

**“ENERGY PORTFOLIO MANAGEMENT”**

**Synopsis submitted to College of Management & Economic Studies for the  
partial fulfillment of the degree of**

**MBA (Energy Trading)**

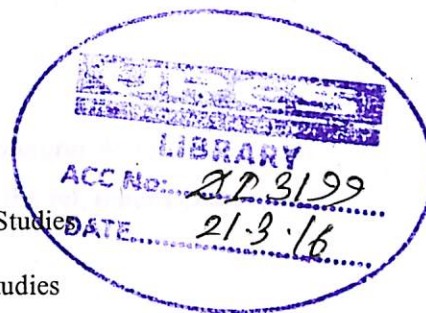
**Guided by:**

**Saumya Sharma**

Assistant Professor

College of Management & Economic Studies

University of Petroleum & Energy Studies



**Submitted by:**

**Siddharth saxena**

**SAP ID: 500014665**

**Roll No.: R590211028**

**MBA (Energy Trading)**

**2011-2013**



**College of Management and Economic Studies**

**University of Petroleum and Energy Studies,**

**Dehradun, Uttarakhand, India**

**MARCH, 2013**

## Certificate of Originality

This is to hereby state with the intention of this report is very original in every sense of the terms and conditions and it carries a sense of honour and belief and that no shortcuts have been taken and I remained both meticulous and caring during the prevalence of this research work. I have put in my point best to keep this work as informative and precise as possible.

It may be also stated here that during the preparation of this report some help has been taken from a scope of professionally shared information & knowledge, a comprehensive description of which has been mention in the references chapter of this report.

Dated: 7/7/13

Signature: Siddharth Saxena.

**Siddharth saxena**

R-590211028

MBA – Energy Trading (2011-13)

University of Petroleum & Energy Studies

Dehradun



## UNIVERSITY OF PETROLEUM & ENERGY STUDIES

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### BONAFIDE CERTIFICATE

This to certify that the project titled “**Energy Portfolio Management**” submitted to University of Petroleum and Energy Studies (UPES), Dehra Dun, by **Siddharth Saxena**, in partial fulfillment of **Masters of Business Administration (Energy Trading)**, is a bonafide work carried out by him under my guidance and supervision. This particular work hasn’t been submitted anywhere else for any other degree. To the best of my knowledge, he has made an earnest and dedicated effort to accomplish this project.

I wish him all the very best for his future endeavors.

*Saumya*  
6/4/2013  
Saumya Sharma

Assistant Professor

College of Management & Economics Studies,

University of Petroleum & Energy Studies,

Dehradun

Corporate Office : Hydrocarbons Education & Research Society  
3rd Floor, PHD House, 4/2 Siri Institutional Area, August Kranti Marg,  
New Delhi 110 016 India Ph.: +91.11.41730151-53 Fax : +91.11.41730154

Campus : Energy Acres, P.O. Bidholi Via Prem Nagar,  
Dehradun 248007 (Uttarakhand) India  
Ph.: +91.135.2776201, 2776061, 2776091 Fax : +91.135.2776090/95


URL : [www.upes.ac.in](http://www.upes.ac.in)

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Siddharth saxena

**MBA (Energy Trading),  
University of Petroleum & Energy Studies,  
Dehradun,  
Uttarakhand**



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# STATEMENT OF THE PROPOSAL

## ***PROBLEM STATEMENT***

“ENERGY PORTFOLIO MANAGEMENT” – is the research work that aims of creating a dynamic portfolio management process with analyzing all the risks that are related with the energy portfolio and how they impact the valuation of the same. It is aimed to provide best immunity to the portfolio from the known risks.

## ***BACKGROUND***

The term “portfolio management” has a long history in the finance and investment. Under that name and others, the same risk management concepts and techniques have long been applied to procurement of commodities, including energy utility procurement of fuels and purchased power. In recent years, the term has begun to be used in the energy industry to describe actual or suggested approaches to default service resource management and trading in business that have restructured energy industry. However, application of portfolio management concepts need not be confined to energy deficient markets.

Energy portfolio management helps utilities like cost-efficiently procure energy by tracking changes in market behavior and consumption, changes in suppliers in deregulated markets, market price volatility, and supply risk. Study also addresses a high-value; cost-effective solution that can reduce risk and provide solid return on investment. Energy portfolio management is a comprehensive study for management of sales and procurement portfolios in the energy industry or energy-intensive companies



***OBJECTIVES***

The following are the key objectives of the topic:

- Price volatility which is tolerable for trader, taking into account the means at their disposal for managing that risk?
- How portfolio depends on the level and instability of prices?
- Timeframe for which the proposed strategy apply?
- What stability level of prices is expected to result during that time?
- How sensitive is the expected level
- What flexibility is available and what point of timeframe

***SCOPE OF RESEARCH***

This dissertation would include various risks which can occur while managing a energy profile. The time duration for collection and analysis of data would be factor that should be most relevant and help provide much needed immunity to the portfolio. This work would be done for energy sector and specially designed model for current valuation of asset i.e. portfolio.

***RESEARCH METHODOLOGY******RESEARCH DESIGN***

The research is descriptive as well as imperial as it will be conducted on the basis earlier research that has been conducted in this area of risk. Insights form market

professionals would be obtain to know the “Ground Realities” of the risks involved and existing valuation models.

### **SOURCE OF DATA**

This research will be based on Secondary data collected from

1. Journals
2. Industry Professionals
3. Past Data models

### **STATISTICAL/MATHEMATICAL TOOLS**

- Lattice model
- Binomial option pricing model
- Local volatility
- Monte Carlo method for option pricing
- Valuation of option
- Fourier analysis
- Taylor analysis
- Bernoulli process
- Markov chain
- Stochastic process
- Geometric Brownian motion
- Stochastic volatility

### **PRICING THEORY**

- Dynamics-Free Pricing

- Pricing Under Bernoulli Dynamics
- Black-Scholes Dynamics
- American Options and 'Exotics'
- Models with Uncertain Volatility
- Discontinuous Processes
- Interest-Rate Dynamics

## INTRODUCTION

In energy portfolios across the hedge funds it is generally observed to have much concentration on the crude oil or other petroleum products. To mitigate this exposes and divide across the energy spectrum we have taken crude oil , natural gas, coal and propane as commodities ,this will help us understand the overall measures and implications across the energy sector.

Energy portfolio is affected by number of attributes which goes around the whole spectrum that is petroleum products and other energy products .this explains the exposes and relative instability in the system .this intern affects the portfolio returns and its growth.

### ***THE FOUR COMMODITIES***

1. Europe Brent Spot Price FOB (Dollars per Barrel)
2. Price of U.S. Natural Gas LNG Imports (Dollars per Thousand Cubic Feet)
3. Coal, South African export price, US Dollars per Metric Ton
4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

### ***UNITS***

1. Dollars per Barrel for crude oil.
2. Dollars per Thousand Cubic Feet for natural gas.
3. US Dollars per Metric Ton for coal.
4. Dollars per Gallon for propane.

