and the dependent variable is unknown. This difficulty is resolved in principle by modifying equation (4) as follows:

$$R_{it} - r_f = \beta_i^*(R_{Mt} - r_f) + V_{it} + \sum_{j=1}^{m} \zeta_{ijt} Xijt \quad (5.5)$$

where the x_{ijt} represent excluded variables, the ζ_{ijt} denote their coefficients, and m denotes the number of excluded variables. Since m cannot be known with certainty, one may assume without restricting it to be equal to a specific number that the regressors of equation (5.5) form a sufficient set in the sense that they exactly determine the values of $R_{it} - r_f$ in all periods (Akhavein et. al).

Erdogan (1996) shows that the bunker and freight risks have impact on the maritime sector and construct a modified CAPM with adding these factor into the model.The oil companies entified some risk factors such as oil price risk, foreign currency exchange rate risk, st rate risk, natural gas price risk, politic risk, natural hazards risk, etc. Although risk factors are important role on the stock return in the petroleum industry, in this ch oil price risk is selected as the excluded variables in Equation 5.5, the others are ed. Then our model becomes:

$$R_{it} - r_f = \beta_i \left[R_{Mt} - r_f \right] + \beta_{oil} \left[R_{OILt} - r_f \right] + V_{it}$$

s returns for stocks are explained by the sum of a market risk premium, an oil price remium.

mpirical Tests of the Data

rical test is done to whole monthly data which are 211 points for selected S&P500 anies and 93 points for selected ISE companies. Tests for aggregate datasets are ucted. In order to test the robustness of the results, data is splitted into sub-ds.The data splits according to oil price, S&P500 and ISE movement in order to tigate the relationship between factors in the specified sub-periods. That sub-periods hosen based on the trend changes.

d on the ICAPM formula, regressions models are constructed. The dependent bles are monthly returns for each company. The regression models are tested by E-s 4.1. Further econometric analysis are applied for each series.

. Tests for Complete Datasets

s are conducted for the overall period. The results of the tests are given at Table 5.2 Table 5.3.

Representative regression results of selected S&P500 data between June,1987 – ,2004.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
0.0000	0.8445	8.4613	0.0460	1.1737	0.3334
0.0000	0.8151	10.3820	0.1868	7.5454	0.3353
1.5223	0.6735	7.7062	0.1246	3.4661	0.2497
1.1500	0.5635	8.8062	0.0683	2.5933	0.2839

observations are 211. The regression result for the XOM is given as
$_{OM} - r_f = 1.1500 + 0.5635\ (R_M - r_f) + 0.0683\ (R_{OIL} - r_f)$
has significant at levels 99% for ASH, COP, CVX and XOM. Oil factor has significant at levels 99% for COP, CVX,

nary time series since the computed ADF test statisticss is -15.2806 which is below critical values 3.4614. The process R(8), AR(18), AR(25), MA(14) and MA(22) lags. r_{COP} is stationary since the computed ADF test statistics is -15.4422. pends on the AR(12) and AR(28) lags. r_{CVX} is stationary since the computed ADF test statisticss is -16.7600. The process e AR(1), AR(9) and MA(18) lags. r_{XOM} is stationary since the computed ADF test statistics is -15.5296. The process AR(1) lag.

firms are affected positively by the oil price factor. COP is the most sensitive to oil factor. In this study, companies are less sensitive to the oil factor for the period. Other factors that are not included in the model may be important in the t of the stock return. The characteristics of the data for the selected period may weak sensitivity.

. Representative regression results of the selected ISE data between April,1997 – r,2004.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
0.0000	1.0081	31.036	-0.1617	-3.4497	0.9046
0.0000	0.8822	10.9301	0.0587	0.4565	0.5784
-0.9970	1.0146	15.916	-0.0747	-0.7711	0.7915
0.0000	0.8698	13.6184	-0.1010	-1.382	0.8054

of observations are 93. Market factor has significant at levels 99% for AYGAZ, PTOFS, PETKM and TUPRS. Oil factor t at levels 99% for AYGAZ.
ionary since the computed ADF test statistics is -10.6332. The process depends on the AR(15), MA(2) and MA(15) lags. onary since the computed ADF test statisticss is -12.1130. The process depends on the AR(6) lag. r_{PETKM} is stationary since d ADF test statisticss is -11.7010. The process depends on the AR(1) and AR(13) lags. r_{TUPRS} is stationary since the DF test statistics is -11.6247. The process depends on the AR(1), AR(4), AR(8) and MA(7) lags.

y returns are affected negatively by the oil price factor, except PTOFS. Higher oil ay lead to inflation, increased input costs, reduced non-oil demand and lower ent in Turkey. Tax revenues fall and the budget deficit increases, due to rigidities rnment expenditure, which drives interest rates up. These may be the reasons for ative effect of the stock returns driven by oil factor for selected companies in the d period. Market factor has a strong effect on the stock returns for the specified

ests for Splitted Datasets

re conducted for the overall period. To investigate the relationship in the sub- data is splitted based on the oil price and the market index. The sub-periods are form overall aggregate test statistics by assuming that the sub-period statistics are dent. Trend changes in the series gives us an idea to determine the sub-periods .4 and Table 5.5).

Table 5.4. Sub-periods for the selected S&P500 companies.

Criteria	Sub-Periods	Start Date	End Date	Observations
Oil Price	Sub-Period 1	June 1987	July 1990	37
	Sub-Period 2	August 1990	April 1991	10
	Sub-Period 3	May 1991	December 1998	92
	Sub-Period 4	January 1999	December 2004	72
Market Index	Sub-Period 7	June 1987	December 1994	91
	Sub-Period 8	January 1995	September 2000	81
	Sub-Period 9	November 2000	December 2004	39

Table 5.5. Sub-periods for the selected ISE companies.

