Research Progress of Algorithmic Trading at Home and Abroad

Wei Gao [a*], *Ruzhen Yan* [b], *Xu Wu* [b]
[a] Sichuan Agriculture University, Chengdu 611830, China
[b] Chengdu University of Technology, Chengdu 610059, China
[*]Corresponding author: Wei Gao, E-mail: gaow956@163.com

Abstract
In recent years, many institutional investors use algorithmic trading to complete their investment decisions. This method reduces the transaction costs, improves the investment return. Algorithmic trading is a new transaction mode. This paper introduces the algorithmic trading and the development process, presents the development process of transactions costs, reviews the latest research literatures of algorithmic trading strategy, and introduces the literatures of investment portfolio selection. Based on the present research and the current situation of algorithmic trading in our country, this paper develops the application and suggestion for algorithmic trading.
Key words: *algorithmic trading; quantitative investment; transaction costs; portfolio; algorithmic trading strategies*

1 Introduction

Since the 1970s, the quantitative investment has been developed by many institutional investors, such as pension funds and hedge funds. Many large securities companies develop corresponding algorithm trading system with the characteristics of their own, and the proportion of the application of the algorithm is gradually increasing, such as Credit Suisse, Stream Base, Thomson Reuters, Progress Software. According to the relevant statistics of the Aite Company, 63% of the transaction amount is completed using the algorithm on the U.S. stock market in 2011, while this this proportion is 63% on the Asian stock market. Compared with the developed countries in Europe and America, the development of algorithms in the Asian securities market is slightly lagging.

With the rapid development of computer and communication technology, and the quantitative methods in the domestic popularity, many institutional investors have been the algorithmic trading as an important source of improve their rapid development[1]. However, there are some problems about the research and application of algorithmic trading in our country. Therefore, the theory and application of the algorithmic trading in our country and research need to be further improved and perfected.

The key of algorithmic trading is the algorithm trading strategy, which is the standard of the transaction costs. The outline of this paper is as follows. Section II provides an overview of the algorithmic trading. Section III analyses the research of transaction cost. Section IV develops algorithmic trading strategy. Section V concludes.

2 An overview of the algorithmic trading

In the securities market, liquidity is limited affected by many factors. If investors trade large orders in a short time, then the stock prices will be caused large change of stock price. So the investors can hardly complete the transaction according to the expected price[2]. In order to

Copyright © 2016, the Authors. Published by Atlantis Press.
This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

reduce the transaction costs, investors urgently need a kind of low cost and high speed of effective trading methods. So, algorithmic trading is produced in this background.

There is not academia and industry consensus about the definition of algorithmic trading at present[3,4]. Domowitz and Yegerman[5] indicate that algorithmic trading is a trading method, which completes the order trading. Further, algorithmic trading is not only the order submission and implementation, it also defines as the use of computer algorithms to automatically make certain trading decisions, submits orders, and manages those orders after submission[6,7]. Algorithmic trading orders not only need the trading strategies, also includes the investor's portfolio selection problem. This paper argues that algorithmic trading is a method of implementing portfolio trading to automatically determine the size of the order, the timing, price, type(Fig. 1).

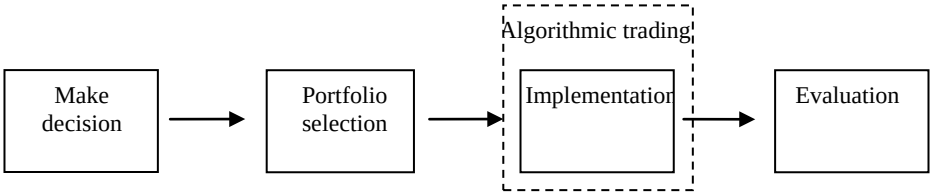

Fig. 1 – Algorithmic trading in the investment

Compared with the traditional trading methods, the advantage of algorithmic trading is cost and speed. First of all, algorithmic trading splits big orders into many small orders, and effectively reduces the price impact of the orders; Second, the algorithmic trading avoids the human irrational factors, and reduces the labour cost; Finally, the operation speed of algorithm is obviously faster than others methods.

3 Transaction cost

The key of algorithmic trading is to reduce transaction costs in the trading process of investors. The standard of algorithmic trading strategy depends on the transaction cost. If transaction cost is smaller, then this strategy would be better for investors. The financial market has sufficient liquidity based on the traditional investment theory, which can supply the demand of any investors. Therefore, the investors can quickly trade any order size. In fact, the liquidity cost of the orders is very large in the short term liquidity shortage[8-10]. Therefore, the research and control of transaction costs is very important.

Transaction costs is all the fee occurred in the trading process, mainly included fees, taxes and fees, market impact, opportunity cost, delay cost, price rise quantity, timing risk[11,12]. The transaction costs can be divided into explicit trading costs and implicit costs. Implicit transaction cost is the main component part of the total transaction cost. Research on implicit transaction cost is particularly important for investors[13]. Based on the framework of rational expectations hypothesis, Kyle[14] develops that the changes of volume and stock price is a significant linear relationship. Glostern and Harris[15] improve the Kyle (1985) model, the trading direction is analysed. Further, Lillo et al.[16] develop a market impact function, and present a positive correlation between volume and stock price change. In addition, there are other factors that research on the securities market impact[17-22]. In fact, the market impact is one of the most costly transaction cost components and always causes adverse price movement. It represents movement in stock price caused by particular trades or orders[23,24].

