CRUDE OIL PRICES AND EQUITY MARKETS: A GLOBAL PERSPECTIVE

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ABSTRACT

This paper examines the relationships between crude oil prices and international equity markets. Some previous research found no significant relationship between oil prices and stock markets. Other research has found significant relationships using both linear and nonlinear methodology, however nonlinear models appear to provide more meaningful results. Few studies using linear methods have found any relationship to be economically significant. Using linear methodology, this study provided evidence of a statistically significant relationship between West Texas Intermediate and Brent crude oil prices and the indices for stock markets in the U.S., the U.K, Japan, Honk Kong, and Australia, as well as indices used as benchmark for worldwide markets. These relationships are stronger since 2001, however none of the relationships are economically significant.

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INTRODUCTION

According to Merriam-Webster's Online Dictionary (2012), the term globalization, defined as "the development of an increasingly integrated global economy marked especially by free trade, free flow of capital, and the tapping of cheaper foreign labor markets," was in first used 1951. Similarly, economic globalization refers to "the increasing interdependence of world economies as a result of the growing scale of cross-border trade of commodities and services, flow of international capital and wide and rapid spread of technologies" (United Nations 2000, p. 1). During the past 20 years, the rate of globalization has increased markedly as technological advances have bolstered the freedom of trade, allowing capital and labor to travel thousands of miles in just a few hours.

As the economies of the world have developed, so have the financial markets. Where trading was once limited by pure geography, today a banker in New York can purchase stock on the Tokyo Stock Exchange with the click of a button. Financial capital and information can travel around the world in the blink of an eye. With the collapse of logistical barriers to world stock markets, a need has developed for analysis of the financial systems beyond one's national borders. Therefore, the purpose of this paper is to determine if, during the 20 year time frame from 1991-2011, there are any statistically significant relationships between the West Texas Intermediate or Brent crude oil prices and the indices of major international stock markets in the U.S., London, Hong Kong, Tokyo, and Australia.

An important part of this analysis includes investigating the effects of crude oil on international stock markets. The crude oil market is the largest commodity market in the world (Levin et al., cited in Driesprong 2004, pp. 5). Given both the high global demand and the volume of trade of crude oil, the potential for oil to have an impact on equity markets is real. In fact the International Monetary Fund estimates that a $5/barrel price increase reduces global economic growth by 0.3 percent in the following year (IMF, cited in Driesprong 2004, pp. 3).

The stock markets to be analyzed are not only five of the largest, most active stock markets in the world, but they are also widely dispersed and therefore more representative of the global economy. Additionally, the effects of oil on three world market indices will be researched in order to get a view of the effect of oil on the world's economies as a whole, the economies of developed nations, as well as the economies of emerging nations. The results of this analysis provide some insight into the overall extent and effects of globalization.

There have been several multinational efforts in recent history aimed to facilitate globalization. The United Nations, founded in 1945 after the Second World War by 51 countries to promote world peace, has historically been at the forefront of many of these efforts Today the U.N. consists of 193 member states and includes every internationally recognized sovereign nation, with the exception of the Vatican (UN 2012).

Even before the war had ended and before the United Nations had officially replaced the League of Nations, a UN Monetary and Financial Conference was held in 1944 and attended by delegates from 44 allied nations. During this conference the Bretton Woods system was established, creating an international monetary regime "designed to combine binding legal obligations with multilateral decision-making" (Cohen 2012).

The International Monetary Fund (IMF) derived from this system (Cohen 2012). Growing from 45 original member states, to 188 current members, the goal of the IMF is to "foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world" (IMF 2012).

Also stemming from the Bretton Woods system is the World Bank Group; a group of five international organizations that make leveraged loans to countries in need. Specifically, these five organizations are the International Bank for Reconstruction and Development (188 members), the International Development Association (172 members), the International Finance Corporation (182 members), the Multilateral Investment Guarantee Agency (177 members), and the International Centre for Settlement of Investment Disputes (159 members)(World Bank Group 2012).

Soon after Bretton Woods, in 1948, the General Agreement on Tariffs and Trade (GATT) was negotiated at a UN conference. According to the World Trade Organization's (WTO) website, "the original intention was to create a third institution to handle the trade side of international economic cooperation, joining the two "Bretton Woods" institutions, the World Bank and the International Monetary Fund". This agreement remained in effect for nearly 50 years, and then in 1995, the WTO was formed, replacing GATT, to "deal with the rules of trade between nations at a global or near-global level". However, most of the WTO framework comes from the original GATT negotiations (WTO 2012). This came shortly after the U.S., Canada and Mexico entered into the North American Free Trade Agreement (NAFTA), in 1994, which created the world's largest free trade area by eliminating all trade barriers between the North American nations (OUSTR 2012).

Similar regional agreements have been established in Europe as well. For example, the Treaty of Rome, signed by Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany in 1957, officially established the European Coal and Steel Community, the European Economic Community, and the European Atomic Energy Community to facilitate cooperation between the ratifying nations (European Union 2012). Over time the communities merged and more European nations joined, and eventually the European Union (EU) was formed in 1993 (EU 2012). In 2002, the Euro note was adopted as currencies for several member states, comprising the Eurozone. Currently there are 27 members of the European Union, with 17 of those members making up the Eurozone (EU 2012).

The Organization of the Petroleum Exporting Countries (OPEC), is another important intergovernmental organization, founded by 5 original members in 1960. Presently having 12 members, membership is based on the extent that a country exports petroleum rather than being based on pure geography, as with the EU. OPEC's mission is to "coordinate and unify the petroleum policies of its Member Countries and ensure the stabilization of oil markets in order to secure an efficient, economic and regular supply of petroleum to consumers, a steady income to producers and a fair return on capital for those investing in the petroleum industry" (OPEC 2012).

Despite oil being the world's largest commodity, previous research on the relationship between oil and stock markets was sparse until recently. Initially, the primary focus was on how macroeconomic variables influenced the stock market. The Gulf War has seemingly generated more research focusing specifically on oil. Some researchers focus on individual stock markets, while others analyze a subset of stock markets. For example, Jones (1999) and Smith (2000) focus specifically on oil producing nations whereas others look at the effects on emerging economies vs. developed economies (e.g Smith 2001). Similarly, the statistical methodology varies, including both linear and nonlinear models. As varied as the research is, so are the conclusions, with a number of authors finding oil shocks to have a significant positive effect, others finding a significant negative effect, and others finding no effect at all.

LITERATURE REVIEW

Macroeconomic variables

Up until the 90's, there appears to be little research conducted on possible linkages between oil shocks and the stock market. Until this time it would seem that research in this area was focused more on the stock market's relationships with macroeconomic variables like inflation and interest rates, and with measures of real activity such as production.

For example, Eugene Fama (1981), investigated the dynamics between stock returns and inflation. His method consisted of formulating tests for relating real stock returns to both inflation measures and those real variables considered fundamental in stock return determination, testing these variables individually and in combination. He concludes that stock returns are positively correlated with the real variables and that output is the most significant variable followed by real rate of return of capital, and finally, capital expenditures. With regards to inflation, Fama accounts for both expected and unexpected components and concludes that both measures are negatively correlated. While Fama's study did not directly address the price of oil as an economic variable, he goes on to use the results of the study to clarify the connections between the monetary sector and the real sector.

James D. Hamilton (1983) narrowed the scope by investigating linkages between spikes in the price of crude petroleum and U.S. recessions since World War II. However his measurements for recession included the standard measures of GNP, inflation, and unemployment. Therefore, there is no direct connection made to stock market in this study. Yet Hamilton did conclude that there is a statistically significant correlation between oil spike prices and some of the recessions prior to 1972. So if one believes that recessions are associated negatively with stock returns, it could be deduced that oil shocks would have a negative correlation with stock market returns.

Later research done by Chen et al. (1986) delves further into the relationship between economic forces and the stock market, specifically addressing the systematic risk certain macroeconomic variables provide to the market. The authors attempt to determine which economic variables, if any, are responsible for the co-movement of asset prices, and thereby supplying the systematic risk that cannot be diversified. Their analysis concludes that several factors, including industrial production and changes in risk premiums, are significant in explaining expected stock returns. While the authors summarize their results, stating that stocks are priced in accordance with their exposure to systematic economic news, the result of their test on the impact of oil price changes on asset pricing show no overall effect.

Oil and the Stock Markets – Pre Iraqi War

Ten years later Jones and Kaul (1996) published their pioneering article addressing the reaction of international stock markets to oil price shocks. Specifically they attempt to evaluate not only the causal effects of oil shocks on the economy and real cash flows, but also to evaluate the ability of the stock market to effectively evaluate the impact of such shocks. The authors begin their article claiming that, with the number of studies which have proclaimed that oil is of great importance to the world economy, they are surprised that there had not been more research on the relationship between stock markets and oil shocks. The authors note a few exceptions of studies in which oil price is used as just one of many risk factors that may affect stock prices, including Chen et al. (1986).

In the opening remarks by Jones and Kaul, the authors discuss the effects of the Iraq-Kuwait war in 1990, comparing the sharp rise in oil prices resulting from the war to the OPEC price hikes of 1973-1974 and 1979-1980. One could reasonably assume that the lack of interest in the specific effects of oil prices, seen up until this point, was reversed as the public eye began to focus more on oil. Nonetheless, it would appear that the postwar period marked the beginning of academia's investigation into the effects of oil shocks on the stock market, arguably beginning with Jones and Kaul's "Oil and the Stock Market".

An interesting aspect of Jones and Kaul's study is that relationships are examined in not only the U.S stock market, but with the stock markets of Canada, the United Kingdom and Japan as well. Previous studies have had a tendency to focus solely on the macroeconomics of the United States and typically ignored international markets. However, the authors theorize that the variation in production and consumption of oil reserves of different countries will likely lead to variations in the effects of oil prices changes on these markets. The authors explain that, largely due to data availability considerations, the empirical analysis of these four markets is limited to the postwar period.