Criteria	Sub-Periods	Start Date	End Date	Observations
Oil Price	Sub-Period 5	April 1997	December 1998	21
	Sub-Period 6	January 1999	December 2004	72
Market Index	Sub-Period 10	April 1997	October 1998	19
	Sub-Period 11	November 1998	January 2000	15
	Sub-Period 12	February 2000	October 2001	21
	Sub-Period 13	November 2001	December 2004	38

:sts of Splitted Data Based On the Oil Price

on investigates the relationship between the oil price and stock returns for the
s that are determined by the oil price trend changes. The main reason behind an
f oil price in sub-period 2 is the invasion of Kuwait by Iraq. The oil price seems
le at sub-period 1 and sub-period 3. After OPEC pledges additional production
il price continuously rises in sub-period 4. Table 5.6. to Table 5.9 shows the
tive regression results for sub-periods 1 to 4, respectively. Since the number of
ns for ISE are relatively small, there are two sub-periods (5 and 6) for oil price
nges. For ISE, Table 5.10. to Table 5.11 shows the representative regression
sub-periods 5 and 6, respectively.

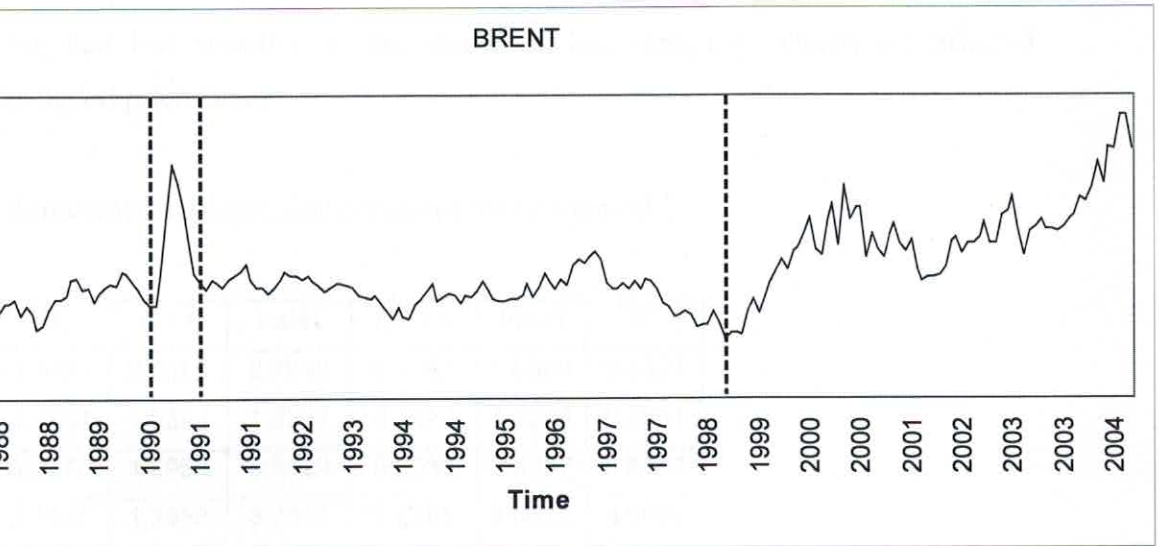

Figure 5.1. Brent Oil Price between 1987-2004.

riod 1, companies are more sensitive to the market factor. Company returns are
ositively by the oil price factor.

resentative regression results of the sub-period 1.

	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
00	0.8308	5.1481	0.1771	1.6786	0.4437
00	1.1240	5.9210	0.3317	2.6729	0.5261
84	0.8355	4.4744	0.0905	-0.9528	0.3934
40	0.6660	6.9151	0.0265	0.4172	0.5848

observations are 37. Market factor has significant at levels 99% for ASH,COP, CVX and XOM. Oil factor has
% for COP, 90% for ASH.
the computed ADF test statistics is -6.1597. r_{COP} is stationary since the computed ADF test statisticss is -5.4206.
the computed ADF test statistics is -5.9747. r_{XOM} is stationary since the computed ADF test statistics is -5.4812.

2, the number of observations which are relatively small, is ten. The
oil price is high due to the Iraq invasion. Companies are more sensitive to
and less sensitive to the market factor. Company returns are affected
ne oil price factor.

presentative regression results of the sub-period 2.

c	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
831	2.0566	2.7842	0.2792	1.6500	0.5421
339	1.0395	1.9207	0.1523	1.2289	0.3531
777	1.9958	3.3529	0.3536	2.5937	0.6163
591	1.3858	3.7046	0.2285	2.6672	0.6632

f observations are 10. Market factor has significant at levels 99% for CVX,XOM; 95% for ASH and 90% for COP.
ant at levels 95% for CVX and XOM.
analysis is not applied due to small number of observations.

3, oil price seems to be stable. Companies are more sensitive to market
s sensitive to the market factor. Company returns are affected positively by
ctor.

...presentative regression results of the sub-period 3.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
...4749	1.0946	6.3093	0.0498	0.6678	0.3426
...0000	0.7257	5.1547	0.3367	5.373782	0.3820
...3004	0.3094	2.5716	0.0949	1.8905	0.3300
...5068	0.4563	4.4831	0.1096	2.5808	0.2229

... of observations are 92. Market factor has significant at levels 99% for ASH,COP, CVX and XOM. Oil factor has ... 99% for COP and XOM, %90 for CVX.
...ince the computed ADF test statistics is -10.2889. The process depends on the AR(3) and AR(18) lags. r_{COP} is ... computed ADF test statisticss is -9.6480. The process depends on the MA(12) lag. r_{CVX} is stationary since the ...t statistics is -11.0270. The process depends on the MA(14) lag. r_{XOM} is stationary since the computed ADF test ...7. The process depends on the AR(1) lag.

