Academic Education Publishing House

Economic Society and Humanities Vol. 1 No. 10, 2024

The Relationship Between the Influence of High-Frequency Trading and Excess Return

Rui Yu

Electronic University of Science &Technology of Hangzhou, Hangzhou, China

Abstract: However, the pursuit of excess returns is often accompanied by higher risks, so investors need to balance the relationship between risk and returns in the pursuit of excess returns.Therefore, this paper will take the difference between quantitative fund with high-frequency trading strategy and ETF fund without high-frequency trading as the core strategy as the entry point, study the level of excess return and the volatility of net return under the high-frequency trading mode, and take this as a bridge to study the link between high-frequency trading and excess return.

Keywords: Component; High-Frequency Trading; Excess Return; Beta; Fluctuation Ratio ; Sharp Ratio

1. Introduction

The impact relationship between high-frequency trading and excess returns is both a complex and volatile issue. This complexity mainly stems from the wide use of HFT and the diversity of factors affecting excess returns. Therefore, in order to deeply understand this issue, this paper will explore the relationship between HFT and excess returns from the perspective of arbitrage.

High-frequency trading, as an important trading mode in the financial market, is characterized by the use of high-speed computer systems and complex algorithms to perform transactions at an extremely high frequency, usually several times or even thousands of times per second. The emergence of this kind of trading method has had a great impact on the liquidity and efficiency of the market and the return of traders.In traditional investment methods, investment decisions often rely on subjective judgment, experience and market sentiment. This makes investment decisions vulnerable to personal emotions and irrational behaviors, leading to uncertainty in investment outcomes. In contrast, quantitative investment can reduce the subjectivity and improve the objectivity and scientificity of decision-making through large-scale data collection, mathematical models and computer algorithms.[1]

There are different estimates of the size of the HFT market due to data sources and statistical caliber issues, but these data are shown its rapid development trend. In 2009, the SEC data showed that the average daily trading volume of high-frequency trading in the U. S. securities markets accounted for more than 50% of the total average daily trading volume. TABB Group Data showed that the share of high-frequency trading volumes in the U. S. stock market has risen from 21% in 2005 to 61% in 2009, with 47 percent being market-making and carry trades.

The Chicago Mercantile Exchange (CME) earnings report for the fourth quarter of 2009 showed 43% of trading on the futures market belongs to high-frequency trading.

According to EBS (electronic broking system), high-frequency trading accounts for between 60% and 80% in the foreign exchange market, depending on the currency. The Boston Consulting Group (BCG) forecasts that high-frequency trading in both Europe and the US will reach more than 60 percent, while Asia will also exceed 20 percent.[2]

First, high-frequency traders are able to leverage market volatility more effectively by quickly capturing market opportunities, executing transactions, and adjusting their strategies, with the potential to reap excess returns. High-frequency traders often have advanced trading technology, rich market experience and strong data processing capabilities, which enable them to make more accurate trading decisions in a short period of time, and then achieve higher profitability.

Besides, the impact of HF trading on the market is also multifaceted. On the one hand, HFT increases the liquidity and efficiency of the market, providing more trading opportunities and a closer price discovery mechanism for the market. On the other hand, high-frequency

trading may also increase market volatility and instability, and even lead to misconduct such as market manipulation. These market effects can also act indirectly on HF traders' returns.

To sum up, there is a certain positive correlation between HFT and excess return, but this relationship is not absolute. HF frequency traders need to constantly adapt to market changes, improve trading technology and risk management ability, in order to obtain stable excess returns in the fierce market competition. At the same time, regulators also need to strengthen the supervision of high-frequency trading to ensure the fairness, justice and stability of the market.

Excess return refers to the return of investors through investment activities above the market average or a specific benchmark index. It is an important indicator of investment performance, reflecting investors' ability to pick stock, market timing or the effectiveness of asset allocation strategies. Excess returns are usually calculated using the actual return of the portfolio minus the risk-free return or the return of the market benchmark index. For example, if the market benchmark index has an annualized return of 5% and an investor's portfolio of 8%, the investor gets an excess return of 3%. The higher the excess return, the more successful the investment strategy, the stronger the management ability of investors. However, the pursuit of excess returns is often accompanied by higher risks, so investors need to balance the relationship between risk and returns in the pursuit of excess returns.Therefore, this paper will take the difference between quantitative fund with high-frequency trading strategy and ETF fund without high-frequency trading as the core strategy as the entry point, study the level of excess return and the volatility of net return under the high-frequency trading mode, and take this as a bridge to study the link between high-frequency trading and excess return.

