



Case Study: Evaluating a Non-Traded Asset in a Multi-Asset Portfolio

Absolute return manager Doug helps manage an endowment fund of \$20 billion. His goal is to keep generating steady returns, ideally in the high single digit range over the medium to long run, in order to support the fund sponsor regardless of how the market fluctuates up and down. The composite benchmark of this portfolio as approved by his sponsor's investment committee is very similar to Harvard Management Company's Policy Portfolio set in 2010, as shown in **Figure 1**:

Product	Description		Position	Weight	Market	Risk	Return	
	Asset Class ^	Currency	Actual	Actual	Last Price	Volatility	Historical	Implied
iPath S&P GSCI Crude Oil TR Index ...	Commodity	USD	2,800,000,00...	14.00%	22.67	10.98%	4.29%	14.39%
Russell 2000 Index	Equity	USD	209,000,000...	1.05%	1,162.47	5.98%	26.27%	14.67%
S&P 500 Index	Equity	USD	1,891,999,99...	9.46%	1,981.60	4.20%	19.53%	13.06%
S&P MidCap 400 Index	Equity	USD	98,999,999.97	0.49%	1,420.83	5.17%	25.19%	13.96%
iShares MSCI EAFE Index Fund (ETF)	Equity	USD	2,200,000,00...	11.00%	66.72	5.05%	20.66%	15.57%
iShares MSCI Emerging Markets Inde...	Equity	USD	2,200,000,00...	11.00%	45.15	5.00%	1.88%	12.67%
PowerShares DB 3x Japanese Gover...	Fixed Income	USD	400,000,000...	2.00%	24.85	2.95%	1.72%	-6.61%
SPDR Barclays International Treasury...	Fixed Income	USD	800,000,000...	4.00%	60.16	2.01%	-3.37%	1.21%
iShares Emerging Markets High Yield...	Fixed Income	USD	400,000,000...	2.00%	52.62	7.41%	4.84%	5.92%
iShares TIPS Bond (TIP)	Fixed Income	USD	1,000,000,00...	5.00%	115.09	4.37%	-3.63%	-2.16%
HRFX Global Hedge Fund Index	Hedge Funds	USD	3,199,999,99...	16.00%	1,239.66	0.95%	5.45%	2.90%
Fidelity US Dollar Cash Fund-A	Money Mar...	USD	400,000,000...	2.00%	11.71	0.01%	0.00%	0.00%
Vista Listed Private Equity Plus A	Private Equ...	USD	2,600,000,00...	13.00%	3.59	4.35%	19.72%	13.39%
SPDR Dow Jones Global Real Estate	Real Estate	USD	1,800,000,00...	9.00%	47.67	7.90%	9.65%	8.18%
Total			19,999,999,9...	100.00%				

Figure 1: Hypothetical \$20 billion Endowment Portfolio

Investment Problem:

Doug now needs to decide how best to implement the investment bucket to target 14% allocation in energy/commodities. He wants to know whether it is better to invest in a traded asset such as a traditional energy ETF or a non-traded asset such as an oil field. ETFs typically have no or very little alpha especially given the size of the portfolio, while a non-traded asset yields higher alpha as well as higher risk. At the moment, he wants to compare the returns on investments relative to the entire portfolio between a typical small size oil field^[1] and an ETF such as the **GSCI Crude Oil TR Index ETN** or an equivalent indexing portfolio. The geological data available suggests that this oil field has a recoverable lifespan of 5 years with the average marginal cost of production^[2] ranging from \$45-\$60^[3] throughout this period. Obtaining reliable cost estimates from geologists allows an investor to purchase an oil field at a customary discount relative to the current spot price of oil of comparable grade, which can be considered as the nominal return of the oil field rather than simply stockpiling the oil asset. Such a discount is justified by the uncertainties in reliably extracting all oil reserve as estimated by geologists. The investment problem to Doug is whether the additional return earned from such discount will justify the additional risk – based on characteristics of the entire portfolio not just the asset on a standalone basis.

[1] A typical small size oil field ranges from 50 mio to 130 mio recoverable barrels of oil.

[2] This is the cost of producing additional one barrel of oil.

[3] This is the best estimate available for this case study.



Portfolio Overview:

Putting **GSCI Crude Oil TR Index ETN** in the portfolio provides a 9+% in its 5-year historical return against volatility of 3%, as shown in **Figure 2**. For an endowment fund seeking only absolute return, such performance statistics appear extremely attractive. However, Doug must also accept the likely possibility that the exceptional performance is a one-off event due to the sharp market recovery after the financial crisis in 2008, and is likely not repeatable.

