

Portfolio Cost Scenario Analysis

Min Seong Kim

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This report is a summary of portfolio cost scenario analyses when (1) hedging instruments are applied and (2) stress testing is performed. The attached Matlab code is for generating distributions of unhedged portfolios only. Please see the features below.

- A total of 10,000 Monte Carlo simulations were implemented.
- Weighted average prices were applied to calculate portfolio cost distributions.
- 12-month-forward prices in the energy market were used from Jan to Dec 2018 by assuming a one-dollar incremental for each month. (Average price as of today: \$45.45)
- For simplicity, only single products were used, rather than multiples.
- The numbers 42 and 50 were randomly chosen to demonstrate changes of probabilities.
- Hypothetical stress testing was conducted by shocking risk factors (forward price and volatility).

1. Portfolio Cost Scenario Analysis by Hedging Instruments

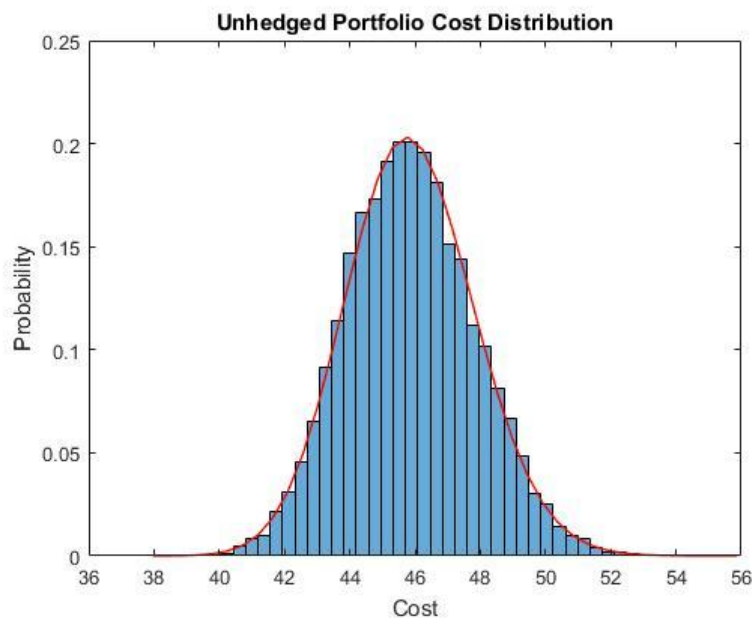


Figure 1. Portfolio Distribution – Unhedged Portfolio

Unhedged Portfolio			
mean	45.5484	$P(x < 42)$	17.39%
std	3.7794	$P(x > 50)$	12.20%

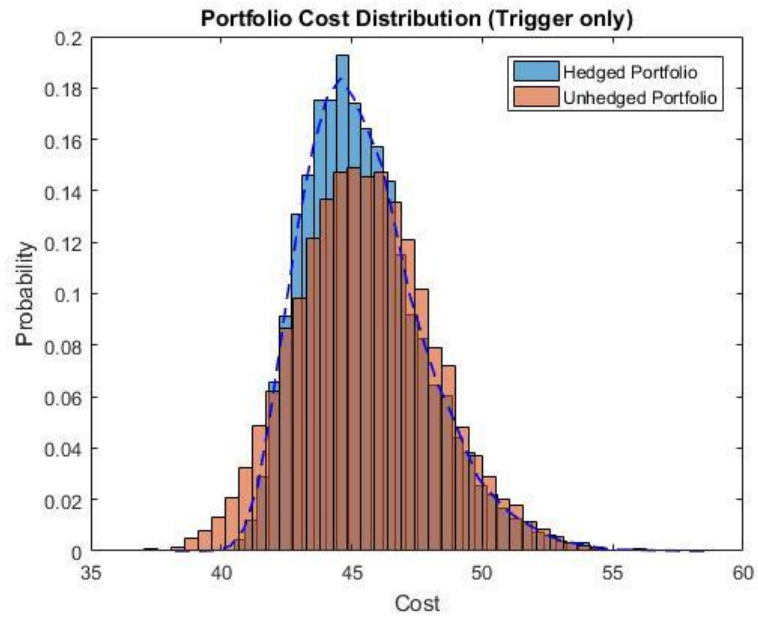


Figure 2. Portfolio Distribution – Trigger was applied to prevent a downside risk

