

Factor Investing Strategy Investigation and Optimization for Chinese Stock Market with Backtesting and Implementation

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ABSTRACT

Quantitative investment has a 50-year-history in the world and a much shorter history in China, which is about 10 years. In 1991, the securities market was established in China. Compared with traditional investment strategy, which is based on investors' active decisions, quantitative investment is passive. It evaluates the performances of stocks by mathematical and statistical factors, which can be divided into the profit factor, the fiscal factor, the market factor, valuation and scale factor and growth factor. Single-factor and are two analysis methods. Multi-factor selection strategy uses investment models involving multiple factors and gives a comprehensive and fair measurement to the stocks. But it's very difficult to decide which factors to be included and whether the prediction is accurate. The research involved three typical factors: emotional factor, TTM EPS_ ttm and TTM operating: _ revenue_ per_ share_ ttm. The first one has been performing well in recent two years. The second one performed badly before and well recently. The third one performed poor

Keywords: Factor Investing Strategy ,Chinese Stock Market, Quantitative investment

1. INTRODUCTION

Since 1991, China's stock market has shown a general upward trend. From Figure 2, we can see that, especially since China's entry into the WTO, the market value of the stock market has shown a state of explosive growth in 2019.

In 1991, the Shanghai and Shenzhen Stock Exchange establishment marked the establishment of China's securities market. Since 1991, the Chinese securities market has gone through a 12-year journey. During these

12 stormy years, the Chinese stock market has experienced the staggering development of ignorance, prosperity, speculation, and silence common to new markets. It is still in the process of growth.[1]

At the end of 2019, the total market capitalization of global Chinese equities was RMB 88 trillion (approximately USD 12.7 trillion), representing a 31.3% increase in market capitalization for the year. Historically, the total global value of Chinese stocks has been rising with the number of new listings on the one hand, and market sentiment has also played a role.[2]

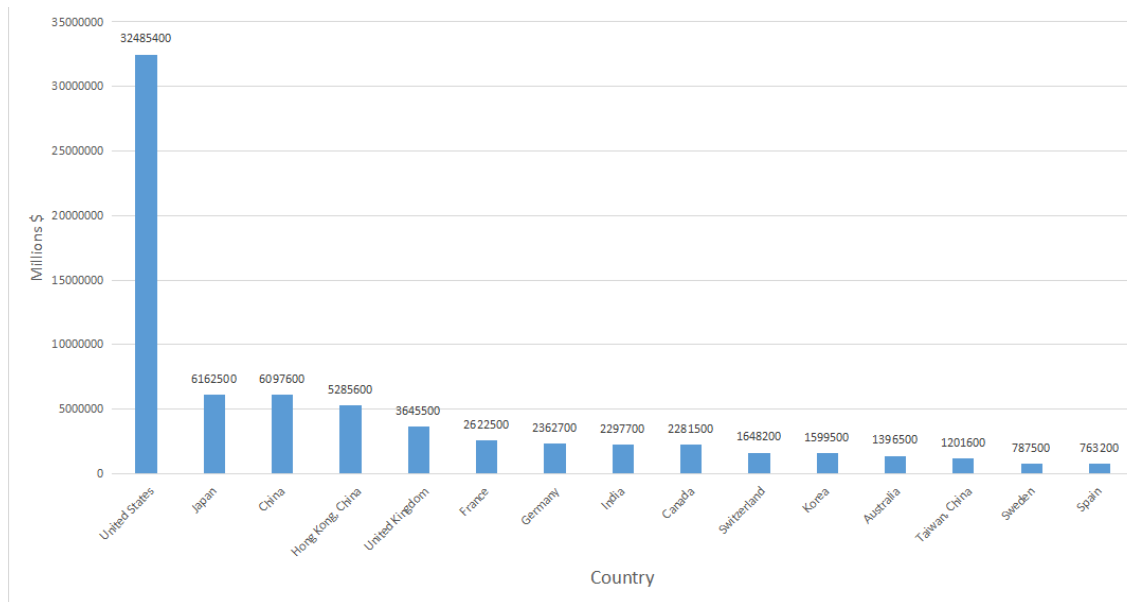


Figure 1 Global Stock Market Capitalization Ranking(August 2018)

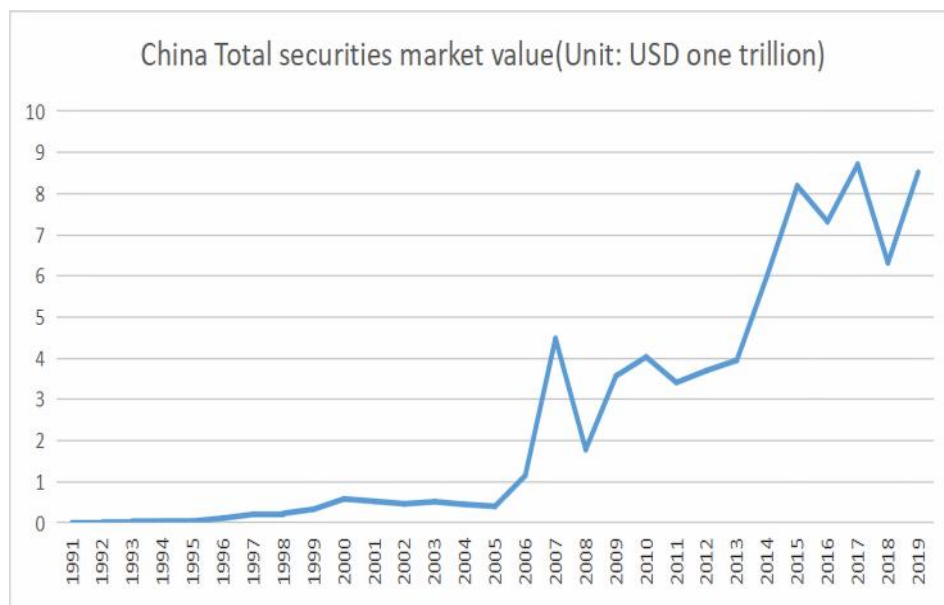


Figure 2 The total market capitalization of the Chinese securities market(1991-2019)

