The Risky Business of Safe Investing Optimizing Conservative Portfolios

FA24-AAI-500 FINAL PROJECT

PRESENTED BY CARRIE LITTLE AND IAN LUCAS

https://github.com/littlecl42/AAA500_FinalProject_CL_IL

Agenda

- Introduction
- Data Overview
- Data Analysis
- Portfolio Strategies
- Key Findings
- Recommendations
- Conclusion
- Next Steps

Introduction

- **Background**

  Significant client losses in 2022 prompted a shift to safer Treasury Bills. With rate cuts now likely, clients are looking for alternative strategies that return over 4% with reduced risk.

- **Goal**

  Explore new investment strategies using liquid funds, comparing Risk Parity, Minimum Variance, and Maximum Diversification approaches to provide enhanced returns while managing risks.

Data Overview

- **Dataset**

  Monthly returns from 15 ETFs and mutual funds from November 2014 to August 2024.

  Assets - Vanguard LifeStrategy (benchmark), Bitcoin, Treasury ETFs, Gold, VIX, commodities, market neutral, long-short equity, etc.

- **Sources**

  From Portfolio Visualizer; standardized with no missing values.

https://www.portfoliovisualizer.com/backtest-portfolio?s=y&sl=5M8RhWX2CyedGtfIDJRlyP

Individual Assets

	Count
Vanguard LifeStrategy Income Fund (VASIX)	118
Vanguard Total World Stock ETF (VT)	118
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	118
AQR Diversified Arbitrage I (ADAIX)	118
iShares Gold Trust (IAU)	118
Bitcoin Market Price USD (^BTC)	118
AQR Risk-Balanced Commodities Strategy I (ARCIX)	118
AQR Long-Short Equity I (QLEIX)	118
AQR Style Premia Alternative I (QSPIX)	118
AQR Equity Market Neutral I (QMNIX)	118
AQR Macro Opportunities I (QGMIX)	118
AGF U.S. Market Neutral Anti-Beta (BTAL)	118
AQR Managed Futures Strategy HV I (QMHIX)	118
ProShares VIX Mid-Term Futures (VIXM)	118
Invesco DB US Dollar Bullish (UUP)	118

Data Analysis

- **Risk and Return Characteristics**

  Benchmark: Growth Rate 3.4%; Volatility 5.6%; Max Drawdown 16.7%

  Growth Rates: 8 Assets > 5%; 4 Assets 0-5%; 2 Assets < 0%

  Volatility: 4 Assets < 10%; 8 Assets 10-20%; 3 Assets > 20%

  Max Drawdown: 3 > -15%; 3 Assets -15 to -30%; 8 Assets

Asset Performance Summary

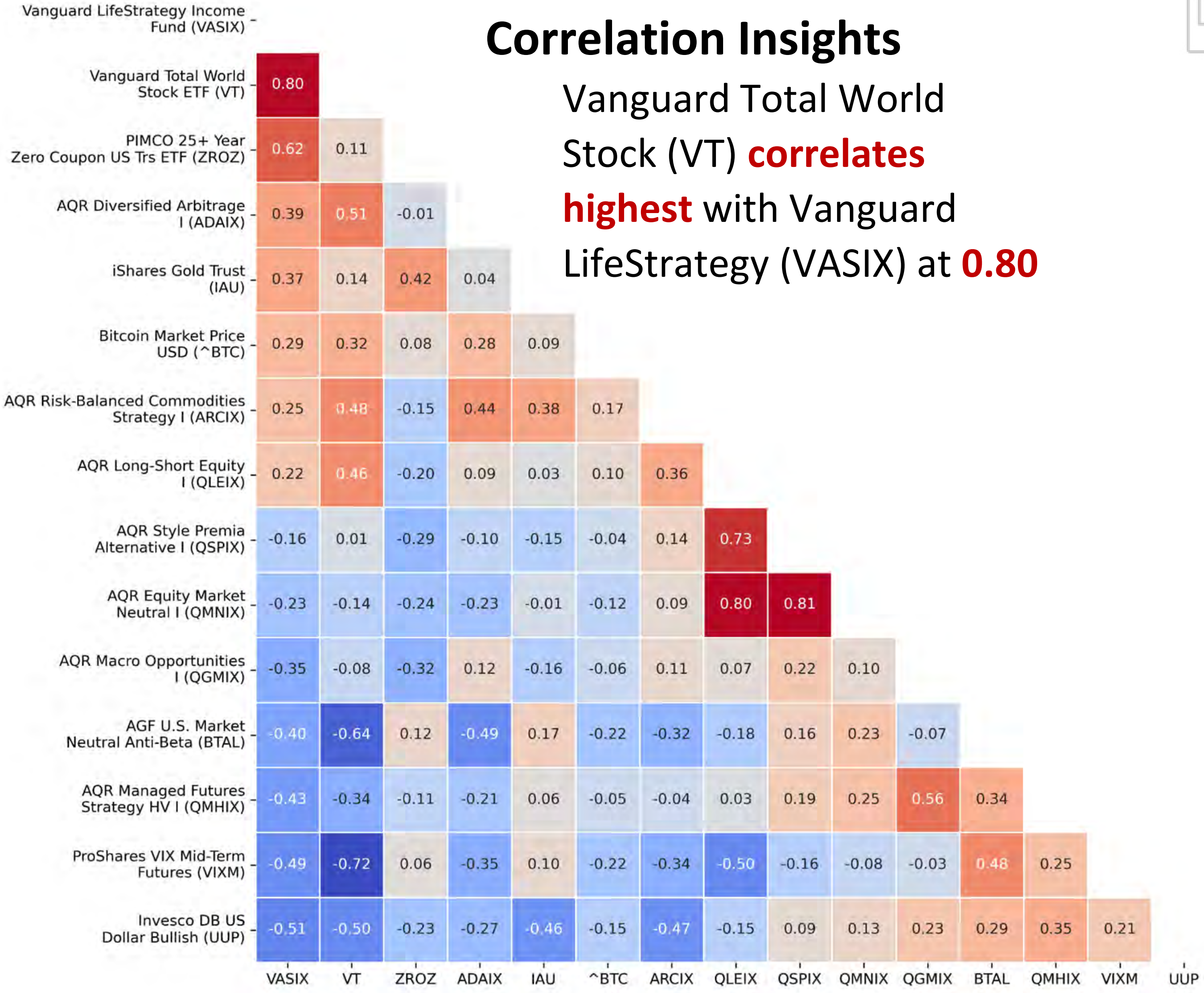
Risk and Return Characteristics for All Assets

	Asset	CAGR (%)	Annualized Std Dev (%)	Best Year (%)	Worst Year (%)	Max Drawdown (%)
0	Vanguard LifeStrategy Income Fund (VASIX)	3.35	5.63	12.05	-13.93	-16.72
1	Vanguard Total World Stock ETF (VT)	9.29	15.06	26.82	-18.02	-25.53
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-0.52	21.06	24.52	-41.31	-61.73
3	AQR Diversified Arbitrage I (ADAIX)	5.19	5.86	25.25	-4.87	-8.15
4	iShares Gold Trust (IAU)	7.75	14.01	25.02	-10.59	-17.86
5	Bitcoin Market Price USD (^BTC)	68.78	76.62	1271.14	-71.76	-73.82
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	5.40	16.25	39.60	-19.50	-30.09
7	AQR Long-Short Equity I (QLEIX)	10.50	11.45	31.09	-16.33	-33.67
8	AQR Style Premia Alternative I (QSPIX)	5.76	13.44	30.61	-21.96	-39.58
9	AQR Equity Market Neutral I (QMNIX)	6.08	9.95	27.21	-19.52	-38.28
10	AQR Macro Opportunities I (QGMIX)	3.24	7.55	29.27	-4.55	-10.00
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	1.16	14.85	20.49	-15.09	-35.41
12	AQR Managed Futures Strategy HV I (QMHIX)	2.99	16.43	49.99	-14.44	-36.26
13	Invesco DB US Dollar Bullish (UUP)	3.15	6.63	9.46	-9.12	-12.07
14	ProShares VIX Mid-Term Futures (VIXM)	-13.84	32.43	72.39	-50.05	-79.79

Data Analysis

- **Correlation Matrix Heatmap (Lower Triangle)**
  - Visually represents how each asset in the portfolio correlates with the others
  - Helps identify opportunities for diversification
  - Optimize the asset mix to minimize risks
- **12 Month Rolling Cross Correlations**
  - Fluctuations in correlation
  - Outlier Analysis
- **Correlation Summary Table**
  - Compares VASIX and other assets
  - Summary of Average Positive And Negative Correlations

Correlation Matrix Heatmap
(Lower Triangle)



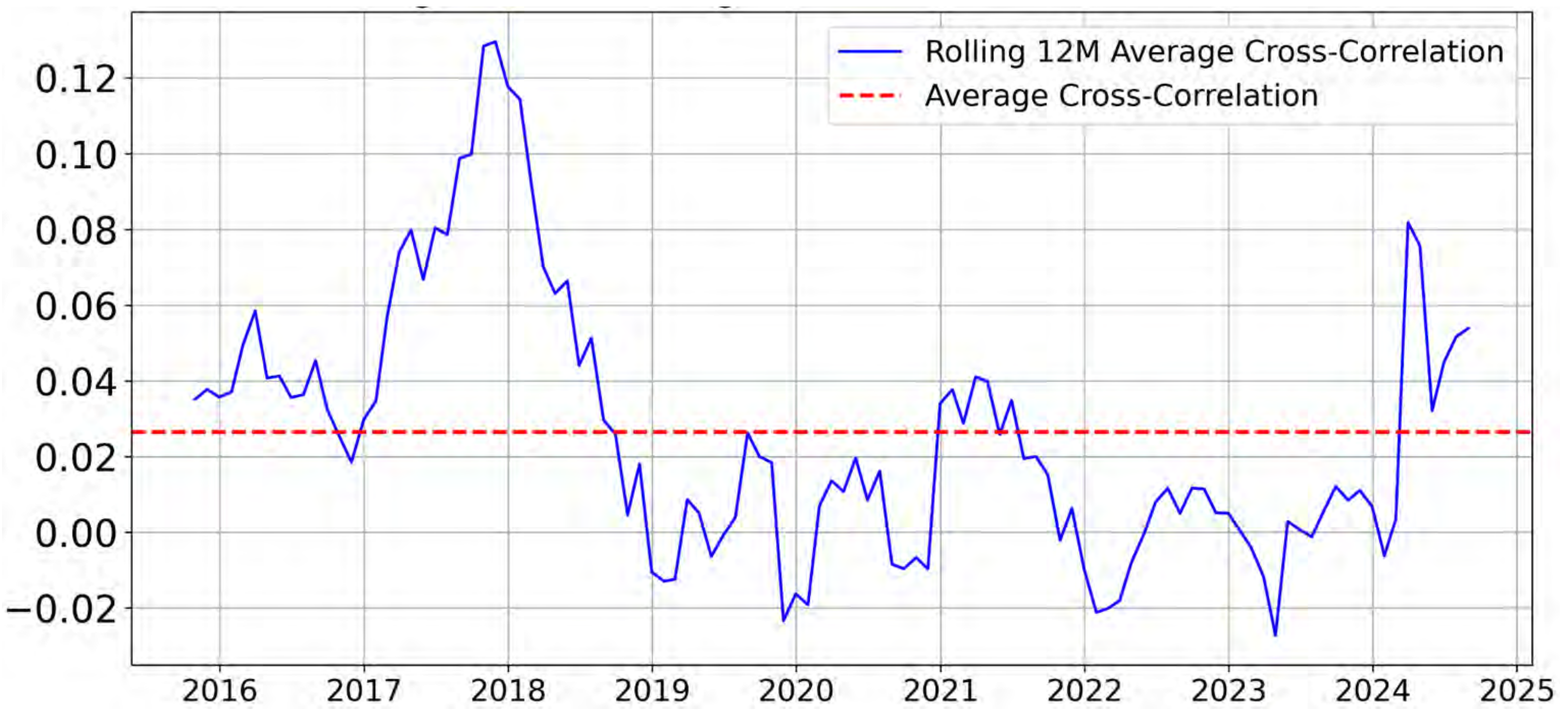
Correlation Insights

Vanguard Total World Stock (VT) **correlates highest** with Vanguard LifeStrategy (VASIX) at **0.80**

Correlation Insights

Numerous assets have **negative cross-correlations**, indicating diversification potential.

Rolling Correlations & Outlier Analysis



	VASIX Return (%)	VT	ZROZ	ADAIX	IAU	^BTC	ARCIX	QLEIX	QSPIX	QMNIX	QGMIX	BTAL	QMHIX	UUP	VIXM
Average Positive	3.88	8.54	8.21	2.07	2.45	20.40	2.51	1.95	-1.47	-1.29	0.09	-6.93	-4.85	-1.57	-8.92
Average Negative	-3.21	-6.69	-6.28	-1.42	-2.04	-13.94	-2.63	-0.12	3.01	2.49	3.29	4.79	7.03	2.72	9.84
Correlation	1.00	0.94	0.80	0.61	0.56	0.68	0.48	0.30	-0.32	-0.34	-0.64	-0.80	-0.95	-0.86	-0.59

Portfolio Optimization Strategies

- **Risk Parity**

  Balances risk across all assets, resulting in lower concentration and a balanced risk profile.

- **Minimum Variance**

  Prioritizes reducing risk in the form of standard deviation, often excluding higher-risk assets and leading to concentration in lower-risk instruments.

- **Maximum Diversification**

  Aims to maximize portfolio diversification, including assets with low correlation to reduce risk.

Key Findings

Optimal Strategy

Risk Parity offers the best balance between risk and return.

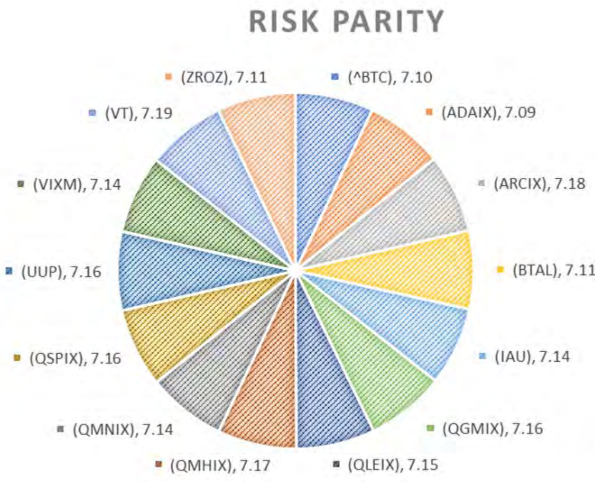
Performance

Risk Parity shows the highest Compound Annual Growth Rate (CAGR) (5.38%) among the models with a modest maximum drawdown (-2.87%) without excluding any assets (doesn't "play favorites")

Performance Metrics Table:

	Risk Parity	Minimum Variance	Maximum Diversification	VASIX (Benchmark)
CAGR (%)	5.38	4.66	4.71	3.38
Standard Deviation (%)	2.93	2.35	2.61	5.63
Maximum Drawdown (%)	-2.87	-2.21	-2.77	-16.72

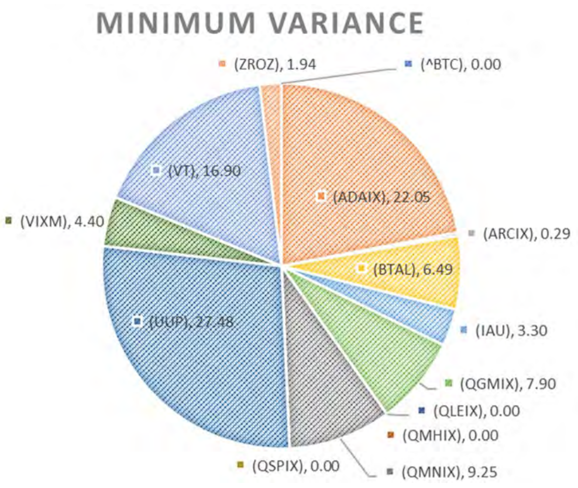
Model Analysis



Risk Parity:
Balances risk across all assets, resulting in lower concentration and a balanced risk profile.

