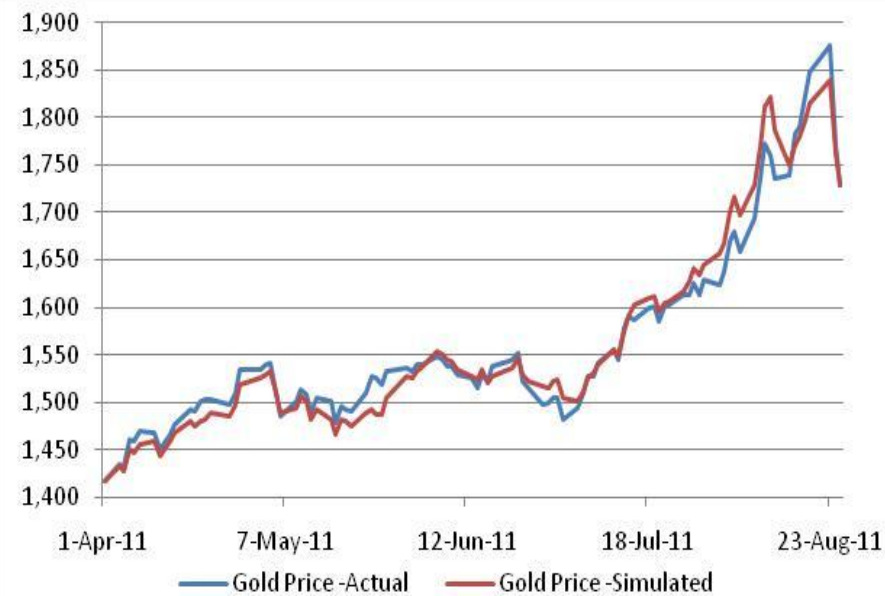


June 2012

# Risk Management

Ideas, Products, Risks, Limits



# Jawwad Intro



**Fellow Society of Actuaries, Investments**

**MBA, Columbia Business School**

**19 years consulting: US, UK, ME & Pakistan**

**Risk Management, Product Development,  
Regulatory Reporting, Actuarial Practice**

**Prefers - Jawwad**

<http://FinanceTrainingCourse.com>

<http://www.alchemya.com>

[jawwad@alchemya.com](mailto:jawwad@alchemya.com)

# Alchemy Intro

**Actuarial & Risk Advisory firm**

**8 years, 4 Markets**

**Derivative & Risk Management models, ALM, ICAAP,  
Stress Testing, Financial Product Development,  
Training workshops**

**120th workshop - 1600 trained professionals**

What is this course about

Price

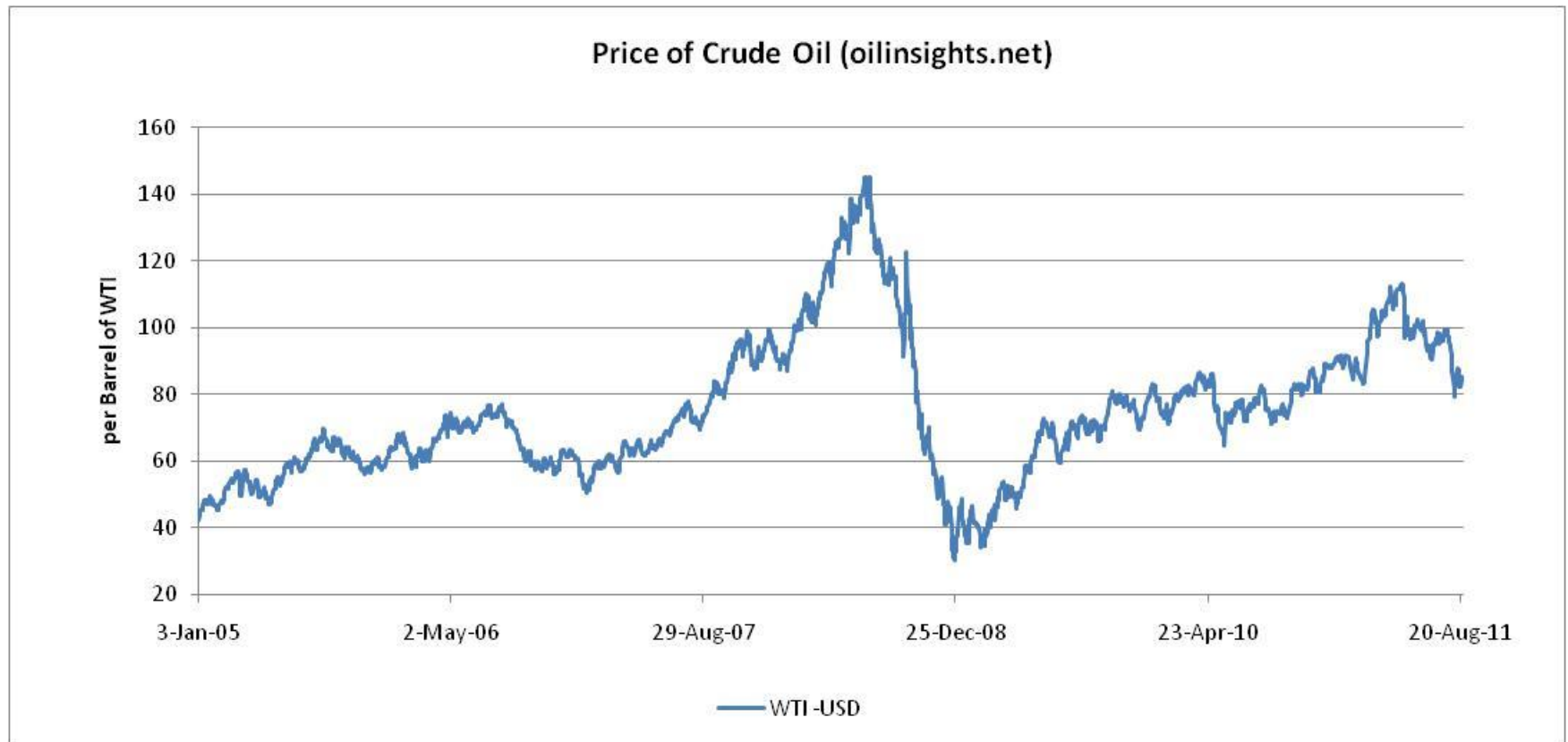
Risk

Value

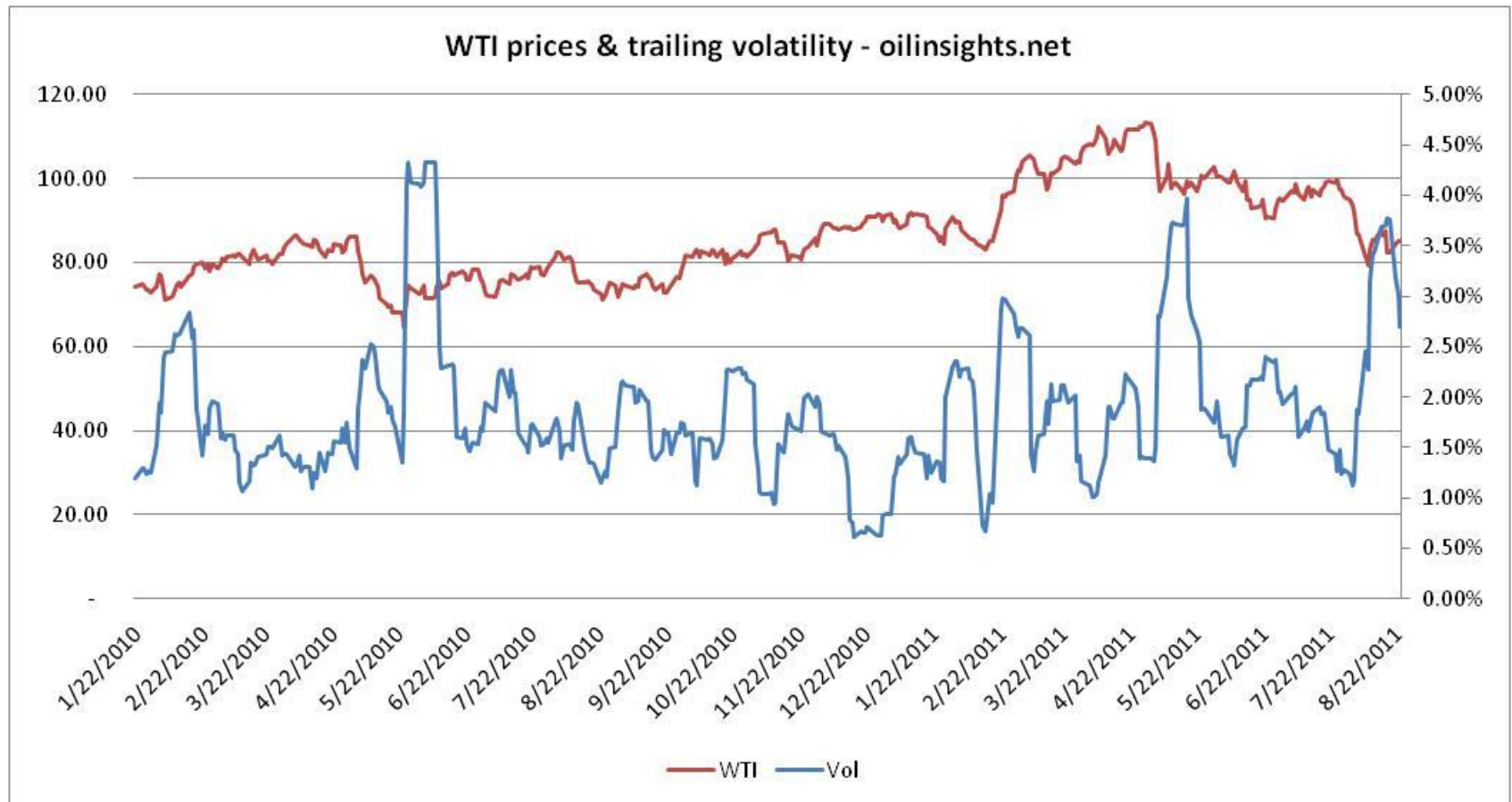
Products

Limits

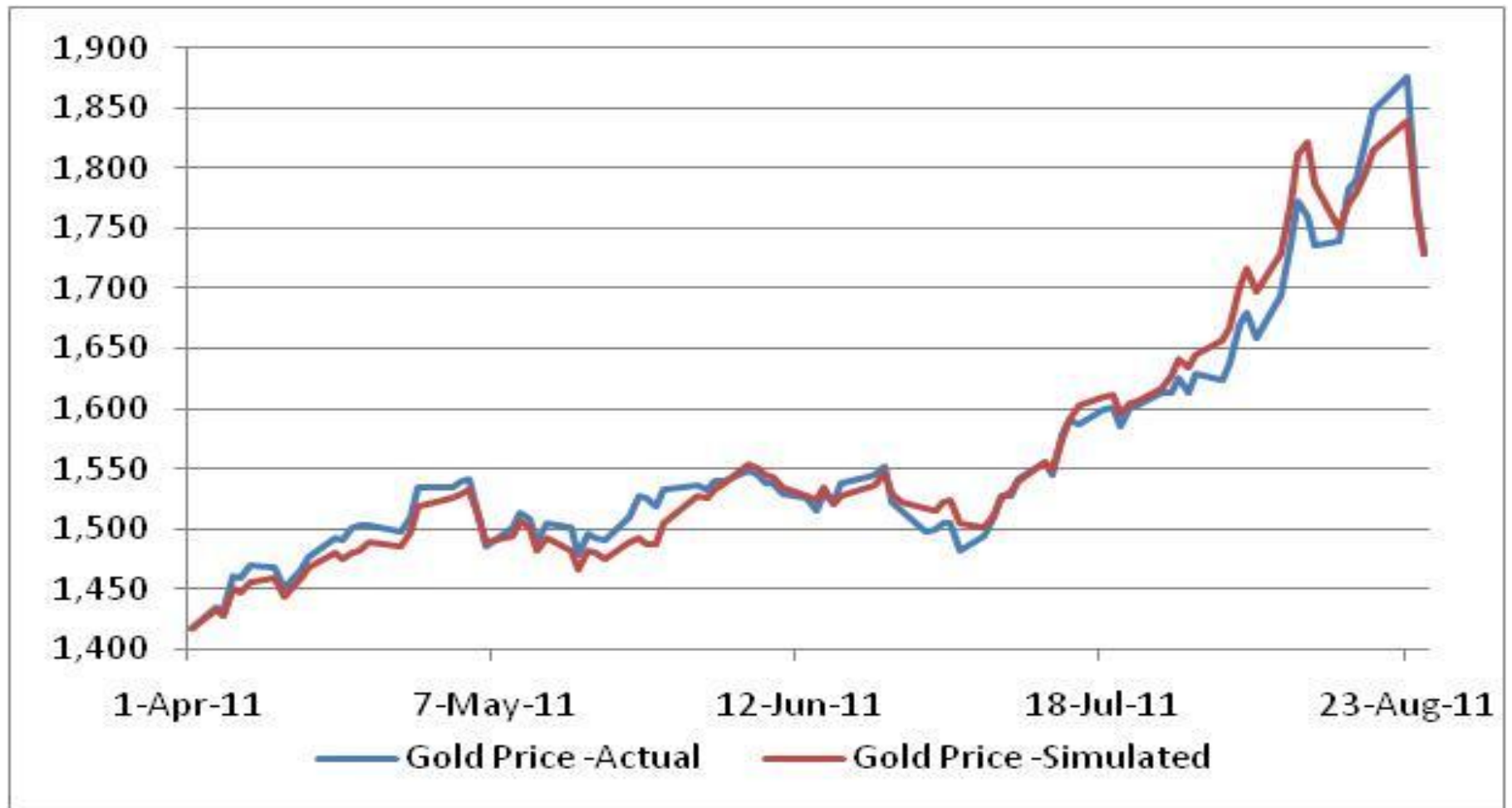
# Price



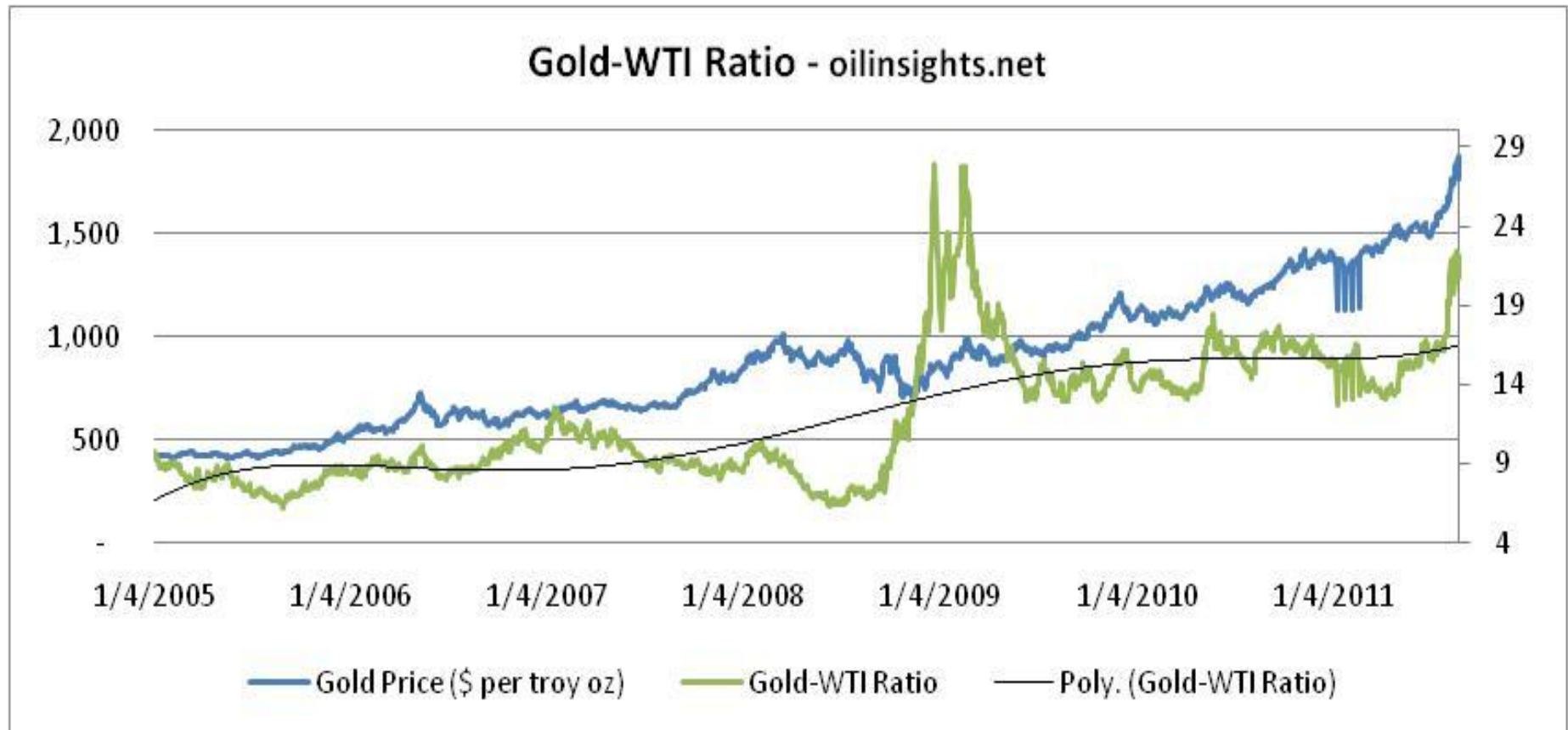
# Volatility



# Models

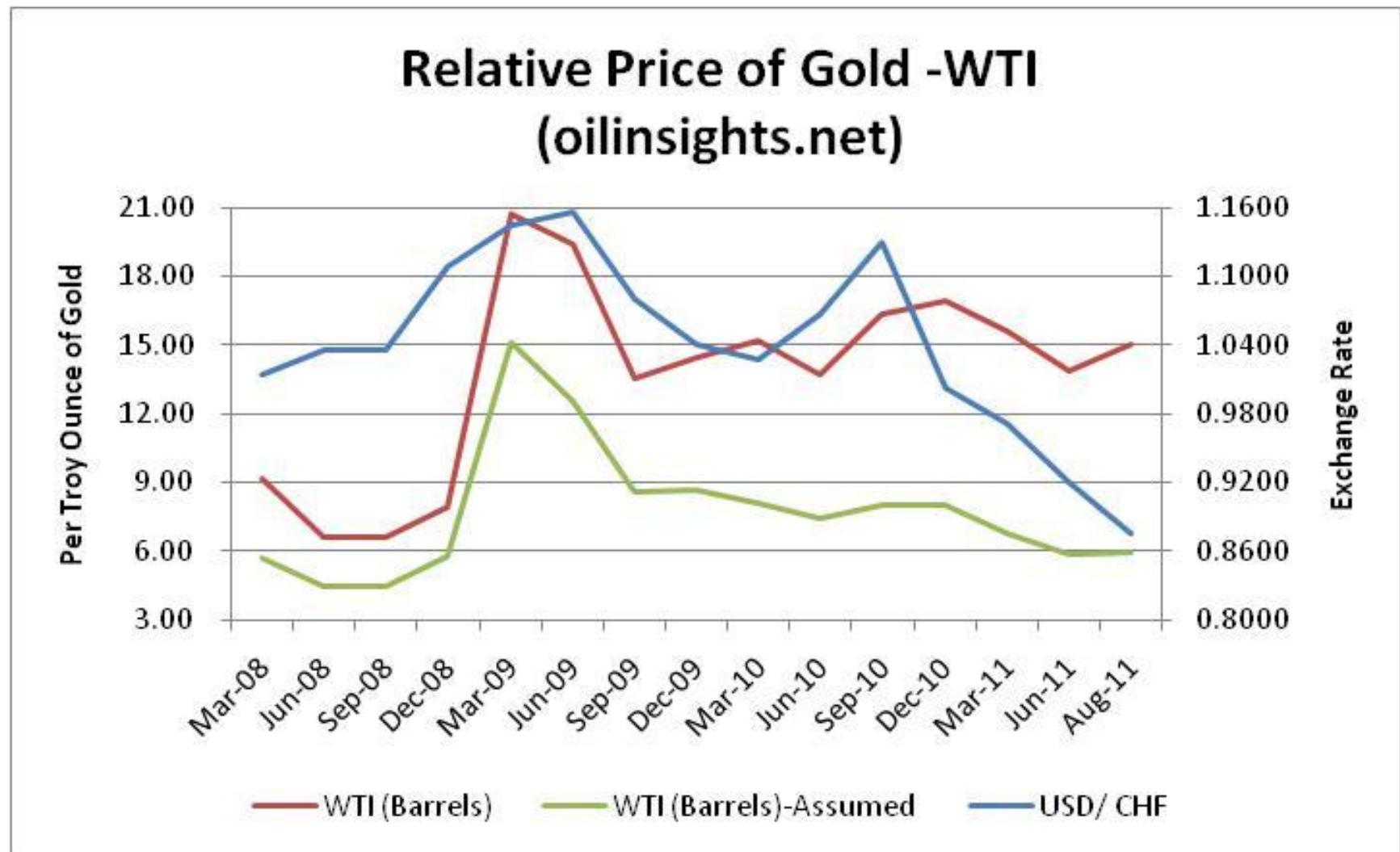


# Relative Value

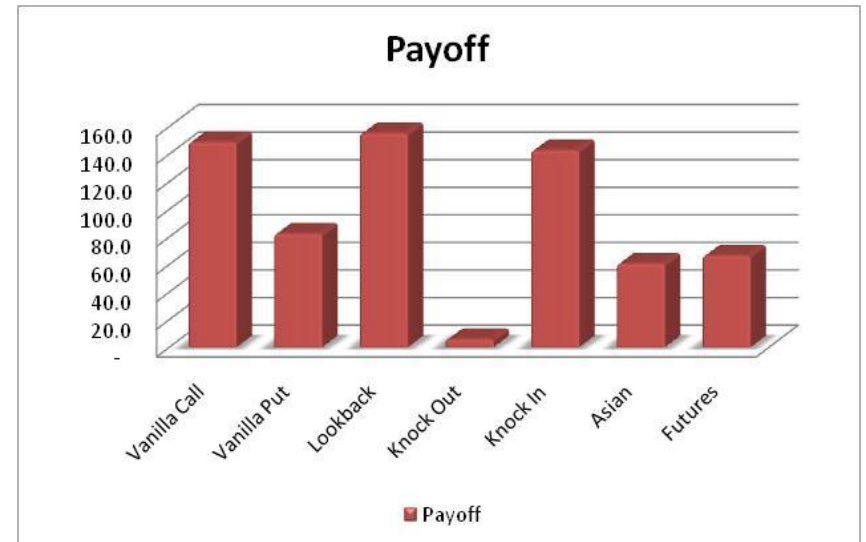
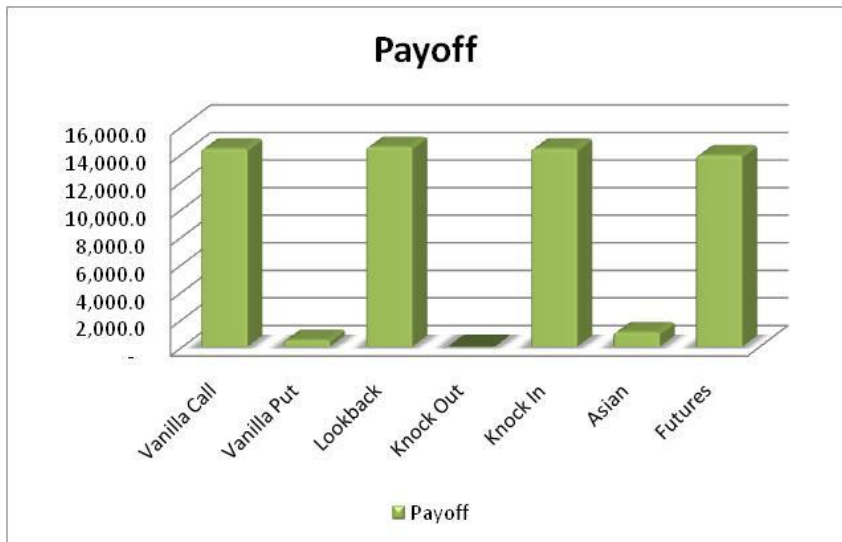
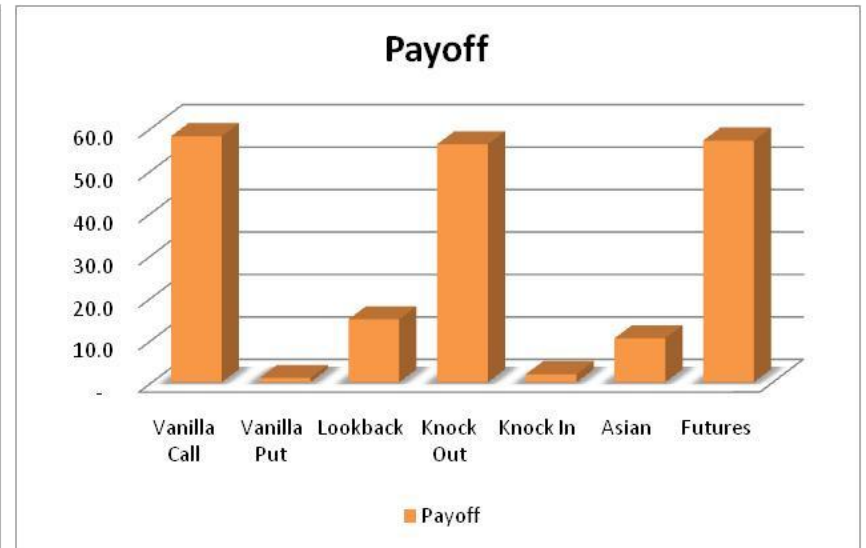
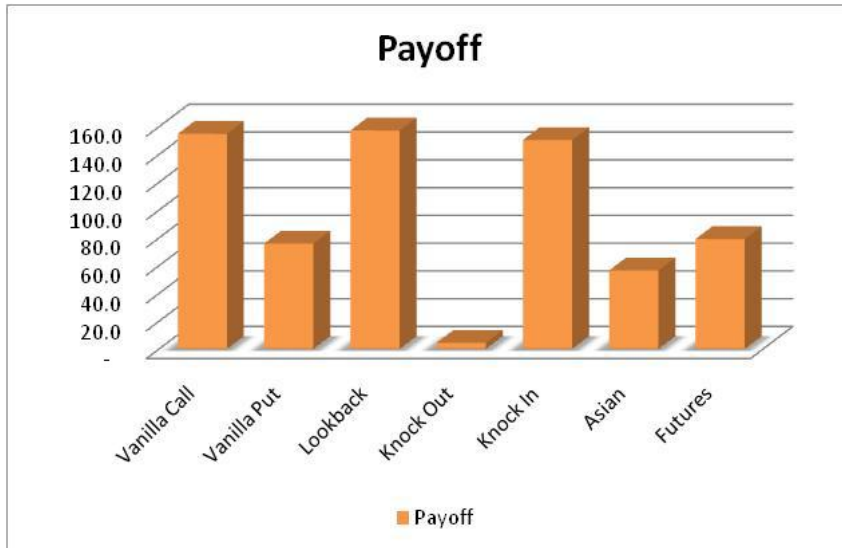




## Relative Value - II

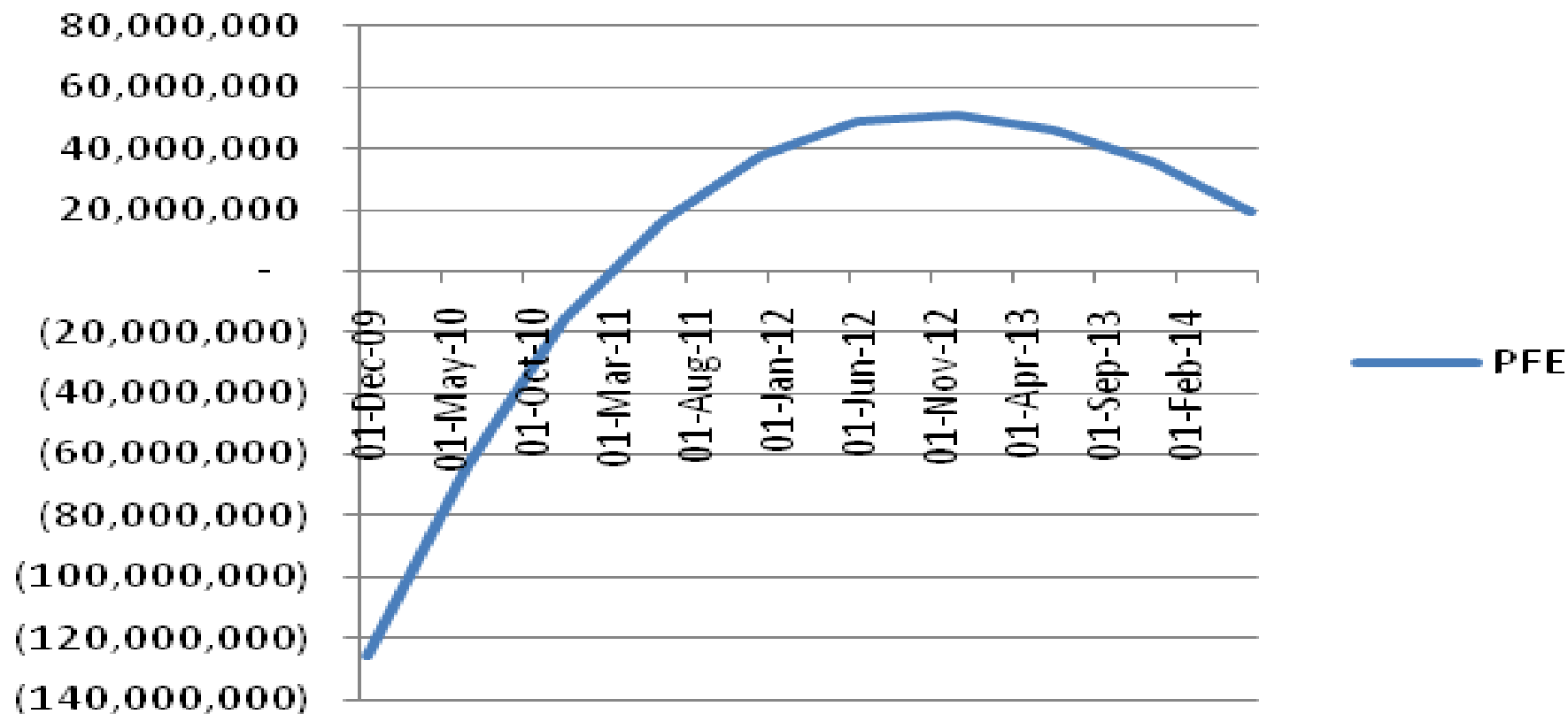


# Products & Payoffs



# Limits

## PFE



## Action Plan – Day One

### Volatility

- Trailing volatility

### Data & Trends

- Review of trends

### Value at Risk

- Understanding & Calculating Value at Risk.

