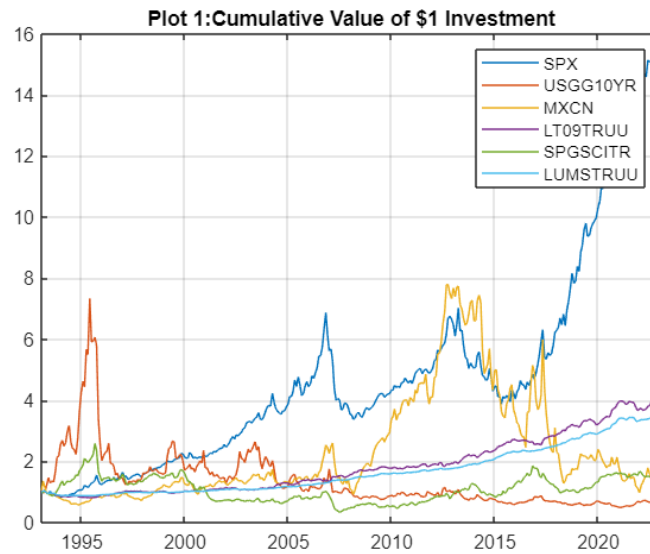




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Exercise Set 5

Question 1:



The cumulative return of 1\$ and annualized return of each index is listed in the table below:

Table 1: Cumulative Return and Annualized Return

Asset Name	Cumulative Dollar Returns	Annualized Mean Returns
SPX	15.808	0.096
USGG10YR	0.580	-0.018
MXCN	1.298	0.009
LT09TRUU	4.188	0.049
SPGCITR	1.461	0.013
LUMSTRUU	3.567	0.043

Question 2:

2.a. Table summarizing the portfolios' weights.

Table 2: Portfolio Weights

Asset Name	wmvBase	wmvStress	wBase	wStress	wrpBase	wrpStress
SPX	-0.009	0.015	0.408	0.408	0.053	0.034
USGG10YR	0.101	0.081	0.000	0.000	0.101	0.085
MXCN	-0.002	-0.012	0.000	0.000	0.027	0.018
LT09TRUU	0.299	0.342	0.592	0.592	0.433	0.516
SPGCITR	-0.004	-0.014	0.000	0.000	0.040	0.023
LUMSTRUU	0.615	0.587	0.000	0.000	0.347	0.324

Note: "wBase" and "wStress" are weights for "MaxSharpeBase" and "MaxSharpeStress" cases respectively.

Comment:



In the minimal variance portfolio for both the base and stress cases, we find that we are shorting several of the assets in our portfolio. This makes sense to ensure minimum variance in returns. In the targeted return portfolio, both the base and stress case involve heavily investing in two assets (SPX & LT09TRUU), and not really investing in any other. This is to hit a higher targeted rate of return. However, the risk parity portfolio (for both cases) reduces overall riskiness by still focusing on investing in those two assets, but with a much greater spread. This contrasts with the targeted rate of return portfolio, which exclusively invests in those two assets.

2.b. Table summarizing the portfolios' returns.

Table 3: Portfolio Returns

Portfolio Type	Base	Stress
mv	0.003	0.003
MaxSharpe	0.006	0.006
riskParity	0.003	0.003

Comment:

The returns are as expected for each portfolio. The minimum variance portfolio has the lowest return because it sacrifices returns for less risk. On the other hand, the target rate of return portfolio hits the target rate exactly, while the risk parity portfolio is somewhere in the middle, due to its distribution of risk.

2.c. Table summarizing the portfolio risks ($w'Vw$)^{1/2}.

Table 4: Portfolio Risks

MaxSharpBase	MaxSharpeStress	RiskParityBase	RiskParityStress
0.068	0.046	0.029	0.016

Comment:

The risks also match up with what we know about the allocations for each portfolio. The risk parity portfolio has lower risk in both cases, as the risk parity method distributes risk. Additionally, risk is lower for the stress case than the base case for both portfolios.