...d 4, oil price seems to be in an upward trend. Companies are less sensitive to ...r as compared to sub-period 1, sub-period 2, and sub-period 3. Company ...ffected positively by the oil price factor.

...epresentative regression results of the sub-period 4.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
...3608	0.6767	4.1235	0.0721	1.1978	0.2262
...9005	0.6891	3.9044	0.1654	2.5294	0.2781
...0000	0.4446	3.2902	0.2428	4.8099	0.2318
...0000	0.4631	3.811603	0.1101	2.2368	0.2592

...er of observations are 72. Market factor has significant at levels 99% for ASH,COP, CVX and XOM. Oil factor has ...ls 95% for XOM and %90 for CVX.
...since the computed ADF test statistics is -8.3431. The process depends on the MA(20) lag. r_{COP} is stationary since the ...est statisticss is -9.8841. The process depends on the MA(12) lag. r_{CVX} is stationary since the computed ADF test ...756. The process depends on the MA(20) and MA(14) lags. r_{XOM} is stationary since the computed ADF test statistics is ...cess depends on the AR(1) lags.

...od 5, oil price seems to be stable. Company returns are affected negatively by ...e factor, except TUPRS. Companies are more sensitive to market factor, and ...ve to the oil price factor.

ıble 5.10. Representative regression results of the sub-period 5.

	C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
AYGAZ	-6.1494	0.7461	6.3639	-0.2811	-1.3615	0.7163
PTOFS	-1.5454	0.8918	3.8904	-0.0895	-0.2217	0.4657
PETKM	-0.8369	0.7414	2.6116	-0.0930	-0.1861	0.2831
TUPRS	9.5784	1.0623	4.1864	0.6531	1.4615	0.5050

: The number of observations are 21. Market factor has significant at levels 99% for AYGAZ,PTOFS, TUPRS and 95% for KM. Oil factor has significant at levels 80% for AYGAZ and TUPRS.

ıer econometric analysis is not applied due to small number of observations.

ub-period 6, oil price shows an upward trend. Company returns are affected negatively he oil price factor, except PTOFS. Companies are more sensitive to market factor, and sensitive to the oil factor. The reasons for the negative effect of oil price factor may be taxation system in the Turkey and the regulations of goverment in the petroleum ıstry.

le 5.11. Representative regression results of the sub-period 6.

	C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
GAZ	0.0000	1.0032	21.994	-0.1615	-2.1860	0.8764
OFS	0.0000	0.8672	9.9355	0.1189	0.8178	0.590332
TKM	-1.4414	1.0746	15.1103	-0.1491	-1.2764	0.7756
PRS	-1.6284	0.8825	16.2748	-0.1932	-2.1690	0.7974

The number of observations are 72. Market factor has significant at levels 99% for AYGAZ, PETKM, PTOFS, TUPRS. Oil factor ıificant at levels 95% for AYGAZ and TUPRS and 80% for PETKM.

is stationary since the computed ADF test statistics is -9.6878. The process depends on the AR(6) lag. $\mathbf{r_{PTOFS}}$ is stationary since puted ADF test statisticss is -10.4244. The process depends on the AR(6) lag. $\mathbf{r_{PETKM}}$ is stationary since the computed ADF test ss is -10.9291. The process depends on the MA(3) lag. $\mathbf{r_{TUPRS}}$ is stationary since the computed ADF test statistics is -9.7555. The depends on the AR(4) and AR(7) lags.

2. Tests of Splitted Data Based On S&P500 Movement

section investigates the relationship between the oil price and stock returns for the eriods that are determined by the S&P500 trend changes. Table 5.12. to Table 5.14 the representative regression results for sub-periods 7 to 9, respectively.

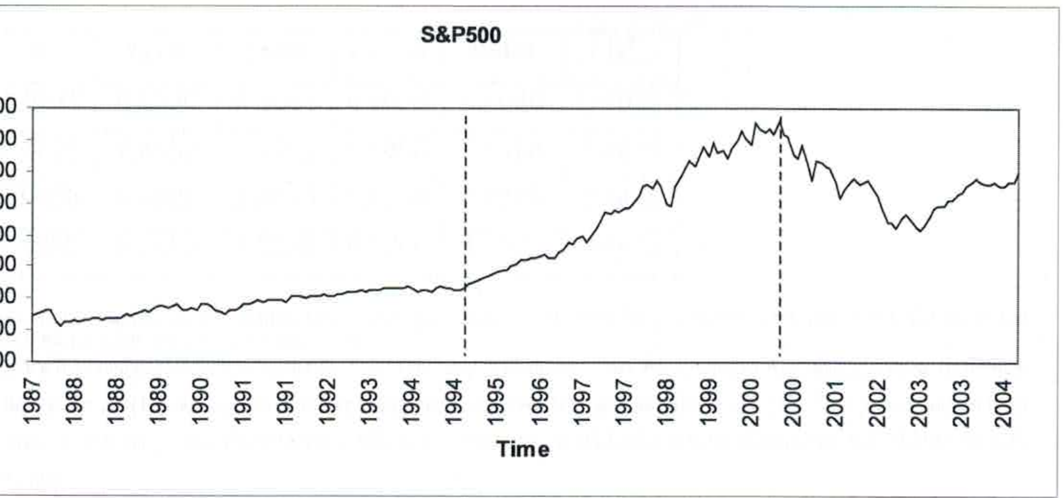

Figure 5.2. S&P500 index value between 1987-2004.

od 7, S&P500 seems to be stable. Company returns are affected positively by e factor. Companies are more sensitive to market factor, and less sensitive to the