### Calculating VaR

- Hands on practice

## Action Plan – Day Two

Working with  
Oil & Gold

- Fundamental models

Air Canada

- Oil

GM

- FX

Measuring  
Exposure

- What would you recommend?

# Distribution & Volatility

# Sigma

# Volatility

## **Variance ==> expectations not met**

- > Std-deviation ==> square root (Variance)
- > Dispersion, Diffusion
- > Volatility
- > Vol
- > Trading Vol
- > Implied Vol

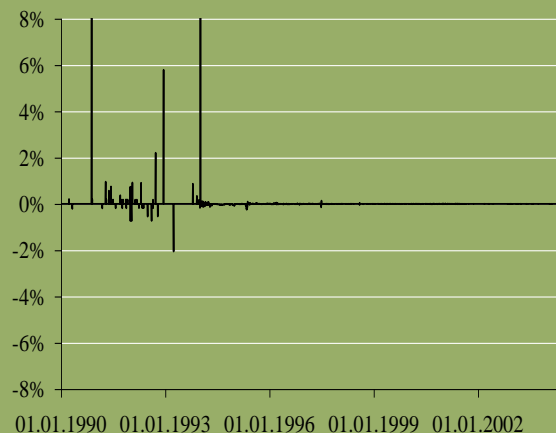
## **Optionality - Volatility - Convexity**



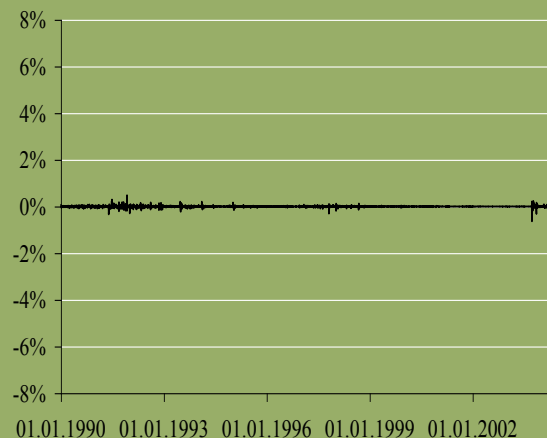
**Exchange Rate Volatility against the US Dollar of  
Selected Crisis and Non-Crisis Currencies,  
1990:01-2004:05 (Daily) - Source Ronald  
Mckinnon, Stanford University**

# Exchange Rate Volatility against the US Dollar of Selected Crisis and Non-Crisis Currencies, 1990:01-2004:05 (Daily) - Source Ronald Mckinnon, Stanford University

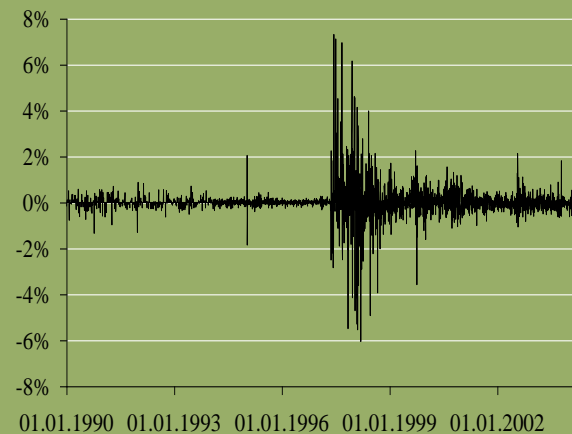
## Chinese Yuan



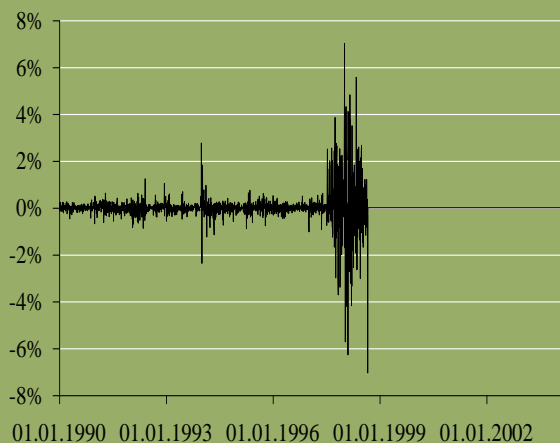
## Hong Kong Dollar



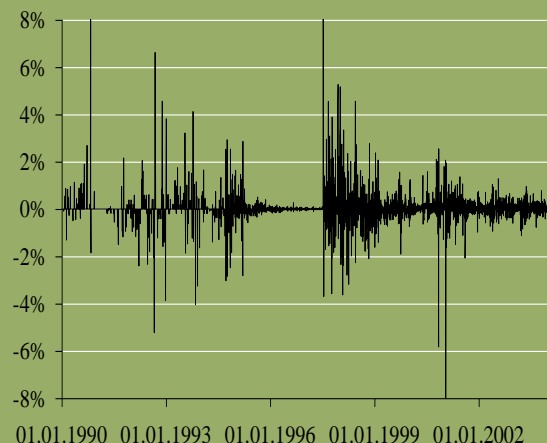
## Thai Baht



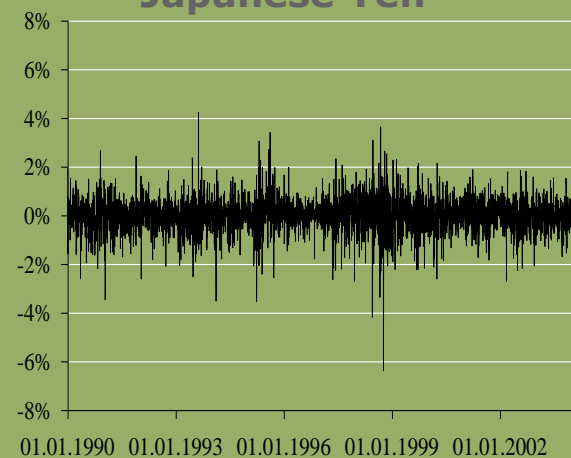
## Malaysian Ringgit



## Philippine Peso

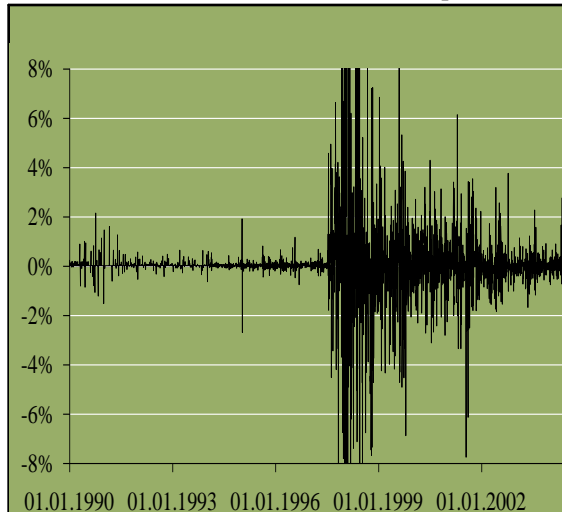


## Japanese Yen

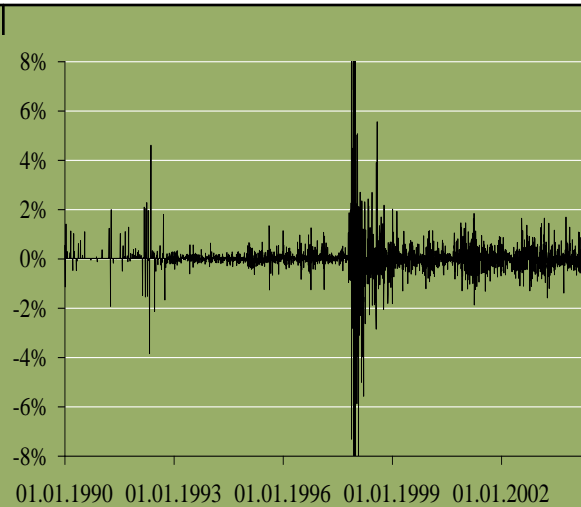


# (Continued), Exchange Rate Volatility against the US Dollar, 1990:01-2004:05 (Daily)

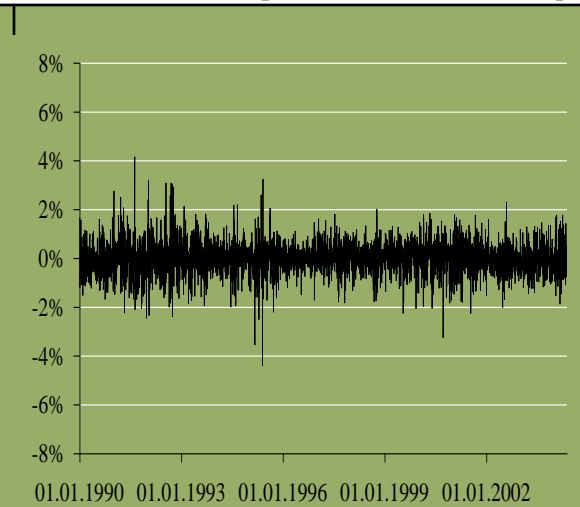
## Indonesian Rupiah



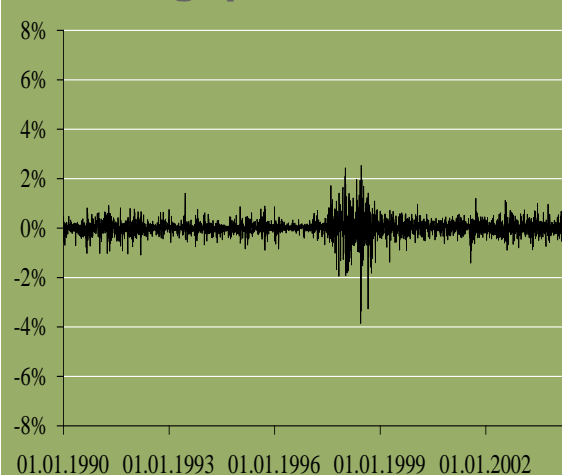
## Korean Won



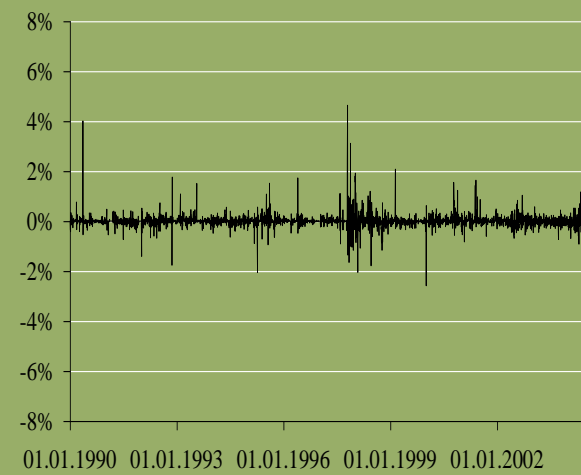
## Euro (German Mark)



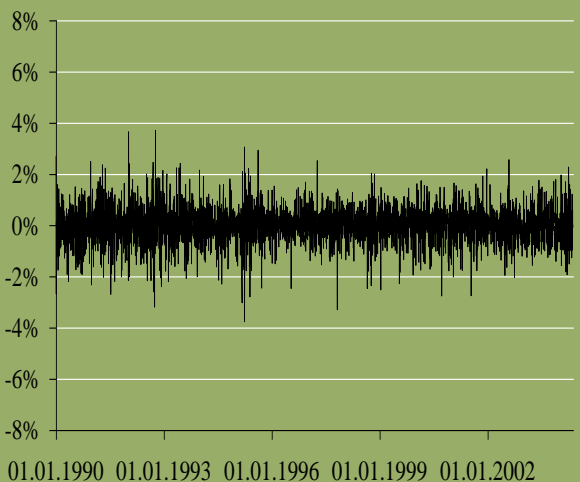
## Singapore Dollar



## New Taiwan Dollar



## Swiss Franc

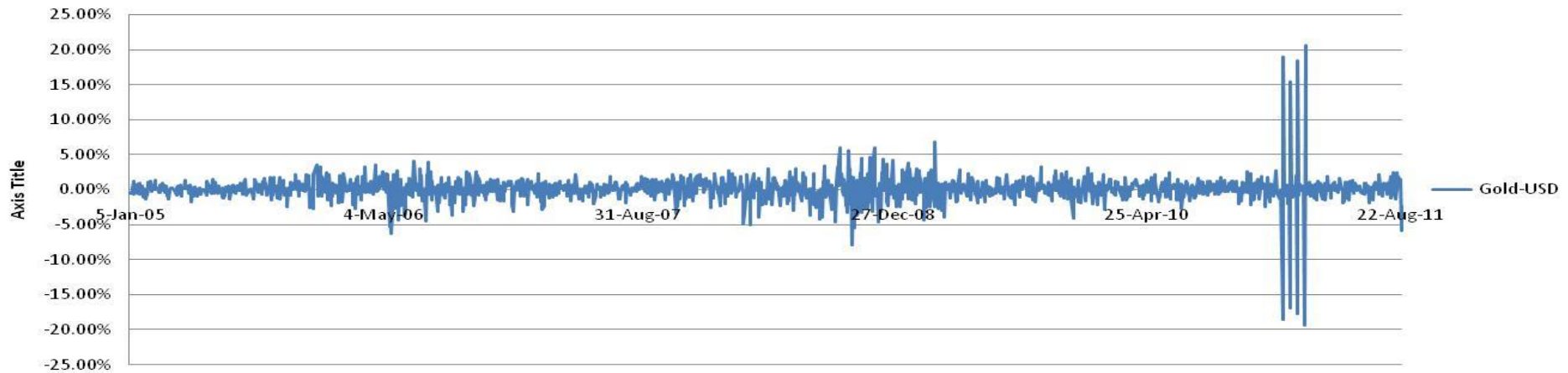


# Standard Deviations of Monthly Exchange Rate Fluctuations against the Dollar

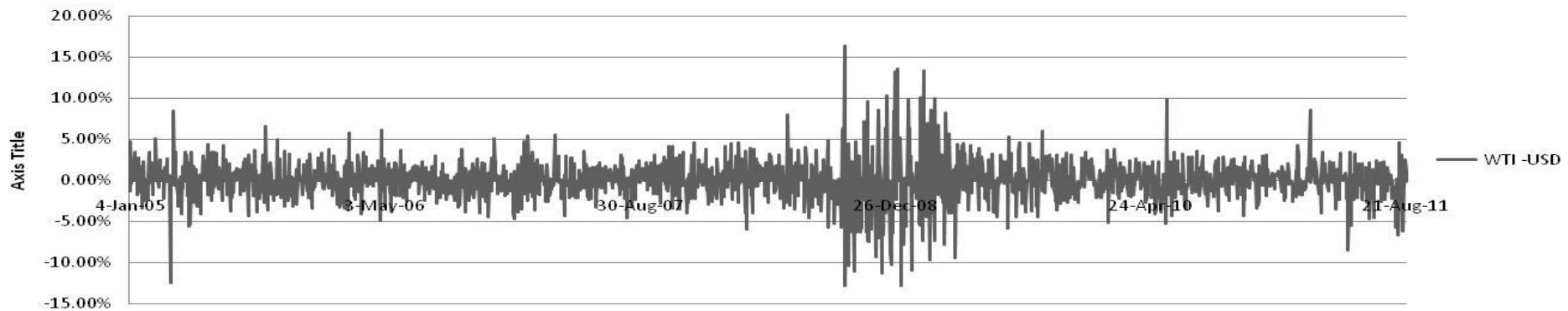
	Pre-crisis	Crisis	Post-crisis
Chinese Yuan	0.25	0.03	0.00
Hong Kong Dollar	0.08	0.07	0.11
Indonesian Rupiah	0.26	26.54	5.16
Korean Won	1.01	11.53	1.92
Malaysian Ringgit	1.06	6.69	0.00
Philippine Peso	1.19	5.25	1.67
Singapore Dollar	0.76	2.88	1.18
New Taiwan Dollar	1.01	2.63	1.35
Thai Baht	0.43	8.88	1.60
Japanese Yen	3.66	3.64	2.39
Euro (Deutsche Mark)	2.20	2.33	2.58
Swiss Franc	2.62	2.60	2.54

Data source: IMF: IFS, Ronald Mckinnon, Stanford University

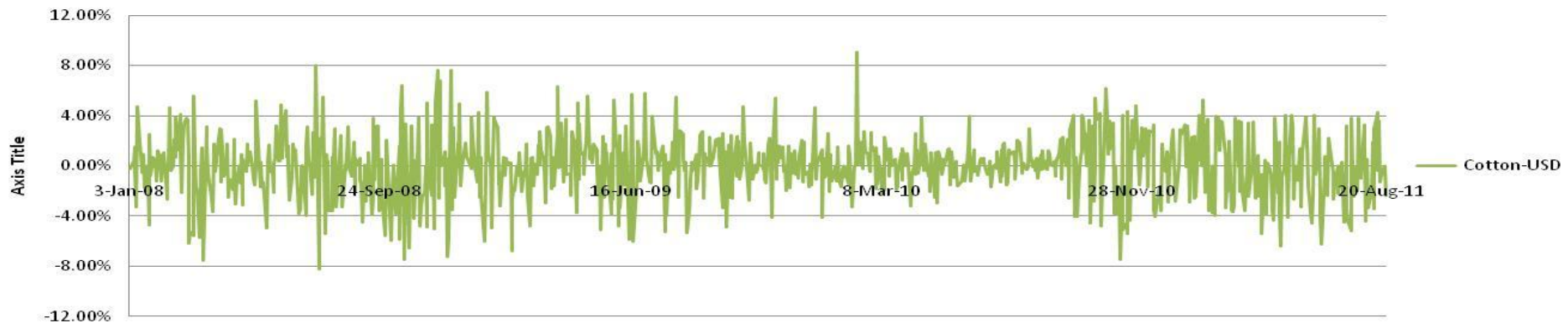
Change in the Value of Gold (US Dollar Amount)- oilinsights.net



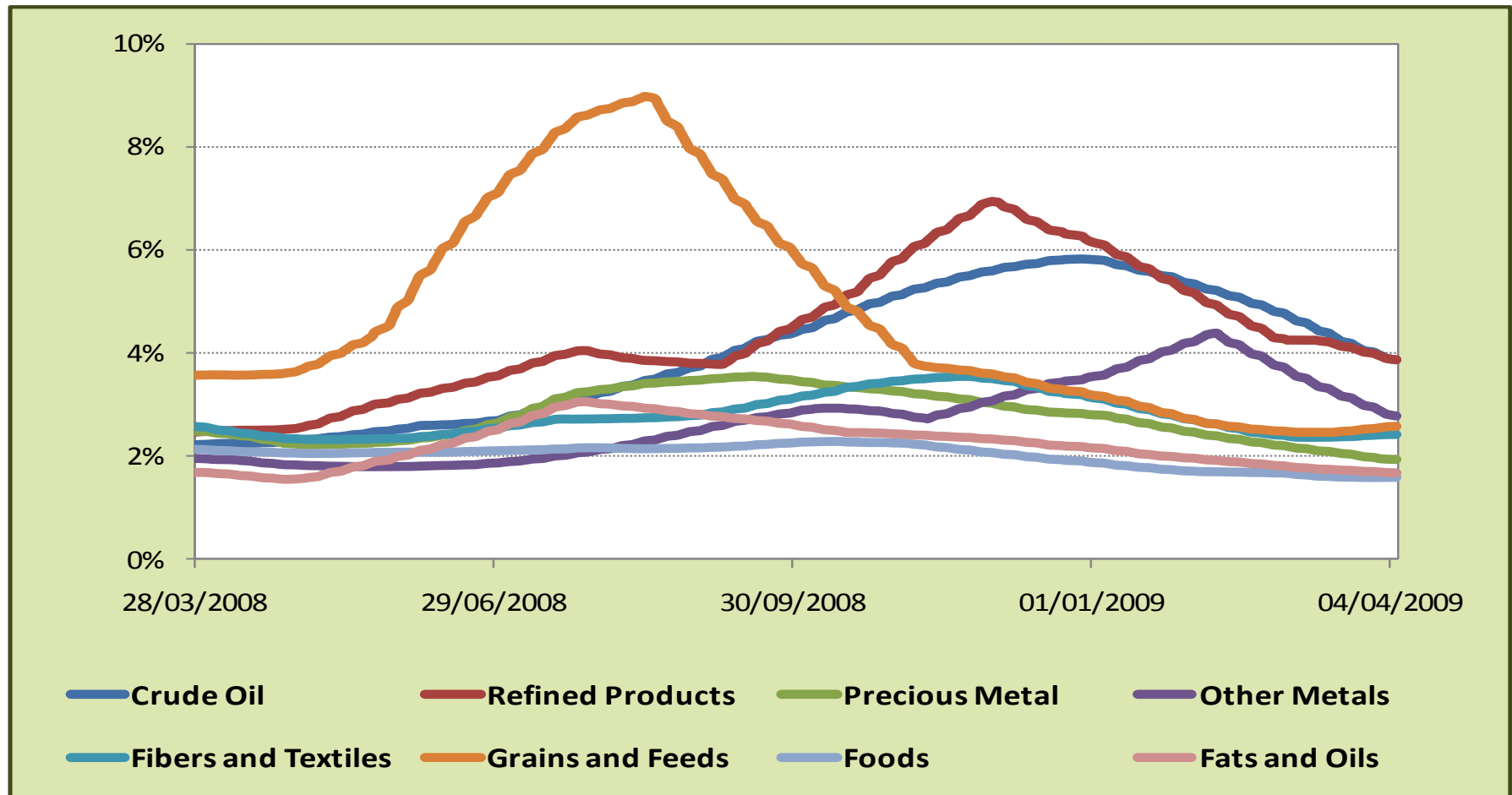
Change in the Value of WTI (US Dollar Amount)- oilinsights.net



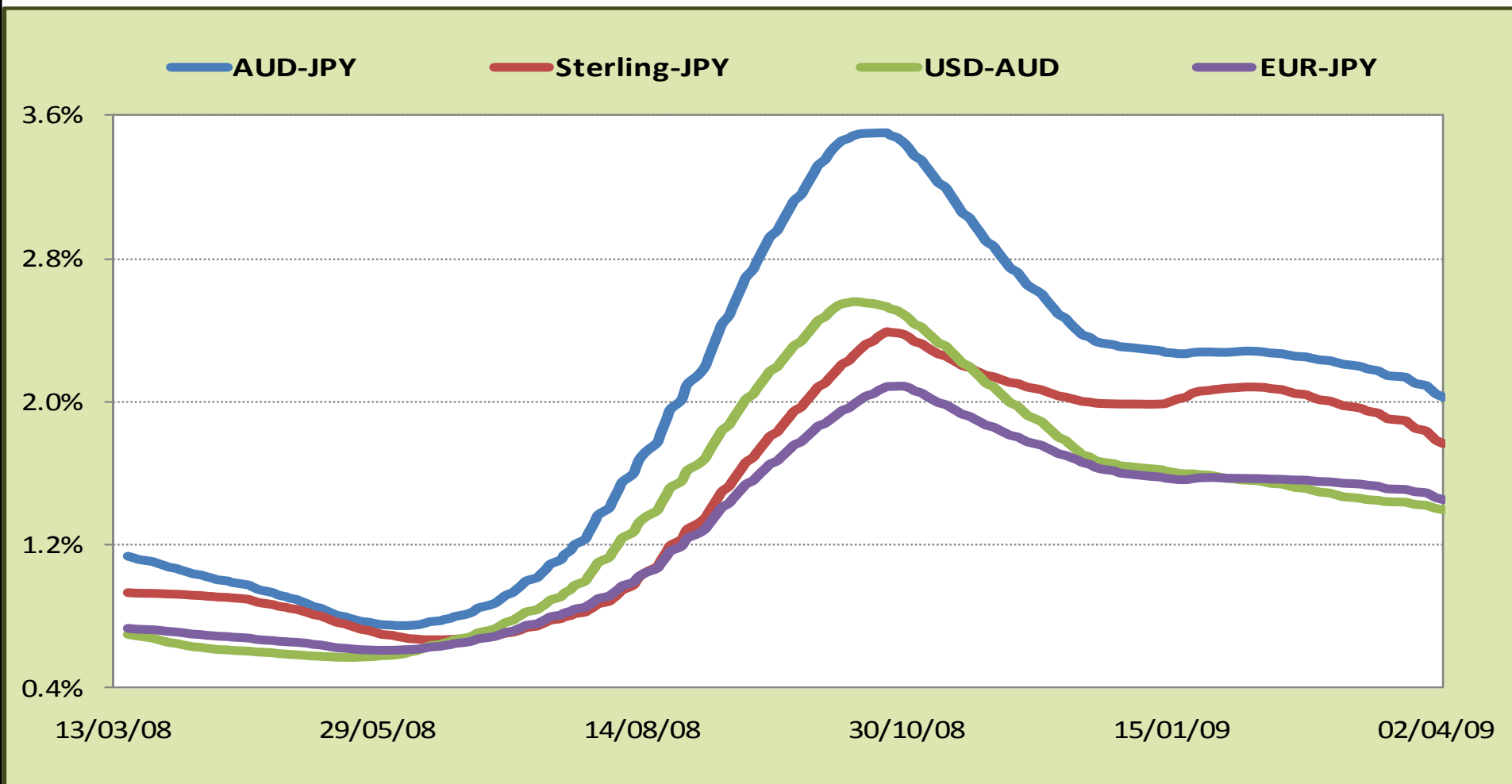
Change in the Value of Cotton (US Dollar Amount)- oilinsights.net