Unhedged Portfolio			
mean	45.4960	$P(x < 42)$	18.01%
std	3.8216	$P(x > 50)$	12.05%
Hedged Portfolio			
mean	45.4616	$P(x < 42)$	12.40%
std	3.2323	$P(x > 50)$	9.54%

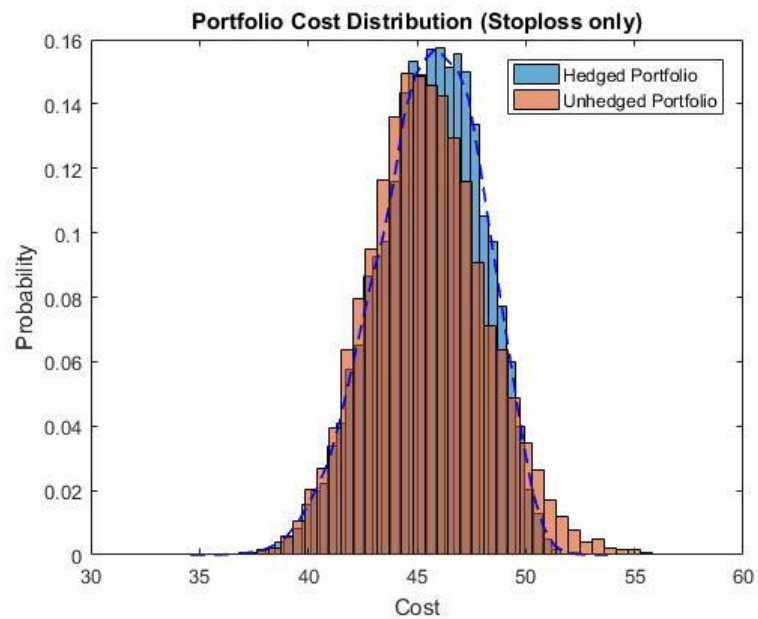


Figure 3. Portfolio Distribution – Stop loss was applied to prevent an upside risk

Unhedged Portfolio			
mean	45.4464	$P(x < 42)$	17.85%
std	3.7820	$P(x > 50)$	11.58%
Hedged Portfolio			
mean	45.5398	$P(x < 42)$	16.10%
std	3.3753	$P(x > 50)$	8.98%

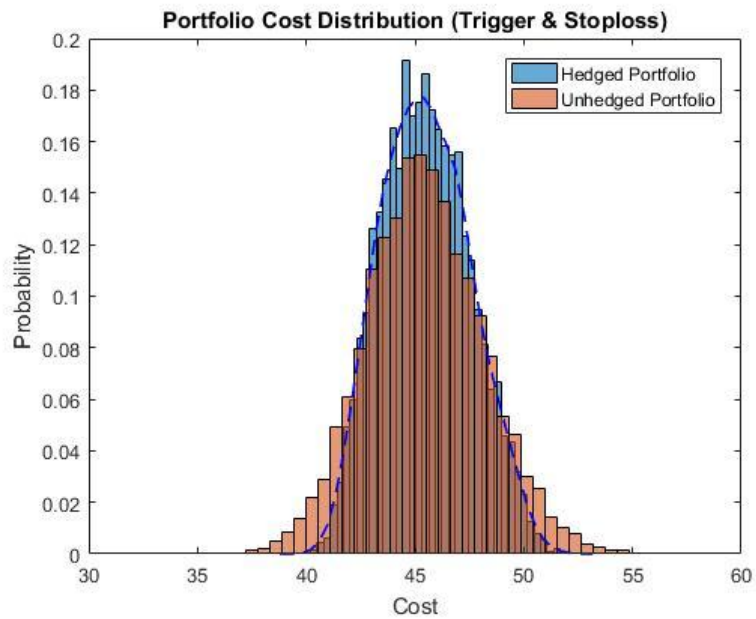


Figure 4. Portfolio Distribution – Trigger and stop loss were applied to prevent both downside/upside risks

Unhedged Portfolio			
mean	45.4766	$P(x < 42)$	18.37%
std	3.7905	$P(x > 50)$	11.77%
Hedged Portfolio			
mean	45.4992	$P(x < 42)$	11.53%
std	2.7834	$P(x > 50)$	6.52%

2. Portfolio Cost Scenario Analysis by Hypothetical Stress Testing

1) Forward Prices, (+/- 10%)