### ***TIME FRAME***

The time frame taken is a span of five years taking average of each month prices.



**Europe Brent Spot Price FOB  
(Dollars per Barrel)**

YEA R	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	92.18	94.99	103.6 4	109.0 7	122.8	132.3 2	132.7 2	113.2 4	97.23	71.58	52.45	39.95
2009	43.44	43.32	46.54	50.18	57.3	68.61	64.44	72.51	67.65	72.77	76.66	74.46
2010	76.17	73.75	78.83	84.82	75.95	74.76	75.58	77.04	77.84	82.67	85.28	91.45
2011	96.52	103.7 2	114.6 4	123.2 6	114.9 9	113.8 3	116.9 7	110.2 2	112.8 3	109.5 5	110.7 7	107.8 7
2012	110.6 9	119.3 3	125.4 5	119.7 5	110.3 4	95.16	102.6 2	113.3 6	112.8 6	111.7 1	109.0 6	109.4 9

**Price of U.S. Natural Gas LNG Imports (Dollars per Thousand  
Cubic Feet)**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	8.42	9.37	9.41	9.85	11.33	12.34	12.99	10.25	9.06	9.16	8.09	8.86
2009	7.63	6.82	6.34 <sup>s</sup>	4.2	3.88	3.89	4.21	3.94	3.35	3.95	4.25	4.63
2010	0.78	5.74	4.87	4.25	4.24	4.2	4.8	4.93	4.6	4.78	5.09	5.41
2011	5.56	4.99	5.35	5.42	4.63	6.66	5.5	6.99	4.48	7.41	4.2	5.57
2012	4.25	4.3	2.95	2.96	4.37	3.1	5.15	4.02	3.17	3.18	7.21	5.22

**COAL, SOUTH AFRICAN EXPORT PRICE**

US.Dollars per Metric Ton

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008		115	111	108.75	120.7	142.38	167.75	156.9	147.75	109.7	89.38	77.25
2009	76.4	69.06	58.56	62.88	58.03	60.2	61.1	64.25	61.13	64.35	66.44	73.8
2010	86.94	83.36	82.96	88.7	90.94	92.81	90.61	87.9	85.82	90.99	103.2	115.24
2011	122.62	117.74	121	124.03	120.46	119.01	116.27	118.27	115.62	110.88	105.47	104.19
2012	106.26	105.3	103.43	101.33	93.77	85.31	87.33	89.11	85.82	82.8	85.74	88.84

**Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.506	1.425	1.475	1.59	1.7	1.813	1.862	1.651	1.53	1.045	0.738	0.61
2009	0.727	0.659	0.653	0.638	0.701	0.846	0.752	0.906	0.946	1.008	1.076	1.19
2010	1.312	1.284	1.136	1.137	1.082	1.037	1.01	1.072	1.132	1.234	1.254	1.296
2011	1.348	1.379	1.397	1.454	1.521	1.52	1.528	1.528	1.56	1.472	1.458	1.395
2012	1.294	1.22	1.261	1.196	0.954	0.788	0.874	0.901	0.91	0.962	0.89	0.797

## COEFFICIENT OF VARIATION (CV)

This measure is the ratio of the distribution's standard deviation to its mean. It is one way to measure risk relative to return, or in such cases, variation in price relative to mean price, measured over a define period. Tolerance bands can be established around coefficient of variation (William Steinhurst, 2006)

To calculate coefficient of variation we will require percentage change per month.corrospoding tabel is given in annexture A.

### CALCULATION

1. Europe Brent Spot Price FOB (Dollars per Barrel)

Coefficient of variation			
STANDARD DEVIATION IN SPOT	24.43969	STANDARD DEVIATION IN % CHANGE	0.093408
MEAN(AVERAGE)	92.153	MEAN(AVERAGE)	0.01
COFFICIENT OF VARIATION	0.265208	COFFICIENT OF VARIATION	12.39

2. Price of U.S. Natural Gas LNG Imports (Dollars per Thousand Cubic Feet)

Coefficient of variation			
STANDARD DEVIATION IN SPOT	2.483838	STANDARD DEVIATION IN % CHANGE	0.877858
MEAN(AVERAGE)	5.775833	MEAN(AVERAGE)	0.11
COFFICIENT OF VARIATION	0.43004	COFFICIENT OF VARIATION	7.878703

## 3. Coal, South African export price, US Dollars per Metric Ton

Coefficient of variation			
STANDARD DEVIATION IN SPOT	24.62738	STANDARD DEVIATION IN % CHANGE	0.08187
MEAN(AVERAGE)	97.16661	MEAN(AVERAGE)	-0.0011
COEFFICIENT OF VARIATION	0.253455	COEFFICIENT OF VARIATION	-77.1

## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

Coefficient of variation			
STANDARD DEVIATION IN SPOT	0.329396	STANDARD DEVIATION IN % CHANGE	0.257909
MEAN(AVERAGE)	1.160667	MEAN(AVERAGE)	0.86
COEFFICIENT OF VARIATION	0.283799	COEFFICIENT OF VARIATION	0.301347

**INFERENCE**

The coefficient of variation value of spot price of natural gas is 0.4 which is more than the other energy forms across the same time spectrum which is around 0.25, thus we can deduce that the risk related to return is substantially high then other energy forms(for given time period)



## BETA

Beta is a measure of the systematic risk of a single instrument or an entire Portfolio and describes the sensitivity of an instrument or portfolio to broad market movements. A portfolio with a large beta will tend to benefit or suffer from broad market moves more strongly than the market overall, while one with a small beta will swing less violently than the broad market. (William Steinhurst, 2006)

Here to get close correspondence of the market fluctuation the benchmark index taken is "Commodity Fuel (energy) Index" which is defined as

Commodity Fuel (energy) Index, 2005 = 100, includes Crude oil (petroleum), Natural Gas, and Coal Price Indices  
(imf)

The calculation of beta is done by the regression which is given by the division of the covariance of the two array in the system by the variance of the benchmark index here it is taken as Commodity Fuel (energy) Index. All the four products percentage change in prices is taken against corresponding change in fuel price index.

### CALCULATION

1. Europe Brent Spot Price FOB (Dollars per Barrel)

<b>COVARIANCE</b>	<b>0.007275</b>
<b>VARIANCE</b>	<b>0.006409</b>
<b>BETA</b>	<b>1.135094</b>

2. Price of U.S. Natural Gas LNG Imports (Dollars per Thousand Cubic Feet)

<b>COVARIANCE</b>	<b>-0.00475</b>
<b>VARIANCE</b>	<b>0.006409</b>
<b>BETA</b>	<b>-0.74036</b>

3. Coal, South African export price, US Dollars per Metric Ton

<b>COVARIANCE</b>	<b>0.003902</b>
<b>VARIANCE</b>	<b>0.006409</b>
<b>BETA</b>	<b>0.608893</b>

4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

<b>COVARIANCE</b>	<b>0.006342</b>
<b>VARIANCE</b>	<b>0.006409</b>
<b>BETA</b>	<b>0.989531</b>

### ***INFERENCE***

Beta corresponds to the systematic risk and correlation of each instrument with respect to the index. Here the value of Europe Brent Spot Price FOB that is 1.2 which relates to the index. Contrarily the U.S. Natural Gas LNG Imports gives negative value deducing that on every move in the index there will be opposite move of slightly less intensity on the natural gas prices.