There are different strategies for investing, which can be divided into active and passive ways generally. Index fund and index replication are passive. Investors follow the index instead of choosing actively. As for active investment, there are traditional (i.e., fundamental analysis and technical analysis) and quantitative ways. Quantitative investors use mathematical and statistical models to make decisions.[3]

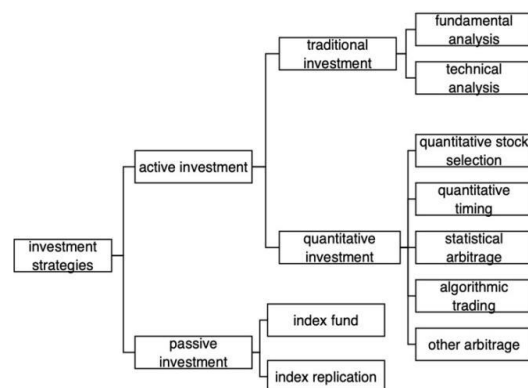


Figure3 Quantitative investment has a 40-year history.

Markowitz published the paper to state the mean-variance model in 1952, which first used mathematical

and statistical methods to analyze investment. Barclays Global Investors firstly issued a passive index fund in 1971 which is the beginning of quantitative investment and then issued the first active index fund in 1977. From 1977 to 1995, it's a slow growth limited by different factors. With the development of computer science, quantitative investment developed rapidly after 1995.

Quantitative investment is growing more and more common in modern portfolio. In U.S. 20% funds are quantitative funds, taking a large proportion.

Next several models will be introduced :

The Capital Asset Pricing Model (CAPM) describes the relationship between systematic risk and expected return for assets, particularly stocks. CAPM is widely used throughout finance for pricing risky securities and generating expected returns for assets given the risk of those assets and cost of capital.

Alpha, beta coefficient:

The alpha coefficient is the difference between the absolute return of an investment or fund and the expected risk return calculated according to the beta coefficient. Absolute return or excess return is the actual return of the fund or investment minus the return on risk-free investment. Absolute return is used to measure the investment technology of an investor or fund manager. Expected return is the product of beta coefficient and market return, which reflects the return of investment or fund due to the overall market change. [4]

Beta is a kind of risk index, which is used to measure the price fluctuation of individual stocks or stock funds relative to the whole stock market and a tool to evaluate the systematic risk of securities. [5]

Sharpe ratio is a standardized index of fund performance evaluation. The research of Sharpe ratio in modern investment theory shows that the size of risk plays a fundamental role in determining the performance of portfolio. The risk adjusted rate of return is a comprehensive index that can consider both the return and the risk at the same time, which can eliminate the adverse effect of risk factors on performance evaluation in the long run. In the investment, the higher the expected return of the investment object, the higher the volatility risk the investor can tolerate; on the contrary, the lower the expected return, the lower the volatility risk. [5]

The Max Drawdown refers to the maximum rate of return retracement when the net product value reaches the lowest point at any historical time point in the selected cycle. The maximum pullback is used to describe the worst possible situation after buying a product.

The Sortino Ratio is a way of measuring the relative performance of an investment portfolio. Similar to the Sharpe Ratio, but it uses the downside standard deviation

rather than the overall standard deviation, to distinguish between bad and good volatility. [6]

2. DIVISOR

2.1. Valuation Category Factors

PB: Price-to-Book Ratio, as we know, it is defined as the ratio of stock price per share to net assets per share.

Its formula is:

$$PB = \text{Net Assets} / \text{Market Capitalization} = \text{Net Assets per Share} / \text{Market Capitalization per Share.} [7]$$

Net assets are used to measure the size of shareholders' equity. When a listed company is consistently profitable, the net assets of the company increase and the shareholders' equity of the company increases. In calculating this indicator, we use "net assets" as "shareholders' equity attributable to the parent company" in the "balance sheet" of the reporting period, and "market capitalization" If the company contains A, H and B shares, the total market value of ABH shares is calculated.

PE: Price-to-earnings ratio, which also becomes 'cost-benefit ratio' and 'share price earnings ratio'. It is the ratio of stock price divided by earnings per share, or a company's market capitalization divided by its annual net income.

Its formula is:

$$P/E \text{ ratio} = \text{Market Price per Share of Common Stock} / \text{Annual Earnings per Share of Common Stock.}$$

A lower P/E ratio means that investors are able to purchase shares at a lower price in return. Earnings per share are calculated by dividing the company's net income for the past 12 months, less preferred dividends, by the total number of shares sold in the offering.

2.2. Technical Factors

MAC: Daily Moving Average.

