Data Analytics for Finance: Final Project

Overview

Gross Profit to Assets is a profitability metric used to measure how well a company uses its assets to create profits. It is measured as ***GROSS PROFIT/ TOTAL ASSETS*** where the gross profit represents the value of the sales without the cost of material or labor utilized (COGS). A good ratio (50 to 70 %) would be an index of a healthy company. However, this strongly depends on the type of business. This is why gross profit to the asset is mostly used to compare businesses in the same industry. Gross Profitability is part of Quality Factors and research shows it has the same predictive potential as traditional value indicators when it comes to stock returns[1].

Let's analyze the ratio more in detail:

- *GROSS PROFIT* (the numerator of our signal) is calculated at the top of the income statement, and it is regarded as a "clean" accounting measure. Indeed, it is a less distorted number compared to Net Income or EBIT. The lower one gets on the income statement, the more contaminated profitability measures become, and the less they are tied to true economic profitability. For instance, if the firm spends a lot of money on R&D to help it sustain its competitive advantage, the company's present earnings will be reduced. Capital expenditures or other expenses on income, diminish the company's free cash flows even more in comparison to its competitors. All these data point to the use of gross profits as an empirical proxy for productivity and returns.
- *TOTAL ASSETS* as opposed to other measures (Total Equity or Invested Capital) make our signal unaffected by a company's structure or leverage.

As a historical background for the utility of this predictor, we should go back to **Benjamin Graham**'s investment style. The famous investor was on the lookout for low-cost stocks since he wanted to invest in high-quality companies with cheap stocks. The perfect tradeoff was to purchase quality companies with low-cost shares. The difficult part of this strategy was to search for stocks (low-priced) with expected growth in future prices, as investors realize the company has qualities, not recognized in the stock price. As a consequence, **Robert Novy-Marx** started searching for a qualitative measure to use together with other value metrics. He published and finally revised a working paper in 2012, with a detailed in-depth study on Gross Profitability and included empirical evidence to back up his results.

[1] Novy-Marx, Robert. "Quality investing." *Unpublished Results* (2014). Page 5-27. (http://rnm.simon.rochester.edu/research/QDoVI.pdf)

In predicting the cross-section of average returns, profitability (in terms of gross profits-to-assets) has nearly the same predictive value as book-to-market[2]. Despite having lower book-to-market ratios and greater market capitalizations, profitable firms generate much higher average returns than unprofitable enterprises. The higher the ratio, the more efficient is the organization. This can be used by management, analysts, and investors to see if a firm is making the best use of its assets in order to make a profit.

From July 1990 to October 2009, **Novy-Marx** studied the profitability strategy in 19 established international markets and discovered that gross profitability as a premium signal is **pervasive**. Other research in Europe and Emerging Markets demonstrated further evidence for the pervasiveness of the signal[3].

Gross profitability is also a **robust** signal, meaning it has been seen to reduce the risk of data mining. As a result, it's been included in multi-factors models. For instance, if we include the profitability factor in the Fama and French model, together with size and value, this has been demonstrated to improve the performance of the model and explain most earnings-related anomalies. Robert Novy-Marx found evidence that Gross Profit to Assets, as a profitability measure, is a strong indicator of a company's **quality**. His findings however are at odds with those of Fama and French (2006), where profitability was considered to produce the "weakest average hedge portfolio returns", as well as weak evidence for a correlation between profitability and returns[2].

While Fama and French model put a lot of confidence on earnings as a metric with explanatory power, Novy-Marx stated that profitability strategies take advantage of a distinct dimension of value, using unproductive assets to fund the acquisition of productive assets.

As a drawback, some studies highlight how macroeconomic risks and mispricing due to expectation errors need to be considered, when considering profitability. E. Lam, S. Wang, and K.C. Wei demonstrated how the profitability premium has some risk associated. Macroeconomic risk and misvaluation factors explain more than one-third of this premium[4].