Limitations

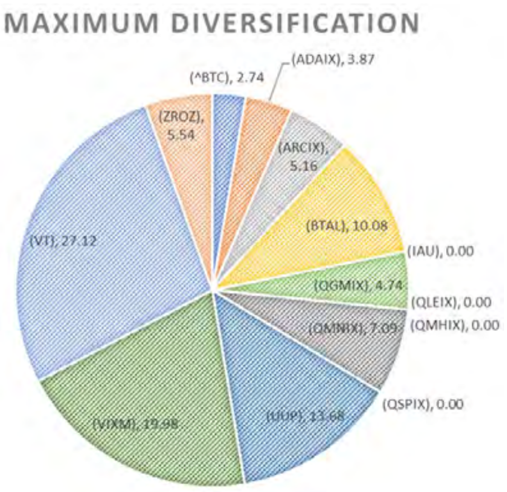
Minimum Variance and Maximum Diversification portfolios exclude too many assets



Minimum Variance Excludes:
Bitcoin Market Price USD (ABTC)
AQR Long-Short Equity I (QLEIX)
AQR Style Premia Alternative I (QSPIX)
AQR Managed Futures Strategy HV I (QMHIX)

Maximum Diversification excludes:

- iShares Gold Trust (IAU)
- AQR Long-Short Equity I (QLEIX)
- AQR Style Premia Alternative I (QSPIX)
- AQR Managed Futures Strategy HV I (QMHIX)



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Recommendations

- **Risk Management**

  Focus on Risk Parity for balanced risk exposure, while Maximum Diversification can enhance potential returns.
- **Extend Data Collection**

  More historical and macroeconomic data would provide robustness to capture different market cycles.
- **Machine Learning Techniques**

  Consider clustering assets based on risk-return characteristics for a streamlined portfolio.

Conclusion

- **Balanced Approach**

  Using Risk Parity with a mix of high and low-risk assets provides robust returns with controlled volatility.

- **Client Alignment**

  The recommended portfolio strategy aligns with client goals for moderate risk and returns exceeding 4%.

Next Steps

- Implement the proposed Risk Parity allocation strategy.
- Broaden the dataset and leverage advanced statistical models for better predictions.
- Regularly review asset performance, especially under changing market conditions, to ensure ongoing alignment with client goals.

Division of Labor

Week 3	Form Teams, Choose Project/Dataset	Ian/Carrie
	In-Person Meeting, Create Collab Files/Folder	Ian/Carrie
	Formulate Research Questions	Ian
	Generate Business Objective	Carrie
	Review Dataset, Generate Data Descriptives	Carrie
Week 4	Outline Data Analysis Plan	Ian
	Develop Preliminary Models	Ian/Carrie
	In-Person Meeting, Analyze Models	Ian/Carrie
	Develop Conclusions and Recommendations	Ian/Carrie
	Submit Final Project Check-in	Ian
Week 5	Draft Report	Ian
	Draft Presentation	Carrie
	In-Person Meeting, Review Drafts	Ian/Carrie
Week 6	Review Tables/Figures/Visualizations	Ian/Carrie
	Review References/Sources/Links	Ian/Carrie
	In-Person Meeting - Presentation Review	Ian/Carrie
Week 7	Finalize Presentation	Ian
	Record Project Presentation	Ian/Carrie
	Finalize Final Report	Carrie
	Finalize GitHub	Carrie
	Submit Final Report /Presentation	Ian

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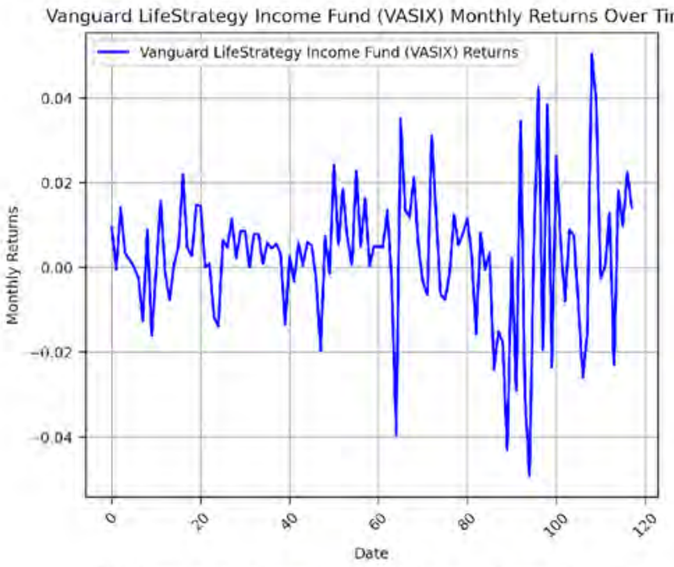
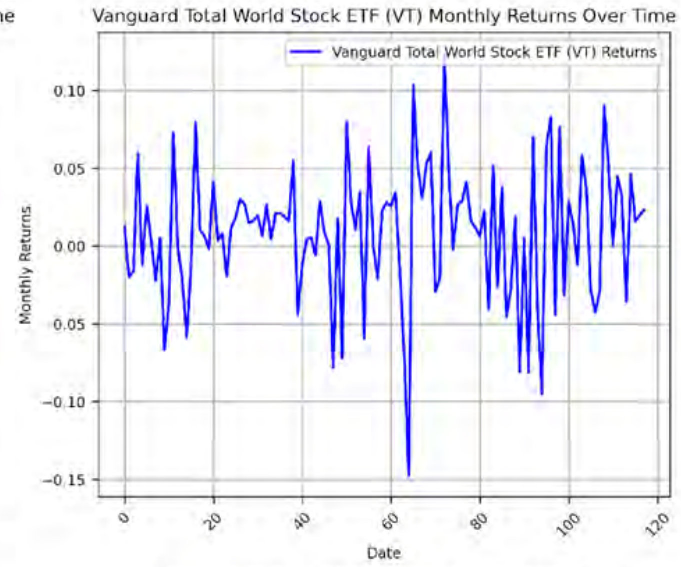
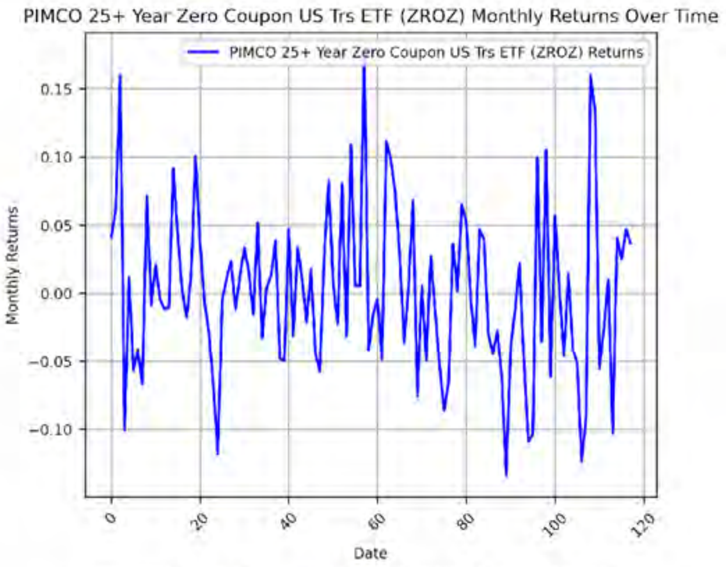
Backup Slides
Data Analytics and Modeling

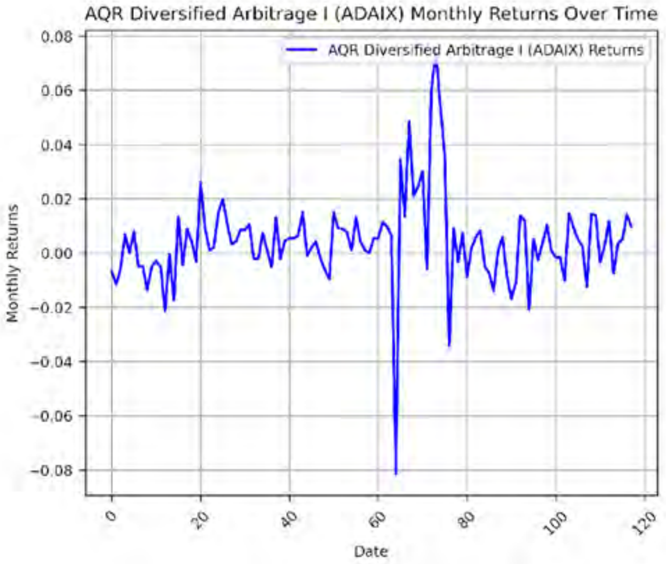
- Monthly Return Time Series Plots
- Raw Return Histograms with Fitted Probability Distributions
- QQ-Plots
- Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns
- Asset Risk-Return Characteristics
- Model Analysis - Portfolio Weights Table
- Model Analysis - Risk Contribution Table
- Model Analysis - Performance Metrics Table
- Model Analysis - Annual Return Table
- Model Analysis - Regression Results Table
- Model Analysis - Fama French Factors
- Monte Carlo Analysis Table (36-months, 10,000 iterations)
- Quantitative Goodness of Fit Tests AIC, BIC, K-S
- Box and Whisker Plot

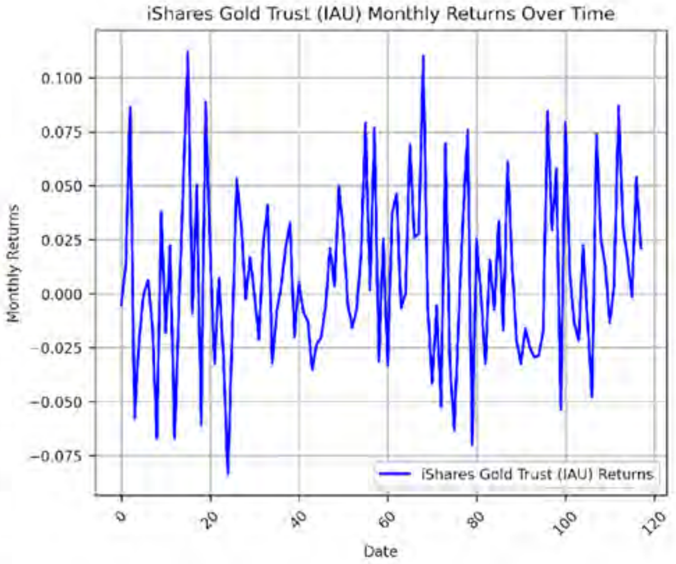
Monthly Return Time Series Plots

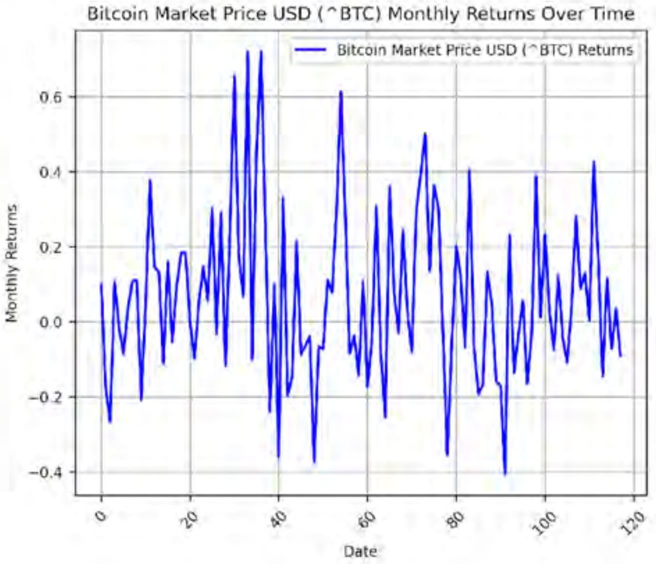












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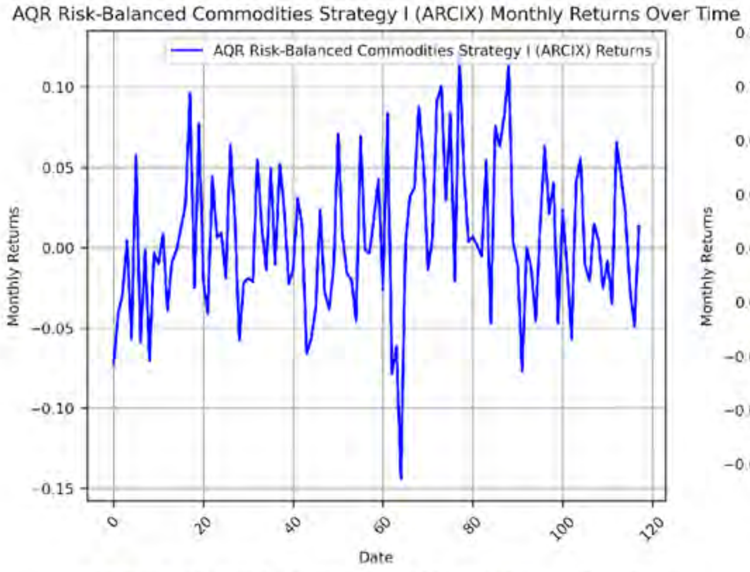

