The Relationship between Sour Crude Oil and Green Energy ETFs

By

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A research project submitted in partial fulfillment of the requirement for the degree of Master of Finance

Saint Mary's University

Written for MFIN 6692
Under the Direction of Dr. Colin Dodds

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Date: September 4, 2013

Acknowledgements

I would like to thank my supervisor Dr. Dodds for his guidance and all instructors in Master of Finance Program for their guidance while studying in the program. I would like to express my appreciation to Saint Mary's University for providing an excellent program, faculty and facilities. I would like to thank my parents, and my friends for their generous support and encouragement.

Abstract

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September, 2012

The main idea of this paper is to test relationship between Sour Crude Oil market and Green Energy ETFs market. The data samples were collected from Bloomberg through Aug 17th 2012 to Aug 15th 2013. To analyse multiple time series data sets, this paper employed the Johansen test and the Vectors Error Correction model. The final results show both long and short-term relationships, that the Sour Crude Oil spot price is a leading indicator between these two markets.

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Chapter1: Introduction

1.1 Purpose of Study

As an indispensable energy product, Crude Oil has become an important economic factor. It is often categorized in two kinds: Sweet Crude Oil and Sour Crude Oil. Sour Crude Oil generates more pollution and like CO_2 and H_2S during oil combustion, which may have a serious impact on the air quality. With rising concerns of quality of life, issues on the environment, energy and its effects have become a hot topic. Thus, high pollution gas emission energy related or offset products have now entered the financial market place. For example, green Energy ETFs represent a pollution gas emission energy offset product, and are traded in the global financial market.

Being an important part of the global financial market, the Crude Oil spot price could significantly influence financial market. According to Kilian and Park (2009), oil demand and oil supply shocks could explain one fifth of the long-run variation in U.S. real stock returns. While, Sour Crude Oil price could follow this basic economic theory as well on the other hand it could also be affected by other economic factors or financial instruments.

This paper aims at examining the relationship between Sour Crude Oil and Green Energy ETFs. Oil demand and oil supply shocks Crude Oil prices directly, therefore, the price of Crude Oil would influence stock price. Based on this logic, this paper uses historical price data. And the data details employed in this study are introduced later.

Generally, investors focus on the correlation between the two instruments, and purpose of this paper is not only to test the relationship between the Sour Crude Oil spot price and the global

Green Energy ETFs, but also to measure how strong a relationship exists. To be specific this requires an estimation of how much of the Sour Crude Oil spot price fluctuation can be explained by the Green Energy ETFs. What is more, this paper will also determine which is a leading indicator based on the results of the empirical study.

1.2 Background of Crude Oil

1.2.1 Brief Introduction of Crude Oil

Crude Oil is the most widely used fuel source which supports the main needs of the world's energy and the market for Crude oil is larger than any other sector in the financial and physical markets. Moreover, crude oil can be used in synthetic fibers, plastics and bitumen. Price changes have a huge effect on financial markets. Most of the crude oil is traded internationally in the OTC market. However, the detail of the transactions can`t be observed, so price reporting agencies hold the responsibility to report the price of oil.

1.2.2 Characteristics of Crude Oil

Density and sulphur content are the most important characteristics to distinguish different types of crude oil. According to the report of the American Petroleum Institute, crude oils may be referred to as either sweet or sour depending on the level of hydrogen sulfide present. Sweet Crude Oil has very little H2S whereas sour crude has larger quantities of present. When the total sulphur level in the oil is more than 0.5%, the oil is called "sour". The lower the density and sulphur content of the crude oil is, the higher quality would be recognised. Sweet crude is usually more expensive than the heavy and sour crude oil. Specifically, heavy crude oils produce less higher-value products, such as diesel, gasoline and jet fuel, so sour crudes require more processing than sweet crudes.

1.2.3 The Market for Crude Oil

Specifically tailored contracts are needed for trading the crude oil in the OTC market. More than ninety percent of the crude oil is traded under medium to long-term contracts. However, there is another market, the "spot market", which is for the physical delivery for the crude oil. Typically in the oil market, the "spot" transaction is not a long-term contract since the buyer has always underestimated the contract requirement. For near-term forward transactions, the "spot" transaction in oil is accurate and the most "spot" transaction will be reported as soon as ten days and up to sixty days after signing the contract. But for commodities, it generally takes much shorter; for example, it usually takes two days for London Metal Exchange delivered the spot price for metals and for the US Henry Hub, it only takes one day to deliver the gas spot price. For crude oil trading in the financial market, consumers, producers and financial institutions often use hedging activities and arbitrage. For the OTC financial contract, swap and options are most commonly used. The forward contracts are the instrument that the OTC market is commonly used, because in the forward contract, the entire price and the future delivery date have been specified and the forward contract is more flexible than the futures contract.

Over the past years, the interest on crude oil in the exchange traded market has increased, which shows that in the futures market, there is an increased number of non-traditional participants. Compared to other commodities, the exchange- traded turnover for crude oil is extremely higher, which shows that it plays an important role in the global economy.

1.2.4 Green Energy ETF

Green Energy is the opposite of fossil energy. Green Energy includes solar, wind, geothermal and other energy. They are trying to displace the oil and other fossil fuels in the future and reduce carbon emission volume dramatically. ETFs are becoming popular investment products in recent years due to their advantages compared to mutual funds. A Green Energy ETF is an exchange trade fund which tracks companies related to the Green energy industry.

Since 2008, there has been an upward spike in oil price, which has caused volatility in the energy sector as well as being controversial on the political side. For instance, there has already been a failure in solar energy projects in the US companies due to politically controversy. The price of some particular solar space is much cheaper in China than in the US, so it is hard for some companies to remain competitive. As a result, no matter how high the price of carbon-based fuel and how energy sources are attractive to the companies, there is still not much accrued profits to ETFs and alternative energy companies. From the research, it shows that ETFs are based on indexes which are tied to some popular index providers such as S&P, MSCI, Russell and Dow Jones.

There is a huge growth in demand for renewable energy in the U.S. According to the statistics, three percent of the U.S households participate in the green pricing program. In fact, each consumer has their own preference and there are many different resources that can produce renewable energy. The prior survey shows that 80 percent of households are willing to save money by cutting energy costs. So the "green" households are a great target for energy efficiency programs. Due to the primary motivator of cost savings for conserving energy, there is a high market potential for the energy efficiency programs.

Chapter 2: Literature Review

2.1 Recent Studies on the Exchange Traded Funds

With the development of financial markets and instruments, Exchange Traded Funds have emerged in recent decades. They have been available in the US and European markets since 1993 and 1999 repectively (SEC Release, 2008). What is more, ETFs are now enjoying huge popularity around the globe with particular rapid growth in developing countries such as China, India, South Korea and Brazil. At the same time, the ETFs are becoming a popular investment tool, which are widely recognized among both individual and institutional investors. They combine parts of the features of mutual funds and parts of the features of stocks. Lot of their growth has led to a surge of empirical studies.

Nguyen (2005) tests the opening and closing of ETF markets in a multi-market trading environment and finds that the opening trades on AMEX are most costly, which is consistent with the market power hypothesis. This paper also inspects competition among exchanges for order flow in ETFs. The result shows that ECNs dominate the market for ETFs. Another essay studies the short-term and the long-term effects of mult-imarket trading and the Nguyen paper examines the entry of multiple markets in the trading of DIA, QQQ, and SPY.

In recent years, many research papers have focued more detail on ETFs. Boney (2007) examines ETFs to connected fund investors and financial market and explored a further understanding. This paper tests the effects new products have on the market of existing and similar products and whether investor perceptions and potential biases affect fundamental aspects of ETFs and closed-end funds.

Sanchez and Wei (2010) observe the bid-ask spread, the information component of the spread, and the holding period of 77 ETFs for the period of April to June in 2004. Buetow and Henderson (2012) analyze ETF returns to evaluate how closely ETF prices replicate exposures to their benchmark indices. The analysis in this paper stresses practical considerations that influence index replication. The study of Rompotis (2012) explores the performance and trading features of 43 German ETFs traded on the XTRA market during the period 2003-05. The analysis shows that these ETFs have almost the same return to the underlying indexes, but suffered greater risk than indexes.

There are also papers that study the ETFs in the newly developing markets. Prasanna (2012) inspects the features and growth pattern of all the 82 exchange traded schemes floated and traded on Indian Stock markets, and estimates their performance using Data Envelopment Analysis.

In 2009 Debasish used the data from June 1995 to May 2009 in the Indian futures and stock markets to test the relationship between index futures trading and spot market volatility. The research paper obtained the results that index futures trading in India are related to two aspects. They are the decrease in spot price volatility and the decrease trading efficiency in the underlying stock market. Thus index futures trading seem to have brought about market stabilization, but along with loss of market efficiency.

Hseu et al (2007) published a paper while covered the relative price efficiencies of S & P 500, Nasdaq-100 and DJIA in the spot, futures and ETF markets from March 2000 to March 2001. This paper employed co-integration in the analysis to find long-run relationships.

