

Application and Improvement of
“Greenblatt Magic Formula”
in A Share Market Value Investing

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Abstract

Value investing originated in the United States nearly 100 years ago. During nearly a century of development, Graham's followers continuously optimized his idea and achieved remarkable results in the market. However, due to complex and highly specialized selection process, the popularity of value investing among ordinary investors is still very low. It was not until Greenblatt, known as the God of Wall Street, first came up with the Magic Formula that value investing came to the attention of the common investor.

In China, the situation is the same. Therefore, in order to truly promote value investing effectively in China, this paper takes the "Magic Formula" as the main body to explore the application status and improvement orientation of value investing represented by the magic formula in **A-Share Market**^①. Firstly, this paper selects a branch of shares in A-Share Market according to the economic significance of the original formula, and verifies the applicability of the original magic formula in China. The second is the research on the corresponding buying strategy. Finding the most appropriate buying time and holding period allows us to maximize the profit. Finally, due to the differences between accounting standards of China and America, it is really hard for common investors in China to build the factors we need to use in this formula. In order to solve this problem, this paper will look for the most simple and accessible financial index combination such as PEG, ROE combination or PEG, ROA combination, carry out multiple linear regression model construction and optimization, and follow the original magic formula ideas to create "Chinese Version of Magic Formula" and discuss its feasibility.

Key Words

Magic Formula, Value Investing, Joel Greenblatt, A-Share Market

① A-Share Market: The name of a market that lists all stocks in Shanghai Security Exchange Market and Shenzhen Security Exchange Market. (Not include STAR MARKET)

1. Introduction

1.1 Value Investing and Magic Formula

Value Investing is a way to look for undervalued securities, to hold them for the long term, and to make profit using the principle that the price of the stock will return to its "Intrinsic Value". This concept was put forward nearly 100 years ago by Benjamin Graham (1934), who is known as "Father of Investment". With the development over a century, different people explained this theory from totally different perspectives.

Graham first pointed out in *Security Analysis* that "A trained rational investor looks for a stock that sells for less than its intrinsic value, and then waits for the market to discover and correct it. As a result, share price will eventually rise. Once the price reaches the real value of, it is time to sell the stock and reinvest the profits in another security that is undervalued by the market." This discussion makes clear that the essence of value investing is to find a "good price", that is, the undervalued price, laying a good foundation for the development of value investing theory in the future.

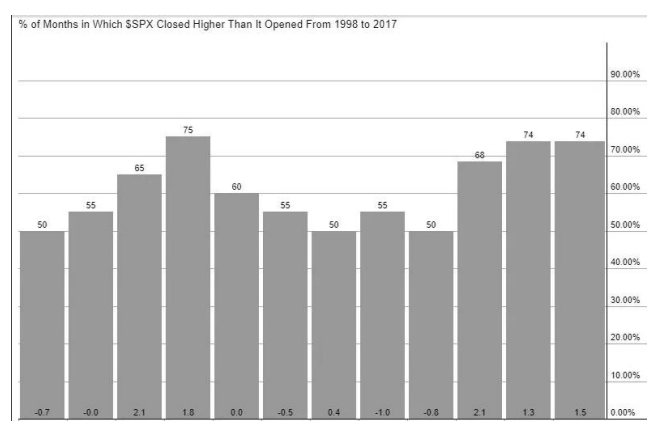
Later, Fisher (Philip Fisher, 1957) proposed a number of value investing criteria related to the company itself, such as the growth potential, the size of the company, the quality and relationship of internal employees, taking into account the situation of the company. In short, based on his value investing philosophy, the criteria for choosing a stock is "good company". As a follower of Fisher, "Stock God" Warren Buffett (2004) also believed that "Only good companies that buy stocks with clear and understandable business, continuous excellent performance, development plan, and a group of strong managers who can consider the interests of shareholders can actually obtain benefits." He proved the importance of investing in "good companies" once again, which is why he has held on to such industry champions as General Motors and Coca-Cola for 20 years.

In China, with the return of Hong Kong and Macao to Mainland China, the economy started to grow rapidly and value investing began to attract attention. Over the last 20 years, domestic scholars have conducted a lot of researches on its effectiveness in the A-Share Market. At the beginning of the introduction, Youqun Sun et al. (2002) compared the situation of Chinese economy and listed enterprises with those of mature markets in Europe and the United States, and made a judgment on the effectiveness of value investing. Jingwei Lin (2004) made an empirical study by studying the relationship between stock price and fundamentals, and found that the basic support of stock price increased over time, further emphasizing the importance of value investment. By 2006, Chenggang Xu confirmed this conclusion by analyzing the relationship between P/E, P/B and many financial indicators and stock returns. After the global financial crisis, Jing Wang (2009) divided stocks into two groups - value stocks and growth stocks, eliminating people's doubts on the effectiveness of value investment in the crisis by comparing the yield with the average market yield. Finally, Hui Yao et al. (2014) pointed out from the theoretical

perspective that weak form EMH and semi-strong form EMH of markets in many countries demonstrated by modern research are basically consistent with the premise followed by value investing.

As for **Magic Formula**, it was presented by Greenblatt in the book named *The Little Book That Beats The Market*. For more than two decades in the late 20th and early 21st centuries, he used Magic Formula to build portfolio of stocks that produced more than 30% annual returns and made Gotham Capital to be a miracle on the Wall Street. The idea is simple - buy shares of good company at a good price. First, he selected two representative indicators: ROTC, which measures "good companies", and EY, which measures "good prices". Then, he sorted the ROTC and EY of different companies from good to bad and added up the rankings, selecting the ranking and the 30 smallest stocks to hold for a long time.

In the following 20 years, western scholars have verified and further discussed the formula. First, in 2010, Mr. Greenblatt himself retested the formula with data from the past five years, further demonstrating the effectiveness of the stock-picking strategy. Secondly, in the report, Telford (2016) calculated and compared the performance of 30 stocks selected by magic formula from 1999 to 2016 with that of the Russell 1000 index, and found that this special stock portfolio performed better than Russell 1000 index in terms of annual return, risk and Sharpe Ratio. In addition, Mitchell (2019) has made a study of buying strategies based on the magic formula. He believes that smart investors will also make an optimal strategy study according to the seasonal changes of the stock market on the basis of decentralized buying, that is, buying 2-3 stocks every month. Those who want to buy more stocks at once can take advantage of the decline in overall prices of market to buy more stocks in late January or early February, or from June to late September. (figure 1.1)



(Source: *What Is Magic Formula Investing*. Mitchell. 2019)

Figure1.1 % of Months in Which \$S&P Closed Higher Than It Opened From 1998 to 2017

However, in China, the research of magic formula came only after stock market crash in 2015, and received mixed reviews in the financial world. Wang(2018) believes that the principle of the magic formula is to look for opportunities in the fluctuations of stock prices, and that the herd behavior of retail investors in A-Share Market will further increase the volatility of stocks, so the magic formula is bound to have an extraordinary effect in China. On the contrary, Ning(2017)

believes that the magic formula will cause serious misleading to domestic investors due to serious time lag and fake information in Chinese financial statements.

But in recent years, there are still many institutions trying to apply the Magic Formula to the a-share market. Tianfeng securities (2017) combines the actual domestic accounting standards and financial statements, and solves the problem that the excess cash of most companies is hard to be captured in other current assets by selecting accounts receivable, other receivables, accounts prepaid and inventory. At the same time, Value Return Quantitative Strategy Index of China Securities is also based on the concept provided by Magic Formula, selecting 80 stocks to constitute a stock portfolio, beat all index fund returns over the same period. (Jin Mengyuan et al., 2018)

1.2 Research Content

1. Verify the applicability of magic formula in A-Share Market

This passage will use the data from 2012 to 2019 to verify the applicability of the "Magic Formula" in A-Share Market. The chosen companies will confirm four important standards I list following.

2. Find the best holding strategy

This passage decided to use the portfolios selected via original Magic Formula to compare both time of purchase and holding period on a quarterly basis to explore in which strategies investors can get the highest excess return and give people feasible suggestions.

3. Construct the "Chinese Version of Magic Formula"

This passage will continue to use similar ideas of original formula to select the portfolio, use other relevant accounting data to replace some indicators, create a "Chinese Version of Magic Formula" and improve the application value of the formula in China.

1.3 Significance

1. Solve the problem of capital allocation in domestic capital market

Since the outbreak of the global financial crisis in 2008, China's financial market has entered a period of continuous volatility, among which the most significant is the fluctuation of house price. In most first-tier and second-tier cities and some third-tier and fourth-tier cities, residents' capital flows mostly to the real estate industry, resulting in the decrease of physical consumption, the downturn of the stock market, the increasing pressure of residents' debt, and the difficulty of capital turnover of enterprises.

Entering to the year 2020, CIRC issued *the Guidance on Promoting High-quality Development Of the Banking and Insurance Industry*, setting out the requirements and expectations for the

capital allocation of participants in the financial market by 2025. Among them, "Multiple channels to promote the effective conversion of residents' savings into long-term capital in the capital market" was put forward, arising people's attention to the value investing represented by long-term investment in the stock market once again. Therefore, it is of great guiding significance for China to solve the current capital allocation problem by encouraging market participants to allocate capital in the long term as far as possible.

2. Promote the ability of stock investors and overall development of stock market

Domestic stock market started late, performed immature, and consisted of more than 80% of individual investors. It conspicuously shows that stock investment in China is currently in a relatively blind stage and that most people rely on technical analysis and lack of knowledge in fundamentals, resulting in the problem of copycat investment.

Magic formula uses two simplest financial indicators to complete the complex work of stock selection, which can improve the popularity of value investing methods and the ability of domestic investors.

3. Improve the empirical research of domestic value investing theory

The research on value investing in our country is much more outdated than it in western countries. This passage will provide an orientation for the research in the future.

4. Encourage students to combine theory with practice and innovate actively

2. Preparation & Explanation

2.1 Tools and Resources

In the first and second chapter of research, we mainly use Excel to conduct the data screening and data analysis, including VBA coding, a variety of charts and several tables. We will use filtered data to calculate gain rate and compare it with the gain rate of market index and portfolios with different buying time or holding period. In the third chapter, SPSS will be used to show the OLS testing results and R coding will be used to transform original data like doing DM(Difference Methods). Multiple linear regression model will help us to identify the relationship of new factors, and then we will use the same method as chapter1 to verify its validity.

