

ANALYSIS OF PRICE VOLATILITY IN ENERGY COMMODITIES

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Abstract

In the recent years, India's energy consumption has been increasing at one of the fastest rates in the world due to population growth and economic development. To meet the demand of the energy which is increasing at the rate of 6% and India is importing 76% crude oil, 22.5% natural gas and 14.8% of coal to meet its energy demand. These energy commodities are also influence the growth and development of the country. The import is increasing which leads to the country fiscal deficit which is continuously increasing. After the development of derivative market the involvement of the investors is increased the basic theme was to mitigate the price risk but recent studies shows that its leads to the speculation activities in the market and become one of the reason behind increased volatility. The example is the Dec. 2008 when prices shoot up and touch the \$147 and suddenly dropped down to \$34 within few months and now it's between \$70-80. We need to identify what are the factors affecting price of the energy commodities analyze them and develop a price forecasting model to reduce the risk exposure.

Introduction

Crude oil, Coal and Natural Gas are the major source of energy for world economy since the last century. These commodities had played a vital role in industrial development and growth of world economy. The global economy is highly affected by the fluctuations in prices of these energy commodities. There are several factors which affect the price of energy commodities, thus affecting the world economy directly. The analysis shows that US inventory data; weather data, dollar index, unemployment rate etc. are the major fundamental factors that affect the prices of energy commodities. These factors directly affect the price of the energy commodities. For example if US inventory data shows decrease in the inventory level the price of crude oil immediately reflects its impact. If the dollar devaluates crude oil prices shows the upward trend and if it appreciates then crude oil prices decline.

Some of the fundamental factors affecting the Natural Gas prices are weather condition such as Katrina, Rita, and coming Richard in Gulf of Mexico affect the supply side of natural gas prices. Also the seasonal demand shows that US consumes 1.5 times more consumption in winters than other months which leads to increase in price. There is a correlation between the price of natural gas and other energy commodity such as crude oil and coal.

Demand is increasing due to economic activities mainly newly developed gas base power plant and economic development of the countries and also concerning the global warming the consumption of natural gas increased.

Coal demand is highly dependent on energy demand, as the majority of power generation in several countries (such as China, India and South Africa) comes from coal generation so the prices are correlated with price of electricity. Due to the weather condition and floods Australia from Richards Bay port not able to transport the coal leads to decrease in the supply to other nations as 1.8 million tonnes to 1.1 million tonnes. In India consumption is higher than

production will leads to price hike in near future. Due to the Global Warming problems in future some restrictions may take place by the government agencies or environment protection agency. It will be macro-economic factors such as GDP, trade deficit, national debt, inflation, interest rates that can indirectly influence the price of coal. There is negative correlation between price of coal and gas prices.

The recent geo-political issues with producer and consumer countries are adversely affecting the prices of energy commodities and Crude, Coal and Natural Gas prices showing upward trend. Libyan rebel and the earthquake in Japan lead to huge volatility in the energy commodities, The prices of crude oil is touching \$115 from \$80-\$90.

Research Methodology

Type of research: Descriptive

Sampling technique:

Non probabilistic method of convenience sampling will be used. The data will be collected from easily available and cost effective sources.

Data Source:

Secondary Data will be collected by visiting various Internet sites such as Bloomberg, Reuters, and Ticker Plant, Website of Commodity Exchanges e.g. Nymex, MCX, ICE, Ministry of Petroleum and Natural Gas; various global futures exchange websites, Platts, IMF, EIA, and MCX etc.

Data Analysis:

Data collected from different sources will be tabulated and analyzed using different analytical tools as:

- ✓ Regression Models
- ✓ Correlation Analysis
- ✓ Technical Tools

Research

ATR calculation of the Crude oil

Time duration taken for long term is from March 1983 to March 2011.

The price data is on daily bases.