**RELEABILITY TEST**

To test the reliability of the beta value special R – SQUARE test is done which corresponds to the accuracy and efficient calculation mechanism.

<b>R - SQUARE</b>	
<b>R – SQUARE(Europe Brent Spot Price FOB)</b>	96.41%
<b>R - SQUARE(U.S. Natural Gas LNG Imports)</b>	0.46%
<b>R - SQUARE(Coal, South African export price)</b>	36.71%
<b>R - SQUARE(Mont Belvieu, TX Propane Spot Price)</b>	61.77%

This clearly shows Europe Brent Spot Price FOB mostly corresponds to the index in subject and the U.S. Natural Gas LNG does not correspond to the index at all.

## EXTREME VALUE MEASURES

This measures the portfolio riskiness. In general, this type of measure is the difference in cost between a portfolio's expected cost and some estimate of its worst-case cost. This measure portfolio riskiness by the difference between its expected cost and average of the worst 10% of its cost's probability distribution. (NorthWestern Energy 2005 Electric Default Supply Resource Procurement Plan, 2005)

In this study of portfolio management the extreme value measure corresponds to mean value, standard deviation, skewness, kurtosis, r square and Engle 1. To calculate all the four commodities are evaluated for corresponding given parameters.

Here the for R square and Engle 1 calculation commodities are evaluated with corresponding Commodity Fuel (energy) Index. For the calculation of R square the correlation coefficient for given data is deduced. Further the product of this coefficient with the sample size gives the value of Engle 1.

### CALCULATION

#### 1. Europe Brent Spot Price FOB (Dollars per Barrel)

mean	92.153
standard deviation	24.43969
skewness	-0.42049
kurtosis	-0.7916
r square	0.976206
sample size	59
engle 1	57.59614

#### 2. Price of U.S. Natural Gas LNG Imports (Dollar/ Thousand Cubic Feet)

mean	5.775833
standard deviation	2.483838
skewness	1.048503
kurtosis	0.799302
r square	0.081253

sample size	59
engle 1	4.79391

## 3. Coal, South African export price, US Dollars per Metric Ton

mean	97.16661
standard deviation	24.62738
skewness	0.540404
kitrous	0.33489
r square	0.62669
sample size	59
engle 1	36.9747

## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

mean	1.160667
standard deviation	0.329396
skewness	0.01812
kitrous	-0.82808
r square	0.586967
sample size	59
engle 1	34.63103

**INFERENCE**

Combined table

	Brent	ng	coal	propane
mean	92.153	5.77	97.166	1.16
standard deviation	24.43	2.48	24.6	0.32
skewness	0.42	1.04	0.54	0.018
kitrous	-0.79	0.79	0.33	-0.828



r square	0.97	0.081	0.62	0.586
sample size	59	59	59	59
engle 1	57.59	4.79	36.97	34.63

### **INTERPRETATION**

(taking all commodities of equal proportions)

- The average of all four mean is 49.06, this corresponds to the minimum value of the portfolio that can be possible with all four commodities doing worse corresponding to the fuel index.
- The average of skewness is around 0.5 which means that the mostly the return achieved by the portfolio is underperforming by fifty percent.
- Kitrous is significantly low and positive for natural gas and coal but just opposite for crude and propane. Thus indicating that the index is related to the portfolio.
- Engle 1 value of natural gas is significantly low indicating low hetroskedasticity. Same is significantly high for all other commodities.

## VALUE AT RISK (VAR)

A traditional approach for quantifying risk of investment portfolios. VaR measures the downside risk of a portfolio. It is always calculated in the context of a risk level and a planning horizon. VaR of a proposed resource portfolio over a one year planning horizon at the 99% risk level. That VaR would tell us the amount of extra cost that would have a 1% chance of occurring over the next year. (William Steinhurst, 2006)

In this study all the commodities are evaluated for VaR analysis

### CALCULATION

1. Europe Brent Spot Price FOB (Dollars per Barrel)

PARAMETER SPOT		PARAMETER(% CHANGE)	
PORTFOLIO VALUE	100	PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	21.07103	AVERAGE RETURN % CHANGE	0.069167
STANDARD DEVIATION IN SPOT	24.43969	STANDARD DEVIATION IN SPOT	0.093408
CONFIDENCE LEVEL	0.95	CONFIDENCE LEVEL	0.95
CALCULATION		CALCULATION	
MINIMUM RETURN WITH 95 % PROB	-19.1287	MINIMUM RETURN WITH 95 % PROB	-0.08448
VALUE OF PORTFOLIO	-1812.87	VALUE OF PORTFOLIO	91.5524
VALUE AT RISK	1912.87	VALUE AT RISK	8.447596

## 2. Price of U.S. Natural Gas LNG Imports (Dollar/ Thousand Cubic Feet)

PARAMETER (SPOT)		PARAMETER(% CHANGE)	
PORTFOLIO VALUE	100	PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	1.948306	AVERAGE RETURN % CHANGE	0.328863
STANDARD DEVIATION IN SPOT	2.483838	STANDARD DEVIATION IN SPOT	0.877858
CONFIDENCE LEVEL	0.95	CONFIDENCE LEVEL	0.95
CALCULATION		CALCULATION	
MINIMUM RETURN WITH 95 % PROB	-2.13724	MINIMUM RETURN WITH 95 % PROB	-1.11508
VALUE OF PORTFOLIO	-113.724	VALUE OF PORTFOLIO	-11.5084
VALUE AT RISK	213.7245	VALUE AT RISK	111.5084

## 3. Coal, South African export price, US Dollars per Metric Ton

PARAMETER (SPOT)		PARAMETER(% CHANGE)	
PORTFOLIO VALUE	100	PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	19.88988	AVERAGE RETURN % CHANGE	0.06009
STANDARD DEVIATION IN SPOT	24.62738	STANDARD DEVIATION IN %CHANGE	0.08187
CONFIDENCE LEVEL	0.95	CONFIDENCE LEVEL	0.95
CALCULATION		CALCULATION	
MINIMUM RETURN WITH 95 % PROB	-20.6186	MINIMUM RETURN WITH 95 % PROB	-0.0746
VALUE OF PORTFOLIO	-1961.86	VALUE OF PORTFOLIO	92.5426
VALUE AT RISK	2061.856	VALUE AT RISK	7.45736



## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

PARAMETER (SPOT)		PARAMETER(% CHANGE)	
PORTFOLIO VALUE	100	PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	0.277567	AVERAGE RETURN % CHANGE	0.104765
STANDARD DEVIATION IN SPOT	0.329396	STANDARD DEVIATION IN SPOT	0.257909
CONFIDENCE LEVEL	0.95	CONFIDENCE LEVEL	0.95
CALCULATION		CALCULATION	
MINIMUM RETURN WITH 95 % PROB	-0.26424	MINIMUM RETURN WITH 95 % PROB	-0.31946
VALUE OF PORTFOLIO	73.57591	VALUE OF PORTFOLIO	68.05417
VALUE AT RISK	26.42409	VALUE AT RISK	31.94583

**INFERENCE**

The value at risk calculated for all four commodities in separate analysis at the spot price as well as on the percentage change of the spot prices. The confidence level taken is 95% as the time spectrum is of five years.