Another notable factor of their analysis lies in their use of real stock returns versus nominal stock returns. The authors define the real return of a common stock as "the difference between continuously compounded return on a country's market index and the inflation rate calculated using the consumer price index" (pp. 468). Similarly, the data for oil prices is compiled from the producer price indexes of the included countries. The authors are careful to note that the countries measure the indices differently: fuel prices are included in the series for the United Kingdom, while Japan and Canada measure coal and petroleum prices, and finally the United States includes in its index, fuel and related products and power.

Jones and Kaul's basic methodology in analyzing the rationality of the stock market consists of two steps. First, they evaluate the effects of oil shocks on real cash flows alone and then they perform tests that account for the changes to expected returns caused by oil price changes. However, they first run regressions to confirm if in fact 1) stock returns are correlated with changes in expected cash flows and 2) if oil shocks have a significant effect on all four markets included in the study. The results of these initial investigations show a strong positive relationship between stock returns and the both the current and future cash flows in the U.S., the U.K., Canada and Japan. Also the results indicate that oil price increases had a significant, (usually) detrimental effect on all four countries' stock markets.

Having established the above relationships, the authors test whether the stock markets in each country properly evaluate the negative effects of oil price shocks on real cash flows.. The model estimation produces evidence that stock markets in both United States and Canada correctly assess the impact of oil shocks. However, the opposite appears to be true in Japan where the model results would seem to imply that the Japanese stock market does not react rationally to oil price changes. And similarly, in the United Kingdom, evidence shows that the impact of oil shocks is not completely explained by the real cash flow variables.

As previously mentioned, the next step in Jones and Kaul's analysis involves a model constructed to evaluate possible changes in expected returns caused by oil shocks. The results for the United States and Canada show that the inclusion of expected return and real cash flow variables eliminates the effects of oil shocks. The authors state that, since the cash flows alone, both current and future, account for the effects of oil shock in both the U.S. and Canada, these results are not surprising. The authors claim that the results for Japan and the United Kingdom remain puzzling in that the financial variables used to proxy for changes in expected returns are again unable to rationalize the effects of oil price changes.

After presenting their empirical evidence, the authors proceed with a thorough discussion of possible biases they feel could be present in their empirical analyses. They address possible measurement errors in inflation, oil prices, and cash flows. Finally, they construct a brief conclusion that oil price shocks have a negative impact on real stock returns during the postwar period, with the U.S. and Canadian markets reacting rationally and the Japanese and U.K stock markets showing excess volatility. Jones and Kaul do not offer any suggestions for further research.

The same year that Jones and Kaul published their article, “Oil and the Stock Markets”, their working paper was referenced in an article published by Huang et al. (1996). Similarly, the authors use the crisis in the Persian Gulf as a testament to the importance of oil and note a gross lack in the research of the effects of energy shocks on financial markets when compared to the large amounts of research in macroeconomic issues. However, in this article, the evaluation of the effects of energy shocks on the financial markets is done through an analysis between stock prices and oil futures prices traded on the New York Mercantile Exchange.

The authors claim that if the markets are efficient, then the oil futures prices and stock prices will be contemporaneously correlated. The study compares oil prices to stock market indices as well as stock prices of companies they feel are the most susceptible to changes in oil prices. In addition, the article examines the lags in the stock market’s adjustments to energy shocks, in an attempt to evaluate the efficiency of the oil futures and stock markets. Also, efficiency is investigated by examining the degree of correlation of return volatility across markets under the assumption that volatility can “be an accurate measure of the rate of information flow in a financial market”(Ross, cited in Huang et al. 1996, pp. 2-3).

Similar to the study by Jones and Kaul, the authors of this study operate under the intuitive assumption that stocks are priced in accordance with their exposure to systematic movements in expected cash flows as well as discount rates. Huang, Masulis, and Stoll elaborate and claim that future oil prices can in fact have an inverse effect on cash flows. Also they explain that the discount rate used in stock pricing models is a factor of expected inflation and interest rates and therefore also subject to dependence on oil prices.

After a brief introduction to the oil futures market traded on the NYMEX comes a description of the data to be used in the study. With oil future being an actively traded commodity, the data was rather easy to identify and two types of oil were used; heating oil and crude oil. Daily closing prices of oil futures contracts were used for a time period starting with October 9, 1979 for heating oil and April 11, 1983 for crude oil and continuing through March 16, 1990. In order to avoid "spurious results" that could be produced by linking the two oil markets together, the authors chose to analyze the returns separately (pp. 7).

The data used to measure stock returns is also relatively straightforward. The S&P 500 is used as a market wide index with prices being collected daily at 3:00pm for the monthly S&P 500 Bulletin. Twelve industry price indices are also used and were selected and organized according to SIC codes with returns obtained from daily NYSE closing prices. The last of the returns analyzed come from the stocks of Chevron, Exxon and Mobil, all companies in the oil industry and again the 4pm daily closing prices are used with returns adjusted for dividends and splits. Finally with regard to interest rates, which are included as a control variable, the authors use the returns on One-month treasury bills quoted daily at 3:00pm.

The article goes on to discuss the empirical analysis, beginning with an evaluation of the cross-correlation between stock returns and future oil returns. The results show that only the correlation coefficients for the oil company returns are statistically significant. This implies that the general economy, reflected here by stock prices, sees very little immediate impact from oil price shocks. The authors go on to compare these results to the previously mentioned study by Chen, Roll and Ross that also concludes that oil prices shocks have no significant effect on stock prices. The article also contrasts the results to the Jones and Kaul study just discussed which produced differing results.

The article further reports a significant correlation between "the returns of the petroleum stock index and the three oil stocks" with "current and lag one oil futures returns" (pp. 12). Huang et al. rationalize these results, by addressing the feasibility that oil companies will likely benefit from rises in oil prices, marked in the analysis as "significant contemporaneous positive correlation" (pp. 12). However the article suggests that the presence of a correlation which lags one day, implies that the markets are inefficient and it is possible for investors to profit from oil price changes the day before. Yet the authors decide that there is a need to investigate possible serial correlations that could generate a lagged effect in the data before accepting the results and their economic implications.

The serial correlations estimated in this article are found through a regression of the current return against its own prior six days' return. The authors summarize that the significant positive serial correlations that the stock indices exhibit at a one-day lag are likely the result of being comprised of component stocks that are infrequently traded. In addition, the article reports that there are significant lag one correlations with T-bill returns, Chevron returns, and heating oil return, but not with Mobil, Exxon, and crude oil returns. No significant serial correlations appear lag six. Once again the authors suggest that further investigation is needed, this time with the VAR approach, which can address possible inaccuracies caused by particular events and delayed reactions.

Huang et al. consider two variables of interest in the context of the VAR approach – stock returns and oil future returns. The returns of t-bills are also included as a control variable. Finally, to address the seasonality concerns previously mentioned, the authors include 18 dummy variables. Eleven of the eighteen are monthly dummies for months other than January. Four are crash dummies for the days of October 16, 19, 20, and 21, respectively, in 1987, one is a dummy for returns that span a weekend, one is a dummy for returns that span a holiday, and one is a dummy for oil futures contract replacement days on which the contract nearing settlement is replaced with the contract one month older. The authors chose to use the VAR method to estimate a series of equations, so as to test a series of hypotheses involving the lead-lag relationships between future returns and stock returns.

The results of the VAR estimate show that only the models testing the petroleum industry stock index and the three oil company stocks have results which allow for a rejection of the null hypothesis that "oil futures do not lead Treasury bill rates and stock returns" (pp. 16). Huang et al. investigate these results through a modified system of equations that test for the effects on the perceived lead of oil futures if t-bills are eliminated from the analysis, and find that the results are the same. Such results imply that the relationship between oil futures and stock returns is not affected by interest rates.

A comparison of the results of the VAR method to the results of the earlier cross correlation tests produces unsurprising results. Both tests indicate that oil futures returns "Granger-cause" stock returns in the oil futures market and then oil specific information is reflected by oil stock with some lag. At the same time, the results of both tests show that the same results are not seen with any of the other stock returns, which the authors mention as surprising.

In an effort to evaluate the economic significance of the oil futures lead over oil stocks, Huang et al perform two tests involving the calculated bid-ask spread for the three oil company stocks included in the analysis. The first test shows that "the average spread substantially exceeds the expected returns associated with a 1% change in oil future prices" (pp. 20). Next the authors test the profitability of exploiting the apparent opportunity for profit produced by the one day lag, including the bid-ask spread in the analysis. Average daily returns came out to be significantly negative for all but one year. The results of these tests would seem to imply the bid ask spread that public investors are subject too is too great to allow for these investors to profit from the one day lag in stock price reaction to oil shocks.

The last section of this article pertains to the volatility in the returns of stocks as the authors reference Ross (1989) who argues that "volatility is a measure of information flow" (Ross, cited by Huang et al. 1996, pp. 23). Once again the VAR system of equations is used to test the hypotheses as well as the implications of removing the t-bill control variable. The results revealed relationships similar to the relationship found with returns.

The overall consensus of this study is that oil price shocks have little effect on the stock market, with an intuitively rational exception of the petroleum stock index and three individual oil stocks. The results suggest that oil futures would provide diversification benefits if included in a portfolio. As for the apparent inefficiencies with the oil stocks, the bid-ask spread seems to eliminate the profit potential for all private investors.

In 2002, Ciner published a study in response to the previously discussed article published by Huang et al.. The new study challenges the results of their original analysis, which only evaluated linear linkages between oil futures and the stock market, by readdressing the same issues using nonlinear methodology along with linear analysis. As with both of the previously discussed articles, the author once again points out that there has been relatively little investigation into the possible linkages between equity markets and oil price changes. In contrast however, the author offers an interesting suggestion, including a reference from Sadorsky (1999) that turbulence in the oil market could contribute to impact of oil price shocks on the stock market.

In order to validate a comparison between the two studies under consideration, Ciner uses the same data that was used in the original study conducted by Huang et al. However, the study also extends to include a more current analysis of data into the 1990s, specifically from March 20, 1990 through March 2, 2000.