Chapter 3: Data and Methodology

3.1 Data

For Sour Crude Oil, this paper selects the U.S. crude oil index (USCOI) as a tool in analyze. USCOI was listed from Jan 14th 2009, which is calculated using the arithmetic average of daily assessed spot Deep Water Mars Blend, Poseidon and Southern Green Canyon crude oil prices. This outright price is derived using the average of three sour crude price spreads versus West Texas Intermediate crude oil at Cushing. In order to match information among all data sets, this paper chooses a time horizon which is owned by all variables. So USCOI data includes the historical daily closing price from Aug 17th 2012 to Aug 15th 2013, 250 days data are collected from Bloomberg. All of the first stationary must be tested before using in regression since time series data are being used, the data need to be tested for stationary before use in the regression analysis. This paper employs Dickey–Fuller test whose null hypothesis is the time series data set has a unit root to check if all data sets are stationary. If the test result shows nonstationary all data sets should be the first difference processed or the regression analyses is meaningless.

What follows is the Dickey–Fuller test result for Sour Crude Oil (Table 3.1):

Dickey-Fuller test for unit root Number of obs = **248**

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	**-18.266**	**-3.461**	**-2.880**	**-2.570**

MacKinnon approximate p-value for Z(t) = **0.0000**

Table 3.1

The p-value=0 in Table 3.1, because of the original confidence interval in Stata is 95% and 0<5%. Therefore, the result rejects the null hypotheses. The Sour Crude Oil data is stationary.

For Green Energy ETFs` data, this paper selects 6 ETFs which are traded on the U.S. market. They are Claymore S&P Global Water Index (CGW), First Trust Global Wind Energy (FAN), First Trust ISE Water Index Fund (FIW), Market Vectors Solar Energy (KWT), Power Shares Wilder Hill Clean Energy (PBW) and First Trust NASDAQ Clean Edge US (QCLN). These 6 Green Energy ETFs cover almost all kinds of green energy industry such as solar, wind and water energy. Furthermore, another two comprehensive ETFs are aimed at fixing missing vectors. As previously mentioned all 250 days data were collected from Bloomberg Terminal.

CGW seeks investment results that correspond generally to the performance of the S&P Global Water Index. It has nearly 250 million dollars market capital and the recent NAV was around $24.3. Table 3.2 shows the result of Dickey–Fuller test on CGW`s daily NAV. P-value=0<5% proved that CGW is a stationary data set.

Dickey-Fuller test for unit root Number of obs = 248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.627	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = **0.0000**

Table 3.2

FAN seeks the ISE Global Wind Energy Index before fees and expenses. Even though FAN acts as a small capital role in the ETF market, 64.81% return supplied a consistent upward trend. For regression analysis, p-value also rejects the null hypotheses of Dickey–Fuller test. Using the same method to another four variables other ETF's, FIW, KWT, PBW and QCLN, are they all stationary as well. Appendix includes this part of the results.

Dickey-Fuller test for unit root — Number of obs = 248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.764	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

Table 3.3

3.2 Methodology

This research focus on both long and short-term relationships between two financial instruments. It uses the Vector Error Correction Model (VECM) or Vector Autoregression Model. The VECM model is a multi-factors model often used in estimating how fast the dependent variables could come back to equilibrium when independent variables change. It is similar to the Vector Autoregression Model and both of them should be used with stationary data.

The Vector Autoregression Model combines multiple variables which are regressed on their own lags. The lags of the other variables are included as independent variables in order to construct a model to test the relationships. Thus many equations are combined in the system and have the same numbers of regressors. But the difference is the VECM model should be used among co-integrated time series data. Therefore this paper will follow the Johansen test co-integration methodology to test time series data, then use

VAR or VECM model to find the relationship. The results from the Johansen test also show long-run causality indirectly. This test also came from the logic of the VAR Model and VECM, thus the functions are similar.

Johansen test:

$$\Delta x_t = \alpha(\beta' x_{t-1} - \beta_0 - \beta_1 t) - \gamma_0 |- \gamma_1 t + \sum_{j=1}^{k} \Gamma_j \Delta x_{t-j} + \varepsilon_t$$

(3.1)

where

X_t = vector of variables observed at date t. There are 7 X_ts in this paper: 6 Green Energy ETFs and the Sour Crude Oil spot price, they expand the test function to including 7 variables.

α = the matrix of coefficients. Many equations exist since putting the multi-time series data in a test. To merge these equations, a matrix should be used which is called the co-integrating matrix. This matrix is defined by how many orders of lags and co-integrating rank of the system. The "α" represents the coefficient of this matrix.

β, β_0, β_1 = matrix of coefficients, they decide the trend, intercept of co-integrating vectors in the system .

γ_0 = intercepts vector in the equations

γ_1 = vector of the linear trend coefficients.

Γ_j = matrices which define the lag structure

VECM or VAR

$$Y_t = V + \sum_{p=1}^{k} \alpha_{(t-p)} Y_{(T-P)} + \sum_{p=1}^{k} \beta_{(t-p)} X_{(t-p)} + \mu \tag{3.2}$$

As the explained above, Yt and Xt are vectors which represent Sour Crude Oil and Green Energy ETFs. In VECM or VAR, Sour Crude Oil and Green Energy ETFs are defined by lagged values and the results explained the relationship between independent variables and dependent variable which are reported by the model. VARs are easy to interpret and use since it is a simple framework that provides a systematic way in multiple time series to capture rich dynamics. The main objective to use VARs is to provide data description, policy analysis, forecasting and structural inference coherently and credibly. VARs have been proven to be reliable and powerful tools in the use of data description and forecasting.

3.3 Hypotheses of Johansen test

H_{01}: no co-integration among variables.

H_{02}: 1 co-integration among variables.

H_{03}: 2 co-integration among variables.

H_{04}: 3 co-integration among variables.

H_{05}: 4 co-integration among variables.

H_{06}: 5 co-integration among variables.

H_{07}: 6 co-integration among variables.

H_{08}: 7 co-integration among variables.

H_{09}: there is co-integration among variables.

From H_{01} to H_{08} are null hypotheses, H_{09} is an alternative hypotheses. As the illustrated in section 3.2, if the test result accepts H_{09} and rejects the null hypotheses, the VECM should be used in further analysis. If it accepts the null hypotheses, the VAR model shows instead of VECM. The results reject the null hypotheses when the trace statistic value is greater than the critical value.

3.4 The results of the test

The most reasonable number of lags should be determined before the test uses all data sets. From Table 3.4 most "*" appear in lag 7, therefore in the Johansen test and other Models in this paper, 7 lags need to be included in the calculation.

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	2391.65				4.7e-18	-20.0391	-19.998	-19.937
1	2668.99	554.68	49	0.000	6.9e-19	-21.9579	-21.6287	-21.1409
2	2821.63	305.27	49	0.000	2.9e-19	-22.8288	-22.2114	-21.2969*
3	2939.34	235.42	49	0.000	1.6e-19	-23.4062	-22.5007	-21.1594
4	3039.93	201.19	49	0.000	1.1e-19	-23.8398	-22.6462	-20.8781
5	3132.18	184.49	49	0.000	7.4e-20	-24.2032	-22.7215*	-20.5266
6	3173.1	81.851	49	0.002	8.0e-20	-24.1353	-22.3655	-19.7439
7	3245.15	144.1	49	0.000	6.7e-20*	-24.329*	-22.2711	-19.2227
8	3290.81	91.32	49	0.000	7.0e-20	-24.301	-21.9549	-18.4798
9	3334.25	86.874	49	0.001	7.6e-20	-24.2542	-21.6201	-17.7182
10	3374.28	80.052*	49	0.003	8.5e-20	-24.1788	-21.2566	-16.9279

Table 3.4.

Table 3.5 displays the results of the Johansen test. The maximum rank means the number of equations and 10 lags were chosen in this test. Since under a fixed number of equations more lags supply larger matrixes which make the test more completely. All the trace statistic values are greater than the 05% critical value, thus under any rank, the results of the test rejected the null hypothesises. As Chapter 3 mentioned, the VECM model should be employed and there is strong long-term co-integration among variables.

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	448	3222.9396	.	302.6751	124.24
1	461	3260.7303	0.27208	227.0938	94.15
2	472	3295.1009	0.25086	158.3525	68.52
3	481	3324.2854	0.21749	99.9836	47.21
4	488	3346.5107	0.17036	55.5329	29.68
5	493	3359.1679	0.10090	30.2186	15.41
6	496	3367.3268	0.06626	13.9009	3.76
7	497	3374.2772	0.05673		

Table 3.5.

Chapter 4: Analysis of Results

4.1 Data Overview

According to Table 4.1 below, there are 249 data points in each data set. SCOSPRET stands for the return of U.S. Sour Crude Oil spot price. Other variables stand for the return of each Green Energy ETFs, which was discussed in the last chapter. All means are negative with high volatility and the information indicated both markets suffered a high risk with a negative daily return.