The VaR value for the percentage change taken is more relevant if correlated with the fuel index thus in percentage change calculation natural gas is the most venerable commodity and others are also quite venerable if invested independently. VaR analysis shows the riskiness in investing in any one of these commodities independently and forming a portfolio will be a wise option.

## REVENUE AT RISK (RAR)

Because of the cost uncertainty of that resource, they have Revenue at Risk (RaR). RaR is equal to the maximum amount of extra resource cost that the manufacturer can afford to pay without severe damage to its finances. (William Steinhurst, 2006)

For our study RaR is a function of the direct impact of the market fluctuations. To measure this if the change in the percentage impact is either greater than ten percent or less than ten percent is noted and analysis is done on the only those values. Thus giving the actual risk related to the revenue and its implication.

### CALCULATION

1. Europe Brent Spot Price FOB (Dollars per Barrel)

MONTH	Spot Price	% CHANGE
MAY,08	122.8	12.59%
AUG,08	113.24	14.68%
SEP,08	97.23	-14.14%
OCT,08	71.58	-26.38%
NOV,08	52.45	-26.73%
DEC,08	39.95	-23.83%
MAY,09	57.3	43.43%
JUN,09	68.61	19.74%
AUG,09	72.51	12.52%
MAY,10	75.95	10.46%
MAR,11	114.64	10.53%

JUN,12	95.16	13.76%
AUG,12	113.36	10.47%

## Calculation

<b>PARAMETER SPOT</b>	
PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	23.25337
STANDARD DEVIATION IN SPOT	26.92094
CONFIDENCE LEVEL	0.95
<b>CALCULATION</b>	
MINIMUM RETURN WITH 95 % PROB	-21.0276
VALUE OF PORTFOLIO	-2002.76
REVENUE AT RISK	2102.764

## 2. Price of U.S. Natural Gas LNG Imports (Dollar/ Thousand Cubic Feet)

MONTH	SPOT PRICE	% CHANGE
FEB,08	9.37	11.28%
MAY,08	11.33	15.03%
AUG,08	10.25	21.09%
SEP,08	9.06	-11.61%
NOV,08	8.09	11.68%
JAN,09	7.63	13.88%
FEB,09	6.82	-10.62%
APR,09	4.2	33.75%
SEP,09	3.35	-14.97%
OCT,09	3.95	17.91%
JAN,10	0.78	-80.25%
FEB,10	5.74	635.90%
MAR,10	4.87	-15.16%
APR,10	4.25	-12.73%
JUL,10	4.8	14.29%
FEB,11	4.99	-10.25%
MAY,11	4.63	14.58%

JUN,11	6.66	43.84%
JUL,11	5.5	-17.42%
AUG,11	6.99	27.09%
SEP,11	4.48	-35.91%
OCT,11	7.41	65.40%
NOV,11	4.2	-43.32%
DEC,11	5.57	32.62%
JAN,12	4.25	-23.70%
MAR,12	2.95	31.40%
MAY,12	4.37	47.64%
JUN,12	3.1	-29.06%
JUL,12	5.15	66.13%
AUG,12	4.02	-21.94%
SEP,12	3.17	-21.14%
AUG,12	4.02	26.81%
SEP,12	3.17	-21.14%
NOV,12	7.21	126.73%
DEC,12	5.22	-27.60%

<b>PARAMETER SPOT</b>	
PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	1.772
STANDARD DEVIATION IN SPOT	2.269332
CONFIDENCE LEVEL	0.95
<b>CALCULATION</b>	
MINIMUM RETURN WITH 95 % PROB	-1.96072
VALUE OF PORTFOLIO	-96.0719



<b>REVENUE AT RISK</b>	196.0719
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3. Coal, South African export price, US Dollars per Metric Ton

MONTH	SPOT	% CHANGE
MAY,08	120.7	10.99%
JUN,08	142.38	17.96%
JUL,08	167.75	17.82%
OCT,08	109.7	-25.75%
NOV,08	89.38	-18.52%
DEC,08	77.25	-13.57%
MAR,09	58.56	-15.20%
DEC,09	73.8	11.08%
JAN,10	86.94	17.80%
NOV,10	103.2	13.42%
DEC,10	115.24	11.67%

Calculation

<b>PARAMETER SPOT</b>	
PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	24.61107
STANDARD DEVIATION IN SPOT	31.89444
CONFIDENCE LEVEL	0.95
<b>CALCULATION</b>	
MINIMUM RETURN WITH 95 % PROB	-27.8506
VALUE OF PORTFOLIO	-2685.06
REVENUE AT RISK	2785.062

## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

MONTH	SPOT	% CHANGE
FEB,08	1.425	181.62%
AUG,08	1.651	-11.33%
OCT,08	1.045	-31.70%
NOV,08	0.738	-29.38%
DEC,08	0.61	-17.34%
JAN,09	0.727	19.18%
JUN,09	0.846	-20.68%
JUL,09	0.752	-11.11%
AUG,09	0.906	20.48%
DEC,09	1.19	10.59%
JAN,10	1.312	10.25%
MAR,10	1.136	11.53%
MAY,12	0.954	20.23%
JUN,12	0.788	-17.40%
JUL,12	0.874	10.91%
DEC,12	0.797	10.45%

## Calculation

PARAMETER SPOT	
PORTFOLIO VALUE	100
AVERAGE RETURN SPOT	0.231547
STANDARD DEVIATION IN SPOT	0.288443
CONFIDENCE LEVEL	0.95
CALCULATION	
MINIMUM RETURN WITH 95 % PROB	-0.2429
VALUE OF PORTFOLIO	75.71005
REVENUE AT RISK	24.28995

***INFERENCE***

- All the commodities are taken only for real fluctuations among all propane comes out to have minimum revenue at risk than come natural gas
- This corresponds that propane and natural gas both requires less purification when compared to other two and both are ready to use thus have much less exposes to market fluctuations.
- To add to this the market capitalizations for these two is also less to have such an impact.