ATR from the **1983 to 2011** is = **0.8023385**

14 days ATR

Maximum ATR from **1983 to 2011** is= **3.74951683**

Last month ATR's

Date	of	ATR	5 day ATR value	14 day ATR value
3/1/2011			3.8286829	2.87724282
3/2/2011			3.7029463	2.93622165
3/3/2011			3.5203571	2.9779456
3/4/2011			3.4282856	3.01011275
3/7/2011			3.2826285	3.02957816
3/8/2011			3.1181028	3.03590135
3/9/2011			2.8964823	3.02594284

3/10/2011	3.2051858	3.03874591
3/11/2011	3.3621486	3.06184611
3/14/2011	3.2277189	3.07369416
3/14/2011	3.1201751	3.07701423
3/16/2011	3.1721401	3.08380894
3/17/2011	3.3737121	3.10451631
3/18/2011	3.4029697	3.1258344
3/21/2011	3.1783757	3.12958735
3/22/2011	3.0947006	3.12709544
3/23/2011	2.8677605	3.10857152
3/24/2011	2.6802084	3.07797415
3/25/2011	2.4341667	3.0319879
3/28/2011	2.3793334	2.98536972
3/29/2011	2.3634667	2.94094808
3/30/2011	2.2327734	2.89036417
3/31/2011	2.3162187	2.84935378

The 5 days ATR and 15 days ATR is commonly used ATR for trading activities. It is considered that the price in a particular day might move to this range and then will stop moving. But we cannot assure that the price will not move more than that because the price is unpredictable and it can move further but chances of moving not more than this level is very less.

The all time ATR or say ATR from 1983 to 2011 says that the average movement in a particular day is **\$0.8023385**. But if there is adverse news then in that case the market may move more than this value so in this case we can take more 5 days ATR or 15 days ATR to know the volatility in short term or can say current volatility in the market.

In this report there is calculation of 14 days ATR of all this time and we find that the max. Value of the ATR is \$ **3.74951683**. Means in the time duration of the 18 years the average movement of the crude was \$ 3.74 and the average value is somewhere around the \$ 3.5

In the calculation of the 5 days ATR we find that the max Value is \$ **5.738812**. in this case we can also take the 5 days ATR because it tells the current market volatility and if the volatility according to the 14 days and 5 days are approx. Same in this case we can say that the market might move near to the ATR value but if both the ATR is not equal then we can say that the market will move the higher value of the ATR.

Standard Deviation:-

Using excel sheet we calculate the Standard deviation of the same 18 years and we find the values similar to the ATR which says the variables and the values which we are calculating are somewhere correct.

The term starts from January 2010 to March 2011. The Standard Deviation for this time duration is represented in the table.

Month	Standard Deviation
January	2.69695
February	4.437884
March	1.819859
April	1.969535
May	2.127439
June	0.463244
July	1.532626

August	3.559421
September	2.116307
October	2.190369
November	4.726454
December	1.358177
January	1.138042
February	2.795458
March	3.452517

Interpretation

The analysis of the Standard Deviation says that in a particular year in a particular month the volatility is on an average is \$ 2.45. It means the deviation in a month from the mean value is near about \$2.5, in a particular trading day the commodity moves not more than this level. Further in a particular month the maximum volatility is \$4.7 when there was adverse news in the market.

On the bases of the analysis by ATR and Standard deviation we can say that in a particular trading day commodity did not move more than \$ 2.5-\$ 3.5. And if we want to see the volatility in crude in a particular day than we can calculate % day ATR, 14 day ATR and Standard Deviation and we will get the value which will tell us that in that day what is the rage of the commodity and how much it may move.

Regression Analysis

It was found that crude oil prices exhibit a strong correlation with global oil demand with a correlation coefficient of 0.64 on a quarterly basis, while on an annual basis, it was found to be further higher at 0.83 indicating the long-term impact on prices taking into account the seasonal variation in demand.

The regression analysis indicates that global oil demand explains around 68.8 percent of the variation in crude oil prices. A one percent increase (decrease) in global oil demand shall result in an increase.

	Correlation	Coefficient	R²	P-Value
Crude oil price as a function of global oil demand	0.829	1.498	0.688	0.0056

The regression analysis indicates that global oil throughput explains around 69.1 percent of the variation in crude oil prices. A one percent increase (decrease) in global oil throughput shall result in an increase (decrease) in crude oil prices by 11.556 percent.

	Correlation	Coefficient	R²	P-Value
Crude oil price as a function of oil throughput	0.831	11.556	0.691	0.0021

	Correlation	Coefficient	R ²	P-Value
Crude oil price as a function of Dollar index	- 0.392	- 1.66	0.153	5.06 E-

The regression analysis indicates the Dollar index can explain 15.3 percent of variation in the Crude oil prices. One percent increase (decrease) in dollar index shall result in a decrease (increase) in crude oil prices by 1.66 percent.