Variable	Obs	Mean	Std. Dev.	Min	Max
SCOSPRET	248	-.0024525	.0660283	-.1819535	.1428967
CGWRET	248	-.0145106	.1726844	-.4954408	.3373984
FANRET	248	-.0032524	.0767457	-.2094495	.1509662
FIWRET	248	-.0275523	.2483339	-.8351063	.3613066
KWTRET	248	-.0185527	.1986018	-.5666667	.3027211
PBWRET	248	-.0372014	.28261	-.751938	.4193342
QCLNRET	248	-.0437112	.3169308	-1.034483	.4704254

Table 4.1.

In table 4.2, the correlation of different main variables were computed. The correlations show a negative relationship between Sour Crude Oil and each Green Energy ETFs. It is obvious to find that the range of correlations is from -0.2 to -0.4, so the influence from all these ETFs might be in the same degree.

	SCOSPRET	CGWRET	FANRET	FIWRET	KWTRET	PBWRET	QCLNRET
SCOSPRET	1.0000						
CGWRET	-0.3019	1.0000					
FANRET	-0.2277	0.8944	1.0000				
FIWRET	-0.2114	0.8897	0.7978	1.0000			
KWTRET	-0.2821	0.9257	0.7971	0.9678	1.0000		
PBWRET	-0.3748	0.9546	0.8564	0.9243	0.9706	1.0000	
QCLNRET	-0.3020	0.8933	0.7335	0.9721	0.9847	0.9408	1.0000

Table 4.2.

4.2 Results of Vector Error Correction Model

The whole results of the VECM were put included in the Appendix and this chapter only includes some parts that are directly related to the analysis. Table 4.3 includes ΔSCOPTRET as the dependent variable. The coefficient column includes all the matrix coefficients and a significant z-value represents the coefficient of an equantion is not equal 0. Furthermore, a long-term causality exists. There are 3 negative coefficients and 3 positive coefficients In Table 4.3. However, 2 out of 6 are not significant under the 95% confidence interval. Comparing the VECM result to the Johansen test result in Chapter 3, only four meaningful coefficents seems less significant so we can reject the nul hypothesises. Further more, all coefficents in Table4.4 are statistically insignificant. That means no short run causality between Sour Crude Oil and Green Energy ETFs.

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_SCOSPRET						
_ce1 L1.	-1.732246	.1175121	-14.74	0.000	-1.962566	-1.501927
_ce2 L1.	-.6139549	.1608816	-3.82	0.000	-.929277	-.2986329
_ce3 L1.	.1924059	.2783062	0.69	0.489	-.3530642	.737876
_ce4 L1.	.1331341	.1519681	0.88	0.381	-.164718	.4309861
_ce5 L1.	-2.016584	.2363731	-8.53	0.000	-2.479867	-1.553301
_ce6 L1.	.8045378	.1314777	6.12	0.000	.5468463	1.062229

Table 4.3.

The conclusion based on the above VECM result which put ΔSCOPTRET in the variable indicate there is not a dependent position short-run relationship and weak relationship between financial instruments. However, it is possible to assume that the difference between the VECM result and the Johansen test result may be because ΔSCOPTRET should appear as an independent position, in other words, the Sour Crude Oil price influences the Green Energy ETFs price significantly, with little inverse feedback.

CGWRET						
LD.	1.059561	.6977995	1.52	0.129	-.3081011	2.427223
L2D.	.6611231	.6424209	1.03	0.303	-.5979988	1.920245
L3D.	.466974	.5749874	0.81	0.417	-.6599807	1.593929
L4D.	.2724752	.5015413	0.54	0.587	-.7105276	1.255478
L5D.	.205089	.4109309	0.50	0.618	-.6003207	1.010499
L6D.	.174228	.3075394	0.57	0.571	-.4285381	.7769941
L7D.	-.0047149	.2009259	-0.02	0.981	-.3985225	.3890926
L8D.	-.0989875	.0922068	-1.07	0.283	-.2797095	.0817346
FANRET						
LD.	-2.246319	1.436477	-1.56	0.118	-5.061761	.569124
L2D.	-1.914993	1.289212	-1.49	0.137	-4.441803	.6118161
L3D.	-1.677433	1.11968	-1.50	0.134	-3.871964	.5170991
L4D.	-1.394637	.9310263	-1.50	0.134	-3.219415	.4301408
L5D.	-1.13517	.7437081	-1.53	0.127	-2.592811	.3224707
L6D.	-.802717	.5439049	-1.48	0.140	-1.868751	.263317
L7D.	-.5423875	.3454854	-1.57	0.116	-1.219527	.1347515
L8D.	-.131362	.1709955	-0.77	0.442	-.4665071	.2037831

Table 4.4

In order to prove the assumption, ΔSCOPTRET would be treated as an independent variable and combine all ETFs as a whole, then we can run the regression using VECM again. The “close” and “lastprice” stand for NAV closing price and Sour Crude Oil last price.The results seem near to the assumption. For the long-run causality, the coefficient of the matrix equation is significant and Z-value much greater than the critical value which is near to 1.9. Therefore, a strong negative relationship exists between the kings of the two financial instruments when ΔSCOPTRET in an independent variable position. For the short-run causality, almost 5 z-values are significant so the short-run causality exists as well, especially before the 4^{th} lag

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D2_close						
_ce1						
L1.	-3.207679	.2280676	-14.06	0.000	-3.654683	-2.760675
close						
LD2.	1.480158	.2191072	6.76	0.000	1.050715	1.9096
L2D2.	.807755	.2035646	3.97	0.000	.4087757	1.206734
L3D2.	.2300198	.1811061	1.27	0.204	-.1249417	.5849812
L4D2.	-.3069505	.1456935	-2.11	0.035	-.5925045	-.0213965
L5D2.	-.8384956	.1119329	-7.49	0.000	-1.05788	-.6191111
L6D2.	-.3759489	.0820289	-4.58	0.000	-.5367227	-.2151751
L7D2.	-.1805703	.0526298	-3.43	0.001	-.2837229	-.0774177
L8D2.	-.0462576	.0264085	-1.75	0.080	-.0980174	.0055022
lastprice						
LD2.	-.0687209	.0130963	-5.25	0.000	-.0943892	-.0430526
L2D2.	-.028287	.0159784	-1.77	0.077	-.059604	.00303
L3D2.	-.032861	.0174456	-1.88	0.060	-.0670537	.0013318
L4D2.	-.0070193	.0178705	-0.39	0.694	-.0420448	.0280063
L5D2.	.0613571	.017453	3.52	0.000	.0271499	.0955643
L6D2.	.0287895	.0163414	1.76	0.078	-.0032391	.0608181
L7D2.	.0184342	.0144123	1.28	0.201	-.0098134	.0466819
L8D2.	.0083461	.0108576	0.77	0.442	-.0129344	.0296266
_trend	-7.31e-07	.0000158	-0.05	0.963	-.0000317	.0000303
_cons	.0004333	.0135591	0.03	0.975	-.0261421	.0270087

Table 4.5.

Chapter 5: Conclusion

In recent years, Sour Crude Oil has been increasingly linked to gas emission issues. At the same time ETFs became popular since they have advantages compared to mutual funds. This paper investigated the dynamics among the Sour Crude Oil spot price and NAVs of five Green Energy ETFs from Aug 17th 2012 to Aug 15th 2013. Using these 250 days data as a sample, I tested if there are long-term and short-term relationships existing between Sour Crude Oil and Green Energy ETFs. This paper found a relationship between two financial markets which is similar to conclusions in previous research (Chapter 2). Financial markets are not absolutely independent among each other, but not all relationships are strong enough to cause a fluctuation.

In Chapter 4, the Johansen test showed a long-term relationship but didn`t express which is leading indicator. In the VECM model, the result contradict this using the Johansen test when put Sour Crude Oil in a dependent variable. Not every short-term coefficient is significant and no long-term co-integration. However if the position of variables was changed, the result showed reasonable significance in both long-term and short-term. Therefore it is easy to find that Sour Crude Oil spot price is a leading indicator. In another word, the Green Energy ETF market was affected by oil spot price. Conversely, our results indicate that there is very little feedback from Sour Crude Oil to ETFs market.

