

DS 2001 Project

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Title -

Analyzing How Various World Events Influence Oil Prices

Important Terminology

The OVX Crude Oil Index is the market's expectation for the volatility of crude oil for the next 30 days.

RBOB Gasoline Futures is a financial product used by traders to speculate the future price of RBOB (reformulated gasoline blend-stock for oxygen blending) contracts.

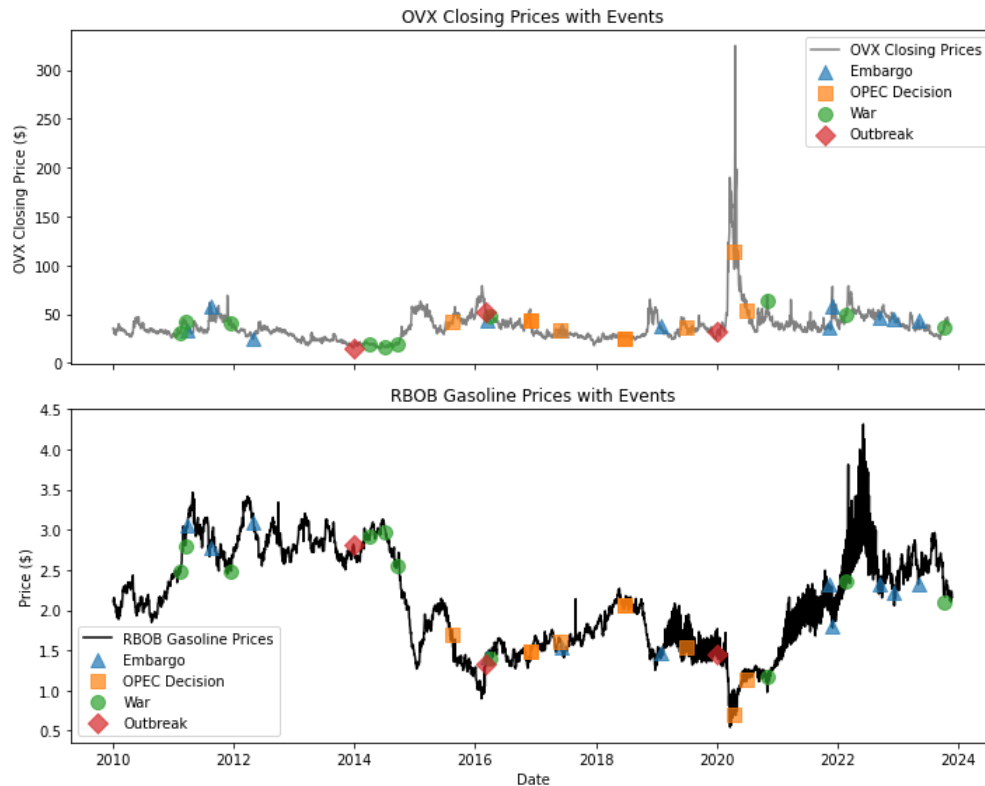
1. Project Overview

As business and finance majors, we wanted to analyze some sort of financial instrument or market that has a significant impact on the entirety of the world. So, we decided to choose 'Oil' as our given commodity. We took into consideration two important financial data sets. The OVX CBOE Crude Oil index is an index that changes minute to minute on the market's speculation of crude oil volatility over the next 30 days. Plus, the RBOB Gasoline Futures Contracts are financial contracts that allow traders to speculate on the future price movements of reformulated blend-stock for oxygen blend (RBOB) gasoline. We used these two datasets in connection with a third data set that includes a variety of 33 world events, such as outbreaks, OPEC decisions, embargos, and geopolitical events, to test which type of events had the greatest change.

Additionally, learning how to use and understand complicated financial data sets can help traders or anyone within a given industry drive the overall macro-landscape, which, in turn, can help better understand the markets as a whole. This is what led us to pick this topic and overall research point as our primary datasets and hypothesis for this data science project.