Take MAC5 as an example. Its formula is:

$$MAC5 = \frac{\text{The Sum of the Closing Prices of the Last 5 Consecutive Trading Days}}{5}$$

The average indicator is an important indicator reflecting the price trend. Once the trend is formed, it will continue to maintain in period of time, the trend is formed by the high or low point and have a blocking or supporting role, so the average indicator is often located in the point of support or resistance is very important, which provides us with a favorable time to buy or sell, the value of the average system is also here.

Since the average line has a certain comparative effect on the stock price trend, it is quite important for technical analysis. The daily MAC5 and MAC10 are generally

used to analyze the short-term trend, the MAC30 and MAC60 to analyze the medium-term trend.

Boll: Bollinger Bands indicator, or BOLL indicator.

Formula of the daily BOLL indicator:

1). Middle line = N-day Moving Average

2). Upper Boll = Mid Boll + Twice the Standard Deviation

3). Lower line = Mid Line - Twice the Standard Deviation

Its full name is "Bollinger Bands," Bollinger Bands (BOLL)[9] created by Mr. John Bollinger, its use statistical principles to find out the standard deviation of stock prices and its trust interval so as to determine the range of fluctuations in stock prices and future trends, the use of bands to show the stock price. It is also known as the Bollinger band because of its safe, high and low price levels. The upper and lower limits are not fixed and change as the stock price rolls. Bollinger and MIKE indicators are the same path indicators, stock price fluctuations in the upper and lower limits of the range, the width of this band, with the size of the stock price fluctuations and changes, the stock price increases and decreases, the band becomes wider, up and down when the narrow consolidation, the band becomes narrower.

Quality factors consist of many financial factors. Below are three of them.

Total assets turnover is the ratio of operating revenue in average total assets. It reflects the total asset operation ability of the company. The higher the ratio, the faster the turnover and the more capable the company.

The net profit ratio is an important factor to reflect the profitability of companies. It can compete as net profit divides main business income. It's more convincing than just focusing on net profit.

Equity turnover rate is the ratio of trade stock amount in a total tradable stock amount in a given period of time. It reflects the vitality of the stock.[8]

Shanghai Stock Exchange(i.e., SSE) divide listed companies in the A-shares market into 19 industries as the chart below.

Table 1 Industry breakdown of listed companies in China published by the Shanghai Stock Exchange

Industry Name	Industry Code
Agriculture,Forestry,Animal Husbandry,Fishery	A
Mining Industry	B
Manufacturing Industry	C
Production and Supply of Electric Power,Heat Power and Fuel Gas	D
Construction Industry	E
Wholesales and Retail Trade	F
Transportation, Warehousing and Postal Services	G

Hotel and Catering Sectors	H
Information Transmission,Software and Information Technology Services	I
Financial Industry	J
Realty Industry	K
Leasing and Business Service	L
Scientific Research and Technical Services	M
Hydraulic Engineering,Environment and Communal Facilities Management Industry	N
Residential Service,Repair and Other Service Sector	O
Education	P
Sanitation and Social Work	Q
Culture,Sport and Entertainment Industry	R
Comprehensive	S

ROA: Return on assets[10], also known as ROA, is used to measure how much net income is generated per unit of assets. Return on assets is one of the most widely used indicators to measure the profitability of banks in the industry. The higher the index is, the better the effect of the enterprise's asset utilization will be, indicating that the enterprise has achieved good results in increasing income and saving the use of funds[11]. Otherwise, it will be the opposite. Bank management usually watches this indicator very closely for strategic management purposes. [12]

The calculation formula of it is:Return on assets = net profit/average total assets *100%

ROE: Return on Equity is an accounting calculation method similar to Return on Investment, which is used to evaluate the profitability of a company. It can be used as an ownership indicator to compare the profitability of different companies in the same industry.

Return on equity is the ratio of net profit after tax to equity investment.

According to its calculation formula:Return on equity = net income/shareholders' equity, the final value of ROE is not a reliable indicator to determine the value or success of an enterprise because net income as a molecule does not truly reflect the performance of the enterprise. However, the formula still appears in many companies' annual reports.

However, a high return on equity does not mean strong profitability. Some industries, such as consulting firms, typically have higher ROE because they do not require much capital investment. Some industries require a lot of infrastructures to be profitable, such as oil refineries. Therefore, the profitability of a company cannot be judged by ROE alone. Generally speaking, capital-intensive industries have higher entry barriers and less competition. On the contrary, industries with high ROE but low assets are easier to enter and face greater competition. So ROE should be used to compare the same industry.

Diluted ESP: Fully Diluted Earnings Per Share is a new concept introduced by the new accounting standards, used to evaluate the impact of "potential common stock" on earnings per share, in order to avoid the false index increase may bring information misleading.

Diluted earnings per share (EPS) is based on basic earnings per share and is calculated by adjusting the current net profit attributable to common shareholders and the weighted average of the outstanding common shares, assuming that all the outstanding diluted potential common shares of the enterprise have been converted into common shares.

"Potential Common Shares" means a financial instrument or another contract that entitles its holders to the right to acquire common shares during or after the reporting period. At present, the potential common stocks issued by Chinese enterprises mainly include convertible corporate bonds, warrants, stock options and so on. Dilutive potential common stock means a potential common stock that is assumed to be converted into common stock in the current period to reduce earnings per share. For a loss-making enterprise, dilutive potential common shares are those potential common shares that are assumed to be converted into common shares in the current period to increase the amount of loss per share.[13]

EPS growth rate: In the growth of discriminating stocks, there are three main indicators: one is the growth rate of EPS, two is PEG, three is the growth rate of sales revenue, which is the test of the stock has no growth of the touchstone, but also the general institutions to measure the growth of stocks of the three core indicators.