Furthermore, all original resources used in this article are acquired from WIND Financial Terminal. The information on the official website of China Securities Regulatory Commission(CSRC) is also a good supplement.

2.2 Data Screening

2.2.1 Standards^①

1. The market is in a stable period.

Wu(2019) points out that most of domestic magic formula website chooses the beginning of bull market or the end of bear market as the beginning of the calculation time, so there is a suspicion of exaggerating the effect. When the market is abnormal, PE will have huge fluctuations. Generally speaking, the higher market average PE, the more likely that stock market will continue to fall in the future, and vice versa. Therefore, in order to truly reflect the effect of the magic formula, I will select the data in a relatively stable period with constant price-to-earnings ratio, that is, from January 2012 to December 2019.

In January 2012, the market average PE ratios of Shanghai Composite Index and Shenzhen Composite Index were 14.01 and 22.77 respectively. In December 2019, they were trading at average PE ratios of 14.55 and 26.15. Consequently, the market valuation will not affect a lot.

2. Remove stocks that prices fluctuate due to the drastic changes of external factors.

The fundamental idea of value investing is to invest in the future sustainable development of a company rather than a sudden event, but some measures such as M&A will make a sudden change in the profitability of a single stock. This kind of change does not need any consideration in value investing, so when selecting stocks, we remove all the stocks with abnormal financial condition, such as ST and ST*, to avoid this fault.

3.Continuity in business.

The number of stocks in the A-Share Market is not constant each year. Some enterprises may just enter the market, have sufficient growth momentum, and perform exceptionally in the period I selected. There are also many enterprises that may experience occasional non-systematic risks and suddenly exit the market after significant performance. However, an essential prerequisite for value investing is continuous operation. Therefore, all the companies selected in this paper have been listed before January 2012 and have not been withdrawn until December 2019.

4.Remove some companies in financial service industry.

There are significant differences in the corporate structure, profit model, financial statement status and stock price movement between some financial companies and other companies. This may make indicators constructed not to accurately reflect the economic meaning of "Magic Formula". Therefore, in order to avoid the impact of such industries on the overall analysis, insurance, capital market services (such as securities and futures), monetary and financial services (such as commercial Banks) and other financial industries (such as trust) in the Broad Industry Standard of CSRC were excluded from the analysis.

①NOTE: All VBA codes needed in this section can be found in appendix 1.

2.2.2 Sample Features

Filtered by four restrictions, 1604 listed companies are selected, forming the large sample. The following characteristics are based on the financial data of the first quarter of 2012, covering industry distribution, enterprise value and financial factors.

	2012	2013	2014	2015	2016	2017	2018	2019
SSE	916	941	946	997	1072	1199	1394	1451
SZSE	1390	1512	1562	1613	1735	1883	2083	2127

Figure2.1 The Number of Listed Shares in SSE and SZSE From 2012 to 2019

The remaining number of shares in Shanghai Security Exchange (SSE) and Shenzhen Security Exchange (SZSE) are 348 and 1,256 respectively. Comparing to the total number of listed shares shown in figure 2.1, we can see that the change of companies in SSE, especially the number of companies exit market, is very large, while companies in SZSE is relatively stable.

For the industry distribution, we selected the Industry Classification Standards formulated by CSRC in 2012. Among all industries, only chemical raw materials and products manufacturing, pharmaceutical manufacturing, electrical machinery and equipment manufacturing, computer application services and specialized equipment manufacturing accounted for more than 5%. Based on the truth listed above, we can preliminarily consider that manufacturing industry can survive for a long time, but there is no obvious difference in the number of sample companies for specific industries. ^①

In the statistics of PE and PB, there are 1223 enterprises whose P/E ratios are in the range of 5-60 and 1301 enterprises whose P/E ratios are in the normal range of 1.3-5. Therefore, most of the basic indicators of sample enterprises are in normal range.

2.3 Explanation of Indicators

2.3.1 Earnings Yield (EY)

$$EY = \frac{EBIT}{EV} = \frac{EBIT}{MARKET\ CAP + DEBT - CASH}$$

Earning Yield is the indicator for "good price". The company we buy will be more profitable at the

^① Note: The list of firms and the classification of industries can be found in the attachment of appendix 2.

same cost if it has higher EY. However, the traditional EY formula is not the case, but by the Net Profit divided by Market Capitalization. The reason the magic formula doesn't include these two items is that EBIT can reflect the real available capital of a company and exclude the influence of tax advantages in different industries, while EV takes into account the different capital structure of different companies rather than just the amount of equity. It is an objective assessment of the original purpose of magic formula, which is to examine the ability of a company to use all its money, not just equity provided by shareholders, to generate returns.

2.3.2 Return On Tangible Capital (ROTC)

$$ROTC = \frac{EBIT}{TANGIBLE\ CAPITAL} = \frac{EBIT}{NWC + NET\ FIXED\ ASSET}$$

Return on Tangible Capital is the indicator of "good company". The company can generate more profits per unit of capital when this factor is higher. Thus, it demonstrates the effectiveness of business strategy, governance structure or product marketing. The reason magic formula chooses "EBIT" and "TC" rather than traditional ROC terms is that intangible assets such as goodwill are not directly used to create fixed value. In this case, we can view goodwill as the result of other prior and present tangible assets, rather than the expenses that can be directly used to create profits. The selection of EBIT is consistent with the reason listed in the former section. But it's worth noting that in the ranking, when the ROTC is negative, the only reason is that its denominator is negative. In other words, the Net Working Capital (NWC) is negative. Plus, when the subtracted Non-interest-bearing Liabilities (such as deposit received or accounts payable) are higher, the company will have strong upstream and downstream bargaining power, thus it performs better. Therefore, our ranking standard for this indicator is that the higher the negative value is, the higher ranking it has; the higher the positive value is, the higher ranking it has. Additionally, the ranking of negative value is always higher than that of positive value.

2.3.3 The Selection of New Indicators

China and the United States have vastly different accounting systems. Many of the indicators in the magic formula, such as EBIT, EV and net working capital, cannot be directly obtained from the financial statements of domestic listed companies, making it difficult for ordinary shareholders to use this method. Furthermore, the indicators constructed by Shengjie Li and Wind Quantitative Team that are suitable for China's accounting standards are also extremely complex, making ordinary investors hard to use. Therefore, in the third chapter, I will test two groups of indicators that are easy to be obtained by the Chinese public.

Since it is difficult to test the effectiveness of all financial indicators, we followed Greenblatt's original idea - testing "good prices" with PEG and "good companies" with weighted ROE and

weighted ROA. Firstly, PEG index is the improvement of PE valuation index, illustrating current status of stock price. Generally speaking, when PEG is less than 1, the stock is in a good buying opportunity, and when PEG is more than 1, the valuation on this stock is too high. It is better than PE because PE indicator can only reflect the current situation rather than the future expectation. However, one of its obvious shortcomings is that it is difficult for people to predict the profit growth rate accurately. Generally, only the companies with excellent ROE or ROA performance for a constant period of time can make the predicted value as close as possible. Therefore, we use weighted ROE or weighted ROA index to make a very good supplement.

3. Chapter 1: Verification

3.1 Construct the Portfolio

Step1: Select the financial data of 2012 Q1 and calculate EY and ROTC of all sample companies.

Step2: Sort two indicators using the way mentioned in 2.3.1 & 2.3.2 and add the rankings up.

Step3: Select the 30 stocks with the lowest ranking and hold them with equally amount.^①

RESULT:

Security Code	Security Name	EY	Rank1	ROIC	Rank2	SUM RANK	FINAL RANK
600988.SH	Chifeng Gold	1.2128	5	-18.6250	3	8	1
002315.SZ	Spot Tech	0.8814	9	-16.2146	4	13	2
000711.SZ	Jinglan Tech	0.6119	12	-100.5856	1	13	3
000156.SZ	Huashu Media	1.1469	6	-3.0511	11	17	4
000035.SZ	China Tianying	0.8058	11	-3.5466	9	20	5
000605.SZ	Bohai Shares	0.3768	20	-86.6087	2	22	6
601101.SH	Haohua Energy	3.6113	1	33.3379	35	36	7
002320.SZ	Strait Shipping	2.1636	2	27.2323	37	39	8
000415.SZ	Bohai Rent	0.2715	35	-5.5099	7	42	9
600136.SH	Mingcheng	1.4689	4	12.9129	40	44	10
300184.SZ	Liyuan Info	1.7319	3	8.7086	45	48	11
300224.SZ	Zhenghai Magnetic	1.0761	8	12.3612	41	49	12
300262.SZ	Baan Water	1.1066	7	9.1252	43	50	13
300282.SZ	Sansheng Education	0.6080	13	14.0064	38	51	14
300153.SZ	Ketai Electric	0.8393	10	4.9706	49	59	15
300246.SZ	Bao Laite	0.4592	16	8.4005	46	62	16
300235.SZ	Fangzhi Tech	0.3737	22	12.2980	42	64	17

002587.SZ	Aotuo Electric	0.4371	18	8.2004	47	65	18
000546.SZ	Jinyuan Shares	0.4856	15	3.6438	59	74	19
300231.SZ	Yinxin Tech	0.3549	26	4.6514	51	77	20
600658.SH	Electric City	0.2606	39	13.3606	39	78	21
300074.SZ	Huaping Shares	0.3628	25	4.0770	55	80	22
300250.SZ	Chuling Info	0.3214	29	4.1640	54	83	23
300141.SZ	Heshun Electric	0.1480	77	-7.8917	6	83	24
300253.SZ	Weining Health	0.2638	37	7.1862	48	85	25
000004.SZ	Guonong Tech	0.2421	41	4.7127	50	91	26
300249.SZ	Yimi Kang	0.3713	23	2.3653	68	91	27
300130.SZ	New Guodu	0.2999	30	3.3961	62	92	28
300044.SZ	Saiwei Intelligence	0.5253	14	1.9015	78	92	29
300248.SZ	New Kaipu	0.3765	21	2.2920	73	94	30

Figure 3.1 Basic Information of Companies Ranks Top 30[®]

