QAM_Project_2

Question 1. CRSP Bond

I have obtained the data for the bond returns from the CRSP Monthly US Treasury Database. The sample period that will be evaluated is from January 1926 - December 2019.
1. Market Value/Weights: For the calculation of the value weighted returns, I will be weighting the bonds according to their outstanding face value (TMTOTOUT) that has been lagged by 1 month to prevent a forward bias and to ensure that the strategy is replicable. Furthermore, as the sample data starts from January 1926, by lagging the face value by 1 month, we will have a missing lagged market value for January 1926 and thus will be excluded from the analysis. Finally, I have also excluded records with missing lagged market value (including January 1926), as the variable is needed to do a value-weighted return and as the number of records with missing lagged market are quite small the effect would be negligible.
2. Missing Returns: The data contains some missing returns and I have treated TMRETNUA = -99 as missing as well as that code indicates that the price is missing for the month or for the previous month. I have treated the bonds data with missing returns but with non-missing lagged market value data as having the returns to be 0 and have excluded the bonds data with missing returns and missing lagged market value. The summary statistics for the bonds data for the sample period of January 1926 - December 2019 is shown by the below:

	Bond_Ew_Ret	Bond_Vw_Ret
Annualized Mean	0.04863	0.04795
t-stat Annualized Mean	13.74331	14.17729
Annualized Volatility	0.03429	0.03278
Annualized Sharpe	1.41814	1.46292
Skewness	0.57897	0.29869
Excess Kurtosis	6.17132	5.50505

and the sample dataset is shown below:

year	month	Bond_Ew_Ret	Bond_Vw_Ret	Bond_lag_MV
1926	2	0.00503	0.00615	809000
1926	3	0.00212	0.00388	809000
1926	4	0.00639	0.00744	809000
1926	5	0.00190	0.00147	809000
1926	6	0.00331	0.00375	809000
2019	7	0.00052	0.00051	14603409000
2019	8	0.02203	0.02370	14764084000
2019	9	-0.00494	-0.00527	14827349000
2019	10	0.00073	0.00061	15010773000
2019	11	-0.00173	-0.00181	15294120000
2019	12	-0.00340	-0.00373	15207150000

Question 2. Data tables Aggregation

I have leveraged the use of PS1_Q1 to create the universe of Monthly CRSP Stocks with some additional assumptions:
1. The sample period for the stocks will be the same as the sample period for the CRSP Bonds universe that is January 1926 - December 2019.
2. I have included all the share codes in the CRSP Stock except for ADRs (SHRCD 30-39) and SHRCD 80s. Similarly, additional exchange codes EXCHD 4, 31, 32, 33, and 34 have also been included in addition to 1, 2, and 3 originally included. 3. Returns and market capitalizations are treated with the same assumptions as before.
The data for the riskless CRSP bonds have been obtained from the CRSP US Treasury and Inflation Indexes with the 90-day and 30-day T-bill rates. I have included the same sample period for the riskless data as well and that is January 1926 - December 2019. Finally, the data for the CRSP Bond universe is obtained from question (1) alongside the assumptions stated in question (1).
To aggregate the 3 data tables, I have merged all 3 datasets with the use of year and month as the joining key. To create the excess return variables, I have substracted the value-weighted return of the stocks and bonds with the 30-day T-bill rate. I have chosen the shorter T-Bill rate as the risk-free rate as I believe the shorter duration rate would be more reflective of the actual risk-free rate as it has less risk (due to the shorter duration) and less liquidity premium.
The summary statistics for the bonds and stocks excess returns data for the sample period of January 1926 - December 2019 is shown by the below:

	Stock_Excess_Vw_Ret	Bond_Excess_Vw_Ret
Annualized Mean	0.07820	0.01527
t-stat Annualized Mean	4.10932	4.65609
Annualized Volatility	0.18441	0.03178
Annualized Sharpe	0.42403	0.48045
Skewness	0.17734	-0.01587
Excess Kurtosis	7.99598	4.54326

