QUALITY INVESTING EVALUATION REPORT

25579 Applied Portfolio Management - Autumn 2023
Assignment 1

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1. Fundamental Intuition behind the quality strategy

The CEO of the Applied Quantitative Research (AQR) fund and his co-workers (Asness et al., 2019) introduced the quality investment strategy with three main factors: high profitability, high growth rate and safety.

The first element is high profitability. Asness et al. (2019) define this concept as a range of profits over the book value, such as net profit, operating profit, gross profit, etc. Unless the company is a non-profit organisation (NPO), the investors will always analyse the company's profitability. Companies with high and consistent profits tend to attract more investors to invest in their company. This concept has been known and accepted by many investors around the world. Particularly, the investors that had invested in the company tend to hold the stock more if the company continues to make a consistent profit. More and more investors will buy and hold the stock. In the simple economic concept of supply and demand, the price will increase when supply stays still but demand increases. Nevertheless, there are a few things investors need to consider when investing in a company with high profitability. First, which source of the profit is coming from and whether it is stable. The high profit in one year can simply be the sale of a significant asset or a subsidiary company that instantly boosts the profit for one year. The second thing to consider is the rivalry between competitors. High-profit companies tend to have a high-profit margin, low cost of goods sold, and low operating cost. These competitors entering the market can decrease the profit in many ways.

The second contributor to the quality method is the high growth rate. Typically, the growth company will have small to medium capital, hence more space to grow. The company with higher growth rates is normally at the initial state of the business cycle, or when they initiate any emerging technology that can considerably impact the revenue and income of the entire company. The advantage of a high growth rate company is the abnormal return on investment for investors who enter at the early stage. Nevertheless, the high profit often goes with a high risk. Vanacker & Manigart, (2010) illustrated that a high-growth and young company financed with debt is the most dangerous type of firm an investor can look for. The start-up company will find it challenging to raise equity funds, and a bank loan is their alternative (Damodaran & Valuing, 2009) also discussed many challenges when evaluating these growth companies. Primarily, forecasting revenue and profit is nearly impossible because there is no limitation in either direction. Moreover, they also emphasized that only a few outstanding among these companies can survive and continue to operate.

Safety is the last component. Asness et al. (2019) included the market and company operation factors in this safety measurement. The market variable is the market price volatility, also known as market beta. On the other hand, the safety factor also considers the fundamental ratio, such as the debt/equity ratio, total revenue, profit and many more. This argument on low risk but high return goes against the fundamental value of the Efficient-market hypothesis (EMH). EMH argues that the risk is the only factor that could impact the return, hence high-risk high return. Many scholars around the work have found a lot of evidence to reject this EMH thesis. Haugen and Heins (1972) published a paper on the correlation between the market beta and the stock return of the US stock market from 1926 to 1971. Surprisingly, the correlation is negative, or the low beta stock yields a higher return.

2. Statistical Analysis

The statistical analysis can be utilised to evaluate the predicting power of the quality signal and its component. Specifically, the Information Coefficient (IC) examines the correlation between the stock's future return and the predicting signals. The score of IC ranged from -1 to +1, where -1 is a strong negative correlation and +1 is a strong positive correlation. On the other hand, the IC of 0 indicates no correlation between the two variables, or the signal has no predicting power toward the stock's future return.

Table 2.1: Predictive power of the quality signal and its component (Next year's return)

	Annualy					Monthly				
	Average_IC	Positive Period (%)	Negative Period (%)	T-Stat	P-Value	Average_IC	Positive Period (%)	Negative Period (%)	T-Stat	P-Value
Quality Signal	**0.063**	78.60%	21.40%	4.418	0	**0.036**	70.30%	29.70%	10.19	0
Growth Signal	**0.062**	79.10%	20.90%	6.217	0	**0.031**	71.30%	28.70%	11.84	0
Profit Signal	**0.116**	90.70%	9.30%	9.206	0	**0.062**	83.30%	16.70%	18.18	0
Safety Signal	**0.043**	73.80%	26.20%	3.063	0.004	**0.026**	67.80%	32.20%	7.858	0

Table 2.1 demonstrated that the predicting power of the four signals tends to be higher in a longer horizon (annually instead of monthly or quarterly). Hence, this section will focus exclusively on the annual IC. This is relatively normal in the stock market concept, where the movement of asset prices in the market is unpredictable in the short term.

