

# ***Integrating Residual Momentum with Deviation Factor Models for Stock Selection in the Hong Kong Market***

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**Abstract.** This paper investigates the application of deviation factor models combined with residual momentum strategies in the selection of stocks in the Hong Kong market between 2014 and 2024. This research uses a novel and advanced residual momentum algorithm to retrieve clean momentum components from stock returns, free from market and industry effects. Parallel to this, technical indicators such as RSI, CCI, and VWAP are also used in the research to detect price deviations and, thus, potential arbitrage opportunities. The analysis shall be among the top 300 stocks by market capitalization listed in Hong Kong, where the strategies tested for both their predictive power and risk-adjusted performance. The findings show that the residual momentum strategy is well on course to pick up excess returns, although its implementation continues to be marred by very high volatility and inefficient markets in Hong Kong. Theoretically sound, in that the deviation factor strategy underperforms, especially in high-volatility conditions. In the last section, recommendations are given on the ways to improve these strategies in being more robust and effective in the Hong Kong stock market; with the major pointers being dynamic adjustments in trading algorithms and stock selection criteria.

**Keywords:** Residual Momentum, Deviation Factor, Hong Kong Market, Algorithmic Trading, Risk-Adjusted.

## **1. Introduction**

### **1.1. Momentum strategy**

#### **1.1.1. Economics intuition**

In the U.S. market, momentum strategies have been widely proven effective, with numerous successful cases and substantial theoretical support. For instance, the seminal study by Jegadeesh and Titman [1,2] demonstrated that stocks with superior past performance tend to continue

performing well in the future, and vice versa. This phenomenon has been extensively validated through empirical research in Western markets and is considered a crucial tool for stock price prediction. However, the effectiveness of momentum strategies in Asian markets is not as pronounced. Many studies have found that price momentum in Asian markets has a lower predictive utility for stock prices. Specifically, the price momentum in these markets tends to be weaker, failing to deliver the significant excess returns observed in Western markets. This discrepancy may be attributed to differences in market structure, investor behavior, and institutional environments.

### 1.1.2. Performance estimate

Table 1. Prediction of relevant data under residual momentum strategy

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	12%	25%	0.48	68%

## 1.2. Momentum strategy

### 1.2.1. Economics intuition

The combined RSI, CCI, and VWAP strategy [3] leverages the distinct strengths of each indicator to exploit market inefficiencies and capture trading opportunities. The RSI can help determine the trend direction of the price. In general, when the RSI [4] is at a high level (usually greater than 70), it indicates that the market is overbought and prices may be due for a correction; When the RSI is at a low level (usually less than 30), it indicates that the market is oversold and prices may rebound. When the market satisfies the efficiency hypothesis and can effectively predict the future trend of the market, the CCI indicator strategy can be used for short-term trading. This strategy is effective when seasonal market fluctuations and market-moving events can be predicted. VWAP [5] (Volume Weighted Average Price) serves as a benchmark, identifying the average price paid per share throughout the day, which institutions often use to gauge fair value [6]. By integrating these three indicators, the strategy help capture short-term price reversals and trend continuations while aligning trades with the market's fair value, enhancing the probability of profitable trades.

### 1.2.2. Performance estimate

Table 2. Prediction of relevant data under deviation factor

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	10%	16%	0.62	-1.08%

## 2. Specification

### 2.1. Data

#### 2.1.1. Universe

We choose the top 300 stocks by market capitalization of Hong Kong stocks. These stocks ensure better liquidity and lower transaction costs, thereby enhancing the feasibility and efficiency of the

strategy.

### 2.1.2. Data sets

The data used in this study consists of data on daily open, close, high, and low prices for individual stocks in the Hong Kong stock market. In addition, the study uses data from Himbo, daily HIS, and trading volume information. These datasets show an overview of conditions and performances in the market, depicted by stocks, that provide in-depth analysis of strategies applied.