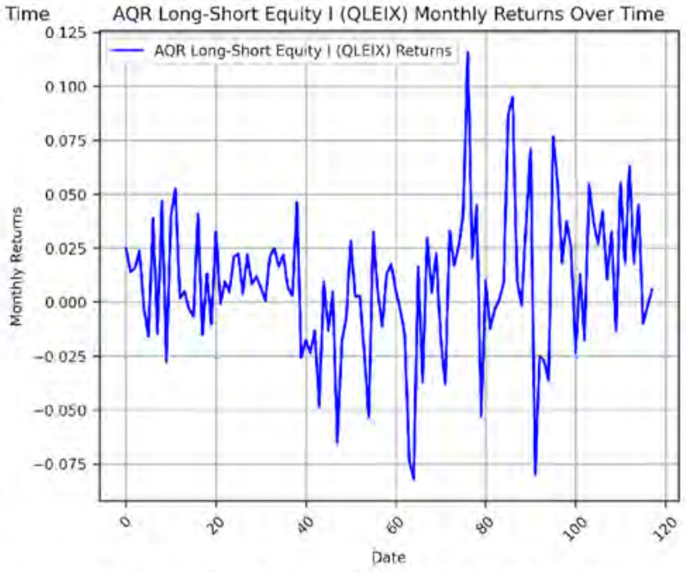

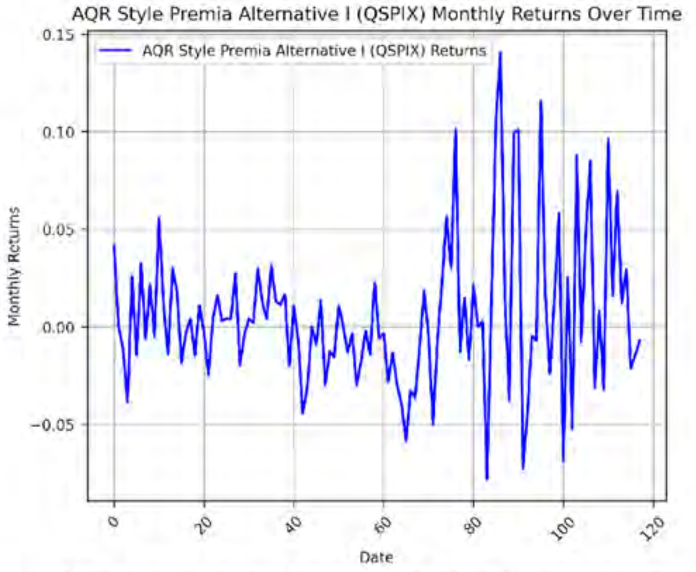

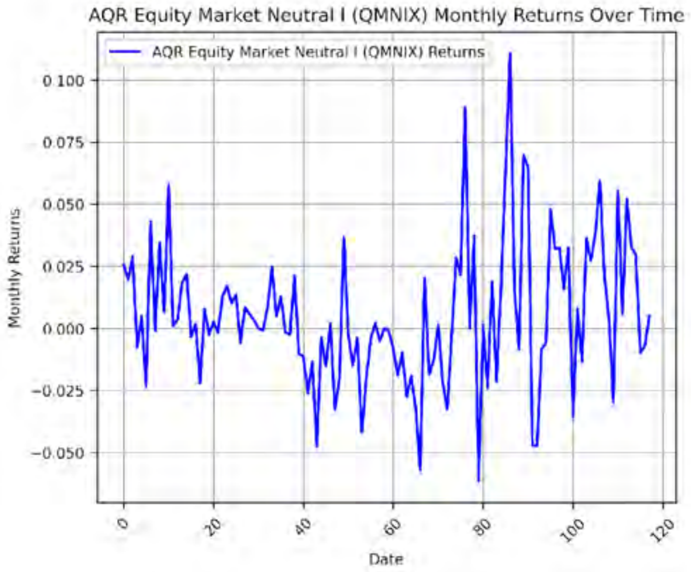

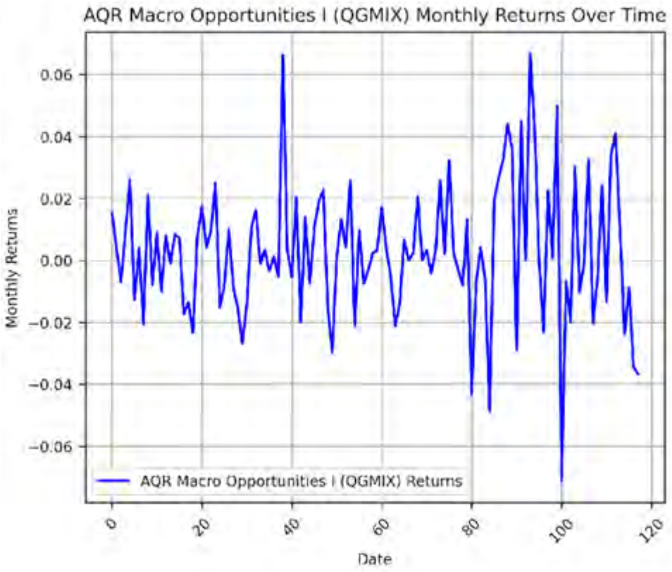

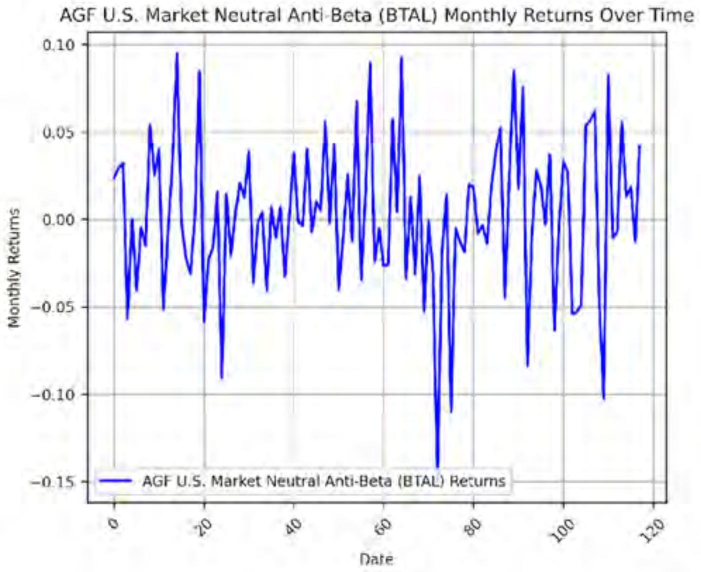

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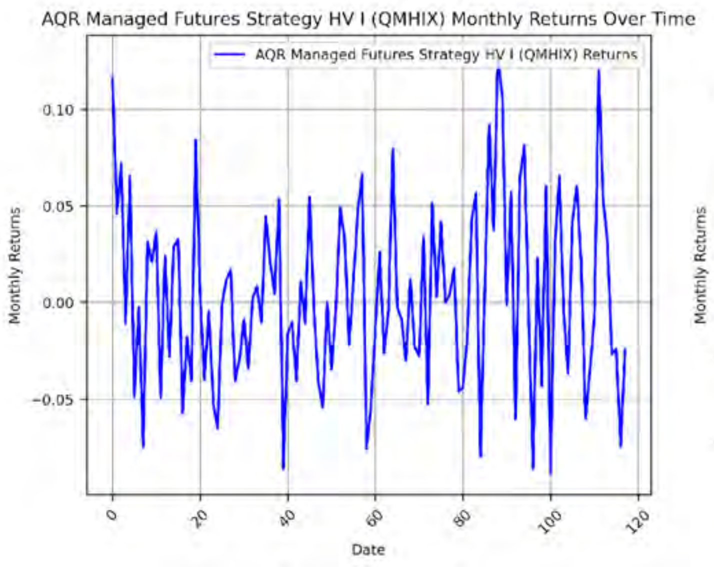
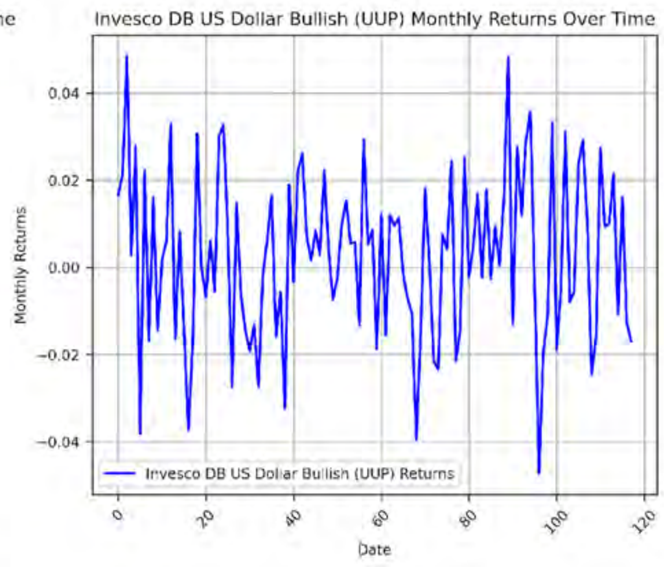
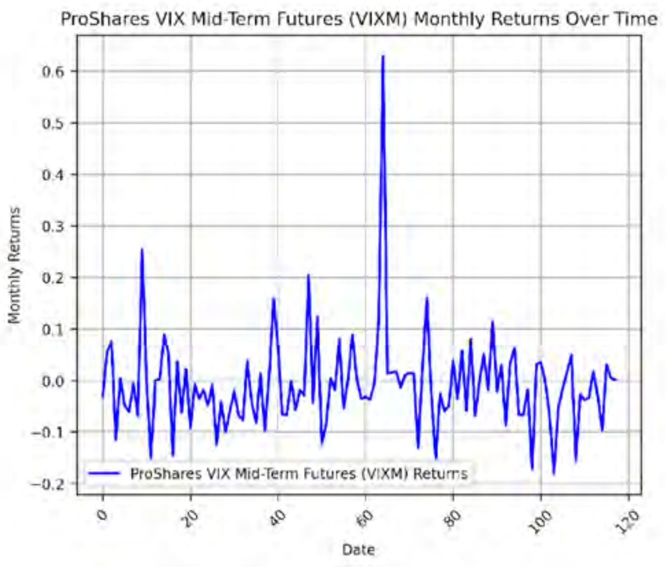
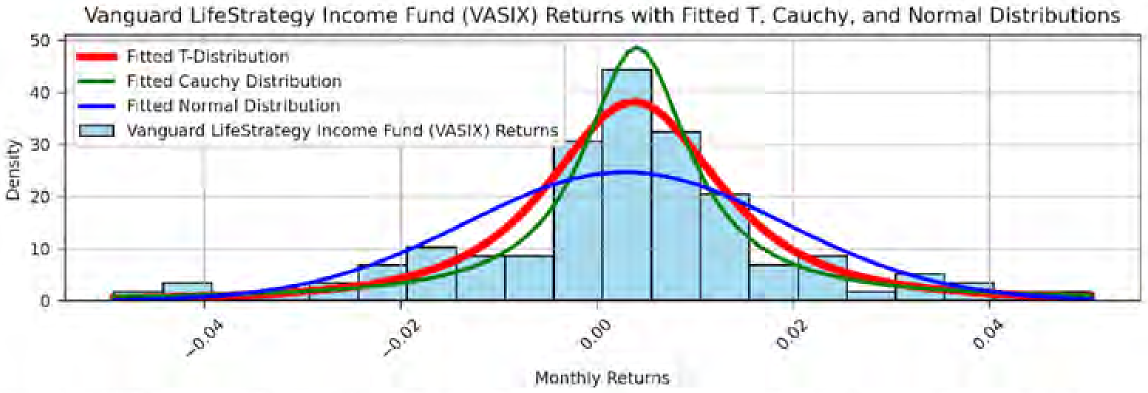


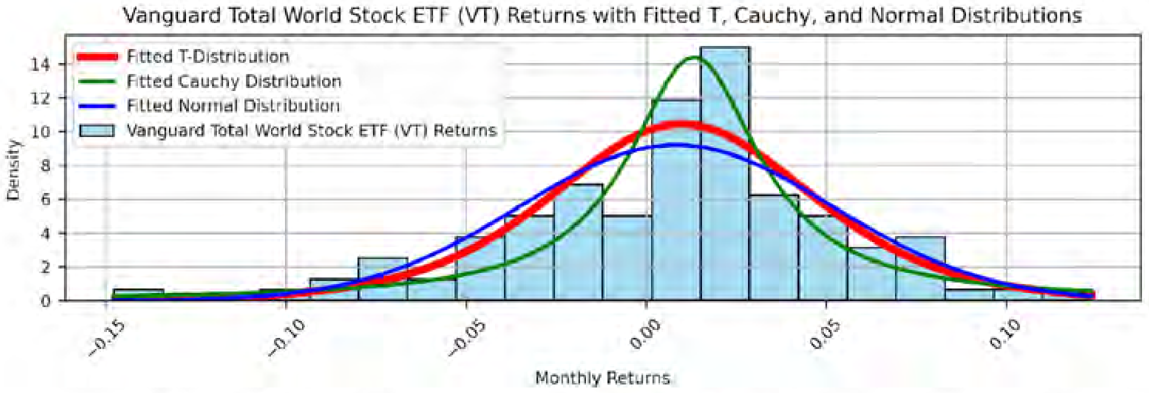


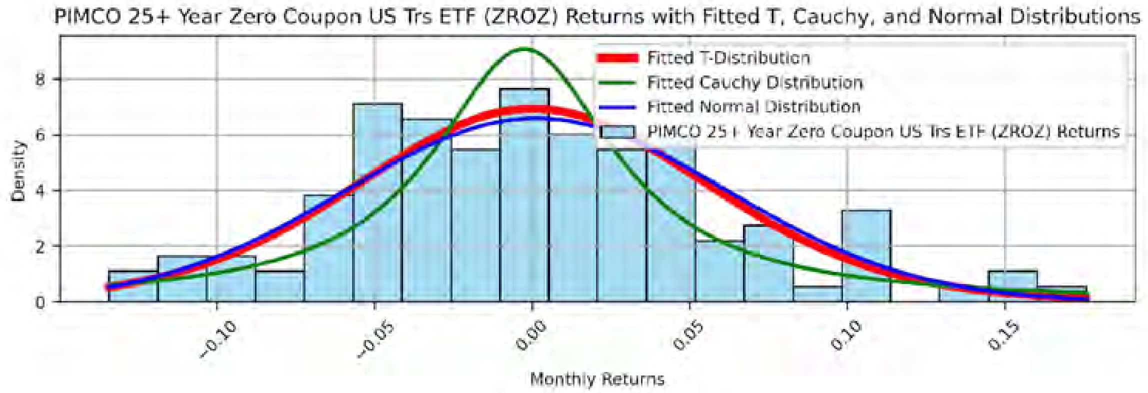


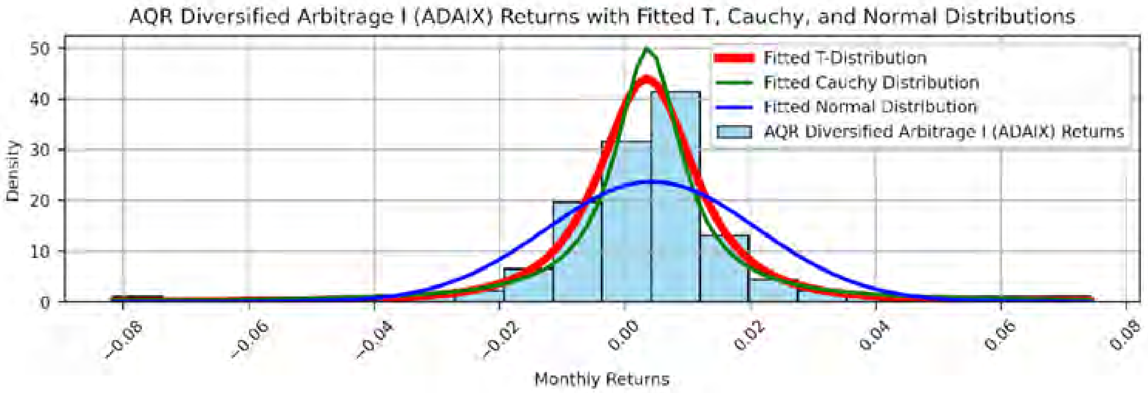
Raw Return Histograms
with Fitted Probability Distributions