## LIQUIDATION VALUE AT RISK

The total potential loss that could occur if an asset has to be liquidated. For instance, a fund might try to determine what would happen if it were forced to retire an unproductive asset. (William Steinhurst, 2006)

For liquidation the confidence level taken has to be ten percent or less than ten percent this is done to make sure the least confidence on the asset and the liquidation value at risk.

### CALCULATION

1. Europe Brent Spot Price FOB (Dollars per Barrel)

<b>LIQUIDATION AT RISK</b>	
<b>PORTFOLIO VALUE</b>	100
<b>AVERAGE RETURN SPOT</b>	21.07103
<b>STANDARD DEVIATION IN SPOT</b>	24.43969
<b>CONFIDENCE LEVEL</b>	0.10
<b>CALCULATION</b>	
<b>MINIMUM RETURN WITH 100 % PROB</b>	52.39176
<b>VALUE OF PORTFOLIO</b>	5339.18
<b>VALUE AT RISK</b>	-5239.18

2. Price of U.S. Natural Gas LNG Imports (Dollar/ Thousand Cubic Feet)

<b>LIQUIDATION AT RISK</b>	
<b>PORTFOLIO VALUE</b>	100
<b>AVERAGE RETURN SPOT</b>	1.948306
<b>STANDARD DEVIATION IN SPOT</b>	2.483838
<b>CONFIDENCE LEVEL</b>	0.10
<b>CALCULATION</b>	
<b>MINIMUM RETURN WITH 100 % PROB</b>	5.131472



<b>VALUE OF PORTFOLIO</b>	613.15
<b>VALUE AT RISK</b>	-513.15

## 3. Coal, South African export price, US Dollars per Metric Ton

<b>LIQUIDATION AT RISK</b>	
<b>PORTFOLIO VALUE</b>	100
<b>AVERAGE RETURN SPOT</b>	21.01588
<b>STANDARD DEVIATION IN SPOT</b>	27.45148
<b>CONFIDENCE LEVEL</b>	0.10
<b>CALCULATION</b>	
<b>MINIMUM RETURN WITH 100 % PROB</b>	56.19638
<b>VALUE OF PORTFOLIO</b>	5719.64
<b>VALUE AT RISK</b>	-5619.64

## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

<b>LIQUIDATION VALUE AT RISK AT RISK</b>	
<b>PORTFOLIO VALUE</b>	100
<b>AVERAGE RETURN SPOT</b>	0.277567
<b>STANDARD DEVIATION IN SPOT</b>	0.329396
<b>CONFIDENCE LEVEL</b>	0.10
<b>CALCULATION</b>	
<b>MINIMUM RETURN WITH 100 % PROB</b>	0.699704

VALUE OF PORTFOLIO	169.97
VALUE AT RISK	-69.97

***INFERENCE***

- All the commodities are taken only for real liquidations, among all propane comes out to have minimum liquidation value at risk than come natural gas.
- This corresponds that propane and natural gas both requires less purification when compared to other two and both are ready to use thus have much less exposes to market liquidation.
- To add to this the market capitalizations for these two is also less to have such an impact.

## COSTS AT RISK

Cost-at-Risk (CaR) is a supplementary measure used in the management of the interest-rate risk on the domestic central-government debt. CaR quantifies the risk on the debt and gives important input to the weighing of interest-rate risk against costs. A distinction is made between absolute and relative CaR. Absolute CaR for a given year indicates the maximum costs with a probability of 95 per cent. Relative CaR is the difference between absolute CaR and the average interest costs. Relative CaR thus indicates the maximum increase in the costs for a given year, with a probability of 95 per cent. (Cost-at-Risk for the Domestic Debt, 2000)

In our study the cost at risk is taken with respect to the Average majority prime rate charged by banks (US banks). All the fluctuations and impacts are calculated annually in order to get maximum exposure to the interest rates. The cost of procuring and trading a commodity is impacted by the interest rates largely.

### CALCULATION

1. Europe Brent Spot Price FOB (Dollars per Barrel)

calculation	spot price
MAX 08	132.72
PROBABILITY	0.95
ABSOLUTE COST AT RISK	126.084
MEAN 08	96.8475
RELATIVE COST AT RISK	29.2365
MAX 09	76.66
PROBABILITY	0.95
ABSOLUTE COST AT RISK	72.827
MEAN 09	61.49
RELATIVE COST AT RISK	11.337
MAX 10	91.45
PROBABILITY	0.95
ABSOLUTE COST AT RISK	86.8775
MEAN 10	79.511667
RELATIVE COST AT RISK	7.3658333

MAX 11	123.26
PROBABILITY	0.95
ABSOLUTE COST AT RISK	117.097
MEAN 11	111.26417
RELATIVE COST AT RISK	5.8328333
MAX 12	125.45
PROBABILITY	0.95
ABSOLUTE COST AT RISK	119.1775
MEAN 12	111.65167
RELATIVE COST AT RISK	7.5258333

## 2. Price of U.S. Natural Gas LNG Imports (Dollar/ Thousand Cubic Feet)

	spot price
MAX 08	12.99
PROBABILITY	0.95
ABSOLUTE COST AT RISK	12.3405
MEAN 08	9.9275
RELATIVE COST AT RISK	2.413
MAX 09	7.63
PROBABILITY	0.95
ABSOLUTE COST AT RISK	7.2485
MEAN 09	4.7575
RELATIVE COST AT RISK	2.491
MAX 10	5.74
PROBABILITY	0.95
ABSOLUTE COST AT RISK	5.453
MEAN 10	4.474167
RELATIVE COST AT RISK	0.978833
MAX 11	7.41
PROBABILITY	0.95
ABSOLUTE COST AT RISK	7.0395
MEAN 11	5.563333



<b>RELATIVE COST AT RISK</b>	1.476167
<b>MAX 12</b>	7.21
<b>PROBABILITY</b>	0.95
<b>ABSOLUTE COST AT RISK</b>	6.8495
<b>MEAN 12</b>	4.156667
<b>RELATIVE COST AT RISK</b>	2.692833

3. Coal, South African export price, US Dollars per Metric Ton

	spot price
<b>MAX 08</b>	167.75
<b>PROBABILITY</b>	0.95
<b>ABSOLUTE COST AT RISK</b>	159.3625
<b>MEAN 08</b>	112.2133
<b>RELATIVE COST AT RISK</b>	47.14917
<b>MAX 09</b>	76.4
<b>PROBABILITY</b>	0.95
<b>ABSOLUTE COST AT RISK</b>	72.58
<b>MEAN 09</b>	64.68333
<b>RELATIVE COST AT RISK</b>	7.896667
<b>MAX 10</b>	115.24
<b>PROBABILITY</b>	0.95
<b>ABSOLUTE COST AT RISK</b>	109.478
<b>MEAN 10</b>	91.6225
<b>RELATIVE COST AT RISK</b>	17.8555
<b>MAX 11</b>	124.03
<b>PROBABILITY</b>	0.95
<b>ABSOLUTE COST AT RISK</b>	117.8285
<b>MEAN 11</b>	116.2967
<b>RELATIVE COST AT RISK</b>	1.531833
<b>MAX 12</b>	106.26
<b>PROBABILITY</b>	0.95
<b>ABSOLUTE COST AT RISK</b>	100.947