3.2 Comparison Between “Magic Formula” Portfolio and Market Portfolio

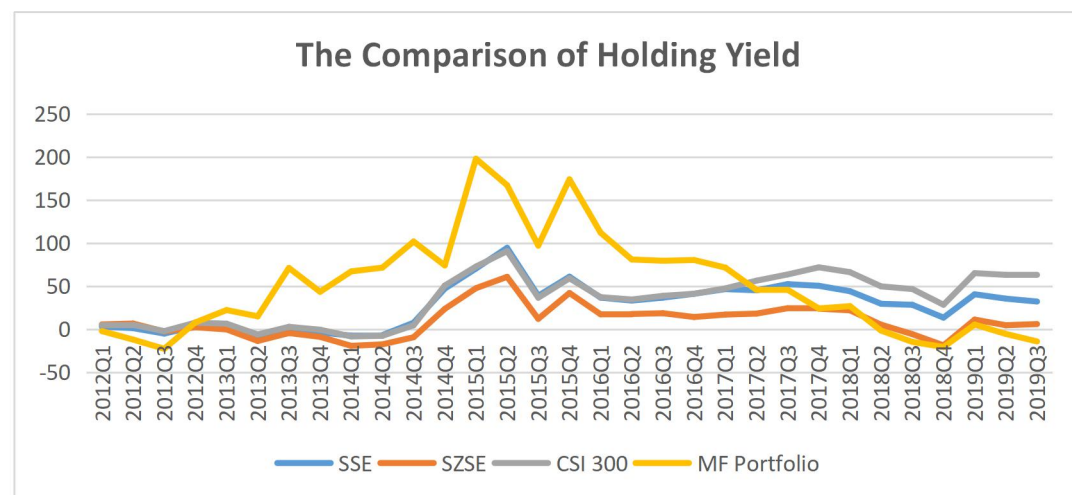


Figure 3.2 The Holding Yields of Different Portfolios From 2012 Q1 to 2019 Q3[®]

① Note: We abandoned holding stocks by market capitalization because this approach would ignore several companies that are small but have strong growing potential in the near future, while paying so much attention to the companies with big market capitalization but weak growth potential. (FRONT PAGE)

② Note: We do not recommend people to navigate the companies by English Names. If readers want to find details, they can use SECURITY CODES directly to find the companies in SSE or SZSE.

③ The gain yields consider both changes of stock price and changes of dividends.

YIELD %	MAX	MIN	RANGE	AVERAGE	VAR
SSE	94.4704	-10.0122	104.4825	27.6973	683.8609
SZSE	60.7608	-19.3887	80.1495	9.6092	356.3642
CSI 300	90.6861	-8.5018	99.1879	35.0680	848.3331
MG Formula	197.9834	-22.8276	220.8110	51.2146	3426.8076

Figure 3.3 Descriptive Statistic Information of Returns

The figure above shows the changes in portfolio returns over time after 30 stocks selected by the criteria listed in 3.1. For a more intuitive comparison, the returns of SSE Composite Index, SZSE Component Index and CSI 300 are introduced to the figure at the same time. It is clear from the chart that the portfolio constructed according to the magic formula performed far better than the other three for most time of eight years, and that in the second half, when the portfolio performs worse, its earning is almost equal to that of the SZSE Component Index, which has the lowest yield.

In the following table, the maximum value, minimum value and range of the magic formula combination are ranked in the first place, showing its huge volatility. Its high average value and high variance show the characteristics of high yield and high risk.

3.3 Brief Summary

The original magic formula is still applicable in A-Share Market because the yield of constructed portfolio is still in a very high compared with the yield of market portfolio. But behind the high yield, high uncertainty and high risk still exist. Consequently, anyone need to be cautious to buy.

At the same time, this chart also conspicuously shows that the yield varies greatly with holding time, and that the purchase time may also have an impact on the final yield, the reason needs further discussion in the next section.

4. Chapter 2: Purchasing Strategy

4.1 Construct the Portfolio

We still select the data of 2012 and construct four different investment portfolios with the data of four quarters. (Use the same method in 3.1.)^①

^① Note: The companies selected in different quarters can be seen in appendix 3.

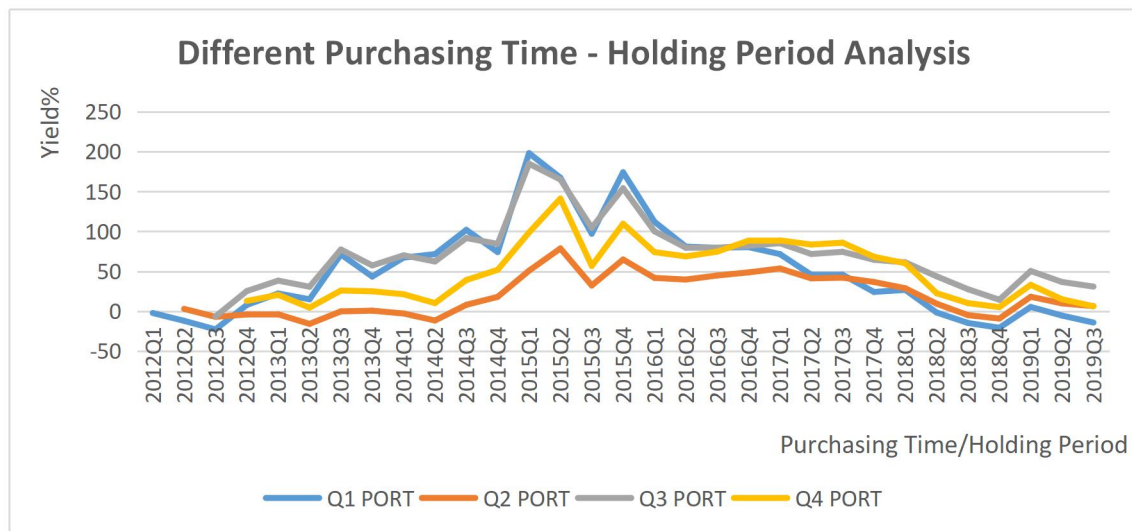


Figure 4.1 Different Yields With different Purchasing Time & Holding Period^①

By drawing four portfolio yield curves into one figure (Figure 4.1), we can easily find that holding yields have significant differences between different purchasing time, and that within each line, yields also changes with holding period. Therefore, in order to enhance the application value of magic formula in China, following paper will analyse the situation based on the quarter interval.

4.2 Purchasing Time

Stock prices fluctuate all the time in one year. Because good news and bad news appear at different periods, stock prices will be higher or lower than the normal valuation at any time. So purchasing time affects the return on the portfolio in a large extent. Figure 4.2 shows the excess returns of portfolio acquired in different quarters compared with CSI 300 Index^② under the same holding time.

Excess Returns Regarding Different Purchasing Time

Purchasing time/ Holding period	1YR	1.25YR	1.5YR	1.75YR	2YR	2.25YR	2.5YR	2.75YR	3YR	3.25YR	3.5YR	3.75YR	4YR	4.25YR	4.5YR	4.75YR	5YR	Sum Number
2012Q1	15.80	21.10	68.39	44.07	75.60	79.18	97.38	23.41	125.28	76.56	60.57	115.00	74.87	46.46	40.79	39.19	24.19	6
2012Q2	-5.60	1.62	5.70	9.65	0.11	8.14	-26.01	-14.29	-3.60	1.74	12.75	10.62	11.15	12.20	13.76	12.70	-8.25	0
2012Q3	79.41	62.64	82.84	74.29	92.07	40.81	120.19	83.24	74.41	102.50	69.42	51.40	47.35	47.54	44.81	22.68	18.53	11
2012Q4	23.33	27.62	15.71	32.14	-2.28	21.92	46.00	17.05	46.89	33.66	31.12	32.69	44.03	38.02	23.60	18.51	-7.61	0
AVG GAIN	28.24	28.24	43.16	40.04	41.38	37.51	59.39	27.35	60.75	53.62	43.46	52.43	44.35	36.05	30.74	23.27	6.72	

Figure 4.2 Excess Returns of Portfolios Regarding Different Purchasing Time

①Note: The calculation methods are same as the methods used in figure 3.2.

② Note: According to figure 3.2, the performance of CSI 300 Index is far better than the performances of other indexes. So, we choose CSI index as the basis.

The table shows excess returns of portfolios with different holding period in 1-5 years. (Note: Value investing is a medium or long-term investment, so we present the results from one year period. Plus, the average excess yields of four portfolios are negative after five years, making it meaningless to present the value here.) The comparison is made on a quarterly basis, and the yellow block shows the portfolio with the highest excess yield over the same holding period. According to the sum numbers listed above, constructing and purchasing the portfolios in the first quarter and the third quarter can gain as much excess yield as possible, while the second quarter is the most dangerous period.

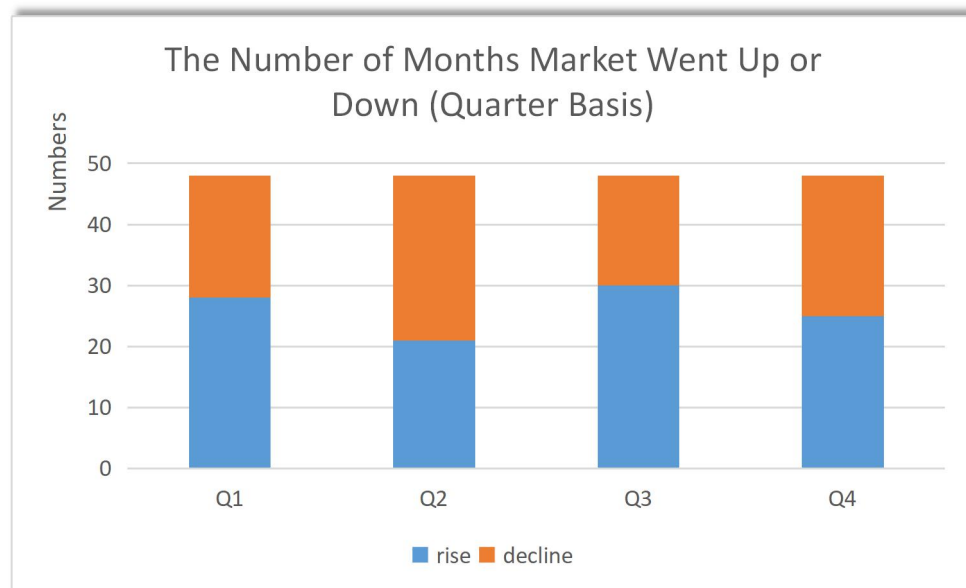


Figure 4.3 The Number of Months That Market Went Up or Down^①

In my opinion, the main reason for this phenomenon is the regular fluctuation of stock market prices. Figure 4.3 shows the number of months that market went up and down over a 16-year period from January 2005 to December 2019, roughly showing the trend of market index in different quarters. In the first three quarters, when the magic formula is applied well, the index shows an upward trend in most months. By contrast, in the fourth quarter, when the magic formula is mediocre, share prices rise in line with their declines. However, in the second quarter, when the index performs bad, declines are more common.