The p-value fluctuating around 0 means that the null hypothesis is statistically significant. T-statistic denoted the difference between the mean of the two datasets: the future annual return and each four predicting signals. A higher t-statistic indicates a more significant gap between the average of the actual IC and the expected IC.

2.1. Predictive power of the quality signal and its component over the entire sample

As seen in Table 2.1, the predictive power of the Quality Signal is positive but relatively weak, with an average information coefficient of 0.063. The t-test has a t-stat of 4.418 and a p-value of 0, denoted that the Quality Signal and the future return are positively correlated and statistically different from zero. Regarding the frequency, the percentage of positive periods of this Quality Signal is 78.6% in the last 42 years, which is relatively high.

The Growth Signal had similar measures to Quality Signal in all five categories. This similarity indicates that this signal has a significant weight in the Quality Signal among the three components. The Growth Signal had an Average IC of 0.062 and a frequency of the positive period is 0.791, not substantially different from the Quality Singal of 0.786. The Growth signal is statistically significant, with a t-stat of 6.217 and a p-value of 0.

Among the three components of the Quality Signal, the Profit Signal had the highest average Information coefficient, denoting the most powerful predicting signal among the three components. The positive period is 90.7%, suggesting that only less than 10% of the time this signal fails to predict the future return. Moreover, the predicting

ability of the Profit Signal is also the most statistically significant, with the highest t-statistic of 9.206 and p-value of 0.0.

The Safety Signal had the lowest average IC of 0.043, implying that this variable had the most inefficient forecasting power among the three components. The percentage period is 73.8%, the lowest among the four signals but only 5% lower than the quality signal. Nevertheless, the t-stat is only 3.063, and the p-value is 0.004. Even though this statistic is still significant, this statistic is significantly less than the other two components of Quality Signals.

In conclusion, the Quality Signal and its three components IC demonstrate a weak but positive predicting power on the stock's future return. All the statistics composed on the annual term are significant based on the t-stat and p-value.

2.2. Change of predictive power over time

Note: Graphs 2.2 - 2.5 in the section are in Appendix B: Graph
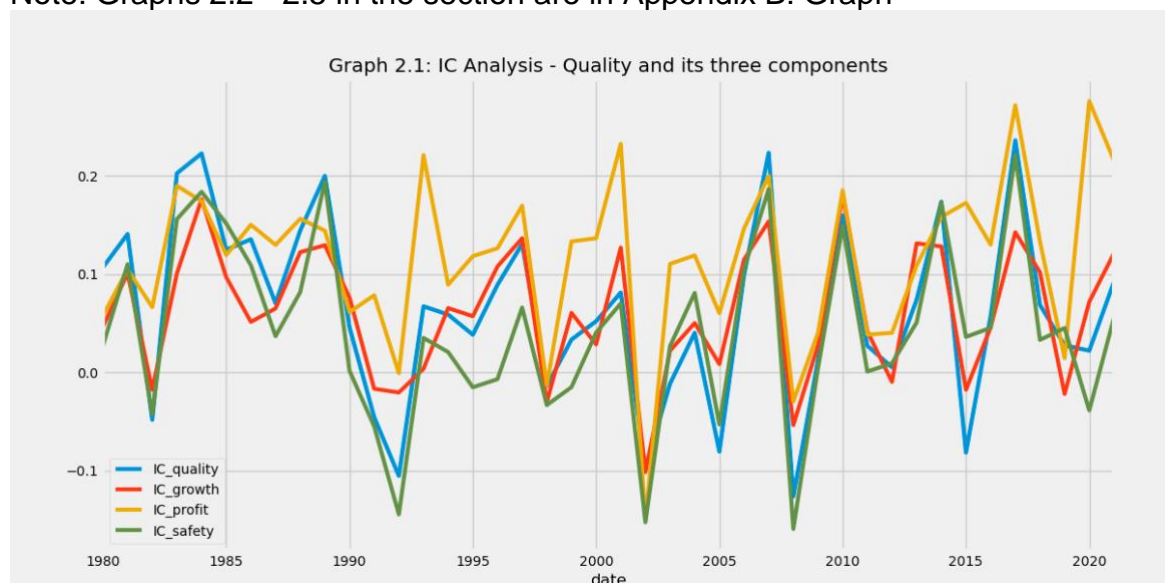
Graph 2.1 shows that the four signals' predictive power, or Information Coefficient, has varied differently over the last four decades. Before 1990, the predictive power of the four signals always stabilised above zero, except for the 1982 recession. According to the Federal Reserve (Sablik, 2013), this was the worst recession between the Global Financial Crisis in 2008 and the Great Depression in 1929. Noticeably, there is a positive correlation between the four signals when there is a black swan event. For instance, the IC of all four signals decreased dramatically during the GFC in 2008 or after the dot com bubble in 2002.

