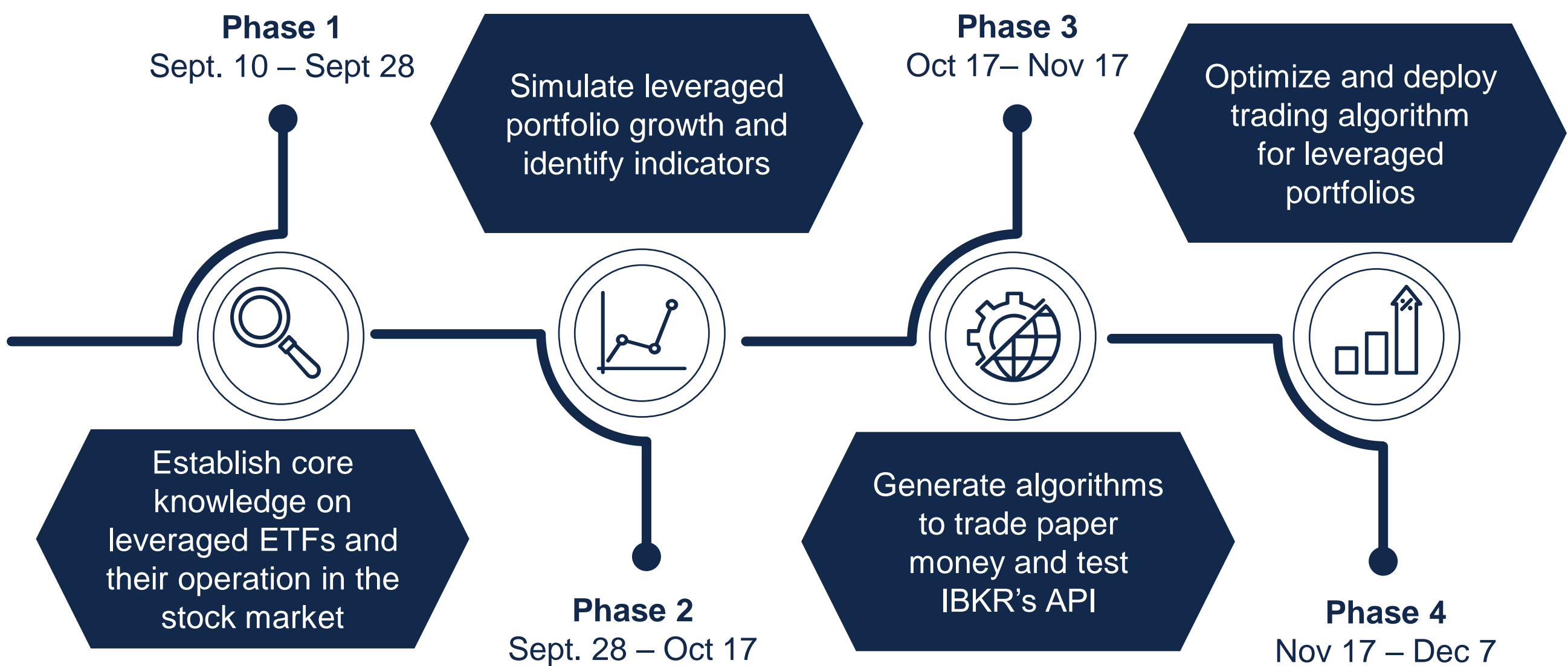


Overview and Timeline

Objective

Our objective is to design and test leverage ETF portfolios and how they compare to long term portfolios. Using a variety of python libraries, we hope to develop an algorithm that will allow us to hedge the market while trading leveraged ETF securities.