So, when the whole market recovers, magic formula can select the portfolio that shows better than the majority of market shares, but when the market is during the falling state, because magic formula combination has shown its potential earlier, it's hard to exceed market expectations again. So in order to maximize returns, investors should actively find the time when index is low, such as the first quarter and the beginning of the third quarter, to utilize the magic formula.

^①Note: We do the calculation on a month basis and follow the trend of SSE Composite Index.

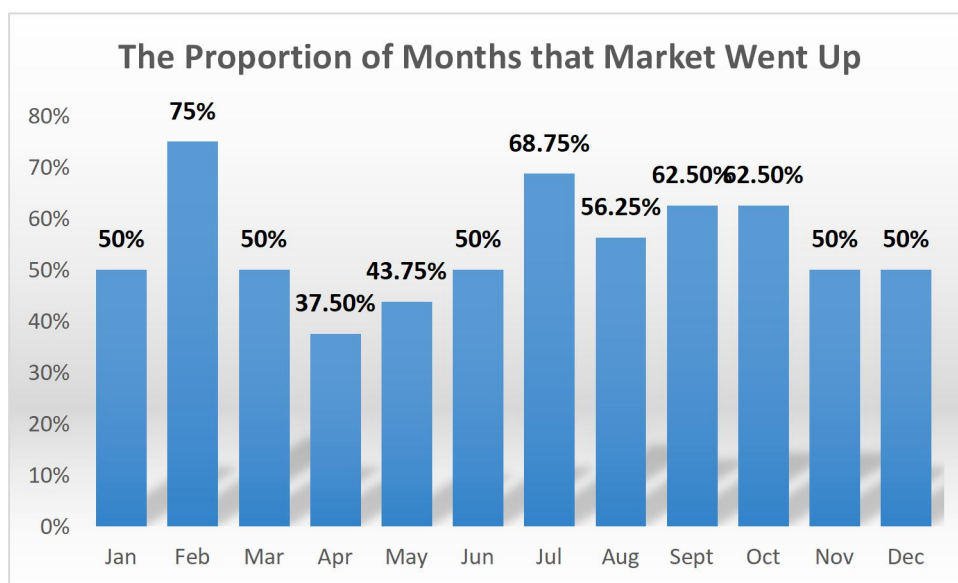


Figure 4.4 The Proportion of Months that Market Went Up from Jan 2005 to Dec 2019^①

We will be able to get further conclusion if we elaborate the statistical data of each month.

In the first quarter, the good performance of portfolio is mainly caused by the rise of stock prices in February. As for this phenomenon, there are two reasons. First of all, the rise of consumption during lunar New Year holiday in February encourages the increase of overall economy and thus the growth in the stock market as whole. Secondly, companies that have outstanding performance in annual reports release hype news in advance and those messages will make their stock prices continue to rise.

However, three months in the second quarter have lower probability that stock prices will rise. The main reason is that most companies with bad annual report reveal their reports in April, the deadline that listed firms reveal financial data. At this stage, the stock market always changes obviously and violates the normal rules. It is so difficult people to find and choose companies with high potential at this time. Then, with time going by, the fund in the stock market is gradually allocated to those big companies with stable performance, so the performance in the latter half of this quarter becomes stable gradually.

In the three months of third quarter, the average number of months that stock prices rise is the highest all over the year, more than sixty percent. This situation is mainly because of company's half annual report disclosure. Generally speaking, companies like to report good news not worries to the public, so they will come up with extremely high growth and bonus expectations for the second half of the year and try their best to whitewash with poor performance for the first half. As a result, the capital will flow into the market, the market will rise constantly, and most importantly, good companies will become very prominent. Under this circumstance, the portfolio constructed by magic formula performs best in this period.

^① Note: We only use the total trend in a month rather than the changes in one day.

However, in the fourth quarter, most companies are in a state of adjustment, and investors' enthusiasm is not very high. The whole market is in a well-regulated state. Since the stock price has been high in the early stage, the better choice at this stage is to hold funds and wait for the opportunity. Therefore, based on the above analysis, January to early February and June to early July are better time periods to use this formula.

4.3 Holding Period

Holding period is the most obvious sign that value investment is different from ordinary short-term investment. Therefore, in order to get the best strategy, the following figure shows the excess return of investment portfolio in different holding periods relative to CSI 300 under the same purchasing time.

Excess Returns of Different Holding Period

	1YR	1.25YR	1.5YR	1.75YR	2YR	2.25YR	2.5YR	2.75YR	3YR	3.25YR	3.5YR	3.75YR	4YR	4.25YR	4.5YR	4.75YR	5YR
2012Q1	15.80	21.10	68.39	44.07	75.60	79.18	97.38	23.41	125.28	76.56	60.57	115.00	74.87	46.46	40.79	39.19	24.19
2012Q2	-5.60	1.62	5.70	9.65	0.11	8.14	-26.01	-14.29	-3.60	1.74	12.75	10.62	11.15	12.20	13.76	12.70	-8.25
2012Q3	79.41	62.64	82.84	74.29	92.07	40.81	120.19	83.24	74.41	102.50	69.42	51.40	47.35	47.54	44.81	22.68	18.53
2012Q4	23.33	27.62	15.71	32.14	-2.28	21.92	46.00	17.05	46.89	33.66	31.12	32.69	44.03	38.02	23.60	18.51	-7.61
AVG GAIN	28.24	28.24	43.16	40.04	41.38	37.51	59.39	27.35	60.75	53.62	43.46	52.43	44.35	36.05	30.74	23.27	6.72
TTR*4				34.92	38.21	40.52	44.58	41.41	46.25	50.28	46.30	52.56	48.46	44.07	40.89	33.60	24.20

Figure 4.5 Excess Returns of Portfolios Regarding Different Holding Period

In figure 4.5, the yellow blocks in each row show three different holding periods with the highest excess returns for the same purchasing time. It is not difficult to find that, except for the abnormal situations occurring in the second quarter, high excess returns are mostly concentrated in the holding period of 2.5-3.75 years. Plus, based on the mean values showed in line 5, all the values above 50 also occur during this period. Finally, the last row presents a forward moving average of the average values in the line 5 over four periods (that is, a year), showing the best time period to sell. Among them, the holding period with the moving average of the average excess yield above 50 are 2.25-3.25 years and 2.75-3.75 years respectively.

In the United States, Greenblatt recommends us to hold the magic formula portfolio for 3 years. Similarly, the optimal holding time in China verified by our analysis is also between 2.25 and 3.75 years. Selling prematurely, I believe, will make inner growth potential of stocks could not fully play out, while holding over 3.75 years may underestimate market variables and great changes in the internal management of firms. Consequently, holding in 3 years (not earlier than 2.5 years to sell, no later than 4 years to sell) is still a good strategy in A-Share Market.

4.4 Further Discussion - The Particularity of Chinese Market

Looking at the companies selected in the first and third quarters, we can easily see a significant difference in their distribution. Gem stocks (starting with the code 300) account for as much as 53% (16/30) of all stocks selected in the first quarter, while only 7% (2/30) of the portfolio that is selected in the third quarter. This difference is an important reflection of the particularity of Chinese financial market.

It can be said that gem stocks are the main driving force of A-Share Market in recent years, no matter market rising or market declining. They played a major role in both the soaring of the market in 2015 and the radical market changes in 2020. Because the growth capacity of gem stocks is much higher than that of listed companies on the main board, those companies could not avoid to release good news for speculation in advance, before the publication of annual report in the first quarter of each year. This action will result in the rise of price of gem stocks. So, in the first quarter, gem occupies a very high proportion in the portfolio.

However, high returns on gems will also bring huge risks when the overall stock market falls, reasonably explaining the rapid decline of excess returns on Q1 investment portfolio after 2016 in figure 4.1. So, gem stock is a "Double-Edged Sword" when we build a portfolio of stocks. It may expand your returns when the overall market is going up and worsen your current situation when the overall market is going down. Therefore, for risk-averse investors, portfolio construction in the third quarter is the best choice to avoid the uncertainty of many gem stocks in the portfolio.

5. Chapter 3: Chinese Version of Magic Formula

5.1 The Principle of Factors Selection and Portfolio Construction

In the original formula, Greenblatt uses two highly specialized financial indicators to reflect his stock-picking ideas - "good company" and "good price". But for investors without good financial background -- especially those in China who read financial statements in different accounting systems -- these two numbers are difficult and error-prone to capture. As a consequence, the application value of two factors is not distinct. Under the premise of using double selection standards like magic formula, the author thinks that the combination of ROA or ROE and PEG would be a good alternative.

$$\text{ROE} = \frac{\text{Net Profit}}{\text{Equity}} \quad \text{ROA} = \frac{\text{Net Profit}}{\text{Asset}} \quad \text{PEG} = \frac{\text{Market Price} / \text{Earnings}}{\text{Growth Rate of Return}}$$

First of all, ROE, as the standard for selecting "good companies" pursued by Stock God Buffett for

many years, has become one of the most popular indicators for A-Share Market Investors. The higher the ROE, the greater the net profit generated by per unit of equity invested by market investors, and thus the better the performance of various aspects of the company, such as business strategy. However, the ROE index also has great limitations: first, it ignores the role of debt financing, and does not exclude income caused by debt from the net profit; second, it ignores the effect of different tax rates, and only EBIT is the earning we can get from main business. At the same time, ROA index also has two problems: first, the assets in the denominator are not totally invested in the main business, and some of them will be invested in other areas such as non-financial assets; second, the tax rate is still the problem. But since these two indicators are the easiest to obtain and the most indicative for good companies, the next section will verify them separately. ^{①***}

Secondly, PEG is a optimized index of P/E, the best substitute of "good price". This indicator not only takes into account the high and low valuation under current market conditions, but also directly reflects whether the current market valuation level is reasonable after considering net profit growth rate (G). PEG equals to 1 symbolizing a reasonable valuation level in the stock market. Additionally, when PEG is less than 1, the stock price is undervalued, indicating a "good price", and when PEG is larger, indicating the over evaluated situation. However, it also has many shortcomings, among which the most serious one is the uncertainty of prediction G. As this part is the prediction of the future market, of the company's unstable operating performance and of the adjustment of business strategy, it is so difficult for people to make an "accurate" prediction.