Market impact is the difference between the stock price trajectory with the order and what the price trajectory would have been had the order not been submitted to the market. Obviously, the investor cannot simultaneously measure these two occurrences. Berkowitz and Logue[25], Kogan[26], Blum et al.[27], Domowitz[28] and other scholars such as using a benchmark price instead of the stock market does not exist on this order, and the benchmark price (volume weighted average price, yesterday's closing price, trading days; the highest and the lowest average trading price, the lowest price, the opening and closing price of the average) measured by the difference between the price impact. Some scholars believe that this difference is due to measure methods[29-32].

4 Algorithmic trading strategies

VWAP trading strategy is an implementation strategy where traders participate with market volume in the attempt to achieve an average execution price equal to the VWAP benchmark price. The main purpose of algorithmic trading is to reduce the transaction costs of investors. If stock price is a random variable, and the market impact is a linear function, then Almgren and Chriss[33] develop an optimal trading strategy for investors. Konishi[34] presents a static optimal trading strategies, the trading strategy is according to complete all transactions order VWAP benchmark prices. Zhong et al.[35] present an algorithm of the optimal trading strategies. Kissell et al.[36], Kissell and Malamut[37] consider the market impact and timing risk impact on investors' optimal trading strategy, and use the Markowitz[38] mean-variance model to construct the specific trading strategy model. Further, Monch[39], Lin Hui[40] respectively analyse the transaction cost, develop the algorithmic trading model, present the corresponding optimal algorithm trading strategies.

Algorithmic trading strategy depends on size of order, stock volatility, order type, order trading speed, experience, investors hardware facilities[41,42]. In this case, investors urgently need the dynamic adjusted algorithmic trading strategy. Bialkowski et al.[43], Humphery-Jenner[44] present a dynamic model to predict future market trading volume, improve the traditional VWAP trading strategies. From the perspective of demand and supply of liquidity, Obizhaeva and Wang[45] develop a limit order book model based on liquidity algorithmic trading, and present the corresponding optimal algorithm trading strategies.

5 Conclusion

Over the past decade, the financial market has witnessed an explosion of algorithmic trading strategy which can efficiently cut down transaction cost and allow traders to control their own trading processes. Since only traders who try to reduce transaction cost can make a higher return, they should not only consider how to capture the optimal opportunity for trading, but pay much attention to how to reduce transaction cost as well.

This paper introduces market impact, opportunity cost, and timing risk for a trading strategy, describes the algorithm trading strategy mainly related research progress of the transaction costs, introduces the algorithm of trading of the securities market and investors portfolio selection.

Acknowledgements

This paper is supported by the Key Projects of Educational Commission of Sichuan Province of China (13ZA0140), the Program of Undergraduate Thesis Foster of Sichuan Agriculture University (34009114), and the National Natural Science Foundation of China (Grant No. 71501018).

References

1. *M. Cheng*, The rise of algorithmic trading and the latest research progress, Securities Market Herald, 9 (2013) 11-17.
2. *S. Chakravart.* Stealth-trading: Which traders trades move stock prices? Journal of Financial Economics, 61(2001) 289-307.
3. *I. Aldridge*. High-frequency trading: A Practical guide to algorithmic strategies and trading systems. Wiley, 2009.
4. *T. Liu, T. Lu.* Algorithmic trading and the prospect of its application in Chinas capital market. Shanghai Finance, 1 (2012) 24-27+116.
5. *I. Domowitz, H. Yegerman.* The cost of algorithmic trading: A first look at comparative performance. Trading, 1 (2005) 30-40.
6. *T. Hendershott, M. C. Jones, J. A.* Menkveld. Does algorithmic trading improve liquidity? The Journal of Finance, 66 (2011) 1-33.
7. *T. Liu, Y. Wu.* The problems of stock market liquidity in China. Shanghai Finance, 3 (2008) 57-60.
8. *J. Hasbrouck*. Empirical market microstructure: the institutions, economics, and econometrics of securities trading. Oxford University Press, 2007.
9. *M. Flood.* Microstructure theory and foreign exchange market. Federal Reserve Bank of St. Louis, 73 (1991) 52-70.
10. *S. M. Zhao.* Algorithmic trading and arbitrage. Xiamen University Press, 2010.
11. *R. Ferstenberg.* Optimal execution strategies. Berkeley Program in Finance Conference, 4 (2000) 42-49.
12. *W. H. Wagner, M. Edwards.* Best execution. Financial Analysts Journal, 2 (1993) 65-71.
13. *C. Florackis, A. Gregoriou, A. Kostakis.* Trading frequency and asset pricing on the London Stock Exchange: Evidence from a new price impact ratio. Journal of Banking & Finance, 35(2011) 3335-3350.
14. *A. S. Kyle.* Continuous auctions and insider trading. Econometrica, 53(1985) 1315-1335.
15. *L. R. Glosten, L. E. Harris.* Estimating the components of the bid/ask spread. Journal of Financial Economics, 21 (1988) 123-142.
16. *F. Lillo, J. D. Farmer, R. N. Mantegna.* Econophysics: Master curve for price-impact function. Nature, 69 (2003) 129-129.
17. *D. Sornette, D. Stauffer, H. Takayasu.* Market fluctuations II: Multiplicative and percolation models, size effects, and predictions. The Science of Disasters, Springer, 2002.
18. *S. Chen, S. F. Li, C. G. Li.* Stock price response to order imbalance and change of volume. Journal of Management Sciences in China, 9 (2010) 68-75.