Quality signal or IC_Quality (Graph 2.2)**:** The predictive power of quality signals fluctuates significantly and is very unstable. The signal was positive and relatively stable before 1990, except for 1982. After 1990, a year of positive IC is followed by a significant drop of 10% - 30%. The more powerful the IC score of one year, the lower the IC in the following year. For instance, the quality signal had an IC of 22% in 2007 but dropped by 30% to -12% in 2008. Or in 2014, the IC was 17%, but it immediately dropped to -8% in 2015. Looking at Graph 2.2, there are five more pairs of years with similar characteristics. This is signalling that the predicting power of this signal has weakened over time.

Growth signal or IC_growth (Graph 2.3)**:** This signal has a similar pattern to the IC of Quality Signal. Table 2.1 shows a high similarity between the two signals, such as the average IC and percentage of positive and negative periods. Graph 2.6 also demonstrates a strong positive correlation between the IC of the two signals. The instability in the predictive power implied that this indicator is no longer reliable.

Growth signal or IC_growth (Graph 2.4)**:** The profit signal is the most reliable signal with the highest IC average, 90% positive period, and a T-Stat of 9.2. The only time this signal significantly dropped below 0 was in 2002. This signal performs particularly well without the black swan events like GFC or Dot Com Bubble. The worst period of this method was between 1998 and 2008 when the IC dropped below zero three times. Regardless, this profit signal had been predicted relatively well in the last 15 years, especially in the most recent five years. The IC achieved 27.2%, 27.6% and 21.5% in 2017, 2020, and 2021. These IC are ranked the top highest IC in the entire period among the four signals.

Safety signal or IC_safety: This has three of the lowest predictive power periods, which are -14.44% in 1992, -15.24% in 2002, -15.92% in 2008. This safety signal performed worst in the period between 1992 and 2008. This signal had slightly improved from 2010 and peaked at 22% in 2017 but had decreased quite substantially in the last four years.

3. Backtesting
3.1 Overall performance from 2005 - 2022
LS active is the difference between the Long short (LS) portfolio and the Benchmark

Table 3.1: Long short performance from 2005 - 2022

	LS Portfolio	Benchmark	LS Active
Mean Return	0.104364	0.072373	0.031991
Standard Deviation	0.136593	0.148094	0.035084
RR ratio	0.760668	0.488697	0.911838
Percentage Postive	0.648148	0.652778	0.634259
Worst Month	-0.140865	-0.186403	-0.037991
Best Month	0.106777	0.109407	0.045538
Max DrawDown	-0.455186	-0.608699	-0.120379

Overall, the 130/30 strategy outperformed the long-only strategy with an LS Active mean return of 3.20%. More specifically, the LS (Long Short) strategy had a mean return of 10.44%, while the benchmark had an average return of 7.24%. Regardless, this strategy also has a higher variance than the benchmark, where the standard deviation of the LS portfolio is 3.5% higher than the benchmark.

The RR ratio is calculated by dividing the mean return by the standard deviation. This ratio illustrates the strategy's yield relative to the volatility of the stock. The RR ratio of the LS portfolio yield is 91% higher than the benchmark ratio.