Portfolio	Volatility	MaxDD	VaR	cVaR	Beta	SR	ASR	Historical Return	Skewness	Kurtosis	Treynor Ratio	Jensen's Measure	Semi-Deviation
Actual Portfolio	2.90%	9.84%	4.67%	5.45%	0.95	2.5706	2.6671	9.45%	0.15	2.50	0.0788	-0.0008	2.70%

Figure 2: Portfolio Statistics with GSCI

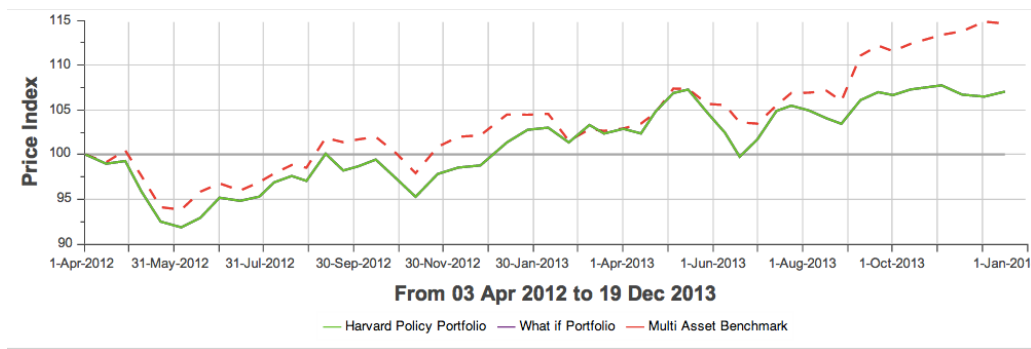


Figure 3: Portfolio Performance Chart^[1]

In other words, such exceptional market returns may only be temporary when the global financial market undergoes through its cycles of boom and bust, and the portfolio will be hurt by the next cycle of events, by which time the portfolio might not look as attractive as it is now. Specifically for his endowment fund, Doug would like to know how the portfolio performs in the long run assuming US Economy keeps a steady but slow growth rate. On the HedgeSPA platform, Doug chooses the “*US Economic Recovery*” scenario, which describes a “goldilocks” economy:

Buy Sell Fields: Default Calc. Horizon: 5 Year Use Active Return Include Cash Use Weekly Import Export												
Description		Position	Weight	Market	Risk	Return		US Economic Recovery				
Product	Asset Class	Currency	Actual	Actual	Last Price	Volatility	Historical	Implied	Pos Chg	Asst Chg	Scen Prc	
iPath S&P GSCI Crude Oil TR Index ...	Commodity	USD	2,800,000,00...	14.00%	22.67	10.98%	4.29%	14.39%	0.66%	4.70%	23.73	
Russell 2000 Index	Equity	USD	209,000,000...	1.05%	1,162.47	5.98%	26.27%	14.67%	0.10%	9.65%	1,274.64	
S&P 500 Index	Equity	USD	1,891,999,99...	9.46%	1,981.60	4.20%	19.53%	13.06%	0.76%	8.00%	2,140.13	
S&P MidCap 400 Index	Equity	USD	98,999,999.97	0.49%	1,420.83	5.17%	25.19%	13.96%	0.05%	9.59%	1,557.15	
iShares MSCI EAFE Index Fund (ETF)	Equity	USD	2,200,000,00...	11.00%	66.72	5.05%	20.66%	15.57%	0.66%	6.02%	70.74	
iShares MSCI Emerging Markets Inde...	Equity	USD	2,200,000,00...	11.00%	45.15	5.00%	1.88%	12.67%	0.35%	3.18%	46.58	
PowerShares DB 3x Japanese Gover...	Fixed Income	USD	400,000,000...	2.00%	24.85	2.95%	1.72%	-6.61%	0.01%	0.75%	25.04	
SPDR Barclays International Treasury...	Fixed Income	USD	800,000,000...	4.00%	60.16	2.01%	-3.37%	1.21%	-0.03%	-0.78%	59.69	
iShares Emerging Markets High Yield...	Fixed Income	USD	400,000,000...	2.00%	52.62	7.41%	4.84%	5.92%	0.08%	3.83%	54.64	
iShares TIPS Bond (TIP)	Fixed Income	USD	1,000,000,00...	5.00%	115.09	4.37%	-3.63%	-2.16%	0.03%	0.60%	115.78	
HFRI Global Hedge Fund Index	Hedge Funds	USD	3,199,999,99...	16.00%	1,239.66	0.95%	5.45%	2.90%	0.38%	2.36%	1,268.88	
Fidelity US Dollar Cash Fund-A	Money Market	USD	400,000,000...	2.00%	11.71	0.01%	0.00%	0.00%	0.00%	0.01%	11.71	
Vista Listed Private Equity Plus A	Private Equity	USD	2,600,000,00...	13.00%	3.59	4.35%	19.72%	13.39%	0.62%	4.77%	3.76	
SPDR Dow Jones Global Real Estate	Real Estate	USD	1,800,000,00...	9.00%	47.67	7.90%	9.65%	8.18%	0.56%	6.20%	50.63	
Total			19,999,999,9...	100.00%					4.22%			

