

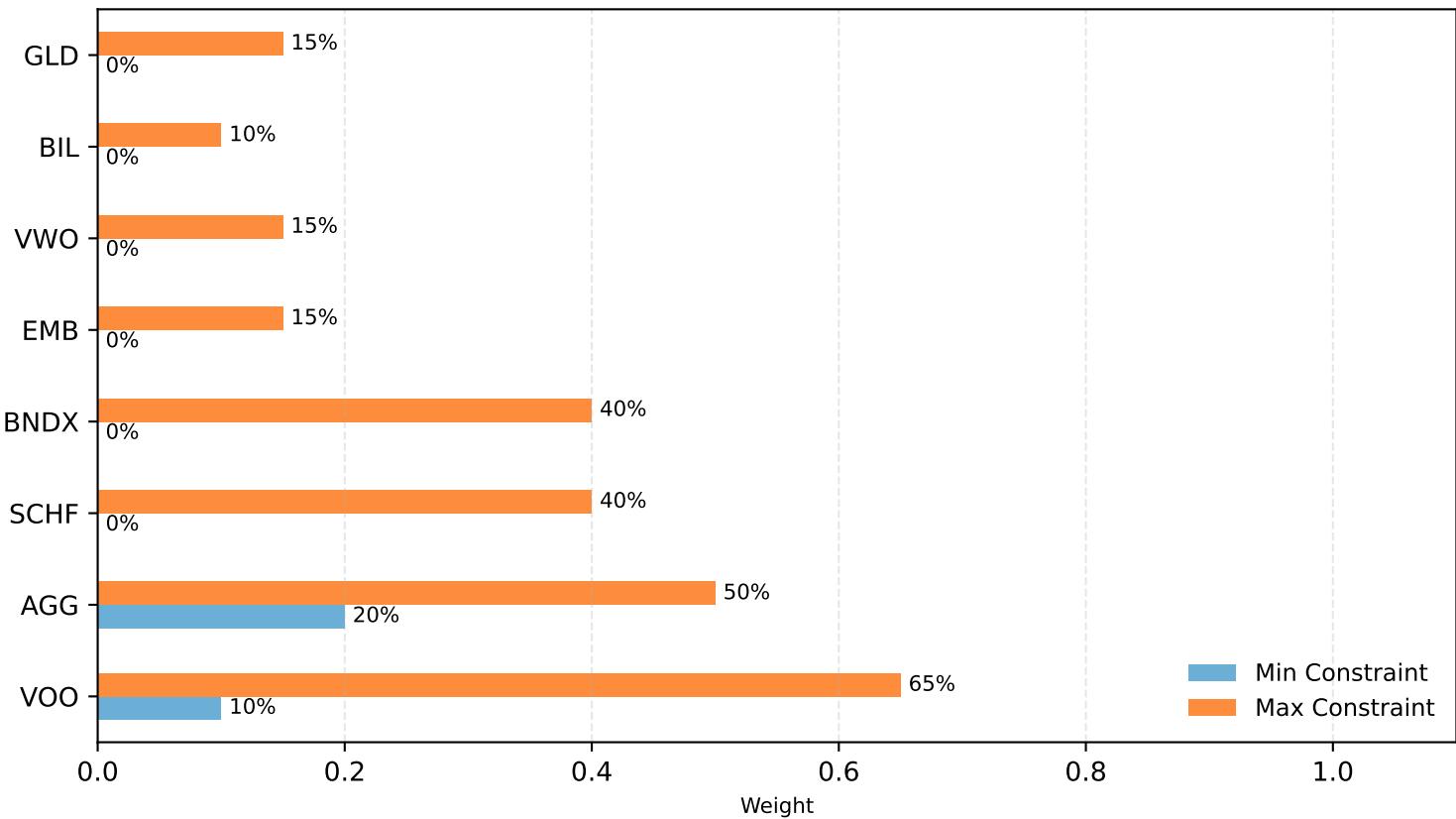
Portfolio Optimization Summary

Basic Details and Constraints Overview

Item	Value
Risk-Free Rate	4.41%
Start Date	2015-06-26
End Date	2025-06-13
Assets Parsed	8

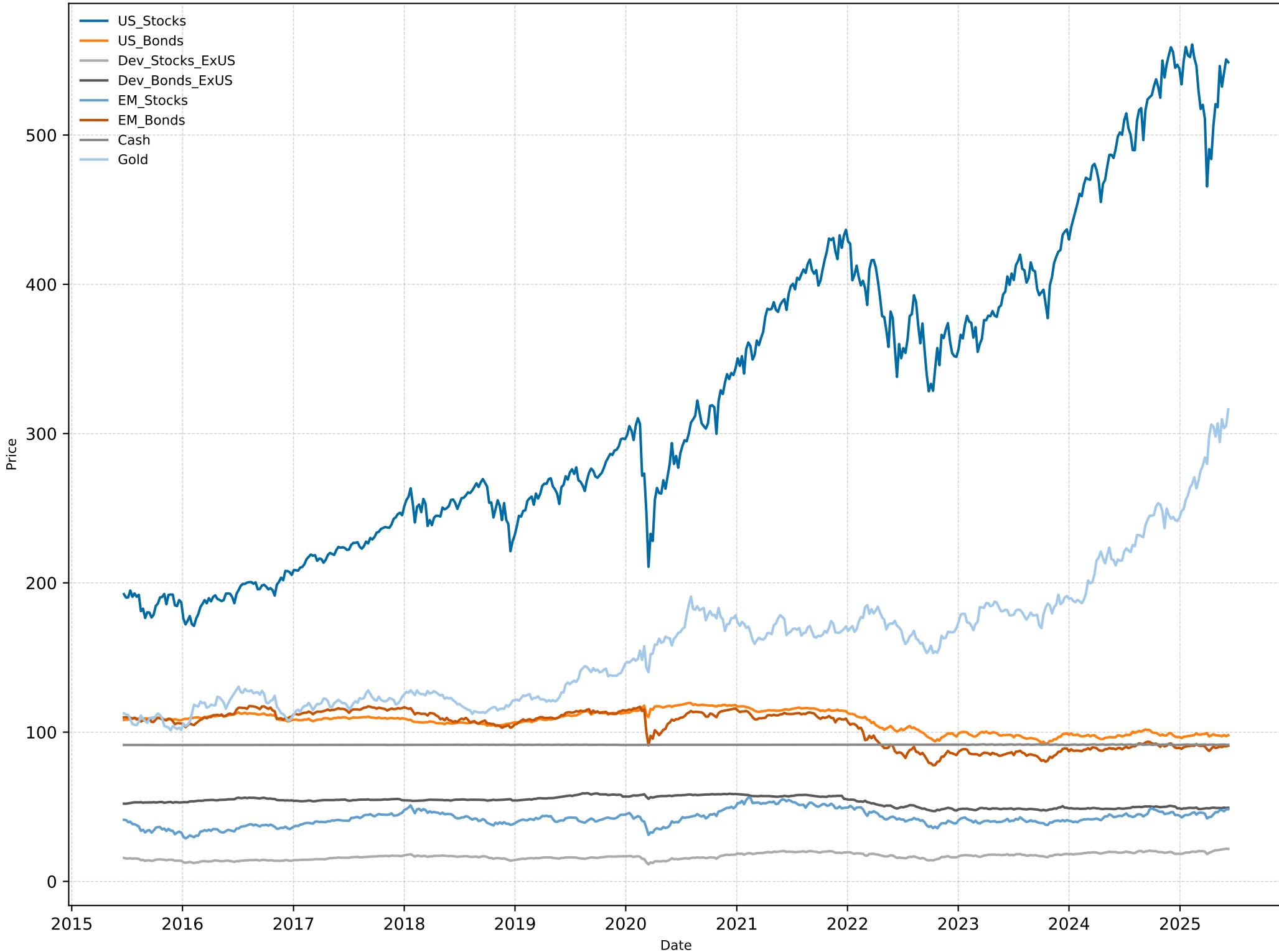
Asset Class	Ticker
US_Stocks	VOO
US_Bonds	AGG
Dev_Stocks_ExUS	SCHF
Dev_Bonds_ExUS	BNDX
EM_Stocks	VWO
EM_Bonds	EMB
Cash	BIL
Gold	GLD

Asset Allocation Constraints

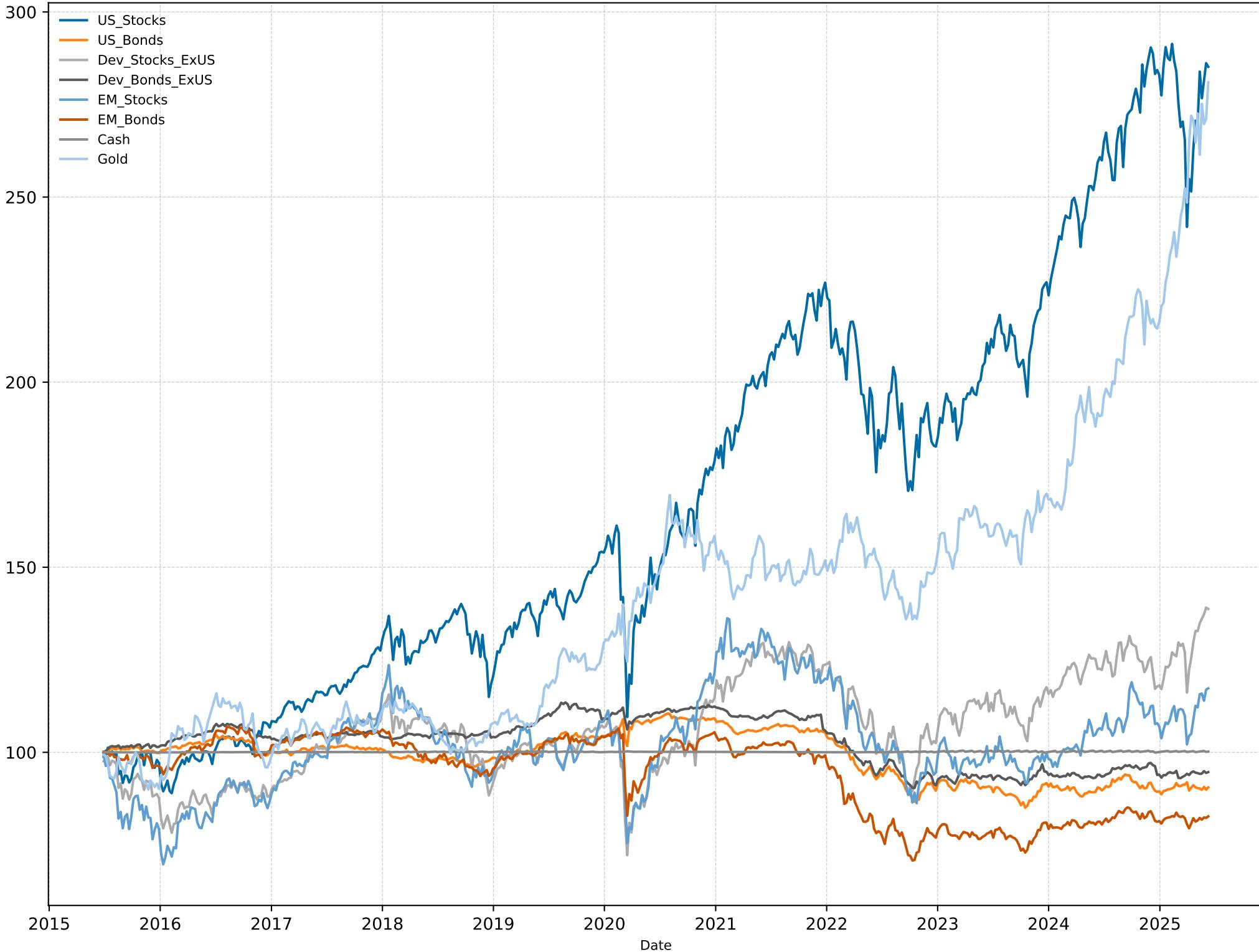


Note: All weights and constraints shown as decimal (0.10 = 10%)

