HW: Financial Ratio Quantile Strategies

January 28, 2024

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 2016 through Jun 2023

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[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 2016 through Jun 2023(preferably more than fleetingly)

- not in the automotive, financial or insurance sector , over the entire period Jan 2016 through Jun 2023[5]

- has feasible calculation of the ratios specified below , over the entire period Jan 2016 through Jun 2023, including for at least one `per_end_date` no more than one year old. A 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` .

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[4]This is about 1000-2000 companies, including BOWL, GGG, PBF and VSAT.

[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, filing dates April 3 and July 6, so V^{3-31} and V^{6-30} were known the day after the filing dates, on 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 just after 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

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

borrow with a repo rate equal to your funding rate minus 100bp[12], and that 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/SOFR.

Analyze performance of a top-and-bottom decile trading strategy. Consider Sharpe ratios and associated metrics, risk metrics such as downside beta, tail metrics and maximum drawdown, and comparisons of PL to traded notional.

Now rank based on *changes* in your ratios rather than the ratios themselves. Play with the effects of sizing positions by rank, for example by doubling or halving the most "attractive" vigintiles, on the theory that they are either particularly attractive, or are untrustworthy outliers respectively.

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[12]This number may sometimes become negative.

6 Data Example

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

6.0.1 SEC Reports

per_end_date	2022-06-30	2022-09-30	2022-12-31	2023-03-31	2023-06-30	2023-09-30
filing_date	2022-08-04	2022-11-01	2023-02-22	2023-04-27	2023-08-08	2023-11-02
tot_revnu	6488.000000	6941.600000	7301.801000	6960.000000	8312.100000	9498.600000
eps_diluted_net	1.050000	1.610000	2.140000	1.490000	1.950000	-0.060000
basic_net_eps	1.050000	1.610000	2.140000	1.490000	1.950000	-0.060000
tot_lterm_debt	14692.000000	14143.800000	14737.500000	18880.500000	18158.400000	17923.600000
net_lterm_debt	-1560.000000	-1560.000000	-1560.000000	3958.500000	3958.500000	3958.500000
net_curr_debt	2117.200000	1741.300000	1498.000000	-1498.000000	-1498.000000	97.000000
zacks_x_ind_code	225.000000	225.000000	225.000000	225.000000	225.000000	225.000000
zacks_sector_code	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000
zacks_metrics_ind_code	13.000000	13.000000	13.000000	13.000000	13.000000	13.000000
tot_debt_tot_equity	1.941700	1.562900	1.507000	1.671900	1.688000	1.783600
ret_invst	4.079000	5.971700	7.595000	4.456900	6.016200	-0.196400
free_cash_flow_per_share	3.289300	5.055800	5.781500	1.175800	1.058800	2.417200
shares_out	950.160000	950.180000	950.180000	949.270000	949.270000	949.310000
per_type	Q	Q	Q	Q	Q	Q
mkt_val	308070.250000	307240.030000	347613.090000	325999.340000	445190.030000	509901.410000
debt_to_eq	1.941700	1.562900	1.507000	1.671900	1.688000	1.783600
earn_per_sh	1.050000	1.610000	2.140000	1.490000	1.950000	-0.060000
long_term_debt	-1560.000000	-1560.000000	-1560.000000	3958.500000	3958.500000	3958.500000

Note the negative earnings per share do not come into play until Nov 2023.

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
2021-10-27 00:00:00	2.266511	5.972855	159.232948
2021-10-28 00:00:00	1.958932	4.313252	202.232157
2021-12-31 00:00:00	1.790877	3.943927	221.209527
2022-01-03 00:00:00	1.820469	4.008969	217.613731
2022-02-23 00:00:00	2.067135	4.550975	191.646411
2022-02-24 00:00:00	2.087139	7.970179	126.855597
2022-03-31 00:00:00	1.771630	6.767552	149.447249
2022-04-01 00:00:00	1.733494	6.622135	152.735015
2022-04-29 00:00:00	1.736698	6.634354	152.453207
2022-05-02 00:00:00	1.725479	7.645313	135.281225
2022-06-30 00:00:00	1.535812	6.802995	151.987938
2022-07-01 00:00:00	1.533542	6.792915	152.212945
2022-08-04 00:00:00	1.628426	7.214236	143.343896
2022-08-05 00:00:00	2.089332	4.390834	282.497026
2022-09-30 00:00:00	1.940811	4.077122	304.115168
2022-10-03 00:00:00	1.951675	4.100062	302.422243
2022-11-01 00:00:00	1.779911	3.737540	331.606389
2022-11-02 00:00:00	1.423720	5.437435	217.724877
2022-12-30 00:00:00	1.377587	5.260454	225.016059
2023-01-03 00:00:00	1.380796	5.272760	224.493252
2023-02-22 00:00:00	1.526555	5.832136	203.058101
2023-02-23 00:00:00	1.677865	8.460450	152.048436
2023-03-31 00:00:00	1.600181	8.066864	159.429879
2023-04-03 00:00:00	1.566785	7.897718	162.828128
2023-04-27 00:00:00	1.407799	7.092939	181.216741
2023-04-28 00:00:00	1.450422	3.872644	263.944889
2023-06-30 00:00:00	1.221106	3.265751	313.511980
2023-07-03 00:00:00	1.241113	3.318780	308.458138
2023-08-08 00:00:00	1.097919	2.938902	348.688320
2023-08-09 00:00:00	1.504358	5.366827	268.798647