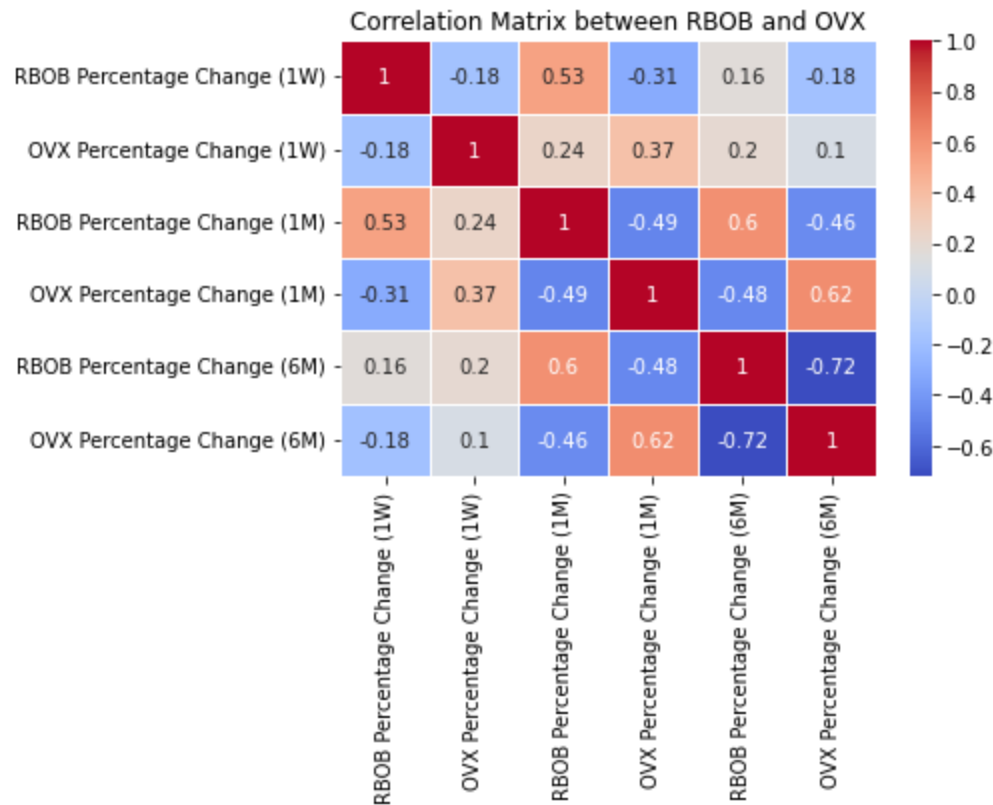
2. Results

We decided to visualize our data with line graphs due to the continuous and frequent x-valued nature of the data. There are smaller changes that exist, which can be documented in a way that promotes easier readability compared to if it were plotted on a bar graph. One would choose to represent the data with a bar graph if the data has fewer x-values or when the data is categorical.



Based on the plots that were created from our code, we were able to extract some key findings. When analyzing the effects that different events (Embargo, OPEC Decision, War, and Outbreak) had on the OVX closing prices, we noticed that all of the events impacted the closing prices at a similar magnitude. However, as seen through the sudden spike in the graph at the start of 2020, there is a visible outlier. There was approximately a 700% increase in change price, which was impacted through an OPEC Decision and can be correlated with the start of COVID-19. Due to these factors, this event still does not have much significance compared to the rest of the events towards the OVX closing prices.

When analyzing the effects that the different events had on the RBOB gasoline prices, we noticed that while Embargoes and Wars kept the prices consistent at around \$3 from 2010 to 2015, OPEC Decisions and Outbreaks caused the prices to significantly decrease by approximately 50% for the 5 years thereafter. Thus, we can reasonably infer that there is a negative relationship between OPEC Decisions and Outbreaks.