T, Cauchy, and Normal distributions









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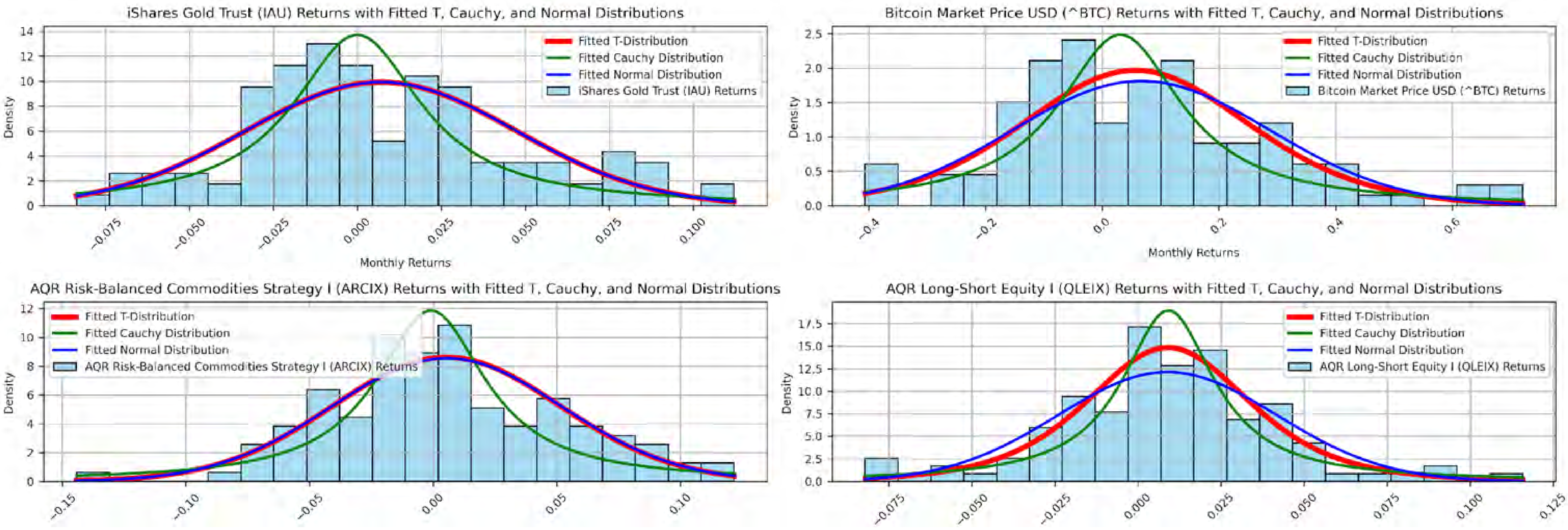

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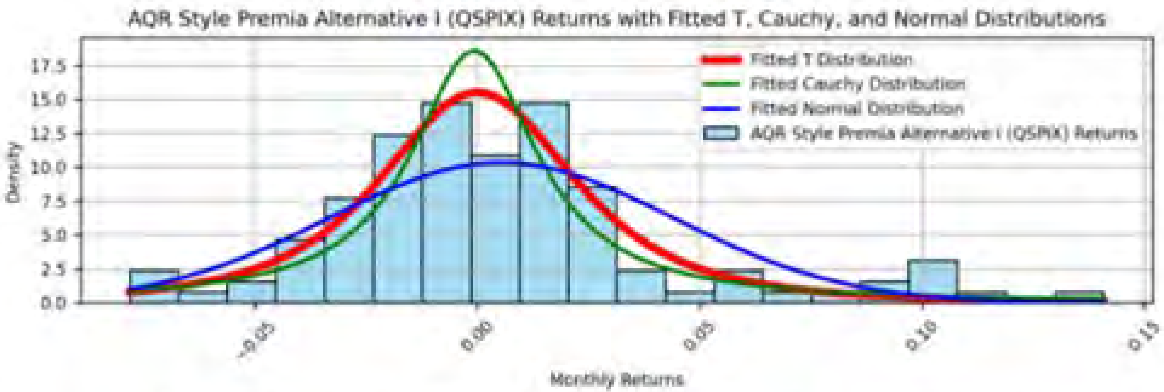

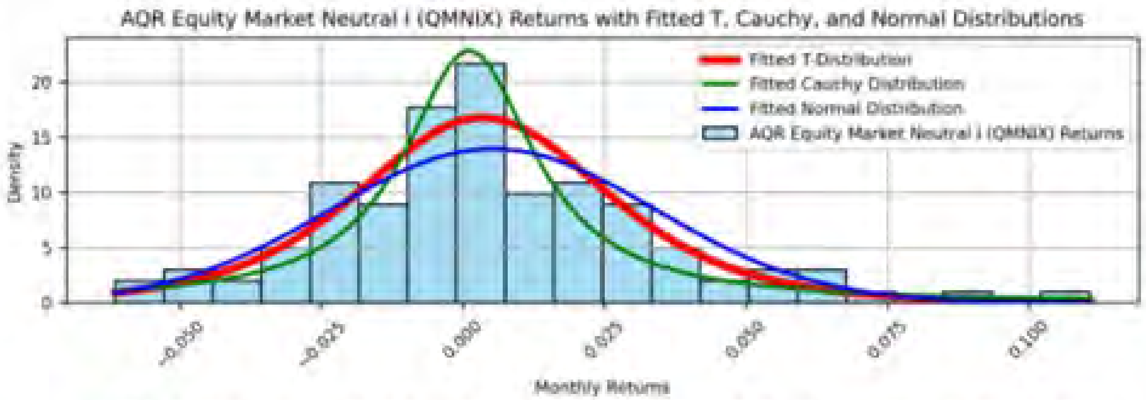

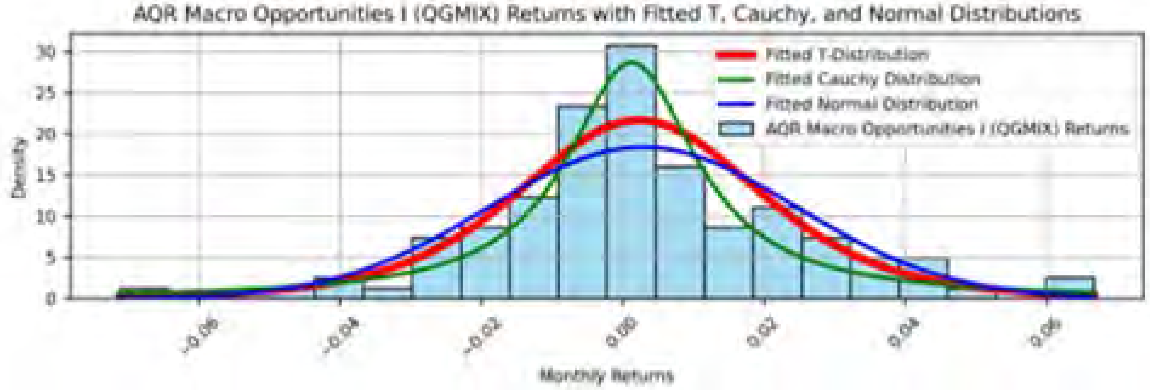

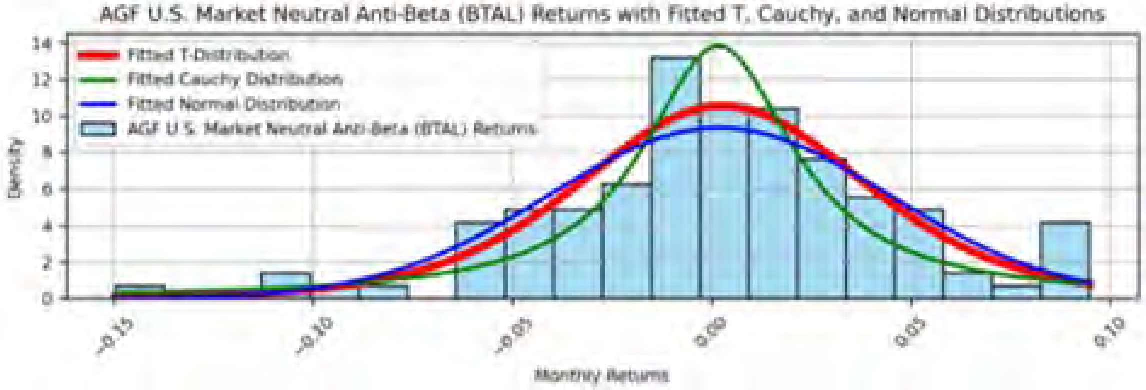

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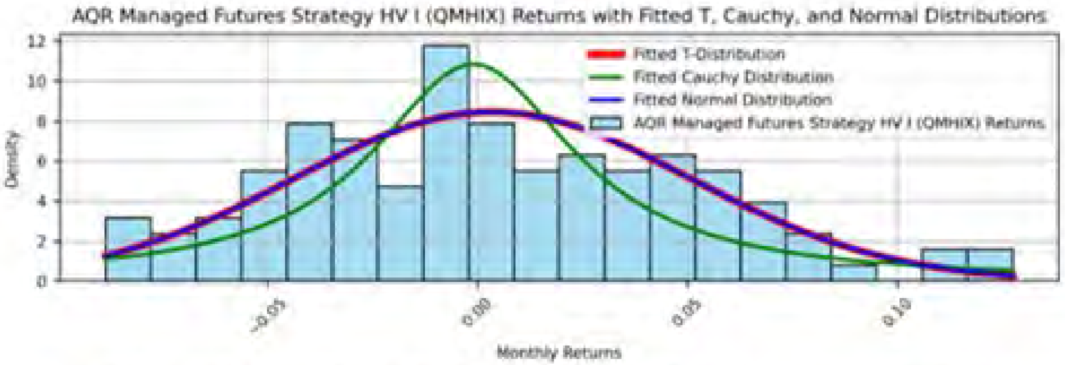
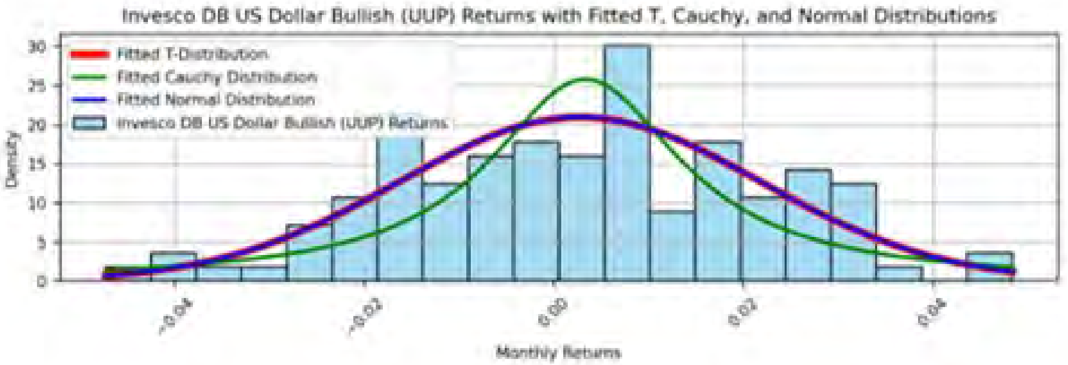
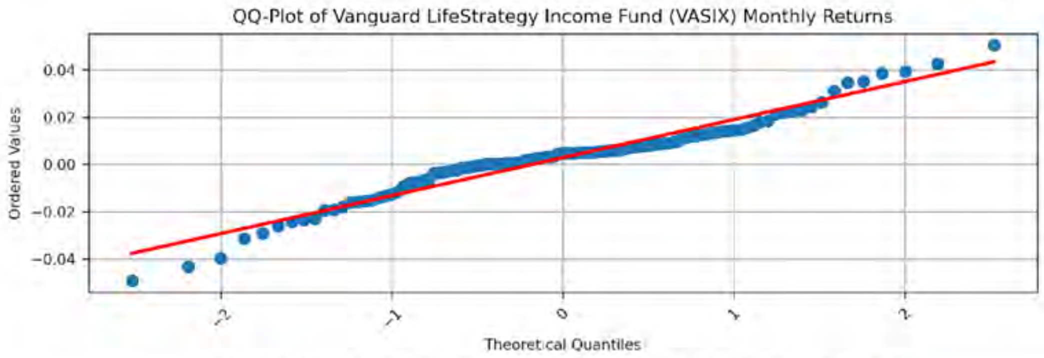
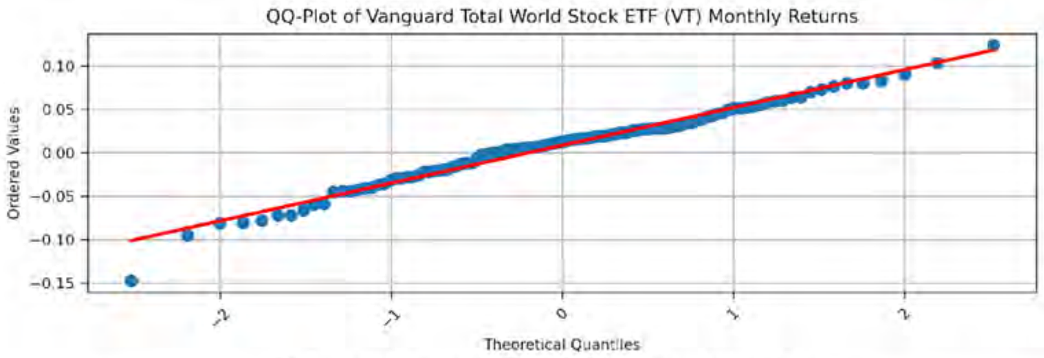
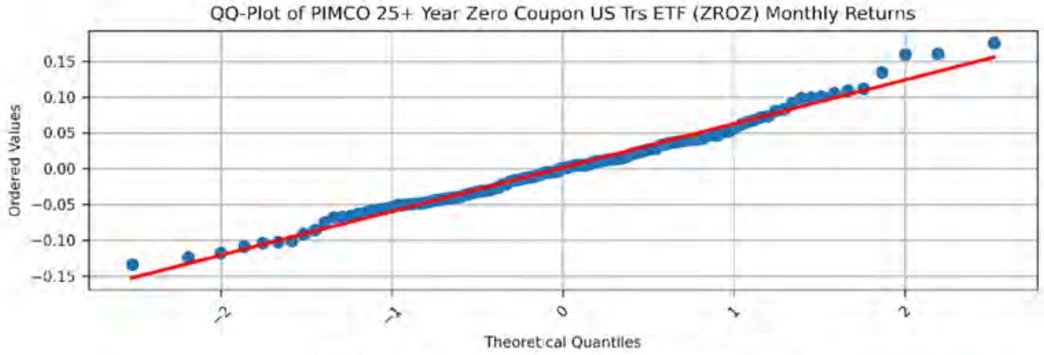