Volatility in Coal

Coal is another energy which is used from the past long time in the world for various purposes. Mainly Coal is used in Iron and Steel industry and Power generation. The change in the prices of coal affects the Industry which is actually backbone of the country as power sector.

ATR of COAL

Long term ATR for the Coal is = \$ **1.43655**

The 14 days ATR is = \$ **3.4563**

The 5 days ATR is = \$ **2.35646**

On the bases of the we can say that in the general condition of the market the price movement in a particular trading day is \$ 1.5 which is the long term ATR.further to know the current volatility as we consider the 5 days ATR and 14 Days ATR which tells us that now days the average movement in the coal prices are near about \$ 2.6. So when we trade in the coal we can say that the expected movement will be near \$ 2.5 - \$ 3 after that the market will retrace or become side wave but if there is any news related to the Demand and Supply of the Coal then the prices will more than the ATR value.

Standard Deviation

SD is another tool to check the volatility in which we can check the volatility and the price movement in a particular time duration we are using the same for coal but as we know that coal prices are mainly depend on the market fundamental factors sp with this we have to consider that also to know the movement.

The long term 1 year standard deviation is = \$ **5.675741**

Month wise SD table

Month	Standard Deviation
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April	1.89786
May	3.45644
June	2.45345
July	1.75532
August	3.372067
September	1.882181
October	1.438301
November	1.078546
December	2.139523
January	2.471605
February	3.152573
March	3.28046

On the bases of the analysis of the SD we can say that volatility in the prices is from \$ 2.1 to \$ 3.1 which means in a particular month the movement of the commodity will be between these values.

On the bases of the two of the analysis we can consider the one day volatility of the coal could be \$2.5, ATR and SD says that in a particular normal trading day when there is no news in the market the Coal prices will move up to the \$ 2 to \$ 3 and in case of the market news the Coal price can move up to \$ 5 in a particular trading day.

Regression analysis of Coal and NG with Crude oil

Coal and Crude oil are highly correlated with 97% correlation. This means there is strong possibility that both the crude oil and coal will move in same direction and with same speed. R square and T statistics are very high which means that coal significantly represents the variation in the Crude oil prices. 1 unit move in the Coal will be followed by 0.68 unit move in the crude oil.

Correlation of Natural gas and Crude oil is also very high (i.e. 89%). With high r square and t statistics which indicates strong association between the crude oil and natural gas.

SUMMARY OUTPUT								
<i>Regression Statistics</i>								
Multiple R	0.94							
R Square	0.88							
Adjusted R Square	0.88							
Standard Error	12.61							
Observations	251.00							
<i>ANOVA</i>								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	1.00	293864.61	293864.61	1846.63	0.00			
Residual	249.00	39624.71	159.14					
Total	250.00	333489.33						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-3.87	2.21	-1.75	0.08	-8.21	0.48	-8.21	0.48
Coal	0.68	0.02	42.97	0.00	0.65	0.71	0.65	0.71

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	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	1.00	285185.09	285185.09	1470.08	0.00			
Residual	249.00	48304.24	193.99					
Total	250.00	333489.33						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-10.42	2.63	-3.96	0.00	-15.61	-5.24	-15.61	-5.24
NG	11.86	0.31	38.34	0.00	11.25	12.47	11.25	12.47

Price Volatility in Natural Gas

The natural gas is less volatile than the Crude Oil because the Natural Gas market is not that much developed as the Crude Oil market. Natural Gas has correlation with Crude oil. If the prices of the crude oil will increase the prices of the Natural Gas increase the price of Natural Gas will also increase.

ATR of NATURAL GAS:-

All time average ATR is = **0.1498101**

Maximum value of the 14 days ATR = **0.64708**

Maximum value of the 5 days ATR = **1.0535879**

List of last month ATR

Date	5 days ATR	14 days ATR
3/1/2011	0.1450759	0.136249
3/2/2011	0.1338607	0.132874
3/3/2011	0.1290886	0.13124
3/4/2011	0.1222709	0.128651
3/7/2011	0.1370167	0.133462
3/8/2011	0.1360133	0.133358
3/9/2011	0.1302107	0.131475
3/10/2011	0.1331685	0.132441
3/11/2011	0.1347348	0.133052
3/14/2011	0.1405879	0.135263
3/14/2011	0.1452703	0.137316
3/16/2011	0.1388162	0.135579
3/17/2011	0.153053	0.140895
3/18/2011	0.1422424	0.137902
3/21/2011	0.1365939	0.136195
3/22/2011	0.1286751	0.133395
3/23/2011	0.1219401	0.130653
3/24/2011	0.1343521	0.134463