Strategy Insights

Tools and Libraries

- Utilized Python and Jupyter Notebook to run simulations and calculations
- Data was extracted through yfinance Python library

Hedging Strategies

- Generate daily performance models using the daily performance algorithm
- Trade following stock indicators such as VIX and long term bond rates
- Daily Performance = (Daily % of underlying total return index) * X - ER/250 - (X - 1) * (1 month LIBOR) * (Current date - previous date)/360
 - ER – Expense Ratio (0.0095)
 - X – Leverage (3)

TQQQ and TMF

- Leveraged ETFs that have a multiplier to a common ETF stock in the stock market. TQQQ ->QQQ, TMF-> Bond
- Using the daily performance algorithm we can calculate the a portfolio with the given stock, minus transaction fees
- Obscure life events such as divergence in borrowing rates, financial crisis, and health outbreaks lead to our simulated model appearing different to the actual data

Improvements

- Hedging model can be improved using backtested data
- Account external factors for non-uniform leverages

Backtesting and Results

Portfolio Analysis Results (Jan 1987 - Dec 2018)

Summary Exposures Metrics Annual Returns Monthly Returns Drawdowns Assets Rolling Returns

Portfolio Allocations

Ticker	Name	Allocation
UPROSIM	UPROSIM	40.00%
TMFSIM	TMFSIM	60.00%

Portfolio Returns

Portfolio	Initial Balance	Final Balance	CAGR	Stdev	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation
Portfolio 1	\$100,000	\$14,045,015	16.71%	23.87%	106.02%	-21.06%	-49.22%	0.64	1.01	0.63
Vanguard 500 Index Investor	\$100,000	\$2,032,752	9.87%	14.79%	37.45%	-37.02%	-50.97%	0.51	0.72	0.99