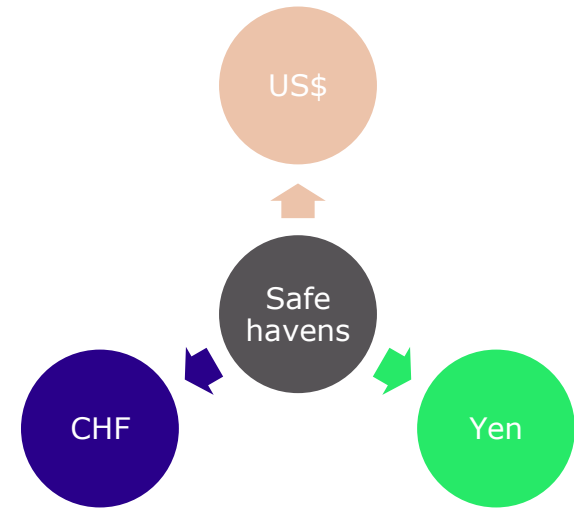
# Vol Trend



# Lagged effects



# Flight to Safety cycle

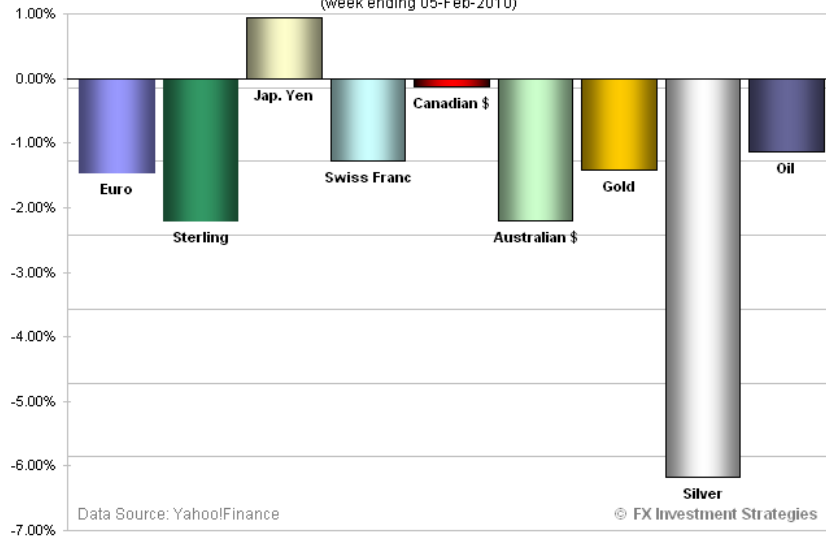




# Flight to Safety - II

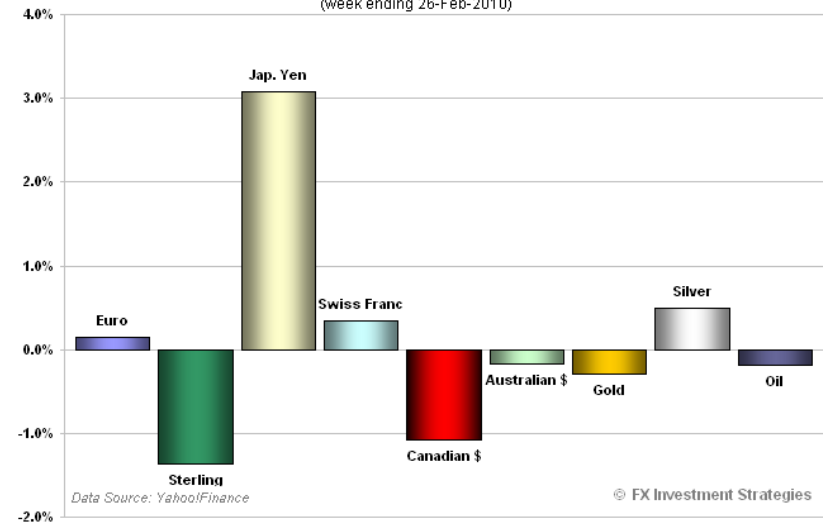
Weekly FX & Commodity Market Barometer

(week ending 05-Feb-2010)



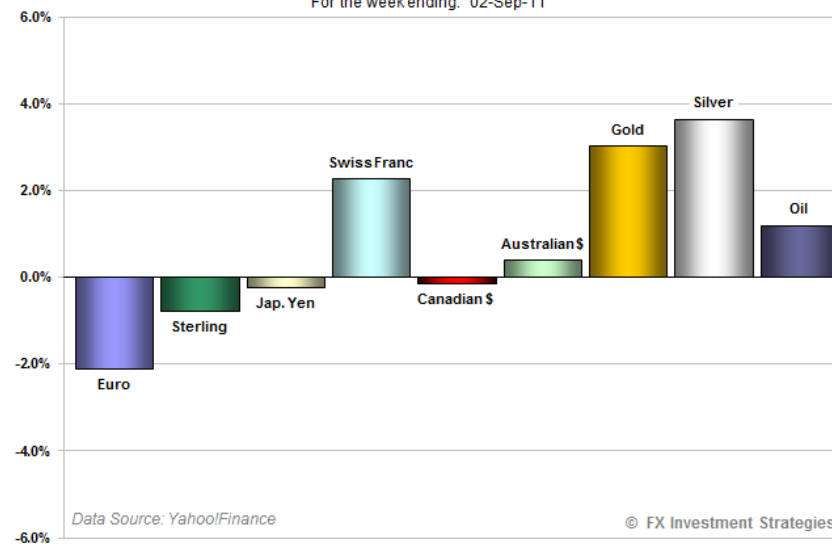
Weekly FX & Commodity Market Barometer

(week ending 26-Feb-2010)



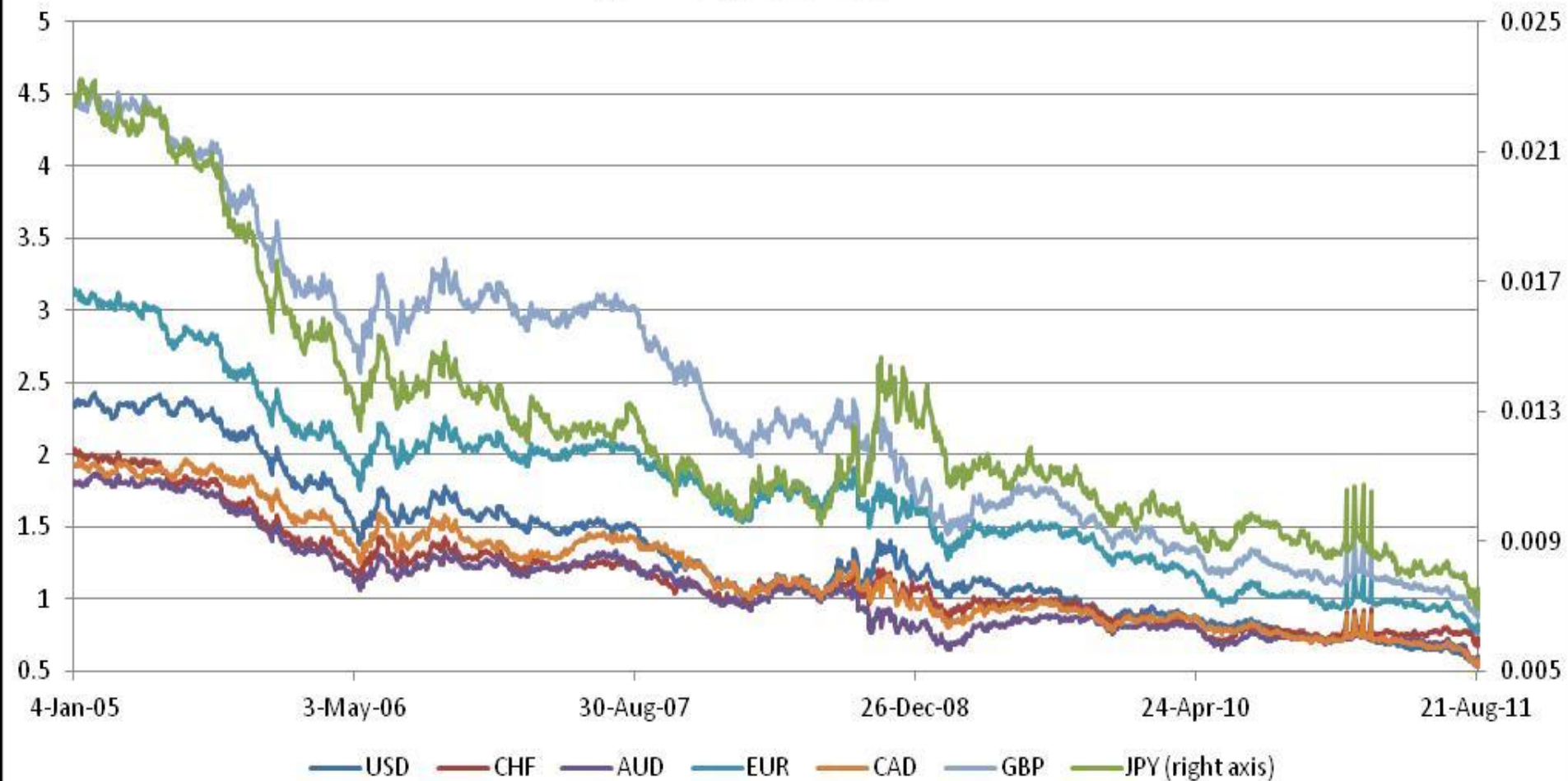
Weekly FX & Commodity Market Barometer

For the week ending: 02-Sep-11



# Thought Experiments?

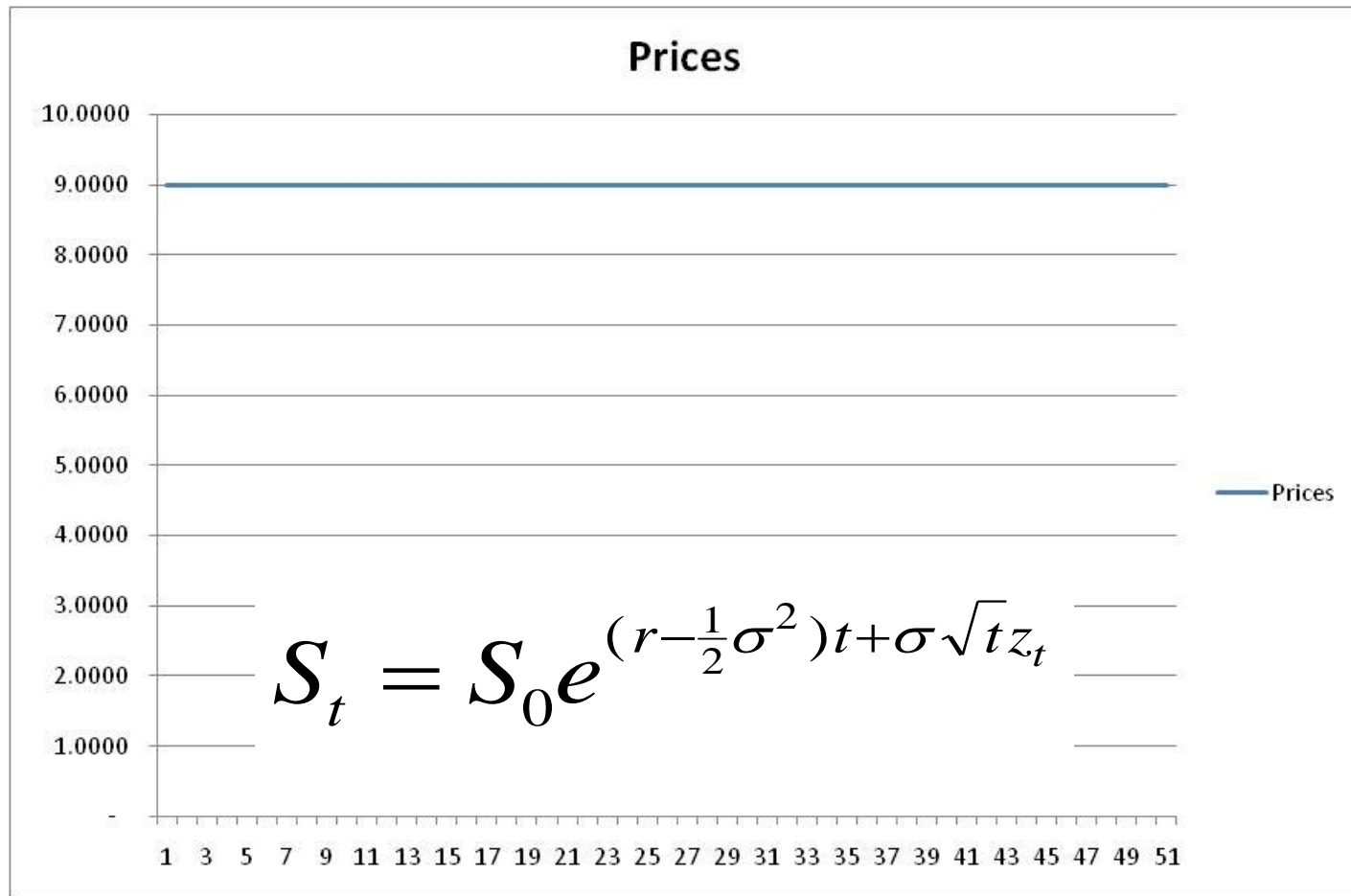
# How many troy ounces of Gold can 1000 units of currency buy (oilinsights.net)



# Volatility Drag?

$\text{Vol} = ?, r = ?$

Vol = 0, r = 0



$$S_t = S_0 e^{(r - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}z_t}$$

Vol = 0, r = 1



$$S_t = S_0 e^{(r - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}z_t}$$

Vol = 0, r = ?



$$S_t = S_0 e^{(r - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}z_t}$$



Vol = ?,  $r = 1$



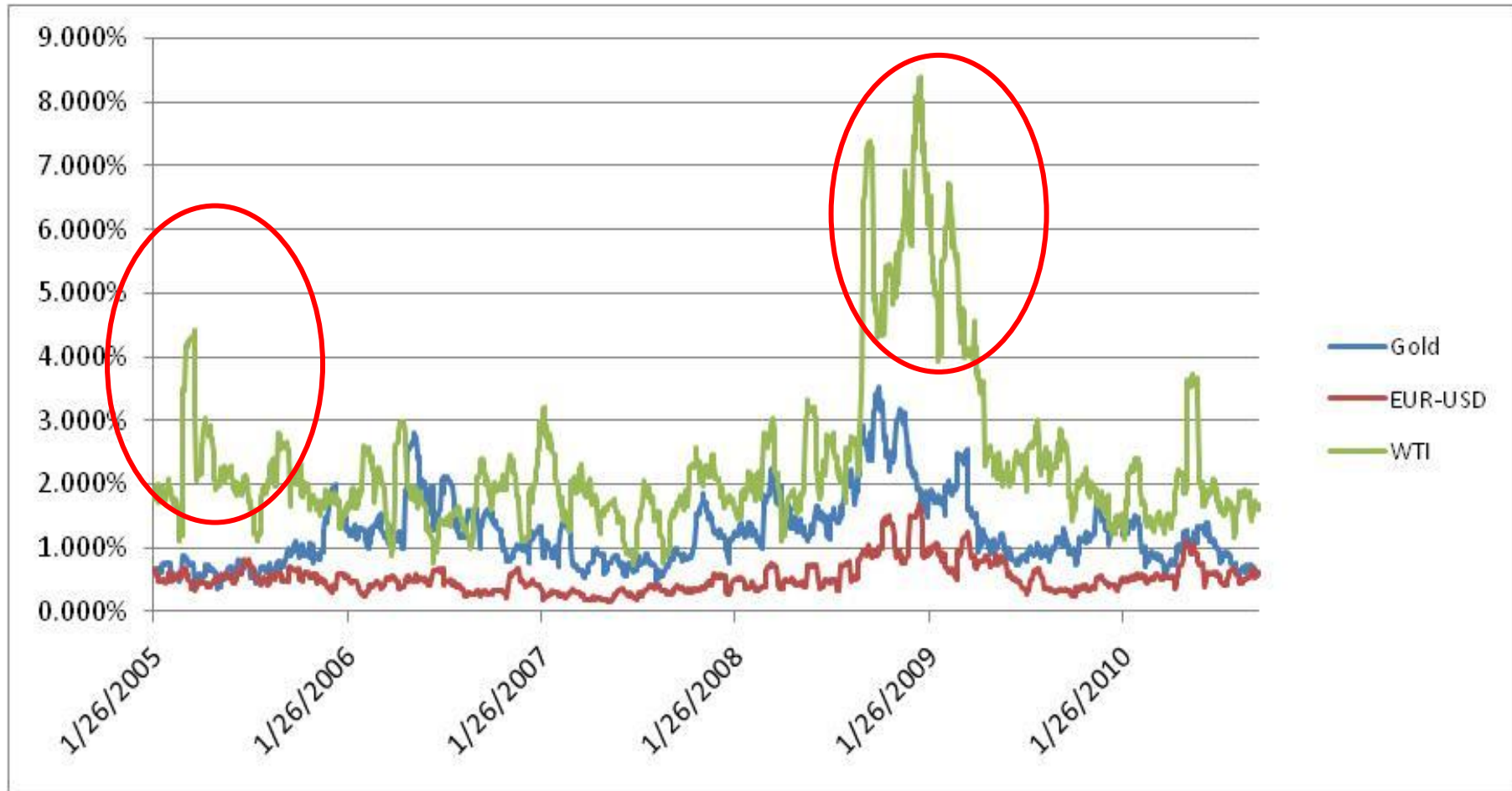
$$S_t = S_0 e^{(r - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}z_t}$$

Vol = ?,  $r = 0$

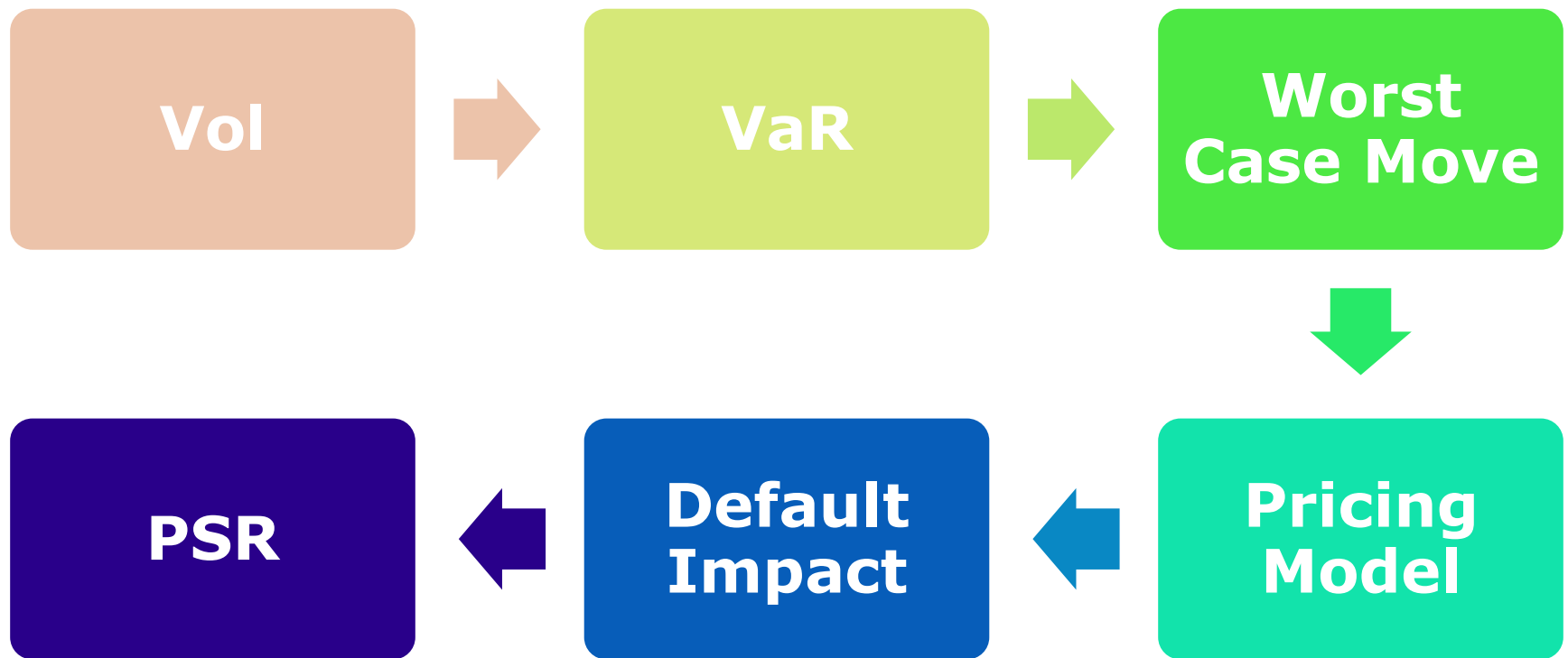


$$S_t = S_0 e^{(r - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}z_t}$$

# Trailing Volatilities



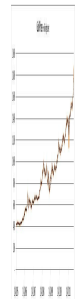
# Thought experiment - PSR Process



# Framing the problem – What is long term?



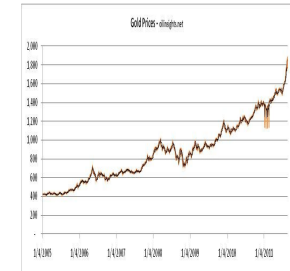
# Framing the problem – What is long term?



**Historical Gold Prices - 1792 - 2010**  
oilinsights.net



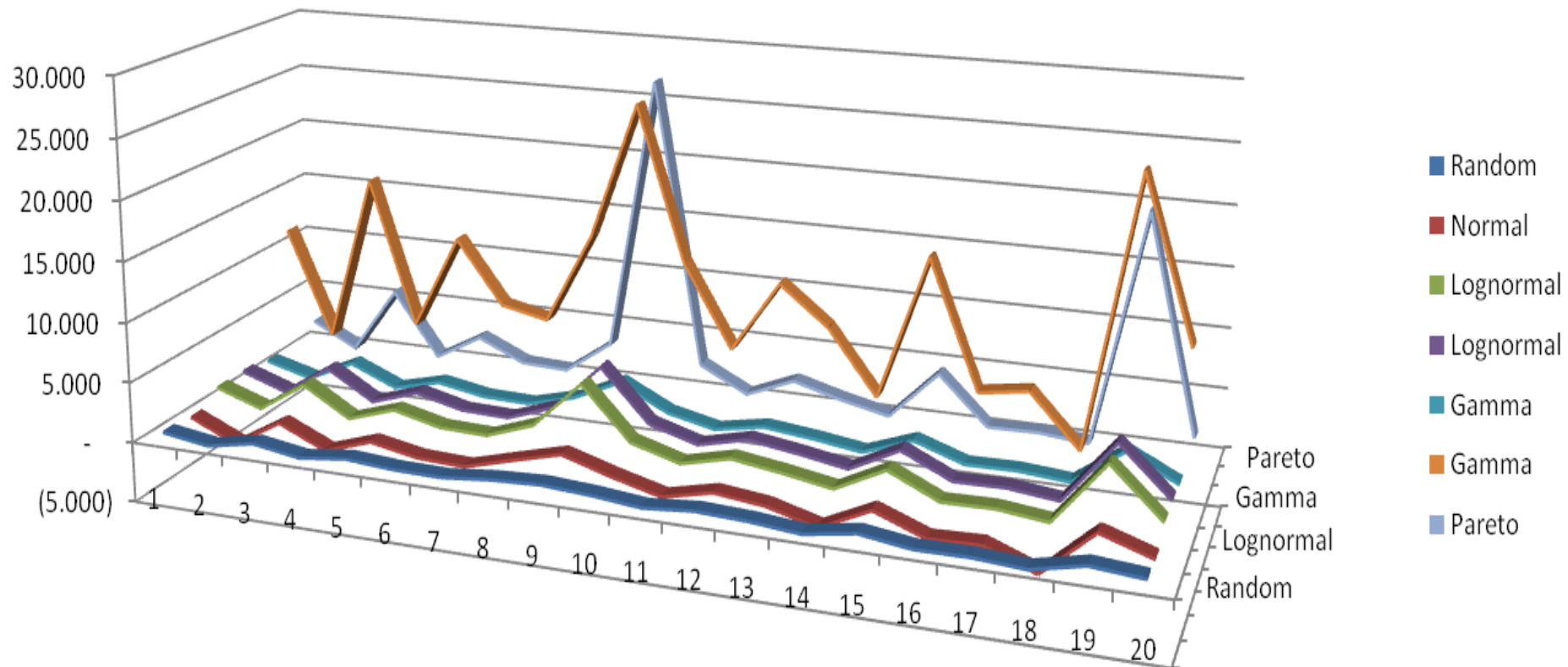
# Framing the problem – What is long term?