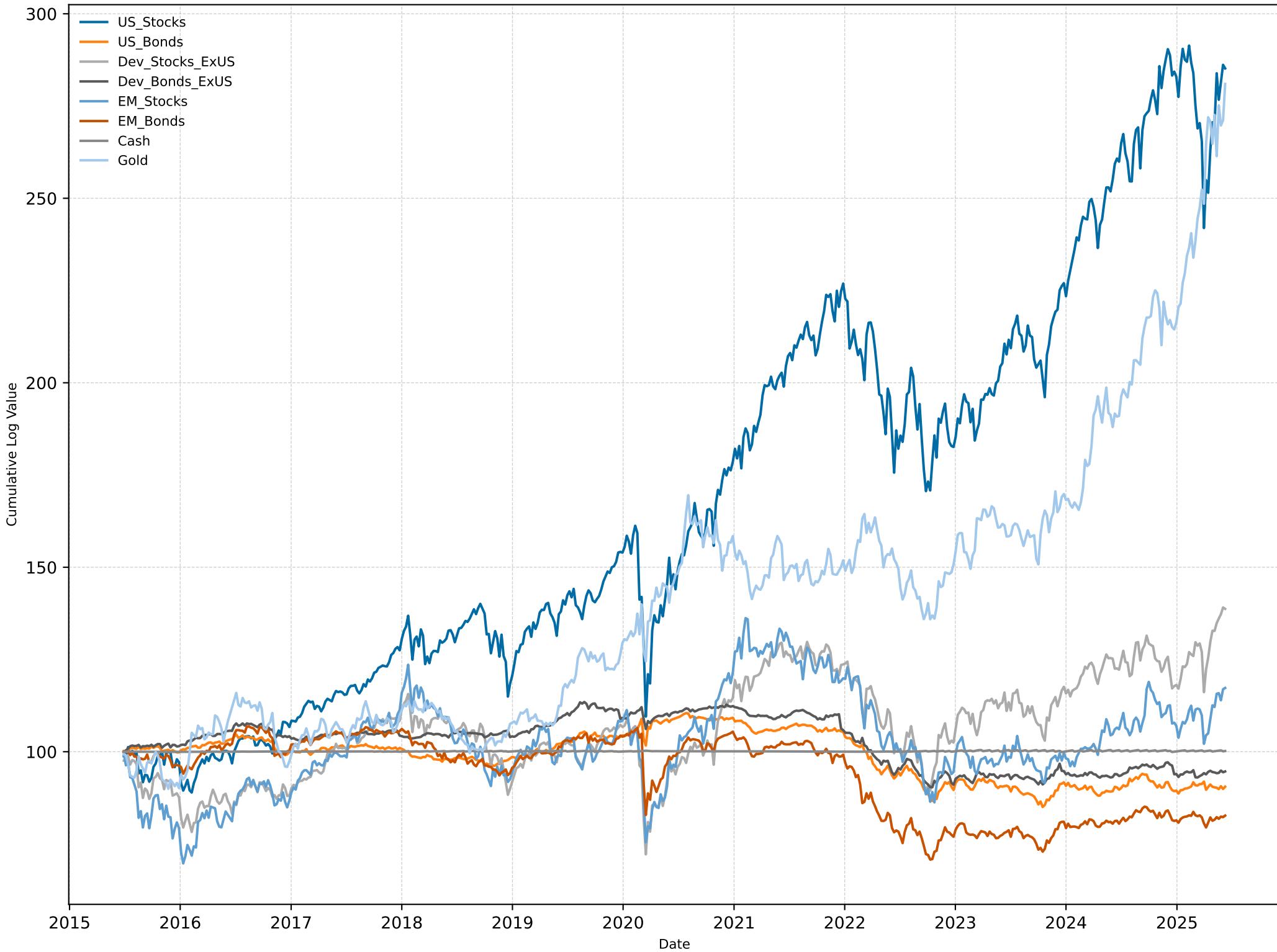
10-Year Weekly Prices of ETF Proxies



Cumulative Returns of Assets (Base = 100)



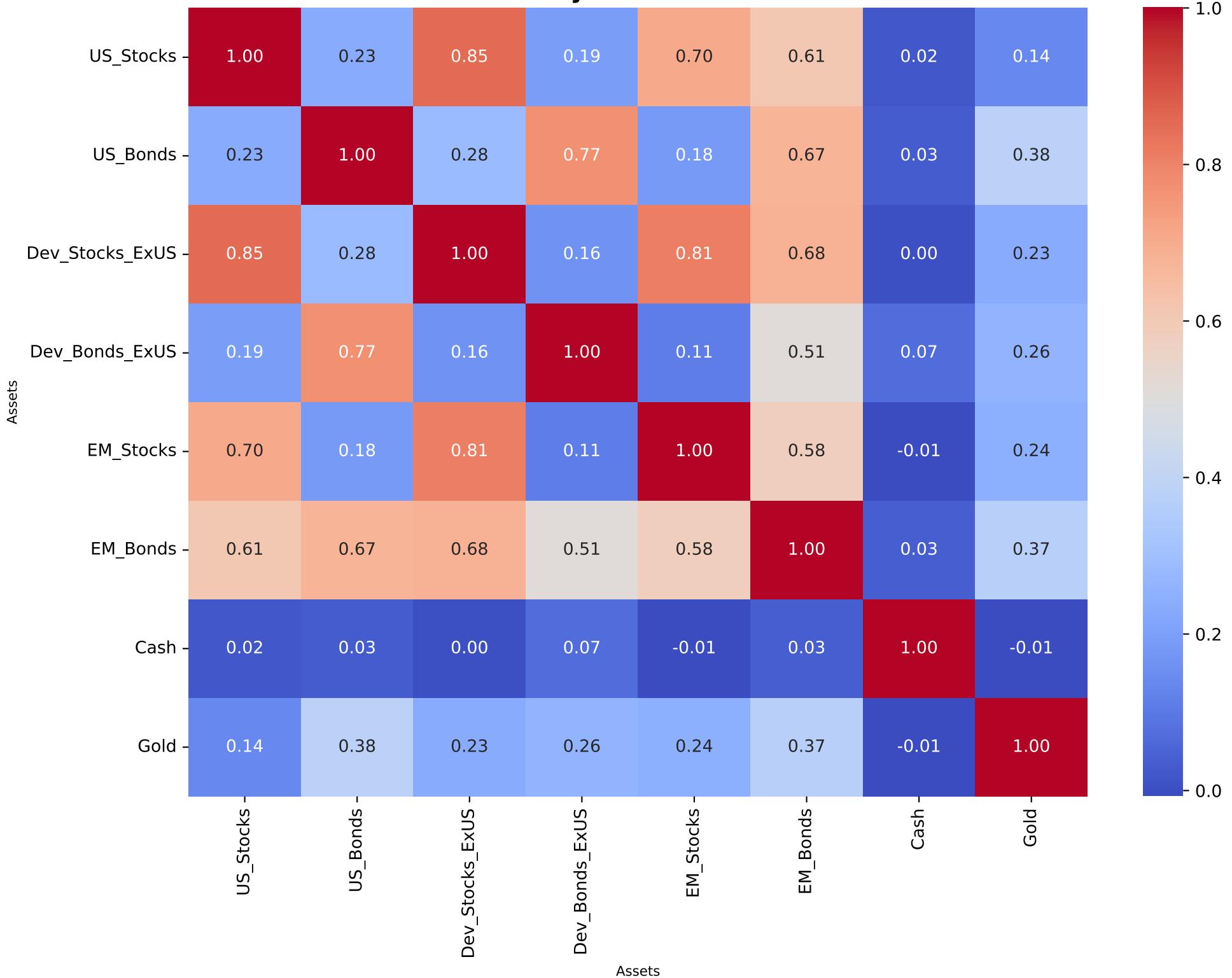
Cumulative Log Returns of Assets (Base = 100)



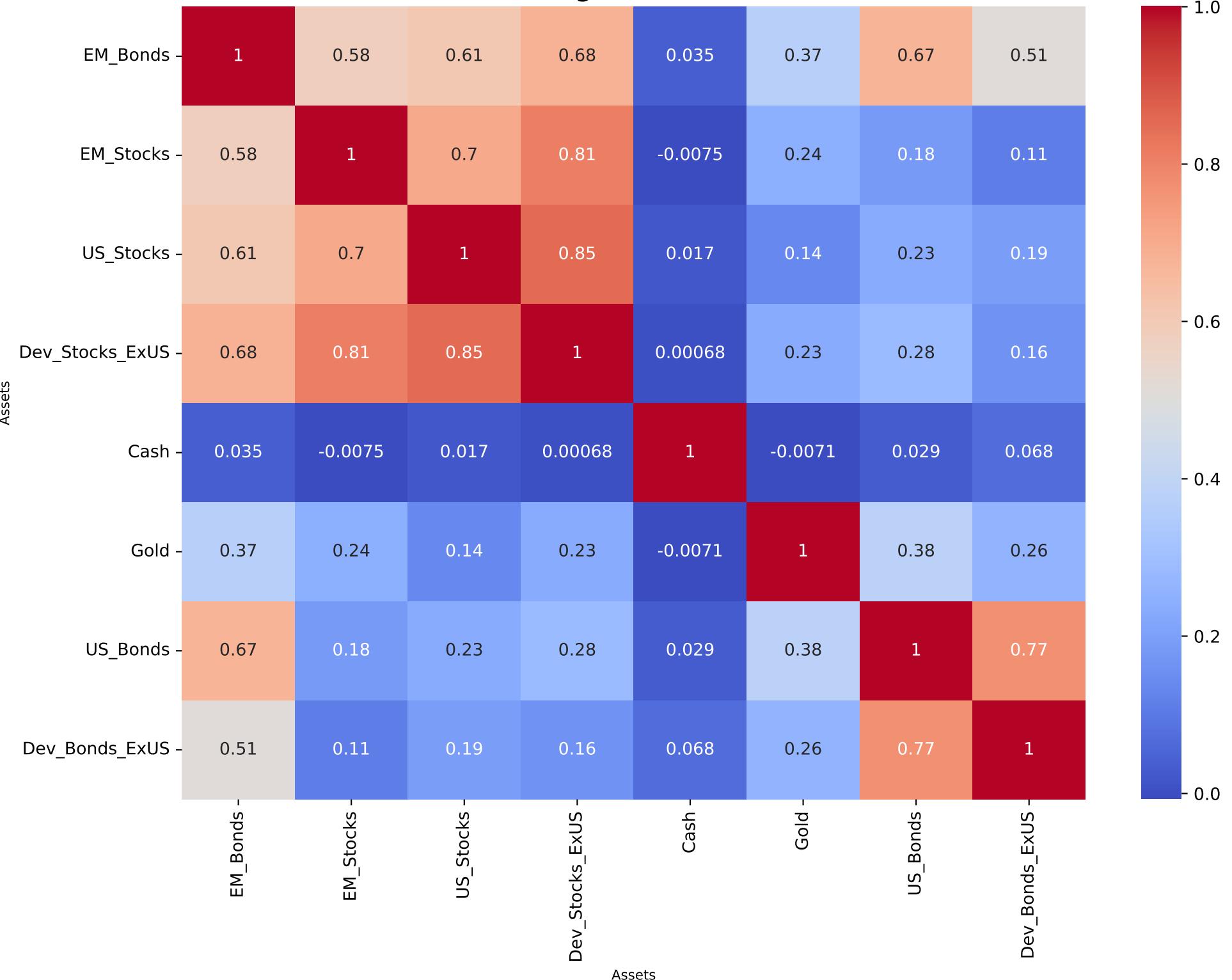
Descriptive Statistics of Weekly Returns (Annualized Where Applicable)