The first part of Ciner's analysis consists of a test for linear Granger causality. Similar to the Huang et al study, the Ciner study uses a VAR model system of equations including dummy variables for seasonalities and specific market crashes. The test produces results with insignificant test statistics, which indicates that there is no linear Granger causality between stock returns and oil futures. However, additional testing conducted on the residuals provide evidence of "significant nonlinear dependencies" (pp. 207).

In the second part of the study, Ciner conducts nonlinear testing of the residuals from the VAR model. The results provide "evidence of nonlinear Granger causality from crude oil futures returns to stock index returns" but "no nonlinear Granger causality from heating oil futures to stock index returns" (pp. 208). Also interesting to note, is that the test shows that there is evidence of a possible feedback relationship from the stock markets to oil prices, becoming more significant in the 1990s.

In summation, this article readdressed a previous article and offers varying results from what would seem to be a more thorough analysis. While the first testing was based solely on linear relationships, Ciner's study delves further into patterns of the data by drawing conclusions from nonlinear testing. The results confirm the already widely held belief that oil price shocks affect the stock market. The article is concluded with suggestions for further research into international equity markets and the implication that a possible feedback relationship could have on market efficiency.

Oil and the Stock Markets – Post Iraqi War

Since Ciner's article was published in 2002, there have in fact been several articles which have addressed, not only those topics suggested by Ciner, but also other topics pertaining to the relationships between oil price and the stock market. As seen with the Persian Gulf War, the wars in Iraq and Afghanistan, and the subsequent dramatic effects on the oil markets, have likely influenced the more recent attention drawn to this area of research. Presently, there are several identifiable themes that have developed in the academic research of the relationship between oil prices and equity markets, each focusing on specific segments of the quickly evolving worldwide equity market.

Of course many articles have been written that focus on the effects of oil prices on the stock market of a single country. A multitude of research limits analysis to the U.S. stock market. Recently however, academia has seen a geographical expansion in the published research with articles investigating individual stock markets all over the world. For example, Faff and Brailsford (1999) researched how 24 Australian industry portfolios reacted to oil prices. Papapetrou (2001) evaluates the relationship between oil prices and the stock markets in Greece. Similarly, El-Shariff et al (2005) conducted a study solely concerning the U.K stock market. Later, Lin et el. (2010) investigated Greater China and Unal and Korman (2012) studied Turkey. Just to name a few.

In 2006, Odusami published an article, "Crude Oil Shocks and Stock Market Returns", which uses nonlinear statistical analysis to investigate the reaction of the U.S. stock market specifically to "unexpected shocks". This article serves as a counterpart to Joshua Pollet's 2002 article that investigates the effects of only "expected shocks" in oil prices. Similarly, Sridhar Gogineni (2007) researched the differing effects of supply side shocks versus demand side shocks on the various industries of U.S. stock market. With variation mainly in the statistical model employed, Kilian and Park (2009), who also differentiated between supply shocks and demand shocks, repeated Gogineni's research.

Another common theme in recent research is the analysis of oil price effects on oil-exporting countries as opposed to oil-importing countries. Arouri et al (2010) used both linear and nonlinear models to investigate the stock markets of the Gulf Cooperation Council. Established in 1981, the GCC consists of six countries that together, "produce about 20% of all world oil, control 36% of world oil exports, and possess 47% of the world oil" (Daly 2011, pp. 45). Arouri et al. present their article as an update to previous articles that also centered on the GCC Nations. Similarly, Daly and Fayyad (2011), compare the effects of oil price shocks on the markets of the GCC nations with the effects on the developed markets of the U.K. and the U.S.

The GCC nations are considered emerging economies, yet the aforementioned articles focused on the countries' statuses as oil-exporters. Other authors have directed their research specifically towards emerging economies, which are largely ignored in earlier research. One such example comes from Ono (2011) who investigates the effect of oil price changes on the stock markets of Brazil, Russia, India, and China, commonly abbreviated as BRIC. These countries are considered the world's "leading emerging economies", and cover nearly half of the world's population.

Driesprong et al (2004) also differentiated between developed and emerging nations when they conducted a very broad evaluation of market efficiency as they tested whether changes in oil prices predict stock returns in their article, "Stock Markets and Oil Prices", published in 2004.

Using stock market data from 48 countries, a world market index and price series of several types of oil, their study finds that investors underreact to oil prices changes. Since oil price is readily available public information, the delayed reaction indicates that markets are inefficient. The authors even claim that simple trading strategies can be employed exploiting this anomaly and would outperform a risk corrected buy and hold benchmark by 4% annually.

Covering a 30 year time span, the authors first analyze the monthly returns on a world market index and the indices of 18 countries with developed markets. Twelve European countries are tested, along with three Asian nations, the U.S., Canada and Australia. Next, the monthly returns of 30 countries with "emerging" markets are evaluated. Finally, various sectors within each country's economy are analyzed. The authors also used several oil series, finding that it was difficult to find long oil series. The Dubai benchmark is used, in addition to the West Texas Intermediate and Brent benchmarks. However, the focus of the article is on the results for the Arabian Gulf Arab Light Crude Oil Spot Prices and both a NYMEX and IPE future series as they find these series to "give a good indication of the 'average' results for all series" (pp. 12).

Using a simple linear regression model, their analysis shows that, in the developed markets, 12 of 18 have a significant negative relationship between stock market returns and the previous month's oil prices. The same results are found with the world market index as well. Only 8 of the 30 emerging markets show a statistically significant negative relationship with the previous month's oil prices. As for the sector analysis, the results indicate that the effects of oil are country specific and not sector specific.

To look further into the apparent underreaction of investors, Driesprong et al. ran regressions including oil prices lagged up to 6 months. They find that most countries experience a delayed reaction time between one and two months. Interestingly, they also find that in some countries there also appears to be a corresponding overreaction around the 3 and 4 month lag. Lastly no effect seems to be found 4 months after the change in oil price.

In order to test the robustness of the predictability they found, the authors simply split the data into two equal time periods. Finding the effect stronger in the first half, they still find the effect to be significant in both periods, and offer this as evidence that the effect is robust over the entire 30 year sample period.

Finally, Driesprong et al. ran a multiple regression that incorporated macroeconomic variables and dummy variables. Specifically, they reviewed the monthly return of the country as a function of the one month lagged dividend yield, the two months lagged inflation rate, the one month lagged return, a dummy for the January effect, and a dummy variable for the "Sell in May" effect. Again, the results show a strong predictability effect for all the variables, with the exception of inflation and the January effect. Running the regression first without a variable for oil, and then incorporating a variable for the one month lagged oil, the authors learn that the effect of a change in oil price is still significant in after the inclusion of the control variables.

Giving a practical effect to the statistical analysis by evaluating economic significance, the authors analyze how a strategy that utilizes the claimed anomaly that oil predicts stock prices would measure against a simple buy hold strategy. Their conclusion is that the oil anomaly would have outperformed the buy and hold strategy by an average of 4% annually. Additionally, they found that "the oil strategy is substantially less risky than investing in the market index in the respective countries" (pp. 23).

This paper, in many ways, serves as an update to Driesprong et al.'s article. However there are a few marked differences. Most important, daily returns are used, not monthly. Three world market indices are used as opposed to one. The world market index for emerging markets is used instead of data for 30 separate emerging markets. Similarly, as opposed to running regressions for 18 different nations (12 being European), the world market index for developed markets is used. To my knowledge, the inverse relationship between oil and the stock markets has never been investigated. That is, no one has determined whether a change in market returns has an effect on oil price. Also, two control variables are incorporated into the analysis: exchange rate and interest rate. Lastly, this paper uses dummy variables to investigate the effects of several major events around the world that are widely believed to have far-reaching economic consequences.

METHODOLOGY

Data

General

Daily data, expressed in U.S. dollars, is used for all variables in this analysis. The data cover the 20-year time period from January 2, 1991 to December 30, 2011. All returns are expressed as the first difference of natural log, shown below:

$$R^0 = \ln(x_t) - \ln(x_{t-1})$$

Oil – West Texas Intermediate and Brent Oil

As of 2011, the Energy Intelligence Group identified a total of 177 major crude oil streams of different varieties and grades. In order to simplify price referencing, oil markers, or benchmarks, were introduced in the mid-1980s. Regression models are estimated separately using two of the three major crude oil benchmarks. West Texas Intermediate is a sweet light crude oil benchmark that is used mainly in the U.S. As the underlying commodity of the Chicago Mercantile Exchange’s oil futures contracts, it is considered a major benchmark in oil pricing, serving as a benchmark for approximately 17-19% of the oil consumed daily worldwide. Similarly, The Brent sweet light crude oil benchmark is the primary benchmark used in Europe, and is considered the leading global benchmark for Atlantic basin crude oils, covering approximately 57-63% of the world's daily oil consumption. With few exceptions, the WTI runs at a slightly higher price than Brent Oil as it is lighter and less sour than Brent oil (Driesprong et al. 2004). However, the prices of the two benchmarks move closely together.

Markets – Japan, Great Britain, US, Australia, Hong Kong

The daily returns on indices of five major stock markets, each located in a developed nation, are used in this analysis. For Japan, the Nikkei 225 is a benchmark index for the Tokyo Stock Exchange. It is a price-weighted average of 225 top-rated Japanese companies. The FTSE 100 Index is a capitalization-weighted index of the 100 most highly capitalized companies traded on the London Stock Exchange. The Standard and Poor's 500 Index is a capitalization-weighted index of 500 stocks listed on the New York Stock Exchange. The Australian All Ordinaries Index is a capitalization-weighted index. The index is made up of the largest 500 companies as measured by market cap that are listed on the Australian Stock Exchange. Finally, the Hang Seng Index is a free-float capitalization-weighted index of a selection of companies from the Stock Exchange of Hong Kong.

World Indices

In order to gain some insight into different effects that oil prices may have on developed nations as opposed to nations with emerging economies, regression models are estimated using three world market indices. The MSCI World Indices are free-float weighted equity indices. MXWO includes developed world markets, and does not include emerging markets. MXWD includes both emerging and developed markets. The MXEF Index is a free float weighted equity index for emerging markets only.