. Representative regression results of the sub-period 7.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
-0.0794	0.9587	6.3992	0.0821	1.2365	0.3176
0.8671	1.1836	8.5595	0.2828	4.6147	0.4826
2.5987	0.8850	6.6900	0.1586	2.7057	0.3468
1.5002	0.6485	7.9773	0.0596	1.6527	0.4197

per of observations are 91. Market factor has significant at levels 99% for ASH,COP, CVX and XOM. Oil factor has els 99% for COP, CVX and 90% for XOM.
since the computed ADF test statistics is -10.2524. The process depends on the AR(17) lag. r_{COP} is stationary since the est statisticss is -8.9160. The process depends on the AR(2) lag. r_{CVX} is stationary since the computed ADF test 57. The process depends on the AR(9) and MA(5) lags. r_{XOM} is stationary since the computed ADF test statistics is - ess depends on the AR(19) and MA(4) lags.

od 8, S&P500 is shown an upward trend. Company returns are affected y the oil price factor. Companies are more sensitive to market factor, and less the oil factor. However, the correlations of market factor is decline compared od 7.

epresentative regression results of the sub-period 8.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
2670	0.6320	4.2584	0.0058	0.1040	0.1925
1725	0.4552	2.8292	0.1898	3.1188	0.2079
9489	0.4227	2.9696	0.0903	1.6776	0.1448
1689	0.4158	3.5352	0.0764	1.7171	0.1823

r of observations are 81. Market factor has significant at levels 99% for ASH,COP, CVX and XOM. Oil factor has s 99% for COP, 90% for CVX and XOM.
ince the computed ADF test statistics is -9.5176. r_{COP} is stationary since the computed ADF test statisticss is -8.9625. ds on the AR(12) lag. r_{CVX} is stationary since the computed ADF test statistics is -11.7832. The process depends on r_{XOM} is stationary since the computed ADF test statistics is -9.3433. The process depends on the AR(13), MA(3), 6) lags.

od 9, S&P500 shows a downward trend. The sensitivity of market factor is igh as compared to sub-period 8. Oil price factor has a positive impact on the

. Representative regression results of the sub-period 9.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
0.7765	1.0928	3.9803	0.1481	1.2975	0.3151
0.9584	0.9238	4.7570	0.2576	3.1897	0.4522
0.6160	0.8786	4.5354	0.2700	3.3520	0.4436
0.4914	0.6925	3.9657	0.1287	1.7731	0.3270

mber of observations are 39. Market factor has significant at levels 99% for ASH,COP, CVX and XOM. Oil factor has evels 99% for COP, CVX and 90% for XOM.
ary since the computed ADF test statistics is -6.0325. r_{COP} is stationary since the computed ADF test statisticss is -5.1383. epends on the AR(1) lag. r_{CVX} is stationary since the computed ADF test statistics is -7.7421. r_{XOM} is stationary since the F test statistics is -7.5494.

Tests of Splitted Data Based On ISE Movement

tion investigates the relationship between the oil price and stock returns for the ods that are determined by the ISE trend changes. Table 5.15 to Table 5.18 shows esentative regression results for sub-periods 10 to 13, respectively.

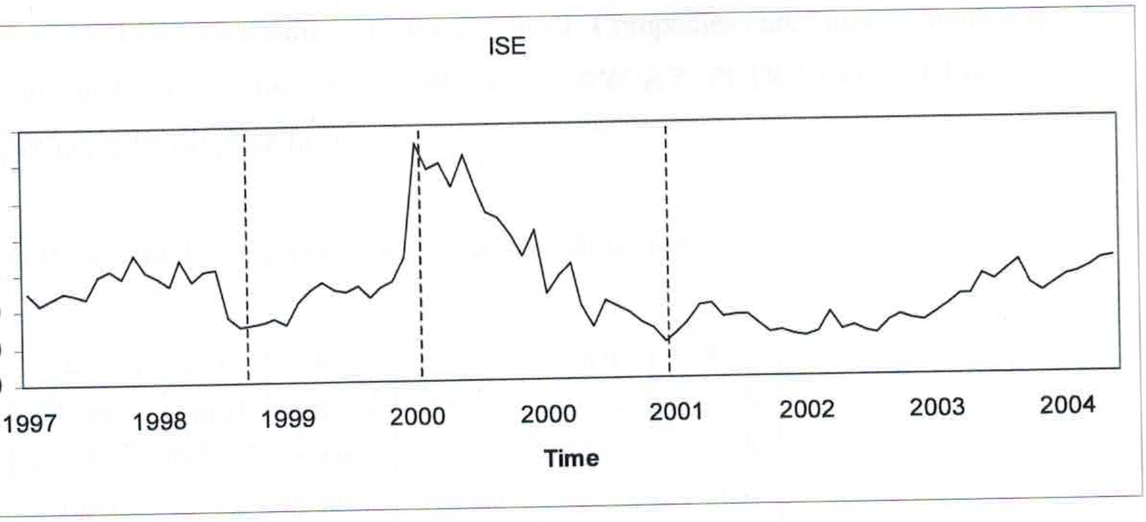

Figure 5.3. ISE index value between 1997-2004.

eriod 10, ISE index shows a smooth movement. Company returns are affected y by the oil price factor. Companies are more sensitive to market factor, and less to the oil factor. Market factor has a strong effect on the return of TUPRS and oil price has a strong effect on the return of TUPRS. The reason behind the ce of the oil factor may be the regulations of the goverment in the petroleum PTOFS and AYGAZ is negatively affected by oil price factor. The structure of ion system in the petroleum industry may cause the negative effect of oil price on ck returns.