### 2.1.3. Data source

Table 3. Article data source

Stock in Hong Kong Market	Choice
HIBOR rate	Hong Kong Inter Bank
Hang Seng Index	Hang Seng Indexes

### 2.1.4. Date range

The data applied in this study spans from January 1, 2014, to April 30, 2024. The in-sample period runs from January 1, 2014, to December 31, 2019, while the out-of-sample period runs from January 1, 2020, to April 30, 2024. This partitioning will help us investigate strategies properly under different market conditions. The out-of-sample period was chosen with a high proportion of the extremely volatile environment in financial markets, especially from the beginning of 2020 to 2022, when the Hong Kong economy turned into a downturn pushed by the pandemic, which has heavily affected the stock market. The idea is that one looks for out-of-sample verification through 2020-2024, to test the stability of strategies under extreme conditions and effectiveness in adapting to changes in market structure. This also lessens the chance of model overfit on data [7].

## 2.2. Strategy

### 2.2.1. Residual momentum

#### 2.2.1.1. Economic intuition

Our study empirically analyzes the top 300 stocks by market capitalization in the Hong Kong market from 2014 to 2024 using the residual momentum algorithm developed by Blitz, David, Joop Huij [3], and Martin Martens [8]. The residual momentum algorithm is an improved momentum strategy that extracts pure momentum components from stock returns by removing the effects of market, industry, and other common factors. Compared to traditional momentum strategies, the residual momentum algorithm theoretically better captures the underlying trends in stock prices, offering stronger predictive power and practical value.

#### 2.2.1.2. Raw alpha

$$r_{i,t} = \alpha_i + \beta RMRF_t + \varepsilon_{i,t}$$

$$r_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} - r_{m,t}$$

where  $r_{i,t}$  is the excess return rate on single stock  $i$  at the end of month/period  $t$  in excess of the risk free interest rate and the  $r_{i,t}$  is the rate of stock  $i$ 's price change in the period  $t$ .  $RMRF_t$  is the market risk premium in the period  $t$ . Alpha ( $\alpha_i$ ) and beta ( $\beta_i$ ) are the respectively the intercepts as well as the coefficients on the market risk premium and  $\varepsilon_{i,t}$  is stock  $i$ 's residual return [4].

$$\varepsilon_{i,t,p} = r_{i,t,p} - \alpha_i - \beta_i RMRF_{t,p}$$

$$RMRF = R_m - R_f$$

$$\alpha_{raw,i,p} = \frac{\sum_{p-t}^p \varepsilon_{i,t}}{t}$$

where  $raw \alpha_{i,n}$  is the sum of stock  $i$ 's residual returns over the past period  $t$  and  $p$  is the decision time point.

### 2.2.1.3. Refined alpha

In terms of the alpha of each stock in one period, it should be transformed by following transformation operations:

$$a_{average,p} = \frac{\sum_1^n \alpha_{raw,i,p}}{n}$$

$$a_{i,p} = \frac{\alpha_{raw,i,p} - a_{average,p}}{\sum_1^n |\alpha_{raw,i,p} - a_{average,p}|}$$

where  $raw \alpha_{i,n}$  is the sum of stock  $i$ 's residual returns over the past period  $t$  and  $p$  is the decision time point.

## 2.2.2. Deviation factor

### 2.2.2.1. Economic intuition

RSI and CCI reflect the abnormal price fluctuations in terms of the strength of price rise and fall, and the degree of price deviation, respectively. VWAP indicator is added to take into account the impact of market volume on the stock price. Stocks with higher scores have a higher likelihood of price volatility in the coming period, and there is more room for arbitrage.

### 2.2.2.2. Raw alpha

#### 1. RSI(relative strength index)

The first part in computing the RSI is to calculate the relative strength, which can be considered as the average gain divided by the average loss over a given period. It is calculated as follows:

$$RSI = 100 - \frac{100}{1 + RS}$$

Once we have the RS value, we can proceed to calculate the RSI using the following formula, where RS is the relative strength computed previously:

$$RS = \frac{N - \text{Day Average growth}}{N - \text{Day Average loss}}$$

To accurately compute the RS value, we need to first calculate the N-Day average growth and N-Day average loss. These values represent the mean of all positive and negative price movements over the selected period, calculated as follows:

$$N - \text{Day Average growth} = \frac{\sum_{i=1}^g \left( \frac{\text{close}_i - \text{open}_i}{\text{open}_i} \right)}{g}$$

$$N - \text{Day Average loss} = \frac{-\sum_{i=1}^l \left( \frac{\text{close}_i - \text{open}_i}{\text{open}_i} \right)}{l}$$