The percentage positive period of the two methods is relatively the same. Similarly, the two portfolios have no significant difference between the best and worst months. The Max drawdown of the LS portfolio is also 12% lower.

3.2 Comprehensive analysis of the performance over time

There are a few significant events that impacted the US stock market between 2005 - 2022. Hence, the 18 years are divided into five sub categories

- **2005 - 2007**: Pre-GFC - This period was before the Mortgage-Backed Securities (MBS) occurred and triggered the Global Finacial Crisis.
- **2008-2009**: Global Financial Crisis and the Great Recession
- **2010 -2012:** There are two noteworthy events happened in this period, which are the European Sovereign Debt Crisis, and the U.S. Debt Ceiling Crisis
- **2013 - 2019**: Pre-covid period
- **2020 - 2022**: Covid 19 crisis

The LS active compares the difference between the LS portfolio and the benchmark. The mean return throughout the five periods showed that this LS portfolio only underperformed during the Covid period from 2020 - 2022 by -2.29% (Graph 3.1) (Table 3.2, Appendix A). Before that, this LS portfolio consistently outperformed the benchmark from 2005 - 2019. Even during the GFC period in 2008, this portfolio still yielded a lower loss of 3.53% less than the benchmark

Note: ls_per0507 is the active performance from year 2005 – 2007.

Graph 3.1 Backtesting the performance of the Long Short Portfolio in the last 18 years
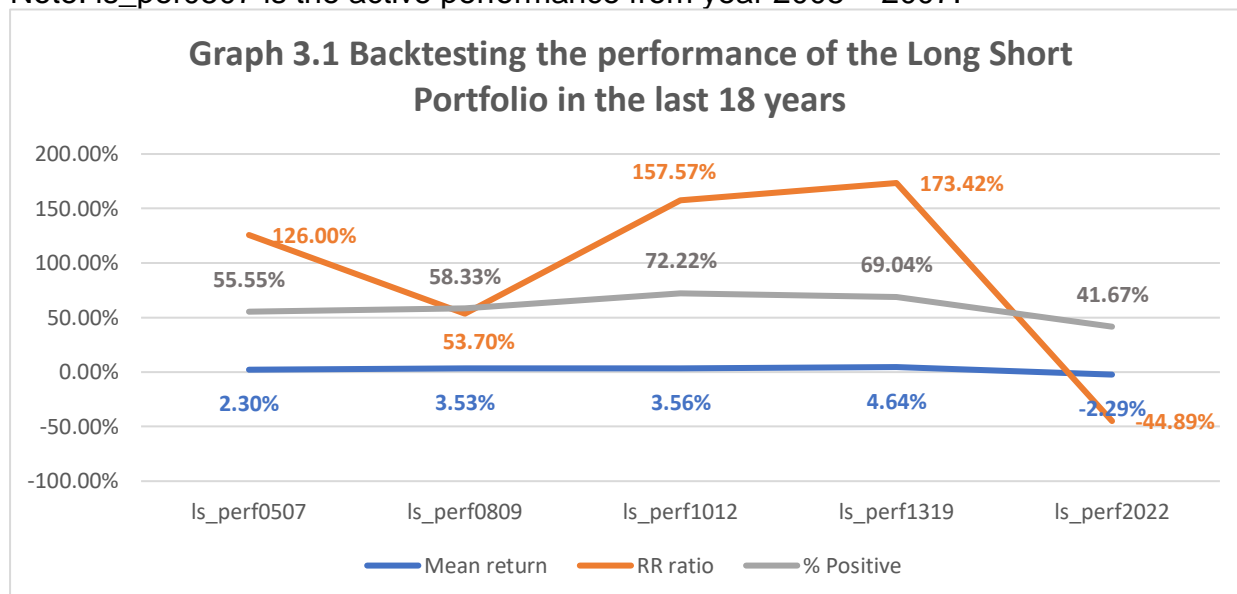
However, the risks taken varied quite significantly between the five periods. The Return to Risk ratio was relatively high during the normal time. Specifically, this ratio was lying around 140% to above 150% during the pre-GFc period (2005-2007), after GFC (2010-2012) and pre-covid period (2013 - 2019). However, the ratio drops to 53% during the GFC and nearly 0% during the Covid-19 period. This Long-Short portfolio did not predict very well during the black-swan events.