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Appendix A: D-fuller Test

D-fuller test for FAN

Dickey-Fuller test for unit root Number of obs = 248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.764	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

D-fuller test for FIW

Dickey-Fuller test for unit root Number of obs = 248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.012	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

D-fuller test KWT

Dickey-Fuller test for unit root Number of obs = 248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-15.078	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

D-fuller test for QCLN

Dickey-Fuller test for unit root   Number of obs   =   248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.327	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

D-fuller test for TAN

Dickey-Fuller test for unit root   Number of obs   =   248

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-15.316	-3.461	-2.880	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

Appendix B: VECM result

L7D.	2.431694	2.957053	0.82	0.411	-3.364023	8.227411
L8D.	2.041059	2.376545	0.86	0.390	-2.616883	6.699001
L9D.	3.241831	1.487748	2.18	0.029	.3258984	6.157764
FAN						
LD.	.3424458	2.596412	0.13	0.895	-4.746428	5.431319
L2D.	.9025888	2.586297	0.35	0.727	-4.166461	5.971639
L3D.	-.1051679	2.414875	-0.04	0.965	-4.838237	4.627901
L4D.	.1044565	2.246158	0.05	0.963	-4.297932	4.506844
L5D.	-.0676468	2.104396	-0.03	0.974	-4.192188	4.056894
L6D.	.4441541	1.929896	0.23	0.818	-3.338373	4.226681
L7D.	-.1609138	1.664111	-0.10	0.923	-3.422511	3.100684
L8D.	1.110586	1.298439	0.86	0.392	-1.434309	3.65548
L9D.	-.0316751	.8809282	-0.04	0.971	-1.758263	1.694912
FIW						
LD.	-1.168604	1.241362	-0.94	0.347	-3.601628	1.264421
L2D.	-1.15497	1.161255	-0.99	0.320	-3.430988	1.121047
L3D.	-1.170146	1.063017	-1.10	0.271	-3.253621	.9133288
L4D.	-1.031371	.9513239	-1.08	0.278	-2.895932	.8331895
L5D.	-.7254667	.8089989	-0.90	0.370	-2.311075	.860142
L6D.	-.7366077	.6785743	-1.09	0.278	-2.066589	.5933735
L7D.	-.2827242	.5671535	-0.50	0.618	-1.394325	.8288763
L8D.	-.5280017	.4485407	-1.18	0.239	-1.407125	.3511219
L9D.	-.090857	.3245961	-0.28	0.780	-.7270537	.5453397
KWT						
LD.	29.50578	17.71406	1.67	0.096	-5.213145	64.22471
L2D.	20.84014	16.90993	1.23	0.218	-12.30271	53.98299
L3D.	15.62451	16.02944	0.97	0.330	-15.79262	47.04164
L4D.	12.85039	14.67074	0.88	0.381	-15.90373	41.60451
L5D.	11.23611	13.43327	0.84	0.403	-15.09261	37.56483
L6D.	16.49229	11.78884	1.40	0.162	-6.613419	39.59799
L7D.	13.08602	10.00883	1.31	0.191	-6.530924	32.70296
L8D.	13.29666	7.891095	1.69	0.092	-2.169602	28.76292
L9D.	9.966533	5.380474	1.85	0.064	-.5790015	20.51207
PBW						
LD.	-7.010011	4.682652	-1.50	0.134	-16.18784	2.167818
L2D.	-5.766091	4.358313	-1.32	0.186	-14.30823	2.776045
L3D.	-5.418959	3.94358	-1.37	0.169	-13.14824	2.310316
L4D.	-5.380428	3.429123	-1.57	0.117	-12.10139	1.34053
L5D.	-4.894292	3.021659	-1.62	0.105	-10.81663	1.028051
L6D.	-5.296393	2.595951	-2.04	0.041	-10.38436	-.2084224
L7D.	-1.979087	2.075147	-0.95	0.340	-6.0463	2.088125
L8D.	-2.795844	1.624056	-1.72	0.085	-5.978935	.3872463
L9D.	-1.732488	1.056545	-1.64	0.101	-3.803279	.3383023

QCLN						
LD.	.045037	2.829781	0.02	0.987	-5.501232	5.591306
L2D.	.715208	2.654909	0.27	0.788	-4.488317	5.918734
L3D.	1.129096	2.451346	0.46	0.645	-3.675453	5.933645
L4D.	1.30199	2.21005	0.59	0.556	-3.029629	5.633608
L5D.	.5993669	1.975636	0.30	0.762	-3.272808	4.471542
L6D.	.0651664	1.72323	0.04	0.970	-3.312303	3.442635
L7D.	-.923233	1.469	-0.63	0.530	-3.80242	1.955955
L8D.	-.375197	1.111601	-0.34	0.736	-2.553895	1.803501
L9D.	-1.172773	.8178309	-1.43	0.152	-2.775692	.4301465
_cons	2.41e-06	.239106	0.00	1.000	-.4686367	.4686415
D_CGW						
_ce1						
L1.	.0346853	.072298	0.48	0.631	-.1070162	.1763867
_ce2						
L1.	.5753179	1.053372	0.55	0.585	-1.489254	2.63989
_ce3						
L1.	.0661793	.5271249	0.13	0.900	-.9669665	1.099325
_ce4						
L1.	.3840489	.2670574	1.44	0.150	-.1393739	.9074717
_ce5						
L1.	-3.788907	3.620335	-1.05	0.295	-10.88463	3.306819
_ce6						
L1.	-1.35964	1.001408	-1.36	0.175	-3.322364	.6030829
lastprice						
LD.	.0136948	.0696324	0.20	0.844	-.1227821	.1501717
L2D.	.0228011	.0665425	0.34	0.732	-.1076199	.153222
L3D.	.0181841	.0617854	0.29	0.769	-.1029131	.1392813
L4D.	.0233596	.0554526	0.42	0.674	-.0853254	.1320446
L5D.	-.021006	.0477192	-0.44	0.660	-.114534	.072522
L6D.	-.0255924	.0425901	-0.60	0.548	-.1090675	.0578826
L7D.	-.0151604	.036817	-0.41	0.681	-.0873203	.0569995
L8D.	.0023598	.0296964	0.08	0.937	-.055844	.0605636
L9D.	-.0066091	.0193786	-0.34	0.733	-.0445904	.0313723
CGW						
LD.	-1.397478	1.027601	-1.36	0.174	-3.41154	.6165837
L2D.	-1.120984	.9923355	-1.13	0.259	-3.065926	.823958
L3D.	-.9832563	.9288803	-1.06	0.290	-2.803828	.8373156
L4D.	-.8583153	.8416749	-1.02	0.308	-2.507968	.7913372
L5D.	-.8380816	.7877246	-1.06	0.287	-2.381993	.7058302
L6D.	-.9217853	.7036766	-1.31	0.190	-2.300966	.4573956
L7D.	-.6811356	.599996	-1.14	0.256	-1.857106	.4948351
L8D.	-.348669	.482209	-0.72	0.470	-1.293781	.5964432

FAN						
LD.	-.0747866	.5268207	-0.14	0.887	-1.107336	.9577631
L2D.	-.3316979	.5247685	-0.63	0.527	-1.360225	.6968296
L3D.	-.3094192	.4899864	-0.63	0.528	-1.269775	.6509365
L4D.	-.0770095	.455753	-0.17	0.866	-.970269	.81625
L5D.	.1110614	.4269891	0.26	0.795	-.7258219	.9479447
L6D.	.1274899	.3915825	0.33	0.745	-.6399977	.8949775
L7D.	.0350374	.3376538	0.10	0.917	-.6267518	.6968265
L8D.	-.1247782	.2634578	-0.47	0.636	-.6411459	.3915895
L9D.	-.3369569	.1787433	-1.89	0.059	-.6872873	.0133736
FIW						
LD.	-.298529	.2518765	-1.19	0.236	-.792198	.1951399
L2D.	-.2520879	.2356225	-1.07	0.285	-.7138996	.2097238
L3D.	-.1318031	.2156897	-0.61	0.541	-.5545472	.290941
L4D.	-.1410627	.1930268	-0.73	0.465	-.5193883	.237263
L5D.	-.1312217	.1641486	-0.80	0.424	-.4529471	.1905037
L6D.	-.1377761	.137685	-1.00	0.317	-.4076337	.1320816
L7D.	-.1124405	.1150774	-0.98	0.329	-.3379881	.113107
L8D.	-.0775068	.0910104	-0.85	0.394	-.2558839	.1008704
L9D.	.0072813	.0658617	0.11	0.912	-.1218052	.1363678
KWT						
LD.	2.988503	3.594244	0.83	0.406	-4.056086	10.03309
L2D.	3.672526	3.431082	1.07	0.284	-3.05227	10.39732
L3D.	2.535706	3.252429	0.78	0.436	-3.838937	8.910349
L4D.	1.733557	2.976743	0.58	0.560	-4.100751	7.567865
L5D.	3.179252	2.725655	1.17	0.243	-2.162934	8.521439
L6D.	3.812587	2.391996	1.59	0.111	-.875639	8.500813
L7D.	3.061585	2.030825	1.51	0.132	-.9187597	7.041929
L8D.	2.330591	1.60113	1.46	0.146	-.8075661	5.468748
L9D.	2.367024	1.091716	2.17	0.030	.2272992	4.506749
PBW						
LD.	1.262871	.950126	1.33	0.184	-.5993413	3.125084
L2D.	.9496258	.8843164	1.07	0.283	-.7836026	2.682854
L3D.	.8820433	.8001659	1.10	0.270	-.686253	2.45034
L4D.	.7776687	.6957807	1.12	0.264	-.5860365	2.141374
L5D.	.1584708	.6131048	0.26	0.796	-1.043192	1.360134
L6D.	.0630053	.5267273	0.12	0.905	-.9693613	1.095372
L7D.	-.1061132	.4210543	-0.25	0.801	-.9313644	.7191381
L8D.	-.1105612	.3295264	-0.34	0.737	-.7564211	.5352987
L9D.	-.101333	.2143766	-0.47	0.636	-.5215035	.3188374
QCLN						
LD.	-.2573415	.5741722	-0.45	0.654	-1.382698	.8680154
L2D.	-.3049918	.53869	-0.57	0.571	-1.360805	.7508212
L3D.	-.3547701	.4973863	-0.71	0.476	-1.329629	.6200893
L4D.	-.2605061	.4484267	-0.58	0.561	-1.139406	.618394
L5D.	-.2227582	.4008632	-0.56	0.578	-1.008436	.5629193
L6D.	-.2689094	.3496493	-0.77	0.442	-.9542094	.4163905
L7D.	-.1708612	.2980651	-0.57	0.566	-.7550581	.4133357