15. Representative regression results of the sub-period 10.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
-4.9369	0.7414	7.3254	-0.0097	-0.0450	0.7717
-1.3510	0.9163	4.8624	-0.2866	-0.7112	0.6087
2.2366	0.7341	3.1958	0.5503	1.1202	0.4063
10.2055	1.0468	4.0371	0.9186	1.6565	0.5302

number of observations are 19. Market factor has significant at levels 99% for AYGAZ,PTOFS, TUPRS and PETKM. Oil gnificant at levels 80% for TUPRS.

nometric analysis is not applied due to small number of observations.

11, ISE index shows an upward trend. Companies are more sensitive to , and less sensitive to the oil factor. AYGAZ, PETKIM and TUPRS are ected by oil price factor.

epresentative regression results of the sub-period 11.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
5778	0.8980	6.8739	-0.5113	-2.8928	0.8145
1081	0.5631	1.2480	0.7279	1.1925	0.2130
0567	1.5849	6.0451	-0.6309	-1.7788	0.7609
4217	0.9229	4.9490	0.0089	0.0353	0.6729

f observations are 15. Market factor has significant at levels 99% for AYGAZ, PETKM and TUPRS. Oil factor has 9% for AYGAZ and 80% for PETKM.
analysis is not applied due to small number of observations.

12, ISE index shows a downward trend. Company returns are affected the oil price factor. Companies are more sensitive to market factor, and to the oil factor. AYGAZ and PETKIM are negatively affected by oil price

epresentative regression results of the sub-period 12.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
2556	0.9386	10.4267	-0.0388	-0.2823	0.8869
4819	0.9387	8.2569	-0.0474	-0.2733	0.8302
0419	0.8291	8.6095	0.0655	0.4456	0.8527
0027	0.8181	9.6654	-0.1634	-1.2651	0.8598

f observations are 21. Market factor has significant at levels 99% for AYGAZ, PETKM, PTOFS and TUPRS.
analysis is not applied due to small number of observations.

l 13, ISE index shows a smooth trend. Company returns are affected the oil price factor. Companies are more sensitive to market factor, and to the oil factor.

18. Representative regression results of the sub-period 13.

C	$r_M - r_f$	t-stat	$r_{OIL} - r_f$	t-stat	R^2
-1.1357	1.0615	13.7673	-0.0318	-0.2587	0.8552
-3.8026	0.9946	6.1642	-0.0459	-0.1785	0.5436
-2.2359	1.0645	8.1516	-0.1119	-0.5382	0.6807
-1.3554	0.8557	8.7697	-0.3964	-2.5517	0.7466

umber of observations are 38. Market factor has significant at levels 99% for AYGAZ, PETKM, PTOFS and TUPRS. Oil nificant at levels 99% for TUPRS.
ionary since the computed ADF test statistics is -6.6490. r_{PTOFS} is stationary since the computed ADF test statisticss is - process depends on the AR(2) lag. r_{PETKM} is stationary since the computed ADF test statisticss is -9.0447. The process he AR(2) lag. r_{TUPRS} is stationary since the computed ADF test statistics is -6.2745. The process depends on the MA(7) lag.

irical Findings

irical results indicate that the stock return is more sensitive to market factor for the period. For selected US companies, the market and oil price factors have an the stock returns on the aggregate sample. The oil price has an effect on the return COP and CVX, these are integrated oil companies that explore, drill, transport, d market the oil and refined oil products. On the other hand, sample company ave a weak relationship with oil price in Turkish market. Turkish oil industry is ly subject to regulation and intervention by governments. Government has the shares of PETKM, PTOFS and TUPRS during the sample period. One of the effects on the Turkish oil industry is taxation. Higher taxation rate will decline the mes of the companies. The other effect is exchange rate. Crude oil prices are set in dollars and fluctuation in exchange rates may cause higher oil price in Turkey. US market has a lot of financial instruments such as future oil market. es market is used by companies to hedge against uncertainty in oil price. The market does not exist in Turkey.

shing the aggregate sample test, the data is splitted into sub-periods which are d by trend changes in oil price and market indices. Oil price trend changes results hat, sub-periods findings resemble to aggregate sample findings for US and ata. We find that oil trend changes do not play an important role in affecting rns. S&P500 trend changes results indicate that, market and oil factor has an in determining the asset returns, and the aggregate results are not too much the sub-periods result. The market factor sensitivity in upward trends is ompared to stable and downward trends. ISE trend changes results indicate no outstanding difference in results from the whole period. A slight on the effects of oil price factor is observed in upward trends.

SION

eblood of modern economies. While oil markets may behave like other arkets much of the time, the oil market does have unique features. Few arkets have an institution like the OPEC; oil has been subject to supply e to political instability as well as technical factors; psychological or effects may lead to price volatility. World oil transactions are settled in US affects the value of the dollar in world currency markets.

of this thesis is to contribute to the literature on stock markets and oil prices the impact of oil price changes on stock market returns. To achieve this price risk is added to ICAPM proposed by Merton. This analysis uses a nthly US market data over the period 1987 to 2004 and Turkish market data d 1997-2004.

clusion is that market factor has a significant impact on the pricing of equities Turkish data over the period under review. For US companies, stock price a positive relationship with the market and oil price factors over the entire emia shows a relatively similar pattern for sub-periods which are determined ges in oil price and S&P500 index. These results are in agreement with the ang et al. (1996) and Sadorsky (1999) in establishing a relationship between and oil stocks. For Turkish companies, stock price returns show a positive with the market and negative relationship with the oil price factors over the . The reasons behind the negative relationship in oil prices are goverment nd taxation, inflation and increased input costs. Oil premia shows a relatively n for sub-periods which are determined by trend changes in oil price and ISE nain contribution to the research in this area is that we investigate some oil rom Turkey. Further research is required to find the explanation of other as natural gas price, inflation rate, etc.