2. The Source of Data and Its Processing Technique

2.1 Data Sources

The main goal of this paper is to explore the relationship between HFT strategies and excess returns in order to reveal whether there is a significant correlation between the two. In order to achieve this goal, I plan to select three groups of different types of fund income data for in-depth analysis and comparison. First, I will select a group of quantitative investment funds, which usually use complex high-frequency trading strategies in order to obtain excess returns. Second, I will select a set of data from ETF funds, which usually develop investment strategies based on the share composition of the index, and high-frequency trading does not become dominant in the investment process.

The source of the data I chose is the fund database of China Private Equity Network, which has a cooperative relationship with the vast majority of Chinese private equity funds on a commission basis, so it can ensure that the information disclosure in the station fully meets the regulatory requirements. The database of this website will be updated at 9:00 every working day, and the data will be updated in real time during the opening of the stock market. Therefore, so I believe that the data of this website is the latest and comprehensive.

For some of the websites with missing data due to various completely random factors, maximum likelihood estimation will be used for data completion in this study. Because of the large number of data and large sample size in this study, there is no need to worry too much about the local extreme value when using this method.

Through the detailed analysis and comparison of these two sets of fund return data, the researchers hope to reveal the impact of high-frequency trading strategies on the excess return in different types of funds. In addition, the researchers also expect to provide investors and fund managers with a reference for the effectiveness of HFT strategies through this empirical study.

In terms of data collection, this study relies on the data provided by the "private platoon net" as the basis of the research. The platform provides a wealth of fund return data, covering different types of funds, including quantitative investment funds and ETF funds. By using these data, the investigators can ensure the accuracy and reliability of the analysis results. This study will rigorously screen and clean the data, excluding funds with significant missing data to ensure that the data used are of high quality and representative, thus providing a solid foundation for subsequent empirical analysis.

2.2 The Yield Processing

For further analysis, the original data needs to be sorted out to obtain the yield rate of different

funds in the past three years. There are usually two ways to deal with the yield rate. (In the following formula, R_e represents the excess yield rate, r_f represents the fund yield rate directly quoted from the raw data, r represents the yield rate derived from the raw market data)

The first one is the geometric average yield rate: $R_e = \frac{r_f + 1}{(r+1)-1}$ .Geometric average return is a method of calculating the average return of long-term investments that takes into account the compound interest effect of each yield during the investment period. This can more accurately reflect the compound effect. The geometric average yield takes into account the compound effect of the return of each issue, that is, the yield of each issue affects the return of the subsequent period. This means that the geometric average yield rate better reflects the compound interest growth in the actual investment process. At the same time, the geometric average yield rate is not affected by extreme values (such as very high single-period returns or very low single-period returns). Even if the yield is very high or very low in some years, the geometric average yield can still give a relatively stable result. Reflecting the actual wealth growth situation The geometric average yield reflects the growth of investors' real wealth, because the return of each issue affects the total asset value. This is different from the arithmetic average yield, which simply adds up the returns of each period and divides them by the number of periods, ignoring the compound interest effect. All in all, geometric average yield is very useful in the risk assessment. The geometric average yield is a better reflection of the long-term risk characteristics of the portfolio.

The second is the arithmetic average yield rate: $R_e = r_f - r$ .The arithmetic average return rate is another method of calculating the return rate on investment. It calculates the average return rate by simply adding the return rate of each period and dividing it by the number of periods. While the geometric mean yield is more appropriate in some cases, the arithmetic mean yield also has its unique advantages. First, the arithmetic average yield is simple by adding the yield of each period and dividing by the number of periods. This simple calculation method makes the arithmetic mean yield easy to understand and calculate, without requiring complicated mathematical operations. Second, the arithmetic mean yield can reflect the intermediate return, which may be useful for some types of analysis. For example, arithmetic average yields can provide a quick overview of evaluating investment performance in the short term or conducting short-term performance monitoring. In addition, it is also convenient for statistical analysis, such as calculating the standard deviation, variance and other statistics. This is very useful for assessing the risk properties of the portfolio.

Finally, in some financial models, such as the capital asset pricing model (CAPM), the arithmetic mean rate of return is sometimes used as an input variable to estimate the expected rate of return. This is because the arithmetic mean yield can provide an estimate of the historical rate of return.

Table 1. Quantitative Fund

Number	Name of fund company	Excess returns in the recent three years (geometry)	Excess returns in the recent three years (arithmetic)
Fund01	Jin Ge Liang Rui	33.51%	24.12%
Fund02	Ming Rui Deng Feng	29.85%	33.00%
Fund03	Ming Rui Song Bo	79.62%	109.17%
Fund04	Qian Hai Qua Ke	169.57%	100.47%
Fund05	Yun Lian Zhi Rong	113.82%	125.94%
Fund06	Bei Jing Jin Yu	110.74%	64.24%
Fund07	Hai Nan Jin Hua Lun	27.72%	16.07%
Fund08	Guang Dong Zhen Yuan	11.87%	9.01%
Fund09	Shang Hai Xiang Sheng	5.41%	32.20%
Fuan10	Long Qi Technology	150.28%	87.14%