2.d. Table summarizing MCR.

Table 5: Portfolio MCR

Asset Name	MaxSharpBase	MaxSharpeStress	RiskParityBase	RiskParityStress
SPX	0.125	0.101	0.09	0.076
USGG10YR	-0.108	-0.039	0.047	0.031
MXCN	0.124	0.136	0.179	0.141
LT09TRUU	0.028	0.008	0.011	0.005
SPGCITR	0.042	0.111	0.121	0.114
LUMSTRUU	0.017	0.008	0.014	0.008

Comment:

In both the stress cases, the MCR is more evenly distributed among every asset for the risk parity portfolio. This makes sense in the context of the weights of either portfolio. The targeted rate of return portfolio invested more heavily in a few assets while the risk parity portfolio spread out investment. Does, the MCR was more evenly distributed for the risk parity portfolio but concentrated in a certain few asset for the targeted rate of return portfolio.

2.e. Table summarizing Risk Attribution.

Table 6: Portfolio Risk Attribution

Asset Name	MaxSharpBase	MaxSharpeStress	RiskParityBase	RiskParityStress
SPX	0.051	0.041	0.005	0.003
USGG10YR	0	0	0.005	0.003
MXCN	0	0	0.005	0.003
LT09TRUU	0.016	0.005	0.005	0.003
SPGCITR	0	0	0.005	0.003
LUMSTRUU	0	0	0.005	0.003

Comment:

Unsurprisingly, the risk budget is reflective of the broader trends already identified. The risk parity portfolio has an equally distributed risk budget while the targeted rate of return portfolio has a risk budget concentrated on certain assets designed to offer a higher potential return.

Question 3:

Table 7: VaR at 1% level

U/L Bound	MaxSharpBase	MaxSharpeStress	RiskParityBase	RiskParityStress
Upper Bound	-0.107	-0.050	-0.035	0.000
Lower Bound	0.243	0.187	0.115	0.082

Comment:

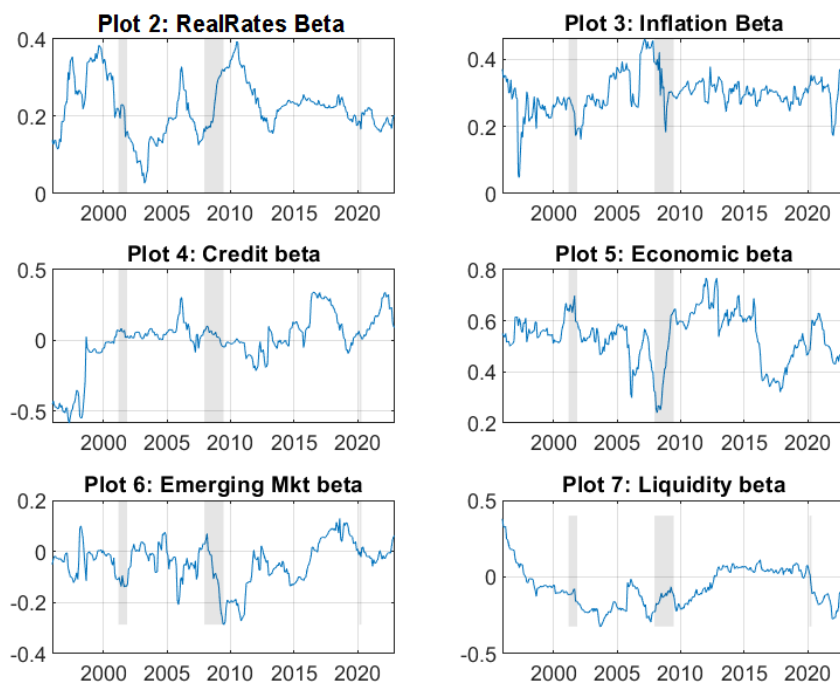


Based on the table above, we are 99% confident that the annualized expected return for each portfolio is as follows:

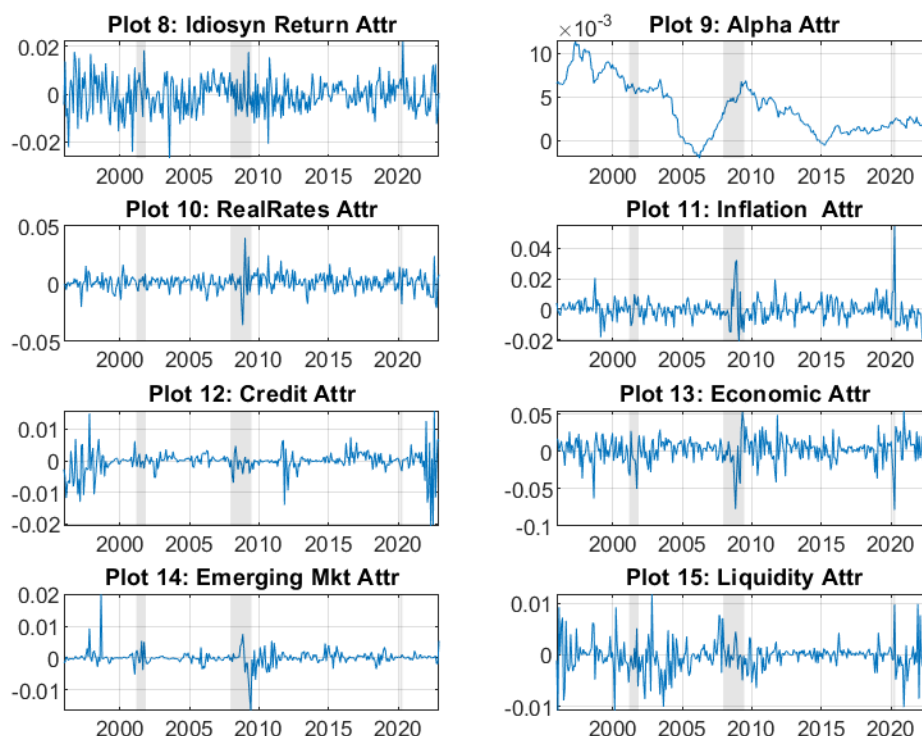
- 1) For the target return portfolio in base case, we are 99% confident that the annualized return falls between -10.7% and 24.3%.
- 2) For the target return portfolio in stress case, we are 99% confident that the annualized return falls between -5.04% and 18.7%.
- 3) For the risk parity return portfolio in base case, we are 99% confident that the annualized return falls between -3.48% and 11.5%.
- 4) For the risk parity return portfolio in stress case, we are 99% confident that the annualized return falls between 0.0057% and 8.25%.

Question 4:

4.a. Using the BlackRock factors and a 36-month trailing window, estimate and plot the betas (factor loadings) as time series.



4.b. Estimate and plot the monthly return attribution having solved for the betas.



Question 5:

Remark on any outstanding behavior in these beta plots, especially over previous recessions

The betas indicate significance of each factor to returns. If we look at the shaded area (recessions), we can see that the Economic factor becomes much more important, as does real rates. On the other hand, the importance of inflation and emerging markets drop drastically, as a reflection of the economic conditions of a recession.



Question 6:

Remark on any outstanding returns behavior in the attribution plots, especially over previous recessions. (Ignore alpha and the idiosyncratic return).

The attribution plots show similar behavior around recessions, in regard to the importance of real rate and the economic factor. For both, we see a fall in attribution at the start of a recession and then a large spike upwards as a recovery begins. This fits with what we know of the business cycle and how a recession occurs. Inflation displays the opposite pattern in its attribution plot, having a greater attribution value initially and then falling towards the end. This is probably reflective of the slowdown from a recession putting a dampener on the economy which makes inflation increasingly important, with the reverse happening during the recovery from a recession.