On the other hand, the Positive period had a slightly consistent performance. The Long short portfolio always has a higher percentage period than the benchmark. Even though it slightly decreased during the Covid pandemic, it is still 41.67% higher than the benchmark.

4. Optimisation
4.1 Mean return optimisation

The optimisation process is similar to Scenario Analysis, where each variable is substituted into a function to find the best result, while the other variables are kept constant. In this case, the two variables of the ls_backtesting() function, including N(number of stock to under/over invest) and the rebalancing frequency, are optimised. Based on Table 4.1 below, the monthly return (frequency = 1) with N = 200 outperform the other eight scenarios.

Table 4.1: Variable Optimisation for mean return - Number of stock to under/over invest and the rebalance frequency

Number of stock to over/under invest	Monthly return	Quarterly return	Yearly return
200	3.76%	3.22%	2.04%
250	3.20%	2.78%	1.83%
300	2.84%	2.50%	1.71%

The result of the optimisation signal that this Long Short method performs excellently with fewer stock to over/under-invest and with a shorter or faster rebalancing frequency. Similarly, Table 4.1 also shows that as rebalancing frequency decrease, the higher the return yield for all three amount of stocks (200, 250, 300). Moreover, as the number of stocks decreased, the higher the return of the Long Short active performance across all three rebalance frequencies (monthly, quarterly and yearly)

4.2 RR ratio optimisation

Table 4.2: Variable Optimisation for RR ratio - Number of stock to under/over invest and the rebalance frequency

Number of stocks over/under invested	Monthly RR	Quarterly RR	Yearly RR
200	97.64%	86.05%	67.99%
250	91.18%	80.53%	66.03%
300	88.77%	79.45%	65.65%

There is a consistent result between RR ratio and the mean return. The highest Return-to-Risk ratio goes to the number of stock equal 200 and the monthly rebalance. Similarly, the lower the rebalance frequency, the higher the RR ratio across three number of stocks (200, 250, 300). Consistently with the rebalance frequency, the lower number stock of stocks to over/under invest yield a higher RR ratio across three categories (monthly, quarterly and yearly.

Conclusion: based on the data above, it can be concluded that the Long Short portfolio performs effectively when it is frequently rebalanced with fewer stocks to over/under-invest. This approach yields a higher average return with or without adjusting the risk factor using the RR ratio.

5. Macroeconomic environment impact on the future performance of the quality strategy

5.1 Inflation

Inflation is a double-edged sword for the quality strategy. Even though the inflation has decreased substantially from 7% in 2021 (US Inflation Calculator, 2023) to 4.9% in 2023, this inflation rate still needs to be diminished more.
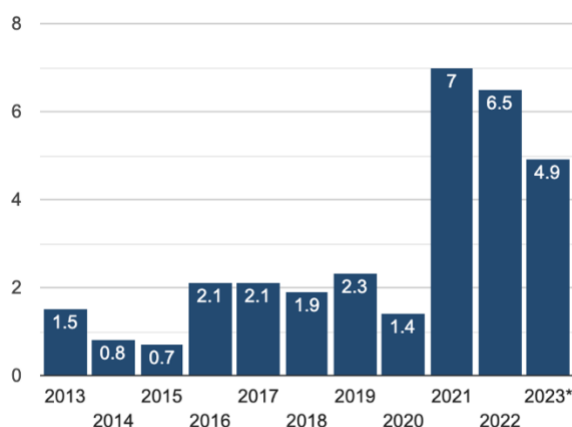

Figure 5.1: US Annually inflation from 2013 – 2023 (US Inflation Calculator, 2023).

Pollin & Zhu (2006) suggested a moderate positive correlation between economic growth and inflation for 40 years from 1960 to 2000 across 80 countries. Economic growth can positively impact the companies' profitability and influence the growth rate of the companies quite significantly. Regardless, inflation's negative impact is much worse than its benefits. A critical factor in quality investing strategy is that the three main components must stay stable throughout an extended period, preferably from half to one decade. The current situation of inflation negatively impacts the stability of the predicting signal. The company's board will hesitate to expand and grow, slowing down the company's growth rate. On the other hand, the CFO is likely to increase the provision for all categories to prevent future crises. Hence, the increase in provision will lead to a significant reduction in the company's profitability.