To sum up, in order to solve this series of problems, some variables should be processed as follows before establishing the model. At first, to avoid serious distortion of PEG index caused by the false prediction of G, we should look for companies with stable yield performance in recent years (including standards ^①stable and small growth or decline ^②constant ^③small and regular fluctuations). The ROE volatility of these companies whose performance can be predicted accurately is generally relatively small, so I choose CV index (coefficient variation) of ROE in annual reports from 2008 to 2011 to rank, and give priority to companies with lower CV. ^② At the same time, in order to prevent the CV index from filtering out a large number of companies and thus losing the universality of the sample, I add Pearson Product-Moment Correlation Coefficient (PPMCC) square (RSQ) of ROE and Y=X array ^③ from 2009 to 2011, and retain some companies with large CV but obvious upward and downward trends. Second, ROE and ROA indicators can be highly contingent on the existence of net profits, so its value for one period alone cannot reflect overall level. Therefore, in line with the principle of continuity and timeliness, the author will adopt the weighted average method to deal with the ROE value of the past four years, and give higher weight to the value near the test period. Finally, in order to solve the problems brought by the structure of ROE and ROA, the author will test with two indicators respectively.

^{①***}: Under the circumstance in China, I believe it is better for us to use Net Income rather than EBIT because more and more Chinese companies are regulated by policies rather than markets. In other words, we must consider the differences between the interest and tax.

^②: Lower CV means stable ROE, so it confirms the standards listed above.

^③: Y=X array represents the most predictable trend. So, this PPMCC can reflect the standard 1.

5.2 Construct the Portfolio

5.2.1 Construct Variables

Step 1: Calculate CV based on ROE from 2008 to 2011.^①

Step 2: Calculate RSQ (the square of PPMCC) based on ROE from 2009 to 2011.^②

Step 3: Sort the RSQ index. Select the stocks with $RSQ > 0.9$, and then select the individuals with $RSQ + (1 - cv) \geq 1.65$ in the former range. (that is, CV equals to 0.25 or less)^③

Step 4: Among the individuals with $RSQ \leq 0.9$, pick out the stocks with $CV \leq 0.2$ and screen other stocks to choose those individuals with three or more similar ROE.^④

Step 5: The ROE and ROA of stocks obtained from the above two steps are assigned with weights of 0.1, 0.2, 0.3 and 0.4 to year 2008, 2009, 2010 and 2011. Then, we obtain the weighted average ROE and weighted average ROA at the end of 2011. Plus, the PEG value can be obtained from the software or Internet. The explanatory variables are set.^⑤

Step 6: The stock price at the end of 2014 divide by the stock price at the beginning of 2012. Thus, we calculate the return per share as the explained variable.

5.2.2 Regression Analysis

①: A-Share Market experienced a huge and abnormal changes from 2015 to 2016 due to government policies so we need to avoid to set our experimental period at those years. Plus, the statistic after 2017 is insufficient for 3-year period, the best holding period for value investing. Therefore, we choose the statistic of 2008 to 2011 as the standard to construct the indicators and the statistic of 2012 to 2014 as the experimental period to verify the new formula.

②: For the accurate estimation of profit growth rate, the fluctuation of ROE is obviously more important than its growth and decline trend. Therefore, the reduction of RSQ index range by one year can eliminate its importance in the parameter selection process. At the same time, it can also avoid the impact of the financial crisis in 2008 on the enterprise, and improve the availability of parameters.

③: $RSQ > 0.9$ shows obvious trend of profit growth and $CV < 0.25$ shows strong stability and predictability of statistic.

④: When the RSQ is smaller than 0.9, it is hard for investors to find a trend. So, we need to strengthen the requirement of another condition (choose the individual with CV no larger than 0.2). (SPECIAL NOTICE: WE NEED TO BE CAUTIOUS ABOUT THE INDIVIDUAL WITH HIGH CV BUT CAUSED BY THE APPROACHMENT OF AVERAGE TO ZERO.)

⑤: We need to choose the PEG that sets the three-year growth rate in the denominator.

(I) Modelling

In this paper, we choose classical linear regression model and construct two multiple linear regressions models (MLR) with variables got above.

$$\text{I) } GAINRATE = \beta_0 + \beta_1 \cdot PEG + \beta_2 \cdot AVGROE + \varepsilon_1, \varepsilon_1 \sim N(0, \sigma^2)$$

And,

$$\text{II) } GAINRATE = \delta_0 + \delta_1 \cdot PEG + \delta_2 \cdot AVGROA + \varepsilon_2, \varepsilon_2 \sim N(0, \sigma^2)$$

In the model, GAINRATE is explained variable, and the combination of PEG and AVGROE (weighted average ROE) or AVGROA (weighted average ROA) is explanatory variable. Besides that, $\beta_0, \beta_1, \beta_2$ and $\delta_0, \delta_1, \delta_2$ are unknown parameters in the model, while ε_1 and ε_2 are random error terms respectively.

In order to ensure the accuracy of the multiple linear regression model, the following data are used to verify the basic assumptions of linear regression model. Unfortunately, by using DW (Durbin-Watson) inspection, the test statistic of constructed model I, II are 0.171 and 0.165, respectively. (Figure 5.1) Therefore, the variables have very strong positive correlation and could lead to errors in statistic significance if we still use these two models.

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.271 ^a	.073	.070	.65667	.171
a. Predictors: (Constant), AVGROE, PEG					
b. Dependent Variable: GAINRATE%					

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.265 ^a	.070	.067	.65776	.165
a. Predictors: (Constant), AVGROA, PEG					
b. Dependent Variable: GAINRATE%					

Figure 5.1 The DW Test Statistics of Model I & II

In order to solve the problems, we use the generalized difference transformation, doing first order difference on each variable after taking logarithm processing. Finally, we get multiple linear regression models III and IV.

$$\text{III) } GAINRATE^* = \beta_0^* + \beta_1^* \cdot PEG^* + \beta_2^* \cdot AVGROE^* + \varepsilon_1^*, \varepsilon_1^* \sim N(0, \sigma^2)$$

And,

$$IV) GAINRATE^* = \delta_0^* + \delta_1^* \cdot PEG^* + \delta_2^* \cdot AVGROA^* + \varepsilon_2^*, \varepsilon_2^* \sim N(0, \sigma^2)$$

In the model III and IV, GAINRATE*, PEG*, AVGROE*, and AVGROA* represent diff(lg(GAINRATE)), diff(lg(PEG)), diff(lg(PEG)), diff(lg(AVGROE)), diff(lg(AVGROA)), respectively. Similar to the former models, $\beta_0^*, \beta_1^*, \beta_2^*$ and $\delta_0^*, \delta_1^*, \delta_2^*$ are parameters in the unknown models and ε_1^* and ε_2^* are random errors items.

It is difficult for us to use the parameters in the new regression equations to explain the economic significance of the corresponding parameters in the original equation directly, but the positive and negative directions are consistent with corresponding parameters in the original equation. So, the positive and negative effects of explanatory variables in the original equation on the explained variables can still be judged by parameters in the new regression equation. The critical basic assumptions of the equation are tested below to determine their accuracy. ^{①②}

1) Auto-Correlation

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.267 ^a	.071	.068	.0416102	2.221
a. Predictors: (Constant), AVGROE, PEG					
b. Dependent Variable: GAINRATE%					

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.181 ^a	.033	.029	.0424595	2.247
a. Predictors: (Constant), AVGROA, PEG					
b. Dependent Variable: GAINRATE%					

Figure 5.2 The DW Test Statistics of Model III & IV

Through difference changes, the DW test statistics of regression equations III and IV have been corrected to 2.221 and 2.247, both of which are close to 2. So, auto-correlation no long appears.

2) Normality & Zero Mean

The curve shapes shown by the residual histograms both show very ideal normal distribution characteristic $N(0, \sigma^2)$. Therefore, it can be considered that the normality is satisfied, and the zero mean assumption is satisfied.

①: The process of dealing with statistics is done by R coding. All codes needed in this process can be found in appendix 4.

②: The charts used to test six MLR assumptions are presented by SPSS Statistic.

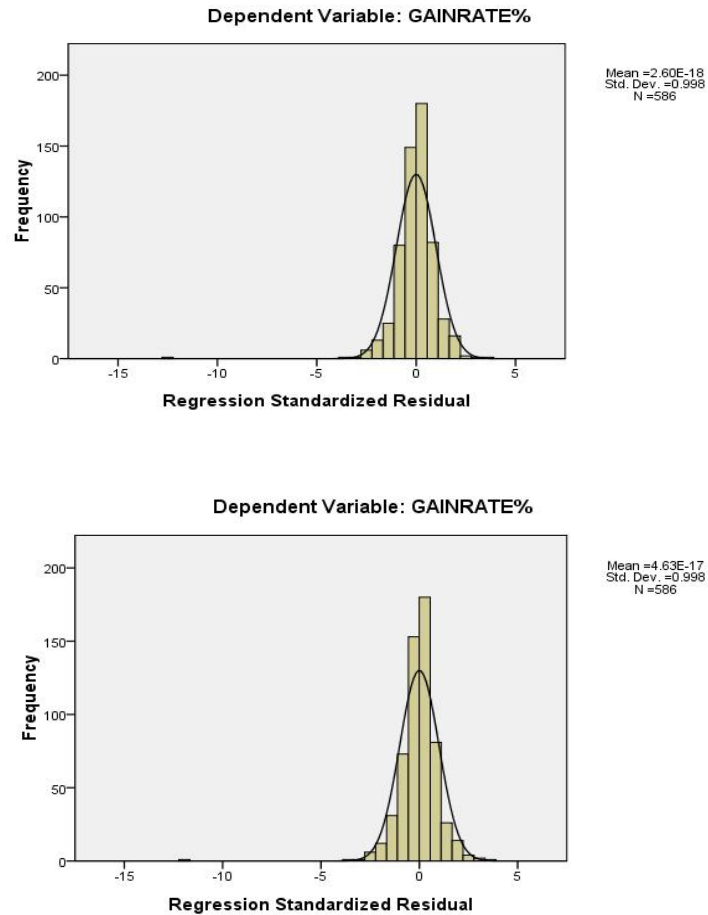
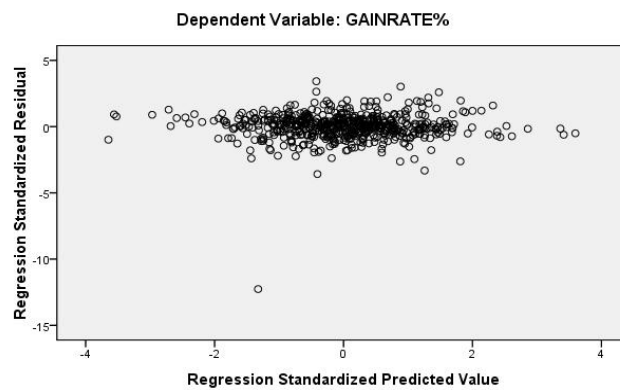


Figure 5.3 Histogram and Curve of Residuals in Model III & IV

3) Homoscedasticity

Figure 5.4 shows the distribution of standardized residuals of regression III and IV. It is not hard for us to find that most standardized residuals distributed in the range of plus or minus two standard deviations (within $-2 \sim 2$). As a result, we can judge that no abnormal points and the strong impact points occur and that variances change independently from variables. So, Homoscedasticity can be established.