D_FAN						
_ce1						
L1.	.018808	.0933553	0.20	0.840	-.164165	.2017809
_ce2						
L1.	1.472794	1.360174	1.08	0.279	-1.193099	4.138687
_ce3						
L1.	-.5953799	.6806537	-0.87	0.382	-1.929437	.7386769
_ce4						
L1.	.4035814	.3448397	1.17	0.242	-.272292	1.079455
_ce5						
L1.	-2.211534	4.674783	-0.47	0.636	-11.37394	6.950872
_ce6						
L1.	-2.043182	1.293075	-1.58	0.114	-4.577563	.4911981
lastprice						
LD.	.0366064	.0899133	0.41	0.684	-.1396203	.2128332
L2D.	.046133	.0859235	0.54	0.591	-.122274	.2145399
L3D.	.0296831	.0797808	0.37	0.710	-.1266845	.1860507
L4D.	.0461627	.0716035	0.64	0.519	-.0941776	.186503
L5D.	.0072585	.0616178	0.12	0.906	-.1135101	.1280271
L6D.	-.0197612	.0549948	-0.36	0.719	-.127549	.0880265
L7D.	-.0162983	.0475402	-0.34	0.732	-.1094753	.0768787
L8D.	.0157473	.0383456	0.41	0.681	-.0594087	.0909034
L9D.	-.0136547	.0250227	-0.55	0.585	-.0626983	.035389
CGW						
LD.	-1.207974	1.326898	-0.91	0.363	-3.808646	1.392698
L2D.	-.9418789	1.28136	-0.74	0.462	-3.453299	1.569541
L3D.	-.710347	1.199423	-0.59	0.554	-3.061173	1.640479
L4D.	-.7500549	1.086819	-0.69	0.490	-2.88018	1.380071
L5D.	-.5656407	1.017155	-0.56	0.578	-2.559228	1.427946
L6D.	-.3140505	.9086274	-0.35	0.730	-2.094928	1.466827
L7D.	-.0668951	.7747491	-0.09	0.931	-1.585375	1.451585
L8D.	-.0601988	.6226557	-0.10	0.923	-1.280582	1.160184
L9D.	.0374543	.3897907	0.10	0.923	-.7265214	.8014299
FAN						
LD.	-.5961224	.680261	-0.88	0.381	-1.929409	.7371647
L2D.	-.8343421	.6776111	-1.23	0.218	-2.162435	.4937512
L3D.	-.6598213	.6326984	-1.04	0.297	-1.899887	.5802448
L4D.	-.2947244	.5884943	-0.50	0.617	-1.448152	.8587032
L5D.	-.1211574	.5513527	-0.22	0.826	-1.201789	.9594741
L6D.	-.1062737	.5056337	-0.21	0.834	-1.097298	.8847501
L7D.	-.2608933	.4359978	-0.60	0.550	-1.115433	.5936466
L8D.	-.0736066	.3401917	-0.22	0.829	-.7403701	.5931569
L9D.	-.4627418	.2308036	-2.00	0.045	-.9151085	-.0103751

FIW						
LD.	-.3042522	.3252374	-0.94	0.350	-.9417057	.3332013
L2D.	-.2413018	.3042493	-0.79	0.428	-.8376194	.3550158
L3D.	-.0800656	.2785109	-0.29	0.774	-.6259369	.4658058
L4D.	-.1624064	.2492473	-0.65	0.515	-.6509221	.3261092
L5D.	-.2202792	.2119581	-1.04	0.299	-.6357094	.1951509
L6D.	-.1856674	.1777868	-1.04	0.296	-.5341231	.1627882
L7D.	-.1015509	.1485945	-0.68	0.494	-.3927908	.1896889
L8D.	-.1612864	.1175179	-1.37	0.170	-.3916172	.0690443
L9D.	.0038824	.0850443	0.05	0.964	-.1628014	.1705662
KWT						
LD.	1.095043	4.641093	0.24	0.813	-8.001332	10.19142
L2D.	.8906192	4.430409	0.20	0.841	-7.792822	9.57406
L3D.	.3172062	4.199722	0.08	0.940	-7.914097	8.548509
L4D.	-.5958247	3.84374	-0.16	0.877	-8.129416	6.937767
L5D.	2.566548	3.519522	0.73	0.466	-4.331588	9.464684
L6D.	4.311842	3.088682	1.40	0.163	-1.741862	10.36555
L7D.	3.786826	2.622318	1.44	0.149	-1.352822	8.926474
L8D.	2.051299	2.06747	0.99	0.321	-2.000868	6.103467
L9D.	3.046741	1.409686	2.16	0.031	.2838067	5.809676
PBW						
LD.	1.968935	1.226857	1.60	0.109	-.4356601	4.373531
L2D.	1.569777	1.14188	1.37	0.169	-.668266	3.807821
L3D.	1.099462	1.03322	1.06	0.287	-.9256117	3.124536
L4D.	1.035718	.8984318	1.15	0.249	-.7251763	2.796612
L5D.	.1525819	.7916759	0.19	0.847	-1.399074	1.704238
L6D.	-.3478705	.6801404	-0.51	0.609	-1.680921	.9851801
L7D.	-.4960861	.5436893	-0.91	0.362	-1.561698	.5695254
L8D.	-.5107484	.4255033	-1.20	0.230	-1.34472	.3232228
L9D.	-.3728562	.2768153	-1.35	0.178	-.9154042	.1696918
QCLN						
LD.	-.1518887	.7414039	-0.20	0.838	-1.605014	1.301236
L2D.	-.0459237	.6955873	-0.07	0.947	-1.40925	1.317402
L3D.	-.109191	.6422536	-0.17	0.865	-1.367985	1.149603
L4D.	.0907777	.5790341	0.16	0.875	-1.044108	1.225664
L5D.	.0824928	.5176175	0.16	0.873	-.9320188	1.097004
L6D.	-.0744485	.4514871	-0.16	0.869	-.9593469	.8104499
L7D.	-.1068407	.3848787	-0.28	0.781	-.8611891	.6475077
L8D.	.2177651	.29124	0.75	0.455	-.3530549	.788585
L9D.	-.1931732	.2142721	-0.90	0.367	-.6131388	.2267923
_cons	-.0000767	.0626459	-0.00	0.999	-.1228603	.122707
D_FIW						
_ce1						
L1.	.7623805	.5109622	1.49	0.136	-.2390869	1.763848
_ce2						
L1.	3.424544	7.444655	0.46	0.646	-11.16671	18.0158

_ce3						
L1.	3.991332	3.725428	1.07	0.284	-3.310373	11.29304
_ce4						
L1.	-.6058188	1.887414	-0.32	0.748	-4.305082	3.093445
_ce5						
L1.	-57.17975	25.58653	-2.23	0.025	-107.3284	-7.031069
_ce6						
L1.	-3.159213	7.077398	-0.45	0.655	-17.03066	10.71223
lastprice						
LD.	-.4236627	.4921231	-0.86	0.389	-1.388206	.5408807
L2D.	-.348363	.4702858	-0.74	0.459	-1.270106	.5733802
L3D.	-.1926268	.4366652	-0.44	0.659	-1.048475	.6632213
L4D.	-.121736	.3919081	-0.31	0.756	-.8898617	.6463897
L5D.	-.3011183	.3372531	-0.89	0.372	-.9621223	.3598856
L6D.	-.3046025	.3010033	-1.01	0.312	-.8945581	.2853532
L7D.	-.1330862	.260202	-0.51	0.609	-.6430727	.3769004
L8D.	.0466604	.2098774	0.22	0.824	-.3646918	.4580126
L9D.	.0167013	.1369572	0.12	0.903	-.25173	.2851325
CGW						
LD.	-.6739302	7.26252	-0.09	0.926	-14.90821	13.56035
L2D.	1.178716	7.01328	0.17	0.867	-12.56706	14.92449
L3D.	3.253737	6.564813	0.50	0.620	-9.613061	16.12053
L4D.	5.335889	5.948494	0.90	0.370	-6.322945	16.99472
L5D.	4.865997	5.567203	0.87	0.382	-6.04552	15.77751
L6D.	2.972987	4.973198	0.60	0.550	-6.774303	12.72028
L7D.	1.484908	4.240441	0.35	0.726	-6.826204	9.796019
L8D.	.722628	3.407987	0.21	0.832	-5.956904	7.40216
L9D.	-.5604239	2.133445	-0.26	0.793	-4.741898	3.621051
FAN						
LD.	-2.923641	3.723278	-0.79	0.432	-10.22113	4.373851
L2D.	-3.296689	3.708774	-0.89	0.374	-10.56575	3.972375
L3D.	-2.744199	3.462954	-0.79	0.428	-9.531464	4.043065
L4D.	-.9436591	3.221011	-0.29	0.770	-7.256724	5.369406
L5D.	.6070422	3.017724	0.20	0.841	-5.307587	6.521672
L6D.	1.2148	2.767489	0.44	0.661	-4.209379	6.638979
L7D.	1.095686	2.38635	0.46	0.646	-3.581475	5.772847
L8D.	-.2180701	1.861974	-0.12	0.907	-3.867472	3.431332
L9D.	-1.810727	1.263259	-1.43	0.152	-4.286669	.6652154
FIW						
LD.	-.3277016	1.780124	-0.18	0.854	-3.816681	3.161278
L2D.	-.0025209	1.66525	-0.00	0.999	-3.266351	3.261309
L3D.	.4679017	1.524376	0.31	0.759	-2.51982	3.455624
L4D.	-.0718494	1.364207	-0.05	0.958	-2.745647	2.601948
L5D.	-.4472868	1.160112	-0.39	0.700	-2.721064	1.826491