5.2 Interest rates

Interest rates had gradually increased and reached 5.25%, the highest rate since 2007 after FED's 10th consecutive increase (Sherman, 2023). Interest rates impact the company's profitability, growth, and safety in many ways. The interest rate increase led to a higher cost of borrowing. More specifically, the upsurge in monthly interest payments will decrease the company's profitability significantly. Moreover, investors' opportunity costs will be much higher, significantly decreasing the company's valuation. Hence, the company will find many challenges to expand when raising capital from current and potential shareholders. Even worse, the company's stock prices will likely decrease and fluctuate more intensively as the investors may find putting money in the bank more appealing. The stock price fluctuations negatively impact the predicting power of the safety signal.

5.3 Unemployment rate

Bureau of Labor Statistics (2023) reported that the unemployment rate had decreased significantly from 6% in April 2021 to 3.4% in April 2023. A higher unemployment rate indicates a more substantial labour market supply, enabling the company to expand and grow. In contrast, the high unemployment rate will

negatively influence the company's operation and discourage the board of directors from setting and achieving a high-profit goal. Hence, the unemployment rate should be continuously monitored to the unemployment rate to make sure the quality strategy work.
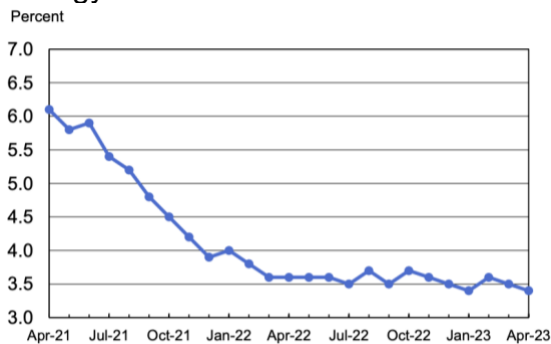

Figure 5.3: Unemployment rate (Bureau of Labor Statistics, 2023*)***

5.4 Consumer sentiment

Consumer Sentiment is quite straightforward where it evaluates the confidence of the consumer on the US economy, ranking up to 100.

Preliminary Results for May 2023

	Annually		
	May-23	**Apr-23**	**May-22**
Index of Consumer Sentiment	**57.7**	63.50	58.40
Current Economic Conditions	**64.5**	68.20	63.30
Index of Consumer Expectations	**53.4**	60.50	55.20