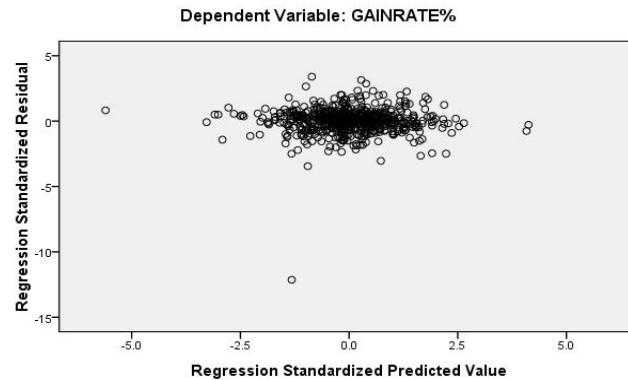


Figure 5.4 Scatter Diagram of Standardized Residual in Model III & IV

4) Non- Multicollinearity

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.006	.002		-3.370	.001		
	PEG	.001	.002	.037	.922	.357	.992	1.008
	AVGROE	-.017	.003	-.261	-6.503	.000	.992	1.008

a. Dependent Variable: GAINRATE%

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.006	.002		-3.305	.001		
	PEG	.003	.002	.079	1.921	.055	.989	1.011
	AVGROA	-.009	.002	-.171	-4.184	.000	.989	1.011

a. Dependent Variable: GAINRATE%

Figure 5.5 VIF Test Statistics in Model III & IV

The Variance Inflation Factors (VIF) in the regression equation III and IV are close to 1, far less than 10, so Non- Multicollinearity assumption is established.

5) Exogenous Hypothesis

The studentized residual figure of equations III and IV shows that those points randomly distributed up and down centered around 0. So, it conforms to the characteristic that the Covariance of independent variables and residual errors is 0. Exogenous hypothesis is established.

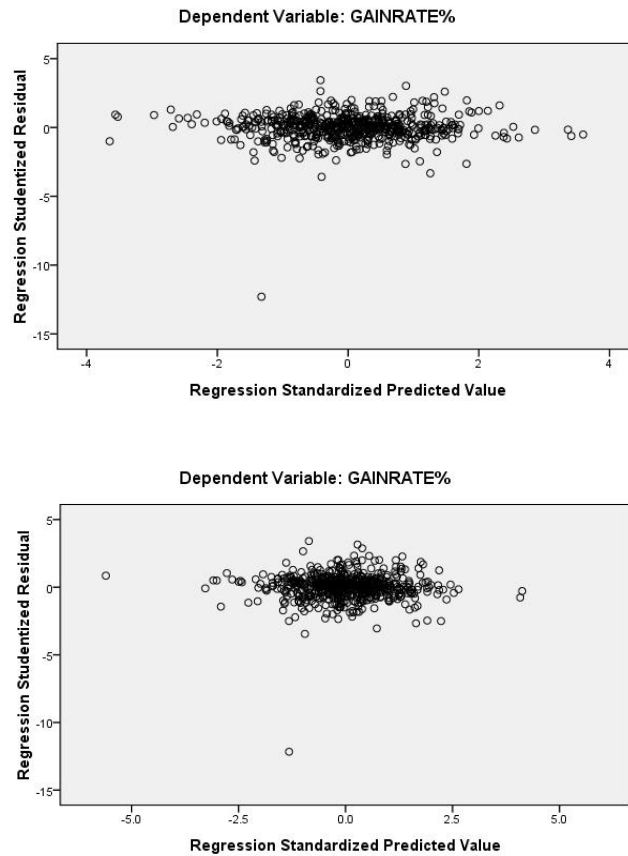


Figure 5.6 Scatter Diagram of Studentized Residual in Model III & IV

All in all, six key assumptions for multiple linear regression model are verified. Model III and IV can be used to do analysis in the following sections.

(II) Regression Analysis

A. PEG & AVGROE Combination

Figure 5.7 shows the test result of regression model III, we can easily obtain that:

Significance F=0.000 < 0.001	significant
P-value (AVGROE*)=0.000 < 0.001	significant
P-value (PEG*)=0.357 > 0.1	insignificant

It can be seen that equation III is significant under 99.9% confidence level, but for the variables in the equation, only AVGROE * is significant. Therefore, under this method, only the AVGROE* index will have impact on the final yield rate, violating the basic policy of stock selection^① in this passage. I will not explain more here.

①: We aim to conduct a "Double Indicator Selection Standard" like magic formula.

Variables Entered/Removed			
Model	Variables Entered	Variables Removed	Method
1	AVGROE, PEG ^a		Enter

a. All requested variables entered.

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.267 ^a	.071	.068	.0416102	2.221

a. Predictors: (Constant), AVGROE, PEG

b. Dependent Variable: GAINRATE%

ANOVA ^b						
Model		Sum of Squares	df	Mean Square	F	
1	Regression	.077	2	.039	22.296	
	Residual	1.009	583	.002		
	Total	1.087	585			

a. Predictors: (Constant), AVGROE, PEG

b. Dependent Variable: GAINRATE%

Figure 5.7 Test Results of Regression Equation III

B. PEG & AVGROA Combination

Figure 5.8 shows the test result of regression model IV, we can obtain that:

Significance F=0.000 < 0.001 **significant**
P-value (AVGROA*)=0.000 < 0.001 **significant**
P-value (PEG*)=0.055 < 0.1 **significant**

It can be seen that equation IV is significant under 99.9% confidence level. Meanwhile, the coefficients of AVGROA* and PEG* in the equation are also significant at the significance level of 99.9% and 90% respectively. We can get the formula:

$$IV) GAINRATE^* = -0.006 + 0.003PEG^* - 0.009AVGROA^*$$

The regression coefficients of this equation have little economic significance, because the variables are obtained by taking logarithm and difference ,and thus the dimension is greatly reduced. However, the positive and negative characteristics in the coefficients of this equation still have reference significance. In other words, when the PEG index is larger, the AVGROA index is smaller, the stock holding yield is also larger.

Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	AVGROA, PEG ^a	.	Enter

a. All requested variables entered.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.181 ^a	.033	.029	.0424595	2.247

a. Predictors: (Constant), AVGROA, PEG

b. Dependent Variable: GAINRATE%

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.036	2	.018	9.860	.000 ^a
	Residual	1.051	583	.002		
	Total	1.087	585			

a. Predictors: (Constant), AVGROA, PEG

b. Dependent Variable: GAINRATE%

Figure 5.8 Test Results of Regression Equation IV

5.2.3 Construct the Portfolio

In the regression equation above, yield rate shows a reverse relationship with Weighted Average ROA and a positive relationship with PEG ratio. That is to say, in order to select the portfolio with high return rate, the portfolio with high PEG and low weighted ROA should be selected. Therefore, the weighted ROA index is numbered from the top to the bottom after ranking from the small to the large, and then the PEG index is numbered from the top to the bottom after ranking from the large to the small. Finally, adding two rankings with certain proportion and selecting thirty stocks with the highest ranking to make investment portfolio.

The selection of proportion is the most difficult process. According to the idea of Greenblatt, the importance of two indicators should be same. But in our stock selection strategy, we need to reconsider this problem because when we choose different weights, the portfolio has reflected obvious and regular difference in excess yields(Figure 5.9). After considering the balance of the two indexes in the portfolio, 60% and 40% weights were given to PEG and AVGROA indexes respectively.

W(PEG): W(AVGROA)	10:0	9:1	8:2	7:3	6:4	5:5	4:6	3:7	2:8	1:9	0:10
GAIN(NO Dividend)	0.64	0.65	0.67	0.65	0.66	0.59	0.59	0.54	0.41	0.39	0.51

Figure 5.9 The Excess Gain Rate After Giving Different Weights to Indicators

The list of stocks we choose is shown in figure 5.10.