Historical Gold Prices - 1967 - 2011  
oilinsights.net



# Distributions - Simulations





**ALL MODELS ARE WRONG  
SOME MODELS ARE MORE  
USEFUL THAN OTHERS**

# Sigma $a,b$

# Questions

**What is the probability that margins will decrease in any month over the next quarter, the next half year, or the next full year?**

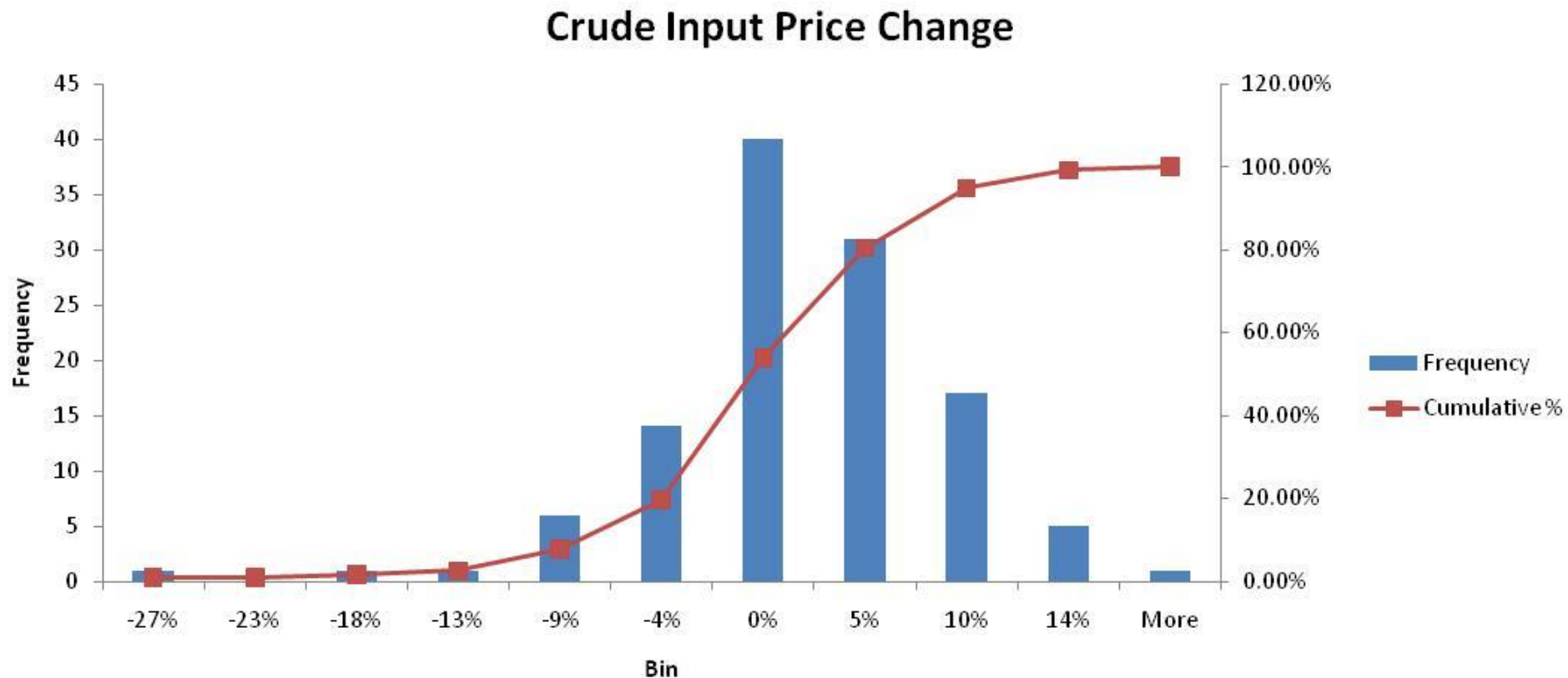
**What is the range of these projected reductions?**

**What is the worst case reduction in any month over the next 12 months?**

**What is the likely reduction in any month over the next 12 months?**

# Value @ Risk

# Monthly Crude Oil Change – The Oil Refinery Case



# VaR and Margins

## Application Questions

# Questions

**What is the probability that margins will decrease in any month over the next quarter, the next half year, or the next full year?**

**What is the range of these projected reductions?**







# Questions

**What is the worst case reduction in any month over the next 12 months?**

**What is the likely reduction in any month over the next 12 months?**

More questions?

**What is the probability that gross margins will shrink below the minimum profitability threshold?**

**What is the probability that gross margins will turn negative?**

# More questions?

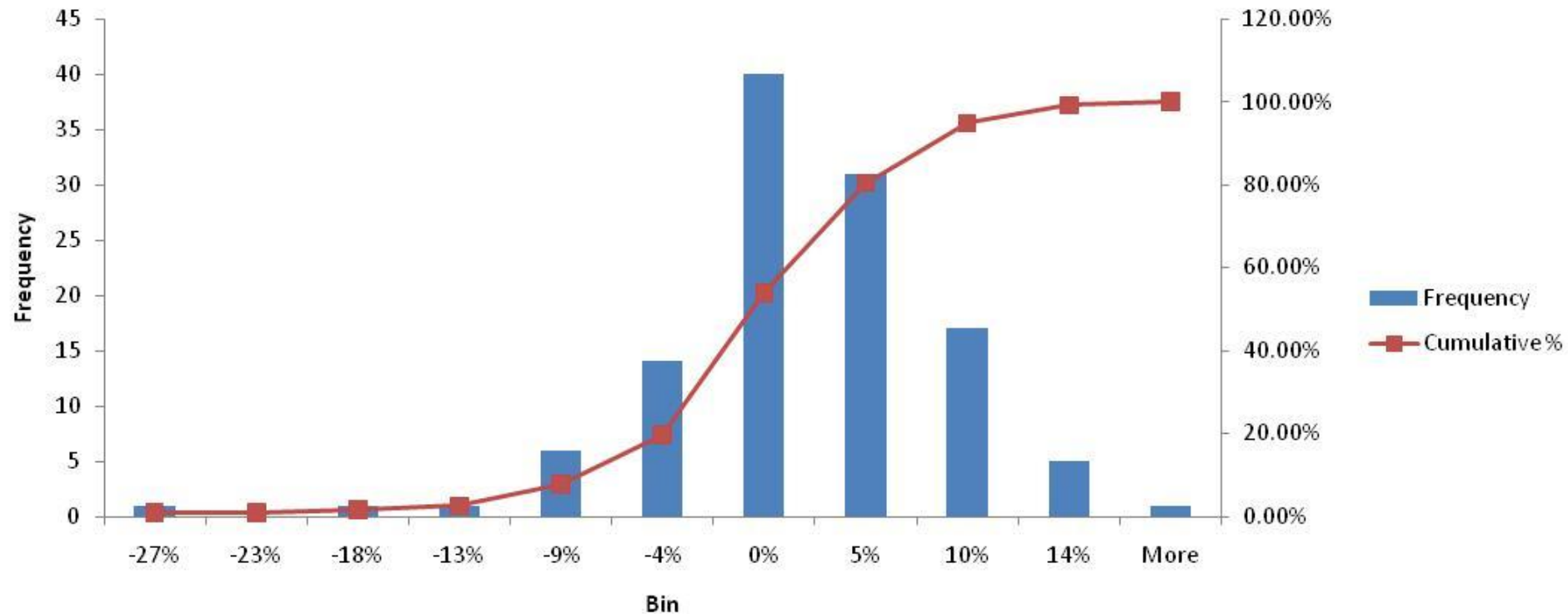
**What is the likely expected gross margin number at current price volatility levels?**

**How will this number change if volatility moves by a percentage point?**

**By how much does a dollar change in prices change the expected margin number?**

# Monthly Crude Oil Change

## Crude Input Price Change

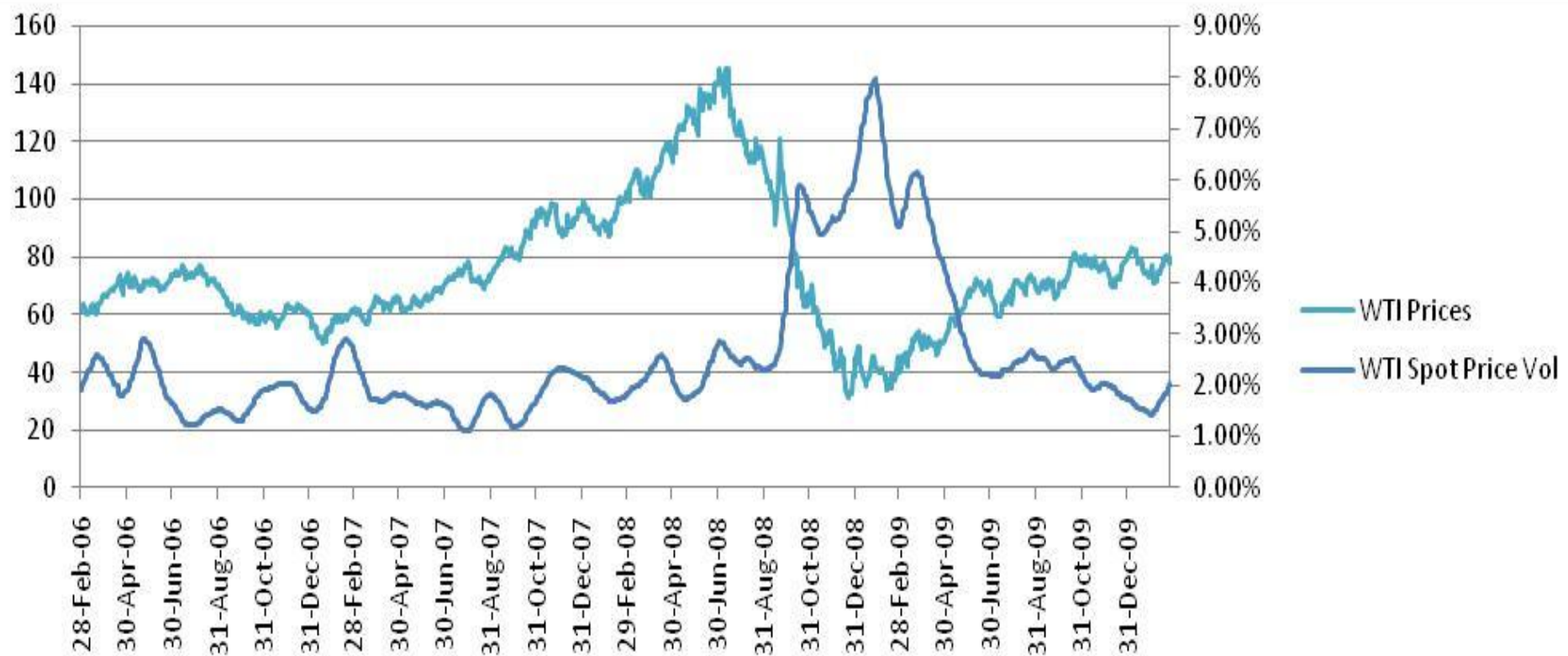




# Integration - Example

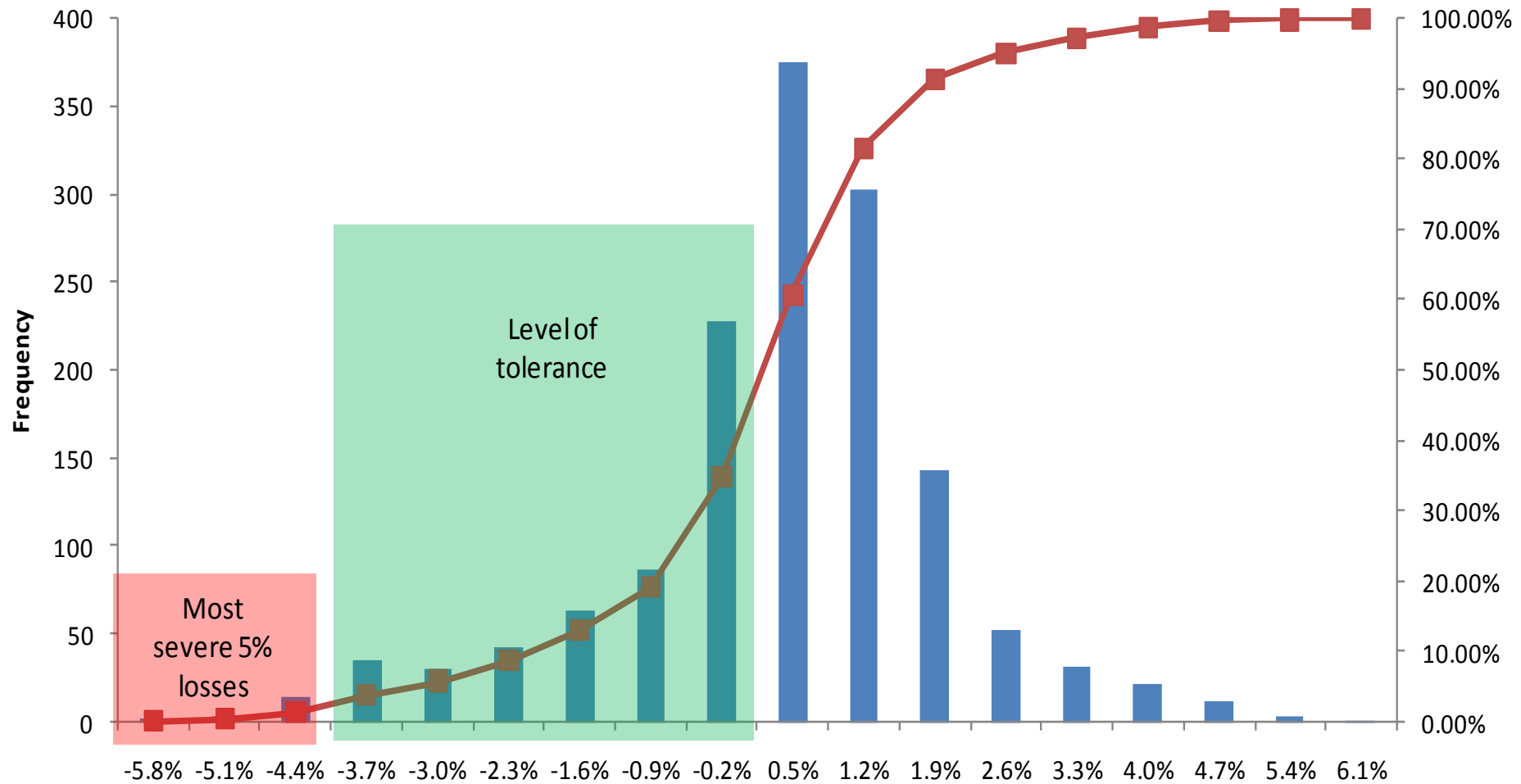
		Input	Input	Inventory	Inventory
		Price	Price	Losses	Losses
Odds	Percentile	Shock-low	Shock-high	Low	High
	99%	145	364	12,310,771	30,885,105
1%	99%	145	364	12,310,771	30,885,105
11%	90%	80	200	6,781,826	17,014,160
18%	85%	65	162	5,484,689	13,759,917
25%	80%	52	132	4,453,765	11,173,548
33%	75%	42	105	3,569,324	8,954,674
43%	70%	33	82	2,775,068	6,962,056
52%	66%	26	64	2,182,708	5,475,951
67%	60%	16	40	1,340,684	3,363,492
82%	55%	8	20	664,986	1,668,308
96%	51%	2	4	132,662	332,820