Asset Class	Mean (Ann.)	Standard Deviation (Ann.)	Sharpe Ratio	Skewness	Kurtosis	Max Return	Min Return
Gold	11.36%	14.30%	0.49	0.03	1.77	8.66%	-9.06%
US_Stocks	12.01%	17.38%	0.44	-0.62	6.02	12.13%	-14.90%
Dev_Stocks_ExUS	4.76%	17.21%	0.02	-0.46	5.48	12.16%	-14.40%
EM_Stocks	3.34%	18.63%	-0.06	-0.40	2.06	9.40%	-13.31%
EM_Bonds	-1.39%	9.99%	-0.58	-1.94	20.76	7.09%	-13.22%
US_Bonds	-0.86%	5.19%	-1.02	-0.08	9.33	5.03%	-5.09%
Dev_Bonds_ExUS	-0.45%	4.44%	-1.09	-0.97	4.69	2.04%	-3.55%
Cash	0.02%	0.66%	-6.64	-2.10	4.99	0.15%	-0.36%

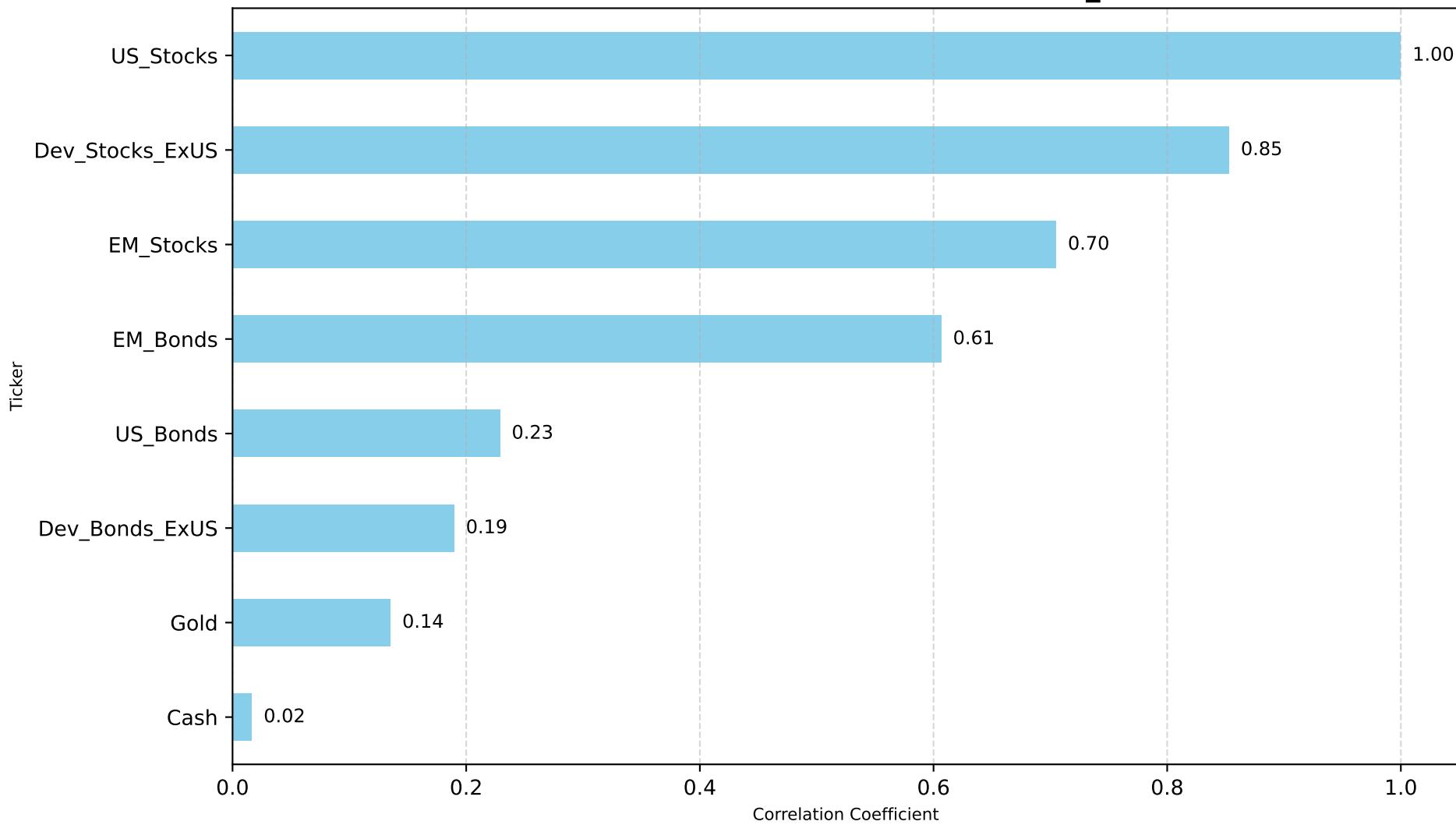
ETF Weekly Return Correlation



Hierarchical Clustering of Asset Returns Correlation



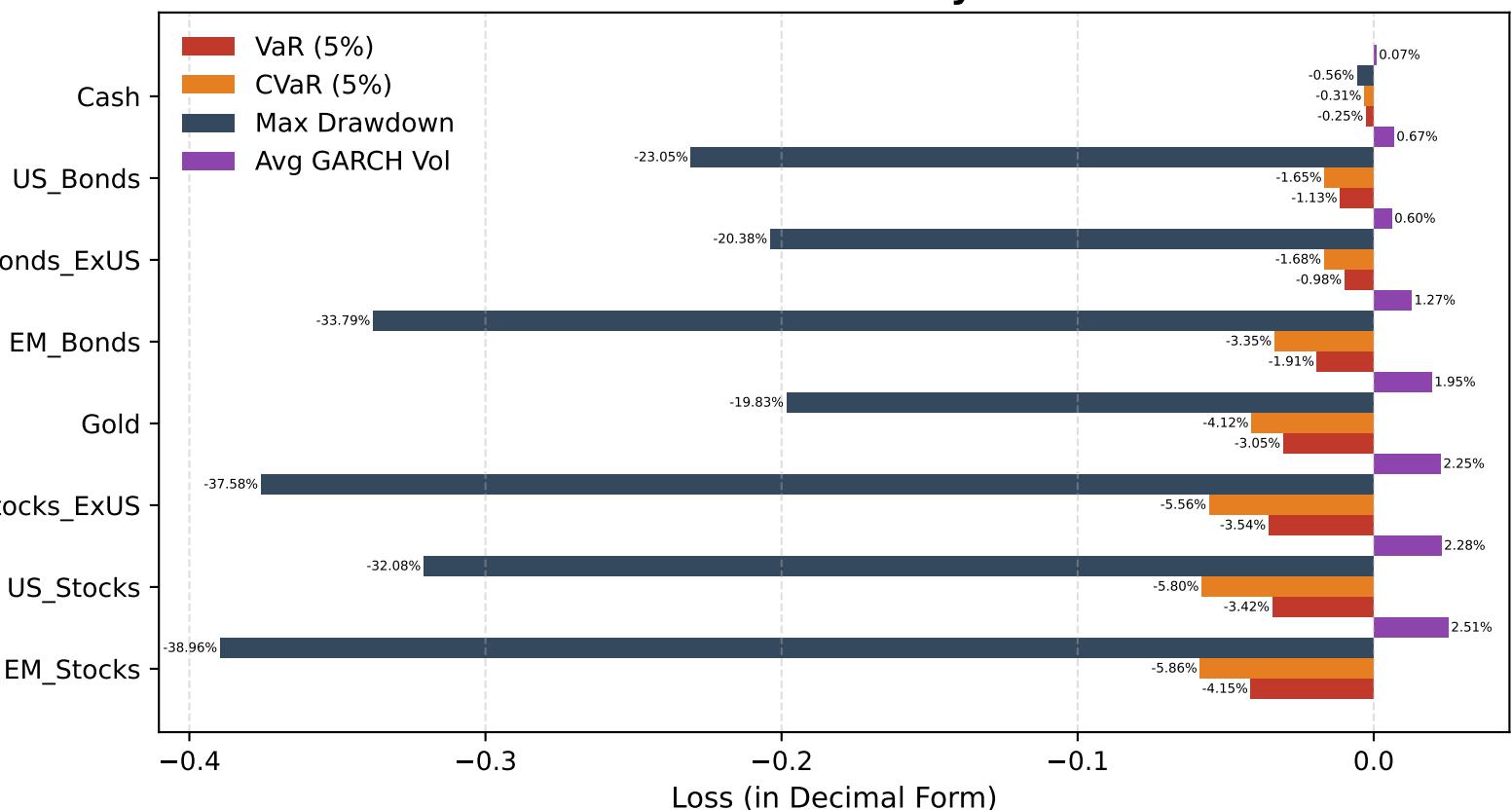
Correlation of Asset Returns with US_Stocks



