Systematic Trading Strategies

of

SSE Composite Index

by

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**Abstract**

Do quantitative trading strategies work in China’s stock market? This research will experiment with various common-used systematic trading strategies on the Shanghai Stock Exchange (SSE) Composite Index to answer this question. The objective of this research is to construct a new trading strategy by combining trend following and counter-trend ones to maximize *alpha* in trading SSE Composite Index. The study period is from December 1990 to February 2019, including over seven thousand observations.

**Keywords**:

SSE Composite Index, systematic trading, algorithmic trading, stock price

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**Introduction**

SSE Composite Index, namely Shanghai Stock Exchange Composite Index, is a capitalization-weighted index[[1]](#footnote-1) that records the overall performance of the daily price of all A-shares and B-shares that are listed at the Shanghai Stock Exchange. The index started to publish in 1990 and by now it has over seven thousand observations.

Systematic trading is a trading method that people adopt mechanical rules to trade based on their own trading objectives and risk preference. It involves partial manual trading decisions and partial automotive trading processed done by computers. Generally, there are two types of systematic trading. The first one is called high-frequency trading. It takes in transaction data at a very short time interval, normally as short as fractions of a second. The second one is systematic trading at a slower pace, which is also called passive index trading. In this paper, the method I am using is the second one and the time-frequency I am using is intraday, since high-frequency data of SSE Composite Index is very hard to obtain especially for the data in the 1990s.

Very few researches and applications of systematic trading have been done specifically for Chinese stock markets due to various reasons, such as people trading based on insider information, manipulations of stock prices, etc. As we know, the Chinese stock market is unique because it is dominated by individual investors while markets in developed countries are dominated by institutional investors. I am particularly interested in stepping towards a new frontier: can we generate ​*alpha* on the SSE Composite Index based on certain systematic trading strategies that previous scholars find effective in trading other indexes? If so, how can we improve ​*alpha* based on our own observations and creative design of the strategies?

To test the hypothesis that quantitative trading strategies do work in China’s stock market, this research will start by replicating some time-based trading strategies that previous scholars find effective in trading other indexes. Then based on these observations, this research will examine different re-composition of strategies to further maximize *alpha*. Finally, this research will evaluate the performance of the strategy constructed and extends the discussion to more contexts and scenarios to better understand the effectiveness of certain trading strategies in a more comprehensive way.

This research can be of great significance for SSE Composite Index traders, or, in a larger sense, all traders intending to exploit systematic trading techniques. Specifically, it will help understand the relationship between risk and return in China’s stock market in the past few decades. Moreover, by working with real data, it will generate insights into emerging market phenomena in comparison to more mature markets.

**Data**

The primary dataset I am working with is the SSE Composite Index daily cash data. The main time period for this research is from December 1990 to February 2019, including over seven thousand observations. All the data are obtained on ​*Yahoo Finance*[[2]](#footnote-2). The data contains the following columns: Date, Open, High, Low, Close, and Adj Close.

In addition, I also use the SSE Composite Index daily cash data from March 2019 to March 2020 in appendix as out-of-sample data to conduct additional testing on my ultimate trading strategy. This part of the data is obtained from the same source.

Besides the columns contained in the original dataset, I also construct new parameters like 20-day volatility, moving average over different periods, etc. as potential market signals in preparation for the realization of different systematic trading strategies.

 *Adjusted Close Price of Shanghai Stock Exchange Composite Index
(from December 1990 to February 2019)*

Above is an equity graph that shows the trajectory of the SSE Composite Index in the main study period. The x-axis represents the date, and the y-axis represents the daily adjusted close price of the SSE Composite Index.

As we can observe from the graph, there were several big drop/crisis periods from December 1990 to February 2019. Some detailed information about these big drop/crisis periods are as following:

* From May 1992 to November 1992: Within only five months, the maximum range of price drop was 7.2%. It was the crisis that had the shortest duration. The equity graph went downwards sharply.
* From February 1993 to July 1994: Within eighteen months, the maximum range of price drop was 79%. It was the crisis that had the largest range of price drops.
* From June 2001 to June 2005: Within forty-nine months, the maximum range of price drop was 55%. It was the crisis that had the longest duration.
* From November 2007 to October 2008: Within twelve months, the maximum range of price drop was 72.8%. This is the period which is called the Great Recession.
* From June 2015 to January 2016: Within eight months, the maximum range of price drop was 49.05%. It was the crisis that had the smallest range of price drops.