[2] Novy-Marx, Robert. "The other side of value: The gross profitability premium." *Journal of financial economics* 108, no. 1 (2013): 1-28.

[3] Swedroe, Larry. "The profitability factor: international evidence". *Alpha Architect.* October 18th, 2018. (https://alphaarchitect.com/2018/10/the-profitability-factor-international-evidence/)

[4] Lam, F. Y., Shujing Wang, and K. C. Wei. "The profitability premium: Macroeconomic risks or expectation errors?." In *Financial Management Association (FMA) 2014 conference*. 2015. Page 9-23.

Companies with high profitability but low book-to-market have significantly abnormal earnings announcement returns, earnings forecast errors, and forecast revisions, compared to firms with low profitability but high book-to-market.

In the following study, we will analyze Gross Profitability as a stand-alone strategy and in combination with VTI stocks and BND bonds, showing how this quality measure can generate significant excess returns for both long-only and long-short investors. Our portfolio is composed of 14 000 stocks, equally distributed among small and large-cap companies.

Strategy Analysis

The use of Gross Profitability as a strategy is rewarding in terms of returns. I explored the performance of signal in the last two decades, taking into consideration a long-only and a long-short investment strategy and comparing the performance with a value-weighted stock market portfolio. Long-only investors have a fundamentally different dilemma than long-short investors[2]. Unconstrained investors can manage their risk by using leverage, which removes the decision about the opportunity from the decision about exposure, allowing them to focus simply on discovering opportunities with the best reward-to-risk ratio. On the other hand, long-only investors do not have this option. They can't separate the opportunity and exposure decisions, so they have to weigh risk and reward together.

As we can see in *Figure 1* long-only portfolio outperforms the long-short strategy. In Table 1, we can see average annualized returns are slightly negative in the first period of our sample, while long-short returns are positive in this same period. As we can see from the Sharpe Ratio, the Long-only strategy follows the value-weighted performance of the market portfolio in terms of volatility and returns. Without the leverage of 10 %, returns are higher, but at the same time, they display negative returns during crises. On the other hand, a long-short portfolio shows how having a well-balanced portfolio is a hedge over high volatility. With 10% Volatility, long-short portfolio performance improves a lot. All in all, gross profitability as a stand-alone strategy outperforms the value-weighted market portfolio.