Downside and Tail Risk Statistics by Asset Class

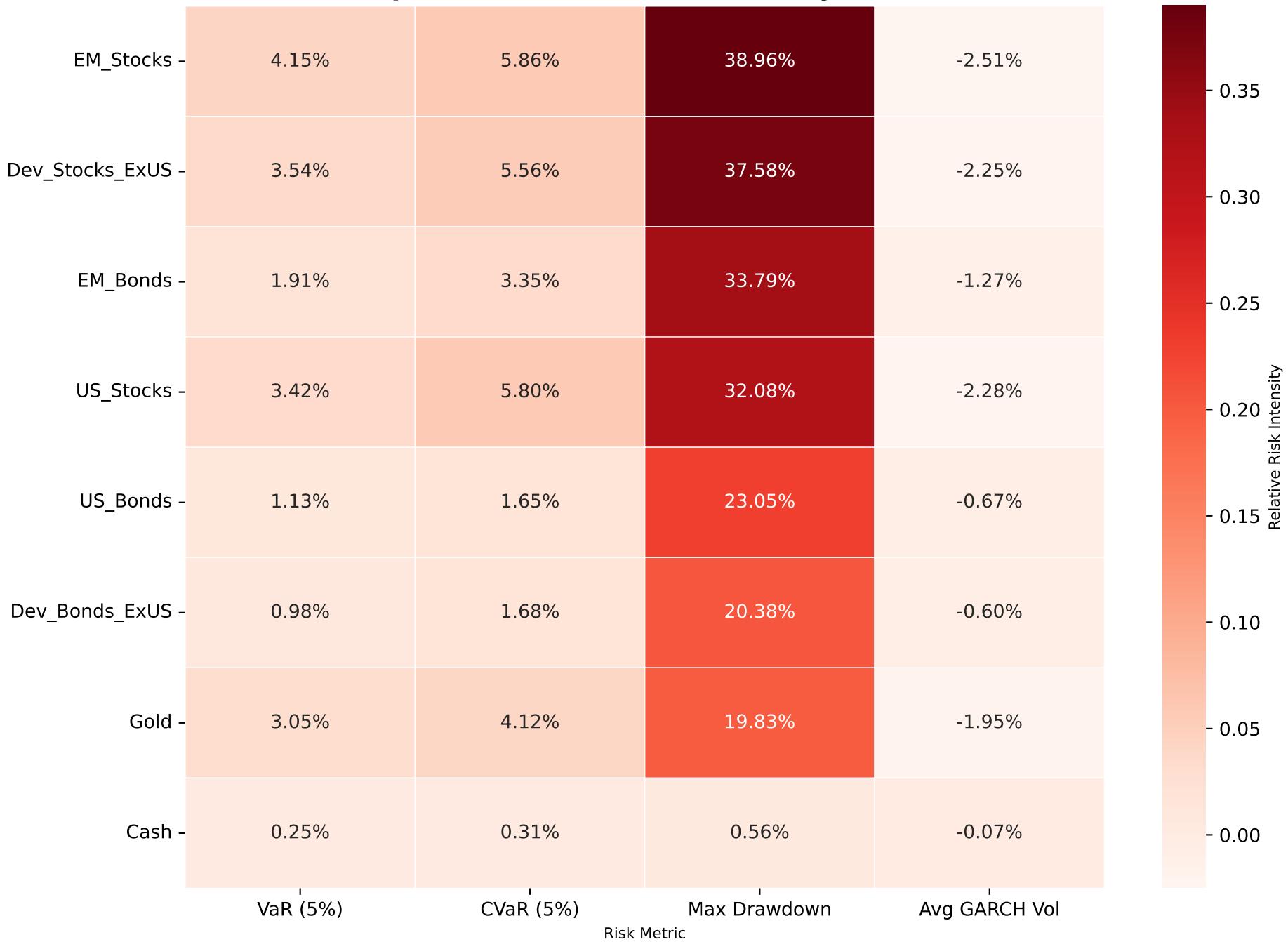
Asset Class	VaR (5%)	CVaR (5%)	Max Drawdown	Beta (vs US_Stocks)	Avg GARCH Vol
US_Stocks	-3.42%	-5.80%	-32.08%	1.00	2.28%
US_Bonds	-1.13%	-1.65%	-23.05%	0.07	0.67%
Dev_Stocks_ExUS	-3.54%	-5.56%	-37.58%	0.84	2.25%
Dev_Bonds_ExUS	-0.98%	-1.68%	-20.38%	0.05	0.60%
EM_Stocks	-4.15%	-5.86%	-38.96%	0.76	2.51%
EM_Bonds	-1.91%	-3.35%	-33.79%	0.35	1.27%
Cash	-0.25%	-0.31%	-0.56%	0.00	0.07%
Gold	-3.05%	-4.12%	-19.83%	0.11	1.95%

Downside Risk Metrics by Asset Class

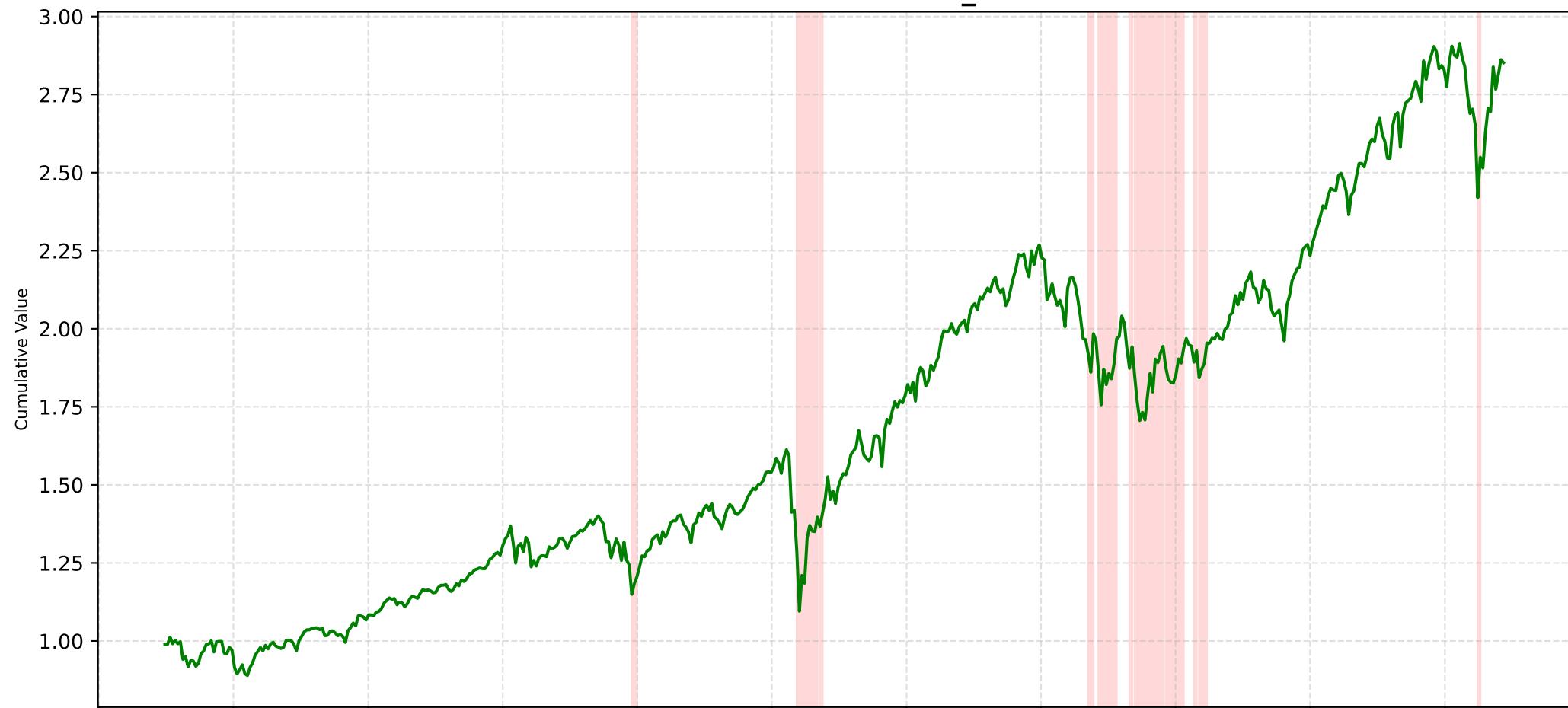


Asset Class	VaR (5%)	CVaR (5%)	Max Drawdown	Avg GARCH Vol
EM_Stocks	-4.15%	-5.86%	-38.96%	2.51%
US_Stocks	-3.42%	-5.80%	-32.08%	2.28%
Dev_Stocks_ExUS	-3.54%	-5.56%	-37.58%	2.25%
Gold	-3.05%	-4.12%	-19.83%	1.95%
EM_Bonds	-1.91%	-3.35%	-33.79%	1.27%
Dev_Bonds_ExUS	-0.98%	-1.68%	-20.38%	0.60%
US_Bonds	-1.13%	-1.65%	-23.05%	0.67%
Cash	-0.25%	-0.31%	-0.56%	0.07%

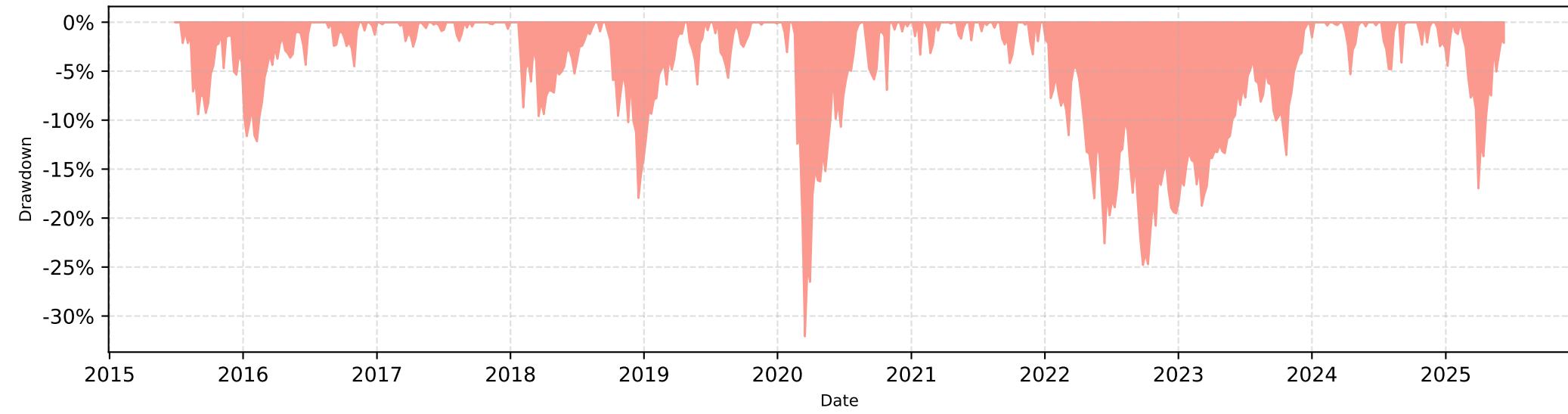
Heatmap of Downside Risk Metrics by Asset Class