**Trading Objective**

In this research, the objective function that I adopt is called information ratio (sometimes also called Sharpe ratio). Information ratio measures the return of a portfolio adjusted by the volatility of the return. Information ratio is commonly used as the primary performance metric in index trading. Below is the calculation formula of information ratio:

*Information Ratio = Average Return / Standard Deviation of Return \* sqrt (260)*[[3]](#footnote-3)

When evaluating a systematic trading strategy, the higher the information ratio the more appealing to investors the strategy is. Having information ratio as the primary performance metrics, there are also several other metrics that investors usually consider in practice.

For example, investors are concerned about the participation rate of a trading strategy. It measures the ratio of the number of days that an investor engages with the market to the total number of days within certain study periods, given that the investor only trades based upon certain systematic trading strategies. Some systematic trading strategies may have a relatively high information ratio but with a very low participation rate. In this case, investors may not adopt the strategy because a low participation rate usually links with a low total return.

Investors are also concerned about the distribution of the sign of daily returns. To be more specific, there can be four situations when we compare a strategy to a baseline situation. The first situation is that both the strategy and baseline situation generates positive returns, then we are interested in comparing the magnitude of the returns. The larger the magnitude, the better strategy it is. The second situation is that both the strategy and baseline situation generates negative returns, then similarly we are interested in comparing the magnitude of the returns. The smaller the magnitude, the better strategy it is. The third situation is that the strategy generates positive returns while baseline situation generates negative returns. These days directly manifest the competitive advantage of the strategy we construct. The more of these days, the better strategy it is. The fourth situation is that the strategy generates negative returns while baseline situation generates positive returns. These days directly manifest the competitive disadvantage of the strategy we construct and reveal the parts that we fail to consider in constructing new strategies. The less of these days, the better strategy it is.

**Part I Stand-alone Analysis**

**Baseline**

The baseline strategy in this research is Buy and Hold. Buy and Hold is a passive investment strategy and a Buy and Hold investor buys the underlying asset and holds it for a long period of time. Usually, investors apply Buy and Hold strategy on investments when they have no concern on short-term price movements and they do not care about short-term technical indicators. In many cases, investing by Buy and Hold outperforms investing by active management and it is a favored investment strategy for many index traders including Warren Buffet[[4]](#footnote-4).

Typically, the advantages of Buy and Hold strategy are: it is very easy for investors or fund managers to implement and they can focus more on building a long-term portfolio instead of spending much time on researching and selecting securities; it reduces manager risk[[5]](#footnote-5) by minimizing investment management activities. The disadvantages of Buy and Hold strategy are: it scarifies partial gains by having relatively lower volatility; investors would may miss out some money-making timings to enter or exit the market if they can correctly identify the market trend at most of the time; it also causes a lack of flexibility on the investor side by simply ruling out active management activities.

In this research, the baseline is Buy and Hold the Shanghai Stock Exchange Index from December 1990 to February 2019.

*Equity Graph of Buy and Hold Strategy*

*(December 1990 to February 2019)*

 *Distribution of Sign of Daily Return Histogram of Daily Return[[6]](#footnote-6)*

 *(December 1990 to February 2019) (December 1990 to February 2019)*

Applying Buy and Hold, the corresponding equity graph is as shown above (essentially the same as the adjusted close price during the main study period). Among all the daily returns, 52% of them are positive while 46% of them are negative[[7]](#footnote-7). As the histogram shows, the return distribution is quite symmetric with a positive mean.

The average return achieved is 0.00026405, the standard deviation of return is 0.01546319. The information ratio is 0.27534519.