Table 5.4 Preliminary Results

Recently, the consumer sentiment index dropped significantly in 2022 and slightly recovered in 2023, but still at a shallow rate of 58.4 (Table 5.4). A lower index indicated that the consumers are very pessimistic about the current economy and less likely to spend a lot. The reduction in total consumer spending could cause a dramatic reduction in the total revenue of companies across industries in the US. This reduction in consumer spending will also discourage the US company from expanding and growing. Looking at the Consumer sentiment index in Figure 5.4 (Wallace, 2022), consumer confidence had dropped even lower than the recent Global Financial Crisis 2008. Part 3 of the report, Backtesting, suggested that the GFC period is where the power of the quality signal performed worst. This index should be closely monitored to ensure the reliability of the quality predicting signal.
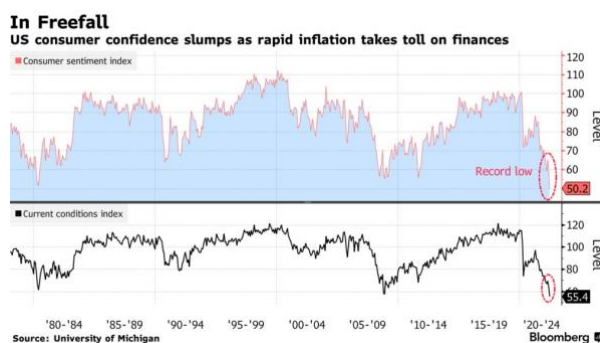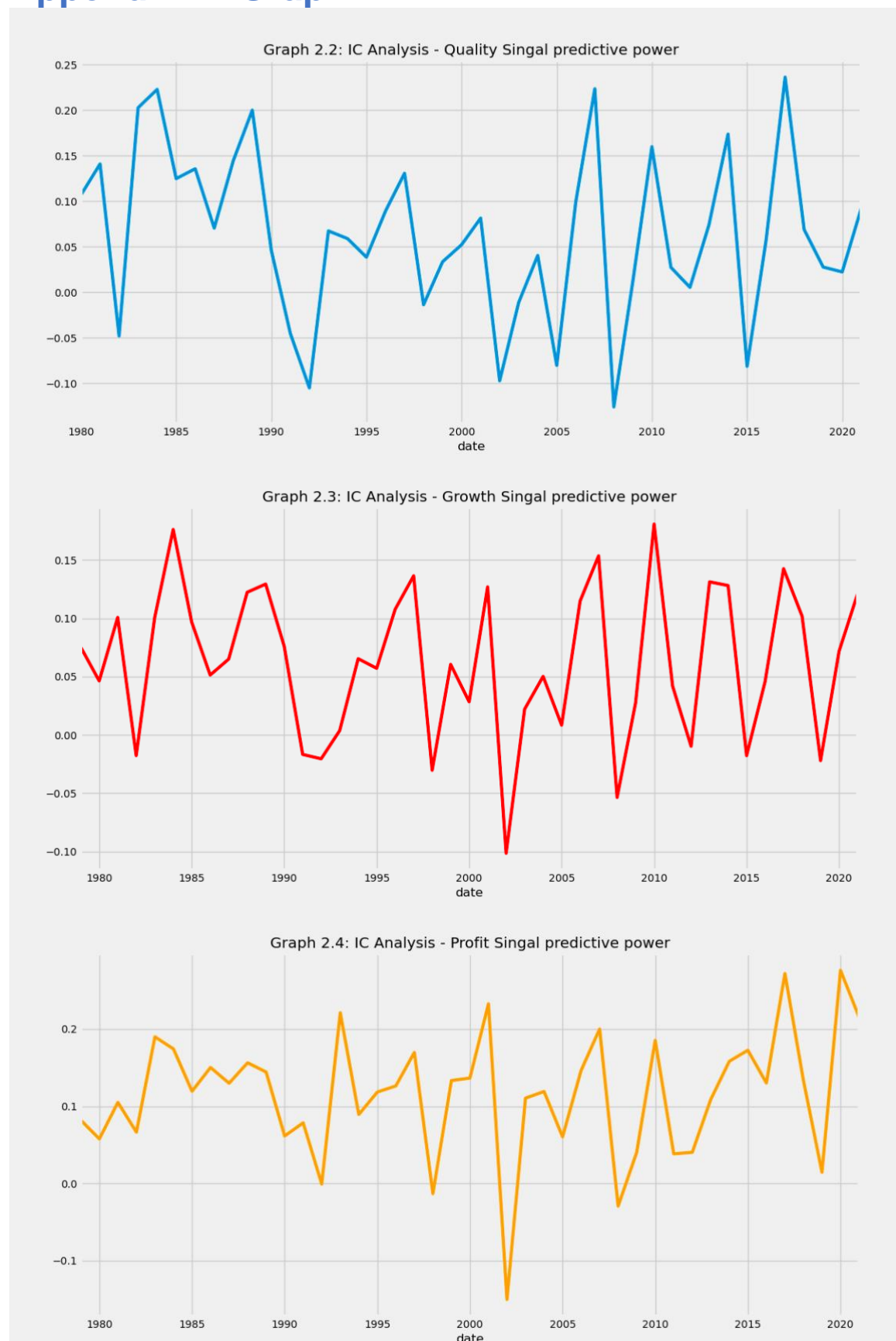

Figure 5.4: Consumer Sentiment Index (Wallace, 2022).