L6D.	-.7290984	.9730818	-0.75	0.454	-2.636304	1.178107
L7D.	-.752894	.8133034	-0.93	0.355	-2.346939	.8411513
L8D.	-.8023154	.6432115	-1.25	0.212	-2.062987	.458356
L9D.	-.0956785	.4654738	-0.21	0.837	-1.00799	.8166334
KWT						
LD.	43.43361	25.40213	1.71	0.087	-6.353659	93.22087
L2D.	37.25207	24.24899	1.54	0.124	-10.27509	84.77922
L3D.	20.32639	22.98637	0.88	0.377	-24.72607	65.37885
L4D.	12.45912	21.03797	0.59	0.554	-28.77455	53.69279
L5D.	20.64502	19.26343	1.07	0.284	-17.1106	58.40065
L6D.	27.99555	16.90531	1.66	0.098	-5.138243	61.12934
L7D.	20.04776	14.35275	1.40	0.162	-8.083115	48.17864
L8D.	12.82012	11.3159	1.13	0.257	-9.358642	34.99888
L9D.	10.88833	7.715649	1.41	0.158	-4.23406	26.01073
PBW						
LD.	2.115207	6.714966	0.31	0.753	-11.04589	15.2763
L2D.	1.037024	6.249861	0.17	0.868	-11.21248	13.28653
L3D.	1.523807	5.655131	0.27	0.788	-9.560046	12.60766
L4D.	1.278722	4.917394	0.26	0.795	-8.359194	10.91664
L5D.	-2.077636	4.333087	-0.48	0.632	-10.57033	6.415058
L6D.	-2.428577	3.722618	-0.65	0.514	-9.724774	4.867621
L7D.	-2.267934	2.975779	-0.76	0.446	-8.100355	3.564486
L8D.	-.9748278	2.328911	-0.42	0.676	-5.539409	3.589754
L9D.	-.2456259	1.515096	-0.16	0.871	-3.215159	2.723907
QCLN						
LD.	-5.796256	4.057932	-1.43	0.153	-13.74966	2.157145
L2D.	-5.419495	3.807164	-1.42	0.155	-12.8814	2.042409
L3D.	-4.6954	3.515252	-1.34	0.182	-11.58517	2.194368
L4D.	-3.479727	3.169232	-1.10	0.272	-9.691308	2.731854
L5D.	-2.639386	2.83308	-0.93	0.352	-8.192121	2.913349
L6D.	-3.056	2.471128	-1.24	0.216	-7.899322	1.787322
L7D.	-1.72261	2.10656	-0.82	0.414	-5.851392	2.406171
L8D.	-.5809004	1.594046	-0.36	0.716	-3.705174	2.543373
L9D.	-.9895848	1.172777	-0.84	0.399	-3.288186	1.309016
_cons	.0000247	.3428802	0.00	1.000	-.672008	.6720575
D_KWT						
_ce1						
L1.	.0591547	.0486233	1.22	0.224	-.0361451	.1544546
_ce2						
L1.	.6517782	.7084348	0.92	0.358	-.7367286	2.040285
_ce3						
L1.	.461274	.3545125	1.30	0.193	-.2335577	1.156106

_ce4						
L1.	.0371268	.1796067	0.21	0.836	-.3148959	.3891494
_ce5						
L1.	-4.259402	2.434819	-1.75	0.080	-9.03156	.5127567
_ce6						
L1.	-.9083343	.6734867	-1.35	0.177	-2.228344	.4116753
lastprice						
LD.	-.0314167	.0468305	-0.67	0.502	-.1232028	.0603695
L2D.	-.0257858	.0447525	-0.58	0.564	-.113499	.0619275
L3D.	-.0109681	.0415531	-0.26	0.792	-.0924108	.0704746
L4D.	-.0086208	.0372941	-0.23	0.817	-.0817158	.0644742
L5D.	-.0324941	.0320931	-1.01	0.311	-.0953954	.0304071
L6D.	-.0321116	.0286435	-1.12	0.262	-.0882519	.0240287
L7D.	-.0164342	.0247609	-0.66	0.507	-.0649646	.0320963
L8D.	.0014701	.019972	0.07	0.941	-.0376743	.0406145
L9D.	-.0011588	.0130329	-0.09	0.929	-.0267028	.0243852
CGW						
LD.	-.3570629	.6911029	-0.52	0.605	-1.7116	.9974739
L2D.	-.2175808	.6673851	-0.33	0.744	-1.525632	1.09047
L3D.	-.0757165	.624709	-0.12	0.904	-1.300124	1.148691
L4D.	.0847993	.5660599	0.15	0.881	-1.024658	1.194256
L5D.	.0024861	.5297761	0.00	0.996	-1.035856	1.040828
L6D.	-.1492809	.4732506	-0.32	0.752	-1.076835	.7782732
L7D.	-.1416847	.4035212	-0.35	0.725	-.9325718	.6492023
L8D.	-.1507765	.3243047	-0.46	0.642	-.7864021	.484849
L9D.	-.1628534	.203019	-0.80	0.422	-.5607634	.2350565
FAN						
LD.	-.3918533	.3543079	-1.11	0.269	-1.086284	.3025775
L2D.	-.4245896	.3529277	-1.20	0.229	-1.116315	.2671361
L3D.	-.3774444	.3295354	-1.15	0.252	-1.023322	.2684331
L4D.	-.1667862	.306512	-0.54	0.586	-.7675387	.4339664
L5D.	-.0095056	.2871672	-0.03	0.974	-.5723429	.5533318
L6D.	.0509594	.2633548	0.19	0.847	-.4652066	.5671254
L7D.	.050473	.2270856	0.22	0.824	-.3946066	.4955525
L8D.	-.0491925	.1771858	-0.28	0.781	-.3964703	.2980854
L9D.	-.1536075	.120212	-1.28	0.201	-.3892187	.0820036
FIW						
LD.	.0019059	.169397	0.01	0.991	-.3301061	.3339179
L2D.	.0257851	.1584655	0.16	0.871	-.2848016	.3363719
L3D.	.0749958	.1450599	0.52	0.605	-.2093164	.3593081
L4D.	.0332205	.1298182	0.26	0.798	-.2212186	.2876596
L5D.	.0141011	.1103965	0.13	0.898	-.202272	.2304743
L6D.	-.0157345	.0925987	-0.17	0.865	-.1972246	.1657555
L7D.	-.0360724	.0773941	-0.47	0.641	-.1877621	.1156173
L8D.	-.0533423	.0612081	-0.87	0.383	-.173308	.0666235
L9D.	-.0159737	.0442946	-0.36	0.718	-.1027894	.0708421