$$N = 21$$

$g = \text{Number of dates when the close} \geq \text{open}$

$l = \text{Number of dates when the close} < \text{open}$

## 2. CCI(Commodity channel index)

Moving on from the RSI, we next compute the Commodity Channel Index (CCI), which measures the deviation of the current price from its statistical mean. To calculate CCI, we first need to determine the typical price, which is the average of the high, low, and close prices for a given period:

$$CCI = \frac{\text{Typical price} - MA}{0.015 \times \text{Mean Deviation}}$$

$$\text{Typical price} = \frac{\text{high} + \text{low} + \text{close}}{3}$$

With the typical price in hand, the next step involves calculating the moving average (MA) of the typical prices over the N-day period, as shown in the equation below:

$$MA = \frac{\sum_{i=1}^N (\text{closing price}_i)}{N}$$

To complete the CCI calculation, we also need to compute the mean deviation, which reflects the average difference between the typical prices and their moving average:

$$\text{Mean Deviation} = \frac{\sum_{I=1}^N |\text{closing price}_i - MA|}{N}$$

$$N = 21$$

### 3. VWAP (Volume Weighted Average Price)

After we calculate CCI, we move on to the Volume Weighted Average Price (VWAP), which considers trading volume to come up with the average price paid for a share. The VWAP is:

$$VWAP = \frac{\sum_{i=1}^n (\text{Price}_i \times \text{Volume}_i)}{\sum_{i=1}^n \text{Volume}_i}$$

$$n = 21$$

4.

$$S_{RSI} = \begin{cases} \frac{30 - RSI}{50}, & RSI < 30 \\ \frac{70 - RSI}{50}, & RSI > 70 \\ 0, & \text{otherwise} \end{cases}$$

The reason we use 50 in the denominator here is because the typical thresholds for the RSI are 30 and 70, in order to provide a linear mapping mathematically, and taking the middle value balances out the impact of overbought and oversold states on the scoring

5.

$$S_{CCI} = \begin{cases} \frac{-100 - CCI}{100}, & CCI < -100 \\ \frac{100 - CCI}{100}, & CCI > 100 \\ 0, & \text{otherwise} \end{cases}$$

In the traditional interpretation of the CCI indicator,  $\pm 100$  is the standard overbought and oversold thresholds. The use of 100 as the denominator directly references this empirical threshold in the scoring system, making the calculation of the score directly related to the overbought or oversold state of the market.

6.

$$S_{VWAP} = \text{sign}(VWAP - \text{Closing price}) \times \log\left(\frac{|VWAP - \text{Closing price}|}{VWAP}\right)$$

The score is positive or negative by comparing the size of the VWAP to the closing price of the stock. The effect of extreme values on the score is reduced by taking the logarithm of the deviation

of the stock price relative to the VWAP.

7.

$$S = S_{RSI} + S_{CCI} + S_{VWAP}$$

The scores of the three indicators were weighted equally and summed to obtain the final score.

### 2.2.2.3. Refined alpha

We have here normalised the final data in order to satisfy the alpha matrix requirement in the following way:

$$S_{de\_i,t} = S_{i,t} - \bar{S}_t$$

$$Scale_i = \frac{S_{de\_i,t}}{\sum_{i=1}^n |S_{de\_i,t}|}$$

## 2.3. Analysis

### 2.3.1. Perform statistics

This is the section that uses statistical analysis to assess the performance of the strategies. This is analyzed through key metrics including: annualized return, a measure of yearly profit or loss as a percentage of the investment; volatility, which estimates the deviation in returns for the investment through time; Information Ratio (IR), a ratio used to describe the risk-adjusted return using excess return produced over the benchmark divided by the volatility of the excess return; and maximum drawdown, which represents the largest single drop from peak to trough in the value of a portfolio. Such metrics would give an all-round understanding of the effectiveness and risk profile of the strategies.

### 2.3.2. Execution cost

The execution cost is one ten-thousandth of the stock transaction amount. When the total amount of each transaction is less than 50,000HKD, the transaction commission is 5 HKD.