3/25/2011	0.1428817	0.137502
3/28/2011	0.1371053	0.135823
3/29/2011	0.1396843	0.136835
3/30/2011	0.1357474	0.135633
3/31/2011	0.1559979	0.142873

As the all time ATR is showing that the movement is around \$.15 which means in a general market the price of the Natural Gas moves either side of the market by \$.15. The 5 days ATR is showing the value of \$ 1.06 that means according to the current market volatility and the time of the energy shocks the price of the Natural Gas may move up to the \$ 1 so at the time of the important news in the market we can expect the price will change up to \$ 1 in one trading day.

The 14 days ATR is showing the value of \$.65 that means in a particular trading day the maximum volatility was \$.65. On the bases of the average of the last month 5 days and 14 days ATR the values are near about the \$.15.

Standard Deviation

For the long term period we had taken the daily prices from April 1990 to March 2011 and the SD of this period is \$ 2.7. On the bases of the analysis we can say that according to the SD the movement in the price or say volatility of the price of Natural Gas was \$ 2.7.

Standard Deviation

Month	Standard Deviation value
January	0.205596
February	0.195777
March	0.105677
April	0.885451
May	0.185215
June	0.140683
July	0.088427
August	0.290022
September	0.163761
October	0.215118
November	0.143578
December	0.121659
January	0.28379
February	0.262
March	0.228274

Now if we look at the SD on month bases then we find that the average SD for the Natural Gas is \$.25 so we can say that the average movement in the Natural Gas in a particular trading day is \$.25-\$.30,

Now if analyze the both values ATR and the SD then we will find that the volatility of the Natural Gas is \$.15 - \$.25, and in case of adverse condition or big market news the market can move up to \$ 1.

Relation between Crude Oil and Natural Gas Prices

The availability of natural gas supplies act as a demand dampener for crude oil in the form of competition for residual crude oil in electricity generation and with distillate crude's for space heating applications. Thus, there stands a relationship between the prices of natural gas and crude oil. Despite the substitution effect of natural gas prices on crude oil prices, prices were found to have a positive correlation to the tune of 82 percent on account of differences in seasonal demand patterns which govern both the commodities.

	Correlation	Coefficient	R²	P-Value
Crude oil prices as a function of Daily natural gas prices	0.819	0.695	0.671	0
Crude oil prices as a function of Monthly natural gas prices	0.824	0.699	0.679	0.0291

The regression analysis indicates the impact of natural gas prices on crude oil prices to an extent of explaining 67 percent of the movement in crude oil prices. However, with the products being inter-dependent, it cannot be completely said that it is natural gas price that dictates crude oil prices rather both the product complement each other.

Conclusion

Energy commodities play an important role in the economy. Small change in the price of these commodities leads to big losses to the consumers and having large impact on economy. In the research we tried to find the factors affecting the price and the movement of the price in a particular day.

- We find that in a particular trading day in normal condition the prices of crude oil moves between \$ 2- \$ 3.5 and if there is any news in the market which affect the market sentiments, it may become more volatile and move according to the news in the market. The factors which are affecting the crude oil prices are Weekly US crude and product demand, Weekly crude and product inventories, Weekly crude oil and product imports, Weekly refinery production of crude oil and products etc, Weather conditions, Natural gas prices, Trend in other global markets, Currency movements and Political/geopolitical issues.
- Natural Gas market is developing now these days and the demand is increasing continuously. In the study we find that in general conditions it moves between\$.15- \$.25 and in adverse condition it can move up to \$1. Natural gas having a very good correlation with crude oil. Crude oil and the demand in power sector and transportation sector influence the price of natural gas with majorly considering the factors affecting the supply.
- Coal is another prominent commodity used mainly in the power generation so the industrial demand and the demand in the power sector having influence in the price of coal. Majorly the coal is not traded in exchanges it is traded in OTC market. Analysis

says that the movement in the price of coal is between \$ 2- \$ 3 and the other market condition it can be reach up to \$5.5.

- Coal and Crude oil are highly correlated with 97% correlation. Correlation of Natural gas and Crude oil is 89% which is very high.

There are still many factors which are affecting the prices such as the correlation between the commodities and the effect of the change in the price currency value in which the commodity trade.

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