Cumulative Return - US_Stocks



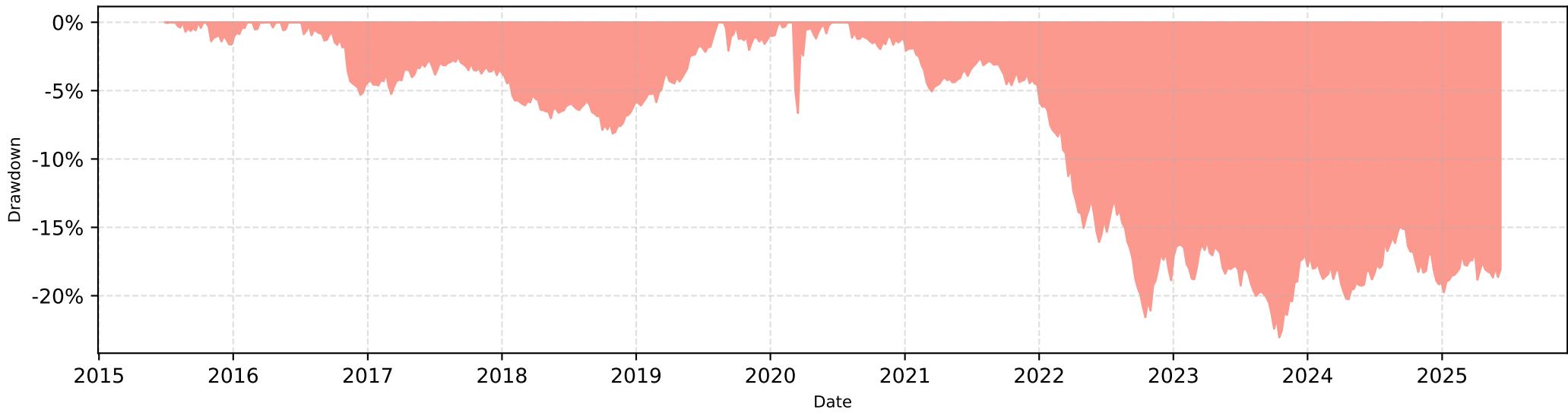
Drawdown Curve



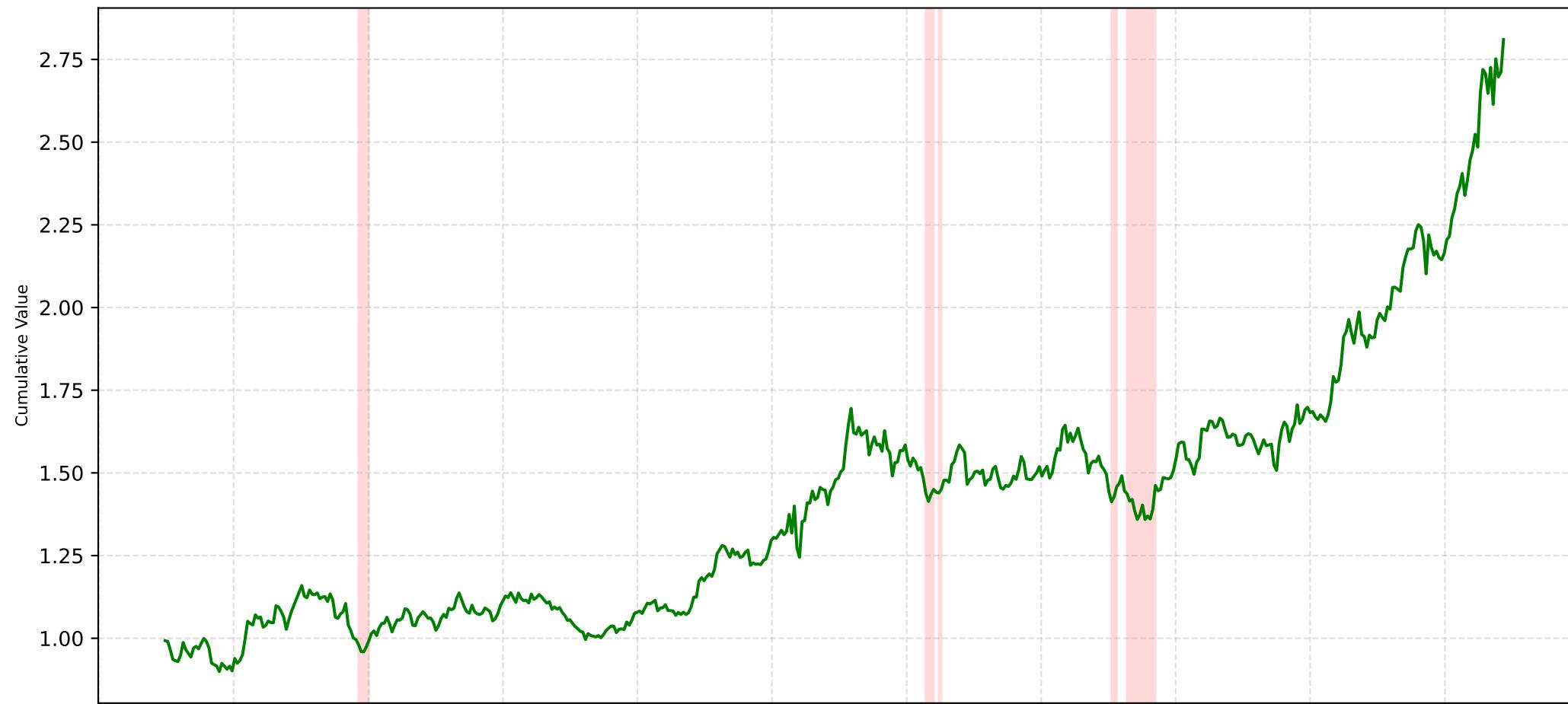
Cumulative Return - US_Bonds



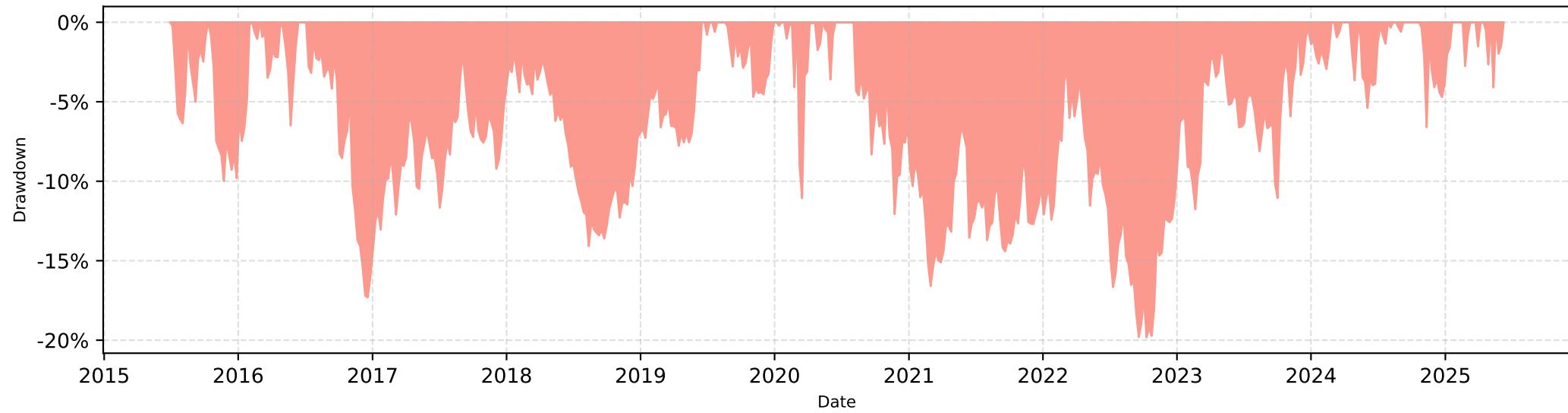
Drawdown Curve



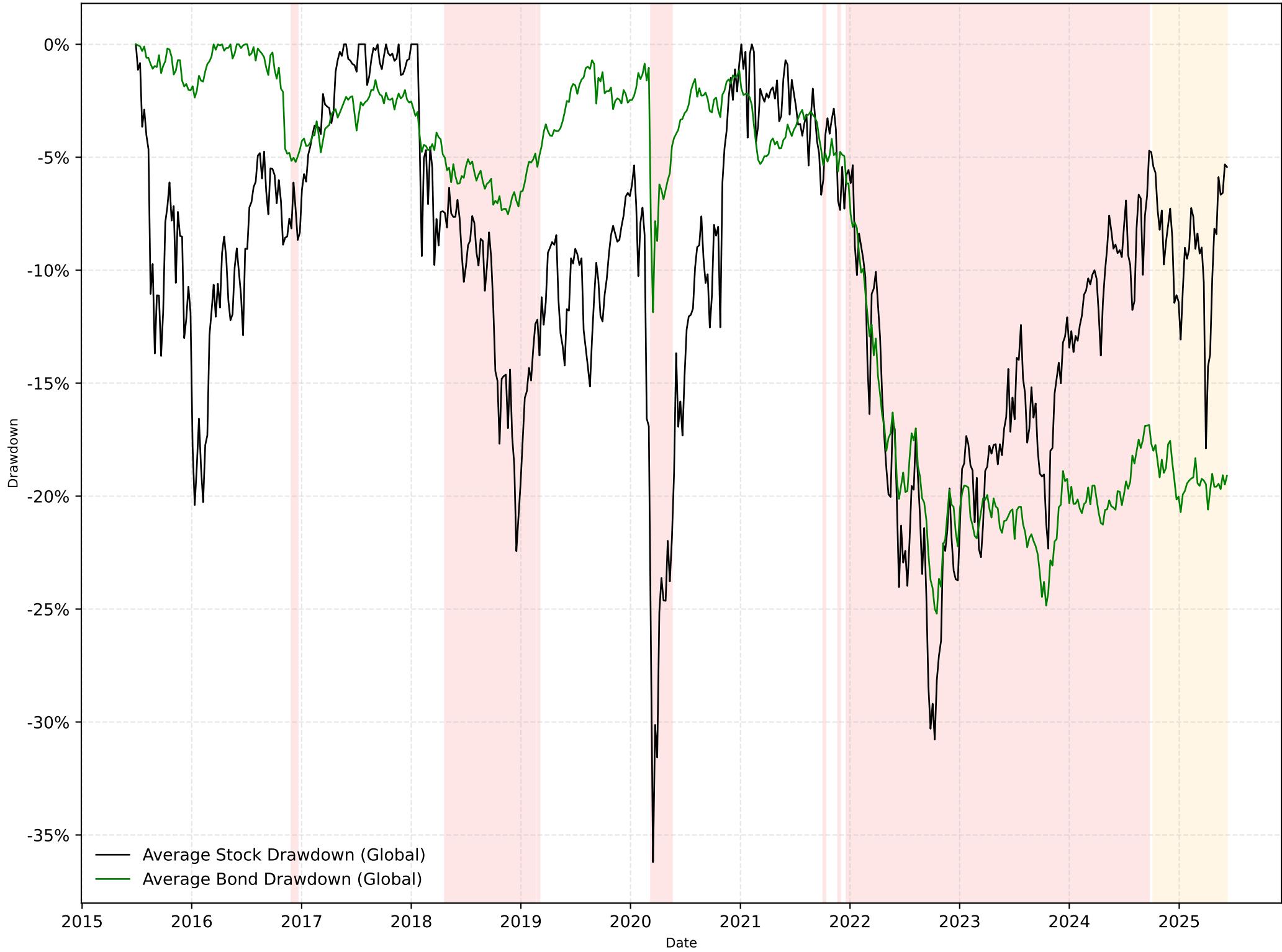
Cumulative Return - Gold



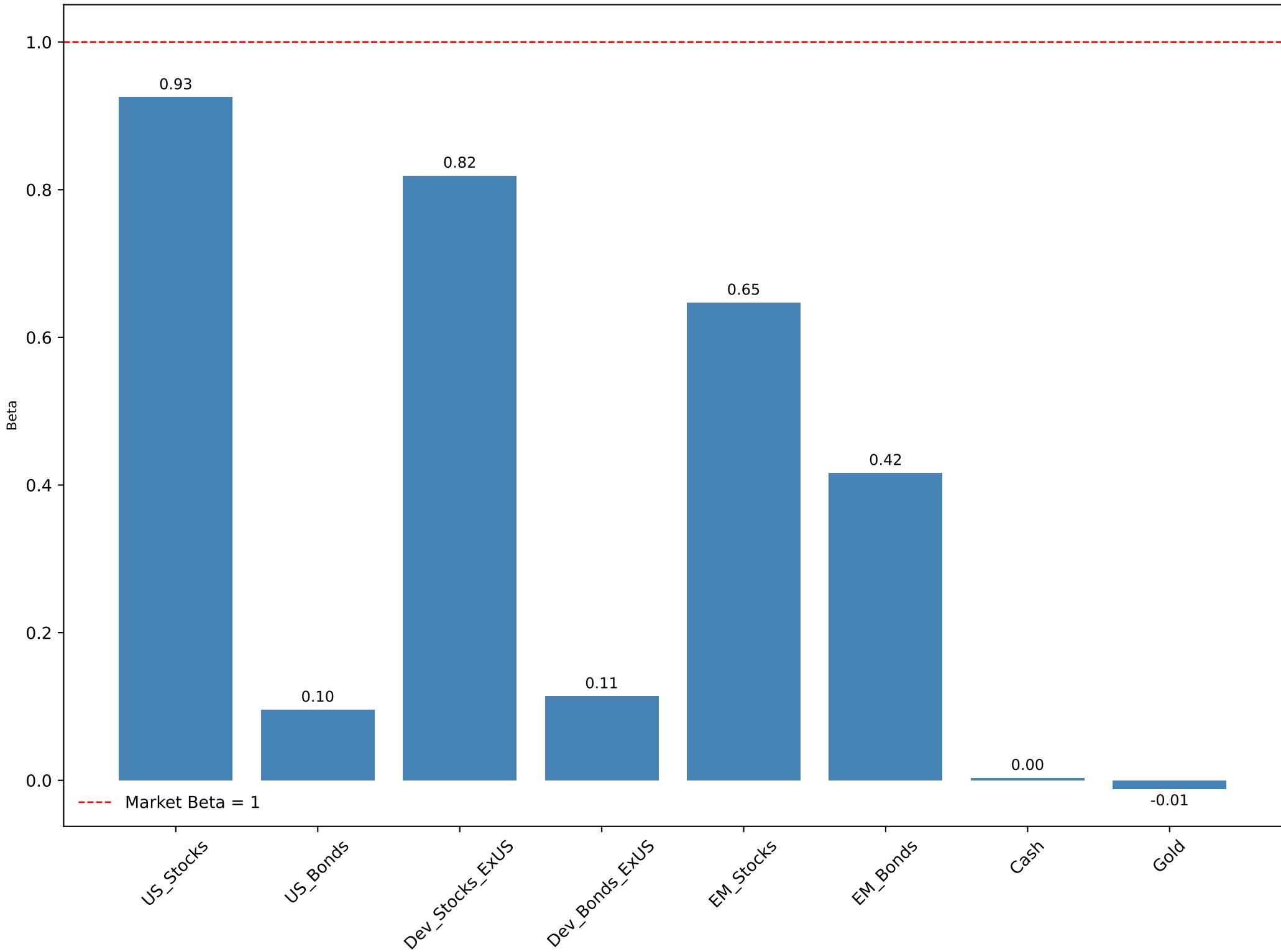