To analyze our data further, we also produced a correlation matrix between RBOB closing prices and OVX gasoline prices through our code. A value of 1 indicates a perfect positive correlation, 0 indicates no correlation, and -1 indicates a perfect negative correlation. As shown by the matrix, the strongest positive correlation is between the 1-month changes of RBOB and the 6-month changes of RBOB. With a correlation of 0.53, this suggests that movements in these periods are more aligned. On the other hand, the most substantial negative correlation is between the 6-month changes of RBOB and OVX. With a correlation of -0.72, this indicates that over a 6-month period, they tend to move strongly in opposite directions, showing an inverse relationship. Other than these two cases, there are no other significant correlations between OVX and RBOB.

3. Discussion

Our results are significant because they show the effects that each event (Embargo, OPEC Decision, War, and Outbreak) has on the OVX Closing Prices and the RBOB Gasoline Prices. Determining which events inflict the most drastic effects and by understanding the correlations between RBOB and OVX can provide valuable insights into the dynamics of the energy market. This can especially be beneficial for commodities traders and investors in terms of anticipating and responding to potential shifts in the market. For example, if there are signs of a war or of an OPEC decision being released, traders can expect the fall of gasoline's market price and execute measures in preparation.

Recognizing the strong positive correlation between short-term RBOB changes can also help traders gauge the direction of prices in the near future. These results enable individuals to gain a deeper level of understanding regarding the context of the market, which is crucial when making decisions and

discussing risk management strategies in the industry. Therefore, with this data, traders are able to navigate energy trends more effectively and efficiently.