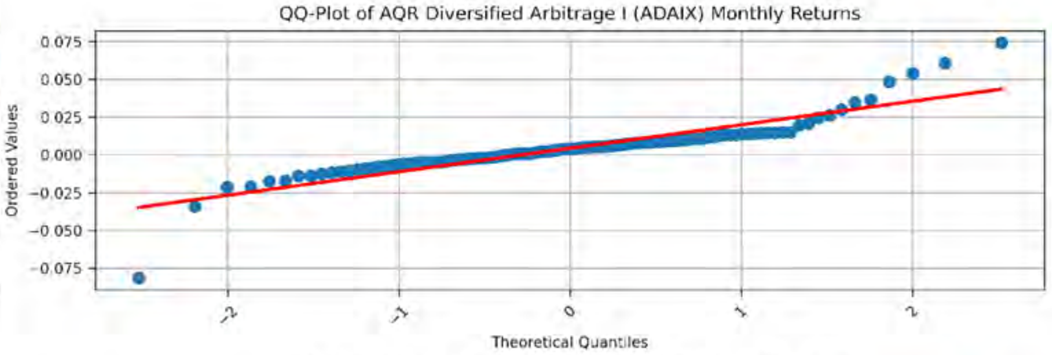


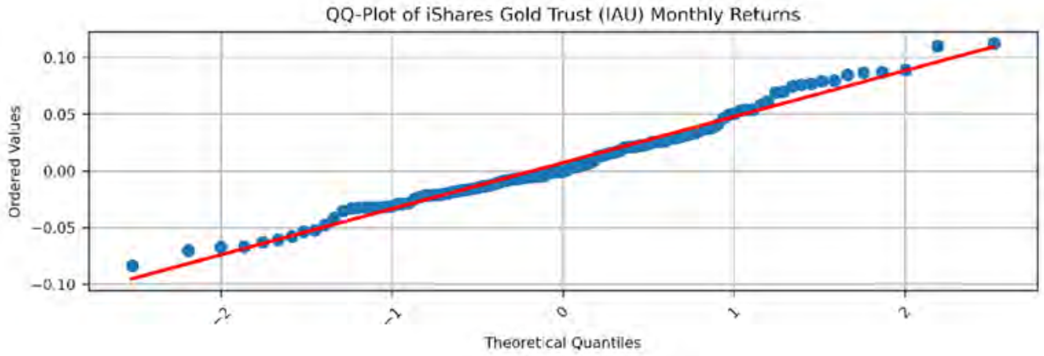
QQ-Plots

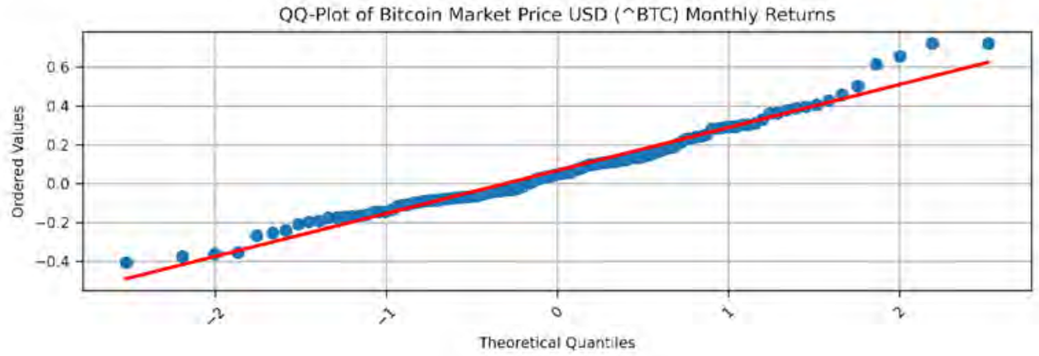

QQ-Plot of Vanguard LifeStrategy Income Fund (VASIX) Monthly Returns
Ordered Values
Theoretical Quantiles


QQ-Plot of Vanguard Total World Stock ETF (VT) Monthly Returns
Ordered Values
Theoretical Quantiles

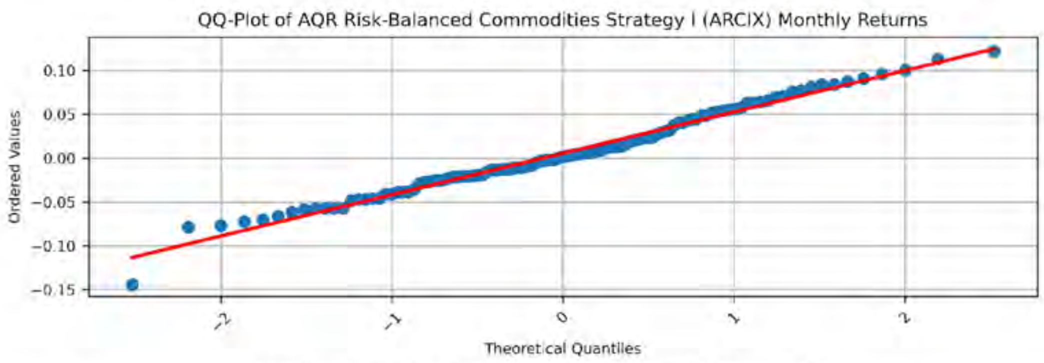

QQ-Plot of PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ) Monthly Returns
Ordered Values
Theoretical Quantiles

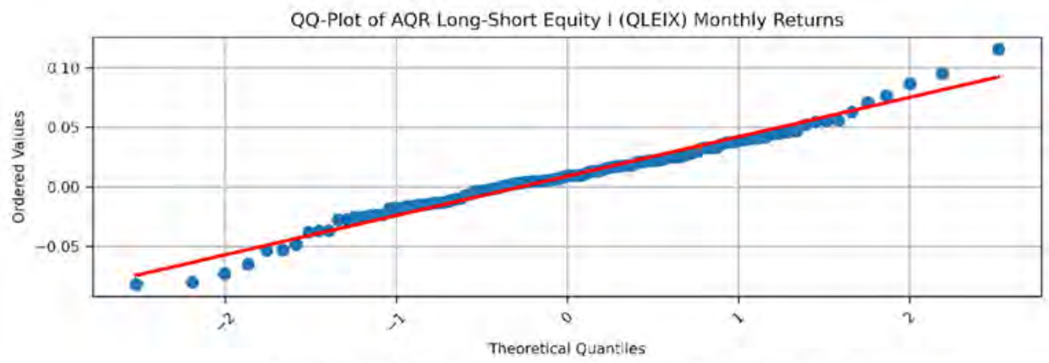

QQ-Plot of AQR Diversified Arbitrage I (ADAIX) Monthly Returns
Ordered Values
Theoretical Quantiles

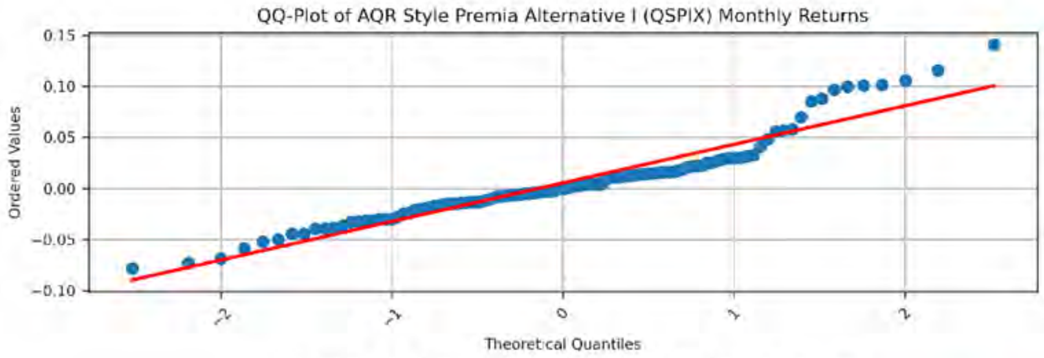

QQ-Plot of iShares Gold Trust (IAU) Monthly Returns
Ordered Values
Theoretical Quantiles

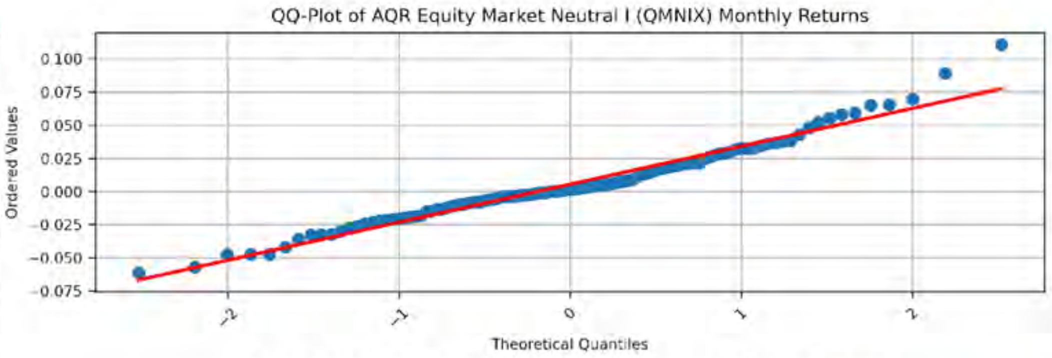

QQ-Plot of Bitcoin Market Price USD (^BTC) Monthly Returns
Ordered Values
Theoretical Quantiles

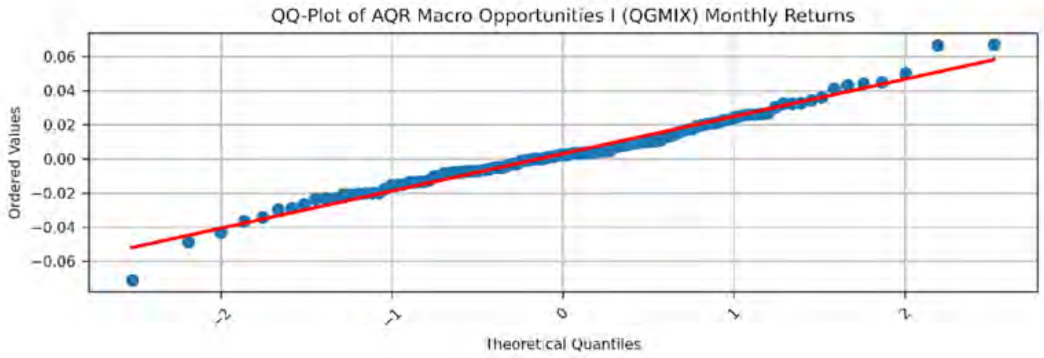
QQ-Plots

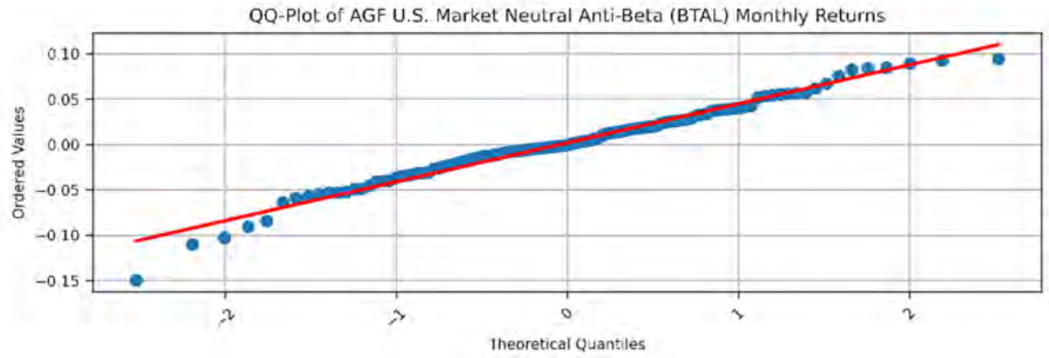

QQ-Plot of AQR Risk-Balanced Commodities Strategy I (ARCIX) Monthly Returns
Ordered Values
0.10
0.05
0.00
−0.05
−0.10
−0.15
-2
-1
0
1
2
Theoretical Quantiles


QQ-Plot of AQR Long-Short Equity I (QLEIX) Monthly Returns
Ordered Values
0.10
0.05
0.00
−0.05
-2
-1
0
1
2
Theoretical Quantiles


QQ-Plot of AQR Style Premia Alternative I (QSPIX) Monthly Returns
Ordered Values
0.15
0.10
0.05
0.00
−0.05
−0.10
-2
-1
0
1
2
Theoretical Quantiles


QQ-Plot of AQR Equity Market Neutral I (QMNIX) Monthly Returns
Ordered Values
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
-2
-1
0
1
2
Theoretical Quantiles


QQ-Plot of AQR Macro Opportunities I (QGMIX) Monthly Returns
Ordered Values
0.06
0.04
0.02
0.00
−0.02
−0.04
−0.06
-2
-1
0
1
2
Theoretical Quantiles


QQ-Plot of AGF U.S. Market Neutral Anti-Beta (BTAL) Monthly Returns
Ordered Values
0.10
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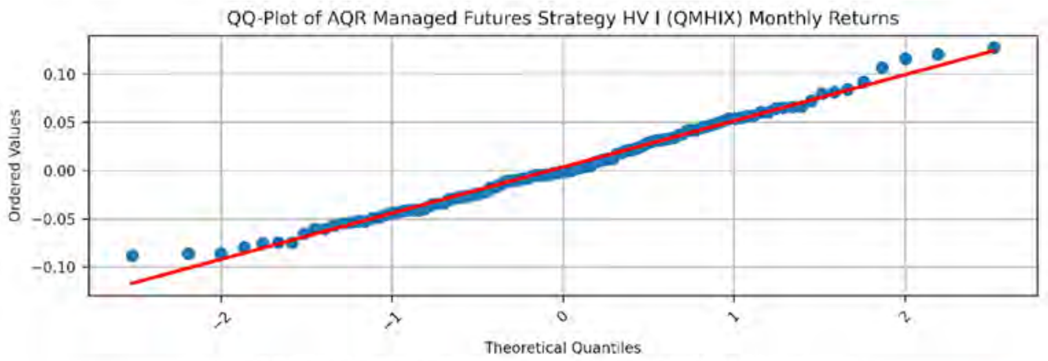
0.00
−0.05
−0.10
−0.15
-2
-1
0
1
2
Theoretical Quantiles