Drawdown Curve



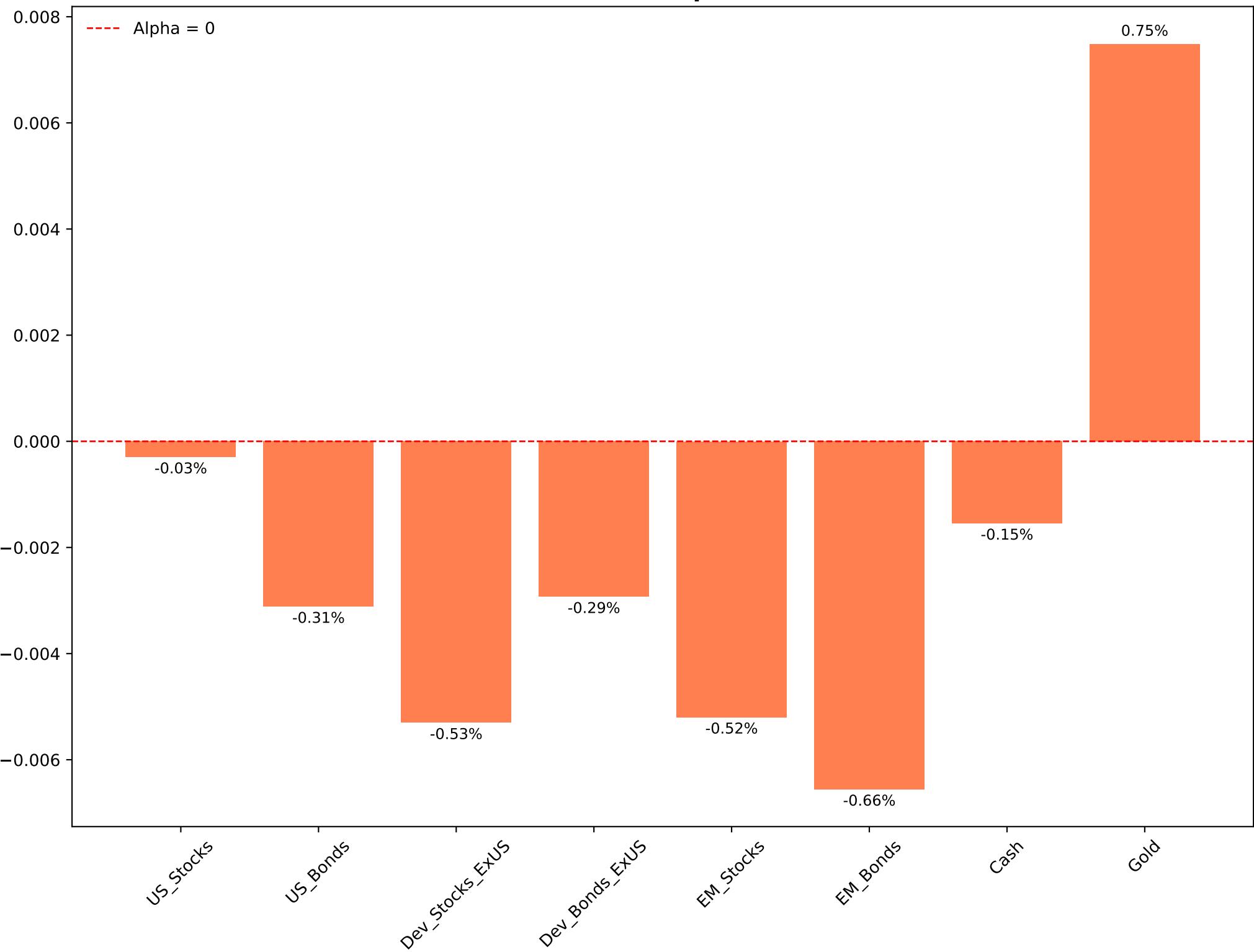
Synchronized Drawdowns: Stocks vs Bonds



CAPM Beta

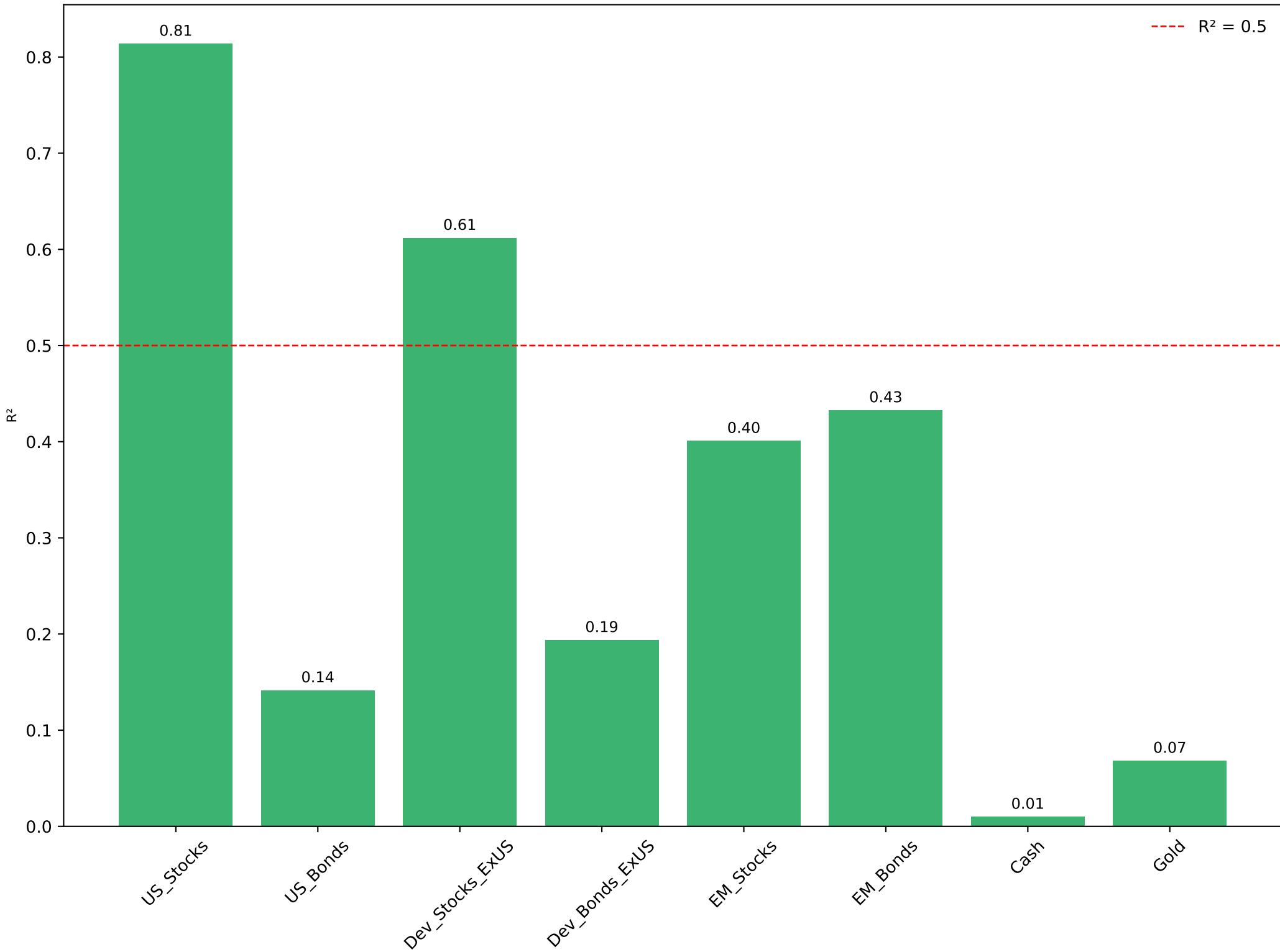


CAPM Alpha



Multi-Factor Model R²

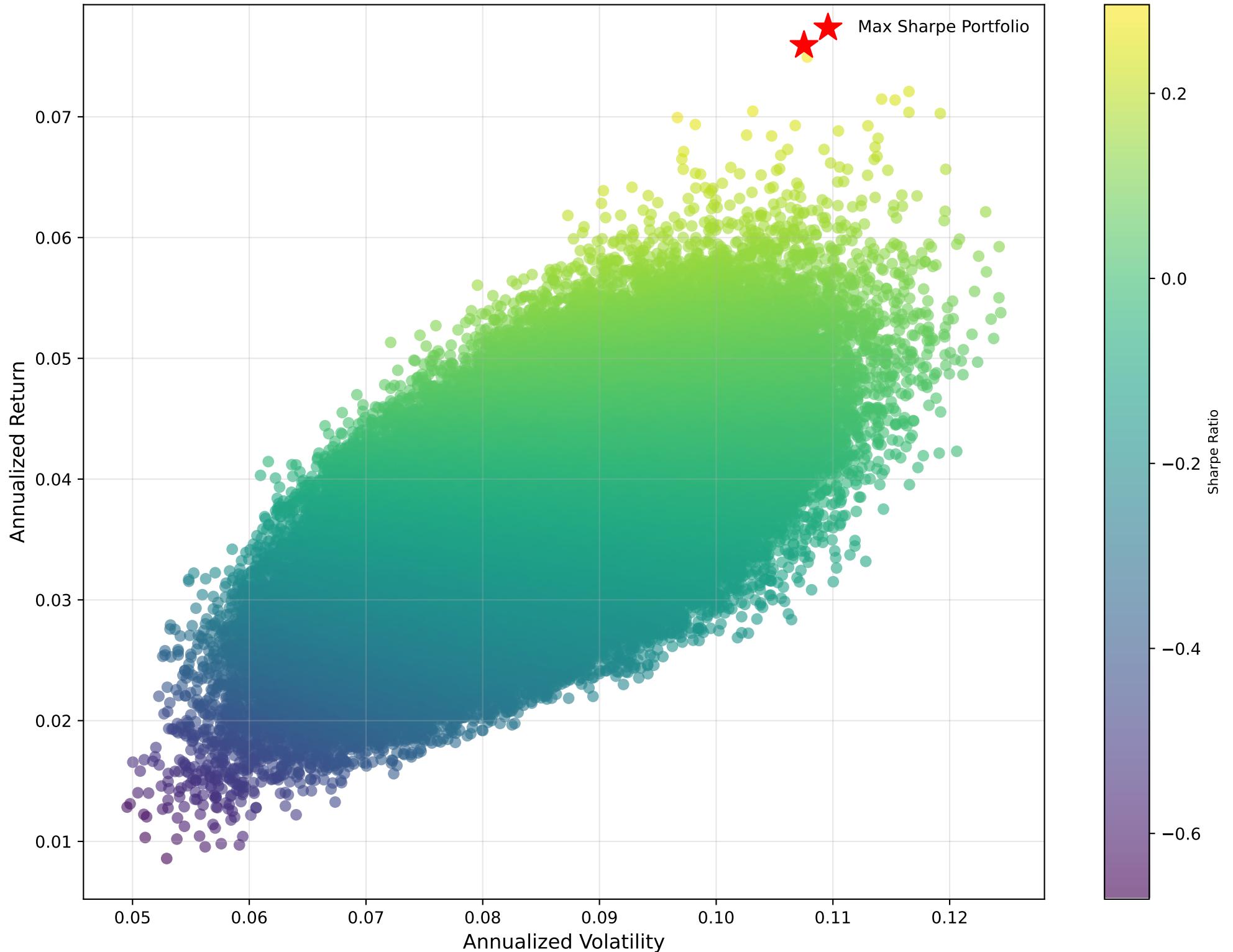
R² = 0.5



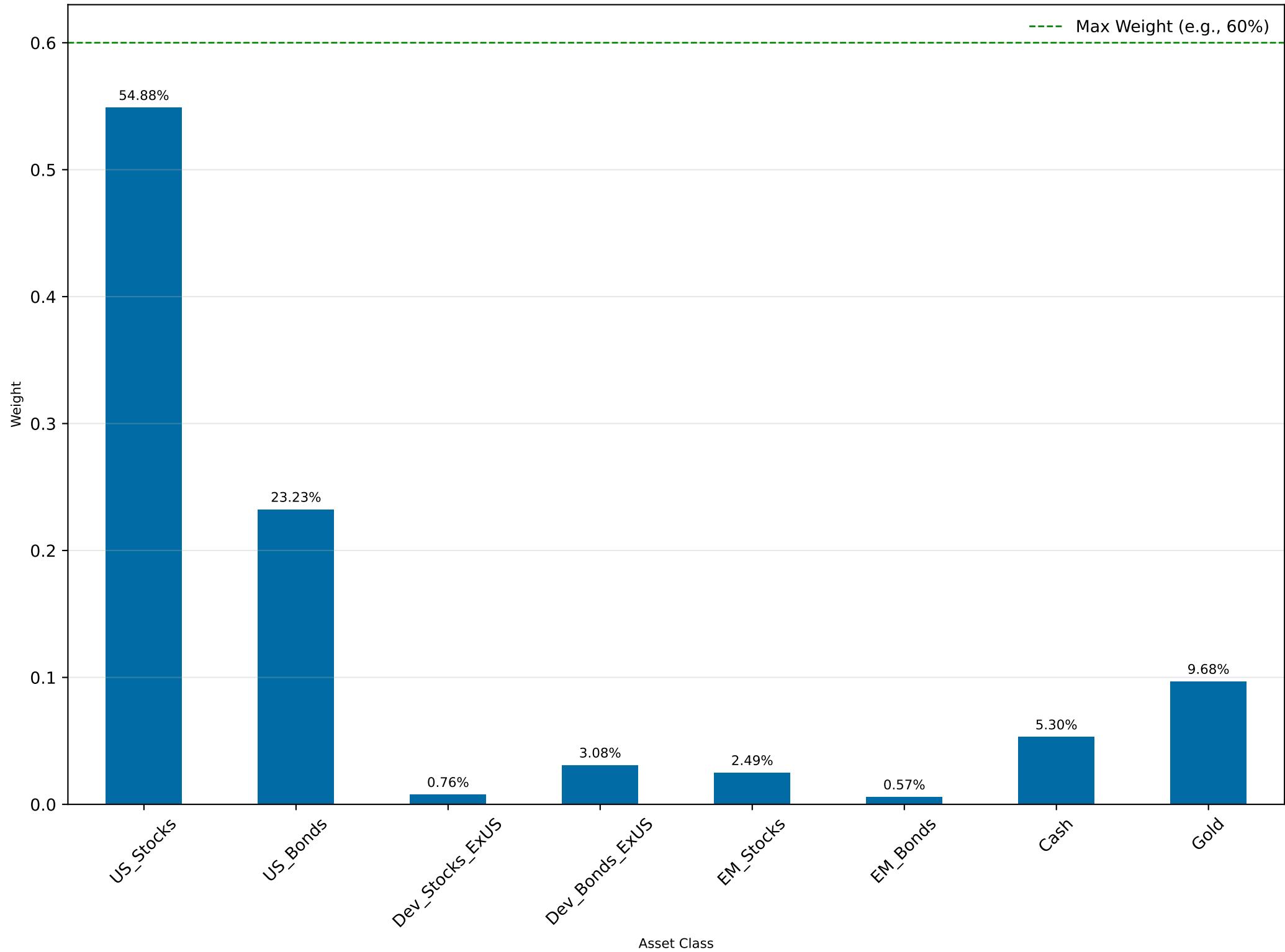
CAPM & Multi-Factor Regression Summary

Asset Class	CAPM Beta	CAPM Alpha	MFC R ²
US_Stocks	0.925	-0.0297%	0.814
US_Bonds	0.096	-0.3114%	0.141
Dev_Stocks_ExUS	0.819	-0.5303%	0.612
Dev_Bonds_ExUS	0.114	-0.2928%	0.194
EM_Stocks	0.647	-0.5199%	0.401
EM_Bonds	0.416	-0.6557%	0.433
Cash	0.003	-0.1546%	0.01
Gold	-0.012	0.7490%	0.068