KWT						
LD.	2.225636	2.417272	0.92	0.357	-2.51213	6.963402
L2D.	2.23322	2.307539	0.97	0.333	-2.289473	6.755913
L3D.	.8975817	2.187388	0.41	0.682	-3.38962	5.184783
L4D.	.1909207	2.001978	0.10	0.924	-3.732884	4.114725
L5D.	1.101975	1.833112	0.60	0.548	-2.490858	4.694808
L6D.	1.709272	1.608713	1.06	0.288	-1.443747	4.86229
L7D.	1.119053	1.365811	0.82	0.413	-1.557887	3.795993
L8D.	.5937549	1.076824	0.55	0.581	-1.516781	2.70429
L9D.	.8693677	.7342227	1.18	0.236	-.5696824	2.308418
PBW						
LD.	.7580291	.6389976	1.19	0.236	-.4943831	2.010441
L2D.	.5766045	.594738	0.97	0.332	-.5890606	1.74227
L3D.	.6278634	.5381434	1.17	0.243	-.4268783	1.682605
L4D.	.5565456	.4679402	1.19	0.234	-.3606005	1.473692
L5D.	.1651782	.4123374	0.40	0.689	-.6429882	.9733446
L6D.	.0729502	.3542451	0.21	0.837	-.6213574	.7672578
L7D.	-.0056034	.2831758	-0.02	0.984	-.5606177	.5494109
L8D.	.0620693	.2216196	0.28	0.779	-.3722972	.4964358
L9D.	.0094766	.1441768	0.07	0.948	-.2731047	.2920579
QCLN						
LD.	-.5039417	.3861537	-1.31	0.192	-1.260789	.2529055
L2D.	-.4962589	.3622905	-1.37	0.171	-1.206335	.2138174
L3D.	-.4630854	.3345121	-1.38	0.166	-1.118717	.1925463
L4D.	-.350257	.3015848	-1.16	0.245	-.9413523	.2408383
L5D.	-.2816013	.2695965	-1.04	0.296	-.8100007	.2467981
L6D.	-.2829326	.235153	-1.20	0.229	-.7438241	.1779589
L7D.	-.1385631	.2004607	-0.69	0.489	-.5314588	.2543326
L8D.	-.0240211	.1516898	-0.16	0.874	-.3213276	.2732854
L9D.	-.057363	.1116017	-0.51	0.607	-.2760983	.1613723
_cons	-.000705	.0326285	-0.02	0.983	-.0646558	.0632458
D_PBW						
_ce1						
L1.	.1679137	.1653271	1.02	0.310	-.1561214	.4919488
_ce2						
L1.	4.155926	2.408795	1.73	0.084	-.5652248	8.877077
_ce3						
L1.	1.299449	1.205401	1.08	0.281	-1.063093	3.661991
_ce4						
L1.	.1983704	.6106923	0.32	0.745	-.9985645	1.395305
_ce5						
L1.	-7.795947	8.278785	-0.94	0.346	-24.02207	8.430174

_ce6						
L1.	-5.525588	2.289965	-2.41	0.016	-10.01384	-1.037339
lastprice						
LD.	-.0781766	.1592315	-0.49	0.623	-.3902646	.2339114
L2D.	-.0580273	.1521658	-0.38	0.703	-.3562668	.2402122
L3D.	-.0311826	.1412875	-0.22	0.825	-.3081011	.2457359
L4D.	-.0188933	.1268059	-0.15	0.882	-.2674283	.2296417
L5D.	-.1132742	.1091217	-1.04	0.299	-.3271489	.1006004
L6D.	-.1238127	.0973927	-1.27	0.204	-.3146989	.0670735
L7D.	-.0703434	.084191	-0.84	0.403	-.2353548	.094668
L8D.	-.0143949	.067908	-0.21	0.832	-.1474921	.1187024
L9D.	-.0191208	.0443139	-0.43	0.666	-.1059745	.0677329
CGW						
LD.	-3.195151	2.349863	-1.36	0.174	-7.800798	1.410496
L2D.	-2.548859	2.269219	-1.12	0.261	-6.996447	1.898728
L3D.	-2.066748	2.124113	-0.97	0.331	-6.229933	2.096437
L4D.	-1.608061	1.924696	-0.84	0.403	-5.380397	2.164275
L5D.	-1.788931	1.801326	-0.99	0.321	-5.319464	1.741603
L6D.	-1.683785	1.60913	-1.05	0.295	-4.837621	1.470051
L7D.	-1.176728	1.372038	-0.86	0.391	-3.865874	1.512418
L8D.	-.8738959	1.102689	-0.79	0.428	-3.035127	1.287335
L9D.	-.8006906	.690298	-1.16	0.246	-2.15365	.5522685
FAN						
LD.	-1.15044	1.204705	-0.95	0.340	-3.511618	1.210739
L2D.	-1.38338	1.200012	-1.15	0.249	-3.735361	.9686008
L3D.	-1.130475	1.120474	-1.01	0.313	-3.326565	1.065614
L4D.	-.3340899	1.042191	-0.32	0.749	-2.376747	1.708567
L5D.	.2192072	.9764156	0.22	0.822	-1.694532	2.132947
L6D.	.2491853	.8954496	0.28	0.781	-1.505864	2.004234
L7D.	.181998	.7721283	0.24	0.814	-1.331346	1.695342
L8D.	-.1965477	.6024609	-0.33	0.744	-1.377349	.984254
L9D.	-.5581129	.4087405	-1.37	0.172	-1.35923	.2430038
FIW						
LD.	-.0004817	.5759776	-0.00	0.999	-1.129377	1.128414
L2D.	.0378018	.5388088	0.07	0.944	-1.018244	1.093848
L3D.	.2155762	.4932276	0.44	0.662	-.7511321	1.182284
L4D.	.0708182	.4414033	0.16	0.873	-.7943164	.9359528
L5D.	.0019894	.3753662	0.01	0.996	-.7337148	.7376935
L6D.	-.0896069	.3148506	-0.28	0.776	-.7067028	.527489
L7D.	-.1526779	.2631527	-0.58	0.562	-.6684477	.3630919
L8D.	-.1844428	.2081177	-0.89	0.375	-.592346	.2234604
L9D.	-.0482411	.1506089	-0.32	0.749	-.343429	.2469469
KWT						
LD.	5.660021	8.219122	0.69	0.491	-10.44916	21.7692
L2D.	7.079572	7.846011	0.90	0.367	-8.298328	22.45747
L3D.	3.934068	7.437477	0.53	0.597	-10.64312	18.51126
L4D.	1.69674	6.807053	0.25	0.803	-11.64484	15.03832

L2D.	7.079572	7.846011	0.90	0.367	-8.298328	22.45747
L3D.	3.934068	7.437477	0.53	0.597	-10.64312	18.51126
L4D.	1.69674	6.807053	0.25	0.803	-11.64484	15.03832
L5D.	5.558994	6.232881	0.89	0.372	-6.657227	17.77522
L6D.	7.198376	5.469886	1.32	0.188	-3.522404	17.91916
L7D.	5.425139	4.643981	1.17	0.243	-3.676897	14.52717
L8D.	3.651176	3.661377	1.00	0.319	-3.524991	10.82734
L9D.	4.050048	2.496478	1.62	0.105	-.8429586	8.943054
PBW						
LD.	3.857326	2.172697	1.78	0.076	-.4010805	8.115733
L2D.	2.953426	2.022207	1.46	0.144	-1.010026	6.916879
L3D.	2.748057	1.829776	1.50	0.133	-.8382376	6.334352
L4D.	2.38457	1.591074	1.50	0.134	-.7338765	5.503017
L5D.	.8017379	1.402015	0.57	0.567	-1.946161	3.549636
L6D.	.3030419	1.204491	0.25	0.801	-2.057718	2.663802
L7D.	-.1732707	.9628441	-0.18	0.857	-2.06041	1.713869
L8D.	-.0165187	.7535431	-0.02	0.983	-1.493436	1.460399
L9D.	-.1028952	.4902248	-0.21	0.834	-1.063718	.8579278
QCLN						
LD.	-1.631907	1.312986	-1.24	0.214	-4.205312	.9414974
L2D.	-1.623741	1.231847	-1.32	0.187	-4.038117	.7906349
L3D.	-1.574016	1.137396	-1.38	0.166	-3.803271	.6552398
L4D.	-1.150041	1.025438	-1.12	0.262	-3.159862	.8597805
L5D.	-.9272202	.9166723	-1.01	0.312	-2.723865	.8694245
L6D.	-.892814	.7995589	-1.12	0.264	-2.459921	.6742927
L7D.	-.4385076	.6815992	-0.64	0.520	-1.774417	.8974022
L8D.	-.1221367	.5157702	-0.24	0.813	-1.133028	.8887542
L9D.	-.2342504	.3794641	-0.62	0.537	-.9779864	.5094856
_cons	.00009	.1109424	0.00	0.999	-.2173531	.2175331
D_QCLN						
_ce1						
L1.	.408913	.31871	1.28	0.199	-.2157471	1.033573
_ce2						
L1.	2.975425	4.643564	0.64	0.522	-6.125793	12.07664
_ce3						
L1.	3.01555	2.323716	1.30	0.194	-1.53885	7.569949
_ce4						
L1.	.2751968	1.177265	0.23	0.815	-2.032199	2.582593
_ce5						
L1.	-26.9973	15.95946	-1.69	0.091	-58.27727	4.282674
_ce6						
L1.	-4.265649	4.41449	-0.97	0.334	-12.91789	4.386592