### 3. Implementation

#### 3.1. Residual momentum

##### 3.1.1. Pnl graph

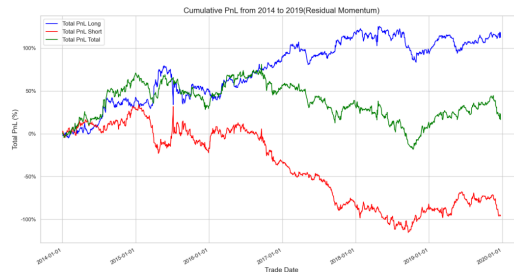


Figure 1. Cumulative PnL from 2014 to 2019 under residual momentum strategy

Universe: Hk market

The overall performance was very little gain. The total information ratio was 0.09, indicating the average risk adjustment performance of the strategy relative to the market benchmark. The short portfolio began to fall in the middle of 2016, with serious losses. But the bullish portfolio is rising, due to huge southbound funds and soaring blue-chip stocks [9,10].

##### 3.1.2. Performance statistics

Table 4. Performance statistics under residual momentum strategy

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	1.41%	16.09%	0.09	83.5%

The overall annualized volatility is relatively high. This strategy is highly volatile and needs to be adjusted. Especially as sentiment turns to risk appetite, investors are more likely to chase bullish stocks, driving up earnings on long positions, while short positions are relatively weaker.

### 3.2. Deviation factor

##### 3.2.1. Pnl graph

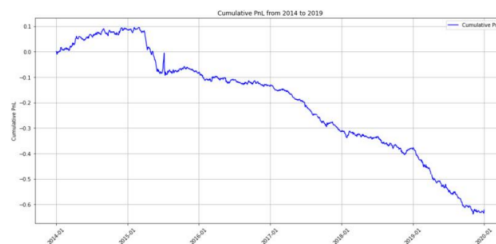


Figure 2. Cumulative PnL from 2014 to 2019 under deviation factor

The long equity portion has a cumulative return of -86.68% with a maximum retracement of -87.2% and a maximum retracement of 12/10/2019.

The short equity portion had a cumulative return of 24.51% with a maximum retracement of -7.09%, with the maximum retracement occurring on 2/6/2015.

The Deviation Factor strategy did not perform well in the Hong Kong trading market. After double-checking the accuracy of the long/short direction of stocks and the accuracy of the code realization volume components, we believe that the abnormal performance of some low-quality stocks affected the overall return of the strategy, in other words, some of the stocks included in the pool did not conform to the assumption of market validity, and we should avoid trading on these stocks in our back-testing [11].

### 3.2.2. Performance statistics

Table 5. Performance statistics under deviation factor

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	-10.36%	5.81%	-1.78	-63.79%

Show in table5, The total annualized return was -10.36%, with the long and short portions at -14.45% and 4.09%, respectively. The overall performance was a loss. The Total Information Ratio was -1.87, indicating poor risk-adjusted performance of the strategy relative to the market benchmark. The total annualized volatility was relatively low at 5.81%. The total maximum retracement was -63.79% and the long portion even reached -87.2%, which implies that the strategy will experience a period of significant floating losses.

To summarize, the strategy underperformed over the 2014-2019 period, with losses and large retracements. The reasons need to be further analyzed and the trading strategy improved.

## 4. Refinement

### 4.1. Residual momentum

#### 4.1.1. Refinement 1(universe improvement)

##### 4.1.1.1. Description

In the Hong Kong stock market, small-cap stocks typically exhibit lower liquidity, higher transaction costs, and greater price volatility, which can lead to difficulties in strategy execution and increased risk. Conversely, the top 300 stocks by market capitalization represent larger companies within the Hong Kong market, characterized by stable operations, strong risk resilience, and higher investment value. These stocks ensure better liquidity and lower transaction costs, thereby enhancing the feasibility and efficiency of the strategy. Moreover, large-cap companies generally have more stable financial conditions and more transparent information disclosure, which helps to mitigate the risks associated with information asymmetry [12].