Exchange Rates and Interest Rates

Variables for exchange rates and interest rates are included in the regression analysis as control variables. Since all variables are expressed in U.S. dollars, the exchange rates are calculated for all countries using the rate of their domestic currency against the U.S. dollar. Intuitively, the exchange rate for the U.S. will be "1". As with the indices and oil prices, the daily return is employed in the analysis for both exchange rates and interest rates. The 10-year government bond rate is used as a measure of interest rates for the countries included in the study. However, this interest rate information was not available for Hong Kong.

Indicator variables

Indicator (dummy) variables provide an opportunity to investigate the effects of non-quantifiable, or qualitative, independent variables. For this study, 16 dummy variables are employed for major world events thought to have substantial economic impact. In order chronologically, these variables cover the following: the Asian financial crisis, the World Trade center attacks on 9/11, the invasion of Iraq and subsequent war, Hurricane Katrina, the earthquake in Indonesia, the missile launches by North Korea, the Israel-Lebanon war, the global financial crisis, the New Years bombing in Nigeria, the pipeline attack in Africa, the Gaza conflict, the Arab Spring, and the earthquake in Japan. See TABLE 1 for the specific dates used for each event.

Descriptive Statistics

Descriptive statistic results, provided in TABLE 2, confirm that the West Texas Intermediate and Brent Oil benchmarks move very closely together. Their means differ by a mere $1/10^{th}$ of a percent, and they are very similarly volatile. Oil prices are more volatile than the returns of all 8 indices, which also have similar volatilities. Honk Kong and Japan's stock market have the most volatile returns of the markets examined, while Australia's stock market has been the least volatile.

Regressing current returns against their own returns from the five days prior tests autocorrelation. The regression equation and null hypothesis are:

$$R_t = \beta_0 + \beta_1 R_{t-1} + \beta_2 R_{t-2} + \beta_3 R_{t-3} + \beta_4 R_{t-4} + \beta_5 R_{t-5} + \varepsilon_t$$

$$H_0: \ \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$$

The purpose of autocorrelation analysis is to determine if past values of certain variables predict their own future values. The results of the autocorrelation analysis are presented in TABLE 3. Brent oil shows a significant negative autocorrelation with one, two, and three day lagged returns. West Texas has significant negative autocorrelations only with two and three day lags. Japan has a very significant negative correlation with lag two returns. As does Great Britain, which also shows a significant three day lag correlation. The U.S. exhibits the most significant negative autocorrelation at one and five day lags, and a less significant negative correlation at lag three. China is unique in that it has a *positive* autocorrelation at a both three and four day lags. Lastly, Australian shows no significant autocorrelation with lagged returns at all.

Cross-correlation analysis, which tests for correlation amongst the oil variables and the indices, can also provide interesting insight into the data. The results for all variables are found in TABLE 4. Interestingly, nearly all of the variables exhibit statistically significant correlation with each other. However, the strength of the cross-correlation is minimal in many circumstances. The three world market indices, unsurprisingly, are highly correlated. Yet, the data show that they are also highly correlated with the indices for the U.S. and the U.K. This could be a result of the world indices being heavily weighted with components from these countries. Logically, the correlation is weakest between the world index for emerging economies and the U.S. and U.K. indices. Similarly logical, the results also indicate a high correlation between the U.S. and the U.K. indices themselves.

Model

To test the relationship between oil and the indices, the following simple regression model is estimated:

$$R_t = \beta_o + \beta X_t + \varepsilon_t$$

$$H_0: \beta = 0$$

The first series of regressions tests the effects, if any, that a change in oil prices has on the returns of the indices. Therefore, in the above model, R_t is the return on the market index and X_t is the oil return on day "*t*". The coefficient β indicates the amount of change the index will realize per a unit change in oil returns. A significant relationship will reject the null hypothesis that oil returns have no effect on contemporaneous market returns.

In contrast, the second series tests the inverse of the relationship above. That is, the effects that market returns have on oil returns are investigated. Accordingly, the variables are reverse in the above model and R_t represents the change in oil prices and X_t is the return on the market index, again on day "t". Likewise the coefficient β indicates the amount of change oil will realize per a unit change in the market return. A significant relationship will reject the null hypothesis that market returns have no effect on oil.

The next step taken in testing the relationship between oil and the markets is to use the same regression analysis as above, but with lagged return data. The model would change accordingly:

$$R_t = \beta_o + \beta X_{t-5} + \varepsilon_t$$

$$H_0 : \beta = 0$$

Using this model tests the effects that a change in returns 5 days ago has on today's returns. A five day lag, otherwise a trading week, is used in order to avoid the effects that infrequently traded stocks could have on the index returns. So one series is run with R_t as the return on the market index on day "t" and X_{t-5} is the oil return five days earlier. The coefficient β indicates the amount of change the index will realize per a unit change in oil returns 5 days prior. A significant relationship will reject the null hypothesis that 5-day lagged oil returns have no effect on current market returns.

Similarly, the effect of market returns 5 days ago has on current oil returns is investigated by reversing the variable so that R_t represents the change in oil prices on day "t" and X_{t-5} is the return on the market index 5 days earlier. With this series, the coefficient β indicates the amount of change oil returns will realize per a unit change in the 5-day lagged market returns. A significant relationship will reject the null hypothesis that market returns have no effect on oil.

Control Variable Analysis

Exchange Rates and Interest Rates

Exchange rates and interest rates are incorporated as control variables in two series of regression. The first series, ignoring interest rate data, employs the following multiple regression model to test the effect of both oil price and exchange rate changes on the market indices:

$$R_t = \beta_o + \beta_x X_t + \beta_y Y_t + \varepsilon_t$$

$$H_0 = \beta_x = \beta_y = 0$$

where,

R_t = return on the index on day "t"

X_t = change in oil prices on day "t"

Y_t = change in exchange rates on day "t"

The second series includes both interest and exchange rata data, and used this multiple regression model:

$$R_t = \beta_o + \beta_x X_t + \beta_y Y_t + \beta_z Z_t + \varepsilon_t$$

$$H_0 = \beta_x = \beta_y = \beta_z = 0$$

where,

R_t = return on the index on day "t"

X_t = change in oil prices on day "t"

Y_t = change in exchange rates on day "t

Z_t = change in interest rates on day "t"

For both of the control variable models, the effect of oil can be compared with the effects of exchange rate and interest rate fluctuations. The coefficients, $\beta_{x,y,z}$, show the magnitude of each independent variables effect on the dependent variable, in the case, return on the index. Due to the lack of comparable data, the world indices cannot be evaluated in terms of the control variables. Hong Kong is also omitted from this analysis due to the inability to procure complete interest rate data.

Indicator Variable Analysis

As previously mentioned, dummy variables allow for the testing of the effects of qualitative independent variables on the dependent variable, in this case, returns on the indices. This study identifies 18 major events that people have speculated have had significant economic consequences. Each event is assigned a dummy variable that has either a daily value of "0" or "1", with a "1" representing those days over which the event occurred and "0" representing all other days in the sample time period. A series of regressions, using the following model, test the effects of these dummy variables:

$$R_t = \beta_o + \beta_x X_t + \beta_y D_t + \varepsilon_t$$
$$H_0 = \beta_x = \beta_y = 0$$

where,

R_t = return on the index on day "t"

X_t = change in oil prices on day "t"

D_t = value of dummy variable on day "t"

The value of this test lies more in the analysis of the significance of the coefficients for the individual variable rather than the utility of the overall regression.

Robustness

The remaining regression series are used as a means to test the robustness of any significant effects found over the 20-year study. Using Driespong et al. methodology as an example, the data is first split into two 10-year halves, and then again into four 5-year quarters. The same regression analysis dictated above is then run against the six new subsets of the data. Comparing the results of the subset regressions to the results of the regressions for the entire timespan helps to identify situations where a significant effect found over the 20-year study might in fact be the result of outliers that are isolated to a subset.

RESULTS

Model

The relationship between oil prices and markets returns is investigated by testing both whether the market returns are a function of oil prices and whether oil prices are a function of market returns. Using both contemporaneous and lagged data allows also for the efficiency of the various markets to be scrutinized.

TABLE 5A and TABLE 5B present the results of the two regression series testing the contemporaneous relationships between oil and the indices. The results indicate highly significant positive relationships between all of the indices and both oil benchmarks. This means that an increase in the price of oil will lead to an increase in returns, and vice versa. However, in the series testing market returns as a function of oil, less than 1% of the total variation in market returns is a result of oil price changes in every country, with the exception of the U.K., where the regression model explains approximately 2.5% of the variation. With the world market indices, oil price changes explain nearly 2.5% of the total variation in returns. Conversely, market returns are the cause of less than 1% of the change in oil prices, again in every country except the U.K. Regarding the world indices, fluctuations in returns account for between 2.4% and 2.9% of the total variation in oil prices. These results indicate that although statistically there is a very strong relationship between contemporaneous oil prices and indices return, the relationships are not economically significant.

The two series examining the effects of 5-day lagged data produce very different results, which are presented in TABLE 6A and 6B. In the series testing the effects of oil changes on market returns, only Great Britain's index has a statistically significant relationship with oil prices from 5 days prior. The relationship is negative, indicating that an increase in oil prices 5 days ago will lead to a decrease in returns on the London Stock Exchange today. Surprisingly, this index has a statistically more significant relationship with the West Texas benchmark than with the Brent benchmark, which is the mostly widely used oil benchmark in Europe. However, very little of the total variation in the FTSE 100 is explained by changes in either benchmark. West Texas price changes only explain 0.15% of the variation and Brent price changes only explain 0.10%.

Regarding the series testing oil prices as a function of the returns 5 days prior, West Texas only has a significant relationship with the U.S. market. The relationship is negative; indicating an increase in returns in the U.S. five days ago will lead to a decrease in the West Texas benchmark today. The Brent benchmark shares a slightly less significant positive relationship with the Fang Seng in Honk Kong. So unlike in the U.S. market, an increase in returns 5 days ago will actually lead to a rise in Brent oil prices today. No other significant relationship is found in this series. Like previous results, neither of these two relationships explains much of the total variations in oil prices. The S&P 500 is only responsible for .14% of the variation in the West Texas returns and the Fang Seng is only responsible for .13% of the variation in the Brent returns. Conclusively there is little to no economic value derived from the statistically significant relationships found between the dependent variables and 5-day lagged independent variables.