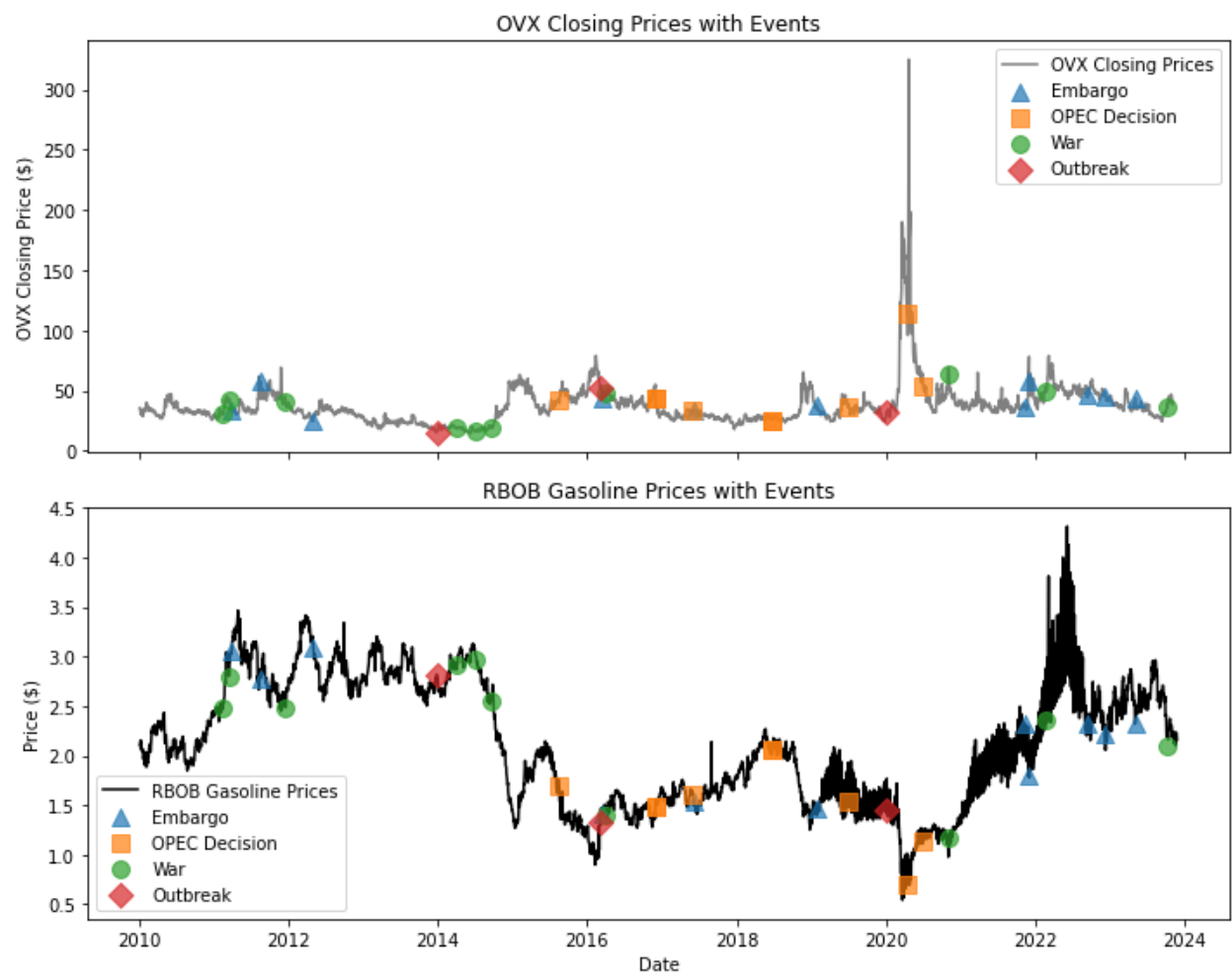
4. Risks & Limitations

There are a few risks and limitations that have to be considered when looking at the results of the data. Firstly, the dataset that was used in the analysis was limited, which introduces an element of uncertainty to the results. There were 33 different events considered, which provides a broad summary and may not fully capture the complexities of the market dynamics. It is only a generalization, which may lead to an incomplete understanding of the relationship between RBOB and OVX, reducing the reliability of the overall results.

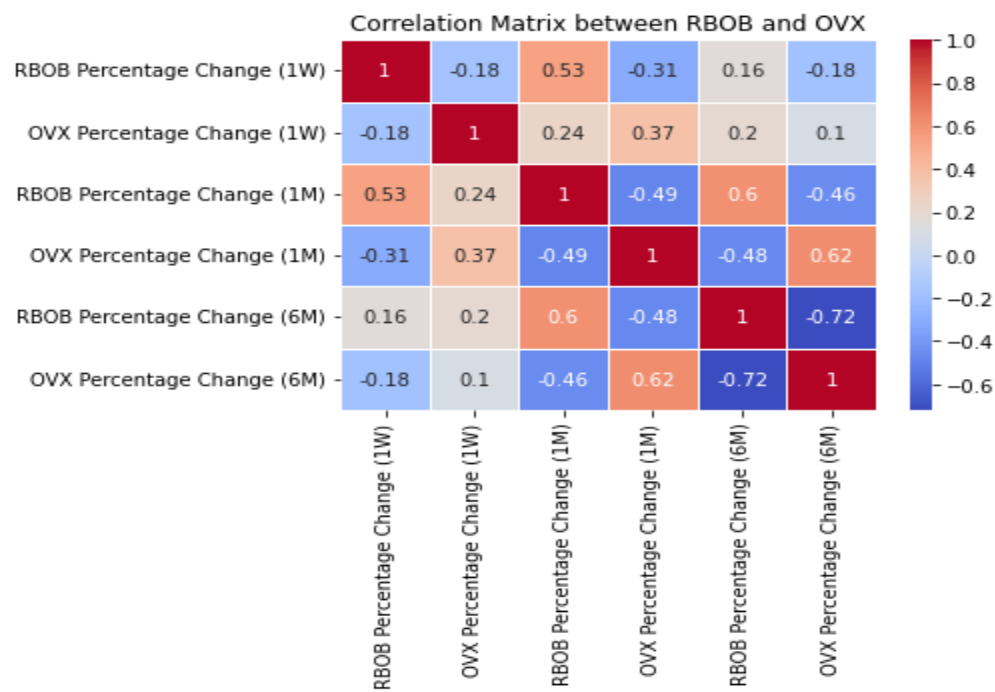
Secondly, the absence of a direct correlation between RBOB and OVX prices raises the risk of a correlation based on coincidence. The fluctuations in prices with the different events could have been driven by external factors that were not considered in the analysis, which, in return, coincidentally created a strong correlation. Thus, it is important to approach with caution when making decisions based on the results created by our data. However, with these risks being said, the data is still helpful in terms of giving investors and traders a better understanding of the energy market.