#### 4.1.1.2. Pnl graph

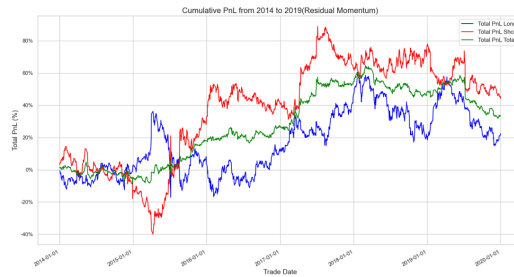


Figure 3. Cumulative PnL of the top 300 stocks in Hong Kong stock market value under the residual momentum strategy (reg 5, back-test 1)

The overall stock presents a fluctuating upward trend. After 2016, short positions have generally returned better investments than long positions.

#### 4.1.1.3. Performance table

Table 6. Performance statistics of the top 300 stocks in Hong Kong stock market value under residual momentum strategy

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	7.58%	21.6%	0.35	31.4%

The annual rate of return has increased significantly than before the adjustment, and the volatility is small, the strategy has achieved some results. The total turnover of the Hong Kong Stock Connect exceeded HK \$2 trillion in 2017, bringing in net inflows of more than HK \$800 billion to Hong Kong stocks. As of December 25,2017, southbound funds have flowed into the market more than 302.535 billion yuan through Hong Kong Stock Connect, among which the net inflow of Hong Kong Stock Connect (Shanghai) is more than 193.646 billion yuan, and the net inflow of Hong Kong Stock Connect (Shenzhen) is 108.889 billion yuan. South of the capital injection and blue chip stocks big market to help Hong Kong stocks rise. For example, Geely Auto (0175.HK)'s share price soared 2.6 times from the beginning to march of the same year, Tencent (0700.HK) also rose 1.2 times, and even the old economic stock HSBC Holdings (0005.HK) rose 28.5% this year [13,14].

### 4.2. Deviation factor

#### 4.2.1. Refinement 1(universe improvement)

##### 4.2.1.1. Description

We adjusted the back-testing dataset to the top 300 Hong Kong stocks by market capitalization once a year.

Back-testing using the entire Hong Kong stock market did not yield satisfactory results. Considering that individual outperforming stocks can have an impact on the overall strategy.

### 4.2.1.2. Pnl graph

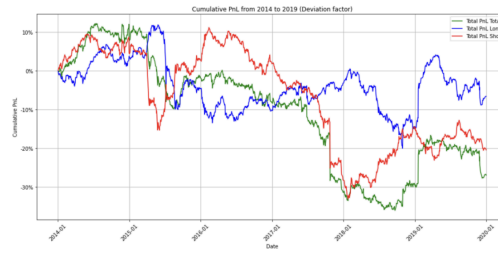


Figure 4. Cumulative PnL of the top 300 stocks in Hong Kong stock market value under deviation factor

After adjusting for UNIVERSE, the strategy had an overall cumulative return of -27.01%, with the largest retracement occurring on September 21, 2018, with an overall downward trend.

The long portion of the strategy had a cumulative return of -6.55%, with the largest retracement occurring on October 30, 2018, and the overall performance was dramatically oscillating.

The short portion of the strategy had a cumulative return of -20.46% with the maximum retracement occurring on January 24, 2018. The overall trend was downward, with several sharp swings during the period.

### 4.2.1.3. Performance table

Table 7. Performance statistics of the top 300 stocks in Hong Kong stock market value under deviation factor

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	-4.50%	9.88%	-0.46	-46.07%

The overall annualized return of the strategy is -4.5%, the long component has an annualized return of -1.09% and the short component is -3.41%. The information ratios of the three components are -0.47, -0.13 and -0.36 respectively, indicating low stability. The annualized volatility of the three components is 9.88%, 8.87% and 9.83%, respectively, which are all high in volatility and the strategy trades with high risk. The maximum retracements of the three components are -36.07%, -20.04%, and -33.14%, respectively, indicating that the strategy will trade with a large floating loss.

After the modification of UNIVERSE, the performance of the deviation factor strategy has improved, but it still shows a loss and there is still room for improvement [15].

## 4.2.2. Refinement 2 (multi-conditional deviation)

### 4.2.2.1. Description

Originally, the three factor scores were calculated by simply adding up the scores for each of the three factors, but this can lead to problems like this - when a stock has different scoring governments for the three factors, the buy and sell signals for that stock aren't as strong, but it still ties up capital, which can affect the final return. Therefore we try to add new stock selection conditions to the original trading strategy.