EPS growth rate, is the growth rate that reflects the profit of each share of the company. The higher the indicator, the better.

EPS growth rate = (net profit for the period / total equity for the period - net profit for the period last year / total equity for the period last year) / ABS (net profit for the period last year / total equity for the period last year) * 100% [14].

Simplified formula : (EPS for the current period - EPS for the previous period) / ABS (EPS for the previous period) * 100%

Single factor analysis step

Single Factor Analysis Steps.

Step 1 (data preparation): relevant data were collected based on the purpose of the study. Factor analysis requires that the data must be quantitative.

Step 2: Start the analysis

Step 3 (Interpretation of results):

1. Judge whether the data are suitable for factor analysis

2. determine the number of extracted factors

3. judge the correspondence between factors and question items.[15]

Step 4 (Result adjustment): If the result of factor analysis is inconsistent with the expected result, this is a very common situation. For the unsatisfactory question items, you can move out the item and analyze it again until all the analyzed items correspond well with the factors.

If the following three types of problems occur, the unreasonable question items need to be removed:

The first category: If the common degree value of an analytic item is less than 0.4, the corresponding analytic item should be deleted;

The second category: If the absolute value of the "factor loading coefficient" of an item is less than 0.4, the item should be deleted;

The third category: If the correlation between an analytic term and a factor is seriously deviated (usually called 'falsification'), the analytic term should be deleted.[16]

Step 5 (factor naming)

Related Data Pre-Processing

Depolarization

Step 1: Find out which are the extreme values

3 σ method: The 3 σ method originates from the most classical statistical 3 σ principle, that is, the probability that the number of normally distributed numbers are distributed in ($\mu - 3\sigma, \mu + 3\sigma$) is 99.73%, and the probability that they are outside 3 σ is 0.27%, that is, those numbers in the tail of the graph. Where μ represents the mean and σ is the standard deviation. The 3 σ de-extremization method actually counts the values that are too far from the mean as extreme values, so how far is far? The distance more than 3 times the standard deviation is far.

Percentile method: The percentile method is to sort all the observed values from smallest to largest, the smallest percent X and the largest percent X of people is the extreme value, usually, this X is generally taken as 2.5, the smallest 2.5% and the largest 2.5% added together, a total of 5% of the value is removed.

Step 2: Process these extreme values

Truncate the tails: remove the extreme values found directly.

Truncation: All values greater than the upper critical value are equal to the upper critical value, and all values less than the lower critical value are equal to the lower critical value, which is equivalent to dragging all the points beyond the critical value back to the boundary

Industry Neutralization

Neutralization in factor studies actually plays a role of purification. The problem dealt with is somewhat similar to the measurement of multicollinearity in econometrics.

As an example, take a basic linear model.

$$Y = a_0 + a_1 * X_1 + a_2 * X_2 + e \quad (1)$$

The purpose of the model is to study the effect of two factors, X_1 and X_2 , on Y . The magnitude of the effect is actually to find the value of the coefficients a_1 and a_2 . Usually, the value of a_1 and a_2 can be estimated by least squares, but if X_1 and X_2 are correlated, for example, there is a relationship between the two such that

$$X_1 = m_1 * X_2 + m_2 * X_3 + e \quad (2)$$

X_1 is partly influenced by X_2 , and the other part is an independent influence of this factor. If the data of X_1 is directly substituted into the model, the estimated coefficients are not allowed, so the influence about X_2 in X_1 should be removed first, and then brought into the model, and this purification step is the neutralization.

In practice, the two most typical examples of neutralization are market value neutralization and industry neutralization.

For example, the daily turnover data is actually influenced by market capitalization, and stocks with large market capitalization usually have larger daily turnover. If both turnover and market capitalization factors are put into the model, there will be a multicollinearity problem, and the magnitude of the influence cannot be accurately estimated.

Therefore, the turnover factor should be purified before substituting into the model to exclude the influence of market capitalization. This is done by running a linear regression of turnover and market capitalization, subtracting the effect of market capitalization, and the remaining residual is the independent influence factor.

Similarly, the influence of industry on the factor is also very common, for example, the dividend yield factor mentioned in the previous section is affected by different industry characteristics, so it is necessary to exclude the influence of industry first through industry neutralization, specifically by setting industry as a dummy variable, which will not be detailed here in this issue.

3. FACTOR IC/IR CALCULATION METHOD

IC: Information Coefficient (IC) represents the factor's ability to predict stock returns. IC is calculated by calculating the linear correlation (Correlation) between the ranking of all stocks at the beginning of the transfer cycle and the ranking of returns at the end of the transfer

cycle. the larger the IC, the stronger the stock selection ability.

IR: Information Ratio (IR) = Multi-period mean of IC/standard variance of IC, representing the ability of the factor to obtain stable Alpha. The IR is equal to the mean value of IC over multiple periods divided by the standard variance of these ICs. So IR takes into account both the stock picking ability of the factor (represented by IC) and the stability of the factor's stock picking ability (represented by the inverse of the standard variance of IC).

A maximum IC value of 1 means that the factor is 100% accurate in stock selection, corresponding to the stock with the highest ranking score, and the selected stock will rise the most in the next transfer cycle; on the contrary, if the IC value is -1, it means that the stock with the highest ranking score will fall the most in the next transfer cycle, and is a completely inverse indicator.