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DIX

PENDIX A. Descriptive statistics detail for each series

le A-1. Descriptive statistics detail for the selected S&P500 data.

	r_{ASH}	r_{COP}	r_{CVX}	r_{XOM}	$r_{S\&P500}$	r_{BRENT}
an	0.579448	1.091326	2.128488	1.750536	0.669936	0.375521
dian	0.388162	1.210962	1.701725	1.766350	1.152919	0.544325
ximum	16.49022	26.08348	20.55398	20.48457	11.95039	41.16344
nimum	-26.31267	-31.32532	-22.78158	-18.90764	-24.67684	-29.88234
. Dev.	7.137468	7.270411	6.377478	4.782985	4.376650	10.64557
ewness	-0.373683	-0.102650	-0.096889	-0.190394	-1.133127	0.278361
rtosis	3.565579	5.150030	4.716055	5.300363	7.804673	4.099934
que-Bera	7.722929	41.01115	26.22023	47.79738	248.1078	13.36153
bability	0.021037	0.000000	0.000002	0.000000	0.000000	0.001255
n	122.2636	230.2698	449.1109	369.3630	141.3565	79.23494
n Sq. Dev.	10698.12	11100.37	8541.168	4804.158	4022.563	23798.90
servations	211	211	211	211	211	211

e A-2. Descriptive statistics detail for the selected ISE data.

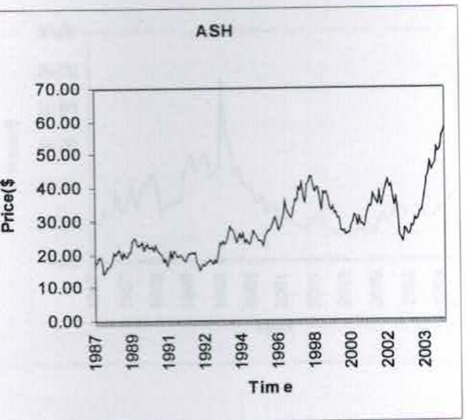
	r_{AYGAZ}	r_{PETKM}	r_{PTOFS}	r_{TUPRS}	r_{ISE}
an	-0.126077	-0.237889	-0.283062	0.483782	0.256349
dian	0.000000	-0.320000	-2.086514	3.348867	1.439289
ximum	59.62974	72.73651	108.3140	66.67648	65.04882
imum	-48.49113	-82.48778	-58.29790	-62.00835	-56.96316
. Dev.	19.47821	24.20101	24.50978	20.76245	18.90904
ewness	0.095280	0.024106	0.971846	0.020063	-0.122923
rtosis	3.399056	4.282531	6.453533	4.076336	4.719955
que-Bera	0.757793	6.382937	60.85621	4.495419	11.69740
obability	0.684617	0.041111	0.000000	0.105641	0.002884
m	-11.72513	-22.12370	-26.32480	44.99169	23.84042
m Sq. Dev.	34904.87	53883.37	55267.11	39659.28	32894.78
servations	93	93	93	93	93

ble A-3. Correlation matrix for US data.

	r_{BRENT}	$r_{S\&P500}$	r_{ASH}	r_{COP}	r_{CVX}	r_{XOM}	r_{BOND}
BRENT	1.0000	-0.0432	0.0473	0.2921	0.1891	0.1309	0.0116
S&P500		1.0000	0.5027	0.4864	0.4556	0.5116	-0.0124
r_{ASH}			1.0000	0.4372	0.3639	0.3663	-0.0601
r_{COP}				1.0000	0.6088	0.5386	-0.0022
r_{CVX}					1.0000	0.6782	0.0831
r_{XOM}						1.0000	0.0927
BOND							1.0000

ble A-4. Correlation matrix for Turkish data.

	r_{BRENT}	r_{ISE}	r_{AYGAZ}	r_{PETKM}	r_{PTOFS}	r_{TUPRS}	r_{ON}
BRENT	1.0000	-0.1952	-0.1577	-0.1707	-0.1034	-0.1232	-0.2101
r_{ISE}		1.0000	0.8949	0.6750	0.7911	0.7879	-0.3585
AYGAZ			1.0000	0.6272	0.7684	0.6973	-0.2819
r_{PETKM}				1.0000	0.5380	0.5800	-0.2075
r_{PTOFS}					1.0000	0.6915	-0.1982
r_{TUPRS}						1.0000	-0.2163
r_{ON}							1.0000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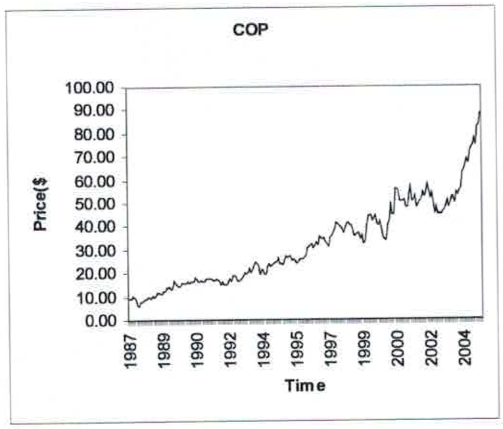
COP
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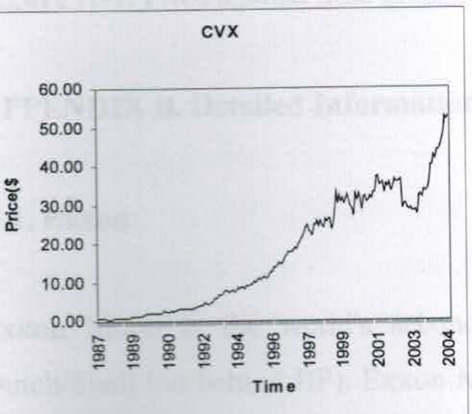
CVX
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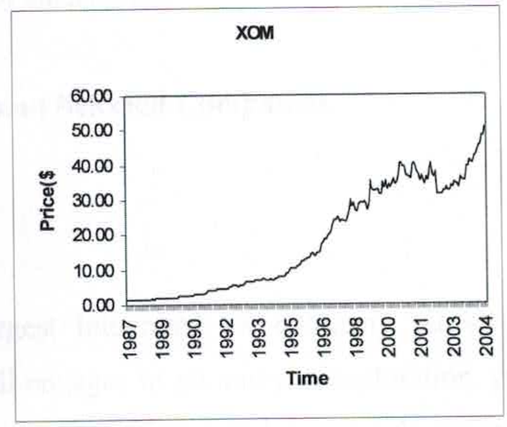
XOM
Price($
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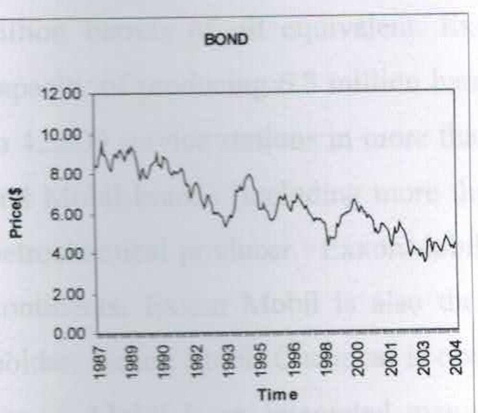
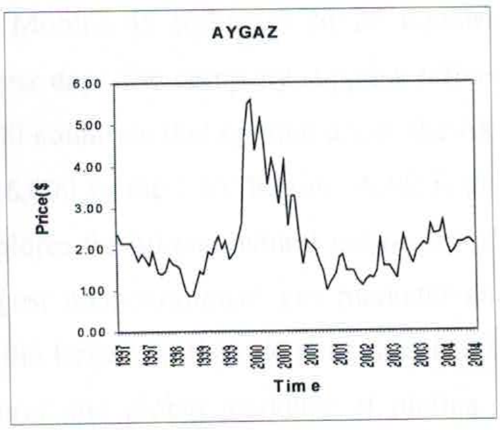