Control Variable Analysis

Exchange Rates and Interest Rates

When incorporating control variables into a regression analysis, the most valuable information come not from the parameter estimates by themselves, but from comparing the estimates to the results from regressions run without control variables. Unlike the previous regression series, only the indices are used as dependent variables. The first series looks at market returns as a function of oil and exchange rates. The second series, goes a step further, and investigates market returns as a function of oil, exchange rates, and interest rates.

The results of the first series, which add only exchange rates, are presented in TABLE 7A. With all four markets, there is a highly significant relationship between market returns and the independent variables for oil and exchange rates. However, the results indicate that the models including exchange rates only explain more of the variation in market returns than the models without exchange rates in Japan and Australia. In Japan, oil alone only explained <1% of the variation, while oil and exchange rates together explain nearly 2%. The results in Australia are more drastic, with oil alone explaining <1% of the total variation, while oil and exchange rates together explain over 9.5% of the total variation.

In the U.S. and the U.K., the results are opposite. In the U.S., the inclusion of exchange rates lowered the percentage of variation explained by the independent variables from around 0.9%, with oil alone, to approximately 0.7% with both oil and exchange rates. The effects in the U.K.

are similar, with oil alone responsible for around 2.3% of total variation, while oil and exchange rates together only account for 1.9% of the variation in market returns.

Reviewing the results of the parameter estimates for the individual coefficients also reveals some interesting information. With the U.K., only the estimates for the oil benchmarks are statistically significant. This could explain why the inclusion of the exchange rate variable causes the regression model to explain less of the variation than the regression without the variable. The same is likely true for the U.S., which has a constant exchange rate of 1. The most interesting result however, is that the oil coefficients are no longer significant in Australia when the exchange rate variable is added to the regression model.

A variable for interest rates is added as an additional control variable in the next series, which results are given in TABLE 7B. Once again, there is a highly significant relationship between the four markets and the three independent variables: oil, exchange rates, and interest rates. The amount of total variation explained by the model increases even more in Japan, to almost 7% with the addition of the interest rate variable. Australia also sees an increase from approximately 9.5% to 10.2%. Unlike the addition of an exchange rate variable, the addition of an interest variable brings about a dramatic increase in the amount of variation explained by the model in the U.S. and the U.K, up to 8.3% and 4.8%, respectively.

The coefficient estimates, once again, shed light on possible causes for the increased model utility provided by the addition of interest rates as an independent variable. First, the coefficient estimates for the interest rate variable is highly significant in all four countries for both oil models. In the U.K., the inclusion of the interest rate variable to the model produces a significant estimate for the exchange rate coefficient, unlike the model with only oil and exchange rates. However, in Australia, the oil coefficients are still not significant.

Indicator Variable Analysis

Dummy variable analysis provides a means for quantifying the effects that a qualitative variable has on the dependent variable being tested. This study investigates the possible effects of several world events, ranging from earthquakes to wars. The results from these series of regressions can be found in TABLE 8A and TABLE 8B. Like all previous series, the series investigating market returns as a function of oil and the enumerated world events (represented by dummy variables) results in highly significant relationships with the indices of all five countries and the three world market indices. Every regression in the series also provides a highly significant coefficient estimate for the oil variables. However, there are very few regressions that produce a significant coefficient for the any of the dummy variables.

The indicator variables for the earthquake in Japan and the attack on the World Trade Center on 9/11 produce the most significant coefficients of all of the dummy variables, limited to the Nikkei and S&P, respectively. The results in Japan are the same for both West Texas and Brent oil. Logically, in the U.S. the relationship is slightly stronger with the West Texas Benchmark. The dummy variable for the 9/11 attacks is one of the two variables that indicate a significant impact in multiple indices; having significant impact on the indices for U.S, Australia, and the world's developed countries. As to be expected, the significance of the 9/11 attacks is stronger in the West Texas series. In fact, the relationship between the 9/11 attacks and the world's developed economies is only slightly significant with the West Texas benchmark and is not significant at all in the Brent regression.

The indicator variable for the Asian Financial Crisis is the other variable to affect multiple indices, specifically the indices for Honk Kong and the world's emerging economies. Both of these relationships are stronger with the West Texas model. Interestingly, the Global Financial

Crisis doesn't show a global impact as the dummy variable only shows a significant relationship with the Australian index. Again, this relationship is stronger, albeit only slightly, in the West Texas model. The dummy variable with a more significant variable in the Brent model is the variable for the Gaza Conflict, and this variable is only significant in relation to the Hong Kong index.

Robustness

In order to test for the robustness of the relationship between market returns and oil prices, the data set is divided into halves. The results from the series for the both 10-year halves and the entire 20-year period are found in TABLE 9A – 9F. In the first half, only the U.S. and the three world indices are significantly affected contemporaneously by oil, and vice versa. When using lagged data in the analysis, none of the models indicate a significant relationship in either direction, be it a model for market returns as a function of oil prices or a model for oil prices as a function of market returns. The addition of the exchange rate variable only produces a significant model for the U.K., the U.S. and Australia. However, adding the variable for interest rates results in significant models for all four countries. (Reminder: Hong Kong and the world indices are not included in the control variable analysis). The results further indicate that oil is responsible for significantly less of the variation in market returns in the first 10-year half compared to the result from the entire 20-year period.

In the second 10-year half, the results show a highly significant, positive, bi-directional relationship between contemporaneous returns on oil and all of the indices. Only the U.K. market is significantly affected by oil prices five days prior, and only by West Texas oil. There is no significant relationship between the FTSE 100 and 5-day lagged Brent oil prices. Interestingly, West Texas oil is significantly affected by 5-day lagged returns in all countries tested, with the exception of the U.K.. Surprisingly, only Australia and Honk Kong lagged returns have a significant effect of Brent oil. Compared with the first half, the inclusion of the exchange rate and interest rate variables results in models that account for markedly more of the total variation in market returns.

CONCLUSIONS

According to the regression analysis conducted in this study, there is a significant bi-directional relationship between oil prices and the markets indices over the 20-year period investigated. However, this relationship only became significant over the last 10 years for all the countries except for the United States. The U.K. is the only market that is affected by lagged oil prices, and again this effect has only been significant in the last 10 years. Interest rates changes are responsible for, by far, more variation in market returns than both exchange rates and oil prices. Lastly, of the world events studied, very few had a significant affect, the strongest of which were the earthquake in Japan and the attacks on the world trade centers on 9/11.

Despite the statistical significance of the relationship between oil prices and the market indices, there is very little economic significance. Transaction costs would likely eliminate any opportunity to exploit this relationship. These results are not surprising in light of the previous research on this topic. For example, Chen et al. (1986) also reported that that oil shocks have no effect on the pricing of financial assets. Similarly, Huang et. al (1996) concluded that although there is a significant relationship between NYMEX oil futures and the S&P 500, any economic significance is eliminated by the bid/ask spread. These determinations, all derived from linear analysis, appears to confirm the research conducted by Ciner (2002) which showed no linear causality between oil future prices and the U.S. stock market. However, his discovery of nonlinear Granger causality where no linear causality could be found indicates that the complexity of the relationship between oil prices and stock markets cannot be sufficiently evaluated using linear methodology. Interesting, these result contradict Driesprong et al. (2004), who also find a significant negative relationship, but find that this relationship can be exploited to outperform a buy/hold strategy. Jones and Kaul (1996) reported similar results, finding markets in the U.K. and Japan to be inefficient, but found that the U.S. and Canadian markets were efficient.

All in all, the results of this study seem to indicate that the effects of globalization, with regard to oil prices and the financial markets are widespread. Oil prices shocks, have a similar effect on all indices tested. Given that oil is the world's largest commodity, this would seem to indicate that globalization has minimized, and almost eliminated, any localized risk from oil price shocks and that market efficiency is worldwide.

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APPENDIX

Table 1: Indicator Variables – SAS Labels, Description, and Dates

SAS Label	Description	Date(s)
US911	World Trade Center (U.S.) Attack	09/11/2001 – 09/18/2001
IRAQWAR	War in Iraq	03/20/2003 – 02/15/2011
IRAQINV	U.S. Invasion of Iraq	03/20/2003 – 05/01/2003
KATRINA	Hurricane Katrina (initial impact)	08/29/2005 – 09/05/2005
KATRINAX	Hurricane Katrina (6 month impact)	08/29/2005 – 02/28/2006
NKMISS1	North Korean Missile Test	07/05/2006 – 07/12/2006
NKMISS2	North Korean Nuclear Test	10/09/2006 – 10/16/2006
ISLEBWAR	Israel/Lebanon Conflict	07/12/2006 – 09/08/2006
NYDAYNIG	Pipeline Bombing (Nigeria)	01/01/2009 – 01/08/2009
PPLNATK	Pipeline Bombing (Nigeria)	04/18/2008 – 04/25/2008
GAZACNFL	Gaza Conflict	12/29/2008 – 01/21/2009
INDOEQ	Indonesian Earthquake and Tsunami	12/26/2004 – 01/02/2005
JAPEQ	Japan Earthquake and Tsunami	03/11/2011 – 03/18/2011
ARABSPR	Arab Spring	02/17/2010 – 12/30/2011
GLOBEFIN	Global Financial Crisis	02/01/2007 – 12/31/2011
ASIAFIN	Asian Financial Crisis	01/01/1997 – 06/01/1998

Table 2: Descriptive Statistics of Crude Oil Benchmarks and Market Indices

Variable	SAS Label	N	Mean	Std Dev	Minimum	Maximum
West Texas Oil	WTDF	5270	0.02498	2.41309	-40.04776	16.40973
Brent Oil	BRDF	5339	0.02625	2.23856	-42.72233	12.89825
Nikkei 225	JPIXDF	5165	-0.02025	1.53883	-12.11103	13.23459
FTSE 100	GBIXDF	5306	0.01814	1.16702	-9.26557	9.38434
S&P 500	USIXDF	5293	0.02548	1.19406	-9.46951	10.95720
All Ordinaries	AUIXDF	5316	0.02186	0.94901	-8.55359	6.06928
Hang Seng	HKIXDF	5192	0.03477	1.71876	-14.73468	17.24710
Developed	MXWODF	5474	0.01719	0.96833	-7.32530	9.09637
All World	MXWDDF	5477	0.01771	0.95825	-7.37214	8.90189
Emerging	MXEFDF	5478	0.02919	1.19272	-9.99479	10.07316