In fact, the reverse indicator is also very meaningful. The most useless IC value is a value of 0 or close to 0, which means that the factor has no predictive power for the stock. When the absolute value of IC is greater than 0.05, the factor has a better ability to select stocks, and when IR is greater than 0.5 the factor has a better ability to obtain excess returns steadily.

4. MULTI-FACTOR GROUP SELECTION STRATEGY

Multiple-factor selection strategy use multiple factors of stock to evaluate the performance, which is more comprehensive than single-factor strategy. To find the expected return of the stock, multiple-factor models are made by the most relative factors. But it is difficult to decide what factors to be included and their predictions are not exactly accurate because horizontal data is used in the models.

The structure of multiple-factor selection strategy is shown in Figure 1. Risk model aims to capture the correlation of individual volatility of different stock and volatility among different stocks, including sample covariance matrix, fundamental models, macroeconomic models and statistical models. Alpha model aims to figure out the extra return unrelated to market volatility. Transaction costs are directly related to combination weight and trading execution strategy. They have a linear relation. Factor data should be processed, including removing the extreme value and standardization.

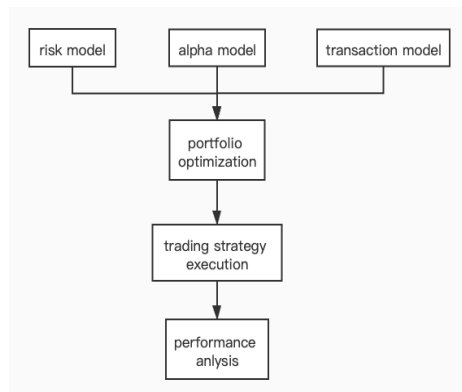


Figure 4 The structure of multiple-factor selection strategy



Figure 5 Factor trend of turnover relative volatility from May 2018 to April 2021

5. SCREENING FOR CURRENT MARKET FACTORS THREE TYPICAL FACTORS

Factor has been performing well in recent two years: the standard deviation of the transaction amount on the 20th is tvstd20

Factor category: emotional factor

Calculation formula: standard deviation of 20 day turnover

The ratio of IC mean value: - 0.043 | IC | > 0.02: 0.880 IR value: - 0.354

Table 2 Factor details of tvstd20

Factor Details	Cumulative Revenue	Annualized Income	Excess Annualized Return	Maximum Retracement	Sharpe Ratio	Turnover Rate
Minimum Quantile	41.28%	12.60%	9.69%	29.21%	0.42	6.28%
Maximum Quantile	-39.39%	-15.80%	-17.97%	46.06%	-0.72	7.41%

TVSTD20 factor has generally performed from May 2018 to April 2019, but after that, its cumulative return rate has risen sharply, and its performance has improved significantly. After may2019, it has been kept 20% higher than the average value of the market. Especially after July and August 2020, the cumulative yield has broken through 40% and has been stable at around 35%, sometimes even reaching 45%, Until recently, it was a cumulative yield of about 40 per cent. The minimum sub-scale of excess annual return of TVSTD20 is 9.69%, which is better in many factors. The maximum retreat was

29.21%, indicating that the stock fell 29.21% from the highest point of price (net value) to the lowest point. Its sharp ratio is 0.42, indicating that when investment risk increases by 1%, the expected return will increase by 0.42%. The turnover rate is 6.28%, which is also relatively high. It indicates that the trading of stocks under the influence of this factor is more active, and is often short-term investment, with strong speculative, large fluctuation of stock price and relatively large risk.[17]

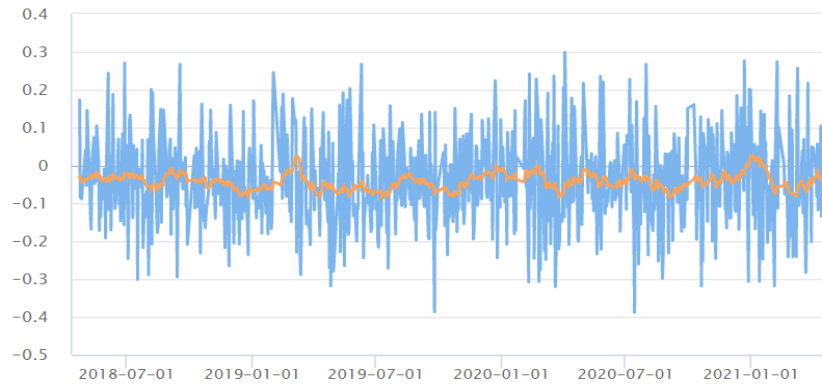


Figure 6 IC sequence diagram of TVSTD20 from July 2018 to April 2021

The absolute value of TVSTD20 factor's ic20 daily moving average is 0.079, which hovers around the absolute value of 0.04 most of the time. The IC moving

average of tvstd20 factor is relatively large, which indicates that the forecasting effect of tvstd20 factor is good.