19. *A. A. Alzahrani, A. Gregoriou, R. Hudson.* Price impact of block trades in the Saudi stock market. Journal of International Financial Markets, Institutions and Money, 23 (2012) 322-341.
20. *M. Scholtus, D.Van, B. Frijns.* Speed, algorithmic trading, and market quality around macroeconomic news announcements. Journal of Banking & Finance, 38 (2014) 89-105.
21. *J. P. O'Brien, P. David, T. Yoshikawa, et al.* How capital structure influences diversification performance: A transaction cost perspective. Strategic Management Journal, 35(2014) 1013-1031.
22. *J. Chen, L. Feng, J. Peng.* Optimal deleveraging with nonlinear temporary price impact. European Journal of Operational Research, 244 (2015) 240-247.
23. *R. Kissell, M. Glantz.* Optimal trading strategies quantitative approaches for managing market impact and trading risk. Amacom, 2003.
24. *D. B. Keim, A. Madhavan.* Transactions costs and investment style: an inter-exchange analysis of institutional equity trades. Journal of Financial Economics, 46 (1997) 265-292.
25. *S. A. Berkowitz, D. E. Logue, E. A. Noser.* The Total cost of transactions on the NYSE. The Journal of Finance, 43 (1988) 97-112.
26. *L. Kogan, S. A. Ross, J. Wang, et al.* The price impact and survival of irrational traders. The Journal of Finance, 61 (2006) 195-229.
27. *G. A. Blum, W. A. Kracaw, W. G. Lewellen.* Determinants of the execution costs of common stock trades by individual investors. Journal of Financial Research, 9 (1986) 291-301.
28. *I. Domowitz, J. Glen, A. Madhavan.* Liquidity, volatility and equity trading costs across countries and over time. International Finance, 4 (2001) 221-255.
29. *G. Hu.* Measures of implicit trading costs and buy-sell asymmetry. Journal of Financial Markets, 12 (2009) 418-437.
30. *D. Ryu.* Price impact asymmetry of futures trades: Trade direction and trade Size. Emerging Markets Review, 2012.
31. *A. A. Alzahrani, A. Gregoriou, R. Hudson.* Can market frictions really explain the price impact asymmetry of block trades? Evidence from the Saudi stock market. Emerging Markets Review, 2012.
32. *C. Hopman.* Do supply and demand drive stock prices? Quantitative Finance, 7 (2007) 37-53.
33. *R. Almgren, N. Chriss.* Optimal execution of portfolio transactions. Journal of Risk, 3 (2001) 5-40.
34. *H. Konishi, N. Makimoto.* Optimal slice of a block trade. Journal of Risk, 3 (2001) 33-51.
35. *L. M. Zhong, H. L. Liu, C. F. Wu.* Institution investor's optimal liquid strategy. Journal of Management Sciences in China, 5 (2002) 18-22.
36. *R. Kissell, M. Glantz, R. Malamut.* A practical framework for estimating transaction costs and developing optimal trading strategies to achieve best execution. Finance Research Letters, 1 (2004) 35-46.

37. *R. Kissell, H. Liet.* U.S. exchange auction trends: Recent opening and closing auction behavior, and the implication order management strategies. The Journal of Trading, 6(2011) 10-30.
38. *H. Markowitz.* Portfolio Selection. The Journal of Finance, 7 (1952) 77-91.
39. *B. Mönch.* Liquidating large security positions strategically: a pragmatic and empirical approach. Financial Markets & Portfolio Management, 23 (2009) 157-186.
40. *H. Lin, D. X. Zhang, H. Yang, Y. Ding.* Study on liquidity-adjusted optimal trading strategy model. Journal of Management Sciences in China, 14 (2011) 65-76.
41. *R. Almgren, J. Lorenz.* Adaptive arrival price. Trading, 2 (2007) 59-66.
42. *D. Cuoco, H. He, S. Isaenko.* Optimal dynamic trading strategies with risk limits[J]. Operations Research, 56 (2008) 358-368.
43. *J. Białkowski, S. Darolles, G. L.* Fol. Improving VWAP strategies: A dynamic volume approach. Journal of Banking & Finance, 32 (2008) 1709-1722.
44. *J. Humphery.* Optimal VWAP trading under noisy conditions. Journal of Banking & Finance, 35 (2011) 2319-2329.
45. *A. A. Obizhaeva, J.* Wang. Optimal trading strategy and supply/demand dynamics. Journal of Financial Markets, 16(2013) 1-32.