Table 3: Auto-correlation Regressions of Oil and Market Indices on Own Lag Returns

		WT	BR	JP	GB	US	AU	HK
Model	F	3.53	3.29	4.14	7.23	7.84	0.6	3.23
	Pr > F	0.0035	0.0058	0.001	<.0001	<.0001	0.7025	0.0065
	r^2	0.0042	0.0039	0.0079	0.0137	0.0148	0.0011	0.0062
Lag 1	Coeff	0.00106	-0.03463	-0.03559	-0.02511	-0.08582	0.01393	0.03015
	t value	0.07	-2.22	-1.81	-1.29	-4.36	0.73	1.56
	Pr > |t|	0.9459	0.0264	0.0701	0.198	<.0001	0.4682	0.119
Lag 2	Coeff	-0.05166	-0.03899	-0.06867	-0.06868	-0.02192	-0.02632	0.01406
	t value	-3.28	-2.49	-3.53	-3.5	-1.1	-1.41	0.73
	Pr > |t|	0.001	0.0129	0.0004	0.0005	0.2726	0.1595	0.4669
Lag 3	Coeff	-0.03497	-0.03706	-0.02834	-0.05607	-0.04533	-0.00016	0.03985
	t value	-2.23	-2.35	-1.44	-2.87	-2.28	-0.01	2.09
	Pr > |t|	0.0258	0.0187	0.1502	0.0042	0.0226	0.9932	0.037
Lag 4	Coeff	0.01533	-0.00047	-0.03067	0.01685	-0.00754	-0.0085	0.04363
	t value	0.98	-0.03	-1.59	0.87	-0.38	-0.45	2.65
	Pr > |t|	0.3292	0.9765	0.1119	0.3864	0.7008	0.6493	0.0082
Lag 5	Coeff	-0.01538	-0.01736	0.0187	-0.07683	-0.07893	-0.0102	0.00755
	t value	-0.98	-1.1	0.95	-3.93	-4.01	-0.54	0.46
	Pr > |t|	0.3264	0.2707	0.3403	<.0001	<.0001	0.5882	0.6487

Table 4: Cross-correlation Between Oil Benchmarks and Equity Market Indices

	WTDF	BRDF	JPIXDF	GBIXDF	USIXDF	AUIXDF	HKIXDF	MXWODF	MXWDDF	MXEFDF
WTDF	1	0.82923	0.06679	0.15148	0.10384	0.06507	0.08255	0.15887	0.16345	0.15514
WTDF		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
BRDF	0.82923	1	0.07573	0.13795	0.10336	0.07959	0.09326	0.15966	0.16483	0.16473
BRDF	<.0001		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
JPIXDF	0.06679	0.07573	1	0.29548	0.12064	0.5264	0.47627	0.42396	0.44594	0.48427
JPIXDF	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
GBIXDF	0.15148	0.13795	0.29548	1	0.49958	0.32037	0.35222	0.71828	0.72476	0.55413
GBIXDF	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
USIXDF	0.10384	0.10336	0.12064	0.49958	1	0.11958	0.16949	0.85676	0.8413	0.42583
USIXDF	<.0001	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001	<.0001
AUIXDF	0.06507	0.07959	0.5264	0.32037	0.11958	1	0.55412	0.35645	0.38745	0.54762
AUIXDF	<.0001	<.0001	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001
HKIXDF	0.08255	0.09326	0.47627	0.35222	0.16949	0.55412	1	0.38752	0.42306	0.63232
HKIXDF	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001
MXWODF	0.15887	0.15966	0.42396	0.71828	0.85676	0.35645	0.38752	1	0.99731	0.64289
MXWODF	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001		<.0001	<.0001
MXWDDF	0.16345	0.16483	0.44594	0.72476	0.8413	0.38745	0.42306	0.99731	1	0.69086
MXWDDF	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001		<.0001
MXEFDF	0.15514	0.16473	0.48427	0.55413	0.42583	0.54762	0.63232	0.64289	0.69086	1
MXEFDF	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	

Table 5a: Regression Results of Market Indices as a Function of Oil

	Model			West Texas		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	19.1	<.0001	0.0041	0.04199	4.37	<.0001
GBIX	122.51	<.0001	0.0255	0.07695	11.07	<.0001
USIX	45.62	<.0001	0.0096	0.04874	6.75	<.0001
AUIX	17.83	<.0001	0.0038	0.02452	4.22	<.0001
HKIX	31.4	<.0001	0.0067	0.05862	5.6	<.0001
MXWO	135.22	<.0001	0.0253	0.06489	11.63	<.0001
MXWD	143.81	<.0001	0.0269	0.06616	11.99	<.0001
MXEF	134.4	<.0001	0.0252	0.07911	11.59	<.0001
	Model			Brent Crude		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	29.28	<.0001	0.0062	0.05523	5.41	<.0001
GBIX	108.53	<.0001	0.0226	0.07814	10.42	<.0001
USIX	44.37	<.0001	0.0094	0.05179	6.66	<.0001
AUIX	31.04	<.0001	0.0066	0.03481	5.57	<.0001
HKIX	44.3	<.0001	0.0094	0.07491	6.66	<.0001
MXWO	138.12	<.0001	0.0259	0.07037	11.75	<.0001
MXWD	147.23	<.0001	0.0275	0.07182	12.13	<.0001
MXEF	146.66	<.0001	0.0274	0.08859	12.11	<.0001

Table 5b: Regression Results of Oil as a Function of Market Indices

	Model			West Texas		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	21.97	<.0001	0.0047	0.10501	4.69	<.0001
GBIX	122.51	<.0001	0.0255	0.33118	11.07	<.0001
USIX	45.62	<.0001	0.0096	0.19786	6.75	<.0001
AUIX	17.83	<.0001	0.0038	0.15463	4.22	<.0001
HKIX	31.4	<.0001	0.0067	0.11359	5.6	<.0001
MXWO	118.79	<.0001	0.0247	0.38251	10.9	<.0001
MXWD	126.23	<.0001	0.0262	0.39819	11.24	<.0001
MXEF	116.36	<.0001	0.0242	0.30905	10.79	<.0001
	Model			Brent Crude		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	29.28	<.0001	0.0062	0.11244	5.41	<.0001
GBIX	108.53	<.0001	0.0226	0.28976	10.42	<.0001
USIX	44.37	<.0001	0.0094	0.18113	6.66	<.0001
AUIX	31.04	<.0001	0.0066	0.1891	5.57	<.0001
HKIX	44.3	<.0001	0.0094	0.12505	6.66	<.0001
MXWO	122.79	<.0001	0.0255	0.36083	11.08	<.0001
MXWD	131.64	<.0001	0.0273	0.37723	11.47	<.0001
MXEF	140.79	<.0001	0.0292	0.31474	11.87	<.0001

Table 6a: Regression results of Market Indices as a Function of Oil 5 Day Lag

	Model			West Texas		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	0.07	0.7887	0	0.00256	0.27	0.7887
GBIX	6.66	0.0099	0.0015	-0.01835	-2.58	0.0099
USIX	0.68	0.4105	0.0002	-0.00604	-0.82	0.4105
AUIX	0.34	0.5574	0.0001	0.00344	0.59	0.5574
HKIX	0.99	0.3209	0.0002	0.01051	0.99	0.3209
MXWO	2.25	0.1333	0.0005	-0.0091	-1.5	0.1333
MXWD	2.11	0.1463	0.0005	-0.00871	-1.45	0.1463
MXEF	0.18	0.6705	0	-0.00316	-0.43	0.6705
	Model			Brent Crude		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	0.02	0.8824	0	0.00151	0.15	0.8824
GBIX	4.36	0.0368	0.001	-0.01589	-2.09	0.0368
USIX	0.19	0.6651	0	0.00339	0.43	0.6651
AUIX	0.16	0.6931	0	-0.00247	-0.39	0.6931
HKIX	0.82	0.3638	0.0002	0.01028	0.91	0.3638
MXWO	0.19	0.6603	0	-0.00285	-0.44	0.6603
MXWD	0.22	0.6398	0	-0.003	-0.47	0.6398
MXEF	0.07	0.7929	0	-0.00208	-0.26	0.7929

Table 6b: Regression results of Oil as a Function of Indices 5 Day Lag

	Model			West Texas		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	3.36	0.0668	0.0007	0.04239	1.83	0.0668
GBIX	0.68	0.4088	0.0002	-0.02571	-0.83	0.4088
USIX	6.2	0.0128	0.0014	-0.07503	-2.49	0.0128
AUIX	2.66	0.1027	0.0006	0.06174	1.63	0.1027
HKIX	3.13	0.0771	0.0007	0.03709	1.77	0.0771
MXWO	2.53	0.112	0.0006	-0.05791	-1.59	0.112
MXWD	1.88	0.1707	0.0004	-0.05044	-1.37	0.1707
MXEF	0.44	0.5059	0.0001	0.0199	0.67	0.5059
	Model			Brent Crude		
Index	F Value	Pr > F	r^2	Coeff	t value	Pr > |t|
JPIX	1.9	0.1684	0.0004	0.02977	1.38	0.1684
GBIX	0.16	0.691	0	-0.01156	-0.4	0.691
USIX	3.61	0.0574	0.0008	-0.05355	-1.9	0.0574
AUIX	3.67	0.0554	0.0008	0.06774	1.92	0.0554
HKIX	5.89	0.0153	0.0013	0.04756	2.43	0.0153
MXWO	1.57	0.2098	0.0003	-0.04271	-1.25	0.2098
MXWD	1.19	0.2754	0.0003	-0.03754	-1.09	0.2754
MXEF	0.36	0.5471	0.0001	0.01683	0.6	0.5471