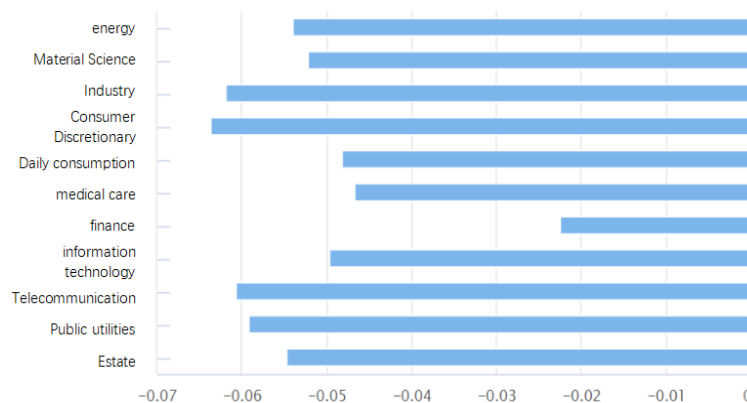


Figure 7 Industry IC chart of tvstd20

The IC value of tvstd20 factor in each industry is negative. The absolute value of industry IC with optional consumption is the largest, which is 0.064; The industry

IC absolute value of financial industry is the smallest, which is 0.023.[18]

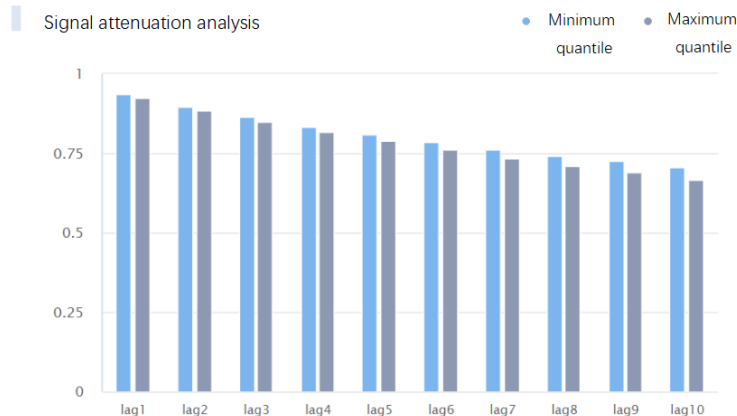


Figure 8 Analysis chart of TVSTD20 signal attenuation

When TVSTD20 factor is in Lag1, the buying ratio of the stocks currently bought is 0.94 in the subsequent position adjustment period, but it drops to 0.9 in lag2. From Lag3 to lag10, the buying ratio shows a downward trend, and it drops to 0.71 in lag10. It shows that the buyers who hold this kind of factor stocks tend to hold

short-term investment attitude towards this kind of stocks, and make a big adjustment to its changes. This also proves the high turnover rate of this kind of factors, the trading of this kind of stocks is very active, and the buyers have greater flexibility in their trading.[19]

Table 3 Factor details of TTM EPS_ ttm

Factor Details	Cumulative Revenue	Annualized Income	Excess Annualized Return	Maximum Retracement	Sharpe Ratio	Turnover Rate
Minimum Quantile	-38.55%	-15.40%	-17.58%	43.25%	-0.79	3.19%
Maximum Quantile	-29.98%	9.42%	6.60%	31.78%	0.24	1.85%

The factor of bad performance before and good performance recently: TTM EPS_ ttm

Factor category: per share index factor

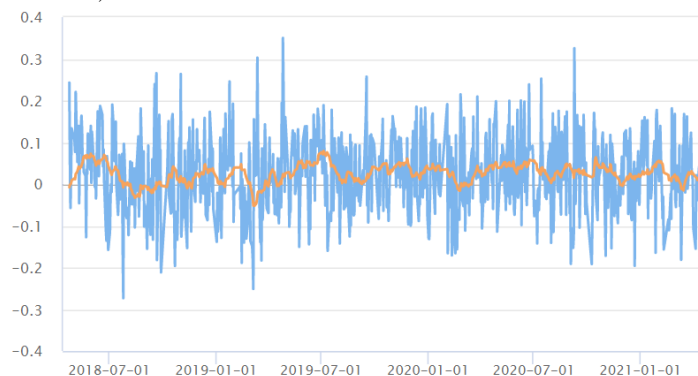
Calculation formula: the net profit (TTM) attributable to the owners of the parent company in the past 12 months divided by the total share capital

IC mean value: 0.026 | IC | > 0.02 ratio: 0.867 IR value: 0.268

**Figure 9** 2018.5-2021.4 TTM eps_ttm Trend of factor value of TTM

The performance of TTM eps_ ttm factor is average from May 2018 to April 2019. After that, its cumulative yield rises slightly, which is about 8 percentage points higher than the average level of the market. From May 2019 to July and August 2020, its performance is neither good nor bad. However, after August 2020, its cumulative yield has soared, breaking through 30%, widening the gap with the average value of the market. The gap has risen from 8% to 15%, and has been stable at this level since then, sometimes reaching 35%. The excess annualized rate of return is 6.60%. Considering the general performance of this factor, the excess annualized

rate of return is also good. The largest retracement is 31.78%, which indicates that the stock price (net value) decreases by 31.78% from the highest point to the lowest point, similar to TVSTD20 factor. Its sharp ratio is 0.24, which indicates that when the investment risk increases by 1%, the expected return will increase by 0.24%. Its turnover rate is 1.85%, which is low, indicating that the trading of stocks under the influence of this factor is not very active, the speculation is low, the fluctuation of stock price is small, and the risk is relatively small.