#### 4.2.2.2. Formulars

Original:

$$S = S_{RSI} + S_{CCI} + S_{VWAP}$$

Refinement:

$$S_{RE} = \begin{cases} S_{RSI} + S_{CCI} + S_{VWAP}, & S_{RSI} \geq 0 \text{ and } S_{CCI} \geq 0 \text{ and } S_{VWAP} \geq 0 \\ S_{RSI} + s_{CCI} + s_{VWAP}, & S_{RSI} \leq 0 \text{ and } S_{CCI} \leq 0 \text{ and } S_{VWAP} \leq 0 \\ 0, & \end{cases}$$

#### 4.2.2.3. Pnl graph

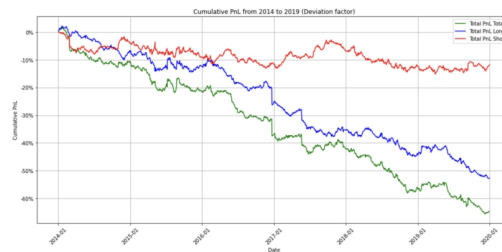


Figure 5. Cumulative PnL of the top 300 stocks in Hong Kong stock market value under multi-conditional deviation factor

#### 4.2.2.4. Performance table

Table 8. Performance statistics of the top 300 stocks in Hong Kong stock market value under multi-conditional deviation factor

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	-10.78%	6.38%	-1.69	-65.56%

The inclusion of the new stock selection condition resulted in a stronger performance of the originally losing strategy, so we believe that this condition can be used as a means to strengthen the performance of the strategy. There are other reasons for the losses.

#### 4.2.3. Refinement 3 (period of the alpha)

##### 4.2.3.1. Description

The trading logic of the deviation factor strategy is to trade long and short on selected stocks by determining the degree of deviation of the stock's real price from the average price and the short-term upward or downward trend. While the price deviation is greatly affected by the calculation period of the factor, at the same time, the deviation factor strategy is a short-term trading strategy. Therefore, we believe that too long a period will cause an error in the calculation of price deviation, and part of the loss of the initial strategy is caused by too long a period in the calculation of alpha.

We will improve the strategy by shortening the alpha calculation cycle from 21 days to 5 days.

In addition, we find that the use of logarithmic processing for the bias calculation of VWAP makes the impact of this alpha on the stock bias scores less pronounced relative to the other two alpha's. Since most of the stocks have RSI,CCI scores of 0, the position of such stocks all depends on the VWAP score. Therefor we will remove the logarithmic processing for this alpha to strengthen the impact of VWAP on the strategy.

#### 4.2.3.2. Formulars

Original:

$$S_{VWAP} = \text{sign}(VWAP - Close) \times \log\left(\frac{|VWAP - Close|}{VWAP}\right) + 1$$

Refinement:

$$S_{VWAP\_new} = \frac{VWAP - Close}{VWAP}$$

#### 4.2.3.3. Pnl graph

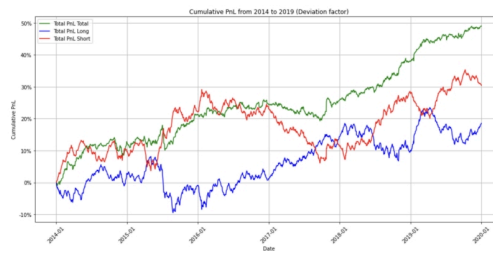


Figure 6. Cumulative pnl of the top 300 stocks in Hong Kong stock market value under multi-conditional deviation factor after modifying period of the alpha

#### 4.2.3.4. Performance table

Table 9. Performance statistics of the top 300 stocks in Hong Kong stock market value under multi-conditional deviation factor after modifying period of the alpha

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	8.16%	5.41%	1.51	-5.96%

After changing the indexing period and VWAP calculation methodology, the strategy return is positive and the overall cumulative return shows an upward trend. The cumulative return is 48.98% and the annualized volatility is 5.41%, indicating a low trading risk. The information ratio is 1.57, which indicates that the strategy is relatively stable, and the maximum retracement is -0.96%, which means that basically there will be no floating loss status, and the risk is extremely low.