**Trend Following**

Trend following is one of the most commonly used systematic trading strategies. It takes the directional move from the past period as an existing trend, and invest following the direction. Once investors have identified an existing trend, they can leverage a variety of tactics to engage with the market, and one of the tactics is using a breakout. The realization of a trend following strategy in this research is as followed:

* First, the investor picks a certain number of days as the time window of “long line”, and calculates the moving average (MA)[[8]](#footnote-8) of the equity value in that period.
* Second, the investor picks a certain number of days as the time window of “short line”, and calculates the moving average (MA) of the equity value in that period.
* Third, the investor compares the value of long-line MA and short-line MA. If the short-line MA surpasses the long-line MA, then take a long position; If the short-line MA is smaller than long-line MA, then take a short position[[9]](#footnote-9).

When comparing the directional move in a long period and a short period, we identify the existing trend using long-line MA, and see whether the short-line breaks it.

The main advantages of trend following are: it enables investors to follow all big movements with a relatively high participation rate and take advantage of extended directional moves; it can generate profit even if it follows the wrong trend as long as the magnitude of positive returns is high enough. The main disadvantages of trend following are: there is a lack of consideration whether an existing trend will continue or only live for a short period, which results in unfavorable timings of investment activities and money-losing trades.

In this research, different combinations of long-line and short-line choices are experimented on data from December 1990 to February 2019.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 |
| 10 | 0.587 | 0.506 | 0.379 | 0.444 | 0.530 | 0.526 | 0.523 | 0.590 | 0.511 | 0.512 | 0.449 | 0.410 | 0.454 | 0.458 | 0.482 | 0.434 | 0.490 | 0.426 |
| 15 | 0.499 | 0.535 | 0.433 | 0.521 | 0.530 | 0.542 | 0.543 | 0.490 | 0.463 | 0.435 | 0.438 | 0.437 | 0.469 | 0.425 | 0.462 | 0.493 | 0.486 | 0.433 |
| 20 |  | 0.402 | 0.328 | 0.385 | 0.488 | 0.465 | 0.449 | 0.397 | 0.323 | 0.324 | 0.278 | 0.373 | 0.410 | 0.430 | 0.490 | 0.492 | 0.418 | 0.413 |
| 25 |  |  | 0.205 | 0.304 | 0.300 | 0.301 | 0.297 | 0.327 | 0.362 | 0.316 | 0.388 | 0.452 | 0.495 | 0.506 | 0.516 | 0.522 | 0.492 | 0.435 |
| 30 |  |  |  | 0.354 | 0.339 | 0.330 | 0.328 | 0.341 | 0.429 | 0.417 | 0.454 | 0.507 | 0.563 | 0.558 | 0.556 | 0.457 | 0.453 | 0.415 |
| 35 |  |  |  |  | 0.346 | 0.408 | 0.395 | 0.378 | 0.465 | 0.456 | 0.559 | 0.614 | ***0.638*** | 0.615 | 0.583 | 0.476 | 0.384 | 0.383 |
| 40 |  |  |  |  |  | 0.421 | 0.471 | 0.465 | 0.489 | 0.544 | 0.597 | 0.605 | 0.567 | 0.520 | 0.539 | 0.478 | 0.401 | 0.364 |
| 45 |  |  |  |  |  |  | 0.502 | 0.594 | 0.515 | 0.533 | 0.523 | 0.538 | 0.474 | 0.478 | 0.458 | 0.391 | 0.401 | 0.356 |
| 50 |  |  |  |  |  |  |  | 0.572 | 0.481 | 0.494 | 0.499 | 0.479 | 0.491 | 0.490 | 0.385 | 0.413 | 0.425 | 0.397 |
| 55 |  |  |  |  |  |  |  |  | 0.490 | 0.435 | 0.483 | 0.467 | 0.402 | 0.419 | 0.400 | 0.451 | 0.443 | 0.335 |
| 60 |  |  |  |  |  |  |  |  |  | 0.508 | 0.412 | 0.446 | 0.380 | 0.419 | 0.422 | 0.438 | 0.358 | 0.280 |
| 65 |  |  |  |  |  |  |  |  |  |  | 0.363 | 0.397 | 0.340 | 0.383 | 0.428 | 0.405 | 0.324 | 0.294 |
| 70 |  |  |  |  |  |  |  |  |  |  |  | 0.385 | 0.374 | 0.410 | 0.463 | 0.370 | 0.332 | 0.211 |
| 75 |  |  |  |  |  |  |  |  |  |  |  |  | 0.398 | 0.447 | 0.414 | 0.317 | 0.207 | 0.138 |
| 80 |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.444 | 0.359 | 0.286 | 0.230 | 0.208 |
| 85 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.251 | 0.209 | 0.232 | 0.257 |
| 90 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.246 | 0.214 | 0.249 |
| 95 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.239 | 0.194 |
| 100 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 0.186 |