MEAN 12	92.92
RELATIVE COST AT RISK	8.027

## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

	spot price
max 08	1.862
probability	0.95
ABSOLUTE COST AT RISK	1.7689
MEAN 08	1.32875
RELATIVE COST AT RISK	0.44015
max 09	1.19
probability	0.95
ABSOLUTE COST AT RISK	1.1305
MEAN 08	0.841833
RELATIVE COST AT RISK	0.288667
max 10	1.312
probability	0.95
ABSOLUTE COST AT RISK	1.2464
MEAN 08	1.1655
RELATIVE COST AT RISK	0.0809
max 11	1.56
probability	0.95
ABSOLUTE COST AT RISK	1.482
MEAN 08	1.463333
RELATIVE COST AT RISK	0.018667
max 12	1.294
probability	0.95
ABSOLUTE COST AT RISK	1.2293

MEAN 08	1.003917
RELATIVE COST AT RISK	0.225383

**INFERENCE**

- For all the years individually natural gas and propane have very less cost at risk when compared to other two commodities.
- This again proves that the more commodity is exposed in terms of market capitalization more is the chance of running into risk, realization is tough and immunity is weak.
- All those commodities namely here Brent and coal have higher cost at risk with respect to interest rate index.

## Volatility

Measure of variation of the value of portfolio within a given time spectrum. This also shows the impact of random market fluctuation on the valuation. Due to impact on one asset the corresponding change in other asset and relative change in valuation.

Volatility impact is calculated with respect to CBOE Volatility Index which is benchmark in volatility index. This will give relative exposure corresponds to each date.

To calculate the implied volatility standard deviation of the stress impact of given index as well as the spot prices are to be deduced. The correlation of the two values is deduced in order to get standard deviation.

### ***CALCULATION***

1. Europe Brent Spot Price FOB (Dollars per Barrel)

<b>standard deviation</b>	<b>6.801573</b>
<b>implied volatility</b>	<b>2.607983</b>

2. Price of U.S. Natural Gas LNG Imports (Dollar/ Thousand Cubic Feet)

<b>standard deviation</b>	<b>1.048153</b>
<b>implied volatility</b>	<b>1.023794</b>

3. Coal, South African export price, US Dollars per Metric Ton

<b>standard deviation</b>	<b>10.80215</b>
<b>implied volatility</b>	<b>3.286663</b>



## 4. Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)

standard deviation	0.114602
implied volatility	0.338529

***INFERENCE***

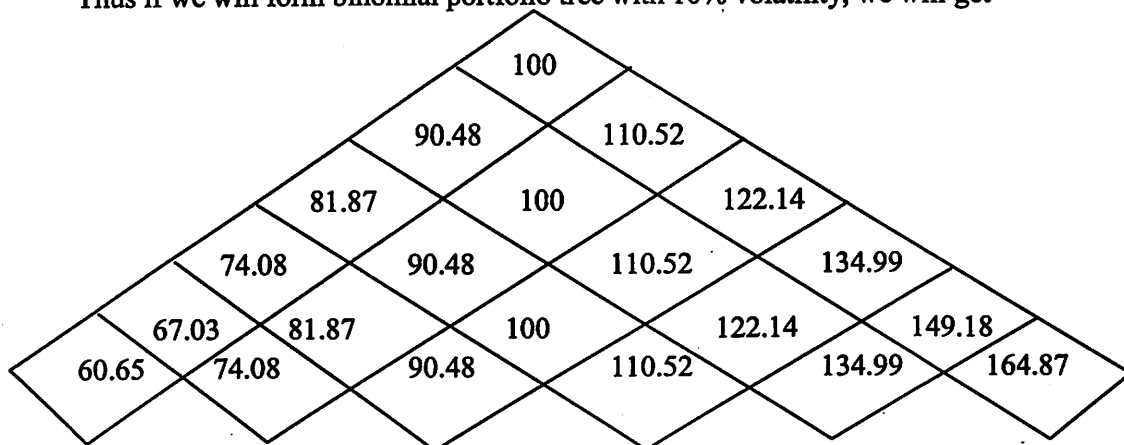
- Coal and Brent have higher volatility with respect to the volatility index in consideration.
- The volatility in the market is impacting the commodities having more exposure to the market and are more venerable in nature.

## Valuation

Based on black soles theory we can find the valuation of the portfolio .there are two main attributes of this theory these are preference free and risk neutral nature of portfolio .from this theory for our study we are adopting only risk neutral nature of portfolio. In this theory of valuation is based on the fact that assert price is lognormally proportional to the market as well as time spectrum

Taking binomial calculation for the current value of portfolio while taking the risk neutral nature of black soles model. For the calculation time frame taken is 5 years, value of portfolio ( assert) is taken 100 units, average riskless interest rate taken in the study is 3 %,market implication affecting the given portfolio is 10 % i.e. implied volatility

Thus if we will form binomial portfolio tree with 10% volatility, we will get



# ANNEXURE

## *Annexure A*

### Europe Brent Spot Price FOB (Dollars per Barrel)

MONTH	Spot Price	% CHANGE
JAN,08	92.18	
FEB,08	94.99	3.05%
MAR,08	103.64	9.11%
APR,08	109.07	5.24%
MAY,08	122.8	12.59%
JUN,08	132.32	7.75%
JUL,08	132.72	0.30%
AUG,08	113.24	-14.68%
SEP,08	97.23	-14.14%
OCT,08	71.58	-26.38%
NOV,08	52.45	-26.73%
DEC,08	39.95	-23.83%
JAN,09	43.44	8.74%
FEB,09	43.32	-0.28%
MAR,09	46.54	7.43%
APR,09	50.18	7.82%
MAY,09	57.3	14.19%
JUN,09	68.61	19.74%
JUL,09	64.44	-6.08%
AUG,09	72.51	12.52%
SEP,09	67.65	-6.70%
OCT,09	72.77	7.57%
NOV,09	76.66	5.35%
DEC,09	74.46	-2.87%
JAN,10	76.17	2.30%
FEB,10	73.75	-3.18%
MAR,10	78.83	6.89%
APR,10	84.82	7.60%
MAY,10	75.95	-10.46%