Table 7a: Regression Results of Indices as a Function of Oil and Exchange Rates

<table>
<tr><td></td><td colspan="3">Model</td><td colspan="3">West Texas</td><td colspan="3">Exchange</td></tr>
<tr><td>Index</td><td>F Value</td><td>Pr > F</td><td>r^2</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td></tr>
<tr><td>JPIX</td><td>44.31</td><td><.0001</td><td>0.0182</td><td>0.03364</td><td>3.61</td><td>0.0003</td><td>0.26465</td><td>8.54</td><td><.0001</td></tr>
<tr><td>GBIX</td><td>52.82</td><td><.0001</td><td>0.0216</td><td>0.07054</td><td>10.22</td><td><.0001</td><td>-0.03956</td><td>-1.51</td><td>0.1315</td></tr>
<tr><td>USIX</td><td>35.44</td><td><.0001</td><td>0.0074</td><td>0.04245</td><td>5.95</td><td><.0001</td><td>0</td><td>.</td><td>.</td></tr>
<tr><td>AUIX</td><td>251.88</td><td><.0001</td><td>0.0954</td><td>0.0047</td><td>0.86</td><td>0.3925</td><td>0.37292</td><td>22.13</td><td><.0001</td></tr>
<tr><td></td><td colspan="3">Model</td><td colspan="3">Brent Crude</td><td colspan="3">Exchange</td></tr>
<tr><td>Index</td><td>F Value</td><td>Pr > F</td><td>r^2</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td></tr>
<tr><td>JPIX</td><td>48.15</td><td><.0001</td><td>0.0198</td><td>0.04532</td><td>4.54</td><td><.0001</td><td>0.26489</td><td>8.56</td><td><.0001</td></tr>
<tr><td>GBIX</td><td>44.04</td><td><.0001</td><td>0.0181</td><td>0.06926</td><td>9.32</td><td><.0001</td><td>-0.04402</td><td>-1.67</td><td>0.0943</td></tr>
<tr><td>USIX</td><td>32.25</td><td><.0001</td><td>0.0067</td><td>0.04347</td><td>5.68</td><td><.0001</td><td>0</td><td>.</td><td>.</td></tr>
<tr><td>AUIX</td><td>252.59</td><td><.0001</td><td>0.0956</td><td>0.00838</td><td>1.42</td><td>0.1563</td><td>0.37122</td><td>21.97</td><td><.0001</td></tr>
</table>

Table 7b: Regression Results of Indices as a Function of Oil, Exchange Rates, and Interest Rates

<table>
<tr><td></td><td colspan="3">Model</td><td colspan="3">West Texas</td><td colspan="3">Exchange</td><td colspan="3">Interest</td></tr>
<tr><td>Index</td><td>F Value</td><td>Pr > F</td><td>r^2</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td></tr>
<tr><td>JPIX</td><td>113.9</td><td><.0001</td><td>0.0671</td><td>0.03211</td><td>3.53</td><td>0.0004</td><td>0.24117</td><td>7.97</td><td><.0001</td><td>0.15670</td><td>15.75</td><td><.0001</td></tr>
<tr><td>GBIX</td><td>82.58</td><td><.0001</td><td>0.0495</td><td>0.06220</td><td>9.07</td><td><.0001</td><td>-</td><td>-1.99</td><td>0.0468</td><td>0.16782</td><td>11.79</td><td><.0001</td></tr>
<tr><td>USIX</td><td>214.72</td><td><.0001</td><td>0.0828</td><td>0.02349</td><td>3.39</td><td>0.0007</td><td>0</td><td>.</td><td>.</td><td>0.21164</td><td>19.79</td><td><.0001</td></tr>
<tr><td>AUIX</td><td>180.64</td><td><.0001</td><td>0.1023</td><td>0.00401</td><td>0.73</td><td>0.4649</td><td>0.35936</td><td>21.16</td><td><.0001</td><td>0.06778</td><td>6.02</td><td><.0001</td></tr>
<tr><td></td><td colspan="3">Model</td><td colspan="3">Brent Crude</td><td colspan="3">Exchange</td><td colspan="3">Interest</td></tr>
<tr><td>Index</td><td>F Value</td><td>Pr > F</td><td>r^2</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td><td>Coeff</td><td>t value</td><td>Pr > |t|</td></tr>
<tr><td>JPIX</td><td>116.11</td><td><.0001</td><td>0.0683</td><td>0.04213</td><td>4.32</td><td><.0001</td><td>0.24162</td><td>7.99</td><td><.0001</td><td>0.15618</td><td>15.7</td><td><.0001</td></tr>
<tr><td>GBIX</td><td>78.09</td><td><.0001</td><td>0.0470</td><td>0.06132</td><td>8.32</td><td><.0001</td><td>-</td><td>-2.15</td><td>0.0319</td><td>0.17040</td><td>11.97</td><td><.0001</td></tr>
<tr><td>USIX</td><td>215.73</td><td><.0001</td><td>0.0832</td><td>0.02709</td><td>3.65</td><td>0.0003</td><td>0</td><td>.</td><td>.</td><td>0.21233</td><td>19.93</td><td><.0001</td></tr>
<tr><td>AUIX</td><td>181.09</td><td><.0001</td><td>0.1026</td><td>0.00781</td><td>1.32</td><td>0.1859</td><td>0.35763</td><td>21</td><td><.0001</td><td>0.06772</td><td>6.01</td><td><.0001</td></tr>
</table>

Table 8a: Regression Results of Indices as a Function of Indicator Variables with West Texas

	JPIX	GBIX	USIX	AUIX	HKIX	MXWO	MXWD	MXEF
	West Texas							
F Value	2.82	7.8	3.98	2.17	3.13	8.17	8.56	8.06
Pr > F	<.0001	<.0001	<.0001	0.0036	<.0001	<.0001	<.0001	<.0001
r^2	0.0102	0.0276	0.0143	0.0078	0.0113	0.0289	0.0302	0.0285
	Pr > |t|							
US911	0.1706	0.1320	**0.0014**	**0.0268**	0.1574	**0.0459**	0.0519	0.6742
IRAQWAR	0.2834	0.7558	0.8965	0.2621	0.9931	0.4721	0.4491	0.3831
IRAQINV	0.6645	0.6215	0.5647	0.6143	0.2916	0.3452	0.3462	0.6021
KATRINA	0.6464	0.4842	0.9273	0.5017	0.4963	0.4305	0.3918	0.1568
KATRINAX	0.2977	0.7770	0.8055	0.8634	0.8852	0.7410	0.7155	0.5798
NKMISS1	0.4461	0.8326	0.5013	0.9096	0.9209	0.3531	0.3536	0.5211
NKMISS2	0.7021	0.3815	0.6440	0.3921	0.6858	0.5736	0.5278	0.2697
ISLEBWAR	0.7984	0.9752	0.8687	0.6075	0.8777	0.8758	0.8736	0.9317
NYDAYNIG	0.0675	0.4218	0.0683	0.1321	0.7513	0.0874	0.1194	0.8579
PPLNATK	0.7074	0.6221	0.4793	0.5075	0.1498	0.6497	0.6450	0.7092
GAZACNFL	0.0794	0.1398	0.1844	0.1992	**0.0108**	0.0668	0.0655	0.1654
INDOEQ	0.9908	0.9563	0.6087	0.7494	0.4167	0.5481	0.5514	0.7409
JAPEQ	**0.0014**	0.4891	0.7704	0.5714	0.2004	0.5005	0.5134	0.7065
ARABSPR	0.7494	0.8701	0.9669	0.9751	0.6771	0.9060	0.8541	0.5467
GLOBEFIN	0.1982	0.3818	0.2297	**0.0326**	0.6197	0.1124	0.1226	0.2848
ASIAFIN	0.4620	0.3772	0.4180	0.4213	**0.0151**	0.5930	0.7487	**0.0025**

Bold values are < 0.05

Table 8b: Regression Results of Indices as a Function of Indicator Variables with Brent Crude

	JPIX	GBIX	USIX	AUIX	HKIX	MXWO	MXWD	MXEF
	Brent Crude							
F Value	3.25	7	3.9	2.93	3.88	8.41	8.88	9.48
Pr > F	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
r^2	0.0117	0.0249	0.014	0.0105	0.0139	0.0297	0.0313	0.0334
	Pr > |t|							
US911	0.1909	0.1160	**0.0016**	**0.0326**	0.1823	0.0571	0.0649	0.7663
IRAQWAR	0.2880	0.7360	0.8886	0.2725	0.9794	0.4667	0.4443	0.3881
IRAQINV	0.6677	0.6343	0.5696	0.6050	0.2944	0.3489	0.3496	0.5990
KATRINA	0.6635	0.5086	0.9472	0.5187	0.5152	0.4562	0.4170	0.1710
KATRINAX	0.2914	0.7943	0.8112	0.8846	0.9004	0.7439	0.7176	0.5682
NKMISS1	0.4347	0.8075	0.4881	0.9255	0.9393	0.3346	0.3343	0.4944
NKMISS2	0.6890	0.3661	0.6302	0.3810	0.6694	0.5510	0.5053	0.2526
ISLEBWAR	0.7896	0.9737	0.8670	0.6199	0.8654	0.8697	0.8669	0.9172
NYDAYNIG	0.0668	0.4065	0.0662	0.1324	0.7528	0.0835	0.1143	0.8475
PPLNATK	0.7162	0.6361	0.4872	0.5157	0.1536	0.6654	0.6613	0.7274
GAZACNFL	0.0731	0.1261	0.1725	0.1841	**0.0093**	0.0576	0.0560	0.1423
INDOEQ	0.9964	0.9627	0.6084	0.7704	0.4032	0.5429	0.5453	0.7218
JAPEQ	**0.0014**	0.4877	0.7700	0.5754	0.2016	0.5008	0.5139	0.7096
ARABSPR	0.7565	0.8815	0.9592	0.9662	0.6678	0.8926	0.8403	0.5325
GLOBEFIN	0.2022	0.3817	0.2308	**0.0340**	0.6313	0.1143	0.1248	0.2928
ASIAFIN	0.4809	0.3531	0.4003	0.4419	**0.0167**	0.5553	0.7054	**0.0030**