Table 2. ETF Fund

Number	Name of fund company	Excess returns in the recent three years (geometry)	Excess returns in the recent three years (arithmetic)
Fund01	Galaxy fund	2.41%	2.56%
Fund02	Manulife fund	2.53%	2.70%

Fund03	Hua Run Yuan Da	1.26%	1.35%
Fund04	Jin Xin Fund	-0.60%	-0.68%
Fund05	Xinjiang Qianhai United	4.62%	4.92%
Fund06	Changsheng Fund	1.12%	1.24%
Fund07	Dong Fang Fund	10.98%	11.65%
Fund08	Merchants fund	4.22%	4.50%
Fund09	Great Wall fund	-6.19%	-6.68%
Fuan10	Tian Hong Fund	-4.33%	-4.62%

Table 3. Statistical Characteristics of the Quantitative Funds

Number	Beta	Annual Fluctuation Rate	Sharp Ratio
Fund01	0.92	21.4%	-0.53
Fund02	-1.85	103.08%	1.05
Fund03	2.32	29.67%	0.51
Fund04	1.12	28.35%	0.73
Fund05	1.38	21.66%	1.95
Fund06	0.63	21.64%	1.17
Fund07	1.45	22.63%	0.02
Fund08	0.87	27.47%	-1.02
Fund09	1.99	34.83%	1.17
Fuan10	-0.12	4.81%	0.81

Table 4. Statistical Characteristics of the ETF Fund

Number	Beta	Annual Fluctuation Rate	Sharp Ratio
Fund01	0.65	0.99%	2.19
Fund02	0.34	0.59%	3.53
Fund03	0.31	0.53%	2.91
Fund04	0.41	0.71%	1.64
Fund05	1.03	1.57%	2.61
Fund06	0.58	1.52%	1.98
Fund07	0.25	0.48%	11.08
Fund08	-2.27	13.08%	-1.06
Fund09	0.35	0.66%	1.23
Fuan10	0.05	3.04%	-0.32

3. Summary of the Sample Fund Data

According to the original data of the fund provided by the private placement network, we can conduct a more in-depth analysis to explore the risk level, volatility and the cost performance of the fund. Through careful look at the detailed calculation results in Table 2.1 and Table 2.2, it is not difficult to find that the annual average annual return of quantitative funds is significantly higher than that of FTE funds. However, the gap between the highest and the lowest yield value of quantitative funds is even more than 140%, indicating that ETF funds have a relatively lower risk assessment compared to quantitative funds. In addition, the beta range of these bond funds is also significantly smaller than the beta range of quantitative funds. This phenomenon suggests that, despite the higher returns of quantitative funds, the associated risks of quantitative funds are also relatively large. In addition, since the funds we selected have been running for more than three years, there is an inevitable survivor bias. As a result, in actual investment decisions, quantitative funds will actually face higher risks.

Through a careful review of the annualized volatility data shown in the table, we can clearly observe the relatively large yield fluctuations of quantitative funds over a one-year period. The main reason behind this volatility is that quantitative funds use high-frequency trading strategies, which rely on complex algorithms and technologies to manage and optimize their portfolios. The core goal of these strategies is to pursue higher returns on investment, but in the process of pursuing high returns, they also inevitably bring higher levels of risk.

Further, quantitative funds may use the leverage effect in the process of operation, that is, by borrowing funds to amplify the investment effect. While leverage can significantly increase investment returns when the market is performing well, at the same time, leverage can multiply the losses, further increasing the volatility of the net value of the fund. In addition, quantitative funds are well known for their ability to respond quickly to market changes. In the event of drastic market fluctuations or major events, quantitative funds can quickly adjust their investment portfolios, and this rapid adjustment behavior will also lead to large fluctuations in the net value of the fund.[3]

It is worth noting that most quantitative funds currently use multi-factor models to assist their investment decision-making process. These multifactor models usually involve numerous input variables, including but not limited to various financial indicators, macroeconomic data, and other relevant market data. Therefore, when the market environment or economic conditions change, the output results of these models will be adjusted accordingly, thus affecting the overall performance of quantitative funds and the yield fluctuations of quantitative

funds.[4]

Based on the data provided in Table 3.1 and Table 3.2, we can clearly see the excess returns brought by each fund at the unit risk level, which actually reflects the cost performance of the portfolio. As an important measure, the Sharpe ratio visually demonstrates the excess return per unit of risk. In other words, the Sharpe ratio reveals the relative level of return that different funds can bring when taking the same risk. This indicator not only helps the investors to evaluate the performance of the fund, but also reflects the investment strategy and risk management ability of the fund managers to a certain extent. Therefore, the Sharpe ratio is one of the indicators that investors pay the most attention to and value when deciding whether to invest in a fund. Through the in-depth analysis of this indicator, investors can better understand the relationship between the risk and return of each fund, and thus make more informed investment decisions.