JUN,10	74.76	-1.57%
JUL,10	75.58	1.10%
AUG,10	77.04	1.93%
SEP,10	77.84	1.04%
OCT,10	82.67	6.21%
NOV,10	85.28	3.16%
DEC,10	91.45	7.23%
JAN,11	96.52	5.54%
FEB,11	103.72	7.46%
MAR,11	114.64	10.53%
APR,11	123.26	7.52%
MAY,11	114.99	-6.71%
JUN,11	113.83	-1.01%
JUL,11	116.97	2.76%
AUG,11	110.22	-5.77%
SEP,11	112.83	2.37%
OCT,11	109.55	-2.91%
NOV,11	110.77	1.11%
DEC,11	107.87	-2.62%
JAN,12	110.69	2.61%
FEB,12	119.33	7.81%
MAR,12	125.45	5.13%
APR,12	119.75	-4.54%
MAY,12	110.34	-7.86%
JUN,12	95.16	-13.76%
JUL,12	102.62	7.84%
AUG,12	113.36	10.47%
SEP,12	112.86	-0.44%
OCT,12	111.71	-1.02%
NOV,12	109.06	-2.37%
DEC,12	109.49	0.39%

**Price of U.S. Natural Gas LNG Imports (Dollars per Thousand Cubic Feet)**

MONTH	SPOT PRICE	% CHANGE
JAN,08	8.42	
FEB,08	9.37	0.11
MAR,08	9.41	0.00
APR,08	9.85	0.05
MAY,08	11.33	0.15
JUN,08	12.34	0.09
JUL,08	12.99	0.05
AUG,08	10.25	-0.21
SEP,08	9.06	-0.12
OCT,08	9.16	0.01
NOV,08	8.09	-0.12
DEC,08	8.86	0.10
JAN,09	7.63	-0.14
FEB,09	6.82	-0.11
MAR,09	6.34	-0.07
APR,09	4.2	-0.34
MAY,09	3.88	-0.08
JUN,09	3.89	0.00
JUL,09	4.21	0.08
AUG,09	3.94	-0.06
SEP,09	3.35	-0.15
OCT,09	3.95	0.18
NOV,09	4.25	0.08
DEC,09	4.63	0.09
JAN,10	0.78	-0.83
FEB,10	5.74	6.36
MAR,10	4.87	-0.15
APR,10	4.25	-0.13
MAY,10	4.24	0.00
JUN,10	4.2	-0.01
JUL,10	4.8	0.14
AUG,10	4.93	0.03
SEP,10	4.6	-0.07
OCT,10	4.78	0.04
NOV,10	5.09	0.06

DEC,10	5.41	0.06
JAN,11	5.56	0.03
FEB,11	4.99	-0.10
MAR,11	5.35	0.07
APR,11	5.42	0.01
MAY,11	4.63	-0.15
JUN,11	6.66	0.44
JUL,11	5.5	-0.17
AUG,11	6.99	0.27
SEP,11	4.48	-0.36
OCT,11	7.41	0.65
NOV,11	4.2	-0.43
DEC,11	5.57	0.33
JAN,12	4.25	-0.24
FEB,12	4.3	0.01
MAR,12	2.95	-0.31
APR,12	2.96	0.00
MAY,12	4.37	0.48
JUN,12	3.1	-0.29
JUL,12	5.15	0.66
AUG,12	4.02	-0.22
SEP,12	3.17	-0.21
OCT,12	3.18	0.00
NOV,12	7.21	1.27
DEC,12	5.22	-0.28

**Coal, South African export price, US Dollars per Metric Ton**

MONTH	SPOT	% CHANGE
JAN,08	0	
FEB,08	115	
MAR,08	111	-0.03
APR,08	108.75	-0.02
MAY,08	120.7	0.11
JUN,08	142.38	0.18
JUL,08	167.75	0.18
AUG,08	156.9	-0.06
SEP,08	147.75	-0.06

OCT,08	109.7	-0.26
NOV,08	89.38	-0.19
DEC,08	77.25	-0.14
JAN,09	76.4	-0.01
FEB,09	69.06	-0.10
MAR,09	58.56	-0.15
APR,09	62.88	0.07
MAY,09	58.03	-0.08
JUN,09	60.2	0.04
JUL,09	61.1	0.01
AUG,09	64.25	0.05
SEP,09	61.13	-0.05
OCT,09	64.35	0.05
NOV,09	66.44	0.03
DEC,09	73.8	0.11
JAN,10	86.94	0.18
FEB,10	83.36	-0.04
MAR,10	82.96	0.00
APR,10	88.7	0.07
MAY,10	90.94	0.03
JUN,10	92.81	0.02
JUL,10	90.61	-0.02
AUG,10	87.9	-0.03
SEP,10	85.82	-0.02
OCT,10	90.99	0.06
NOV,10	103.2	0.13
DEC,10	115.24	0.12
JAN,11	122.62	0.06
FEB,11	117.74	-0.04
MAR,11	121	0.03
APR,11	124.03	0.03
MAY,11	120.46	-0.03
JUN,11	119.01	-0.01
JUL,11	116.27	-0.02
AUG,11	118.27	0.02
SEP,11	115.62	-0.02
OCT,11	110.88	-0.04
NOV,11	105.47	-0.05
DEC,11	104.19	-0.01

JAN,12	106.26	0.02
FEB,12	105.3	-0.01
MAR,12	103.43	-0.02
APR,12	101.33	-0.02
MAY,12	93.77	-0.07
JUN,12	85.31	-0.09
JUL,12	87.33	0.02
AUG,12	89.11	0.02
SEP,12	85.82	-0.04
OCT,12	82.8	-0.04
NOV,12	85.74	0.04
DEC,12	88.84	0.04

**Mont Belvieu, TX Propane Spot Price FOB (Dollars per Gallon)**

MONTH	SPOT	% CHANGE
JAN,08	0.506	
FEB,08	1.425	1.82
MAR,08	1.475	0.04
APR,08	1.59	0.08
MAY,08	1.7	0.07
JUN,08	1.813	0.07
JUL,08	1.862	0.03
AUG,08	1.651	-0.11
SEP,08	1.53	-0.07
OCT,08	1.045	-0.32
NOV,08	0.738	-0.29
DEC,08	0.61	-0.17
JAN,09	0.727	0.19
FEB,09	0.659	-0.09
MAR,09	0.653	-0.01
APR,09	0.638	-0.02
MAY,09	0.701	0.10
JUN,09	0.846	0.21
JUL,09	0.752	-0.11
AUG,09	0.906	0.20
SEP,09	0.946	0.04
OCT,09	1.008	0.07



NOV,09	1.076	0.07
DEC,09	1.19	0.11
JAN,10	1.312	0.10
FEB,10	1.284	-0.02
MAR,10	1.136	-0.12
APR,10	1.137	0.00
MAY,10	1.082	-0.05
JUN,10	1.037	-0.04
JUL,10	1.01	-0.03
AUG,10	1.072	0.06
SEP,10	1.132	0.06
OCT,10	1.234	0.09
NOV,10	1.254	0.02
DEC,10	1.296	0.03
JAN,11	1.348	0.04
FEB,11	1.379	0.02
MAR,11	1.397	0.01
APR,11	1.454	0.04
MAY,11	1.521	0.05
JUN,11	1.52	0.00
JUL,11	1.528	0.01
AUG,11	1.528	0.00
SEP,11	1.56	0.02
OCT,11	1.472	-0.06
NOV,11	1.458	-0.01
DEC,11	1.395	-0.04
JAN,12	1.294	-0.07
FEB,12	1.22	-0.06
MAR,12	1.261	0.03
APR,12	1.196	-0.05
MAY,12	0.954	-0.20
JUN,12	0.788	-0.17
JUL,12	0.874	0.11
AUG,12	0.901	0.03
SEP,12	0.91	0.01
OCT,12	0.962	0.06
NOV,12	0.89	-0.07
DEC,12	0.797	-0.10