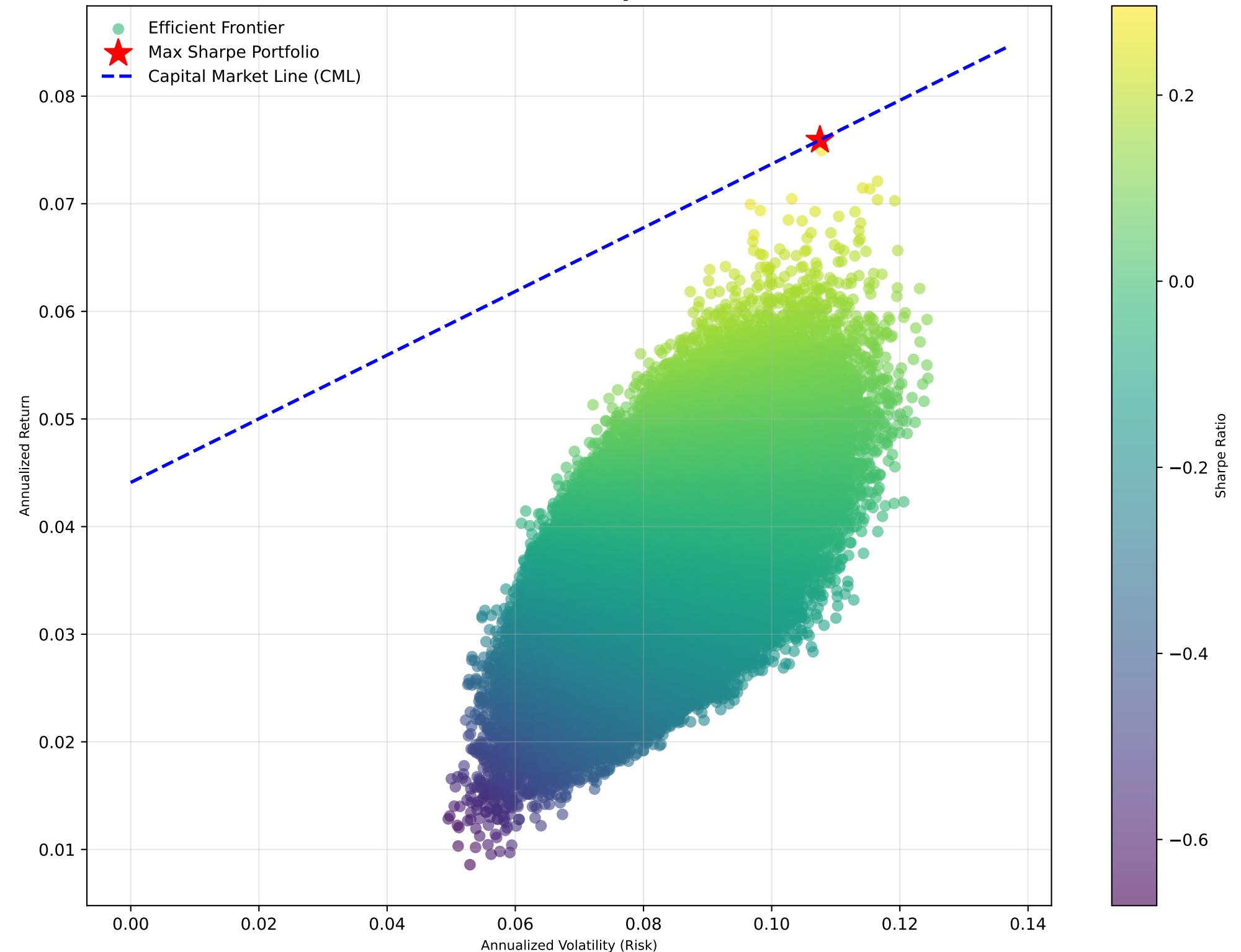
Efficient Frontier with Constraints



Optimal Portfolio Allocation



Efficient Frontier with Capital Market Line



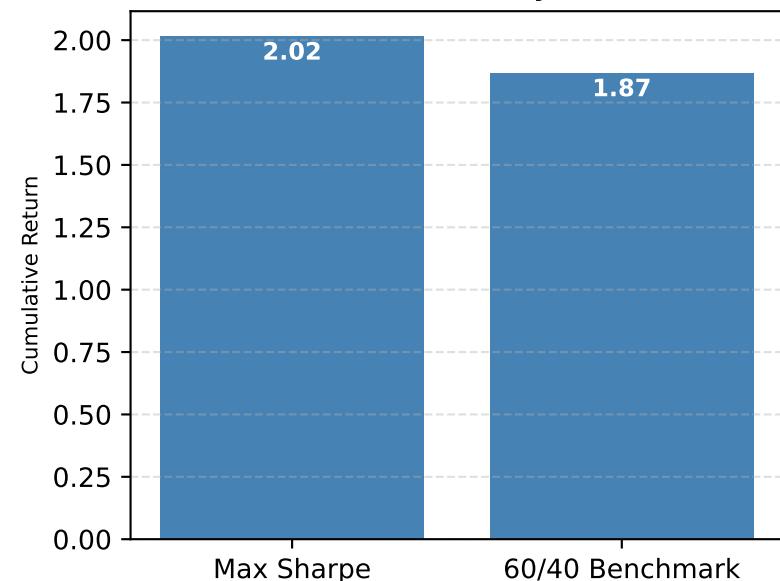
Comparison of Optimal and Minimum Variance Portfolios with Constraints

Asset Class	Weight	Return	Standard Deviation	Sharpe Ratio
US_Stocks	54.88%	12.01%	17.38%	0.44
US_Bonds	23.23%	-0.86%	5.19%	-1.02
Dev_Stocks_ExUS	0.76%	4.76%	17.21%	0.02
Dev_Bonds_ExUS	3.08%	-0.45%	4.44%	-1.09
EM_Stocks	2.49%	3.34%	18.63%	-0.06
EM_Bonds	0.57%	-1.39%	9.99%	-0.58
Cash	5.30%	0.02%	0.66%	-6.64
Gold	9.68%	11.36%	14.30%	0.49
Expected Optimal Portfolio	100.00%	7.59%	10.75%	0.30

Asset Class	Weight	Return	Standard Deviation	Sharpe Ratio
US_Stocks	14.22%	12.01%	17.38%	0.44
US_Bonds	31.45%	-0.86%	5.19%	-1.02
Dev_Stocks_ExUS	0.34%	4.76%	17.21%	0.02
Dev_Bonds_ExUS	38.03%	-0.45%	4.44%	-1.09
EM_Stocks	1.55%	3.34%	18.63%	-0.06
EM_Bonds	4.44%	-1.39%	9.99%	-0.58
Cash	9.89%	0.02%	0.66%	-6.64
Gold	0.08%	11.36%	14.30%	0.49
Expected Min Portfolio	100.00%	1.28%	4.95%	-0.63

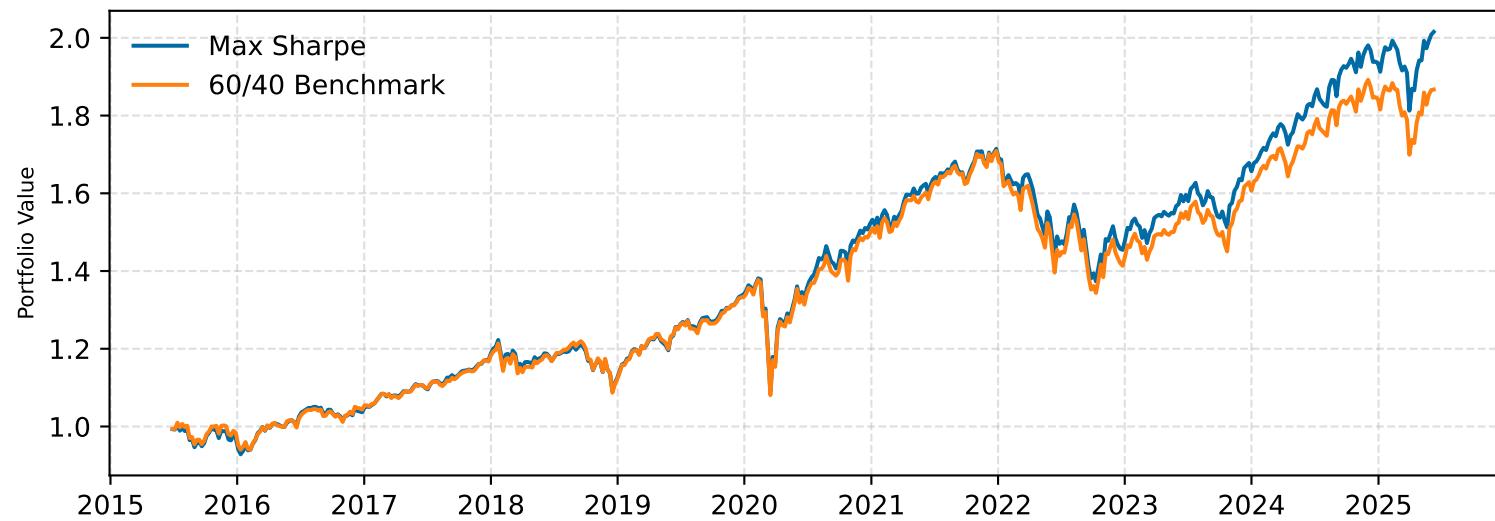
Backtest Performance Summary

Cumulative Return by Portfolio

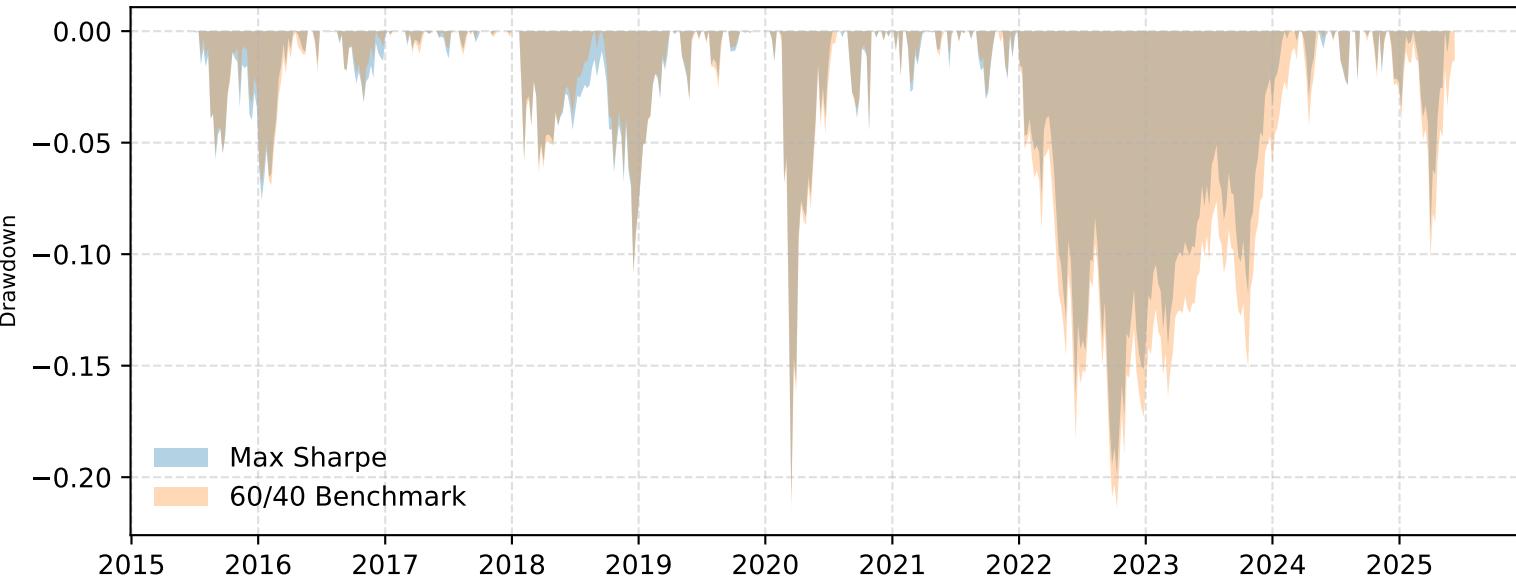


Metric	Max Sharpe	60/40 Benchmark
Cumulative Return	1.0152	0.8671
Annualized Return	0.0759	0.0686
Annualized Volatility	0.1075	0.1109
Sharpe Ratio	0.2959	0.2213
Sortino Ratio	0.3716	0.2775
Max Drawdown	-0.2103	-0.2152

Cumulative Return Over Time



Drawdown Curve



Backtest Summary Statistics

Asset Class	Cumulative Return	Annualized Return	Annualized Volatility	Sharpe Ratio	Sortino Ratio	Max Drawdown
US_Stocks	1.8519	0.1201	0.1738	0.4375	0.5433	-0.3208
US_Bonds	-0.0947	-0.0086	0.0519	-1.0161	-1.3544	-0.2305
Dev_Stocks_ExUS	0.3872	0.0476	0.1721	0.0206	0.0269	-0.3758
Dev_Bonds_ExUS	-0.0534	-0.0045	0.0444	-1.0947	-1.2904	-0.2038
EM_Stocks	0.1728	0.0334	0.1863	-0.0575	-0.0811	-0.3896
EM_Bonds	-0.173	-0.0139	0.0999	-0.5809	-0.6461	-0.3379
Cash	0.002	0.0002	0.0066	-6.6405	-5.3716	-0.0056
Gold	1.81	0.1136	0.143	0.4862	0.7597	-0.1983