## 4.2.4. Refinement 4 (the calculation of VWAP)

### 4.2.4.1. Description

In addition, we find that the use of logarithmic processing for the bias calculation of VWAP makes the impact of this alpha on the stock bias scores less pronounced relative to the other two alpha's. Since most of the stocks have RSI,CCI scores of 0, the position of such stocks all depends on the VWAP score. Therefore we will remove the logarithmic processing for this alpha to strengthen the impact of VWAP on the strategy.

### 4.2.4.2. Formulars

Original:

$$S_{VWAP} = \text{sign}(VWAP - Close) \times \log\left(\frac{|VWAP - Close|}{VWAP}\right)$$

Refinement:

$$S_{VWAP\_new} = \frac{VWAP - Close}{VWAP}$$

### 4.2.4.3. Pnl graph

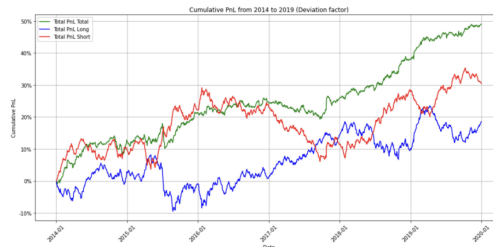


Figure 7. Cumulative pnl of the top 300 stocks in Hong Kong stock market value under multi-conditional deviation factor after modifying VWAP

The strategy's overall cumulative return in the sample set was 61.39%, with a smooth uptrend, small retracements, and basically no floating status during trading.

The long portion of the strategy had a cumulative return of 23.13% in the sample set, with a general upward trend in cumulative returns, but with significant volatility during the period.

The short portion of the strategy had a cumulative return of 38.28% in the sample set, with a general upward trend in cumulative returns, and the volatility was again significantly greater than the overall strategy, but the curve was smoother relative to the long portion. The short curve showed a sustained and larger increase in mid-2015 and mid-2018, probably because the Hong Kong Hang Seng Index experienced a large drop during that time period, making the short position consistently profitable.

#### 4.2.4.4. Performance table

Table 10. Performance statistics of the top 300 stocks in Hong Kong stock market value under multi-conditional deviation factor after modifying VWAP

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	10.23%	5.72%	1.79	-1.08%

The total return as 10.23%, the long portion was 3.86% and the short portion was 6.38%. The Total Information Ratio is 1.87, the Long Portion has an Information Ratio of 0.54 and the Short Portion has an Information Ratio of 0.92. The overall stability of the strategy is high relative to the Long or Short Portion. The overall annualized volatility was 5.7%, the long portion annualized volatility was 7.43% and the short portion annualized volatility was 7.13%. The overall risk of the strategy is significantly lower than the long-short unilateral component. In addition, the maximum retracements for the overall, long, and short portions are -1.08%, -7.12%, and -0.02%. This indicates that the strategy does not generate large floating losses during the trading period.

To summarize, long-short hedging is an outstanding contribution to the overall strategy in terms of improving stability and reducing risk.

## 5. Conclusion

### 5.1. Final selection

#### 5.1.1. Residual momentum

In the end, based on the data from the two alpha's we chose to dynamically update the universe's refinement from 2014-2024, and based on the high-frequency trading we chose to regress every 5 days and trade every day.

#### 5.1.2. Deviation factor

In the end, based on the data from the two alpha's we chose to dynamically update the universe's refinement from 2014-2024, and keep all of the refinement in refinement 4.

### 5.2. Out of sample

#### 5.2.1. Residual momentum

##### 5.2.1.1. Pnl graph

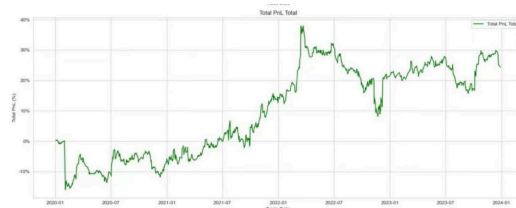


Figure 8. Cumulative pnl from 2020 to 2024 under residual momentum strategy

Through the back-test of the top 300 stocks in Hong Kong stocks by market value from January 2020 to January 2024, the overall income brought by the residual momentum strategy shows an upward trend, but there is a downward trend in 2020. In general, the overall volatility is obvious.