# Crude Volatility

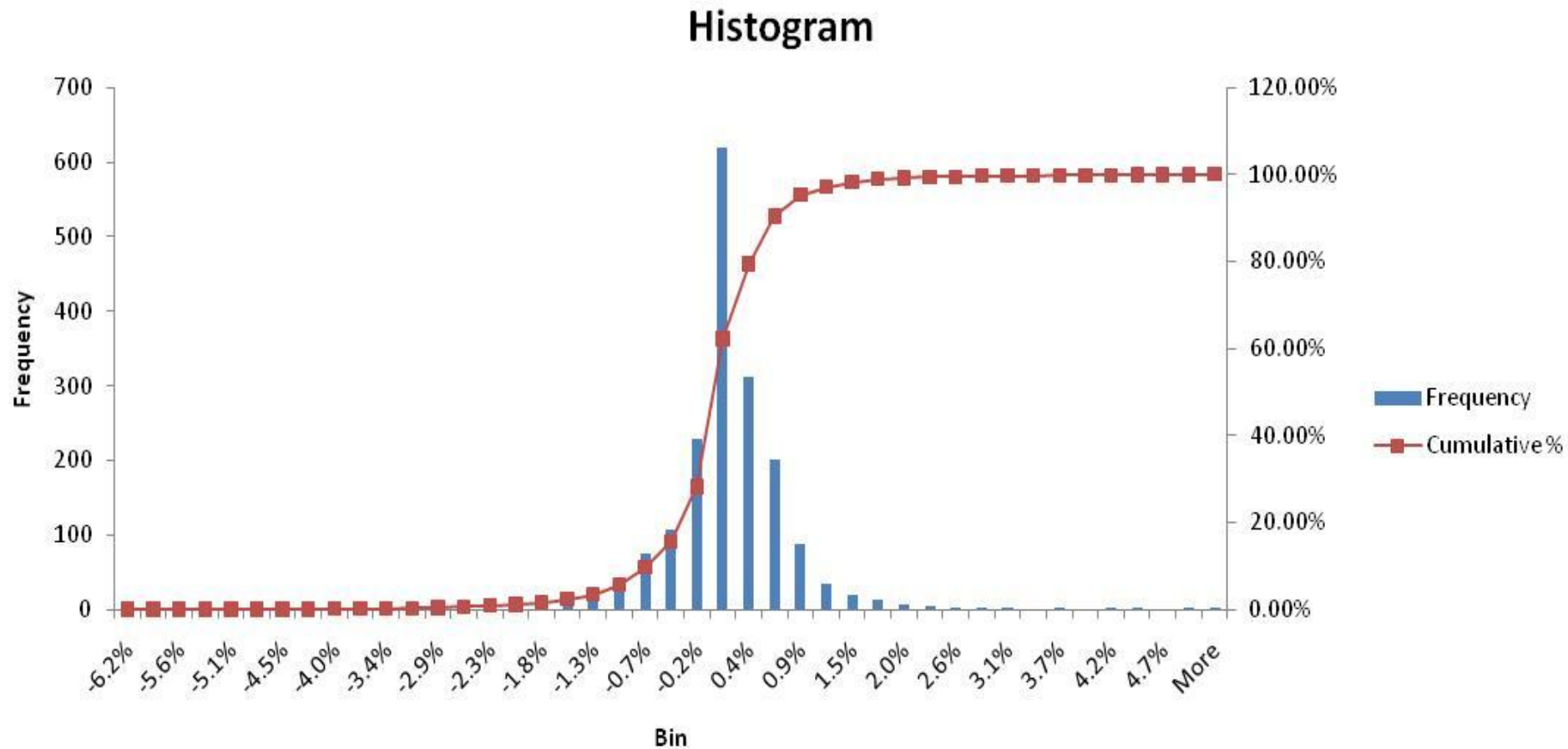




# VaR

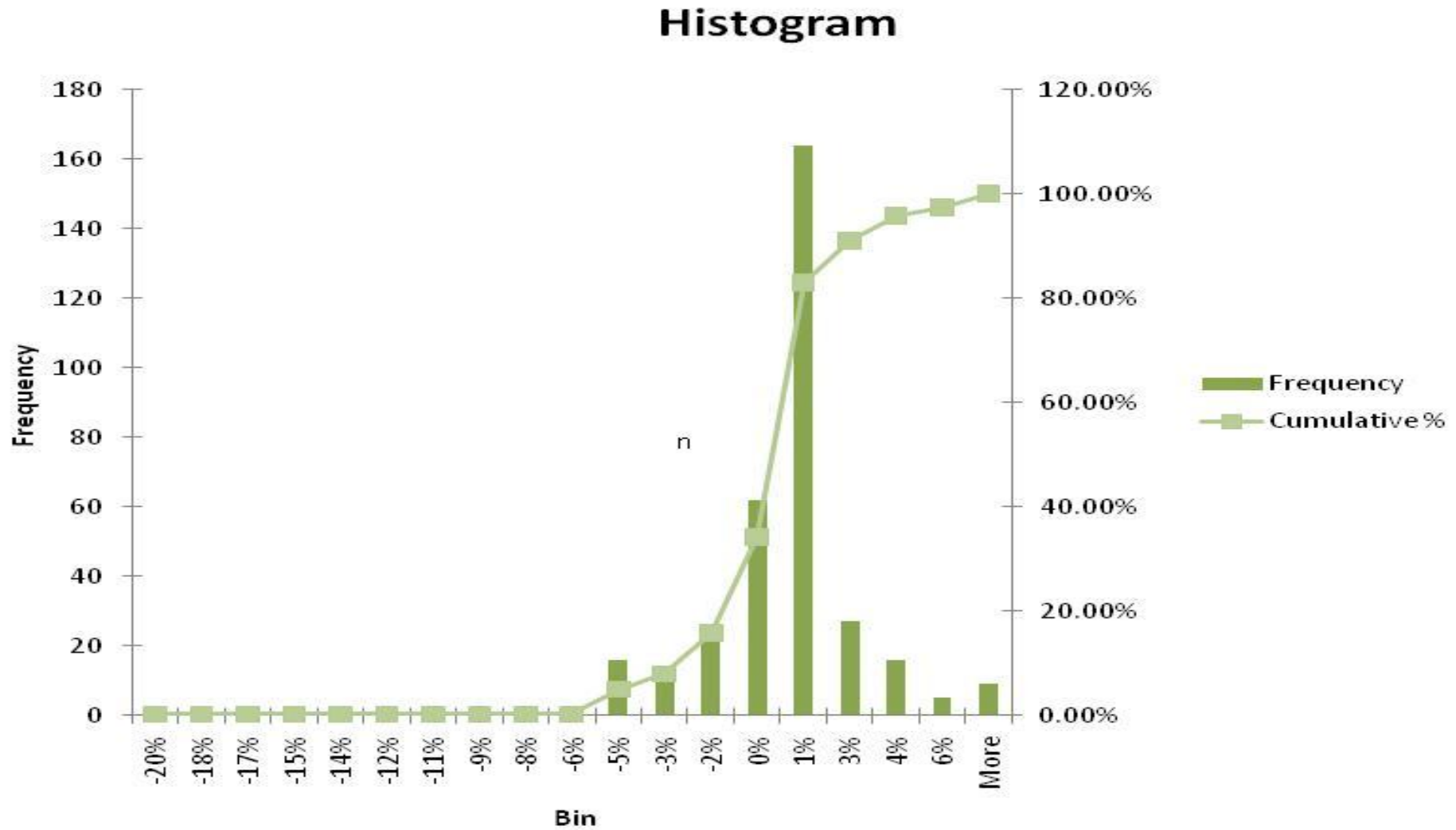


# AUD/USD Exchange Rate



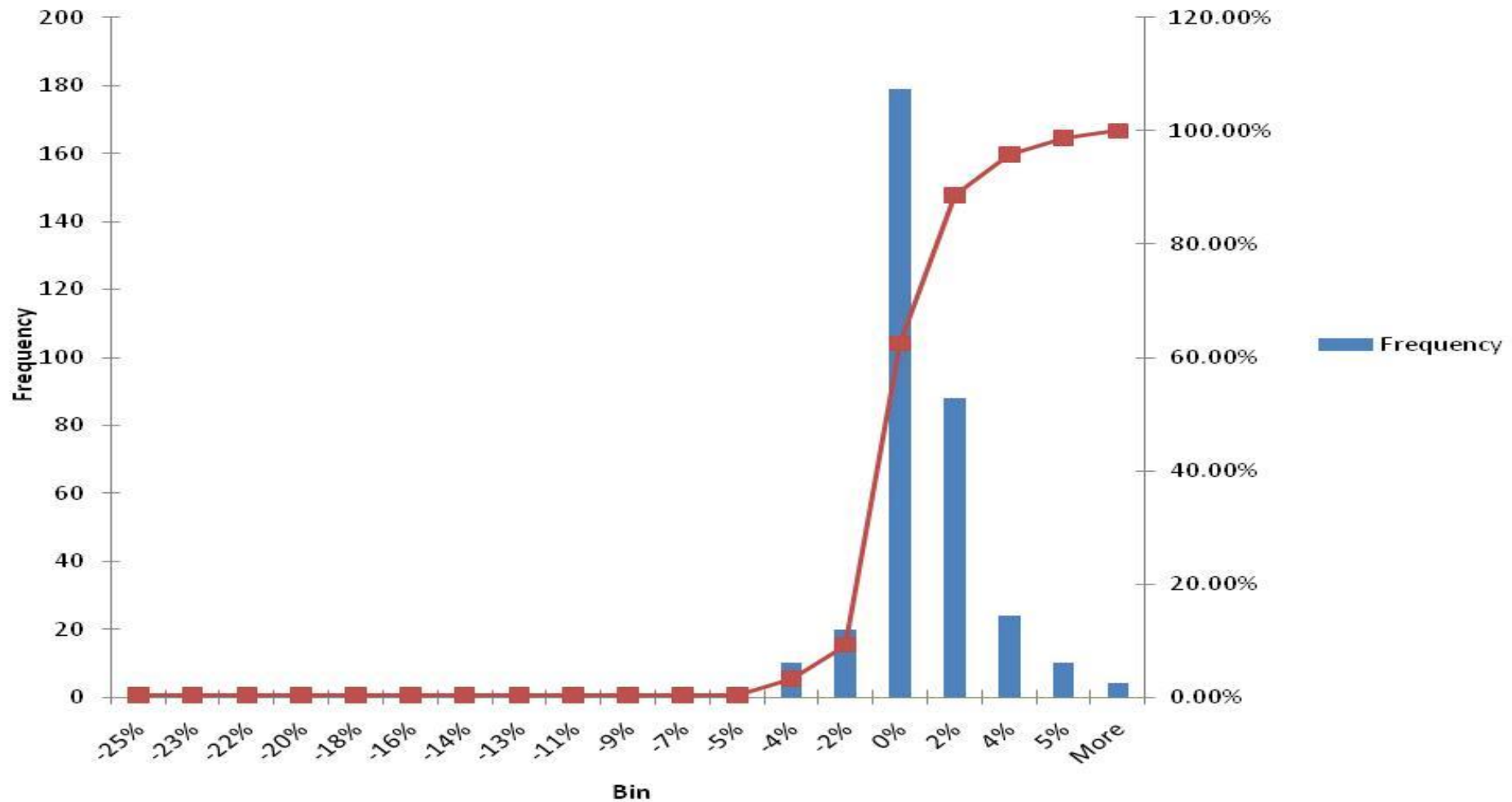
# VaR Case

# Portfolio A



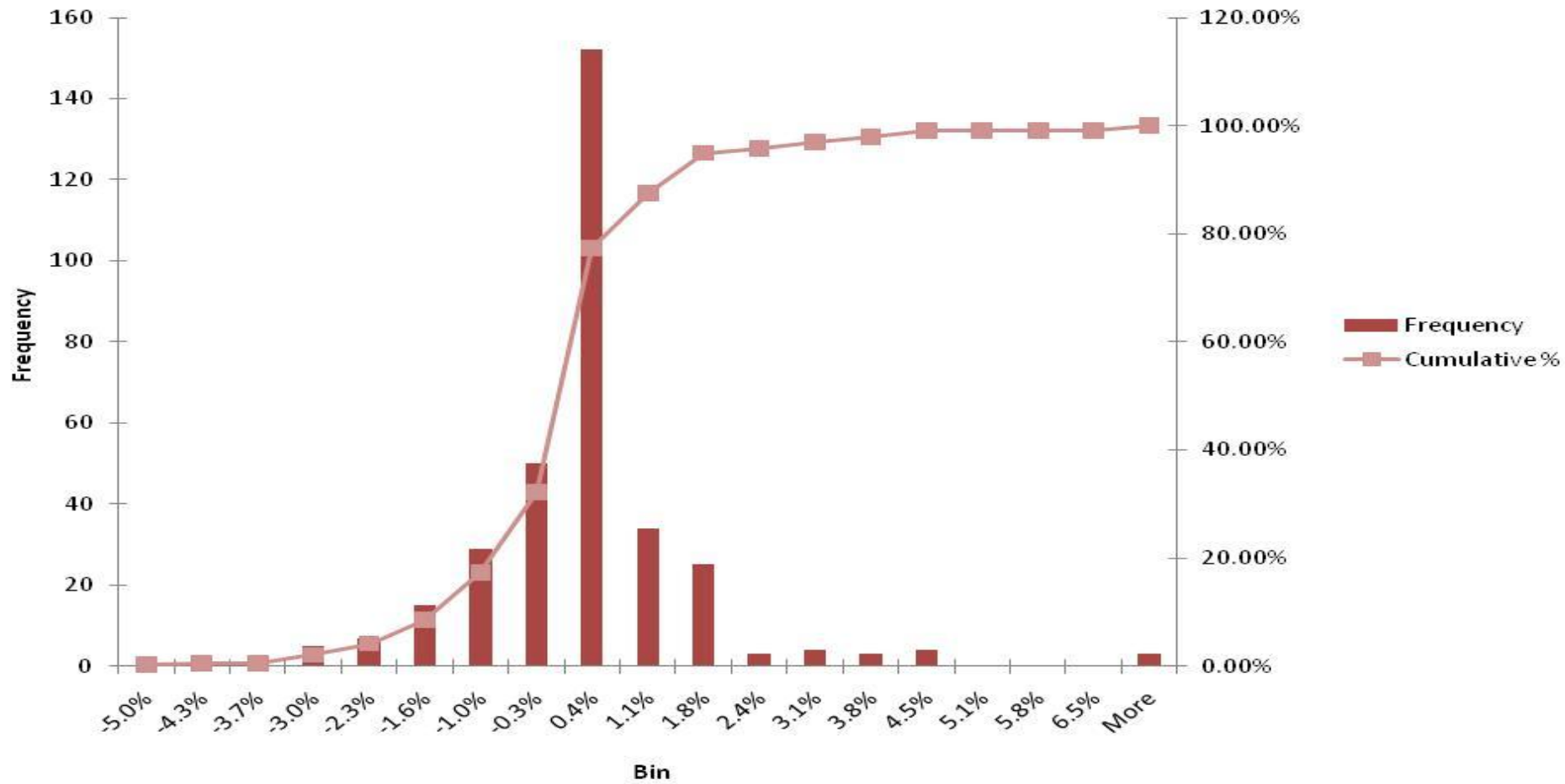
# Portfolio B

## Histogram



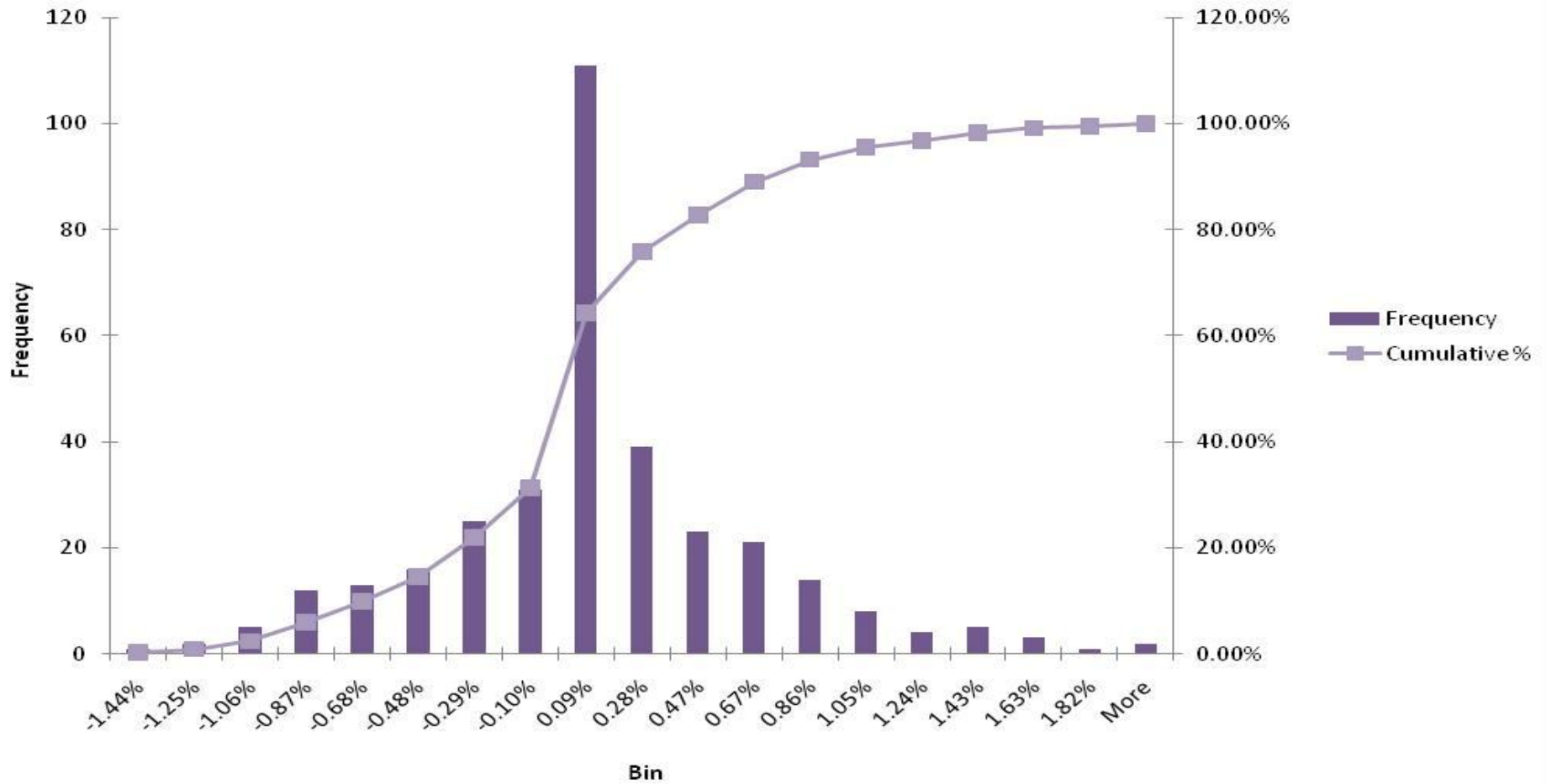
# Portfolio D

## Histogram

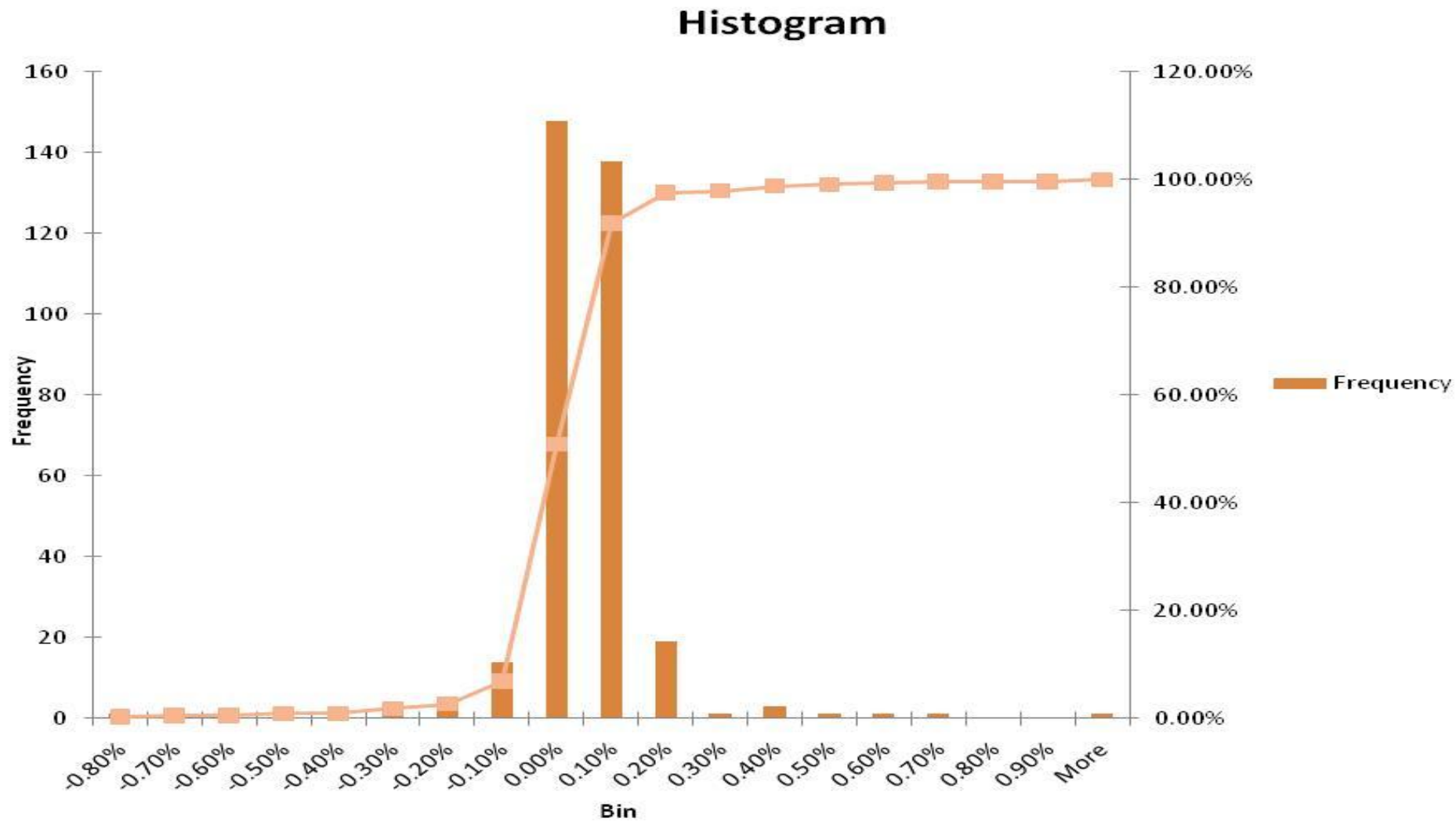


# Portfolio J

## Histogram



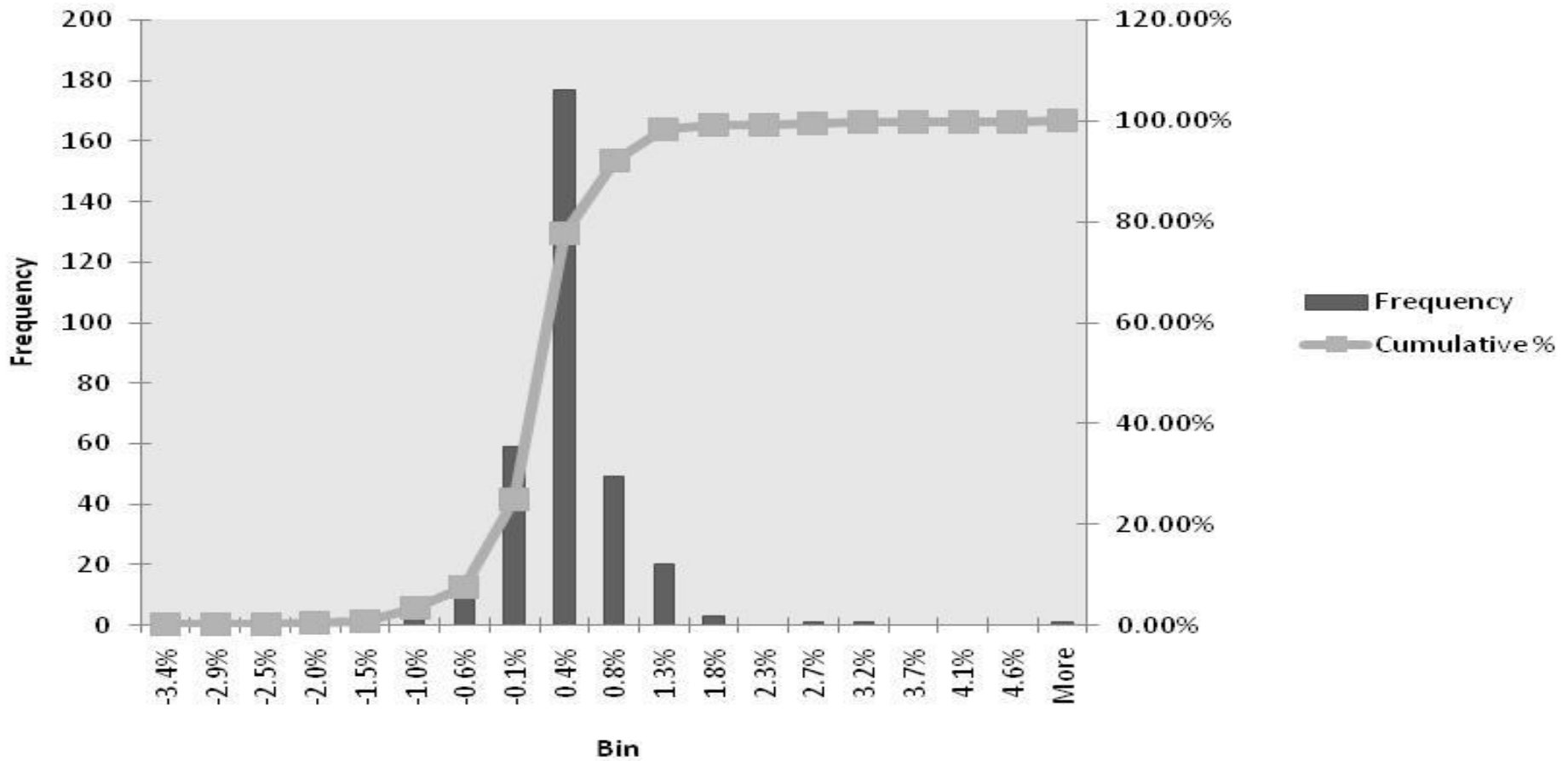
# Portfolio N





# Portfolio P

## Histogram



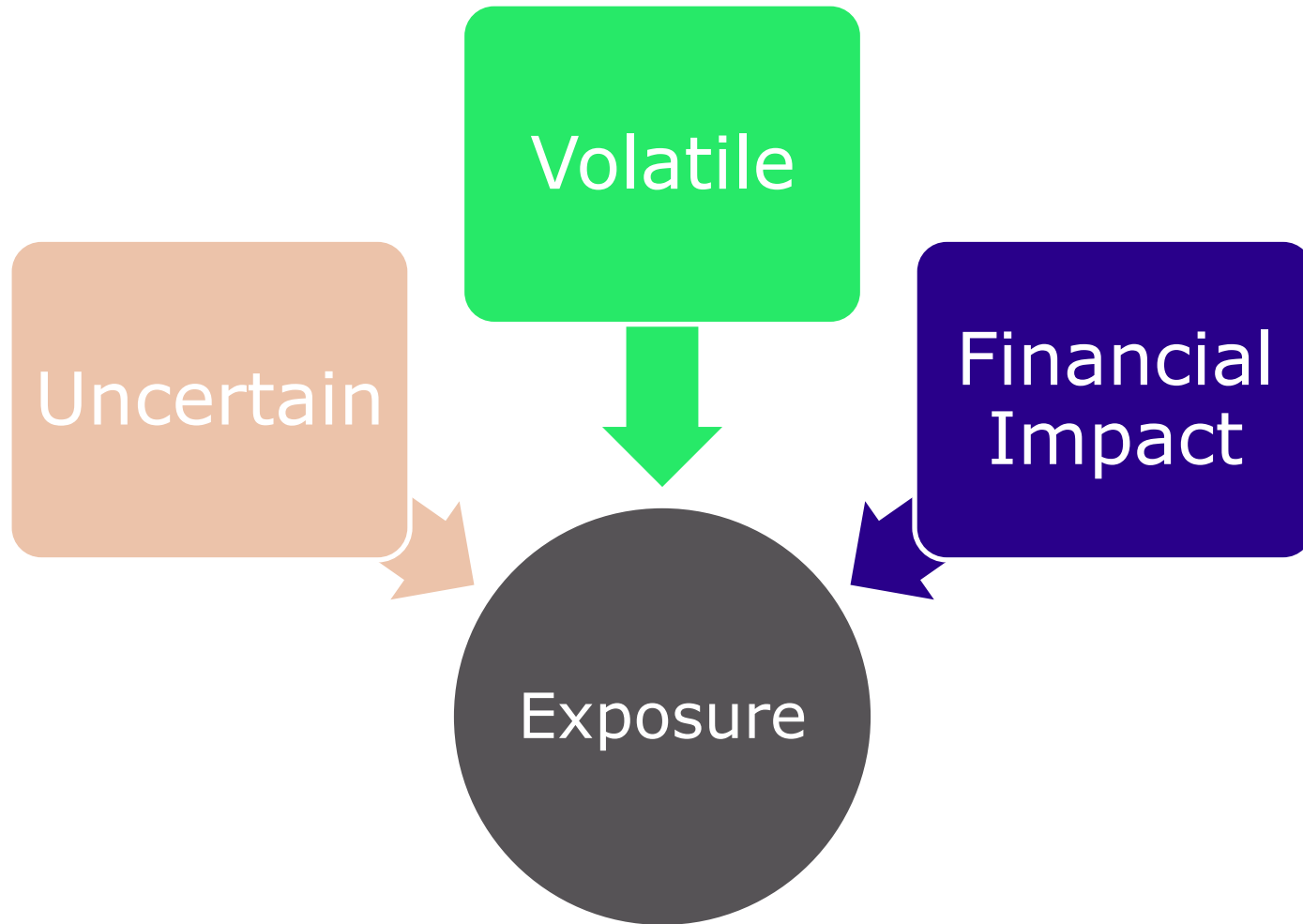
# Histogram Source

A			B			D		
Bin	Freq	Cumulative %	Bin	Freq	Cumulative %	Bin	Freq	Cumulative %
-20%	1	0.30%	-25%	1	0.30%	-5.0%	1	0.30%
-18%	0	0.30%	-23%	0	0.30%	-4.3%	1	0.60%
-17%	0	0.30%	-22%	0	0.30%	-3.7%	0	0.60%
-15%	0	0.30%	-20%	0	0.30%	-3.0%	5	2.08%
-14%	0	0.30%	-18%	0	0.30%	-2.3%	7	4.17%
-12%	0	0.30%	-16%	0	0.30%	-1.6%	15	8.63%
-11%	0	0.30%	-14%	0	0.30%	-1.0%	29	17.26%
-9%	0	0.30%	-13%	0	0.30%	-0.3%	50	32.14%
-8%	0	0.30%	-11%	0	0.30%	0.4%	152	77.38%
-6%	0	0.30%	-9%	0	0.30%	1.1%	34	87.50%
-5%	16	5.06%	-7%	0	0.30%	1.8%	25	94.94%
-3%	10	8.04%	-5%	0	0.30%	2.4%	3	95.83%
-2%	26	15.77%	-4%	10	3.27%	3.1%	4	97.02%
0%	62	34.23%	-2%	20	9.23%	3.8%	3	97.92%
1%	164	83.04%	0%	179	62.50%	4.5%	4	99.11%
3%	27	91.07%	2%	88	88.69%	5.1%	0	99.11%
4%	16	95.83%	4%	24	95.83%	5.8%	0	99.11%
6%	5	97.32%	5%	10	98.81%	6.5%	0	99.11%
More	9	100.00%	More	4	100.00%	More	3	100.00%

# Histogram Source

J			N			P		
Bin	Freq	Cumulative %	Bin	Freq	Cumulative %	Bin	Freq	Cumulative %
-1.44%	1	0.30%	-0.80%	1	0.30%	-3.4%	1	0.30%
-1.25%	2	0.89%	-0.70%	1	0.60%	-2.9%	0	0.30%
-1.06%	5	2.38%	-0.60%	0	0.60%	-2.5%	0	0.30%
-0.87%	12	5.95%	-0.50%	1	0.89%	-2.0%	1	0.60%
-0.68%	13	9.82%	-0.40%	0	0.89%	-1.5%	1	0.89%
-0.48%	16	14.58%	-0.30%	3	1.79%	-1.0%	9	3.57%
-0.29%	25	22.02%	-0.20%	3	2.68%	-0.6%	13	7.44%
-0.10%	31	31.25%	-0.10%	14	6.85%	-0.1%	59	25.00%
0.09%	111	64.29%	0.00%	148	50.89%	0.4%	177	77.68%
0.28%	39	75.89%	0.10%	138	91.96%	0.8%	49	92.26%
0.47%	23	82.74%	0.20%	19	97.62%	1.3%	20	98.21%
0.67%	21	88.99%	0.30%	1	97.92%	1.8%	3	99.11%
0.86%	14	93.15%	0.40%	3	98.81%	2.3%	0	99.11%
1.05%	8	95.54%	0.50%	1	99.11%	2.7%	1	99.40%
1.24%	4	96.73%	0.60%	1	99.40%	3.2%	1	99.70%
1.43%	5	98.21%	0.70%	1	99.70%	3.7%	0	99.70%
1.63%	3	99.11%	0.80%	0	99.70%	4.1%	0	99.70%
1.82%	1	99.40%	0.90%	0	99.70%	4.6%	0	99.70%
More	2	100.00%	More	1	100.00%	More	1	100.00%

# What is exposure?



What is exposure?

Air Canada

- Rising Jet Fuel Prices

GM

- Rising Canadian Dollar

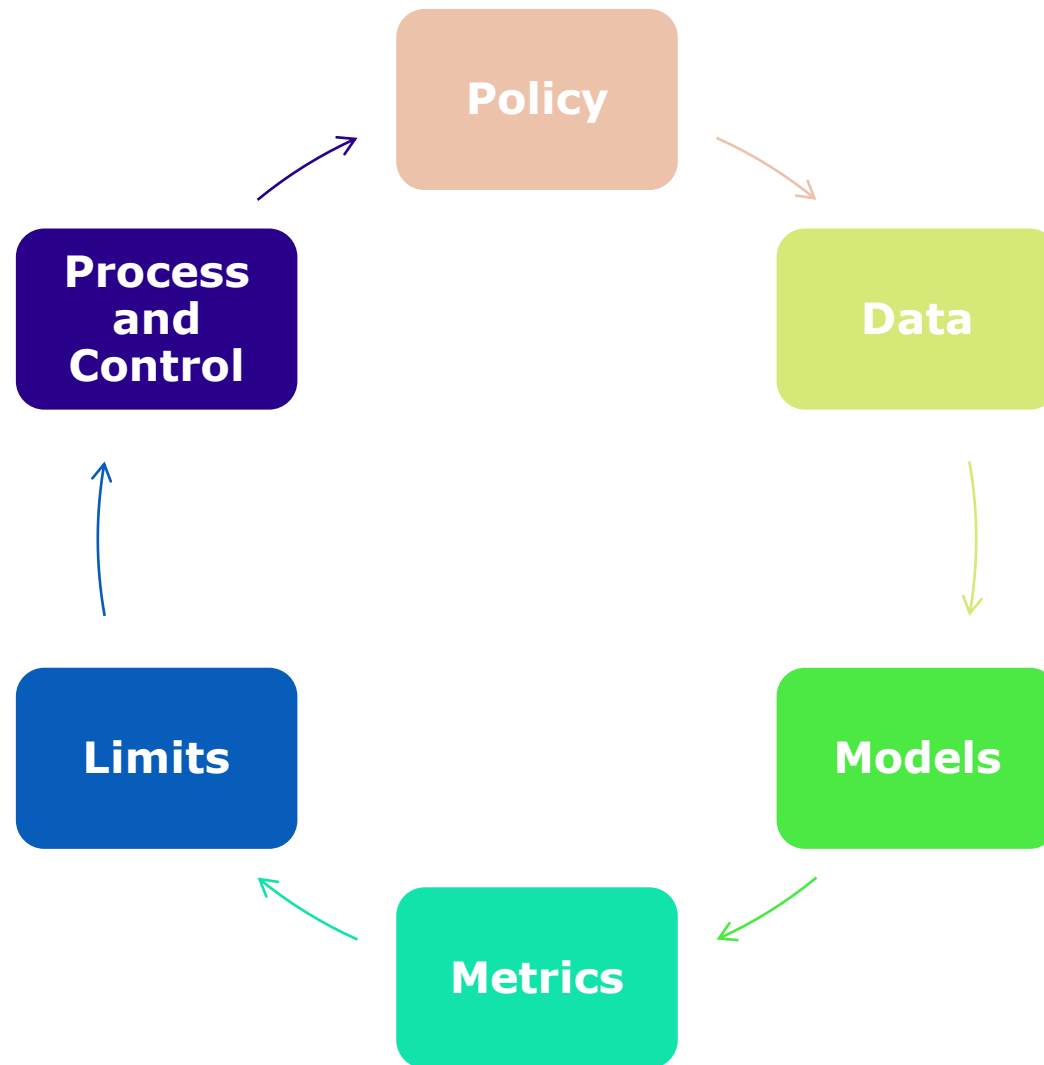
Banc One

- Interest Rates

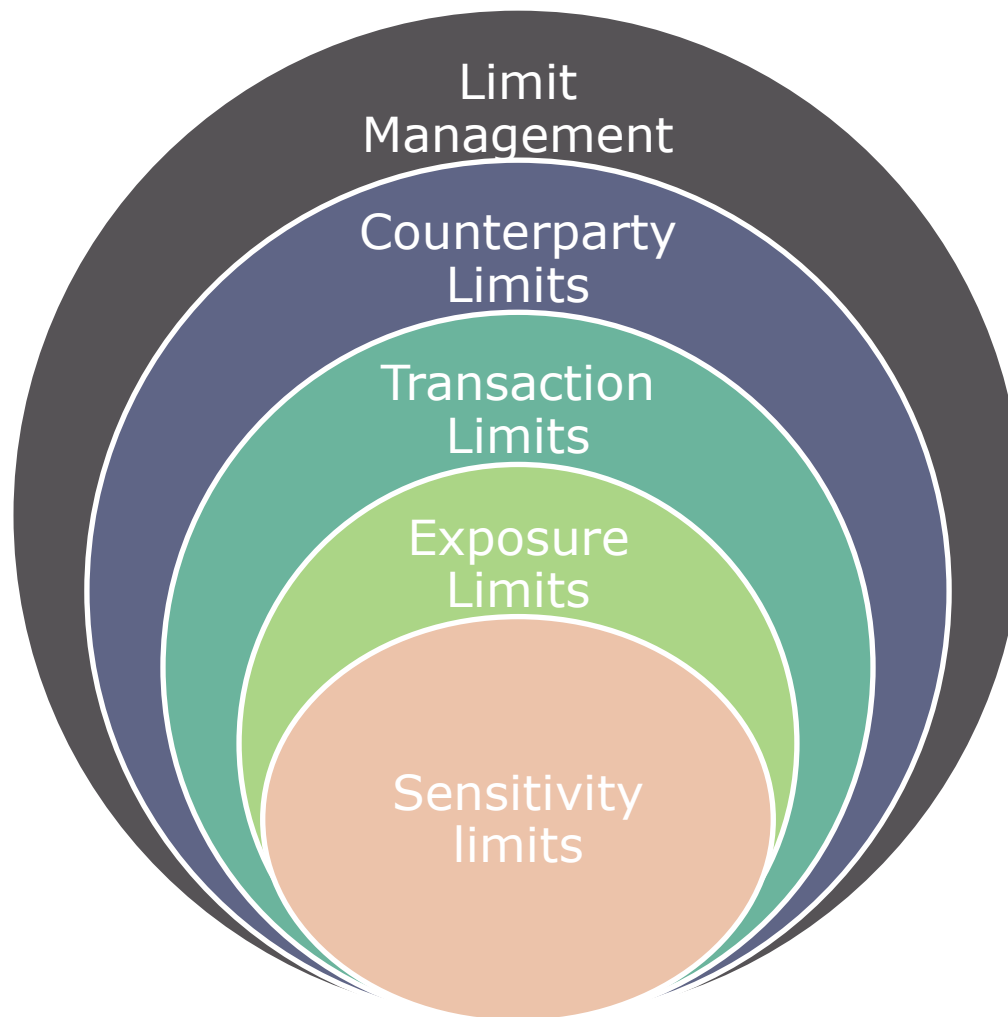
LTCM

- Volatility

# Issues



# Limit Management



# Stop Loss Limit Process

## Risk appetite

- Loss Capital Amount – depends on Expected and Minimum Rates of Return, Capital Amount

