Name Huanyu Liu

Discussed with: Nanhao Wang

Q1.

* Shareholders’ equity (SHE): variable reported in Compustat is “Stockholders’ Equity - Total” (SEQ). If not available, use “Common/Ordinary Equity - Total” (CEQ) plus “Preferred/Preference Stock (Capital) - Total” (PSTK). If not avail- able, use “Assets - Total” (AT) minus “Liabilities - Total” (LT) minus “Minority Interest (Balance Sheet)” (MIB). If not available, use AT minus LT.
* Deferred taxes and investment tax credit (DT): variable reported in Compustat is “Deferred Taxes and Investment Tax Credit” TXDITC. If not available, use “Investment Tax Credit (Balance Sheet)” (ITCB) plus “Deferred Taxes (Balance Sheet)” (TXDB). If not available, sum what is not missing.
* Book value of preferred stock (PS): Use redemption value, which is variable “Preferred Stock Redemption Value” (PSTKRV). If not available, use liquidation value, which is “Preferred Stock Liquidating Value” (PSTKL). If not available, use par value, which is “Preferred/Preference Stock (Capital) - Total” (PSTK).
* Define book equity (BE) as: BE = SHE − PS + DT − PRBA (need value of SHE to compute BE, other variables included if not missing). The last variable is “Postretirement Benefit Asset” (PRBA), and you will have to get this variable from Compustat’s Pension Annual data: merge to Compustat using Compustat’s global variable key (GVKEY).
* (optional) For missing value of book equity, you can use historical book equity value available n French’s website—Davis, Fama and French (2000)’s data.
* To calculate book-to-market, you will have to sum the market equity of subsidiaries. A company (permanent identifier variable: PERMCO) may have different securities (identified by PERMNO).

Reference: <https://wrds-www.wharton.upenn.edu/pages/support/applications/risk-factors-and-industry-benchmarks/fama-french-factors-python/>

Connect to WRDS using Python package wrds to download all the data sets: Compustat, CRSP, and linked table.

Create Shareholders' equity, deferred taxes and investment tax credit, preferred stock, and create book equity as the instructions above by using Compustat data set.

Create total market cap of all the firms by sum up all the me across different PERMNO according to the same PERMNO on a given date. And denote the market cap of each December as dec\_me.

Create a column called ‘ffyear’, which is the fiscal year corresponding to the period from July last year to this June.

Link link table with compustat by gvkey. And then link with CRSP by ffyear and PERMNO. Calculate book-to-market using be/dec\_me.

Extract July data as the benchmark to rebalance for the next fiscal year. And then extract NYSE data to create breakpoints for both size and book-to-market. And then create decile by using those breakpoints.

Merge back the deciles to get the final dataframe based on fiscal year, so that for each PERMNO, the decile does not change within the same fiscal year.

Calculate value-weighted return based on both size decile and book-to-market decile.

For SMB, it’s similar to size decile except that the market cap is divided to 2 parts. And for HML, it’s similar to book-to-market decile expect that the book-to-market is divided to 3 parts: the lower 30%, higher 30% and 40% in the middle.

Output of question 1

Year Month port Size\_Ret BtM\_Ret HML\_Ret SMB\_Ret

0 1973 1 1.0 -0.036063 -0.010181 2.223979 -3.108647

1 1973 1 2.0 -0.041768 -0.049391 2.223979 -3.108647

2 1973 1 3.0 -0.050724 -0.050517 2.223979 -3.108647

3 1973 1 4.0 -0.066884 -0.047901 2.223979 -3.108647

4 1973 1 5.0 -0.054671 -0.018638 2.223979 -3.108647

5 1973 1 6.0 -0.046942 -0.004542 2.223979 -3.108647

6 1973 1 7.0 -0.057130 -0.017961 2.223979 -3.108647

7 1973 1 8.0 -0.047499 -0.011810 2.223979 -3.108647

8 1973 1 9.0 -0.066290 -0.029559 2.223979 -3.108647

9 1973 1 10.0 -0.005412 -0.048175 2.223979 -3.108647

10 1973 2 1.0 -0.077244 -0.024979 2.147442 -3.591549

11 1973 2 2.0 -0.086348 -0.046918 2.147442 -3.591549

12 1973 2 3.0 -0.076031 -0.049377 2.147442 -3.591549

13 1973 2 4.0 -0.064241 -0.042010 2.147442 -3.591549

14 1973 2 5.0 -0.075851 -0.053065 2.147442 -3.591549

15 1973 2 6.0 -0.065527 -0.050147 2.147442 -3.591549

16 1973 2 7.0 -0.064866 -0.046174 2.147442 -3.591549

17 1973 2 8.0 -0.049762 -0.057316 2.147442 -3.591549

18 1973 2 9.0 -0.036469 -0.025129 2.147442 -3.591549

19 1973 2 10.0 -0.032830 -0.039739 2.147442 -3.591549

20 1973 3 1.0 -0.025368 -0.015935 2.278014 -2.354737

21 1973 3 2.0 -0.029205 -0.008121 2.278014 -2.354737

22 1973 3 3.0 -0.017010 -0.021288 2.278014 -2.354737

23 1973 3 4.0 -0.027501 -0.014330 2.278014 -2.354737

24 1973 3 5.0 -0.021702 0.009721 2.278014 -2.354737

25 1973 3 6.0 -0.027830 0.007591 2.278014 -2.354737

26 1973 3 7.0 -0.015350 0.007414 2.278014 -2.354737

27 1973 3 8.0 -0.029137 0.004760 2.278014 -2.354737

28 1973 3 9.0 -0.010600 -0.008195 2.278014 -2.354737

29 1973 3 10.0 0.002189 0.019358 2.278014 -2.354737

... ... ... ... ... ... ... ...