**Figure 10** 2018.7-2021.4 IC sequence diagram of TTM eps_ttm

The absolute value of TTM eps_ ttm factor's ic20 daily moving average is 0.079, and most of the time it hovers around the absolute value of 0.03. The IC moving

average of TTM factor is decent, which shows that the factor has a good prediction.[20]

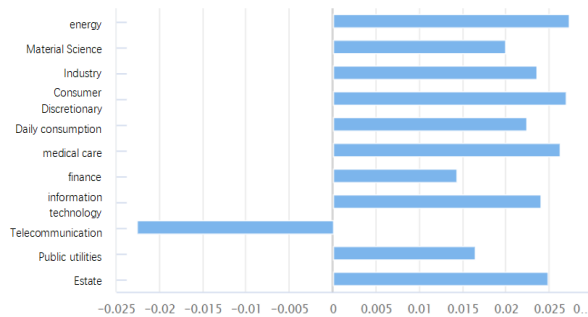


Figure 11 Industry IC chart of TTM eps_ttm

The IC value of TTM eps_ttm factor is almost positive in all industries, except the telecom service industry. The absolute value of IC in energy industry is the largest, which is 0.027; The absolute value of industry

IC of financial industry is the smallest, which is 0.014; The absolute value of IC in telecom service industry is 0.023.

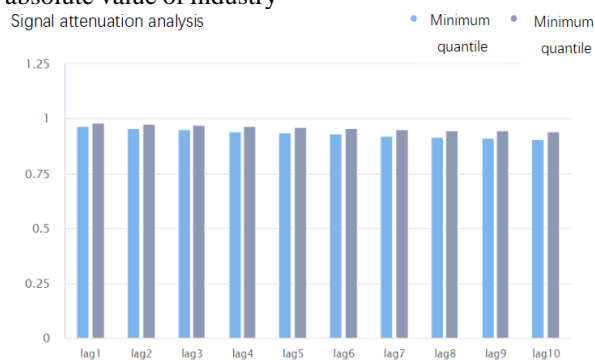


Figure 12 TTM eps_ttm signal attenuation analysis chart

Calculation formula: total operating revenue (TTM) divided by total equity

IC mean value: 0.01 |IC| > 0.02 ratio: 0.768 IR value: 0.185

The performance of TTM operating_revenue_per_share_ttm factor is not good from May 2018 to April

2020, and it has been almost equal to the average of the market. During this period, it is slightly higher than the average of the market. However, from April 2020 to now, its cumulative yield has dropped to about -15%, and it is lower than the average of the market, about 5 percentage points lower than the average.



Figure 13 2018.5-2021.4 Trend of factor value of TTM operating_revenue_per_share_ttm

When TTM eps_ttm factor is between lag1-lag10, the ratio of stocks currently bought is relatively stable in the subsequent position adjustment period, which keeps above 0.9, from 0.98 of Lag1 to 0.94 of lag10, the decrease is not obvious, the decrease range is small. It shows that the buyers who hold this kind of factor stocks hold long-term investment attitude towards this kind of

stocks and make a small adjustment to its changes. This is also due to the low turnover rate of such factors. The trading of such stocks is neither active nor hot.

A factor with poor performance: TTM operating_revenue_per_share_ttm

Factor category: per share index factor

Table 4 Factor details of TTM operating_revenue_per_share_ttm

Factor Details	Cumulative Revenue	Annualized Income	Excess Annualized Return	Maximum Retracement	Sharpe Ratio	Turnover Rate
Minimum Quantile	-20.13%	-7.43%	-9.82%	33.55%	-0.49	2.33%
Maximum Quantile	7.08%	2.38%	-0.27%	31.55%	-0.07	1.58%

The minimum quantile of tvstd20's excess annualized return is -0.27%, which is not very good among many factors. The largest retracement was 31.55%, indicating that the stock price (net value) fell by 31.55% from the highest point to the lowest point. The Sharpe ratio is -0.07, indicating that when the investment risk increases by 1%, the expected return will decrease by 0.07%. Its turnover rate is 1.58%, which is also relatively low, indicating that the trading of stocks under the influence of this factor is relatively flat, which is often a long-term investment, with weak speculation, small fluctuation of stock price, relatively small risk, and limited upper and lower limits of profits.

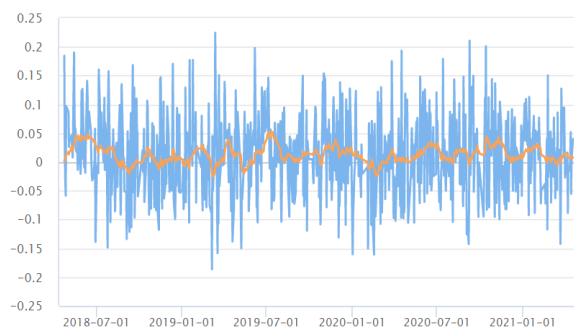


Figure 14 2018.7-2021.4 IC sequence diagram of TTM operating_revenue_per_share_ttm

The highest absolute value of TTM operating_revenue_per_share_ttm's IC 20 daily moving average is 0.052, and most of the time it hovers around the absolute value of 0.02. Its IC moving average is small, which indicates that the prediction effect of this factor is not good.

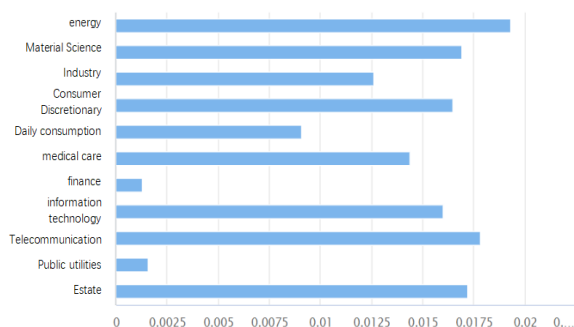


Figure 15 Industry IC chart of TTM operating_revenue_per_share_ttm

The IC value of TTM operating_revenue_per_share_ttm factor in each industry is positive. Among them, the absolute value of energy industry IC is the largest, which is 0.019; The industry IC absolute value of financial industry is the smallest, which is 0.001.