Bold values are < 0.05

Table 9a: Results of Robustness Test Regressions with Indices as a Function of Oil

West Texas									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.54	0.4645	0.0002	43.14	<.0001	0.0174	19.1	<.0001	0.0041
GBIX	0.32	0.5741	0.0001	184.72	<.0001	0.0704	122.51	<.0001	0.0255
USIX	13.56	0.0002	0.006	103.35	<.0001	0.0407	45.62	<.0001	0.0096
AUIX	1.99	0.158	0.0009	37.28	<.0001	0.0151	17.83	<.0001	0.0038
HKIX	0.09	0.7694	0	59.28	<.0001	0.0237	31.4	<.0001	0.0067
MXWO	13.68	0.0002	0.0061	224.65	<.0001	0.0844	135.22	<.0001	0.0253
MXWD	13.77	0.0002	0.0061	237.59	<.0001	0.0888	143.81	<.0001	0.0269
MXEF	8.86	0.0029	0.0039	231.78	<.0001	0.0868	134.4	<.0001	0.0252
Brent Crude									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.42	0.5151	0.0002	58.96	<.0001	0.0236	29.28	<.0001	0.0062
GBIX	2.5	0.1141	0.0011	194.43	<.0001	0.0739	108.53	<.0001	0.0226
USIX	18.04	<.0001	0.008	117.06	<.0001	0.0458	44.37	<.0001	0.0094
AUIX	0.94	0.3335	0.0004	59.15	<.0001	0.0237	31.04	<.0001	0.0066
HKIX	0.31	0.5748	0.0001	84.62	<.0001	0.0335	44.3	<.0001	0.0094
MXWO	19.27	<.0001	0.0085	264.58	<.0001	0.0979	138.12	<.0001	0.0259
MXWD	19.38	<.0001	0.0086	281.82	<.0001	0.1036	147.23	<.0001	0.0275
MXEF	8.66	0.0033	0.0038	297.02	<.0001	0.1086	146.66	<.0001	0.0274

Table 9b: Results of Robustness Test Regressions with Oil as a Function of Indices

West Texas									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.54	0.4645	0.0002	43.14	<.0001	0.0174	21.97	<.0001	0.0047
GBIX	0.32	0.5741	0.0001	184.72	<.0001	0.0704	122.51	<.0001	0.0255
USIX	13.56	0.0002	0.006	103.35	<.0001	0.0407	45.62	<.0001	0.0096
AUIX	1.99	0.158	0.0009	37.28	<.0001	0.0151	17.83	<.0001	0.0038
HKIX	0.09	0.7694	0	59.28	<.0001	0.0237	31.4	<.0001	0.0067
MXWO	13.68	0.0002	0.0061	224.65	<.0001	0.0844	118.79	<.0001	0.0247
MXWD	13.77	0.0002	0.0061	237.59	<.0001	0.0888	126.23	<.0001	0.0262
MXEF	8.86	0.0029	0.0039	231.78	<.0001	0.0868	116.36	<.0001	0.0242
Brent Crude									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.42	0.5151	0.0002	58.96	<.0001	0.0236	29.28	<.0001	0.0062
GBIX	2.5	0.1141	0.0011	194.43	<.0001	0.0739	108.53	<.0001	0.0226
USIX	18.04	<.0001	0.008	117.06	<.0001	0.0458	44.37	<.0001	0.0094
AUIX	0.94	0.3335	0.0004	59.15	<.0001	0.0237	31.04	<.0001	0.0066
HKIX	0.31	0.5748	0.0001	84.62	<.0001	0.0335	44.3	<.0001	0.0094
MXWO	19.27	<.0001	0.0085	264.58	<.0001	0.0979	122.79	<.0001	0.0255
MXWD	19.38	<.0001	0.0086	281.82	<.0001	0.1036	131.64	<.0001	0.0273
MXEF	8.66	0.0033	0.0038	297.02	<.0001	0.1086	140.79	<.0001	0.0292

Table 9c: Results of Robustness Test Regression with Indices as a Function of Oil Lag 5

West Texas									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.54	0.4645	0.0002	43.14	<.0001	0.0174	21.97	<.0001	0.0047
GBIX	0.32	0.5741	0.0001	184.72	<.0001	0.0704	122.51	<.0001	0.0255
USIX	13.56	0.0002	0.006	103.35	<.0001	0.0407	45.62	<.0001	0.0096
AUIX	1.99	0.158	0.0009	37.28	<.0001	0.0151	17.83	<.0001	0.0038
HKIX	0.09	0.7694	0	59.28	<.0001	0.0237	31.4	<.0001	0.0067
MXWO	13.68	0.0002	0.0061	224.65	<.0001	0.0844	118.79	<.0001	0.0247
MXWD	13.77	0.0002	0.0061	237.59	<.0001	0.0888	126.23	<.0001	0.0262
MXEF	8.86	0.0029	0.0039	231.78	<.0001	0.0868	116.36	<.0001	0.0242
Brent Crude									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.42	0.5151	0.0002	58.96	<.0001	0.0236	29.28	<.0001	0.0062
GBIX	2.5	0.1141	0.0011	194.43	<.0001	0.0739	108.53	<.0001	0.0226
USIX	18.04	<.0001	0.008	117.06	<.0001	0.0458	44.37	<.0001	0.0094
AUIX	0.94	0.3335	0.0004	59.15	<.0001	0.0237	31.04	<.0001	0.0066
HKIX	0.31	0.5748	0.0001	84.62	<.0001	0.0335	44.3	<.0001	0.0094
MXWO	19.27	<.0001	0.0085	264.58	<.0001	0.0979	122.79	<.0001	0.0255
MXWD	19.38	<.0001	0.0086	281.82	<.0001	0.1036	131.64	<.0001	0.0273
MXEF	8.66	0.0033	0.0038	297.02	<.0001	0.1086	140.79	<.0001	0.0292

Table 9d: Results of Robustness Test Regression with Oil as a Function of Indices Lag 5

West Texas									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.21	0.6502	0.0001	3.91	0.0482	0.0017	3.36	0.0668	0.0007
GBIX	0.02	0.8939	0	1	0.3163	0.0004	0.68	0.4088	0.0002
USIX	0.01	0.9056	0	7.44	0.0064	0.0032	6.2	0.0128	0.0014
AUIX	1.07	0.3014	0.0005	7.26	0.0071	0.0031	2.66	0.1027	0.0006
HKIX	0.09	0.7689	0	5.05	0.0247	0.0022	3.13	0.0771	0.0007
MXWO	0.07	0.7846	0	2.55	0.1105	0.0011	2.53	0.112	0.0006
MXWD	0.09	0.7669	0	1.79	0.1807	0.0008	1.88	0.1707	0.0004
MXEF	0.62	0.4301	0.0003	1.68	0.1953	0.0007	0.44	0.5059	0.0001
Brent Crude									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0	0.9849	0	3.33	0.0682	0.0014	1.9	0.1684	0.0004
GBIX	0.63	0.4263	0.0003	0.91	0.3395	0.0004	0.16	0.691	0
USIX	1.65	0.1992	0.0008	1.89	0.1698	0.0008	3.61	0.0574	0.0008
AUIX	0.35	0.5539	0.0002	8.03	0.0046	0.0034	3.67	0.0554	0.0008
HKIX	0.8	0.3726	0.0004	6.95	0.0084	0.003	5.89	0.0153	0.0013
MXWO	1	0.3168	0.0005	0.65	0.4195	0.0003	1.57	0.2098	0.0003
MXWD	1.07	0.3011	0.0005	0.36	0.5478	0.0002	1.19	0.2754	0.0003
MXEF	2.1	0.1474	0.001	3	0.0832	0.0013	0.36	0.5471	0.0001

Table 9e: Results of Robustness Test Regression with Indices as a Function of Oil and Exchange

West Texas									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.29	0.7506	0.0003	101.92	<.0001	0.0791	44.31	<.0001	0.0182
GBIX	31.56	<.0001	0.0274	86.21	<.0001	0.0678	52.82	<.0001	0.0216
USIX	13.56	0.0002	0.006	91.13	<.0001	0.037	35.44	<.0001	0.0074
AUIX	8.69	0.0002	0.0077	260.69	<.0001	0.1802	251.88	<.0001	0.0954
Brent Crude									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	0.23	0.7907	0.0002	110.12	<.0001	0.085	48.15	<.0001	0.0198
GBIX	32.88	<.0001	0.0285	83.95	<.0001	0.0661	44.04	<.0001	0.0181
USIX	18.04	<.0001	0.008	93.27	<.0001	0.0378	32.25	<.0001	0.0067
AUIX	8.23	0.0003	0.0073	262.41	<.0001	0.1812	252.59	<.0001	0.0956

Table 9f: Results of Robustness Test with Indices as a Function of Oil, Exchange and Interest

West Texas									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	16.6	<.0001	0.0213	132.9	<.0001	0.1396	113.9	<.0001	0.0671
GBIX	69.48	<.0001	0.0834	181.8	<.0001	0.1816	82.58	<.0001	0.0495
USIX	33.55	<.0001	0.0284	290.32	<.0001	0.191	214.72	<.0001	0.0828
AUIX	45.85	<.0001	0.0566	269.95	<.0001	0.2478	180.64	<.0001	0.1023
Brent Crude									
	First Half (10 years)			Second Half (10 years)			Full (20 years)		
	F	Pr > F	r^2	F	Pr > F	r^2	F	Pr > F	r^2
JPIX	16.58	<.0001	0.0212	138.67	<.0001	0.1448	116.11	<.0001	0.0683
GBIX	69.76	<.0001	0.0837	182.58	<.0001	0.1822	78.09	<.0001	0.047
USIX	33.96	<.0001	0.0288	297.68	<.0001	0.1949	215.73	<.0001	0.0832
AUIX	45.32	<.0001	0.056	271.35	<.0001	0.2488	181.09	<.0001	0.1026