## Target Stop loss limit

- applicable for given period

## Book Size

- Allocation of book size to individual business/ investment lines

## Actual stop loss limits

- individual lines for given period



# What is a Target Account?



Measurable/  
Reportable

Sensitive/  
Relevant

Explainable/  
Understandable

## Target Accounts

Air Canada

- P&L Shortfall

GM

- FX Factor Sensitivity

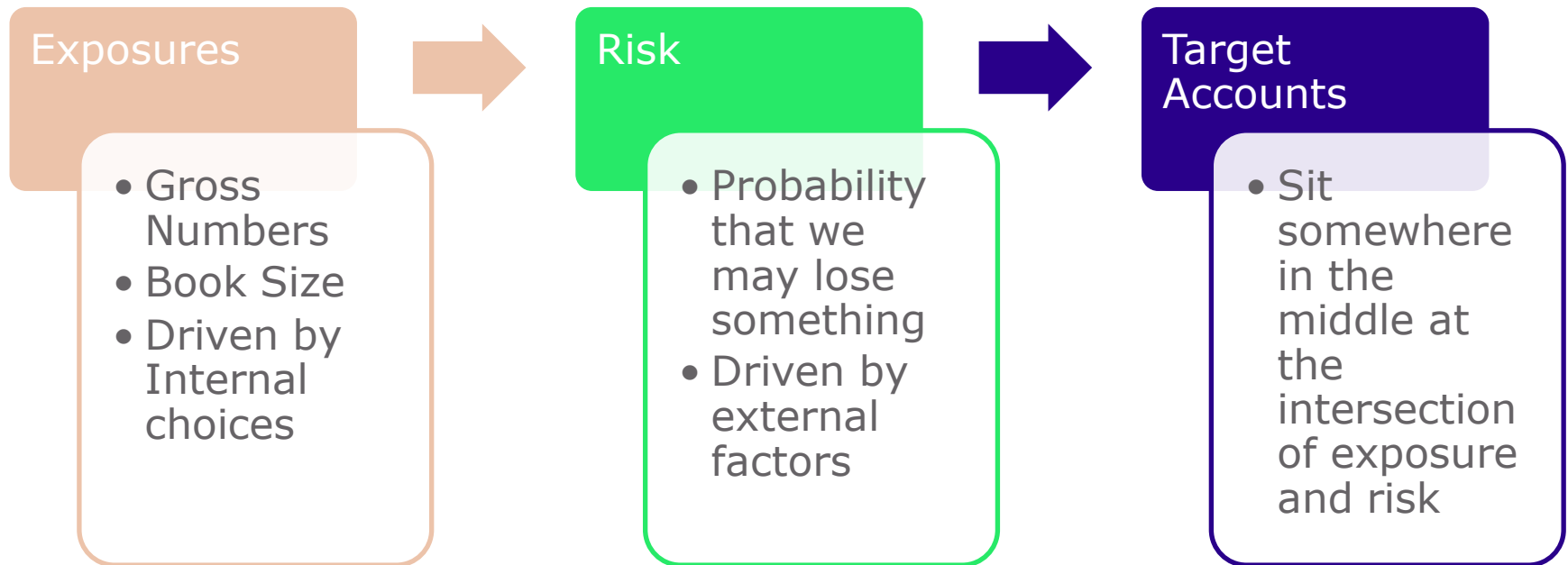
Banc One

- Interest Rate Impact on Earnings

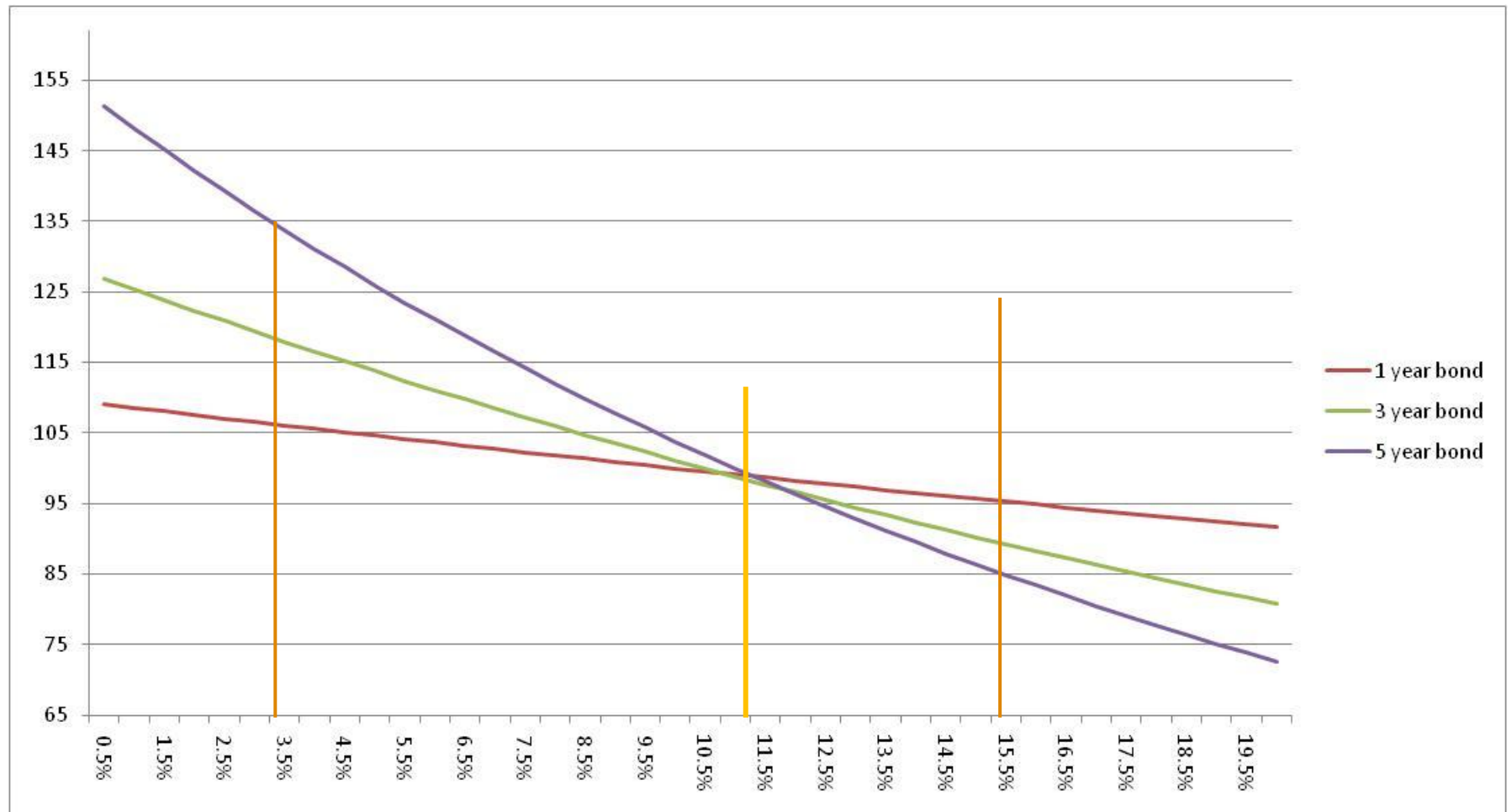
LTCM

- Volatility, Value at Risk

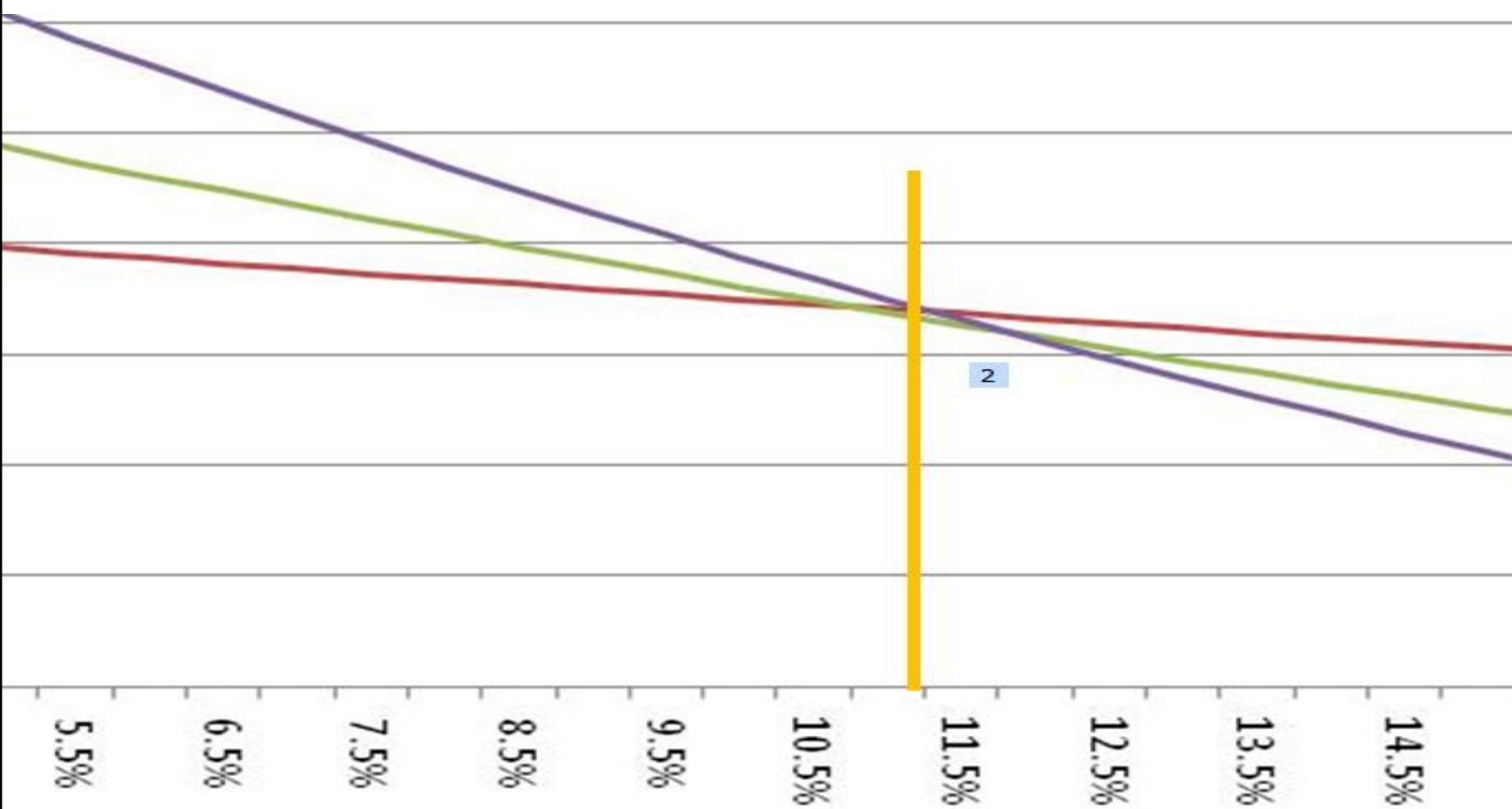
# Exposure, Risk, Target Accounts



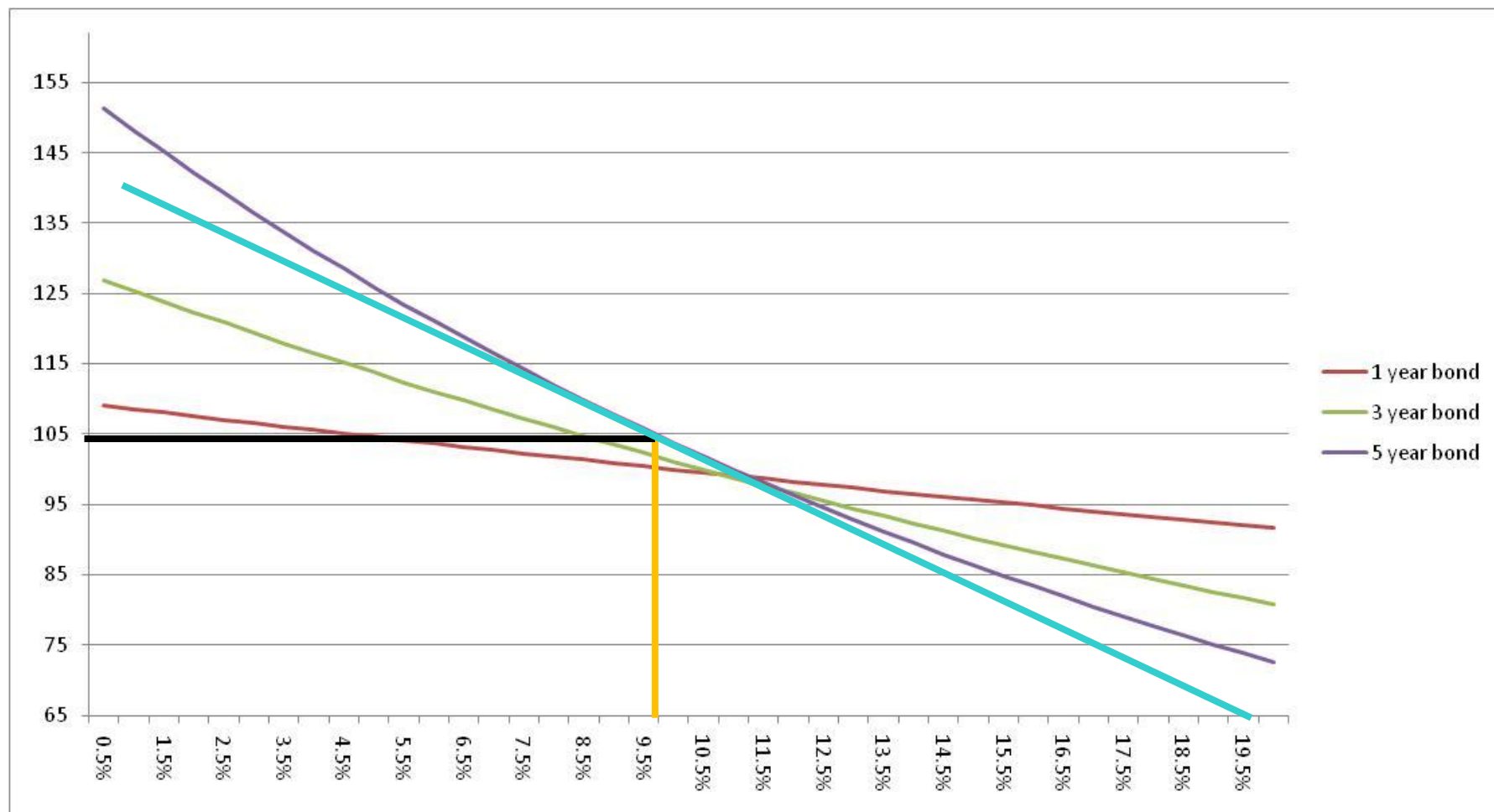
# Duration / Convexity



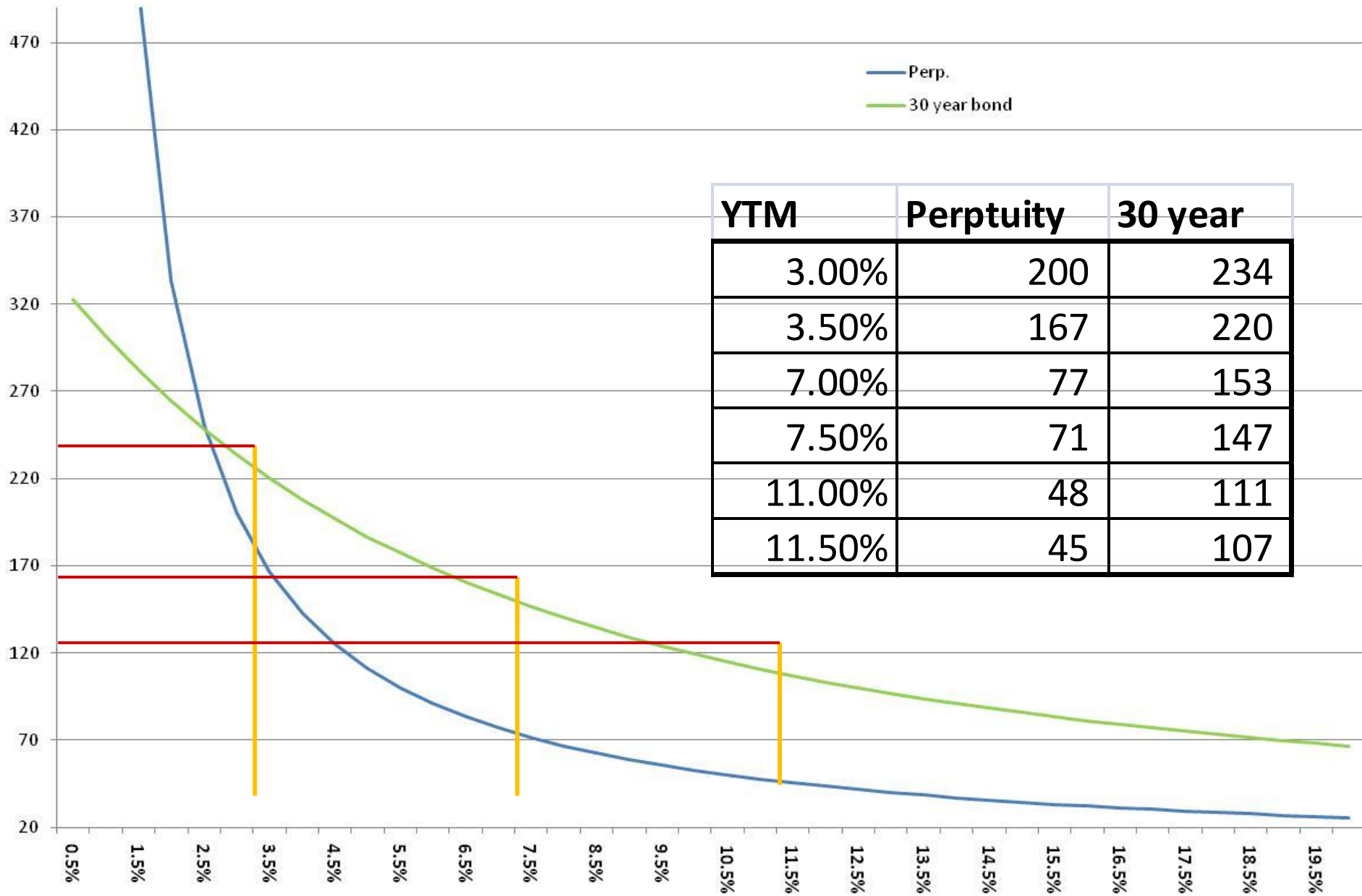
# Convexity



# Convexity

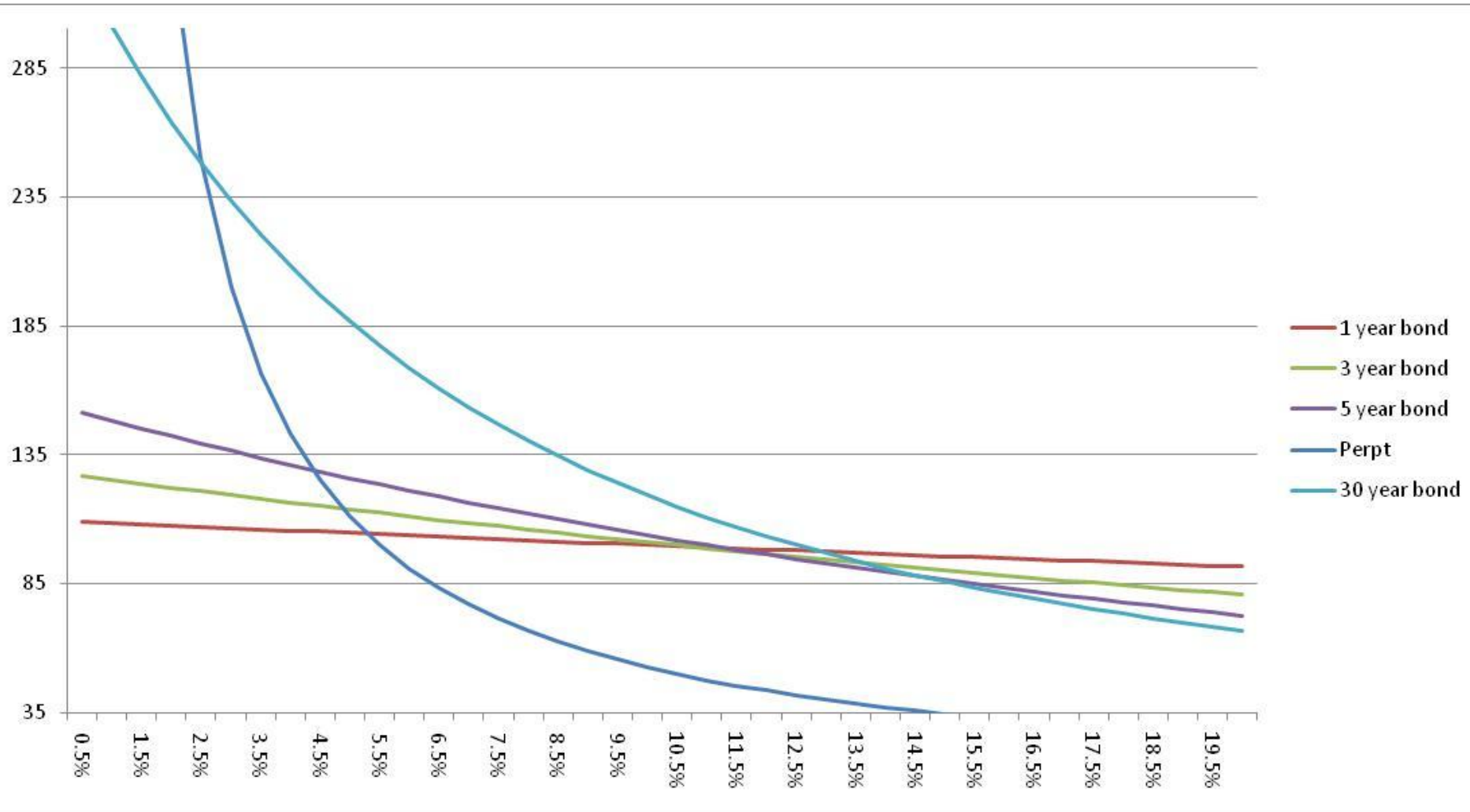


# Alternate Convexity



YTM	Perptuity	30 year
3.00%	200	234
3.50%	167	220
7.00%	77	153
7.50%	71	147
11.00%	48	111
11.50%	45	107

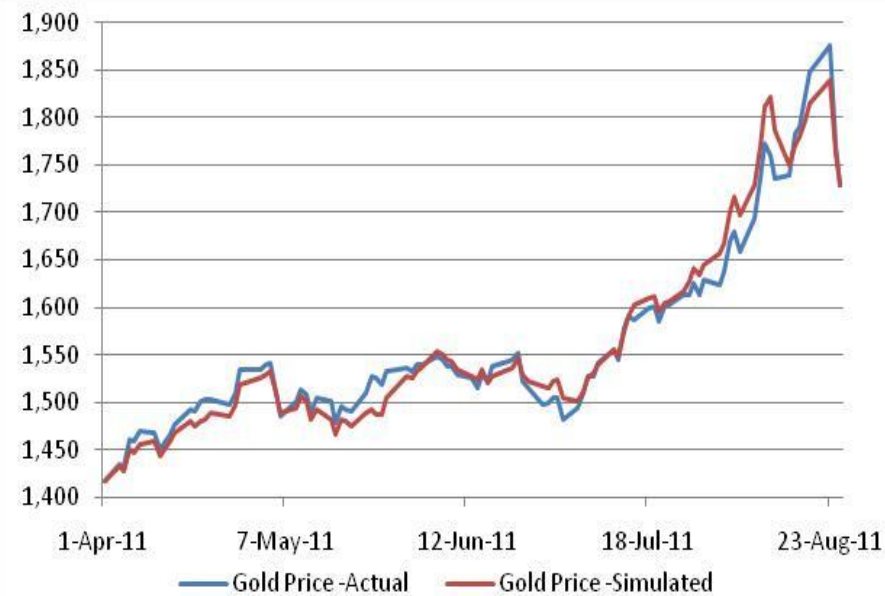
# Convexity – long bond





# Measuring Exposure

## Oil Refinery Case Study



# Case Study One

## **Crude Oil Refinery**

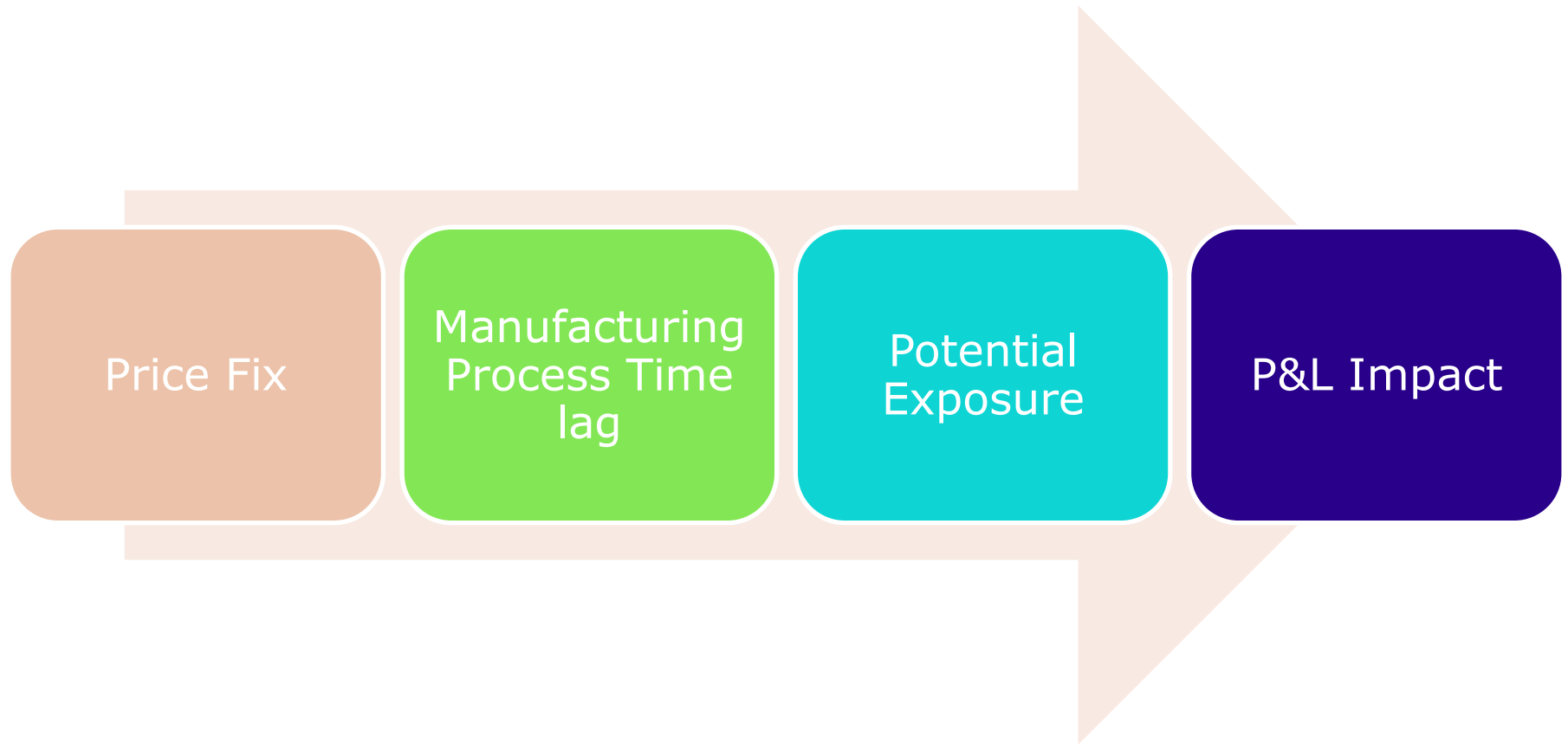
**Lag between crude oil purchase and product arrival for distribution**