### 5.2.1.2. Performance table

Table 11. Performance statistics under residual momentum strategy from 2020 to 2024

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	12.21%	36.19%	0.34	17.8%

The strategy showed a clear upward trend from 2020 to 2022, while it began to fluctuate in the middle of 2022 and the total pnl declined. At the beginning of 2020, the COVID-19 epidemic had a great impact on the economy and affected the stability of the Hong Kong stock market. However, in the face of extreme situations, residual momentum strategy still captures the residual income of stocks and brings benefits.

### 5.2.2. Deviation factor

#### 5.2.2.1. Pnl graph

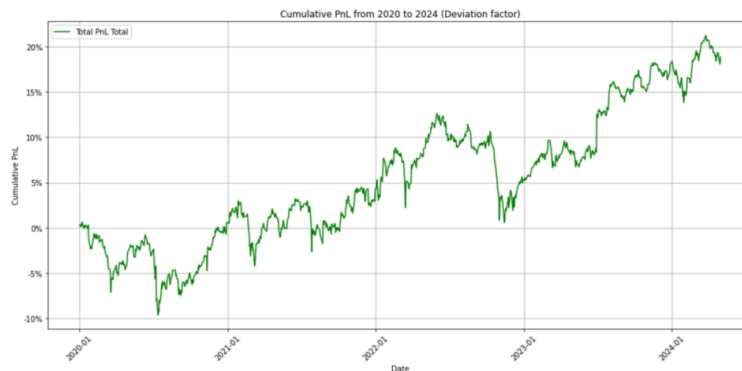


Figure 9. Cumulative pnl from 2020 to 2024 under deviation factor

#### 5.2.2.2. Performance table

Table 12. Performance statistics under deviation factor from 2020 to 2024

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	4.72%	8.61%	0.53	-11.6%

The deviation factor strategy tested relatively well in the test set with an overall upward trend in cumulative returns. The overall cumulative return is 18.88% and the annualized return is 4.72%, which is not as good as the strategy's total performance in the sample set, but it is still better. The annualized volatility is 8.61%, which is large and shows that the strategy has some risk. The information ratio is 0.53, indicating that the strategy is not stable enough. The maximum retracement is -9.6%, indicating that investors incur a small floating loss during the period of holding the position, which is within the acceptable range.

### 5.2.3. Residual momentum and deviation strategy

#### 5.2.3.1. Pnl graph

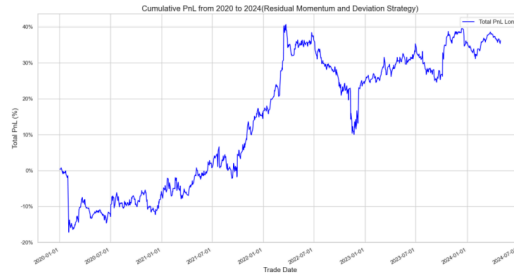


Figure 10. Cumulative pnl from 2020 to 2024

We add the daily\_pnl of the two strategies, average them, sum them, and output the final cumulative pnl. The reason for this is that both strategies decide whether to go long or short a stock when it shows a profitable signal, so combining them will help us to get more out of our stock picking and hedging process. The reason for this is that both strategies are based on the decision to go long or short a stock when there is a profitable signal.

#### 5.2.3.2. Performance table

Table 13. Performance statistics from 2020 to 2024

	Annualized Return	Annualized Volatility	Information Ratio	Max Drawdown
total	8.03%	40.12%	0.20	-30.02%

### 5.3. Trading recommendation

#### 5.3.1. Residual momentum

From the analysis, it is observed that the residual momentum strategy has nice results in annualized returns during the last out-of-sample period; however, the strategy comes with huge volatility that does not match the profile of the investment. From the high volatility detected, we can recommend further study and the execution of tougher measures to help in the reduction of this before the strategy can be considered for practical implementation.

#### 5.3.2. Deviation factor

The deviation factor strategy exhibits relatively satisfactory performance in both the in-sample and out-of-sample tests. However, it is important to note that this strategy is particularly suited for short-term trading. Long-term investors should exercise caution and consider adjusting the trading frequency to align with their investment horizon. Additionally, the strategy's inherent volatility is characteristic of short-term trading approaches, necessitating a careful assessment of the investor's risk tolerance before implementation.

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