 *Information Ratio Under Different Combinations of Long-line & Short-line Choices[[10]](#footnote-10)*

*(December 1990 to February 2019)*

The diagram above shows the information ratio associated with different combinations of long-line and short-line choices. As we can observe, the most effective strategy is to use 35-day moving average as the short line and 80-day moving average as the long line. This strategy yields an information ratio of 0.638, which is 100% higher than the baseline.

*Avg IR against Short-line Choice Avg IR against Long-line Choices*

*(December 1990 to February 2019) (December 1990 to February 2019)*

Above are two graphs showing the average information ratio under different short-line and long-line choices. It gives us an idea that the most effective short-line choices are around MA40, and the most effective long-line choices are around MA60 to MA90.[[11]](#footnote-11)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Coefficients* | *Standard Error* | *t Stat* | *P-value* |
| Intercept | 0.22028 | 0.04052 | 5.43682 | 0.00000 |
| Short | 0.00296 | 0.00127 | 2.32822 | 0.02089 |
| Long | 0.00662 | 0.00123 | 5.39228 | 0.00000 |
| Short\*Short | -0.00003 | 0.00001 | -2.74625 | 0.00657 |
| Long\*Long | -0.00004 | 0.00001 | -4.54517 | 0.00001 |
| Short\*Long | -0.00002 | 0.00002 | -1.51343 | 0.13173 |

*Linear Regression Result: IR against 5 X variables*

*(December 1990 to February 2019)*

A linear regression model is run on information ratio against short-line choice, long-line choice with interaction term, and quadratic terms. Coefficients show that long-line choices have a stronger influence on information ratio compared to short-line choices.

*Equity Graph of MA35/MA80 Trend Following*

*(December 1990 to February 2019)*

*Distribution of Sign of Daily Return Histogram of Daily Return[[12]](#footnote-12)*

*(December 1990 to February 2019) (December 1990 to February 2019)*

Applying MA35/MA80 trend following, the corresponding equity graph is as shown above. Compared with baseline, it obviously yields higher returns. It enjoys a smoothly increasing trend before 2009, however, it generates relatively high volatility after 2009. Among all the daily returns, 50% of them are positive while 44% of them are negative[[13]](#footnote-13). As the histogram shows, the return distribution is asymmetric with more days on the negative side but has a higher mean compared to baseline.

**Counter-trend**

While trend following is the most commonly used systematic trading strategy, counter-trend is gaining more popularity nowadays among investors and fund managers. Counter-trend strategies aim at identifying the reversal point of a trend. It exploits the theory that the market is inefficient that it cannot self-correct in the short run, and the inefficiency leads to short-term market extremes. Counter-trend investors believe that the price would bounce back to a reasonable range in the near future. The realization of a counter-trend strategy in this research is as follows:

* First, establish an average range of the period by calculating the average day range in the previous 20 days[[14]](#footnote-14).
* Second, calculate a range exhaustion system by: previous-day high - retracement \* 20-day MA. Retracement is a parameter for triggering market entry[[15]](#footnote-15).
* Third, if the equity price breaks the lower bound of the range exhaustion system, the investor takes a long position[[16]](#footnote-16).

The main advantages of counter-trend are: if the price oscillates around a certain range, a counter-trend strategy can take advantage of it and has a lot of trading opportunities; the magnitude of negative returns of a counter-trend strategy is usually smaller than that of a trend following strategy although it also applies to positive returns. The main disadvantage of counter-trend is: if we consider extremely low points, the price goes down over a period, and counter-trend can be triggered several times where the investor loses money continuously.