Security Code	Security Name	PEG	RANK1	AVGROA	RANK2	SUM RANK	FINAL RANK
600593. SH	Dalian Shengya	2.24	22	0.18	1	13.6	1
600478. SH	Ke Liyuan	2.23	24	0.89	4	16	2
002178. SZ	Yanhua Intelligence	2.75	19	1.80	15	17.4	3
600896. SH	Lanhai Investment	1.92	34	1.56	10	24.4	4
600283. SH	Qianjiang Hydraulic	5.12	7	3.03	54	25.8	5
600501. SH	Hangtian Chenguang	2.15	25	2.32	28	26.2	6
600736. SH	Suzhou Gaoxin	1.88	36	2.36	29	33.2	7
600038. SH	Zhongzhi Shares	5.38	6	3.74	86	38	8
600874. SH	Chuangye Environment	3.27	16	3.35	72	38.4	9
600598. SH	Beidahuang	1.77	40	2.76	43	41.2	10
600037. SH	Gehua Online	9.84	1	4.25	106	43	11
600578. SH	Jingneng Electric	1.64	45	3.09	58	50.2	12
601999. SH	Chuban Media	6.61	4	4.70	129	54	13
600468. SH	Baili Electronic	2.11	26	4.11	101	56	14
600893. SH	Hangfa Energy	1.27	73	2.68	41	60.2	15
000777. SZ	Zhonghe Technology	1.91	35	4.09	100	61	16
600990. SH	Sichuang Electronic	2.38	20	4.63	124	61.6	17
600900. SH	Changjiang Electricity	3.91	12	4.98	145	65.2	18
600461. SH	Hongcheng Hydraulic	1.23	75	3.20	63	70.2	19
600825. SH	Xinhua Media	5.08	9	5.27	162	70.2	20
600055. SH	Wandong Medical	1.86	37	4.60	123	71.4	21
000027. SZ	Shenzhen Energy	2.81	18	5.18	159	74.4	22
600628. SH	New World	1.42	58	4.39	114	80.4	23
000428. SZ	Huatian Hotel	1.14	85	3.43	75	81	24
600998. SH	Jiuzhou Tong	1.35	63	4.26	108	81	25
002193. SZ	Ruyi Corporation	0.88	118	2.28	26	81.2	26
600663. SH	Lujiazui	4.27	10	5.93	191	82.4	27
000099. SZ	Zhongxin Haizhi	1.45	57	5.02	147	93	28
600438. SH	Tongwei Shares	0.83	133	2.56	34	93.4	29
000564. SZ	Gongxiao Daji	0.86	124	2.88	49	94	30

Figure 5.10 The List of Stocks Selected Through PEG - AVGROA

5.3 The Yield of New Portfolio (With Dividend)

In order to verify the effectiveness of new stock selection strategy, the yield of portfolio selected by PEG- AVGROA method is compared with the return rate of portfolio selected by "magic formula", CSI 300 Index, SSE index and SZSE index over the same period. The result is shown in figure 5.11.

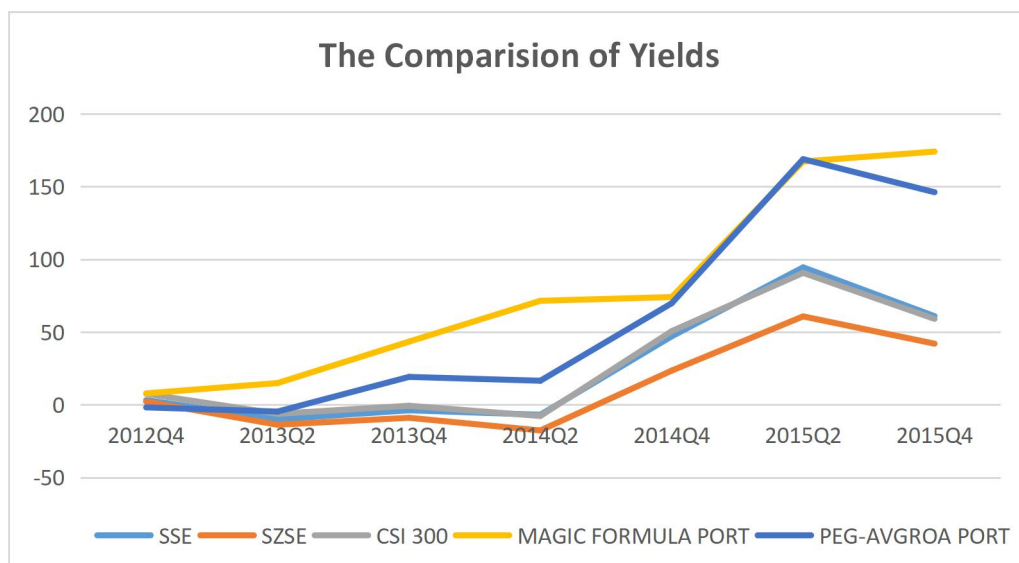


Figure 5.11 The Comparison of Yield Between Different Portfolios From 2012Q4 to 2015 Q4^①

All the portfolios shown in the figure above are purchased at the beginning of first quarter of 2012 and held to the end of the corresponding periods. The curve apparently shows the effectiveness of PEG- AVGROA strategy. From the beginning of the two-year holding period, the yield of new portfolio is much higher than that of CSI 300 Index, SSE Index and SZSE Index. Additionally, from 3 to the 3.5 years of holding period, the portfolio yield is even slightly higher than the magic formula portfolio. In conclusion, the PEG - AVGROA strategy mentioned above can help us to choose a combination that performs well in A-Share Market. The gains are much higher than the market portfolio over 1.5 years and are similar to the yield of magic formula at 3-3.5 years period. Although the yields are lower than that of "magic formula" sometimes, this strategy can simplify the process of choosing a stock, enhance the practicability of ordinary investors without financial knowledge. So, it still has great significance.

5.4 Conclusion and Further Discussion

The Chinese Version of Magic Formula is proved to be effective in the four-year holding period,

but it seems that the indicators affect each other in a way that contradicts their economic significance. Under normal circumstances, PEG index reflects the valuation of stocks in the market. The potential for the future growth of stocks is not large when PEG Index is higher, so PEG should be inversely proportional to the stock yield. At the same time, AVGROA index reflects the ability of enterprises to make profits by using assets, and the company with higher AVGROA is more effective, so it should be positive correlation to the rate of return.

However, the result is completely opposite, that is, high PEG and low AVGROA will bring high excess return. I believe this phenomenon is mainly caused by the following three reasons.

First, after the global financial crisis in 2008, China implemented a massive fiscal and monetary stimulus to help businesses face the difficulties. Of course, those plans led to the overcapacity of many enterprises in a long period of time. Under this status, enterprises wasted so many resources and lost the capital. At the same time, due to the social background of the transformation from secondary industry to tertiary industry and the urbanization needs in our country, local governments are willing to provide large-scale funds to local companies because those companies may enhance the performance of government a lot. All reasons listed above improved the leverage of the firm. In this case, the availability of adequate and sustainable loans has become the most important guarantee for the development of enterprises. That is to say, only the enterprises with low ROA are the "good enterprises" that can develop in the future.

Secondly, PEG index can do accurate valuation for companies with stable and sustained performance. Although this paper has screened the company's own earnings through ROE over several years, it is still difficult to cover up the fact that the market is immature. In 2007-2008 bull market, PEG index are extremely popular because the performance of most companies, affected by overall market rise, can rise according to or even beyond market expectations. However, in the period of time selected by this article, the whole market is relatively stable. Therefore, the rise or the decline of share prices is not determined by the performance of company in long run, but affected by the short-term speculation and the profitability of other business. In order words, low PEG numbers at that time are not caused by the undervaluation of the market, but by the overestimation of the rate of return growth. Most companies cannot grow as expected. In contrast, for many companies with PEG concentration around 2, their performance is relatively stable, in line with the growth expectations, so the PEG indicators of selected stocks are mostly concentrated in this range.

Third, the imperfect regulatory system leads to frequent financial fraud. A-Share Market has only developed for 30 years, but there are nearly 4,000 stocks. A large number of companies have flooded the capital market, resulting in the collapse of the system. Many companies use various methods to print their financial statements in an attempt to get money again from the market when their performance is poor. Although the previous screening process has deleted some companies, such stocks still exist inevitably. Therefore, the PEG and ROA data obtained in this paper are likely to be falsified. In a nutshell, the falsification of financial statement data is still one of the most important reasons for the unreasonable meaning of indicators

6. Conclusion

Through the analysis of the company information and stock prices of 1604 listed companies after screening for 31 quarters (from Q1 2012 to Q3 2019), this paper conducts a comprehensive study on the applicability, purchasing strategies and optimization of Magic Formula in China, and draws the following conclusions.

6.1 Theoretical Research Results

Greenblatt's "magic formula" strategy still shows ideal return relative to CSI 300 portfolio, SSE index portfolio and SZSE index portfolio for most time. However, there are still more volatility and more risk behind high yields, with worse performance when the overall stock market is falling.

At the same time, different purchasing time and holding period will also produce a great impact on the portfolio yield. By comparing the gain rate of portfolio constructed in four quarters in 2012, we can find that although the yields of different combinations have similar trend in holding same period of time, the returns of combinations constructed in the first and the third quarter are higher than other two quarters, and the yield of second quarter combination performs significantly worse than the other three combinations. In terms of holding period, 2.5 to 4 years is a good choice, similar to the original formula which suggests a holding period of 3 years.

Finally, due to the complexity of obtaining financial indicators in original formula in China, this paper uses the performance of A-Share Market from 2012 to 2015 to study the return rate of PEG- AVGROE strategy and PEG- AVGROA strategy, and obtains the "Chinese Version of the Magic Formula". Among them, in order to solve the serious Auto-correlation problem in the multiple linear regression with the rate of return as the explained variable, the combination of PEG and AVGROE or PEGROA as the explanatory variables, this paper uses first-order difference after logarithm calculation to establish the model. After OLS estimation, although the equation of PEG- AVGROE combination is significant, the PEG index is not significant. Thus, this strategy is not in line with our stock selection idea, so it is discarded. For PEG- AVGROA combination, the equation and parameters are very significant, and the positive and negative parameters can be used as the basis for the final sorting. After PEG ranked from big to small with 0.6 weight and AVGROA ranked from small to big with 0.4 weight, we add the rankings up and choose the stocks with top 30 rankings to construct the portfolio. Under this situation, for most of the holding period, we can still get higher excess returns than the market portfolio, even in the 3-3.5 years hold period can get close to or even greater than that of "magic formula" portfolio returns. It can be said that the stock selection strategy represented by PEG- AVGROA is effective in China.

6.2 Political and Applied Research Results

The most important part of this paper lies in the empirical analysis that can supply stock selection strategy for investors and policy guidelines for the regulators.

On the one hand, for capable institutional investors or financially savvy independent investors, the original version of magic formula in A-Share Market is a good value investment choice. Through the study of purchasing time and the overall trend of the stock market, every year from January to early February and June to early July are the good time to construct the portfolio. If you're risk-averse investor, buying the stocks in the third quarter is the best way; if not, both the first and the third quarters can be used as an opportunity. For investors without a good financial basis, they can choose the "Chinese version of the magic formula", which has more accessible financial indicators. This method uses the combination of PEG and AVROA and can still choose the investment portfolio that has returns far exceeding the returns of market index in the 2-4 year of holding period. Therefore, this paper can really popularize value investment in A-Share Market and make the capital market of our country to become more perfect.