**Retail price sensitive to pricing set by market price regulator**

**Market regulator link pricing to international crude prices**

**There is a 30 day lag in every price reset**

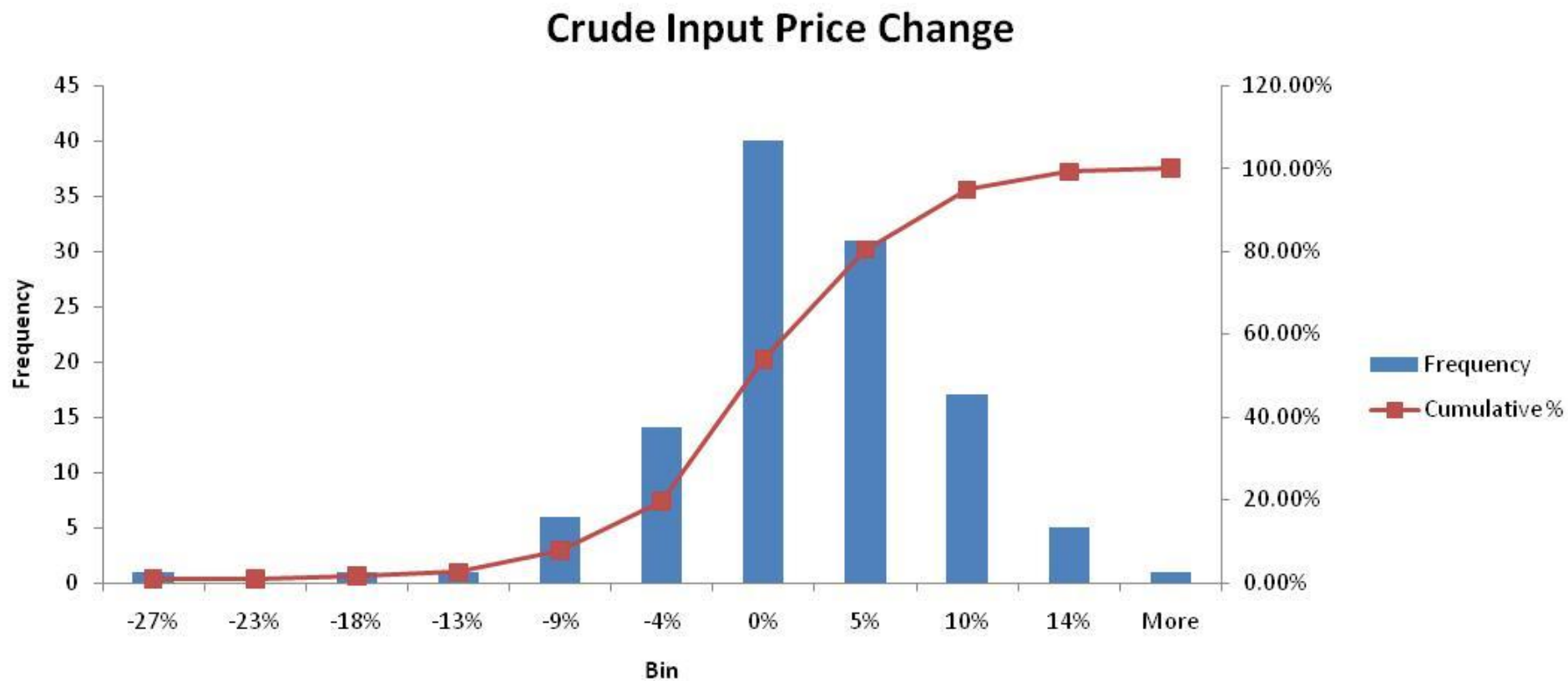
# Crude Oil Oil Refiner



# Assumption

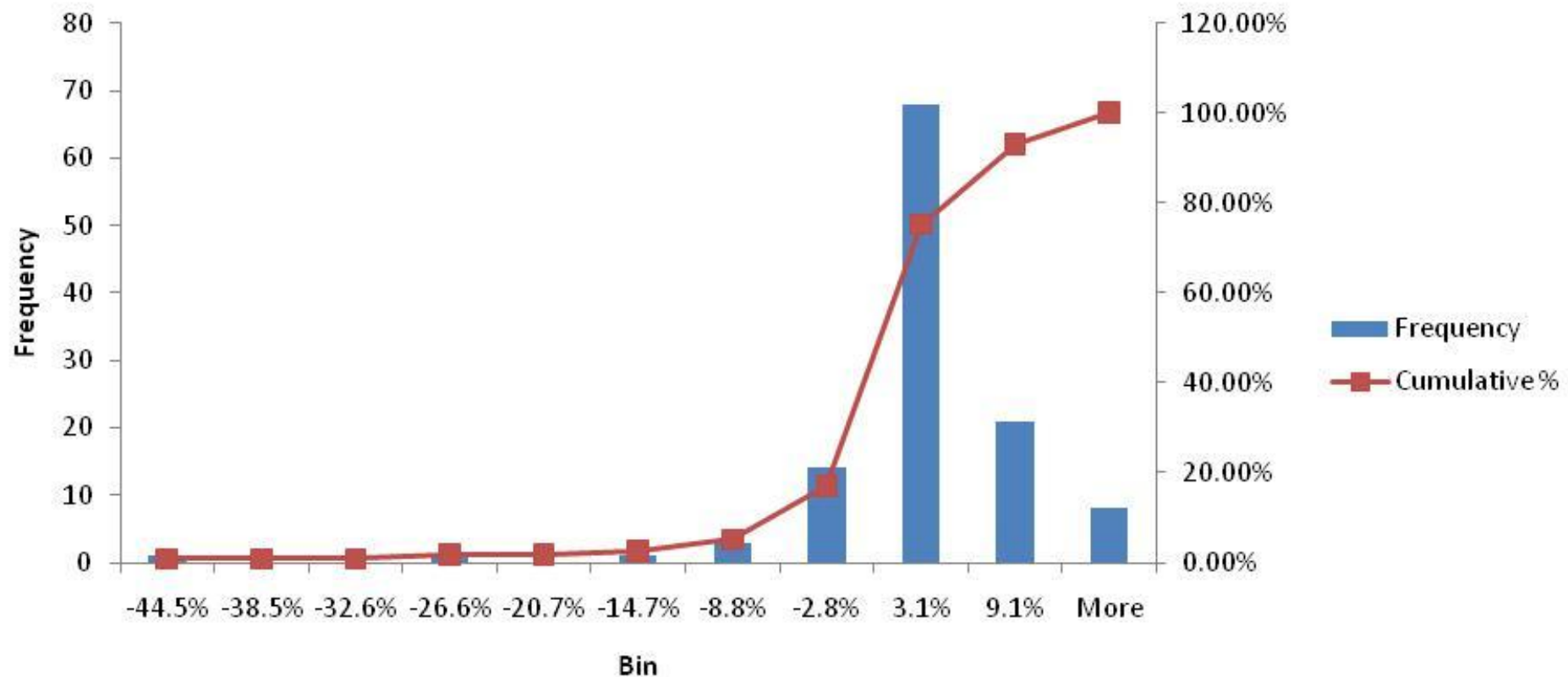
HSFO	NAPHTHA	MOGAS	HOBC	KERO	Aviat Fuels	HSD	LDO
6.6	8.22	8.53	8.51	7.73	8.08	7.52	7.24
32.50%	0.00%	19.03%	0.29%	2.67%	10.50%	33.84%	0.39%

# Crude Oil - input

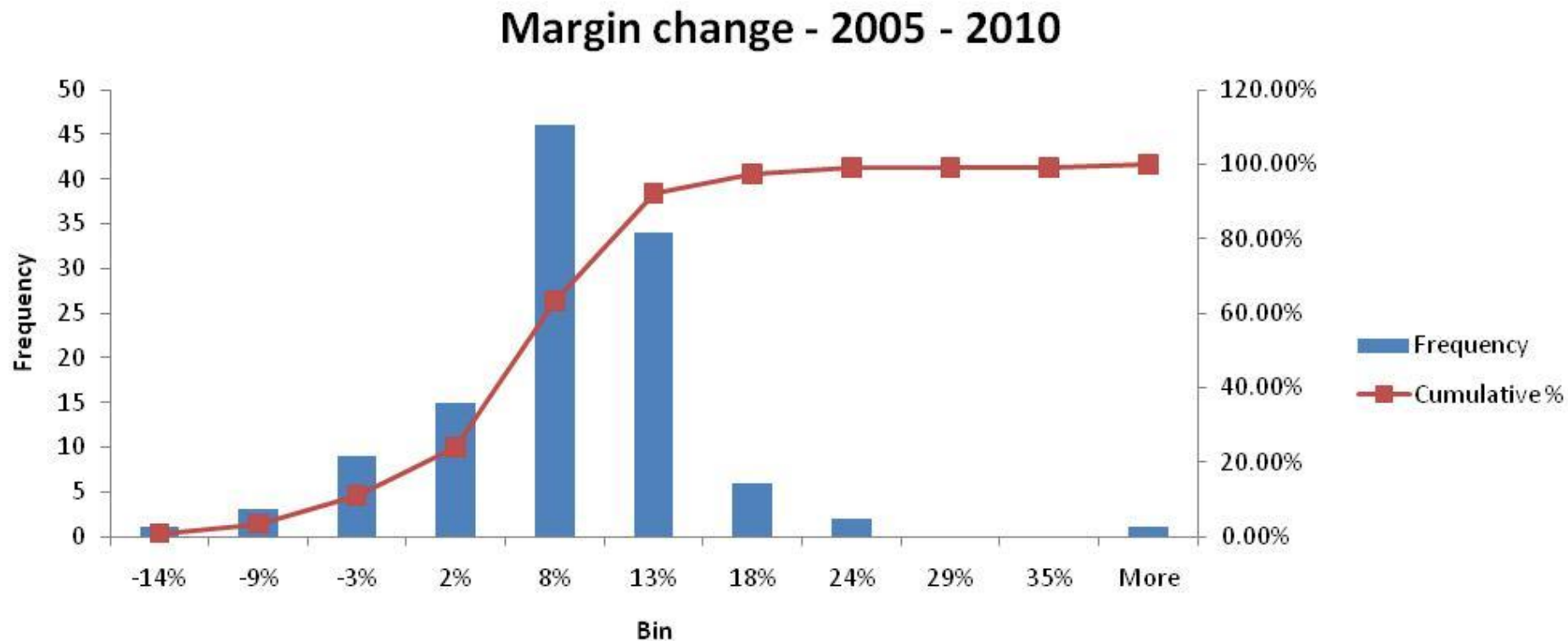


# Refined products

## Output Price Change 2005-2010



# Margin Impact



# Crude Oil Refiner

## Exposure Assessment


- > Understand Manufacturing Process
- > Estimate time lag between input price fix and retail product delivery
- > Breakdown between fixed and variable pricing
- > Estimate dollar sensitivity to unit change in input price
- > Estimate projected impact on P&L



# Questions & Answers

		Input	Input	Margin	Margin
		Price	Price	shortfall	shortfall
Odds	Percentile	Shock-low	Shock-high	Low	High
	99%	145	364	25%	63.4%
1%	99%	145.0	363.8	25.0%	63.4%
11%	90%	79.9	200.4	13.6%	34.7%
18%	85%	64.6	162.1	11.0%	28.0%
25%	80%	52.5	131.6	8.8%	22.7%
33%	75%	42.0	105.5	7.0%	18.1%
43%	70%	32.7	82.0	5.4%	14.0%
52%	66%	25.7	64.5	4.2%	10.9%
67%	60%	15.8	39.6	2.4%	6.6%
82%	55%	7.8	19.7	1.0%	3.1%
96%	51%	1.6	3.9	-0.1%	0.3%

# Questions & Answers

		<b>Input</b>	<b>Input</b>	<b>Inventory</b>	<b>Inventory</b>
		<b>Price</b>	<b>Price</b>	<b>Losses</b>	<b>Losses</b>
<b>Odds</b>	<b>Percentile</b>	<b>Shock-low</b>	<b>Shock-high</b>	<b>Low</b>	<b>High</b>
	99%	145	364	12,310,771	30,885,105
1%	99%	145	364	12,310,771	30,885,105
11%	90%	80	200	6,781,826	17,014,160
18%	85%	65	162	5,484,689	13,759,917
25%	80%	52	132	4,453,765	11,173,548
33%	75%	42	105	3,569,324	8,954,674
43%	70%	33	82	2,775,068	6,962,056
52%	66%	26	64	2,182,708	5,475,951
67%	60%	16	40	1,340,684	3,363,492
82%	55%	8	20	664,986	1,668,308
96%	51%	2	4	132,662	332,820
		FinanceTrainingCourse.com			

# Questions

**What is the probability that margins will decrease in any month over the next quarter, the next half year, or the next full year?**

**What is the range of these projected reductions?**

**What is the worst case reduction in any month over the next 12 months?**

**What is the likely reduction in any month over the next 12 months?**

# More questions?

**What is the probability that gross margins will shrink below the minimum profitability threshold?**

**What is the probability that gross margins will turn negative?**

# More questions?

**What is the likely expected gross margin number at current price volatility levels?**

**How will this number change if volatility moves by a percentage point?**

**By how much does a dollar change in crude prices change the expected margin number?**

# Questions for Air Canada & GM

**What is the probability that margins will decrease in any month over the next quarter, the next half year, or the next full year?**

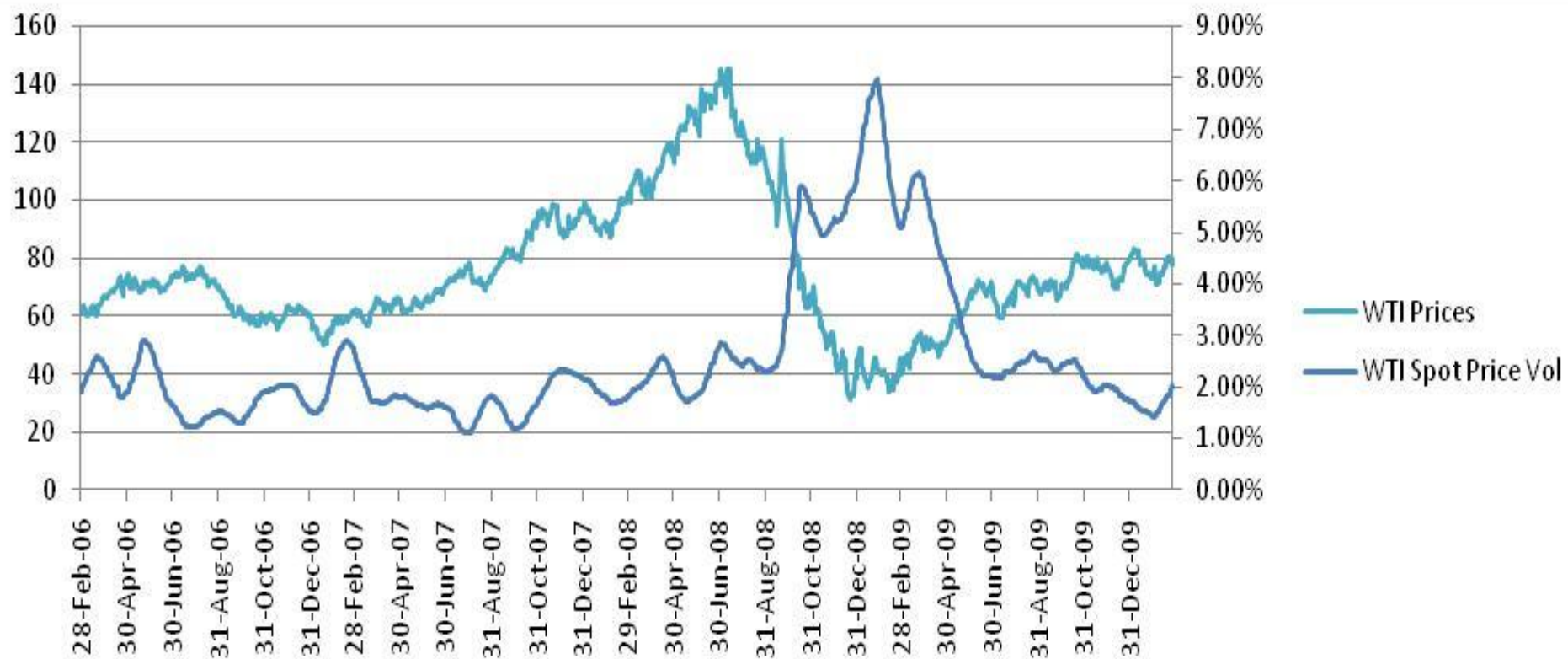
**What is the range of these projected reductions?**