In this research, different retracement parameters are experimented on data from July 1997 to February 2019[[17]](#footnote-17).

*Retracement vs. Information Ratio*

*(July 1997 to February 2019)*

The graph above shows the information ratio of different counter-trend strategies associated with different retracement parameter choices. As we can observe, the most effective strategy is with a retracement value of 1.45. This strategy yields an information ratio of 0.674.

*Equity Graph of Counter-trend with Retracement=1.45*

*(July 1997 to February 2019)*

 *Distribution of Sign of Daily Return Histogram of Daily Return*

 *(July 1997 to February 2019) (July 1997 to February 2019)*

Applying counter-trend with a retracement value of 1.45, the corresponding equity graph is as shown above. Compared with baseline, it does a much greater job avoiding big losses. It enjoys a smoothly increasing trend although the total return is much smaller. Among all the daily returns, 12% of them are positive while 11% of them are negative[[18]](#footnote-18). As the histogram shows, the return distribution is quite symmetric with a positive mean, however, the magnitude of returns is much smaller than that in trend following.

**Part II Strategy Combination**

**Analysis on Combination**

The underlying methodologies of trend following and counter-trend are opposite. The former goes with the trend and the latter goes against the trend. By the nature of both strategies, they can be potentially complementary to each other.

Diving deep into the performance of the most effective stand-alone trend following strategy, it does not have obvious improvement on volatility reduction compared to baseline and the return distribution is heavier on the negative side. At the same time, based on our analysis of the most effective stand-alone counter-trend strategy, we learn that counter-trend strategies are good at avoiding big volatility while maintaining a similar positive-to-negative ratio in all returns compared to trend following. Based on these considerations, we acknowledge that with information ratio as the primary objective function, certain traits of counter-trend can effectively complement trend following.

To implement the combination of both strategies, the following analysis gives us hints on the optimal allocation proportion and some critical criteria in determining strategy choice.

*Retracement vs. Participation Rate*

*(July 1997 to February 2019)*

The graph above shows the participation rate of counter-trend strategies with different retracement parameter choices. As retracement increases, the market participation rate decreases. We can see from the graph that with a retracement of 1.45 (the most effective stand-alone counter-trend strategy), the participation rate is only 24%. It gives us a hint that we should not apply counter-trend on the majority of the days, otherwise the market participation rate of the ultimate strategy would be too low to generate enough profits.

*Return Sign Distribution (Retracement=1.45)*

*(July 1997 to February 2019)*

The pie chart above shows the comparison of return signs between the most effective stand-alone counter-trend strategy and baseline. In 47% of the time, both of them yield negative returns. In 30% of the time, both of them yield positive returns. In 23% of the time, the counter-trend yields positive returns while the baseline yields negative returns. Data shows that even the most effective stand-alone counter-trend strategy only has an accuracy of 53% in determining the price trend. It gives us a hint that we may apply counter-trend strategies only when trend following performs bad. Counter-trend strategies do not help increase the predictive accuracy of trends but only avoid big losses caused by trend following strategies.

Recall that the objective is to maximize information ratio, our goal should be maximizing average return and minimizing risk/volatility. The combination of both strategies could follow the following two lines of thinking:

* *Increase return* by applying trend following for most of the time. Previous analysis shows that trend following yields a larger magnitude of returns compared to counter-trend. Therefore, we choose the best-performing trend following (MA35/MA80) as the base strategy
* *Decrease risk* by applying counter-trend during high volatility periods. It is generally true that days generating high volatility returns are days with high volatility in price. Previous analysis shows that counter-trend strategies yield less volatile returns on average compared to trend following. Therefore, we decide to apply counter-trend strategies during high volatility periods.