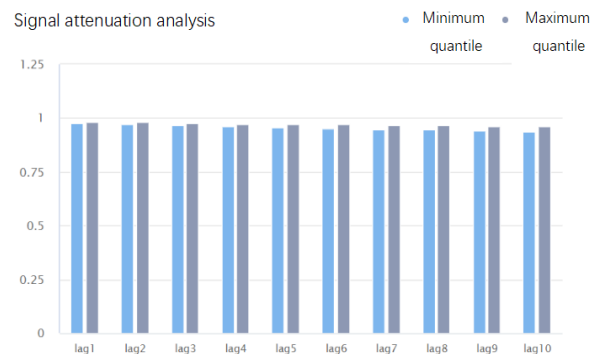


Figure 16 TTM operating_revenue_per_share_TTM signal attenuation analysis chart

When TTM operating_revenue_per_share_ttm factor is between lag1-lag10, the ratio of stocks currently bought in the subsequent position adjustment period does not change much, and they all remain above 0.95. From 0.98 of Lag1 to 0.96 of lag10, the decline is not obvious, and the decline is less than the TTM EPS discussed above_TTM factor. It shows that the buyers who hold this kind of factor stock hold a long-term investment attitude towards this kind of stock and make a small adjustment to its changes. This also deals with the low turnover rate of this kind of factors, and the turnover rate of this kind of factors is indeed less than the TTM EPS just discussed_ The turnover rate of TTM factor, this kind of stock trading is not very active, it is a relatively unpopular stock.

The well performing factors of CSI300: momentum, relative_strength, debt_to_equity_ratio, TTM value_change_profit_ttm, debt_to_asset_ratio, price_no_fq, net_profit_ratio

The well performing factor of CS500 : turnover_volatility, VOL5, VOL20, TTM operating_profit_per_share_ttm, TTM roe_ttm

6. DISSCUSSION

6.1. Strategy result description

We use CSI300 as stock pools to select stock from and baseline index. The number of holding stocks is 15 and the period for adjustment position is 20 trade days.

The backtest of our strategy is from January 1st,2019 to January 1st,2021, and the initial fund is 10,000,000 RMB. The table below is the data we collected for strategy.

Table 5 Basic data of strategy Index of csi300 consistently during the year.

Strategy return	Annualized strategy return	Excess return	Baseline return	Alpha	beta	Sharpe ratio
83.61%	36.52%	39.12%	31.12%	0.204	1.071	1.270
Winning rate	Earn loss rate	Max drawdown	Sortino ratio	Daily excess return	Max drawdown for excess return	Sharpe ratio for excess return
0.791	3.280	20.56%	1.805%	0.07%	9.30%	1.222
Daily winning rate	Number of winning trades	Number of loss trades	Information coefficient	Volatility of strategy	The volatility	The interval
0.506	102	27	1.794	0.256	0.212	2021/02/10, 2021/03/24

6.2. future research direction

When we study factors, we find that some examples have the asymmetry of variance.

Asymmetry means that a realized variance with direction also needs to be calculated. Its algorithm is also very simple. According to the profit per minute is positive or negative, the minute yield is divided into two parts. The square of the positive minute return is added to get the realized variance; The realized variance of the downward trend can be obtained by calculating the square sum of the yields in the falling minutes. Finally, the asymmetry of variance can be obtained by subtracting the downlink variance from the uplink variance. Of course, it is usually standardized by dividing the realized variance.

$$RSJ_t = \frac{RV_t^+ - RV_t^-}{RV_t} \quad (3)$$

$$RV_t = \sum_{i=1}^n r_{t-1+i/n}^2 \quad (4)$$

$$RV_t^+ = \sum_{i=1}^n r_{t-1+i/n}^2 I(r_{t-1+i/n} > 0) \quad (5)$$

$$RV_t^- = \sum_{i=1}^n r_{t-1+i/n}^2 I(r_{t-1+i/n} < 0). \quad (6)$$

When will the asymmetry of variance be larger? There are two situations. The first is that there are many minutes to go up; The second is that, though on average, rising and falling yields are similar. But when it goes up, it goes up quickly, and when it goes down, it goes down smoothly.

Intraday returns are often characterized by mean reversion. Therefore, if the asymmetry of realized variance is relatively large, it can be expected that in the future, or the next day, the return of the stock will be relatively low.

We could try to make use of this new type of data and investigate its effect for predicting stock return. We expect those new sources of data could bring in more excess returns.

7. CONCLUSION

Single factor analysis and multiple factor analysis are two quantitative methods. Single factor analysis starts with collecting the relevant data. After the analysis, interpret the results, that is to including judging whether the data and factors are suitable. Then, adjust the results

and name the factors. Multiple-factor analysis uses multiple factors to evaluate the performance of stocks. To do so, the multiple-factor models are made by the most relative factors. There are three main types of models: risk model, alpha model, and transaction model.

Factors performed differently. Three typical factors were chosen from factors in the recent market, in which one performed well recently, and one performed badly recently. A quantile cumulative return chart was used to analyze and test whether the IC ratio is larger than 0 steadily.

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