Appendix.

1. OVX & RBOB Prices (2010-Present) with Events Plotted



2. Correlation Matrix Between OVX & RBOB (1-Week, 1-Month, 6-Month Changes)



3. Statistical Analysis Results

	Event Name	Start Date \
0	Belarus Sanctions	2021-12-02
1	Eritrean Sanctions	2021-11-13
2	Iranian Nuclear Sanctions	2012-05-01
3	Myanmar (Burma) Sanctions	2011-03-30
4	North Korea Sanctions	2016-03-16
5	Qatari Diplomatic and Economic Embargo	2017-06-05
6	Russian Sanctions	2022-12-05
7	Sudanese Sanctions	2023-05-04
8	Syrian Sanctions	2011-08-18
9	Venezuelan Sanctions	2019-01-28
10	Zimbabwean Sanctions	2022-09-15
11	OPEC Oil Production Increase (2018)	2018-06-22
12	OPEC Oil Production Increase (2015)	2015-08-11
13	OPEC Output Agreement (2018)	2018-06-22
14	OPEC Output Agreement (2016)	2016-11-30
15	OPEC Production Cut (2016)	2016-11-30
16	OPEC Production Cut (2020)	2020-04-12
17	OPEC Production Cut (2017)	2017-05-25
18	OPEC Production Cut Extension (2019)	2019-07-01
19	OPEC Production Cut Extension (2020)	2020-07-01
20	Yemeni Civil War	2014-09-16
21	2014 Gaza War	2014-07-08
22	Iraqi Insurgency	2011-12-18
23	Israel - Gaza Conflict	2023-10-07
24	Libyan Civil War	2011-02-15
25	Nagorno-Karabakh Conflict	2016-04-01
26	Russian Invasion of Ukraine	2022-02-24
27	Syrian Civil War	2011-03-15
28	Tigray War, Ethiopia	2020-11-03
29	War in Donbass, Ukraine	2014-04-06
30	COVID-19 Pandemic	2020-01-06
31	Ebola Outbreak	2013-12-26
32	Zika Virus Outbreak	2016-03-04

	OVX Percentage Change (1W)	RBOB Percentage Change (1W) \
0	-17.181771	8.117588
1	30.102182	-5.044191
2	15.684713	-3.316005
3	-2.026005	4.206919
4	1.364256	2.524149
5	0.711955	-3.257265
6	-0.924906	-5.288853
7	-18.308571	5.666624
8	-10.449321	6.636246
9	-10.396171	2.637138
10	1.007935	0.302154
11	6.504702	5.245110
12	-6.356736	-2.769085
13	6.504702	5.245110
14	-18.531073	1.167159
15	-18.531073	1.167159
16	97.596994	2.420052
17	-5.570693	-0.490897
18	-5.345212	-2.604911
19	-8.571963	4.175805
20	9.508716	2.731749
21	10.116493	-2.499243

22	-10.467652	8.022980
23	23.991031	7.650637
24	26.485067	4.552395
25	-0.711893	4.430651
26	31.260196	6.360664
27	-10.486538	7.192551
28	-21.986484	5.082301
29	0.375536	3.841422
30	5.971535	-3.405190
31	33.157895	-4.432624
32	-3.160532	8.422791