**ANNEXURE B****Average majority prime rate charged by banks US BANKS**

MONTH	Average majority prime rate charged by banks US BANKS
JAN,08	6.98
FEB,08	6
MAR,08	5.66
APR,08	5.24
MAY,08	5
JUN,08	5
JUL,08	5
AUG,08	5
SEP,08	5
OCT,08	4.56
NOV,08	4
DEC,08	3.61
JAN,09	3.25
FEB,09	3.25
MAR,09	3.25
APR,09	3.25
MAY,09	3.25
JUN,09	3.25
JUL,09	3.25
AUG,09	3.25
SEP,09	3.25
OCT,09	3.25
NOV,09	3.25
DEC,09	3.25
JAN,10	3.25
FEB,10	3.25
MAR,10	3.25
APR,10	3.25
MAY,10	3.25
JUN,10	3.25
JUL,10	3.25
AUG,10	3.25
SEP,10	3.25
OCT,10	3.25

NOV,10	3.25
DEC,10	3.25
JAN,11	3.25
FEB,11	3.25
MAR,11	3.25
APR,11	3.25
MAY,11	3.25
JUN,11	3.25
JUL,11	3.25
AUG,11	3.25
SEP,11	3.25
OCT,11	3.25
NOV,11	3.25
DEC,11	3.25
JAN,12	3.25
FEB,12	3.25
MAR,12	3.25
APR,12	3.25
MAY,12	3.25
JUN,12	3.25
JUL,12	3.25
AUG,12	3.25
SEP,12	3.25
OCT,12	3.25
NOV,12	3.25
DEC,12	3.25

**ANNEXRE C****CBOE Volatility Index**

MONTH	CBOE Volatility Index	stress impact
JAN,08	26.2	0.132572
FEB,08	26.54	0.378195
MAR,08	25.61	0.3777475
APR,08	20.79	0.330561
MAY,08	17.83	0.30311
JUN,08	23.95	0.4342135
JUL,08	22.94	0.4271428
AUG,08	20.65	0.3409315
SEP,08	39.39	0.602667
OCT,08	59.89	0.6258505
NOV,08	55.28	0.4079664
DEC,08	40	0.244
JAN,09	44.84	0.3259868
FEB,09	46.35	0.3054465
MAR,09	44.14	0.2882342
APR,09	36.5	0.23287
MAY,09	28.92	0.2027292
JUN,09	26.35	0.222921
JUL,09	25.92	0.1949184
AUG,09	26.01	0.2356506
SEP,09	25.61	0.2422706
OCT,09	30.69	0.3093552
NOV,09	24.51	0.2637276
DEC,09	21.68	0.257992
JAN,10	24.62	0.3230144
FEB,10	19.5	0.25038
MAR,10	17.59	0.1998224
APR,10	22.05	0.2507085
MAY,10	32.07	0.3469974
JUN,10	34.54	0.3581798
JUL,10	23.5	0.23735
AUG,10	26.05	0.279256
SEP,10	23.7	0.268284
OCT,10	21.2	0.261608

NOV,10	23.54	0.2951916
DEC,10	17.75	0.23004
JAN,11	19.53	0.2632644
FEB,11	18.35	0.2530465
MAR,11	17.74	0.2478278
APR,11	14.75	0.214465
MAY,11	15.45	0.2349945
JUN,11	16.52	0.251104
JUL,11	25.25	0.38582
AUG,11	31.62	0.4831536
SEP,11	42.96	0.670176
OCT,11	29.96	0.4410112
NOV,11	27.80	0.405324
DEC,11	23.40	0.32643
JAN,12	19.44	0.2515536
FEB,12	18.43	0.224846
MAR,12	15.50	0.195455
APR,12	17.15	0.205114
MAY,12	24.06	0.2295324
JUN,12	17.08	0.1345904
JUL,12	18.93	0.1654482
AUG,12	17.47	0.1574047
SEP,12	15.73	0.143143
OCT,12	18.60	0.178932
NOV,12	15.87	0.141243
DEC,12	18.02	0.1436194

**ANNEXURE D****Commodity Fuel (energy) Index**

MONTH	Commodity Fuel (energy) Index	CHANGE
JAN,08		
FEB,08	176.27	-
MAR,08	188.85	7.14%
APR,08	202.3	7.12%
MAY,08	226.24	11.83%
JUN,08	243.39	7.58%
JUL,08	249.4	2.47%
AUG,08	217.46	-12.81%
SEP,08	192.02	-11.70%
OCT,08	146.68	-23.61%
NOV,08	113.7	-22.48%
DEC,08	91.55	-19.48%
JAN,09	94.99	3.76%
FEB,09	89.7	-5.57%
MAR,09	93.64	4.39%
APR,09	97.05	3.64%
MAY,09	109.78	13.12%
JUN,09	127.94	16.54%
JUL,09	119.83	-6.34%
AUG,09	130.44	8.85%
SEP,09	124.74	-4.37%
OCT,09	134.81	8.07%
NOV,09	140.82	4.46%
DEC,09	137.84	-2.12%
JAN,10	143.74	4.28%
FEB,10	139.3	-3.09%
MAR,10	146.29	5.02%
APR,10	155.22	6.10%
MAY,10	141.62	-8.76%
JUN,10	140.14	-1.05%
JUL,10	139.75	-0.28%
AUG,10	141.35	1.14%
SEP,10	141.95	0.42%
OCT,10	151.33	6.61%
NOV,10	157.12	3.83%

DEC,10	167.13	6.37%
JAN,11	173.3	3.69%
FEB,11	181.53	4.75%
MAR,11	198.75	9.49%
APR,11	212.57	6.95%
MAY,11	199.95	-5.94%
JUN,11	196.65	-1.65%
JUL,11	200.92	2.17%
AUG,11	189.65	-5.61%
SEP,11	190.45	0.42%
OCT,11	189.22	-0.65%
NOV,11	197.22	4.23%
DEC,11	195.28	-0.98%
JAN,12	199.69	2.26%
FEB,12	208.65	4.49%
MAR,12	216.98	3.99%
APR,12	210.62	-2.93%
MAY,12	194.23	-7.78%
JUN,12	172.47	-11.20%
JUL,12	181.19	5.06%
AUG,12	194.79	7.51%
SEP,12	196.48	0.87%
OCT,12	191.02	-2.78%
NOV,12	187.8	-1.69%
DEC,12	188.46	0.35%



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