**Ultimate Strategy**

Based on the lines of thinking in the previous section, the trend following strategy of interest is already selected, and the remaining task is to identify the best-performing counter-trend strategy during high volatility periods.

|  |  |  |  |
| --- | --- | --- | --- |
| *Retracement* | *Avg Return* | *S.D of Return* | *Avg Return/S.D.* |
| 1 | 0.00035124 | 0.00942873 | 0.037252186 |
| 1.1 | 0.00034339 | 0.00902757 | 0.038037447 |
| 1.2 | 0.00036681 | 0.00868027 | 0.042258207 |
| 1.3 | 0.00030965 | 0.00809185 | 0.03826653 |
| 1.4 | 0.00034332 | 0.0077606 | 0.044238611 |
| ***1.5*** | ***0.00034661*** | ***0.00741478*** | ***0.046745696*** |
| 1.6 | 0.00028352 | 0.0070014 | 0.04049507 |
| 1.7 | 0.00024106 | 0.00655194 | 0.036792868 |
| 1.8 | 0.00024017 | 0.00619281 | 0.038782372 |
| 1.9 | 0.00019842 | 0.00576655 | 0.034408159 |
| 2 | 0.00018244 | 0.00549889 | 0.033178416 |
| 2.1 | 0.00015313 | 0.00512912 | 0.029855047 |
| 2.2 | 0.00012959 | 0.00489432 | 0.026477501 |

*Retracement vs. Performance (high vol periods[[19]](#footnote-19))*

*(July 1997 to February 2019)*

The diagram above shows the performance of counter-trend strategies with different retracement parameter choices during high volatility periods. As we can see, a retracement value of 1.5 yields the best result with the highest average return and the lowest standard deviation of returns. Therefore, we select this counter-trend as the complementary strategy for the selected trend following strategy in the previous section.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Avg Return* | *S.D. of Return* | *Information Ratio* | *IR Improvement[[20]](#footnote-20)* |
| Baseline (BuyNHold) | 0.00026405 | 0.01546319 | 0.27534519 | / |
| Best-performing TF (MA35/MA80) | 0.00052322 | 0.0152464 | 0.5533573 | 100% |
| Composite Strategy (TF + CT) | 0.00034654 | 0.00741408 | 0.75368096 | 173% |

 *Information Ratio Comparison*

*(July 1997 to February 2019)*

*Return Comparison*

*(July 1997 to February 2019)*

The above two diagrams summarize the performance of the ultimate strategy. From the first diagram, we learn that the combined method of trend following and counter-trend outperforms the baseline by 173% and outperforms the most effective stand-alone trend following strategy by 36%[[21]](#footnote-21). From the second diagram, we can intuitively see that the yellow graph which represents the daily returns of the ultimate strategy, enjoys a low volatility and a high mean.

**Part III Critical Analysis**

**Conclusions**

This research examines the performance of trend following strategies and counter-trend strategies on trading the Shanghai Stock Exchange Composite Index during the period December 1990 to February 2019. Using Buy and Hold as the baseline, the most effective trend following strategy identified achieves a 100% increase in information ratio. In addition, data shows that trend following strategies and counter-trend strategies can be commentary to each other according to their own traits. Based on some deep dives into parameter choices and combination possibilities, a composite strategy with 80% of trend following and 20% of counter-trend is constructed. The ultimate strategy achieves a 173% increase in information ratio compared to baseline.

This research draws interesting perspectives on creatively combining different systematic trading strategies and it is worth exploring in future studies. In terms of index trading, it would be interesting to further compare strategy performance on Shenzhen Stock Exchange Component Index and Shanghai Stock Exchange Composite Index.

**Discussions**

There still exist some issues that are worth considering but not discussed in this research yet. First, transaction cost plays an important role in intraday trading and the evaluation of different strategies in this research does not include transaction cost. In further research, it would be interesting if we could add a cost to each market exit in simulating different trading strategies. Second, in this research backtesting is done on all the data we have. Although it is a common practice to simply back test on the whole data, I think it would be even better if we can also test the ultimate strategy on out-of-sample data to evaluate the robustness, and thus I include an “out-of-sample testing” part in the appendix section. Third, this research has identified some potential key indicators in trading SSE Composite Index and a potential extended research direction would be applying these insights into constructing machine learning models in index trading. Forth, scenario-based analysis such as big rise periods and big drop periods can be added to the evaluation of different trading strategies.

**Appendix**

**Out-of-sample Testing**

The testing period chosen is from March 2019 to March 2020 including 262 trading days. The two diagrams below show a robust performance of the composite strategy constructed in this research. With the baseline and MA35/MA80 both yielding a negative information ratio, the composite strategy yields an information ratio of 2.76. From data, we know that the composite strategy generates the highest average return with the lowest volatility.