QQ-Plots


QQ-Plot of AQR Managed Futures Strategy HV I (QMHIX) Monthly Returns
Ordered Values
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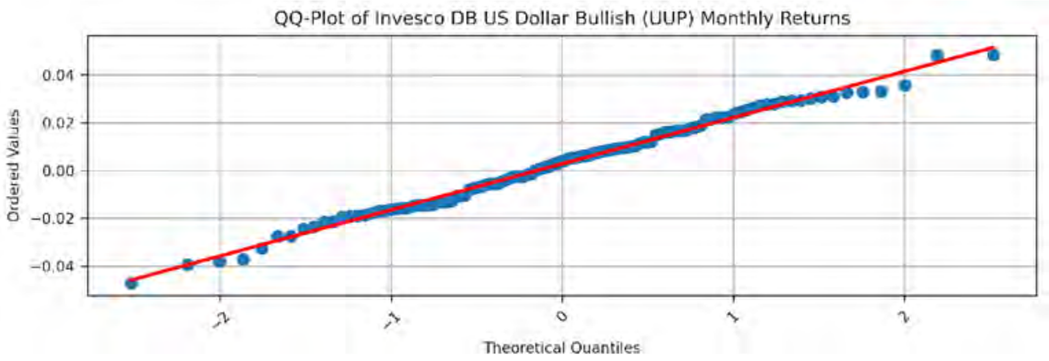
0.05
0.00
−0.05
−0.10
-2
-1
0
1
2
Theoretical Quantiles


QQ-Plot of Invesco DB US Dollar Bullish (UUP) Monthly Returns
Ordered Values
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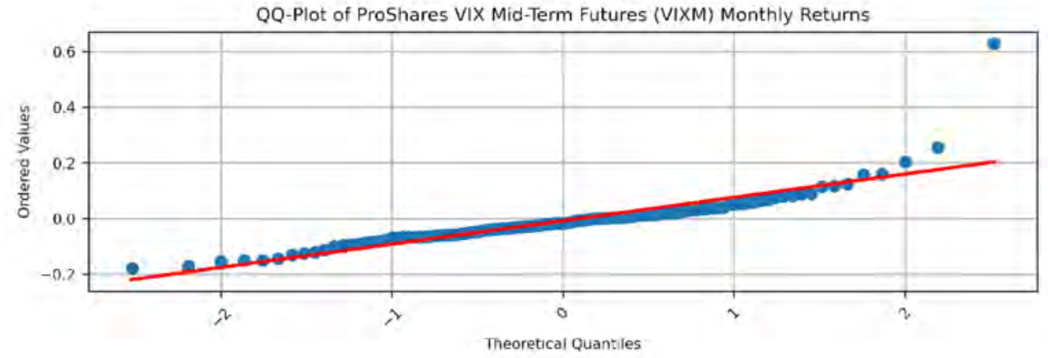
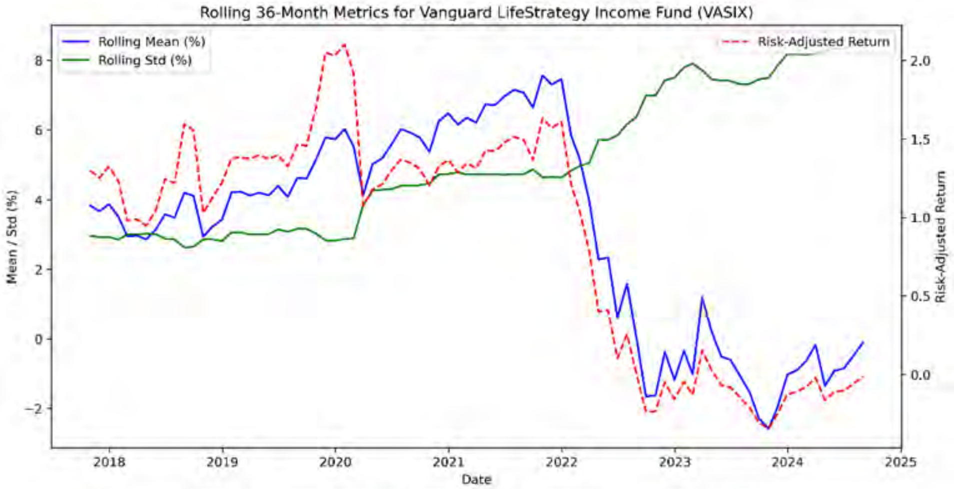
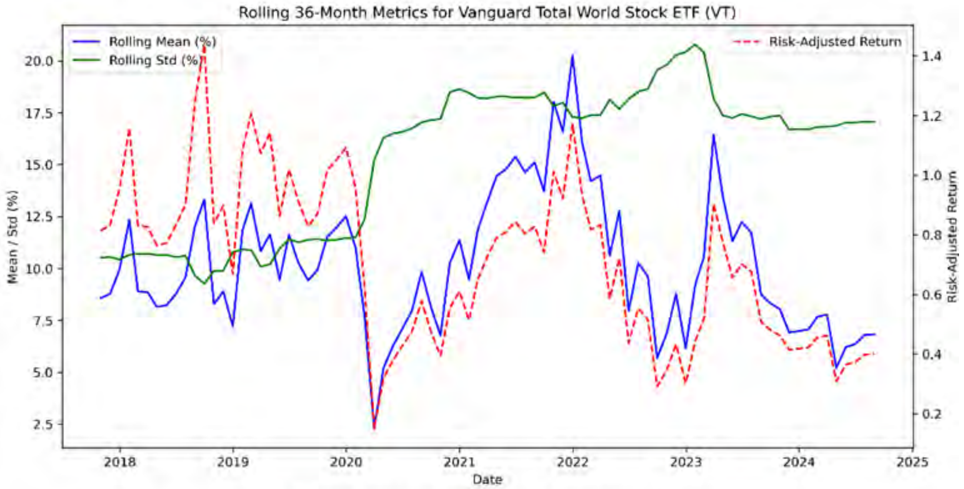
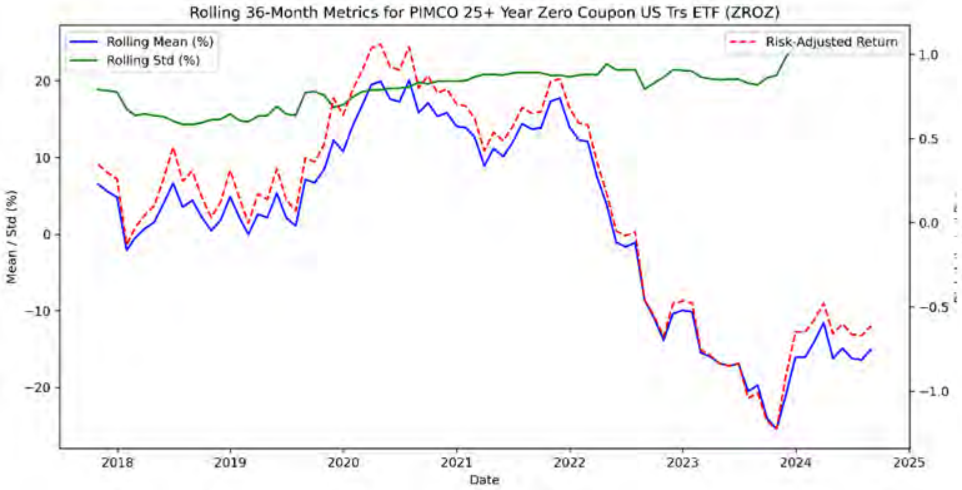
0.02
0.00
−0.02
−0.04
-2
-1
0
1
2
Theoretical Quantiles

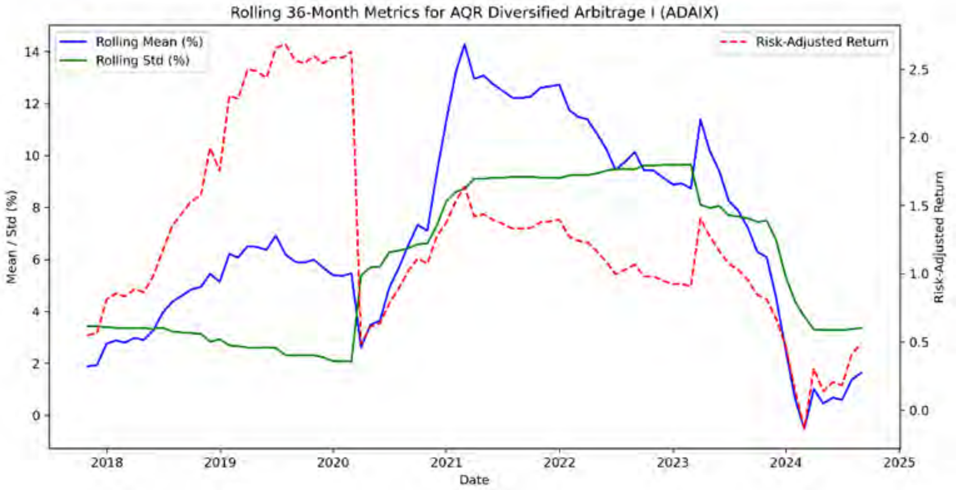

QQ-Plot of ProShares VIX Mid-Term Futures (VIXM) Monthly Returns
Ordered Values
0.6
0.4
0.2
0.0
−0.2
-2
-1
0
1
2
Theoretical Quantiles

Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns

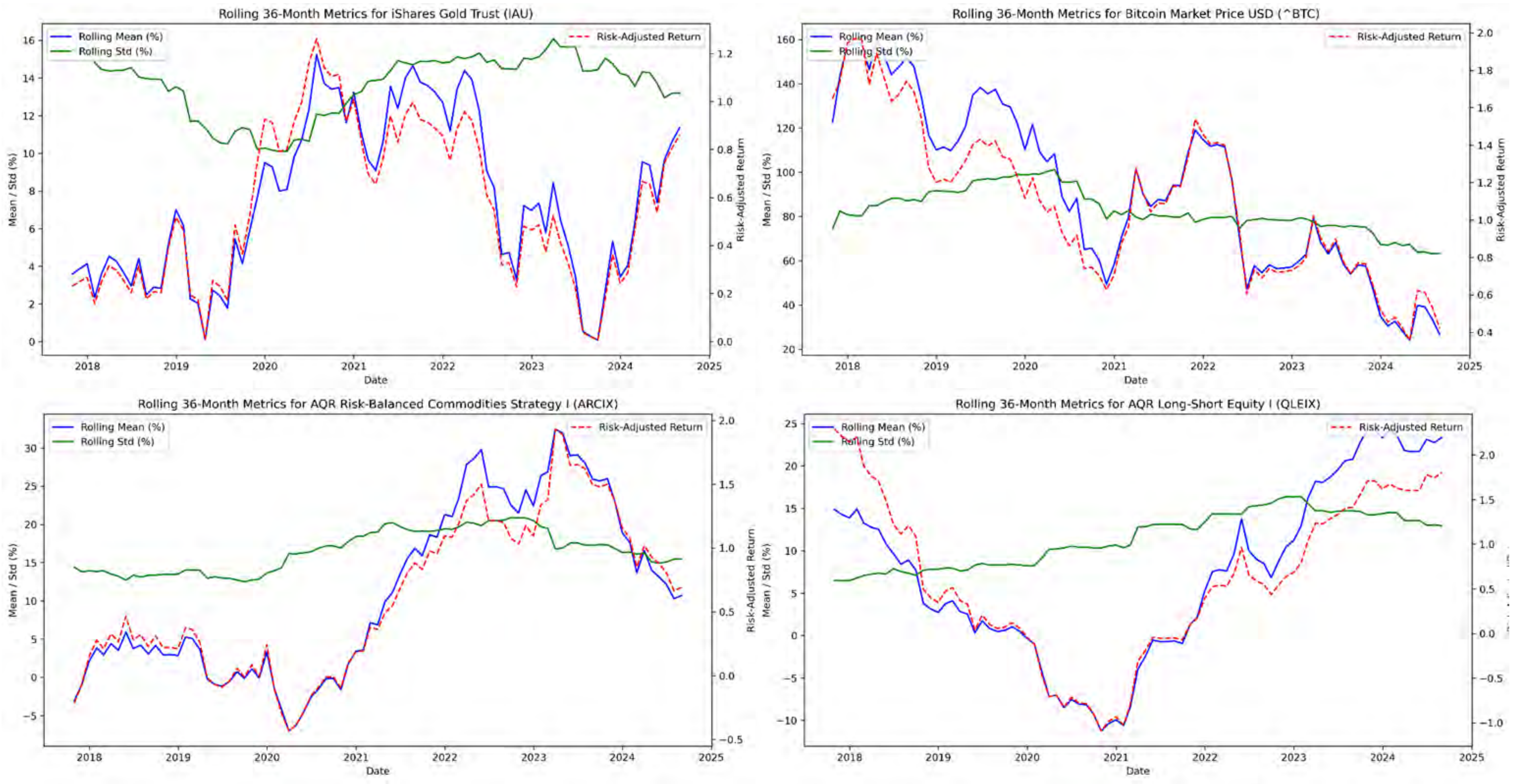




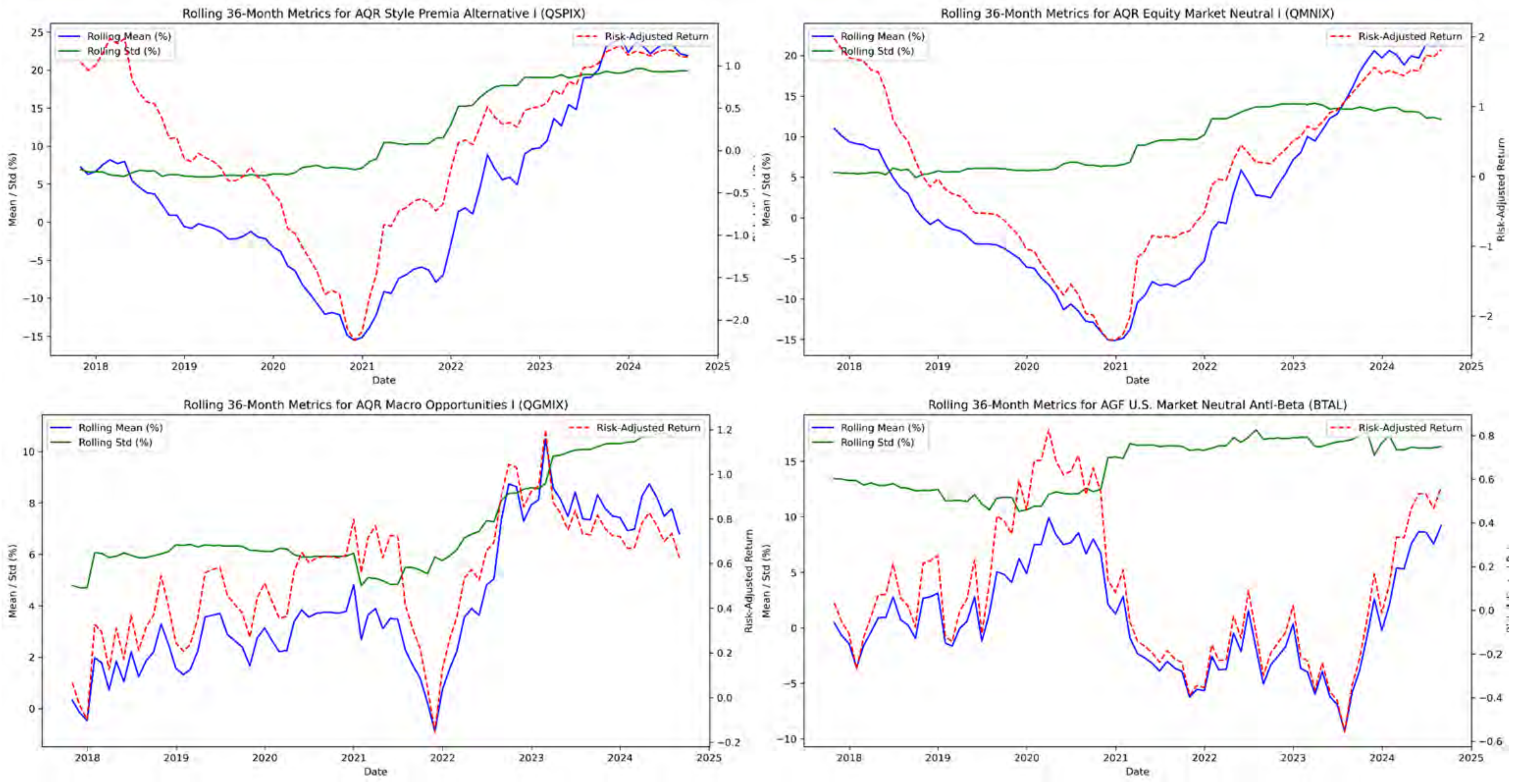




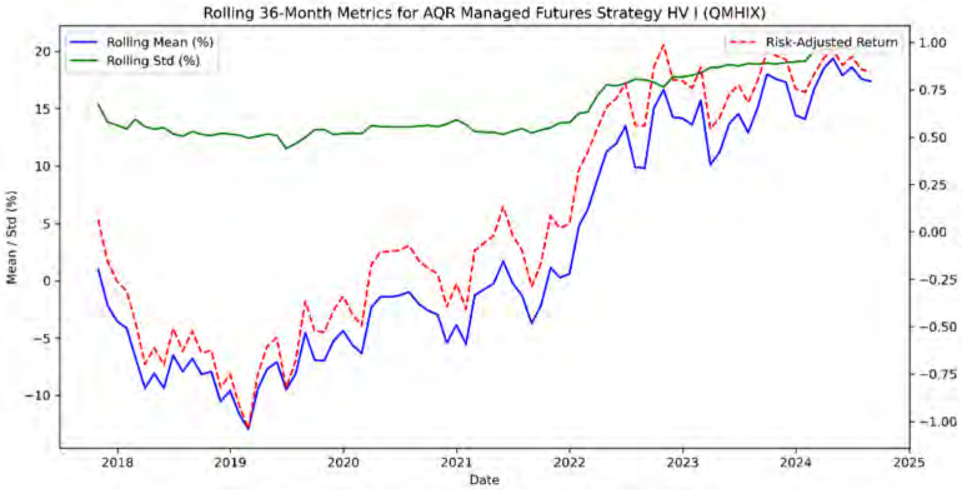
Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns

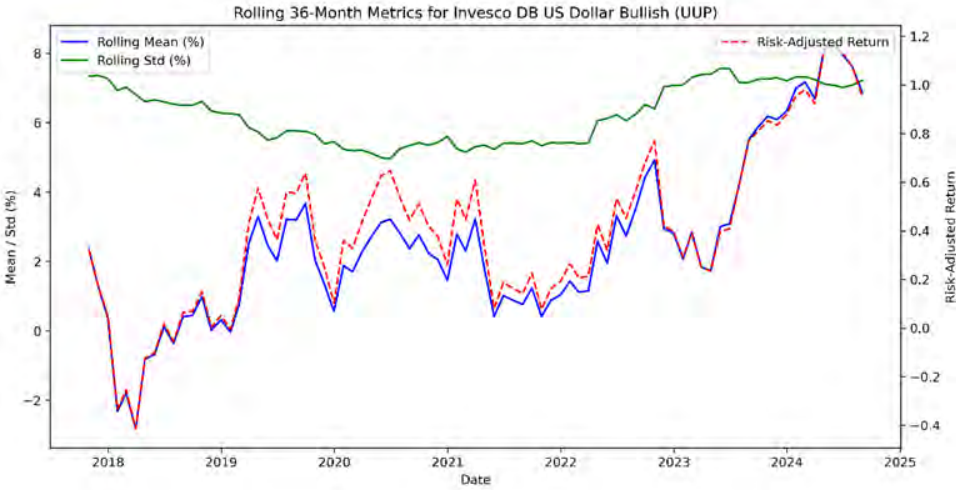


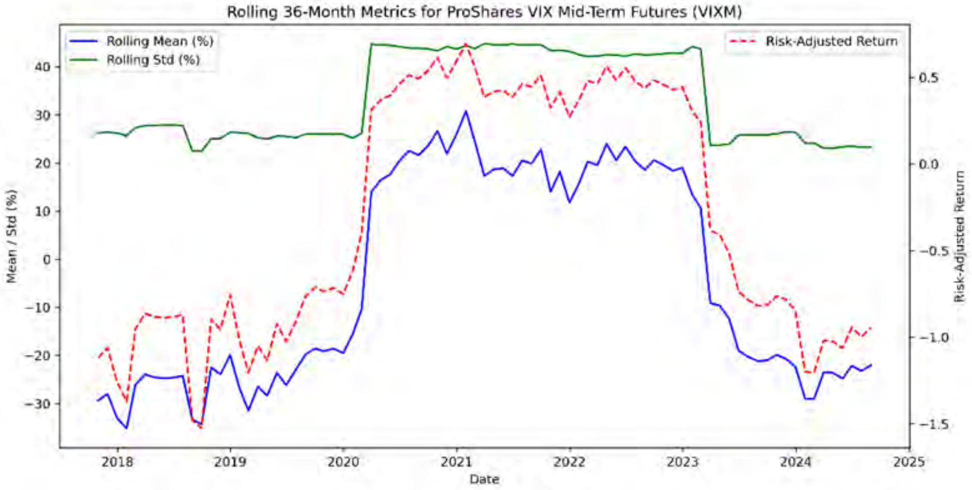
Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns



Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns







Asset Risk-Return Characteristics

Risk and Return Characteristics for All Assets

	Asset	CAGR (%)	Annualized Std Dev (%)	Best Year (%)	Worst Year (%)	Max Drawdown (%)	Sharpe Ratio	Sortino Ratio
0	Vanguard LifeStrategy Income Fund (VASIX)	3.35	5.63	12.05	-13.93	-16.72	0.26	0.10
1	Vanguard Total World Stock ETF (VT)	9.29	15.06	26.82	-18.02	-25.53	0.53	0.22
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-0.52	21.06	24.52	-41.31	-61.73	-0.02	-0.01
3	AQR Diversified Arbitrage I (ADAIX)	5.19	5.86	25.25	-4.87	-8.15	0.55	0.20
4	iShares Gold Trust (IAU)	7.75	14.01	25.02	-10.59	-17.86	0.46	0.26
5	Bitcoin Market Price USD (^BTC)	68.78	76.62	1271.14	-71.76	-73.82	1.02	0.67
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	5.40	16.25	39.60	-19.50	-30.09	0.28	0.15
7	AQR Long-Short Equity I (QLEIX)	10.50	11.45	31.09	-16.33	-33.67	0.76	0.33
8	AQR Style Premia Alternative I (QSPIX)	5.76	13.44	30.61	-21.96	-39.58	0.33	0.20
9	AQR Equity Market Neutral I (QMNIX)	6.08	9.95	27.21	-19.52	-38.28	0.44	0.24
10	AQR Macro Opportunities I (QGMIX)	3.24	7.55	29.27	-4.55	-10.00	0.20	0.09
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	1.16	14.85	20.49	-15.09	-35.41	0.02	0.01
12	AQR Managed Futures Strategy HV I (QMHIX)	2.99	16.43	49.99	-14.44	-36.26	0.14	0.08
13	Invesco DB US Dollar Bullish (UUP)	3.15	6.63	9.46	-9.12	-12.07	0.20	0.10
14	ProShares VIX Mid-Term Futures (VIXM)	-13.84	32.43	72.39	-50.05	-79.79	-0.38	-0.23

Asset Risk-Return Characteristics

Risk and Return Characteristics for All Assets

	Asset	CAGR (%)	Annualized Std Dev (%)	Best Year (%)	Worst Year (%)	Max Drawdown (%)	Sharpe Ratio	Sortino Ratio
0	Vanguard LifeStrategy Income Fund (VASIX)	3.35	5.63	12.05	-13.93	-16.72	0.26	0.10
1	Vanguard Total World Stock ETF (VT)	9.29	15.06	26.82	-18.02	-25.53	0.53	0.22
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-0.52	21.06	24.52	-41.31	-61.73	-0.02	-0.01
3	AQR Diversified Arbitrage I (ADAIX)	5.19	5.86	25.25	-4.87	-8.15	0.55	0.20
4	iShares Gold Trust (IAU)	7.75	14.01	25.02	-10.59	-17.86	0.46	0.26
5	Bitcoin Market Price USD (^BTC)	68.78	76.62	1271.14	-71.76	-73.82	1.02	0.67
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	5.40	16.25	39.60	-19.50	-30.09	0.28	0.15
7	AQR Long-Short Equity I (QLEIX)	10.50	11.45	31.09	-16.33	-33.67	0.76	0.33
8	AQR Style Premia Alternative I (QSPIX)	5.76	13.44	30.61	-21.96	-39.58	0.33	0.20
9	AQR Equity Market Neutral I (QMNIX)	6.08	9.95	27.21	-19.52	-38.28	0.44	0.24
10	AQR Macro Opportunities I (QGMIX)	3.24	7.55	29.27	-4.55	-10.00	0.20	0.09
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	1.16	14.85	20.49	-15.09	-35.41	0.02	0.01
12	AQR Managed Futures Strategy HV I (QMHIX)	2.99	16.43	49.99	-14.44	-36.26	0.14	0.08
13	Invesco DB US Dollar Bullish (UUP)	3.15	6.63	9.46	-9.12	-12.07	0.20	0.10
14	ProShares VIX Mid-Term Futures (VIXM)	-13.84	32.43	72.39	-50.05	-79.79	-0.38	-0.23

Model Analysis
Portfolio Weights Table

Portfolio Weights Table (%):

Asset	Risk Parity	Min Variance	Max Diversification
Vanguard Total World Stock ETF (VT)	11.62	15.84	23.15
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	4.75	2.01	3.38
AQR Diversified Arbitrage I (ADAIX)	15.04	22.46	8.49
iShares Gold Trust (IAU)	4.05	3.29	0.00
Bitcoin Market Price USD (^BTC)	0.92	0.00	0.46
AQR Risk-Balanced Commodities Strategy I (ARCIX)	4.27	0.31	4.08
AQR Long-Short Equity I (QLEIX)	4.58	0.00	0.00
AQR Style Premia Alternative I (QSPIX)	3.82	0.00	0.00
AQR Equity Market Neutral I (QMNIX)	5.59	9.09	9.16
AQR Macro Opportunities I (QGMIX)	8.89	7.80	8.07
AGF U.S. Market Neutral Anti-Beta (BTAL)	6.13	6.69	8.73
AQR Managed Futures Strategy HV I (QMHIX)	2.68	0.00	0.00
Invesco DB US Dollar Bullish (UUP)	22.30	27.87	26.54
ProShares VIX Mid-Term Futures (VIXM)	5.36	4.64	7.92

Model Analysis
Risk Contribution Table

Risk Contribution Table (%):

Asset	Risk Parity	Min Variance	Max Diversification
Vanguard Total World Stock ETF (VT)	7.19	16.90	27.12
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	7.11	1.94	5.54
AQR Diversified Arbitrage I (ADAIX)	7.09	22.05	3.87
iShares Gold Trust (IAU)	7.14	3.30	0.00
Bitcoin Market Price USD (^BTC)	7.10	0.00	2.74
AQR Risk-Balanced Commodities Strategy I (ARCIX)	7.18	0.29	5.16
AQR Long-Short Equity I (QLEIX)	7.15	0.00	0.00
AQR Style Premia Alternative I (QSPIX)	7.16	0.00	0.00
AQR Equity Market Neutral I (QMNIX)	7.14	9.25	7.09
AQR Macro Opportunities I (QGMIX)	7.16	7.90	4.74
AGF U.S. Market Neutral Anti-Beta (BTAL)	7.11	6.49	10.08
AQR Managed Futures Strategy HV I (QMHIX)	7.17	0.00	0.00
Invesco DB US Dollar Bullish (UUP)	7.16	27.48	13.68
ProShares VIX Mid-Term Futures (VIXM)	7.14	4.40	19.98

Model Analysis
Performance Metrics Table

Performance Metrics Table:

	Risk Parity	Minimum Variance	Maximum Diversification	VASIX (Benchmark)
CAGR (%)	5.38	4.66	4.71	3.38
Standard Deviation (%)	2.93	2.35	2.61	5.63
Maximum Drawdown (%)	-2.87	-2.21	-2.77	-16.72

Model Analysis
Annual Return Table

Annual Return Table (%):