OVX Percentage Change (1M) RBOB Percentage Change (1M) \

0	-25.580583	24.586604
1	26.705330	-16.628584
2	38.495223	-8.785638
3	-8.104022	13.080940
4	16.575716	3.024748
5	-3.263127	-2.321045
6	0.924906	2.124582
7	-9.485714	9.493099
8	-27.377220	0.032337
9	-17.548524	7.345826
10	7.870470	14.106272
11	2.468652	-0.144893
12	18.714421	-17.718604
13	2.468652	-0.144893
14	-30.327684	11.691709
15	-30.327684	11.691709
16	-24.099965	43.330452
17	-3.360581	-11.358976
18	-14.337416	-3.131090
19	-16.844469	4.465304
20	80.084522	-13.596217
21	15.573268	-6.747620
22	-17.688394	11.337431
23	1.765695	6.244060
24	41.450607	18.555127
25	-5.464824	14.133847
26	40.517945	10.143943
27	-23.523855	15.405473
28	-35.643564	6.516206
29	-3.648069	-1.373889
30	17.202970	-8.238363
31	28.026316	-5.560284
32	-1.927154	4.691840

OVX Percentage Change (6M) RBOB Percentage Change (6M)

0	-13.008556	56.188408
1	45.567523	18.029748
2	28.224522	-10.987698
3	64.227396	-16.142298
4	-10.959527	-2.002397
5	-29.753782	12.821013
6	-12.794539	15.120694
7	-4.022857	-4.669160
8	-41.414141	7.160822
9	-14.145174	23.850085
10	1.672743	10.199853
11	99.294671	-29.992755
12	62.191651	-41.524473

13	99.294671	-29.992755
14	-31.525424	9.370808
15	-31.525424	9.370808
16	-62.967494	79.703256
17	-19.346049	10.178338
18	-29.955457	13.323373
19	-25.753322	15.089043
20	200.739567	-32.444896
21	253.586757	-53.533587
22	-12.091107	8.541240
23	NaN	NaN
24	46.570397	15.497428
25	-5.276382	5.429509
26	-3.446166	8.687529
27	-20.784128	-2.308324
28	-36.900833	76.786017
29	29.935622	-18.711552
30	56.961634	-13.703144
31	17.960526	10.843972
32	-23.877433	6.013062

OVX Percentage Change (1W) RBOB Percentage Change (1W) \

count	33.000000	33.000000
mean	3.979919	2.263366
std	22.535549	4.282203
min	-21.986484	-5.288853
25%	-10.396171	-2.499243
50%	-0.711893	2.731749
75%	9.508716	5.245110
max	97.596994	8.422791

OVX Percentage Change (1M) RBOB Percentage Change (1M) \

count	33.000000	33.000000
mean	1.220965	4.128831
std	25.574005	12.499872
min	-35.643564	-17.718604
25%	-17.548524	-3.131090
50%	-3.263127	4.465304
75%	16.575716	11.691709
max	80.084522	43.330452

OVX Percentage Change (6M) RBOB Percentage Change (6M)

count	32.000000	32.000000
mean	18.021246	4.880999
std	68.423911	28.812072
min	-62.967494	-53.533587
25%	-24.346405	-11.666560
50%	-8.117954	8.614384
75%	45.818241	13.764790
max	253.586757	79.703256

Events associated with Maximum Changes:

	Event Name	Start Date	OVX Percentage Change (1W) \
16	OPEC Production Cut (2020)	2020-04-12	97.596994
32	Zika Virus Outbreak 2016	2016-03-04	-3.160532
20	Yemeni Civil War 2014	2014-09-16	9.508716
16	OPEC Production Cut (2020)	2020-04-12	97.596994
21	2014 Gaza War	2014-07-08	10.116493
16	OPEC Production Cut (2020)	2020-04-12	97.596994