Figure 4: Portfolio with US Economic Recovery scenario



Modeling Strategy:

When Doug incorporates the oil field to the portfolio, he must make a simplifying assumption: oil extraction can be done at a roughly constant rate. Two factors influence the pricing of oil fields: 1) Every day the portion already drilled out of the ground is priced with the difference between WTI^[1] spot price and the marginal cost of production; and 2) the oil underground is modeled as a call option (for the remaining life of the oil field) on WTI spot prices with strike price equal to the marginal cost of production. Instead of using a simple forward contract, he uses a call option because the owner has the option *not* to extract any oil when oil price drops below marginal cost of production; the owner should not continue extraction at a loss, but still has the right to resume in a more favorable market. These are modeled as **Crude Oil – Structured, MCP^[2] 45** and **Crude Oil – Structured, MCP 60**.

Result Analysis:

Since the marginal cost of production ranges from \$45 to \$60, Doug is trying to see what effects the low-end and high-end prices will have on the portfolio. Therefore, he switches from **GSCI Crude Oil TR Index ETN** to **Crude Oil – Structured, MCP 45** and **Crude Oil – Structured, MCP 60**, as shown in **Figure 5** and **Figure 6**:

	Description			Position Actual	Weight Actual	Market Last Price	Risk Volatility	Return		US Economic Recovery		
	Product	Asset Class ^	Currency					Historical	Implied	Pos Chg	Asst Chg	Scen Prc
	Crude Oil - Structured, MCP 45	Commodity	USD	2,800,000,00...	14.00%	53.26	20.62%	18.62%	44.23%	1.91%	13.61%	60.51
	Fidelity US Dollar Cash Fund-A	Money Market	USD	400,000,000....	2.00%	11.71	0.01%	0.00%	0.00%	0.00%	0.01%	11.71
	HFRX Global Hedge Fund Index	Hedge Funds	USD	3,199,999,99...	16.00%	1,239.66	0.95%	5.45%	2.63%	0.38%	2.36%	1,268.88

Figure 5: Portfolio with product “Crude Oil – Structured, MCP 45”

	Description			Position Actual	Weight Actual	Market Last Price	Risk Volatility	Return		US Economic Recovery		
	Product	Asset Class ^	Currency					Historical	Implied	Pos Chg	Asst Chg	Scen Prc
	Crude Oil - Structured, MCP 60	Commodity	USD	2,800,000,00...	14.00%	38.26	29.55%	26.25%	64.64%	2.61%	18.67%	45.40
	Fidelity US Dollar Cash Fund-A	Money Market	USD	400,000,000....	2.00%	11.71	0.01%	0.00%	0.00%	0.00%	0.01%	11.71
	HFRX Global Hedge Fund Index	Hedge Funds	USD	3,199,999,99...	16.00%	1,239.66	0.95%	5.45%	2.14%	0.38%	2.36%	1,268.88

Figure 6: Portfolio data with product “Crude Oil – Structured, MCP 60”

Both of the new products increase the portfolio historical return from 9.84% to 11+% and 12+%, while volatility increases from 2.9% to only 3.77% and 4.72%, respectively. See **Figure 7** and **Figure 8** below:

Portfolio	Volatility	MaxDD	VaR	cVaR	Beta	SR	ASR	Historical Return	Skewness	Kurtosis	Treynor Ratio	Jensen's Measure	Semi-Deviation
Actual Portfolio	3.77%	11.73%	6.64%	8.04%	1.00	2.5073	2.4048	11.45%	-0.38	2.45	0.0767	-0.0036	3.94%

Figure 7: Portfolio data with product “Crude Oil – Structured, MCP 45”

Portfolio	Volatility	MaxDD	VaR	cVaR	Beta	SR	ASR	Historical Return	Skewness	Kurtosis	Treynor Ratio	Jensen's Measure	Semi-Deviation
Actual Portfolio	4.72%	13.37%	8.47%	10.39%	1.05	2.2271	2.1354	12.52%	-0.51	2.62	0.0715	-0.0120	5.04%

Figure 8: Portfolio data with product “Crude Oil – Structured, MCP 60”

[1] WTI, or West Texas Intermediate, is a light sweet oil that is often used as a benchmark in oil pricing.

[2] MCP stands for marginal cost of production.