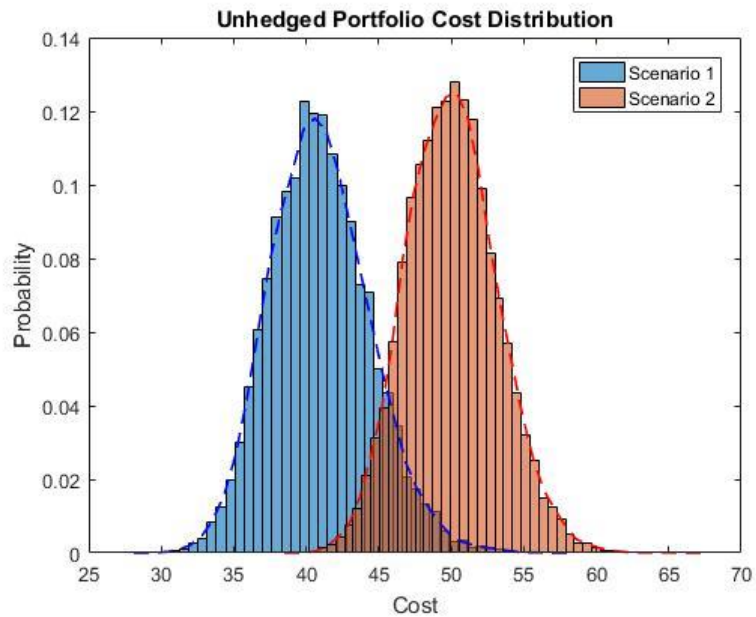


Figure 5. Portfolio Distribution – Forward Prices, (+/- 10%)

Unhedged Portfolio - Scenario 1 (-10%)			
mean	40.9415	$P(x < 42)$	63.85%
std	3.3927	$P(x > 50)$	0.77%
Unhedged Portfolio - Scenario 2 (+10%)			
mean	50.0463	$P(x < 42)$	0.21%
std	3.1036	$P(x > 50)$	49.53%

2) Long and Short-Term Volatilities, (+/- 10%)

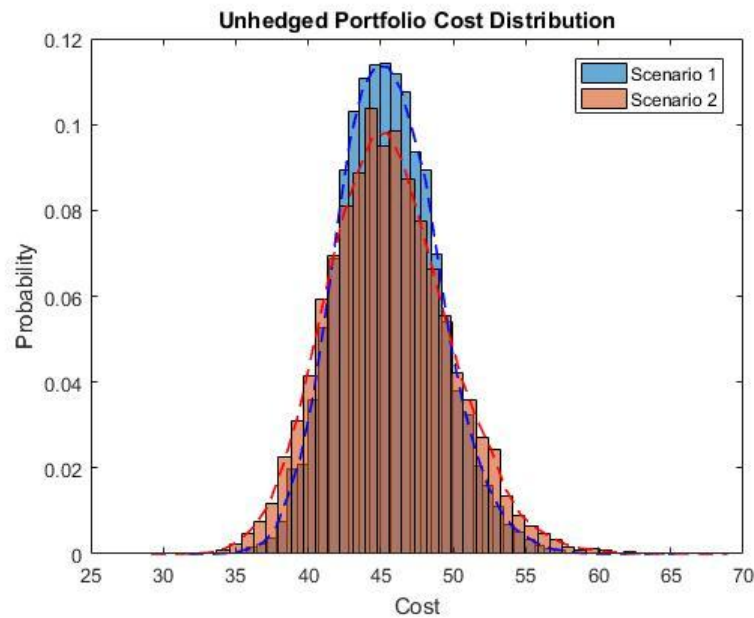


Figure 6. Portfolio Distribution - Long and Short-Term Volatilities, (+/- 10%)

Unhedged Portfolio - Scenario 1 (-10%)			
mean	45.5393	P(x < 42)	14.32%
std	3.3596	P(x > 50)	9.34%
Unhedged Portfolio - Scenario 2 (+10%)			
mean	45.5228	P(x < 42)	19.70%
std	4.1175	P(x > 50)	13.93%

3. Summary

Figures 2-4 illustrate that Monte Carlo simulations were well utilized, given that the means of expected forward prices were equal to the average value of the prices as of today. In addition, the hedging instruments, trigger and stop loss, were seen to effectively reduce the portfolio's downside and upside risks.

The stress testing, as demonstrated in Figures 5 and 6, was applied to unhedged portfolios only. Additionally, the testing could be expanded on portfolios with hedging instruments. We may also consider drastic changes of macroeconomic factors (such as interest rate and currency) or an unusually strong correlation among assets in a portfolio for further risk factors.