BOND
Price($
Time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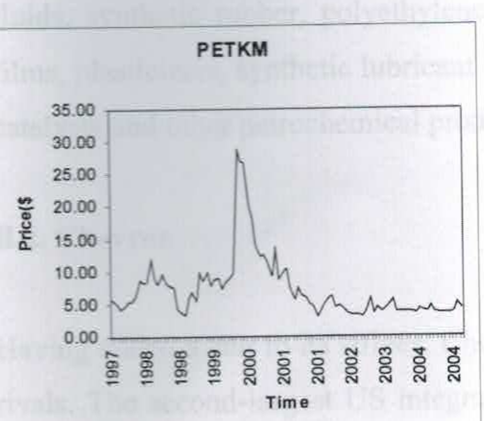
PETKM
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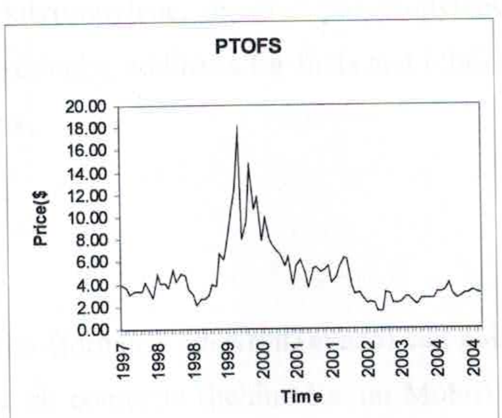
PTOFS
Price($)
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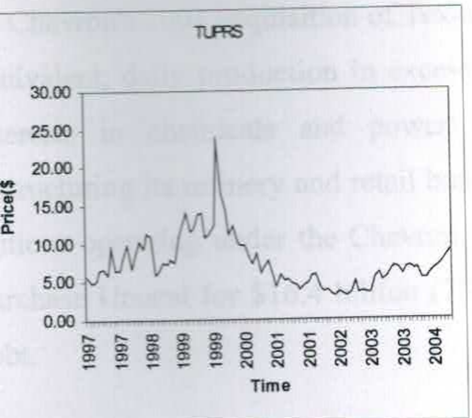

igure A-1. Price against time graphics for each series.

PPENDIX B. Detailed Information about Selected Companies.

.1. Exxon

xxon Mobil is the world's second-largest integrated oil company (ahead of Royal)utch/Shell but behind BP). Exxon Mobil engages in oil and gas exploration, production, upply, transportation, and marketing around the world. It has proved reserves of 21.2 illion barrels of oil equivalent. Exxon Mobil's 45 refineries in 25 countries have a apacity of producing 6.3 million barrels per day. The company supplies refined products) 42,000 service stations in more than 100 countries that operate under the Exxon, Esso, nd Mobil brands (including more than 16,000 in the US). Exxon Mobil is also a major etrochemical producer. ExxonMobil explores for oil and natural gas on six of the seven ontinents. Exxon Mobil is also the largest nongovernment gas marketer and reserves older. Exxon Mobil Chemical is one of the largest worldwide petrochemical companies. Exxon Mobil is an integrated manufacturer and global marketer of olefins, aromatics, luids, synthetic rubber, polyethylene, polypropylene, oriented polypropylene packaging ilms, plasticizers, synthetic lubricant basestocks, additives for fuels and lubricants, zeolite catalysts and other petrochemical products.