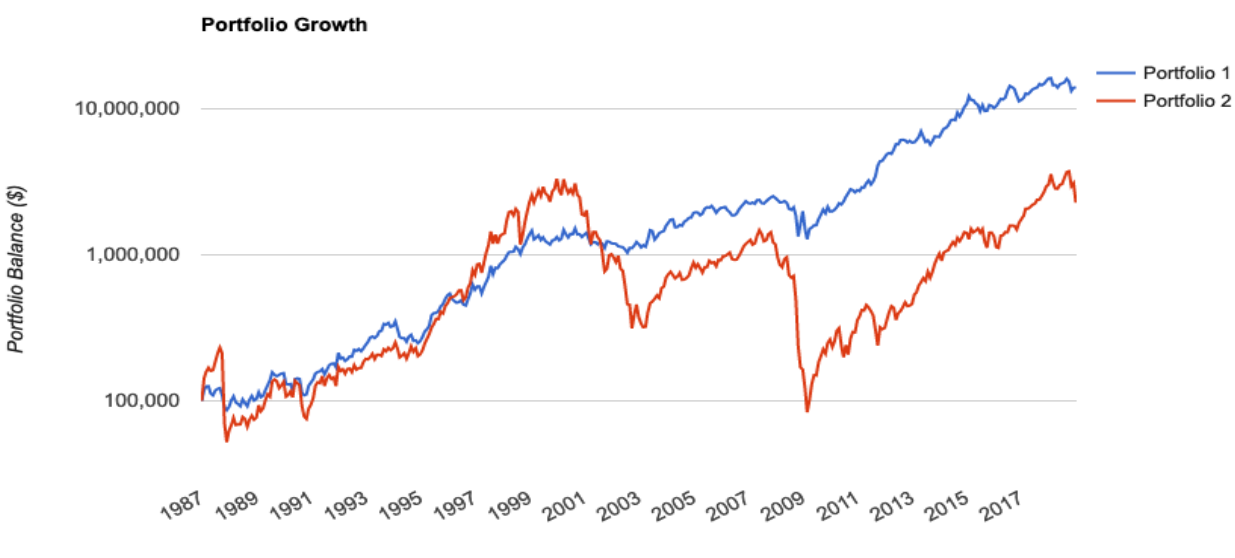
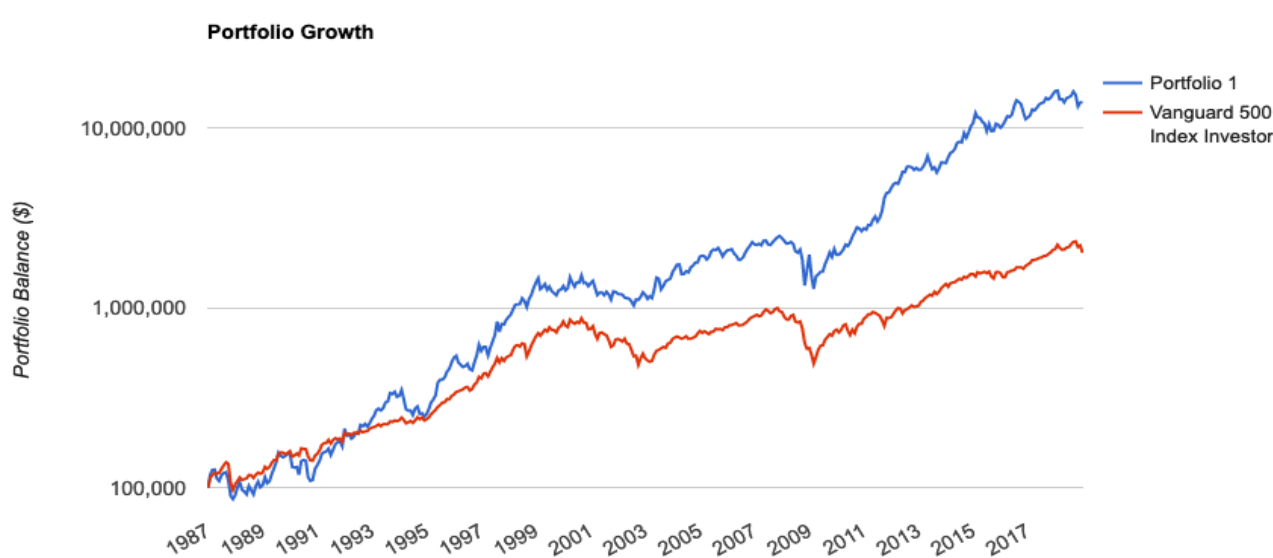
Roll Period	Portfolio 1			Vanguard 500 Index Investor		
	Average	High	Low	Average	High	Low
1 year	20.15%	106.02%	-21.06%	11.27%	37.45%	-37.02%
3 years	18.78%	51.42%	-4.73%	10.65%	31.03%	-14.60%
5 years	18.66%	40.28%	0.46%	10.27%	28.49%	-2.38%
7 years	18.19%	31.17%	6.07%	9.83%	21.44%	-1.64%
10 years	17.30%	29.67%	3.66%	9.32%	19.04%	-1.46%
15 years	15.95%	20.14%	10.75%	8.25%	13.56%	4.13%

Result statistics are based on annualized rolling returns over full calendar year periods

Portfolio	Initial Balance	Final Balance	CAGR	Stdev	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation
Portfolio 1	\$100,000	\$14,045,015	16.71%	23.87%	106.02%	-21.06%	-49.22%	0.64	1.01	0.63
Portfolio 2	\$100,000	\$2,272,646	10.25%	44.84%	123.58%	-86.09%	-97.48%	0.40	0.57	0.99

Drawdowns for Historical Market Stress Periods

Stress Period	Start	End	Portfolio 1	Vanguard 500 Index Investor
Black Monday Period	Sep 1987	Nov 1987	-29.26%	-29.78%
Asian Crisis	Jul 1997	Jan 1998	-12.02%	-5.61%
Russian Debt Default	Jul 1998	Oct 1998	-10.65%	-15.38%
Dotcom Crash	Mar 2000	Oct 2002	-31.87%	-44.82%
Subprime Crisis	Nov 2007	Mar 2009	-49.22%	-50.97%



(From left-most image, clockwise)

1. Portfolio Analysis, 1987 - 2019

(includes tests on simulated data)

2. Rolling Returns (vs. Vanguard 500)

3. Drawdowns in Major Crises

4. Portfolio vs. 100% UPRO (blue vs. red)

Acknowledgements and References

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