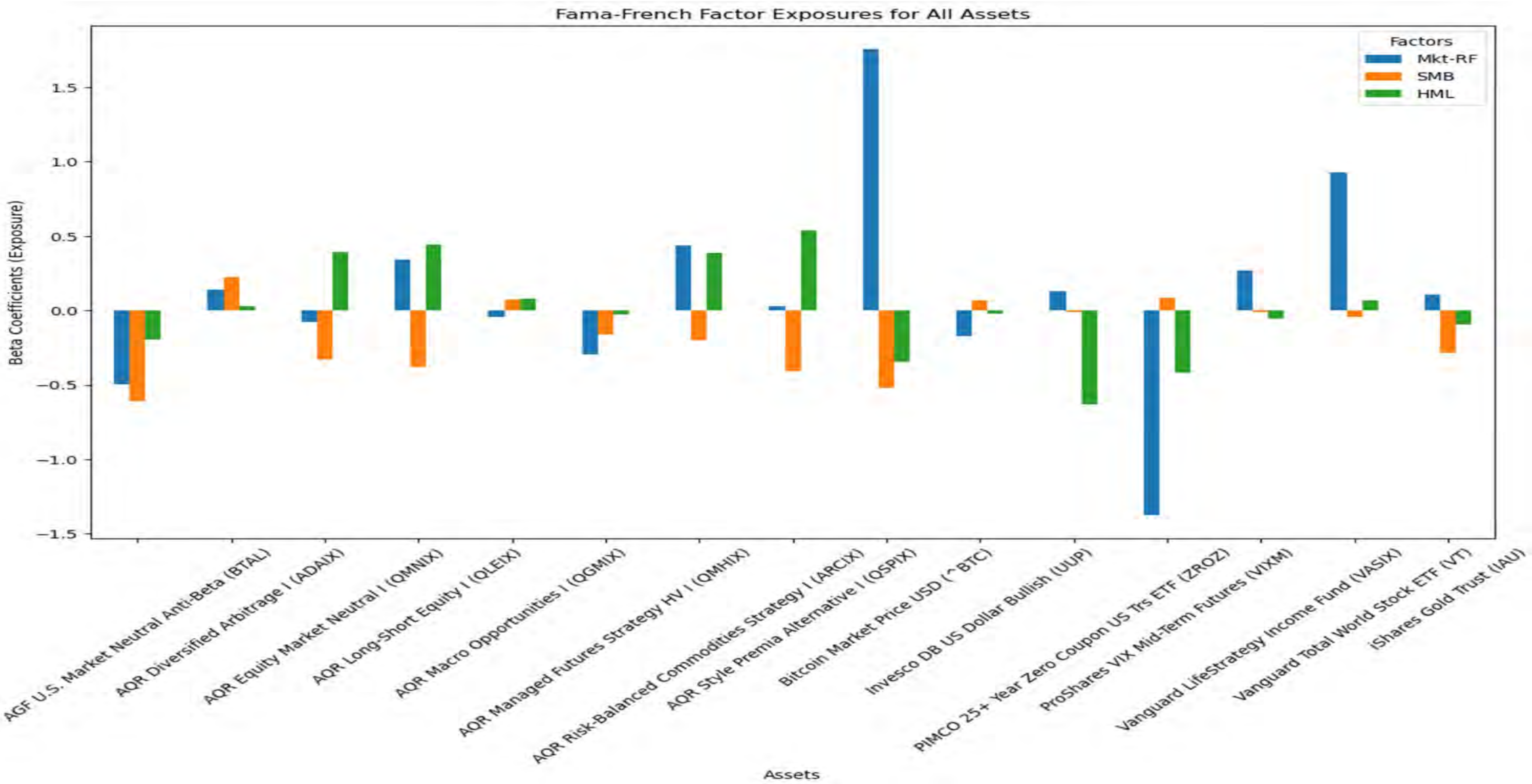
Date	Risk Parity (%)	Minimum Variance (%)	Maximum Diversification (%)	VASIX (Benchmark) (%)
2014-12-31	2.11	1.77	1.77	0.89
2015-12-31	1.36	1.39	1.29	0.23
2016-12-31	4.17	3.82	3.35	4.60
2017-12-31	3.51	-0.03	0.39	6.97
2018-12-31	-0.34	2.60	1.60	-1.06
2019-12-31	7.19	6.64	7.48	12.05
2020-12-31	9.11	8.56	9.61	9.14
2021-12-31	7.99	5.97	7.47	1.92
2022-12-31	5.71	4.01	3.29	-13.93
2023-12-31	4.62	4.07	3.03	9.48
2024-12-31	7.27	6.92	6.94	5.21

Model Analysis
Regression Results Table

Regression Results Against Benchmark (VASIX)

	Portfolio	R2	Intercept (Annualized)	Intercept t-stat	Intercept p-value	Beta	Beta t-stat	Beta p-value
0	Risk Parity	0.03	**4.96**	**5.26**	**0.0000**	0.08	1.73	0.0864
1	Minimum Variance	0.03	**4.33**	**5.74**	**0.0000**	0.07	1.75	0.0826
2	Maximum Diversification	0.05	**4.24**	**5.13**	**0.0000**	**0.11**	**2.53**	**0.0129**

Model Analysis
Fama French Factors



Monte Carlo Analysis, 50th Percentile (36-mo., 10,000 iterations)

Asset	Portfolio End Balance ($)	Annual Compounded Return (%)	Annualized Volatility (%)	Maximum Drawdown (%)
Vanguard LifeStrategy Income Fund (VASIX)	11,015	3.27	6.88	-8.18
Vanguard Total World Stock ETF (VT)	12,825	8.65	18.40	-20.64
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	9,464	-1.82	25.73	-37.05
AQR Diversified Arbitrage I (ADAIX)	11,612	5.11	7.16	-7.51
iShares Gold Trust (IAU)	12,310	7.17	17.11	-19.83
Bitcoin Market Price USD (^BTC)	23,976	33.84	93.60	-74.97
AQR Risk-Balanced Commodities Strategy I (ARCIX)	11,458	4.64	19.85	-25.07
AQR Long-Short Equity I (QLEIX)	13,357	10.13	13.98	-14.22
AQR Style Premia Alternative I (QSPIX)	11,650	5.22	16.41	-20.20
AQR Equity Market Neutral I (QMNIX)	11,843	5.80	12.16	-14.04
AQR Macro Opportunities I (QGMIX)	10,955	3.09	9.23	-11.74
AGF U.S. Market Neutral Anti-Beta (BTAL)	10,170	0.56	18.14	-26.03
AQR Managed Futures Strategy HV I (QMHIX)	10,683	2.23	20.07	-27.10
Invesco DB US Dollar Bullish (UUP)	10,940	3.04	8.10	-10.11
ProShares VIX Mid-Term Futures (VIXM)	5,676	-17.20	39.62	-62.35

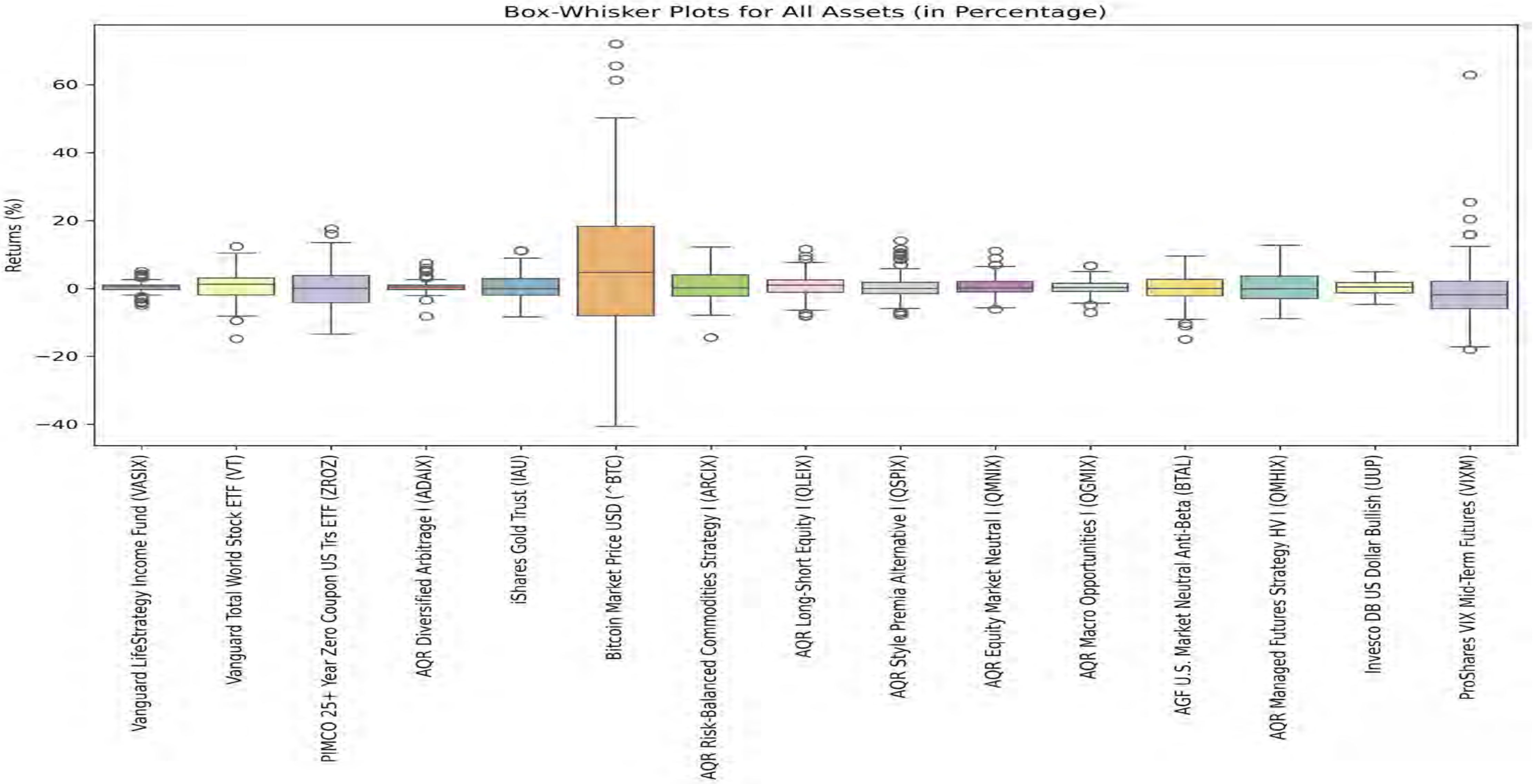
Quantitative Goodness of Fit Tests AIC, BIC, K-S

	Asset	AIC_T	AIC_Cauchy	AIC_Normal	BIC_T	BIC_Cauchy	BIC_Normal	K-S_T	K-S_Cauchy	K-S_Normal
0	Vanguard LifeStrategy Income Fund (VASIX)	**-647.000**	-639.908	-634.216	**-638.688**	-634.366	-628.675	0.058	**0.054**	0.122
1	Vanguard Total World Stock ETF (VT)	**-403.166**	-379.327	-402.084	-394.854	-373.786	**-396.542**	**0.066**	0.072	0.089
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-321.459	-288.056	**-322.976**	-313.147	-282.515	**-317.435**	**0.039**	0.083	0.052
3	AQR Diversified Arbitrage I (ADAIX)	**-679.596**	-667.710	-624.802	**-671.284**	-662.168	-619.261	**0.047**	0.070	0.169
4	iShares Gold Trust (IAU)	-417.207	-382.092	**-419.207**	-408.895	-376.550	**-413.665**	0.078	0.094	**0.078**
5	Bitcoin Market Price USD (^BTC)	-17.637	15.443	**-18.210**	-9.325	20.985	**-12.669**	**0.071**	0.097	0.076
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	-382.235	-345.458	**-384.209**	-373.923	-339.916	**-378.668**	**0.066**	0.097	0.067
7	AQR Long-Short Equity I (QLEIX)	**-471.236**	-448.901	-466.863	**-462.924**	-443.360	-461.322	**0.034**	0.059	0.064
8	AQR Style Premia Alternative I (QSPIX)	**-444.950**	-432.415	-429.054	**-436.638**	-426.874	-423.513	**0.055**	0.084	0.134
9	AQR Equity Market Neutral I (QMNIX)	**-503.627**	-483.176	-499.914	**-495.315**	-477.635	-494.372	**0.063**	0.077	0.101
10	AQR Macro Opportunities I (QGMIX)	**-567.909**	-544.492	-564.954	**-559.597**	-538.950	-559.412	0.068	**0.067**	0.084
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	**-406.536**	-379.027	-405.510	-398.224	-373.485	**-399.969**	**0.042**	0.077	0.060
12	AQR Managed Futures Strategy HV I (QMHIX)	-379.619	-334.573	**-381.619**	-371.307	-329.032	**-376.078**	**0.059**	0.103	0.059
13	Invesco DB US Dollar Bullish (UUP)	-593.853	-545.432	**-595.853**	-585.541	-539.890	**-590.312**	**0.054**	0.099	0.054
14	ProShares VIX Mid-Term Futures (VIXM)	**-270.022**	-252.818	-221.081	**-261.710**	-247.276	-215.539	**0.048**	0.073	0.140

Quantitative Goodness of Fit Tests AIC, BIC, K-S

	Asset	AIC_T	AIC_Cauchy	AIC_Normal	BIC_T	BIC_Cauchy	BIC_Normal	K-S_T	K-S_Cauchy	K-S_Normal
0	Vanguard LifeStrategy Income Fund (VASIX)	**-647.000**	-639.908	-634.216	**-638.688**	-634.366	-628.675	0.058	**0.054**	0.122
1	Vanguard Total World Stock ETF (VT)	**-403.166**	-379.327	-402.084	-394.854	-373.786	**-396.542**	**0.066**	0.072	0.089
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-321.459	-288.056	**-322.976**	-313.147	-282.515	**-317.435**	**0.039**	0.083	0.052
3	AQR Diversified Arbitrage I (ADAIX)	**-679.596**	-667.710	-624.802	**-671.284**	-662.168	-619.261	**0.047**	0.070	0.169
4	iShares Gold Trust (IAU)	-417.207	-382.092	**-419.207**	-408.895	-376.550	**-413.665**	0.078	0.094	**0.078**
5	Bitcoin Market Price USD (^BTC)	-17.637	15.443	**-18.210**	-9.325	20.985	**-12.669**	**0.071**	0.097	0.076
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	-382.235	-345.458	**-384.209**	-373.923	-339.916	**-378.668**	**0.066**	0.097	0.067
7	AQR Long-Short Equity I (QLEIX)	**-471.236**	-448.901	-466.863	**-462.924**	-443.360	-461.322	**0.034**	0.059	0.064
8	AQR Style Premia Alternative I (QSPIX)	**-444.950**	-432.415	-429.054	**-436.638**	-426.874	-423.513	**0.055**	0.084	0.134
9	AQR Equity Market Neutral I (QMNIX)	**-503.627**	-483.176	-499.914	**-495.315**	-477.635	-494.372	**0.063**	0.077	0.101
10	AQR Macro Opportunities I (QGMIX)	**-567.909**	-544.492	-564.954	**-559.597**	-538.950	-559.412	0.068	**0.067**	0.084
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	**-406.536**	-379.027	-405.510	-398.224	-373.485	**-399.969**	**0.042**	0.077	0.060
12	AQR Managed Futures Strategy HV I (QMHIX)	-379.619	-334.573	**-381.619**	-371.307	-329.032	**-376.078**	**0.059**	0.103	0.059
13	Invesco DB US Dollar Bullish (UUP)	-593.853	-545.432	**-595.853**	-585.541	-539.890	**-590.312**	**0.054**	0.099	0.054
14	ProShares VIX Mid-Term Futures (VIXM)	**-270.022**	-252.818	-221.081	**-261.710**	-247.276	-215.539	**0.048**	0.073	0.140

Box and Whisker Plot



Box and Whisker Plot