B.2. Chevron

Having added a star to its stripes, Chevron (formerly ChevronTexaco) can pull rank on its rivals. The second-largest US integrated oil company (behind Exxon Mobil) was formed

Chevron's 2001 acquisition of Texaco. It has proved reserves of 8.5 billion barrels of oil valent, daily production in excess of 2.3 million barrels of oil equivalent, and owns rests in chemicals and power production businesses. The company, which is ructuring its refinery and retail businesses, owns or has stakes in more than 19,000 gas ions operating under the Chevron, Texaco, and Caltex brands. Chevron has agreed to chase Unocal for $16.4 billion (75% stock and 25% cash) and assume $1.6 billion in t.

evron Corporation operates as an energy company worldwide. Its petroleum operations nsist of exploring for, developing, and producing crude oil and natural gas; refining de oil into finished petroleum products; marketing crude oil, natural gas, and various oducts derived from petroleum; and transporting crude oil, natural gas, and petroleum oducts by pipeline, marine vessel, motor equipment, and rail car. The company, through joint venture with Chevron Phillips Chemical Co., manufactures petrochemicals and astics, as well as markets chemicals products, including olefins, polyolefins, aromatics, d specialty products. In addition, Chevron, through its joint venture with Chevron onite Company, develops, manufactures, and markets performance additives for fuels d lubricating oils. Further, the company engages in coal mining, power generation, surance, and real estate activities. It had approximately 8.2 billion barrels of oil-quivalent of net proved oil and gas reserves, as of December 31, 2004. It also had 21 holly owned and affiliated refineries and approximately 25,700 retail outlets worldwide, of the above date. The company was founded in 1879 under the name Pacific Coast Oil o. and later changed its name to ChevronTexaco Corporation. Further, it changed its ame to Chevron Corporation in May 2005. Chevron Corporation is headquartered in San amon, California.

.3. Ashland Inc.

Ashland, Inc. operates in transportation construction, chemical, and petroleum industries worldwide. The Valvoline segment produces and markets packaged motor oil and automotive chemicals, including appearance products, antifreeze, filters, and automotive fragrances. It also provides fast oil change services through Valvoline Instant Oil Change outlets. The Refining and Marketing segment owns and operates refineries in the United States. Its operations include crude oil atmospheric and vacuum distillation, fluid catalytic cking, catalytic reforming, and desulfurization and sulfur recovery. As of September 30, 04, the Refining and Marketing segment owned and operated seven refineries in the ited States. Ashland was organized in 1936 and is headquartered in Covington, ntucky.

4. ConocoPhillips

nocoPhillips operates as an integrated energy company worldwide. It operates in six gments: Exploration and Production, Midstream, Refining and Marketing, LUKOIL vestment, Chemicals, and Emerging Businesses. The Exploration and Production gment primarily explores for, produces, and markets crude oil, natural gas, and natural s liquids. It also mines deposits of oil sands in Canada and upgrades into a synthetic ude oil. The Midstream segment gathers and processes natural gas; and fractionates and arkets natural gas liquids, primarily in the United States, Canada, and Trinidad. The efining and Marketing segment purchases, refines, markets, and transports crude oil and troleum products, mainly in the United States, Europe, and Asia. LUKOIL Investment gment consists of 10% interest in LUKOIL, an international, integrated oil and gas ompany. The Chemicals segment manufactures and markets petrochemicals and plastics. he Emerging Businesses segment encompasses the development of new businesses, cluding new technologies related to natural gas conversion into clean fuels and related roducts. In addition, the company provides technological solutions in deepwater xploration and production, reservoir management and exploitation, 3-D seismic echnology, petroleum coke upgrading, and sulfur removal. It operates in the United States, Iorway, the United Kingdom, Canada, Venezuela, Indonesia, offshore Timor Leste in the Timor Sea, Australia, Vietnam, China, Nigeria, the United Arab Emirates, and Russia. ConocoPhillips was incorporated in 2001 and is headquartered in Houston, Texas.

3.5. Aygaz

n 2004, Aygaz reported US$ 2,833 mn net sales. Aygaz has two subgroups; LPG products group (Aygaz) and petroleum products group (OPET); 55% of total sales comes from Aygaz group and the remaining 45% from OPET group. Cost of production is US$ 2,605 mn, leading to a gross profit of US$ 228 mn. LPG group makes up 60% of the gross profit. Unit sales information is not disclosed. Aygaz posted US$ 206 mn operating expenses, ılting in an operating profit of US$ 22 mn. Aygaz's EBITDA was US$ 98 mn in 2004, resenting an EBITDA margin of 3.5%. LPG group's operating profit constitutes 80% of ısolidated operating profit.

;. Petrol Ofisi

trol Ofisi was founded in 1941 with a capital of TL 2.5 million. Its goal was to meet the troleum product needs of end users as well as public and private enterprises with tivities that included purchasing, importing and stockpiling petroleum products in rious parts of the country. In 1983, with a capital of TL 3.7 billion, the Company was corporated and on September 5, 1990, it was placed under the authority of the Prime inistry Privatization Administration for full privatization. On July 21, 2000, Petrol Ofisi came one of Turkey's largest privatizations to date, with 51% of its shares purchased by rtak Girişim Grubu (Joint Venture Group) made up of Türkiye İş Bankası and Doğan olding, for US$ 1,260 million. Operating out of its Head Office, Petrol Ofisi is made up 3,600 branded service stations, approximately 4,000 fuel dealers, six regional offices, o lubricant blending plants, nine terminals, two depots, one refinery liaison office, three bricant depots and provides aviation services at 25 airports.

.7. Tüpraş

ÜPRAŞ's main field of activity is to produce petroleum products by processing crude oil its refineries. Fields of activity are:

Crude oil supply.

Crude oil refining.

Importing and exporting petroleum products.

Establishment, acquisition, takeover and operation of petroleum refineries and new units.

Establishing and operating factories and plants in the petrochemical industry and trading f these materials in domestic and foreign markets.

Establishing and operating power stations and plants in energy sector and related fields.