Doug is still deciding on the right investment product. Like any seasoned investor, he realizes that he needs to do more than looking at historical returns. Having a larger increase in return compared to volatility does not necessarily suggest that the oil field is a better investment than the GSCI ETF, or vice versa. To perform further analysis, he uses the *Return Attribution* analytics on HedgeSPA and produces the following table:

Product Name	Scenario Implied Return ^[1]	Scenario Historical Return	Additional Required Return under Scenario ^[2]	5-Year Additional Required Return	Portfolio Maximum Drawdown	Additional MaxDD (compared to GSCI)	Additional Contribution to MaxDD ^[3]
GSCI	6.43%	4.70%	1.73%	8.65%	9.84%	N.A	N.A.
Oil Field (MCP 45)	21.12%	13.61%	7.51%	37.55%	11.73%	1.89%	13.5%
Oil Field (MCP 60)	31.88%	18.67%	13.21%	66.05%	13.37%	3.53%	25.21%

Figure 9: Scenario Return Comparison

Under this scenario, he can see that the GSCI ETF and the portfolio are performing at roughly the same level, both generating about 4% historical return (**Figure 10**), while the oil field assets outperform their own portfolios 2 to 3 times (**Figure 11 & 12**, 13.61% to 5.47% and 18.67% to 6.18%). That means an oil field investment can help the portfolio reach its target high single-digit return level.

However, Doug worries about the substantial risk as a result of the massive additional contribution to portfolio maximum drawdown: on an unweighted basis, both oil field asset models contribute additional 14% (= $[11.73\% - 9.84\%]/14\%$)^[3] and 25% (= $[13.37\% - 9.84\%]/14\%$)^[3] in portfolio maximum drawdown, meaning that the oil field assets have the potential to cause much larger damages to the portfolio as compared to the GSCI ETF.

This increase in maximum drawdown explains the large difference in the break-even returns (or implied returns, i.e. the return an asset is expected to produce in order to justify the risk that it contributes to the portfolio). The break-even returns of the oil field assets are 15% and 25% higher respectively, meaning that they must be bought at steep discounts in order to justify the additional risks they contribute to the portfolio. The oil field asset with MCP of \$45 requires an approximate 40% additional required returns and the one with MCP of \$60 has an approximation of 66%, both measured over 5 years. Any oil field with MCP falling into this range (\$45-\$60) will require an additional return within the 40% to 66% range. Effectively, these assets require discounts of 40% or more in order to fully compensate for the risk that they may bring to the portfolio.

Return Attribution	Scenario		
	Un ScenRet	Un ScenImplRet	Scen vs Impl
Total	4.22%	4.22%	-
Commodity	4.70%	6.43%	↓
Equity	5.81%	6.18%	↓
Fixed Income	0.70%	-0.25%	↑
Hedge Funds	2.36%	1.30%	↑
Money Market	0.01%	0.00%	↑
Private Equity	4.77%	5.98%	↓
Real Estate	6.20%	3.65%	↑

Figure 10: Return attribution for portfolio with GSCI

Return Attribution	Scenario		
	Un ScenRet	Un ScenImplRet	Scen vs Impl
Total	5.47%	5.47%	-
Commodity	13.61%	21.12%	↓
Equity	5.81%	5.28%	↑
Fixed Income	0.70%	-1.48%	↑
Hedge Funds	2.36%	1.26%	↑
Money Market	0.01%	0.00%	↑
Private Equity	4.77%	5.39%	↓
Real Estate	6.20%	0.67%	↑

Figure 11: Return attribution for oil field portfolio, MCP = \$45

Return Attribution	Scenario		
	Un ScenRet	Un ScenImplRet	Scen vs Impl
Total	6.18%	6.18%	-
Commodity	18.67%	31.88%	↓
Equity	5.81%	4.04%	↑
Fixed Income	0.70%	-1.95%	↑
Hedge Funds	2.36%	1.05%	↑
Money Market	0.01%	0.00%	↑
Private Equity	4.77%	4.30%	↑
Real Estate	6.20%	-1.06%	↑

Figure 12: Return attribution for oil field portfolio, MCP = \$60

[1] The unweighted return the individual product should produce in order to justify the risks it contributes to the portfolio.

[2] This is the difference between Scenario Implied Return and Scenario Historical Return.

[3] It is the calculated by dividing the additional MaxDD by its weight 14%.



The results so far are based on the crude assumption of no liquidation risk. Nevertheless, considering the nature of any non-traded asset, Doug is also concerned his investment committee will ask for a liquidation risk charge, even though they will most likely keep holding onto such an asset until its exhaustion if they choose to invest. To justify this risk, his investment committee may add another 10% to the required return of the oil field asset, which further reduces the profitability of this investment.

Conclusion:

As Doug anticipates, the oil field asset can help the overall portfolio perform better, but he is surprised to see it actually contributes so much risk given existing portfolio characteristics. Therefore, only with an aggressively large discount of roughly 50% can he possibly justify buying the oil field in front of his investment committee. Along with the liquidation problem, the oil field probably fails to meet with the investment objective of an endowment fund: to generate stable return with well managed risks. Doug now realizes that it may not be such a great idea to invest in an oil field. He might want to explore other options for non-traded assets or invest in an ETF directly.

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