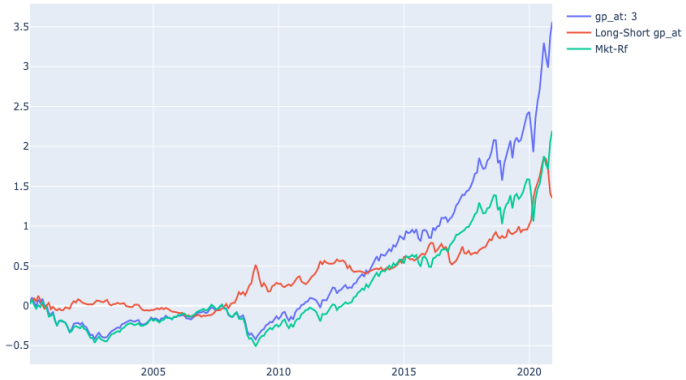

Figure 2: Cumulative Returns Plot

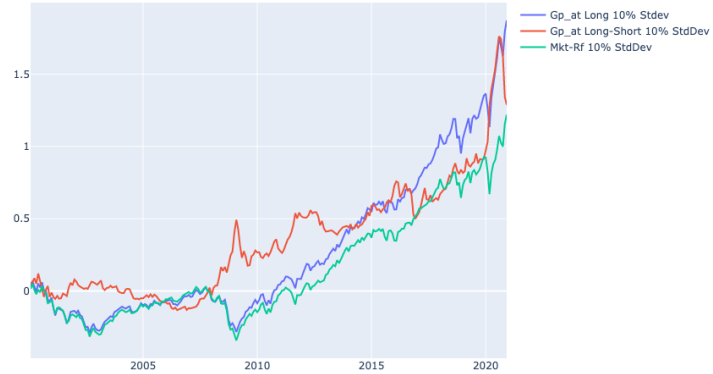

Figure 1: Cumulative returns 10 % Volatility

Table 1 shows mixed results on the strategy based on gross profitability. The strategy looks slightly better when evaluated against the Fama and French three-factor model for the long-short portfolio. For the long-only portfolio, we can see the same alpha of 0.02% per year for both the CAPM and Fama-French factor model. By incorporating Gross Profit to Asset in the two strategies, the stand-alone performance generates positive CAPM alphas, ranging from 0.01 to 0.1 in the long-short portfolio. Gross Profitability CAPM alphas are statistically significant, and this is in line with the findings over Quality Investing[1], where is also demonstrated how Gross Profit to Asset outperforms other quality strategies (e.g., Piotrowski's F-score, Earnings quality, ROIC).

By considering other factors besides the market one, we can notice improvements in the information ratio, meaning our portfolio is achieving higher returns in excess of the Fama and French benchmark, compared to CAPM.

Table 1: Gross Profitability Strategy Performance

Portfolios	Avg r^e	Sharpe Ratio	α_{CAPM}	α_{FF3}	IR_{CAPM}	IR_{FF3}
Long-only (full period)	8.44	0.55	0.02	0.02	0.55	0.80
			[29.64]	[43.44]		
Long-only (1st half)	-0.66	-0.04	0.01	0.02	0.23	0.71
			[8.74]	[26.45]		
Long-only (2nd half)	17.64	1.27	0.03	0.01	1.02	0.50
			[37.71]	[17.98]		
Long-Short (full period)	4.63	0.45	0.06	0.07	0.57	0.90
			[31.18]	[48.82]		
Long-Short (1st half)	2.86	0.26	0.03	0.66	0.25	0.82
			[9.52]	[30.27]		
Long-Short (2nd half)	6.40	0.64	0.10	0.026	1.00	0.46
			[37.13]	[16.27]		
VW Stock Market (full period)	6.83	0.43	-	-	-	-
VW Stock Market (1st half)	-1.73	-0.10	-	-	-	-
VW Stock Market (2nd half)	15.33	1.05	-	-	-	-

Strategy as part of a diversified portfolio

In this analysis we will study the performance of a mean-variance efficient portfolio, both for long-only and long-short strategies, comparing it with a 60-40 portfolio (common investment portfolio with 60% stock and 40% bond). We first created a diversified portfolio with VTI and BND ETFs and we backtested these portfolios to the end of 2007.

As we can see from Figure 3, cumulative returns in the two strategies partly differ because they have different volatilities. For a long-only portfolio, volatility is around 5%, similar to the one for a long-short portfolio at 4%. For the 60-40 portfolio volatility it is obviously equal to 10%. To have a sense of which portfolios are better per unit of volatility, we normalized volatilities to 10%. The mean-variance portfolios outperform the 60-40 portfolio. This is because we constructed the MVE portfolio by looking at the highest Sharpe Ratio in the sample period.

Without leverage, the 60-40 portfolio results in higher returns during the first period, compared to the Long-Short mean-variance portfolio which shows deep drawdowns during the crises (2008 financial crisis, 2020 Covid-19). On the other hand, the long-only portfolio performs better than the others. This finding is in line with Novy-Marx's research about the contribution of Gross Profitability to investment performance, especially for long-only investors[2]. As we can see in Figure 4, at the same level of risk, it's clear that mean-variance portfolios perform way better than the 60/40 portfolio. Average excess returns double for the long-only portfolio from 7.36% to 15.1%. The long-short strategy has the biggest growth from an average of 5.73% to 14.13%. As for the Sharpe Ratio, the performance is good for both portfolios, meaning they provide a superior return on a risk-adjusted basis.

