# HW: Financial Ratio Quantile Strategies

January 18, 2023

## 1 Introduction

Here you will consider a few financial accounting ratios, as an approximation of "quantamental" models that typically take much more numerous and carefully defined financial accounting into consideration. You will then investigate profit opportunity of a quantile-based long-short scheme.

## 2 Understand Your Data

Read all documentation webpages for Zacks Fundamentals B. You will see they supply 6 related tables, FC, FR, MT, MKTV, SHRC and HDM [1]. The strategy coding for this assignment will be reasonably easy. The data assembly, deliberately, is the difficult part.

## 3 Define the Universe

Choose at least 200 tickers[2] of US equities such that[3] they satisfy the following:

- end-of-day adjusted closing prices are available , over the entire period Jan 2015 through Jan 2022

[1] It is easiest to download your data through full-table downloads. Use URLs such as *https://www.quandl.com/api/v3/datatables/ZACKS/MT?qopts.export=true*

[2] You can find the full list of available tickers online

[3] We will not concern ourselves with *selection bias* in this exercise.

- debt/market_cap ratio is greater[4] than 0.1 somewhere in the period Jan 2015 through Jan 2022 (preferably more than fleetingly)
- not in the automotive, financial or insurance sector , over the entire period Jan 2015 through Jan 2022[5]
- has feasible calculation of the ratios specified below , over the entire period Jan 2015 through Jan 2022, including for at least one `PER_END_DATE` no more than one year old. Debt ratio of zero is OK.

# 4 Select Financial Ratios

For this assignment, we will work with the following ratios:

- debt to market cap[6].
- return on investment[7]
- price to earnings[8]

Note that these data items are reported (at best) quarterly. Use annual numbers *only* when quarterly ones do not exist. As the equity price changes day-to-day, each ratio changes accordingly[9], so ultimately the time series you have will be on daily data[10]. Recall that we did not know any of these numbers until the `FC/FILING_DATE` .

[4] This is about 1000-2000 companies, including ASH, VTOL, ISUN and VIVO.

[5] See the Quandl ZFB fields `ZACKS_SECTOR_CODE`, `ZACKS_X_IND_CODE`, and the classification list

[6] `FR/TOT_DEBT_TOT_EQUITY` in Quandl. In this homework we pretend that it is OK to treat market capitalization and book equity as equivalent, though they are not the same thing.

[7] Based on `FR/RET_INVST`, `MKTV/MKT_VAL`, `FC/NET_LTERM_DEBT`, `FC/TOT_LTERM_DEBT`. Investment is defined here as market cap plus long term debt. Use net debt where available, total debt otherwise. Quandl will report debt as NaN if it was 0.0, but be careful about net versus tot debt.

[8] Compute this based on `FC/EPS_DILUTED_NET`, `BASIC_NET_EPS`, `SHRS/SHARES_OUT`, `MKTV/MKT_VAL`, use the basic version (GAAP) if no diluted number is available. Treat negative earnings per share as 0.001.

[9] In many cases `PER_END_DATE` is not a trading day, so go ahead and forward fill equity price from the previous trading day.

[10] If you have memory errors when joining data, you are probably mistakenly creating a combinatorial explosion in your merging code.

As an example, consider $V$, return on investment. Say that our entity had successive report dates of March 31 and June 30, $V^{3-31}$ and $V^{6-30}$ and those numbers were known on filing dates April 4 and July 7. Our equity price series, which we take (also a bit problematically) as adjusted close prices, will be $P^t$. We have a debt number $D$ for each report date as well.

We can infer the "return" $R$ for a given report date as the unknown element in

$$V = \frac{R}{D + M}$$

and we assume it doesn't change day-to-day. Rather only the market value element $M$ changes daily, and we estimate the corresponding $\tilde{V}$ values according to the filing dates. So for example our inferred values look like

$$\tilde{V}^{7\text{-}6} = \frac{R^{3\text{-}31}}{D^{3\text{-}31} + M^{7\text{-}6}}$$

but the next day is the filing date so we have

$$\tilde{V}^{7\text{-}7} = \frac{R^{6\text{-}30}}{D^{6\text{-}30} + M^{7\text{-}7}}$$

where

$$M^{7\text{-}6} = M^{3\text{-}31}\frac{P^{7\text{-}6}}{P^{3\text{-}31}}$$

and

$$M^{7\text{-}7} = M^{6\text{-}30}\frac{P^{7\text{-}7}}{P^{6\text{-}30}}.$$

# 5 Analysis

Study performance of weekly or monthly quantile trading strategies using each of these single ratios as well as your choice of least one nontrivial combination of them[11].

Set initial capital to be 10 times the gross notional of your first month's set of positions. You may assume zero trading costs, that trading fractional shares and arbitrary positions sizes are possible, that all securities are easy to borrow with a repo rate equal to your funding rate minus 100bp[12], and that

[11] That is to say, at least 4 types of scores.

[12] This number may sometimes become negative.

the portfolio capital is equal to the initial capital, adjusted for all realized and unrealized PL to date. Choose either a constant funding rate, or rolling 3-month LIBOR.