*Return Comparison*

*(March 2019 to March 2020)*

|  |  |  |  |
| --- | --- | --- | --- |
|  | *Avg Return* | *S.D. of Return* | *Information Ratio* |
| Baseline (BuyNHold) | -0.017228573 | 1.287201362 | -0.215818907 |
| Best-performing TF (MA35/MA80) | -0.000201601 | 0.012508252 | -0.259885862 |
| Composite Strategy (TF + CT) | 0.002102945 | 0.012266339 | 2.764392322 |

 *Information Ratio Comparison*

*(March 2019 to March 2020)*

1. The way that SSE Composite Index is calculated:

SSE Composite Index = Total Market Capitalization of constituents × Base Value / Base Period;

Total Market Capitalization = ∑ (Price × Number of Shares Issued). [↑](#footnote-ref-1)
2. https://finance.yahoo.com/quote/000001.SS/history?p=000001.SS [↑](#footnote-ref-2)
3. Sqrt(260) is a normalization term, and the number 260 indicates that there are approximately 260 trading days per year at Shanghai Stock Exchange. [↑](#footnote-ref-3)
4. Warren Buffet praises Buy and Hold strategy for its ability to generate healthy long-term returns and describes it as an ideal investment strategy for individual investors.
 [↑](#footnote-ref-4)
5. Manager risk refers to the risk associated with the management activities of an investor or a fund manager. Manager risk is magnified when one adopts active investment styles because there is a higher change that the manager makes investment decisions that negatively affect financial returns. [↑](#footnote-ref-5)
6. One data point on the right tail is cut. [↑](#footnote-ref-6)
7. The daily return is zero on 2% of the days. These are non-trading days that are recorded in the original data for various reasons. In this research, we ignore them and compare different trading strategies based on the proportion of days with positive returns and days with negative returns. [↑](#footnote-ref-7)
8. Moving average refers to the arithmetic mean of a security over a number of time periods.
MA = (A1+A2+...+An) / n; where: A = average in period n; n = number of time periods.

Sometimes we use exponential moving average (EMA) to put more weight on recent data points.

EMAn = multiplier \* adj close pricen + (1-multiplier) \* EMAn-1 ;
where multiplier usually takes the value of [2 / (time window + 1)]. [↑](#footnote-ref-8)
9. By default, investor leaves the market at close of every day. [↑](#footnote-ref-9)
10. Titles on horizontal axis represent short-line choices and titles on vertical axis represent long-line choices. [↑](#footnote-ref-10)
11. I did not identify MA10 as the most effective long-line choice because there were too few data points for that, and the information ratio might be strongly affected by short-line choices shorter than MA10. [↑](#footnote-ref-11)
12. Several outliers are cut. [↑](#footnote-ref-12)
13. The daily return is zero on 6% of the days, among which 2% are non-trading days that are recorded in the original data for various reasons, and 4% are non-trading days based on the trend following strategy. [↑](#footnote-ref-13)
14. The 20-day period is chosen here since it is a common practice in index trading. [↑](#footnote-ref-14)
15. Retracement usually takes value from 0 to 5. [↑](#footnote-ref-15)
16. 1) By default, investor leaves the market at close of every day.

 2) We do not consider short positions here because there are very few cases that the equity price breaks the upper bound of the range exhaustion system. [↑](#footnote-ref-16)
17. July 1997 is chosen as the starting date for experimenting counter-trend strategies because day range data of previous dates is not recorded thus not available. [↑](#footnote-ref-17)
18. At most of the time (up to 77%), investors do not participate in the market under the most effective stand-alone counter-trend strategy. [↑](#footnote-ref-18)
19. Dates with top 20% previous 20-day average volatility are categorized as high vol periods. [↑](#footnote-ref-19)
20. Compared to baseline. [↑](#footnote-ref-20)
21. IR(combined strategy) / IR(the most effective stand-alone trend following strategy) - 1 $≈36\%$ [↑](#footnote-ref-21)