RBOB Percentage Change (1W) OVX Percentage Change (1M) \

16	2.420052	-24.099965
32	8.422791	-1.927154
20	2.731749	80.084522
16	2.420052	-24.099965
21	-2.499243	15.573268
16	2.420052	-24.099965

RBOB Percentage Change (1M) OVX Percentage Change (6M) \

16	43.330452	-62.967494
32	4.691840	-23.877433
20	-13.596217	200.739567
16	43.330452	-62.967494
21	-6.747620	253.586757
16	43.330452	-62.967494

RBOB Percentage Change (6M)

16	79.703256
32	6.013062
20	-32.444896
16	79.703256
21	-53.533587
16	79.703256

Events associated with Minimum Changes:

Event Name Start Date \

28	Tigray War, Ethiopia 2020-11-03
6	Russian Sanctions 2022-12-05
28	Tigray War, Ethiopia 2020-11-03
12	OPEC Oil Production Increase (2015) 2015-08-11
16	OPEC Production Cut (2020) 2020-04-12
21	2014 Gaza War 2014-07-08

OVX Percentage Change (1W) RBOB Percentage Change (1W) \

28	-21.986484	5.082301
6	-0.924906	-5.288853
28	-21.986484	5.082301
12	-6.356736	-2.769085
16	97.596994	2.420052
21	10.116493	-2.499243

OVX Percentage Change (1M) RBOB Percentage Change (1M) \

28	-35.643564	6.516206
6	0.924906	2.124582
28	-35.643564	6.516206
12	18.714421	-17.718604
16	-24.099965	43.330452
21	15.573268	-6.747620

OVX Percentage Change (6M) RBOB Percentage Change (6M)

28	-36.900833	76.786017
6	-12.794539	15.120694
28	-36.900833	76.786017
12	62.191651	-41.524473
16	-62.967494	79.703256
21	253.586757	-53.533587

Correlation Matrix between RBOB and OVX:

RBOB Percentage Change (1W) \

RBOB Percentage Change (1W)	1.000000
OVX Percentage Change (1W)	-0.177074
RBOB Percentage Change (1M)	0.533520

OVX Percentage Change (1M)	-0.314800
RBOB Percentage Change (6M)	0.163703
OVX Percentage Change (6M)	-0.183927

OVX Percentage Change (1W) \	
RBOB Percentage Change (1W)	-0.177074
OVX Percentage Change (1W)	1.000000
RBOB Percentage Change (1M)	0.239742
OVX Percentage Change (1M)	0.373033
RBOB Percentage Change (6M)	0.200778
OVX Percentage Change (6M)	0.099989

RBOB Percentage Change (1M) \	
RBOB Percentage Change (1W)	0.533520
OVX Percentage Change (1W)	0.239742
RBOB Percentage Change (1M)	1.000000
OVX Percentage Change (1M)	-0.487552
RBOB Percentage Change (6M)	0.604508
OVX Percentage Change (6M)	-0.462121

OVX Percentage Change (1M) \	
RBOB Percentage Change (1W)	-0.314800
OVX Percentage Change (1W)	0.373033
RBOB Percentage Change (1M)	-0.487552
OVX Percentage Change (1M)	1.000000
RBOB Percentage Change (6M)	-0.476447
OVX Percentage Change (6M)	0.617878

RBOB Percentage Change (6M) \	
RBOB Percentage Change (1W)	0.163703
OVX Percentage Change (1W)	0.200778
RBOB Percentage Change (1M)	0.604508
OVX Percentage Change (1M)	-0.476447
RBOB Percentage Change (6M)	1.000000
OVX Percentage Change (6M)	-0.719281

OVX Percentage Change (6M)	
RBOB Percentage Change (1W)	-0.183927
OVX Percentage Change (1W)	0.099989
RBOB Percentage Change (1M)	-0.462121
OVX Percentage Change (1M)	0.617878
RBOB Percentage Change (6M)	-0.719281
OVX Percentage Change (6M)	1.000000