Analyze performance of a top-and-bottom decile trading strategy. Now rank based on *changes* in your ratios rather than the ratios themselves. Play with the effects of sizing positions by rank.

# 6 Data Example

Here is recent sample data for Eli Lilly (ticker LLY):

### 6.0.1 SEC Reports

| per_end_date | 2021-06-30 | 2021-09-30 | 2021-12-31 | 2022-03-31 | 2022-06-30 | 2022-09-30 |
|---|---|---|---|---|---|---|
| filing_date | 2021-08-03 | 2021-10-27 | 2022-02-23 | 2022-04-29 | 2022-08-04 | 2022-11-01 |
| tot_revnu | 6740.1 | 6772.8 | 7999.902 | 7810.0 | 6488.0 | 6941.6 |
| eps_diluted_net | 1.53 | 1.22 | 1.88 | 2.1 | 1.05 | 1.61 |
| basic_net_eps | 1.53 | 1.22 | 1.9 | 2.1 | 1.05 | 1.61 |
| tot_lterm_debt | 14736.6 | 15522.4 | 15346.4 | 15152.9 | 14692.0 | 14143.8 |
| net_lterm_debt | NaN | 505.5 | 505.4 | -710.1 | -1560.0 | -1560.0 |
| net_curr_debt | 196.3 | -1.5 | -4.0 | 499.7 | 2117.2 | 1741.3 |
| zacks_x_ind_code | 225.0 | 225.0 | 225.0 | 225.0 | 225.0 | 225.0 |
| zacks_sector_code | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| zacks_metrics_ind_code | 13.0 | 13.0 | 13.0 | 13.0 | 13.0 | 13.0 |
| tot_debt_tot_equity | 2.4784 | 2.148 | 1.8444 | 1.7447 | 1.9417 | 1.5629 |
| ret_invst | 6.4962 | 4.7286 | 7.045 | 7.7307 | 4.079 | 5.9717 |
| free_cash_flow_per_share | 3.066 | 4.4859 | 6.5274 | 2.3541 | 2.8613 | 4.5929 |
| shares_out | 959.03 | 956.59 | 956.59 | 950.16 | 950.16 | 950.18 |
| per_type | Q | Q | Q | Q | Q | Q |
| mkt_val | 220115.53 | 221020.67 | 264229.97 | 272097.19 | 308070.25 | 307240.03 |

### 6.0.2 Ratios On Key Dates

(Using `MKTV/MKT_VAL, FC/NET_LTERM_DEBT` to infer operating income)

| Date | Debt_To_Mkt_Cap | Return_On_Inv | Price_To_Earnings |
|---|---|---|---|
| 2020-10-28 | 4.755473 | 9.075546 | 81.908198 |
| 2020-10-29 | 3.782411 | 6.317094 | 96.358352 |
| 2020-12-31 | 2.953930 | 4.948484 | 123.383705 |
| 2021-01-04 | 3.013544 | 5.047243 | 120.942923 |
| 2021-02-17 | 2.405588 | 4.038046 | 151.508437 |
| 2021-02-18 | 2.381655 | 7.910124 | 84.975909 |
| 2021-03-31 | 2.563957 | 8.509632 | 78.933966 |
| 2021-04-01 | 2.585826 | 8.581494 | 78.266395 |
| 2021-04-30 | 2.620772 | 8.696299 | 77.222786 |
| 2021-05-03 | 2.293549 | 5.842814 | 121.784601 |
| 2021-06-30 | 1.849797 | 4.789536 | 150.999792 |
| 2021-07-01 | 1.836912 | 4.758436 | 152.059001 |
| 2021-08-03 | 1.658523 | 4.324818 | 168.414241 |
| 2021-08-04 | 2.167266 | 5.725783 | 168.162952 |
| 2021-09-30 | 2.454071 | 6.436395 | 148.509924 |
| 2021-10-01 | 2.469677 | 6.474765 | 147.571493 |
| 2021-10-27 | 2.266511 | 5.972855 | 160.799514 |
| 2021-10-28 | 1.958932 | 4.313252 | 204.221759 |
| 2021-12-31 | 1.790877 | 3.943927 | 223.385833 |
| 2022-01-03 | 1.820469 | 4.008969 | 219.754660 |
| 2022-02-23 | 2.067135 | 4.550975 | 193.531868 |
| 2022-02-24 | 2.087139 | 7.970179 | 128.103628 |
| 2022-03-31 | 1.771630 | 6.767552 | 150.917542 |
| 2022-04-01 | 1.733494 | 6.622135 | 154.237654 |
| 2022-04-29 | 1.736698 | 6.634354 | 153.953073 |
| 2022-05-02 | 1.725479 | 7.645313 | 136.612150 |
| 2022-06-30 | 1.535812 | 6.802995 | 153.483227 |
| 2022-07-01 | 1.533542 | 6.792915 | 153.710448 |
| 2022-08-04 | 1.628426 | 7.214236 | 144.754143 |
| 2022-08-05 | 2.089332 | 4.390834 | 285.276291 |