According to the basic data on the website, we can also see that high-frequency trading has brought unprecedented liquidity to the market. Between 2021 and 2024, we can intuitively see that the average daily trading volume of each fund is extremely high, indicating that tens of thousands of trading orders can be executed in a very short period of time, which not only cover a wide range of asset classes, but also across different exchanges and time zones. This efficient trading mechanism ensures that the market has enough buyers and sellers at any time, maintaining the liquidity of the market. With good market expectations, high-frequency traders would buy heavily to increase their positions, which would push up market prices even further. But when market expectations turn around, they will sell quickly to reduce their holdings, which in turn leads to a sharp drop in market prices. This big buying and selling behavior, dominated by high-frequency traders, allows the market to experience sharp fluctuations in a short period of time. These fluctuations will undoubtedly increase the risk of the market, and may also threaten the stability of the market.

To more intuitively understand the impact of HFT on market volatility, we can cite some data from empirical studies. According to a research report by a well-known financial institution, the daily volatility of major stock index markets around the world has generally rose since the rise of high-frequency trading. Especially when the market is hit by major news or events, the rapid response of high-frequency traders often exacerbates the market panic and further amplify the volatility. In addition, some scholars have found a significant correlation between the trading behavior of high-frequency traders and the extreme market fluctuations through empirical analysis.[5]

To sum up, the impact of HFT on the market is complex and multifaceted. It has both brought unprecedented liquidity to the market and increased its volatility to some extent. Therefore, we need to take a comprehensive view of the role and impact of HFT, not only to make full use of its advantages to promote the development and improvement of the market, but also to pay close attention to the risks and challenges it may bring.

4. Conclusion and Future Research Directions

4.1 Conclusion

High-frequency trading can give investors higher return potential because it can capture small price differences in the market and quickly buy and sell operations to achieve profit. However, high-frequency trading is also accompanied by a higher risk. This is because HFT relies on extremely fast execution speeds, and any small fluctuations in the market can have a significant impact on trading results. For example, factors such as market fluctuations, technical failures, or changes in regulatory policy may all quickly affect trading results, thereby increasing the likelihood of losses. In addition, the complexity of high-frequency trading also requires investors to have high technical knowledge and coping ability to deal with various possible emergencies.

Therefore, investors must, in the pursuit of high-frequency trading brings high returns, have a full understanding of the potential risks, and take the corresponding risk management measures. This includes, but is not limited to: establishing strict risk management mechanisms to ensure the stability and reliability of the trading system, and the continuous monitoring of market dynamics and changes in regulatory policies. Only when fully understood and prepared, can investors achieve solid returns in high-frequency trading.

4.2 Future Research Direction

The future academic research in the field of HFT can explore the following valuable directions:

Firstly, in-depth study of the impact of HFT on market microstructure. Further study the impact of HFT on market microstructure, including order book depth, trading mechanism, market liquidity and market transparency; through a deeper understanding of how HFT changes the existing market microstructure, we can improve the regulatory policies for HFT and improve market efficiency. In particular, it analyzes and studies how HF affects extreme market risk, including the impact on systemic risk, market volatility and market collapse and preventive measures, focusing on the performance of HF in extreme market conditions and the impact on the overall system stability.[6]

Second, the cross-cutting study of high-frequency trading and other disciplines. For example, how HFT integrates with basic mathematical theory, life sciences, bioinformatics, physics, fluid mechanics, psychology, cognitive neuroscience and other disciplines in order to obtain a more comprehensive research perspective. In particular, in-depth research on the application of machine learning and artificial intelligence technology in high-frequency trading, including deep learning, reinforcement learning, natural language processing, speech signal recognition, etc., which helps to improve the prediction ability, adaptability and intelligence of trading systems and regulatory systems.

References

[1] Zheng Kelu, and I. N. Sneddon, An Empirical Study on Measurement and Prevention of Volatility Risk of Quantitative Investment Funds in China, May, 2023.

[2] Lai Shengqiang, Trading Strategy in High Frequency Financial Data and Volatility Analysis, April, 2009.

[3] Hu Tianfu, Application analysis of high frequency trading (HFT) in Chinese securities market, November, 2012.

[4] Qi Congshan, Zhao Li, and Hang Hang, Basic quantitative investment theory and technology system based on the multi-factor model, Modern Business Trade Industry 13,2024, pp.127~129, 2024.

[5] Hu Jun, The Analysis about Effect of High-Frequency Trading on The Stock Index Futures Market, December, 2024.

[6] Li Lu, Zhang Yugui, He Yuqian, High-frequency trading: status quo, theory and regulation, Insurance Studies, NO.7, pp.3~17, 2024