Appendix A: Table

Table 3.2 Backtesting the performance of the Long Short Portfolio in the last 18 years

	ls_perf0507	ls_perf0809	ls_perf1012	ls_perf1319	ls_perf2022
Mean return	2.30%	3.53%	3.56%	4.64%	-2.29%
RR ratio	126.00%	53.70%	157.57%	173.42%	-44.89%
% Positive	55.55%	58.33%	72.22%	69.04%	41.67%

Appendix B: Graph

Graph 2.2: IC Analysis - Quality Singal predictive power

Graph 2.3: IC Analysis - Growth Singal predictive power
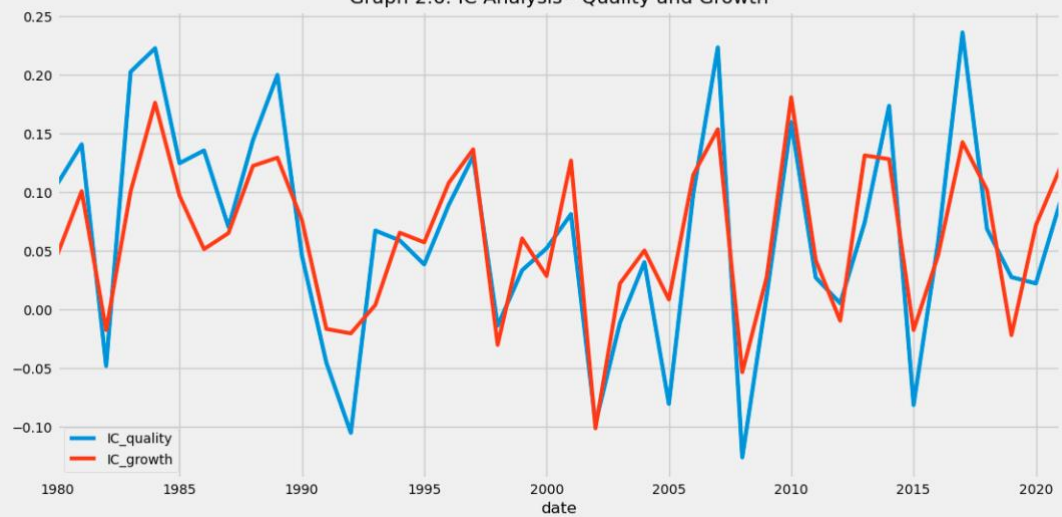
Graph 2.4: IC Analysis - Profit Singal predictive power

Graph 2.5: IC Analysis - Safety Singal predictive power
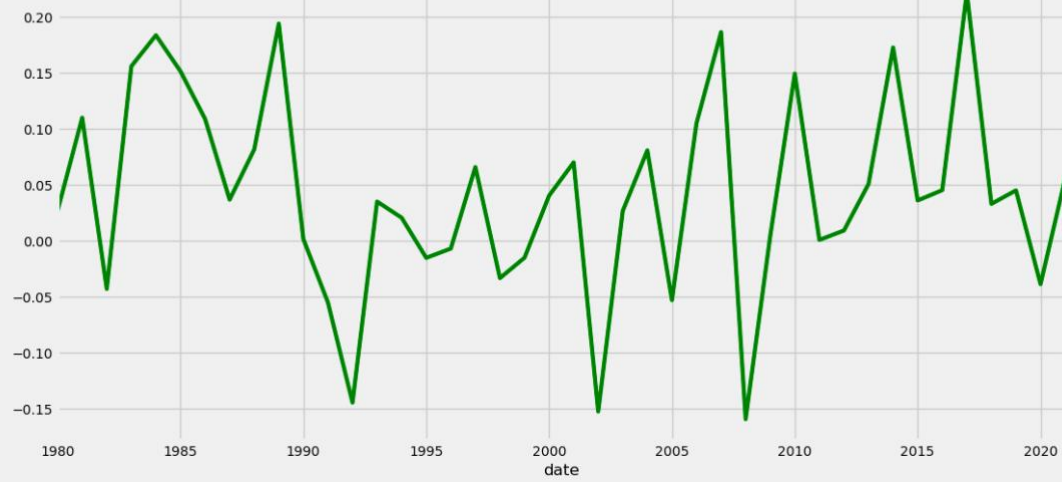
Graph 2.6: IC Analysis - Quality and Growth

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