A sample dataset of the output is shown by the table below:

year	month	Stock_lag_MV	Stock_Excess_Vw_Ret	Bond_lag_MV	Bond_Excess_Vw_Ret
1926	2	27600952	-0.03581	809000	0.00339
1926	3	26683758	-0.06678	809000	0.00110
1926	4	24920556	0.03392	809000	0.00437
1926	5	25742578	0.01175	809000	0.00113
1926	6	26092831	0.05018	809000	0.00029
2019	7	38034704405	0.01006	14603409000	-0.00127
2019	8	38501236935	-0.02225	14764084000	0.02179
2019	9	37609114068	0.01425	14827349000	-0.00706
2019	10	38136802091	0.01771	15010773000	-0.00092
2019	11	38726685885	0.03380	15294120000	-0.00301
2019	12	39994746128	0.02705	15207150000	-0.00516

Question 3. Portfolio Returns

When calculating the stock volatility and bond volatility weights, I have calculated their respective estimated volatilities using their past 3-years returns data up to month t-1. The value weighted excess returns are calculated based on their lagged market value of the stocks and bonds to prevent a forward bias. The 60/40 weighted portfolio is an investment of 60% in stocks and 40% in bonds that is rebalanced monthly. The unlevered RP portfolio is weighted based on their volatilities i.e. $w_{t,i} = k_t \hat{\sigma}_{t,i}^{-1}$ where k_t is the unlevered k constant calculated as follows $k_t = \frac{1}{\Sigma_i \hat{\sigma}_{t,i}^{-1}}$ which makes sure that the weights in stocks and bonds sum to 1. The levered RP portfolio weights are calculated similarly with the exception of keeping the levered constant k constant over-time i.e. $k_t = k$ for all periods. The k is set such that the annualized volatility of the levered RP strategy matches the ex-post realized volatility of the value-weighted portfolio for the sample period being considered.

Question 4. Portfolio Strategy Replication

The resulting portfolio strategies and their summary statistics can be found in the table below:

	Annualized Mean	t-stat Annualized Mean	Annualized Volatility	Annualized Sharpe	Skewness	Excess Kurtosis
CRSP Stocks	7.00%	3.30692	18.99%	0.36858	0.27874	8.04347
CRSP Bonds	1.56%	4.33263	3.22%	0.48290	-0.05152	4.83568
Value-Weighted Portfolio	4.14%	2.48694	14.94%	0.27718	0.60229	14.69265
60/40 Portfolio	4.82%	3.70873	11.67%	0.41336	0.27308	7.96904
Unlevered-RP	2.25%	4.78150	4.23%	0.53292	0.05959	4.81911
Levered-RP	8.13%	4.88333	14.94%	0.54427	-0.35992	2.01045

The table presented above closely replicates Panel A of Table 2 in Asness, Frazzini and Pedersen (2012). However, there are certainly some differences between the results of the two tables. First off, the sample period being considered between the two tables are different. The table above considers the period January 1930 - June 2010, whereas in Asness, the sample period being considered is January 1926 - June 2010 which would inadvertently result in some differences in all the summary statistics. The different sampling period is because I do not have access to the CRSP data prior to 1926 and thus when calculating the estimated volatilities used for replicating the RP portfolios, I have no choice but to exclude the first 3 years of the dataset. Furthermore, it has not been specified in the paper which T-bill rate the excess returns are calculated as off and I have taken the 30-day US T-bill rate as the risk free rate.

The difference between the two tables is somewhat economically significant. As seen for the annualized return for CRSP Stocks the results shown by the table above is 7% while the paper shows a result of 6.57% this big difference will impact all the other portfolio returns as they all depend on the CRSP stock returns. Hence, the annualized returns for all the strategies are showing better returns in the table above than the actual strategy in the paper. THe annualized volatility do not differ as much but they still impact the results quite significantly and affects the resulting sharpe ratios as well. Again, the difference between the two results can be attributed to the different sampling period used in these two tables.