5490 2018 10 1.0 -0.106321 -0.115916 3.490169 -4.552330

5491 2018 10 2.0 -0.112489 -0.066827 3.490169 -4.552330

5492 2018 10 3.0 -0.117944 -0.050660 3.490169 -4.552330

5493 2018 10 4.0 -0.114711 -0.066817 3.490169 -4.552330

5494 2018 10 5.0 -0.112032 -0.091214 3.490169 -4.552330

5495 2018 10 6.0 -0.095991 -0.049168 3.490169 -4.552330

5496 2018 10 7.0 -0.104168 -0.044148 3.490169 -4.552330

5497 2018 10 8.0 -0.088892 -0.059503 3.490169 -4.552330

5498 2018 10 9.0 -0.078257 -0.060141 3.490169 -4.552330

5499 2018 10 10.0 -0.066754 -0.083860 3.490169 -4.552330

5500 2018 11 1.0 -0.020913 0.035290 0.375407 -0.890703

5501 2018 11 2.0 -0.006387 -0.024576 0.375407 -0.890703

5502 2018 11 3.0 0.012520 0.024782 0.375407 -0.890703

5503 2018 11 4.0 0.031010 0.040562 0.375407 -0.890703

5504 2018 11 5.0 0.015718 0.016926 0.375407 -0.890703

5505 2018 11 6.0 0.015628 0.025952 0.375407 -0.890703

5506 2018 11 7.0 0.039732 0.018410 0.375407 -0.890703

5507 2018 11 8.0 0.020782 0.020342 0.375407 -0.890703

5508 2018 11 9.0 0.017583 0.028547 0.375407 -0.890703

5509 2018 11 10.0 0.017759 -0.001027 0.375407 -0.890703

5510 2018 12 1.0 -0.125755 -0.081975 -1.121218 -2.589685

5511 2018 12 2.0 -0.122696 -0.095641 -1.121218 -2.589685

5512 2018 12 3.0 -0.116662 -0.080497 -1.121218 -2.589685

5513 2018 12 4.0 -0.124721 -0.083660 -1.121218 -2.589685

5514 2018 12 5.0 -0.121940 -0.109434 -1.121218 -2.589685

5515 2018 12 6.0 -0.116842 -0.108027 -1.121218 -2.589685

5516 2018 12 7.0 -0.112798 -0.113162 -1.121218 -2.589685

5517 2018 12 8.0 -0.105454 -0.110789 -1.121218 -2.589685

5518 2018 12 9.0 -0.093070 -0.099780 -1.121218 -2.589685

5519 2018 12 10.0 -0.087640 -0.121404 -1.121218 -2.589685

Q2.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 |
| Annualized Mean | 4.956 | 6.166 | 7.519 | 7.755 | 7.186 | 7.552 |
| Annualized Volatility | 18.290 | 16.487 | 16.095 | 16.462 | 15.850 | 15.625 |
| Sharpe Ratio | 0.271 | 0.374 | 0.467 | 0.471 | 0.453 | 0.483 |
| Skewness | -0.236 | -0.443 | -0.547 | -0.491 | -0.472 | -0.367 |
| correlation | 0.991 | 0.980 | 0.971 | 0.970 | 0.964 | 0.968 |
|  |  |  |  |  |  |  |
|  | 6 | 7 | 8 | 9 | 10 | Long-Short |
| Annualized Mean | 7.552 | 7.571 | 7.987 | 8.289 | 9.297 | 4.341 |
| Annualized Volatility | 15.625 | 15.442 | 15.895 | 15.847 | 19.332 | 15.390 |
| Sharpe Ratio | 0.483 | 0.490 | 0.502 | 0.523 | 0.481 | 0.282 |
| Skewness | -0.367 | -0.273 | -0.520 | -0.284 | -0.162 | 0.354 |
| correlation | 0.968 | 0.952 | 0.952 | 0.943 | 0.951 | 0.906 |

Q3.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 |
| Annualized Mean | 4.956 | 6.166 | 7.519 | 7.755 | 7.186 | 7.552 |
| Annualized Volatility | 18.290 | 16.487 | 16.095 | 16.462 | 15.850 | 15.625 |
| Sharpe Ratio | 0.271 | 0.374 | 0.467 | 0.471 | 0.453 | 0.483 |
| Skewness | -0.236 | -0.443 | -0.547 | -0.491 | -0.472 | -0.367 |
| correlation | 0.991 | 0.980 | 0.971 | 0.970 | 0.964 | 0.968 |
|  |  |  |  |  |  |  |
|  | 6 | 7 | 8 | 9 | 10 | Long-Short |
| Annualized Mean | 7.551558 | 7.570848 | 7.987096 | 8.289102 | 9.296549 | 4.340931 |
| Annualized Volatility | 15.625131 | 15.442419 | 15.895425 | 15.847016 | 19.331899 | 15.389518 |
| Sharpe Ratio | 0.483296 | 0.490263 | 0.502478 | 0.52307 | 0.480892 | 0.282071 |
| Skewness | -0.367341 | -0.273134 | -0.520222 | -0.284202 | -0.161642 | 0.353955 |
| correlation | 0.968325 | 0.952223 | 0.951935 | 0.943369 | 0.951071 | 0.905526 |

Q4.



According to the graph above, the value and size anomaly worked in the past few years.

Q5.

decile SMB HML

Annualized Mean 2.305072 3.844527

Annualized Volatility 10.661128 10.415698

Sharpe Ratio 0.216213 0.369109

Skewness 0.540577 0.036251

correlation 0.992527 0.971065

Q6.