**What is the worst case reduction in any month over the next 12 months?**

**What is the likely reduction in any month over the next 12 months?**

**As a board member what % of hedging do you recommend and why?**

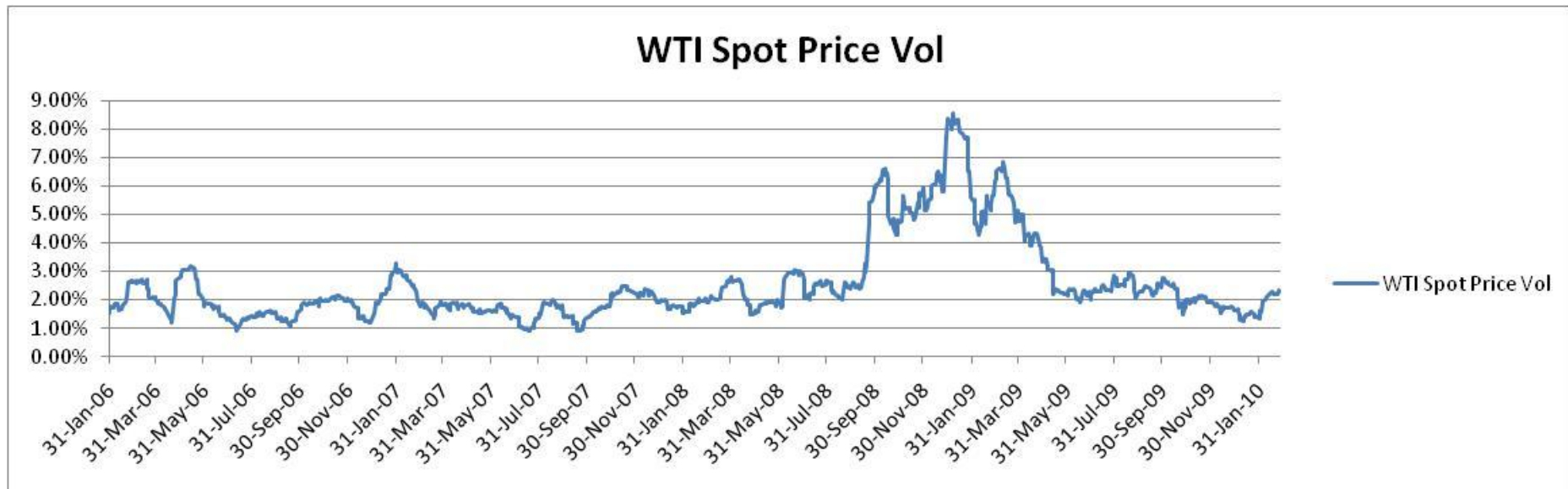
# Crude Oil



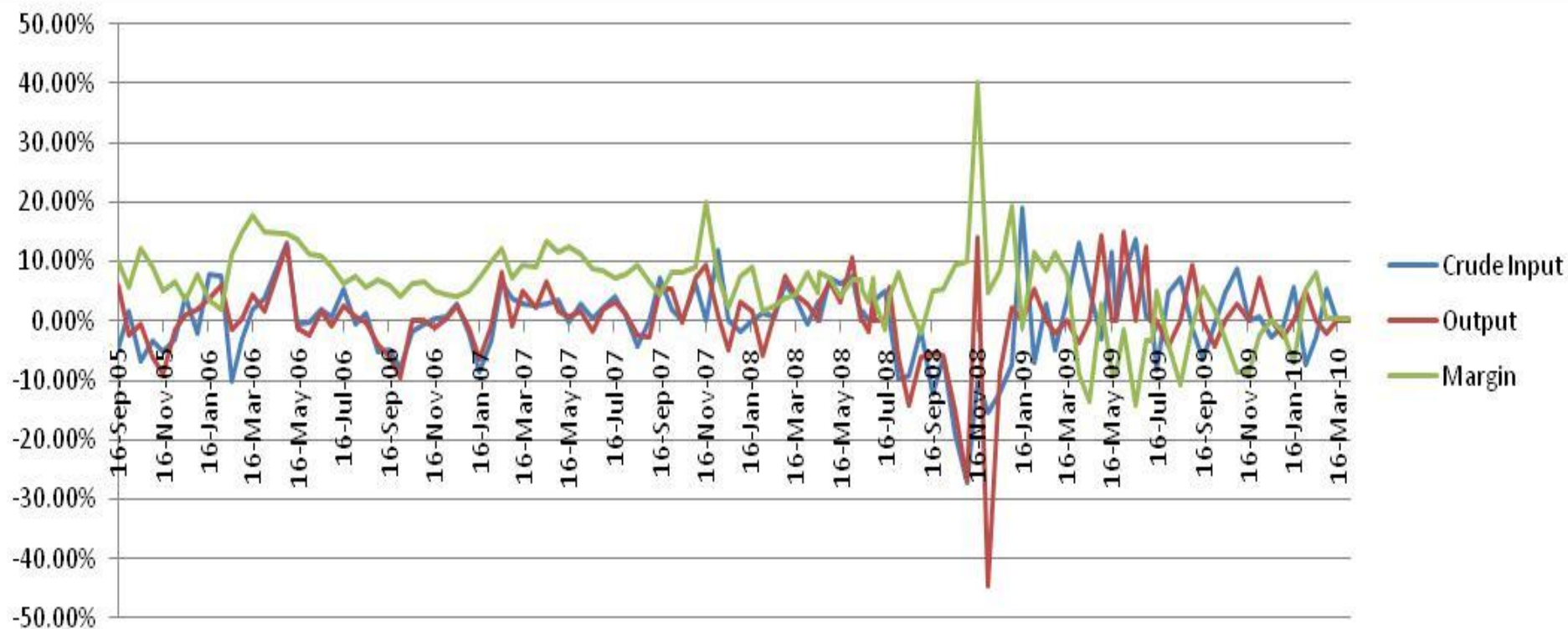




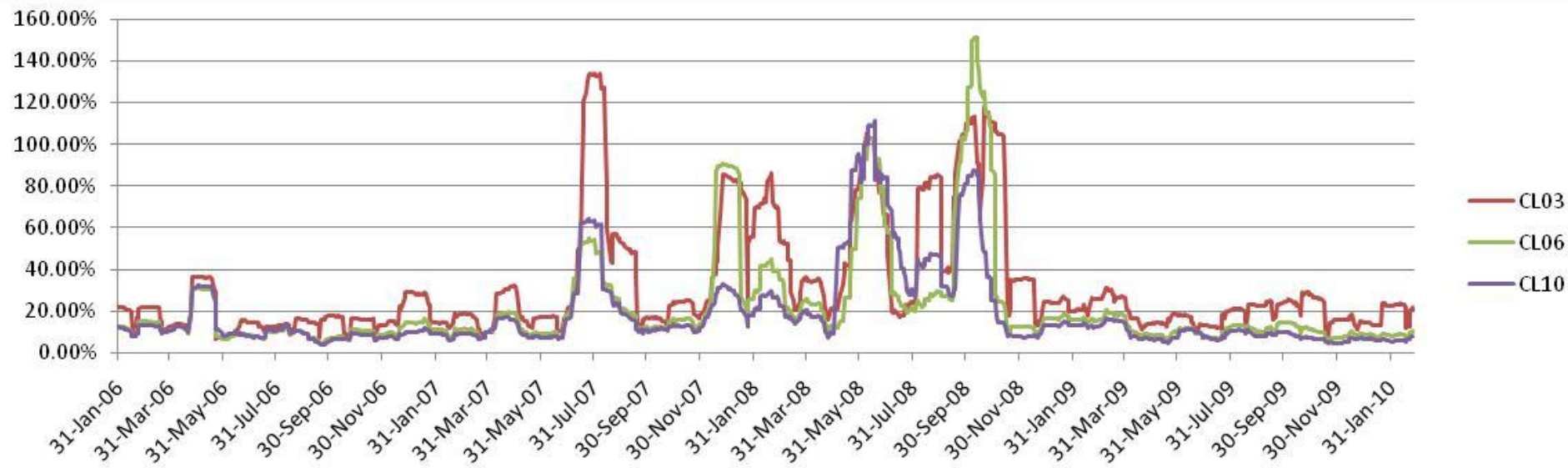
# Price Volatility



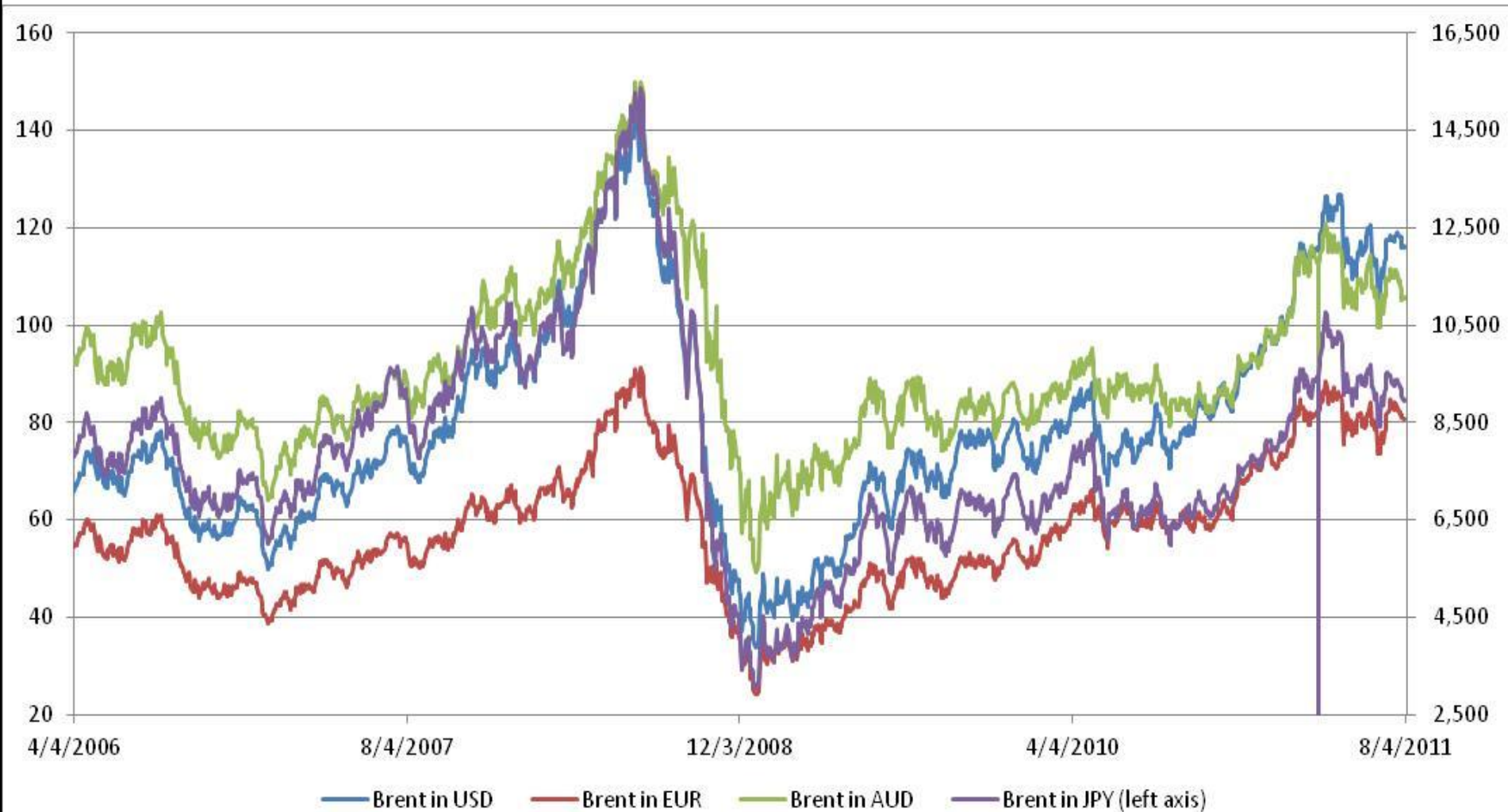
# Integrated



# Future spreads

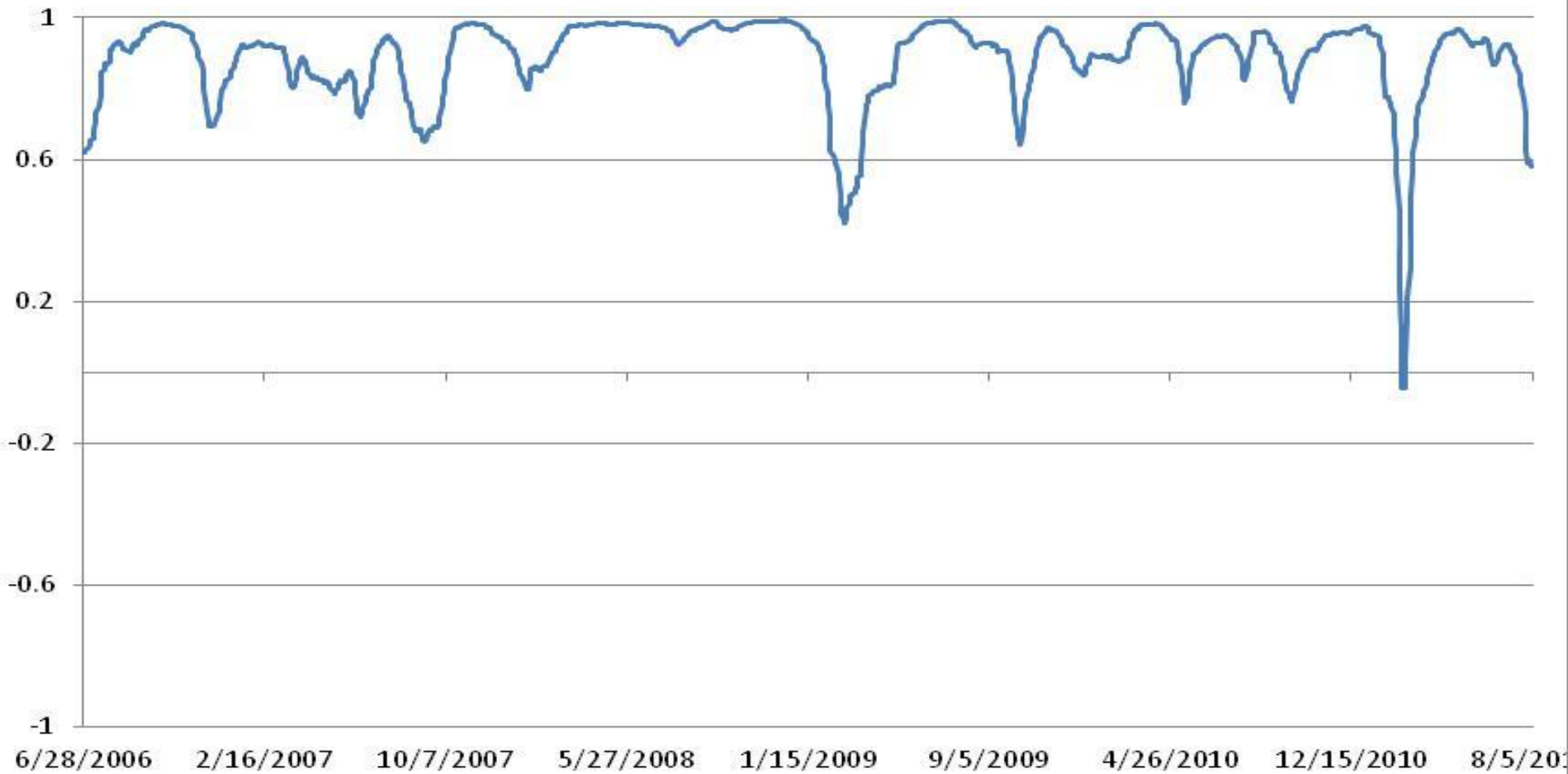


# Brent Relative Price in USD, EUR, AUD, JPY

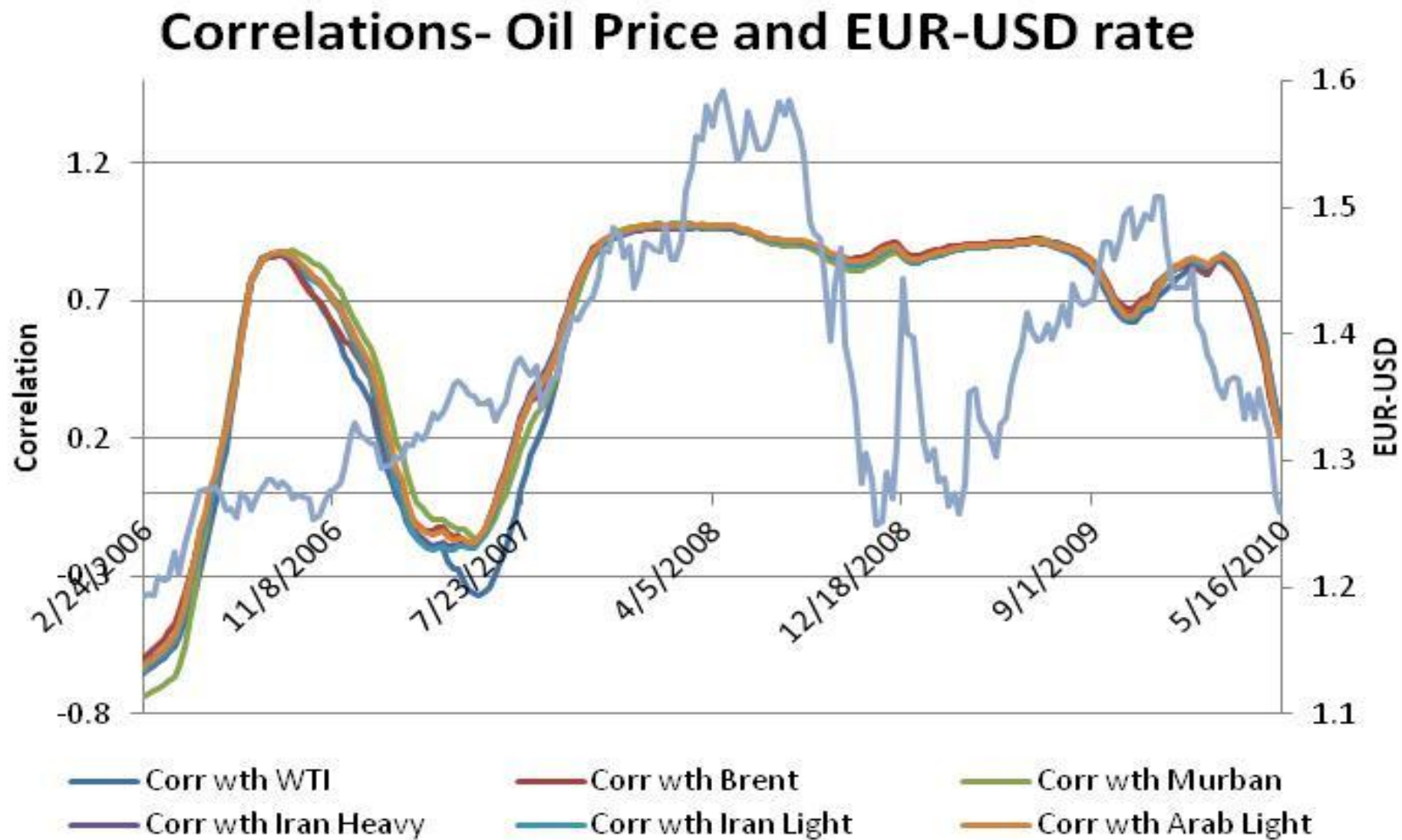


# Brent, WTI Correlation

**60-day Trailing Correlations (WTI & Brent)**



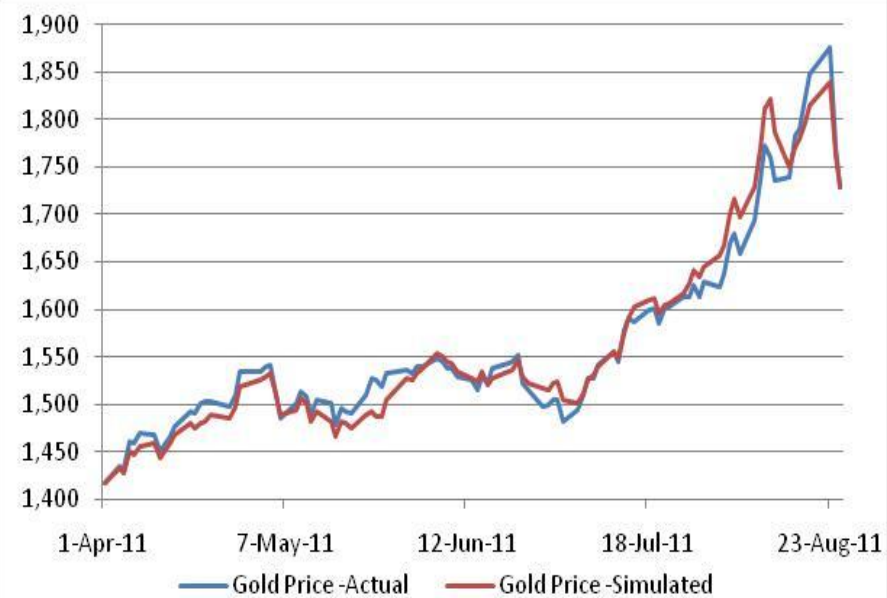
# Correlation with EUR-USD



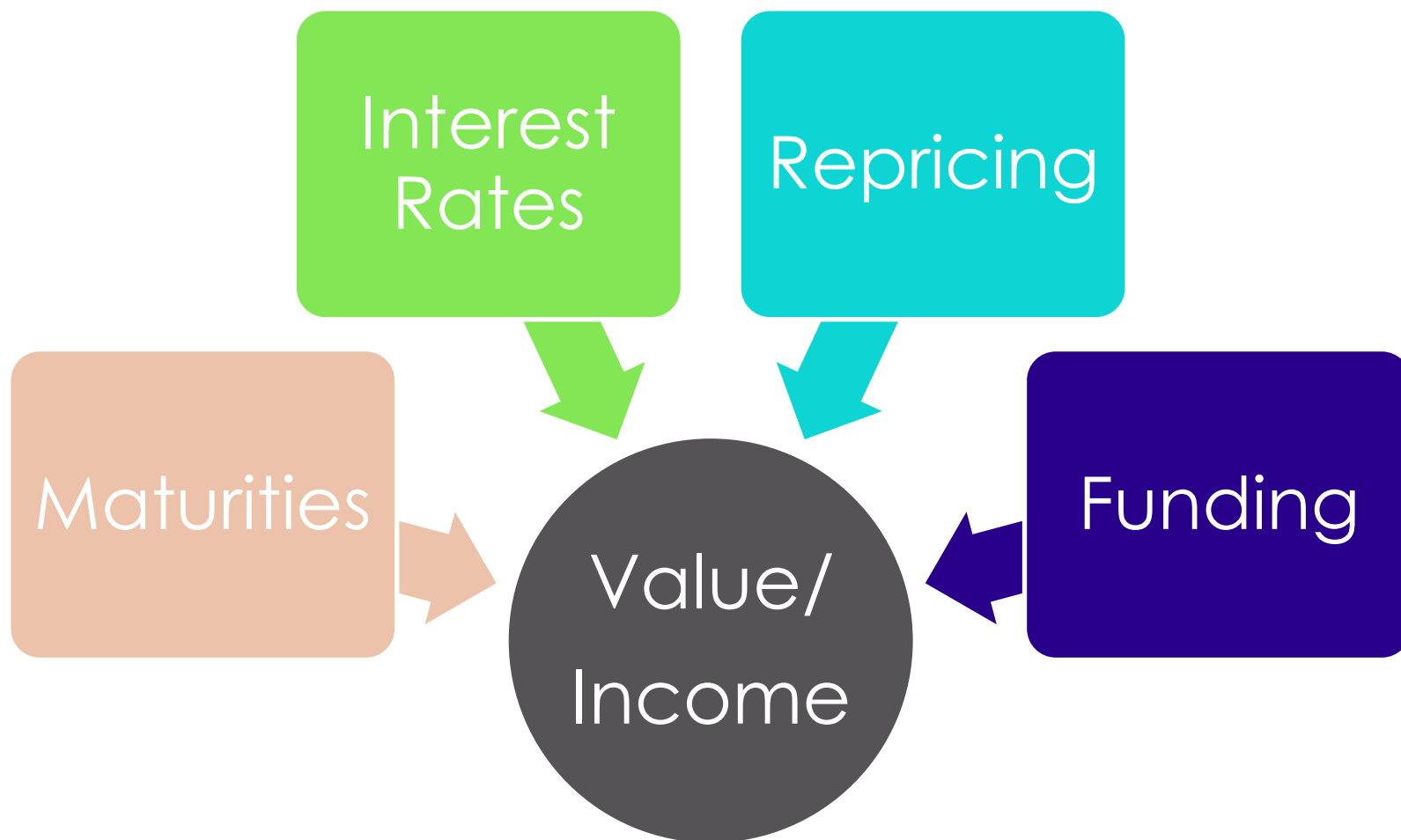


# ALM

## Banc One Case



# ALM at a glance





# A tale of two banks

## Bank A

A → 100 M

L → 90 M

E → 10 M

## Bank B

- A → 100 M

- L → 90 M

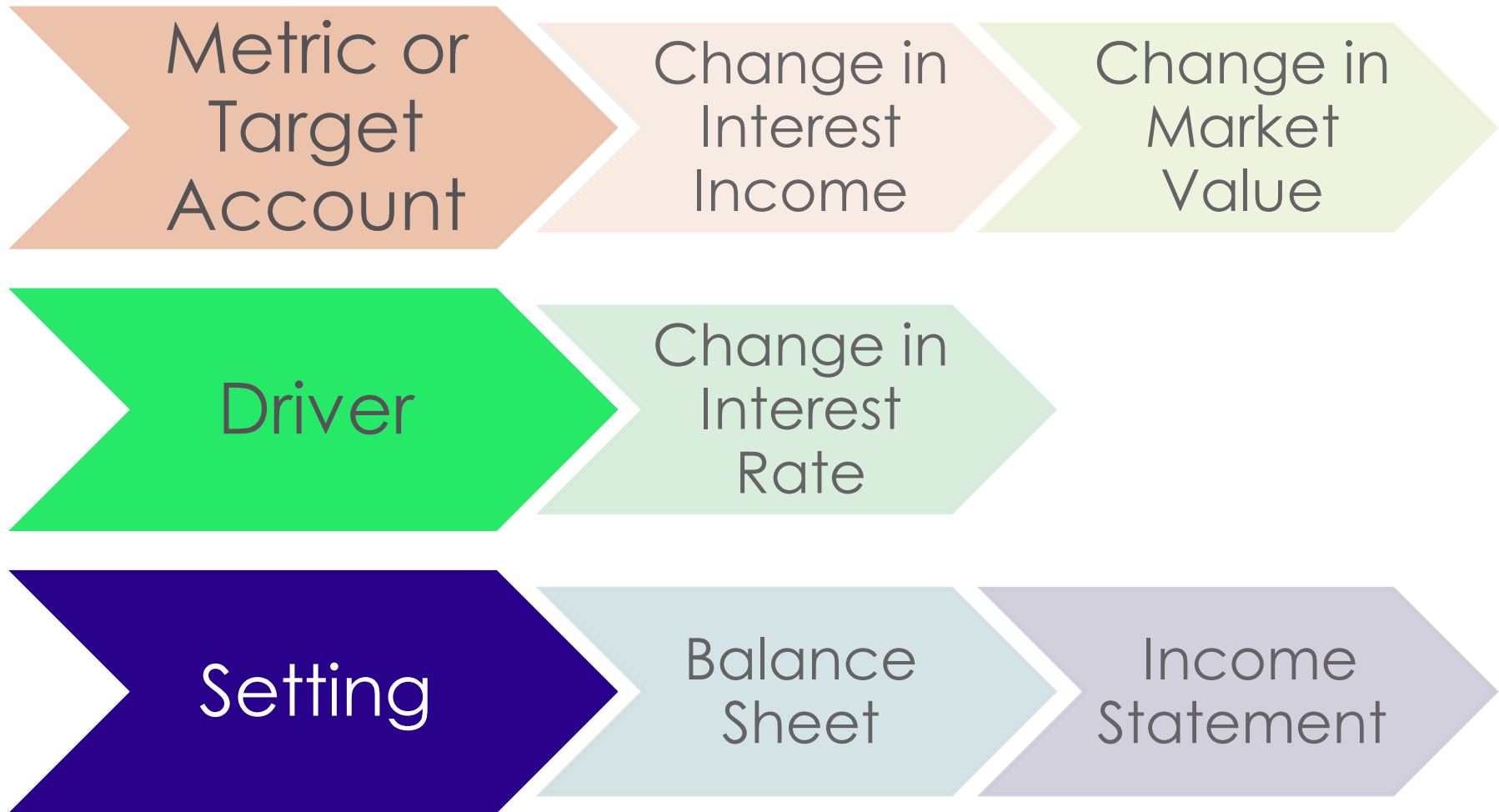
- E → 10 M

Assets?  
Maturity?

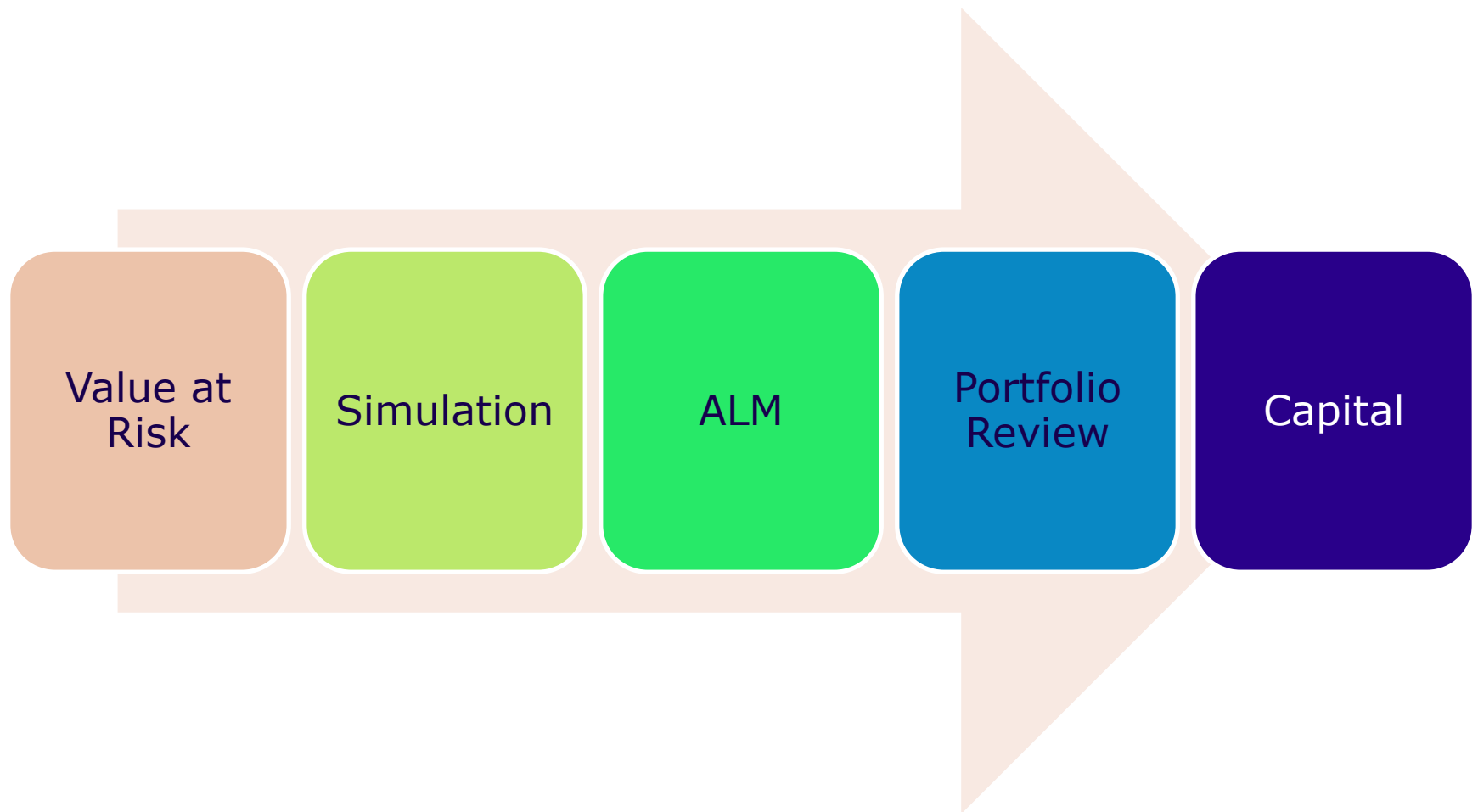
Liquidity?  
Funding?

Risk → Return → Sensitivity

# Risk - Return



# ALM – Framework - II



# Concepts

Sigma

Duration

Convexity

Asset Sensitive

Liability Sensitive

Value at Risk

Hedging Tools



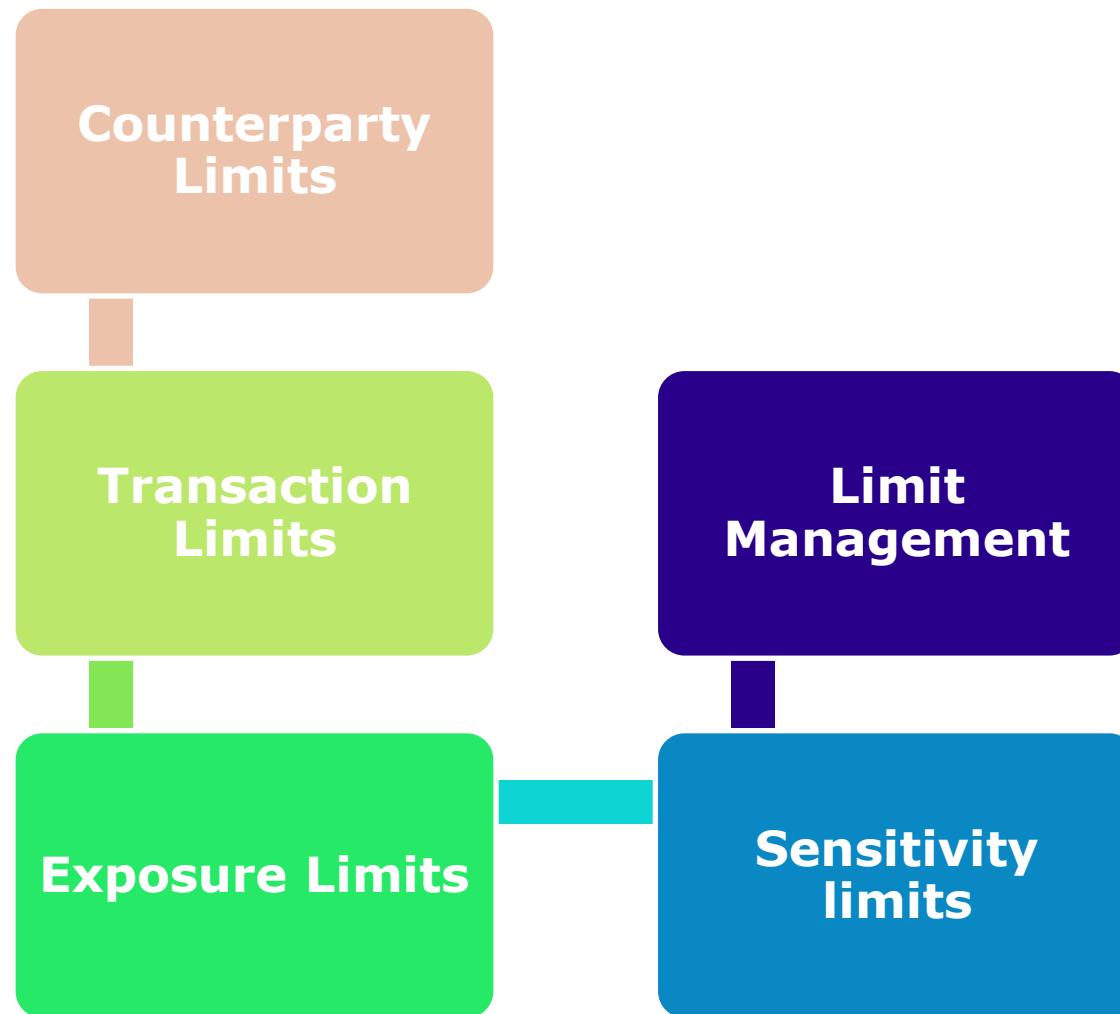
Liquidity – Funding

Liquidity – Market (Tbills)

Liquidity – Assumptions

Earnings at Risk

# Limit Management



# Banc one Questions?

**How does Banc One measure its interest rate exposure? Given Banc One's exposure should they worry about rising rates or declining rates environment?**

**Can you optimize Earning at risk and NPV at risk at the same time? How would you go about it? Take Banc One's example and show through numbers.**

**How do derivatives and other non-funded instrument help with capital optimization. Show through numbers.**

**Review the annexure on pages 26-29. If you look at these numbers as an analyst, what are your conclusions? Your recommendations to Banc One?**