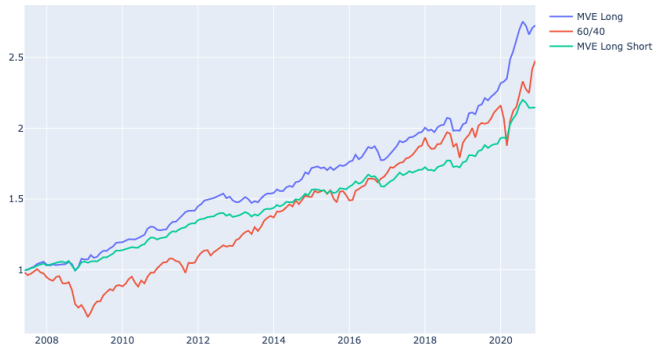

Figure 3: Cumulative Returns Plot (Diversified Portfolio)

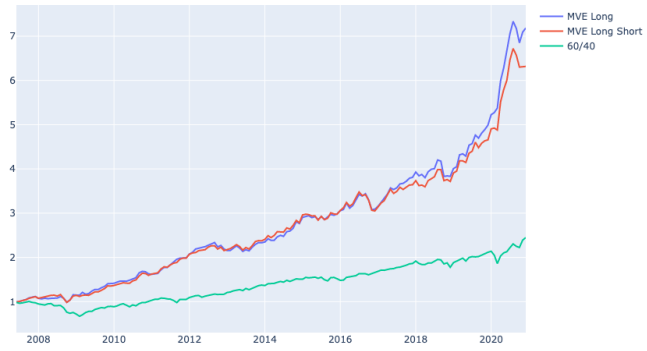

Figure 4: Cumulative Returns Levered Plot (Diversified Portfolio)

Nevertheless, outsized gains might bring the risk of outsized losses in value. Investing in ETFs provides exposure to a variety of asset classes, making them ideal for diversification and safer investments.

Table 2: Diversified Portfolio Performance

Portfolios	Avg r^e	Sharpe Ratio	E[r^e] 10% Vol	Sharpe Ratio 10% Vol
Long-only	7.36	1.46	15.1	1.51
Long-Short	5.73	1.39	14.13	1.41
60-40	7.22	0.71	7.11	0.71

Gross profitability represents the other side of value[2]. Valuation and profitability ratios are both designed to acquire productive capacity cheaply. Profitability strategies achieve this goal by funding the purchase of productive assets via the sale of unproductive assets, whereas value strategies finance the purchase of affordable assets through the sale of expensive assets.

In this study, we analyzed Gross Profits to Assets signal and demonstrated how an investor can capture the full profitability premium without additional risk by adding a profitability/value strategy on top of his strategy.

If we compare these results to the Gross Profitability stand-alone strategy, the combination of the portfolio with ETFs leads to higher returns only if we consider 10% of leverage. On the other hand, by looking at the Sharpe Ratios, we can state that the combination of these strategies improves the quality of the investment.

As for the relatively short evaluation period (less than 20 years), even if we didn't consider a lot of past data, we are considering recent years with relevant crises. However, 20 years is not enough to draw reliable conclusions. By comparing our evaluation with academics who evaluated the signal in a larger timeframe, we can conclude that this relatively short period doesn't affect the conclusions.

Conclusion

As Novy-Marx's first conceived, we don't have to go any further down the income statement since figures like EBIT or income could be changed using accounting methods. The top line, not the bottom line, should be scrutinized to identify truly profitable businesses.

Attention to quality, measured by gross profitability, helps traditional value investors distinguish bargain stocks[1], undervalued, from value traps stocks. In general, the Gross Profitability strategy can benefit both long-only and long-short investors and allows them to not "leave money on the table"[1]. Nevertheless, as previously found by academics and our previous performance evaluation, this signal contributes the most for long-only investors.