lastprice						
LD.	-.2200402	.3069591	-0.72	0.473	-.821669	.3815887
L2D.	-.2065115	.2933383	-0.70	0.481	-.781444	.368421
L3D.	-.1036998	.2723676	-0.38	0.703	-.6375305	.4301309
L4D.	-.0877656	.2444506	-0.36	0.720	-.5668799	.3913488
L5D.	-.2258649	.2103598	-1.07	0.283	-.6381626	.1864328
L6D.	-.208997	.1877492	-1.11	0.266	-.5769787	.1589846
L7D.	-.1149413	.1622996	-0.71	0.479	-.4330427	.2031602
L8D.	-.00662	.1309099	-0.05	0.960	-.2631988	.2499588
L9D.	-.000059	.0854263	-0.00	0.999	-.1674916	.1673735
CGW						
LD.	-1.02974	4.529959	-0.23	0.820	-9.908296	7.848816
L2D.	-.2201388	4.374496	-0.05	0.960	-8.793994	8.353716
L3D.	.3403401	4.094768	0.08	0.934	-7.685257	8.365937
L4D.	1.716711	3.710342	0.46	0.644	-5.555424	8.988847
L5D.	.8738378	3.472513	0.25	0.801	-5.932163	7.679839
L6D.	-.4365425	3.102006	-0.14	0.888	-6.516363	5.643278
L7D.	-.5987692	2.644953	-0.23	0.821	-5.782781	4.585243
L8D.	-.7167148	2.125714	-0.34	0.736	-4.883037	3.449608
L9D.	-1.294311	1.330725	-0.97	0.331	-3.902484	1.313861
FAN						
LD.	-2.314945	2.322375	-1.00	0.319	-6.866717	2.236826
L2D.	-2.726684	2.313328	-1.18	0.239	-7.260724	1.807357
L3D.	-2.394489	2.159999	-1.11	0.268	-6.62801	1.839031
L4D.	-1.305216	2.009088	-0.65	0.516	-5.242957	2.632524
L5D.	-.1629504	1.882289	-0.09	0.931	-3.852169	3.526268
L6D.	.2051046	1.726207	0.12	0.905	-3.178198	3.588408
L7D.	.3579418	1.488473	0.24	0.810	-2.559413	3.275296
L8D.	-.3506738	1.161397	-0.30	0.763	-2.626969	1.925622
L9D.	-.8782228	.7879512	-1.11	0.265	-2.422579	.6661331
FIW						
LD.	-.1017141	1.110343	-0.09	0.927	-2.277947	2.074519
L2D.	.1194088	1.038691	0.11	0.908	-1.916388	2.155206
L3D.	.3642606	.9508215	0.38	0.702	-1.499315	2.227836
L4D.	.1541028	.8509171	0.18	0.856	-1.513664	1.82187
L5D.	.0770433	.7236136	0.11	0.915	-1.341213	1.4953
L6D.	-.1313422	.6069546	-0.22	0.829	-1.320951	1.058267
L7D.	-.2836779	.5072937	-0.56	0.576	-1.277955	.7105995
L8D.	-.362089	.4011998	-0.90	0.367	-1.148426	.4242481
L9D.	-.0915962	.2903368	-0.32	0.752	-.6606459	.4774535
KWT						
LD.	19.9707	15.84445	1.26	0.208	-11.08384	51.02524
L2D.	20.65191	15.12518	1.37	0.172	-8.992897	50.29672
L3D.	10.4853	14.33763	0.73	0.465	-17.61593	38.58654
L4D.	6.136313	13.12232	0.47	0.640	-19.58297	31.8556
L5D.	10.16071	12.01546	0.85	0.398	-13.38916	33.71058
L6D.	13.17871	10.5446	1.25	0.211	-7.488321	33.84574
L7D.	8.603404	8.952454	0.96	0.337	-8.943082	26.14989

KWT						
LD.	19.9707	15.84445	1.26	0.208	-11.08384	51.02524
L2D.	20.65191	15.12518	1.37	0.172	-8.992897	50.29672
L3D.	10.4853	14.33763	0.73	0.465	-17.61593	38.58654
L4D.	6.136313	13.12232	0.47	0.640	-19.58297	31.8556
L5D.	10.16071	12.01546	0.85	0.398	-13.38916	33.71058
L6D.	13.17871	10.5446	1.25	0.211	-7.488321	33.84574
L7D.	8.603404	8.952454	0.96	0.337	-8.943082	26.14989
L8D.	4.931598	7.058234	0.70	0.485	-8.902287	18.76548
L9D.	4.672673	4.812595	0.97	0.332	-4.75984	14.10519
PBW						
LD.	3.263053	4.188425	0.78	0.436	-4.946108	11.47221
L2D.	2.293465	3.898318	0.59	0.556	-5.347097	9.934027
L3D.	3.074935	3.527358	0.87	0.383	-3.838559	9.988429
L4D.	2.654685	3.067199	0.87	0.387	-3.356914	8.666284
L5D.	.4762993	2.70274	0.18	0.860	-4.820973	5.773572
L6D.	.3608331	2.321963	0.16	0.877	-4.190131	4.911798
L7D.	-.1784939	1.856127	-0.10	0.923	-3.816435	3.459448
L8D.	.4344605	1.452646	0.30	0.765	-2.412673	3.281594
L9D.	.2742747	.9450329	0.29	0.772	-1.577956	2.126505
QCLN						
LD.	-3.493203	2.531114	-1.38	0.168	-8.454095	1.467688
L2D.	-3.70527	2.374698	-1.56	0.119	-8.359593	.9490532
L3D.	-3.295785	2.19262	-1.50	0.133	-7.593241	1.001672
L4D.	-2.72774	1.976792	-1.38	0.168	-6.602181	1.146701
L5D.	-2.196653	1.767119	-1.24	0.214	-5.660142	1.266836
L6D.	-2.187995	1.541353	-1.42	0.156	-5.208991	.8330018
L7D.	-1.056126	1.313956	-0.80	0.422	-3.631431	1.51918
L8D.	-.3648703	.994278	-0.37	0.714	-2.313619	1.583879
L9D.	-.3188012	.7315135	-0.44	0.663	-1.752541	1.114939
_cons	.0000187	.2138697	0.00	1.000	-.4191582	.4191955

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	1	7.237788	0.0071
_ce2	1	34.79588	0.0000
_ce3	1	14.64638	0.0001
_ce4	1	161.0878	0.0000
_ce5	1	432.814	0.0000
_ce6	1	87.58016	0.0000

Identification: beta is exactly identified

close2						
LD.	1.3078	1.164384	1.12	0.261	-.9743496	3.58995
L2D.	2.238782	1.391244	1.61	0.108	-.4880056	4.96557
L3D.	1.203979	1.470946	0.82	0.413	-1.679022	4.08698
L4D.	.9318056	1.495015	0.62	0.533	-1.99837	3.861981
L5D.	.7988182	1.517878	0.53	0.599	-2.176168	3.773804
L6D.	1.233067	1.50673	0.82	0.413	-1.720069	4.186202
L7D.	.7540426	1.401396	0.54	0.591	-1.992643	3.500728
L8D.	1.431288	1.184796	1.21	0.227	-.8908692	3.753445
L9D.	.1656252	.8343042	0.20	0.843	-1.469581	1.800831
close3						
LD.	-1.149958	1.182418	-0.97	0.331	-3.467455	1.167539
L2D.	-1.108347	1.105965	-1.00	0.316	-3.275998	1.059304
L3D.	-1.114564	1.016225	-1.10	0.273	-3.106328	.8772001
L4D.	-1.084519	.9189194	-1.18	0.238	-2.885568	.71653
L5D.	-.7560727	.7817732	-0.97	0.333	-2.28832	.7761746
L6D.	-.6387031	.6558042	-0.97	0.330	-1.924056	.6466495
L7D.	-.5315131	.5543057	-0.96	0.338	-1.617932	.5549061
L8D.	-.4729201	.4433769	-1.07	0.286	-1.341923	.3960826
L9D.	-.2574342	.304086	-0.85	0.397	-.8534317	.3385634
close4						
LD.	-7.944589	4.360271	-1.82	0.068	-16.49056	.6013853
L2D.	-13.02928	5.774265	-2.26	0.024	-24.34663	-1.711929
L3D.	-15.89661	7.131443	-2.23	0.026	-29.87398	-1.919235
L4D.	-16.90549	7.899079	-2.14	0.032	-32.3874	-1.423577
L5D.	-15.98794	8.376562	-1.91	0.056	-32.4057	.4298227
L6D.	-9.185679	7.940842	-1.16	0.247	-24.74944	6.378085
L7D.	-.6367146	7.210503	-0.09	0.930	-14.76904	13.49561
L8D.	-.0534582	5.793532	-0.01	0.993	-11.40857	11.30166
L9D.	2.049787	4.178164	0.49	0.624	-6.139264	10.23884
close6						
LD.	2.259772	1.819915	1.24	0.214	-1.307197	5.82674
L2D.	2.916182	1.780462	1.64	0.101	-.5734587	6.405823
L3D.	3.134568	1.750637	1.79	0.073	-.2966173	6.565754
L4D.	3.311837	1.666797	1.99	0.047	.0449748	6.5787
L5D.	2.463672	1.600519	1.54	0.124	-.6732869	5.600631
L6D.	1.511164	1.494362	1.01	0.312	-1.417732	4.440059
L7D.	.5716207	1.348566	0.42	0.672	-2.07152	3.214762
L8D.	.4644565	1.065055	0.44	0.663	-1.623012	2.551925
L9D.	-.428958	.8010183	-0.54	0.592	-1.998925	1.141009
_cons	-.0074445	.249334	-0.03	0.976	-.4961301	.4812411