On the other hand, the abnormal ranking of financial indicators in the investment strategy gives enlightenment to the regulatory system and economic policies: the main goal in the future is to strengthen the supervision of capital market and carry out the strategy of "Eliminating Leverage, Cutting Capacity and Reconstructing"^① for enterprises. First, only when the leverage level of enterprises is reduced to a reasonable level and the capital structure is adjusted to the healthy status can China's economy achieve sustainable and better development. Second, only when all participants in the capital market invest in an open, fair and transparent market can both companies and investors achieve a win-win situation.

6.3 Future Development

This passage also provide so many orientations for the research in the future, both in the academic perspective and political perspective.

For the academic area, people must realize that the stock market is constantly developing and advancing, and there is no one way to be called a "Eternal Bible". Since there was no enough data (more than three years) after A-Share Market fully recovered from the stock market crash in 2015-2016 and the stock market was even worse before 2010, this paper chooses 2012 as the benchmark year to verify the magic formula, explore the ideal strategy and build the portfolio of the new formula. With the improvement of China's financial market, the opening of the "New OTC Market", and the speeding up of the capital market opening to the outside world, the structure of the company will change dramatically in recent years and the near future. Therefore, I believe that the study of the relationship between yield and portfolio will gradually return to

^①Note: This policy was presented by Chinese President Xi Jinping in 2016.

economic meaning of the indicators themselves. That is to say, when the future stock market data can support the study of the recent situation, we can still use the ideas and methods of this paper to carry out further research and discussion.

Furthermore, in the era of artificial intelligence, the stock selection strategy proposed in this paper can be reflected on the electronic computer, improving the speed and accuracy of calculation and timely finding stocks with investment value. Fund managers can also refer to the method of this paper and consider the current situation of A-Share Market to build a stable portfolio of the market.

For the political perspective, the coefficients of formula can be used as signals for the government to measure the performance of financial regulatory system. For instance, the abnormal relationship between stock yield and PEG or AVGROA may reflect several problems related to the companies and laws in the Chinese Market. If we conduct this method in some mature financial market like American financial market, the relationship may be more reasonable. Therefore, as soon as we apply this method to most of the financial markets in the world, we might find a rule that can help us to know the economic situation easily. At the same time, the government can also use the indicators to supervise the market clearly and concisely.

References:

- [1] Jin Mengyuan. *Magic index: stick to value investment and make money with time -- a visit to Yao Ting, fund manager of index fund of quantitative strategy of value return of China post fund*. Public financial adviser, 2018 (12) : 18-19.
- [2] Wang Jixiang. *Review of "the magic formula of steady gains in the stock market"*. Securities times, 2018-01-11 (A09).
- [3] Wang Ning. *"magic formula" in China*. Financial expo (wealth), 2017 (04) : 96.
- [4] Wu Yichen. *"the magic formula" domestic interpretation, application and thinking*. One of the magic formula series, 2019 (3). 1-2
- [5] Zhao Yabo. *Research on stock selection method based on magic formula and dog stock theory*. Times finance, 2013 (18) : 248.
- [6] Graham, Benjamin, David Le Fevre Dodd, and Sidney Cottle, 1934, "Security Analysis", New York: McGraw-hill.
- [7] *The Little Book That Beats The Market*. Joel Greenblatt . US, 2006. P. 171
- [8] Philip a. fisher. Luo Yaozong. *How to choose growth stocks*. China: Hainan press, 1999.
- [9] Sun Youqun, Chen Xiaoyang, Wei Fei. *Thoughts on the connection between value investment and Chinese stock market*. Financial and economic theory and practice, 2nd issue, 2002: p64-67
- [10] Lin Xingwei. *Empirical analysis on the performance of value investment in China's stock market*. Journal of finance and economics, 2004: p270-274
- [11] Xu Chenggang. *Application analysis of value investment theory in Chinese stock market*. Value engineering. 12th issue: p39-42, 2006
- [12] Wang Jing. *Empirical research on value investment of Chinese securities funds*. Ocean university of China, 2009
- [13] Li Weiqiang. *Empirical study on the effectiveness of stock selection method in a-share market value investment*. Master's thesis of south China university of technology, 2014
- [14] Yao Hui, Wu Tingting. *Empirical research on value investment strategy with consideration of fundamentals and valuation indexes -- empirical data from China's Shanghai and Shenzhen a-share markets from 2000 to 2013*. Investment research, 2014,33 (11) : 123-138.
- [15] Ryan Telford. *Greenblatt Wizardry: A Quantitative Look At The Magic Formula*. Seeking Alpha.
- [16] Cory Mitchell. *What Is Magic Formula Investing?*. The balance. 2019.11.20-2019.12.5.
- [17] The Essays of Warren e. Buffet To Shareholders. Warren e. Buffett. China. 2004.
- [18] Chui, Andy CW, k. c. Wei, 1998, "book-to-market, Firm Size, and the Turn of the year Effect: Evidence from pacif-ba-sin Emerging Markets", Finance Journal, 6, pp. 275-293.
- [19] Fama, Eugene F, Kenneth R French, 1998, "Value versus Growth: the International Evidence", the Journal of Finance, 53, pp.1975-1999.
- [22] Basu, Sanjoy, 1977, "Investment Performance of Common Stocks in Relation to Their price-earnings Ratios: A Test of the Efficient Market Hypothesis", Journal of Finance, 32, pp: 663-682.

Appendix:

Appendix 1: VBA Codes used in 2.2.1.

(Note: The codes showed below can be used to select the firms according to four standards.)

MODEL 1: PREPARATION

PREPARATION WORK, SET THE FORM FOR THE FURTHER WORK

```
Sub TOTAL()  
Dim fso, sh  
Set fso = CreateObject("scripting.filesystemobject")  
For Each f In fso.getfolder(ThisWorkbook.Path).Files  
    If InStr(f.Name, ThisWorkbook.Name) = 0 Then  
        With Workbooks.Open(f)  
            With .Sheets(1)  
                .[a1].CurrentRegion.Copy  
ThisWorkbook.Worksheets.Add(after:=Sheets(Sheets.Count)).[a1]  
                ThisWorkbook.Sheets(Sheets.Count + 1).Name = Replace(f.Name, ".xlsx", "")  
            End With  
            .Close False  
        End With  
    End If  
Next  
End Sub  
Sub FORMSETTING()  
For Each sh In Worksheets  
    With sh  
        .Rows("1").RowHeight = 30  
        .Columns.AutoFit  
    End With  
Next  
End Sub
```

Model 2: DEAL WITH THE STATISTIC

DEAL WITH THE STATISTIC ACCORDING TO THE FIVE STANDARDS LISTED ABOVE

```
Option Base 1  
Sub DELETINGDATA1()  
On Error Resume Next
```

```

Application.ScreenUpdating = False
For Each sh In Worksheets
If sh.Name <> "SUMTOTAL" And sh.Name <> "CODE" Then
    With sh
        arr = .[a1].CurrentRegion
        For i = 2 To .[a65536].End(3).Row
            If .Cells(i, 4).Value = 0 Then
                .Rows(i).Delete
            End If
            If .Cells(i, 4) = "" Then
                .Cells(i, 4).ClearContents
            End If
        Next
        r = .[a1].CurrentRegion.Rows.Count
        .Range("d2:d" & r).SpecialCells(4).EntireRow.Delete
    End With
End If
Next
Application.ScreenUpdating = True
End Sub

Sub DATADELETING()
On Error Resume Next
Application.ScreenUpdating = False
For Each sh In Worksheets
If sh.Name <> "SUMTOTAL" And sh.Name <> "CODE" Then
    With sh
        arr = .[a1].CurrentRegion
        For i = 2 To .[a65536].End(3).Row
            If InStr(.Cells(i, 3), "证券, 期货" & "|" & "保险业" & "|" & "银行业" & "|" & "资本市场服务" & "|" & "货币金融服务" & "|" & "其他金融业") <> 0 Then
                .Cells(i, 3).ClearContents
            End If
        Next
        r = .[a1].CurrentRegion.Rows.Count
        .Range("c2:c" & r).SpecialCells(4).EntireRow.Delete
    End With
End If
Next
Application.ScreenUpdating = True
End Sub

Sub RETAININGBANKS1()
On Error Resume Next
Dim sh As Worksheet, arr, brr(10000, 1 To 1)
For Each sh In Worksheets

```

Note: Those words are the Chinese names of financial industries. We need to use Chinese here because original data are presented by Chinese. The English names are shown in standard 4.

```

If sh.Name <> "SUMTOTAL" And sh.Name <> "CODE" Then
    With sh
        arr = .[a1].CurrentRegion
        For i = 2 To UBound(arr)
            brr(i - 1, 1) = arr(i, 1)
        Next
    End With
    Erase arr
End If
With Sheets("SUMTOTAL")
    c = .[bz1].End(xlToLeft).Column
    .Cells(1, c + 1).Resize(UBound(brr), 1) = brr
End With
Erase brr
Next
End Sub
Sub DELETING1()
    Dim d, arr
    Set d = CreateObject("Scripting.Dictionary")
    arr = Sheets("汇总").[b1].CurrentRegion
    For i = 1 To UBound(arr)
        For j = 1 To UBound(arr, 2)
            d(arr(i, j)) = ""
        Next
    Next
    Sheets("SUMTOTAL").[a1].Resize(d.Count, 1) = Application.Transpose(d.keys)
End Sub
Sub OBTAININGCODE()
    Dim d, d1, arr
    On Error Resume Next
    With Sheets("SUBTOTAL")
        brr = .Range(.Cells(1, 1), .Cells(.[a65536].End(3).Row, 1))
        Set d1 = CreateObject("Scripting.Dictionary")
        For k = 1 To UBound(brr)
            d1(brr(k, 1)) = ""
        Next
        For i = 2 To .[a1].End(xlToRight).Column
            arr = .Range(.Cells(1, i), .Cells(.Cells(65536, i).End(3).Row, i))
            Set d = CreateObject("Scripting.Dictionary")
            For j = 1 To UBound(arr)
                d(arr(j, 1)) = ""
            Next
            For k = 1 To UBound(brr)
                If Not d.exists(brr(k, 1)) Then

```

```

        d1.Remove brr(k, 1)
    End If
Next
Set d = Nothing
Erase arr

Next
End With
Sheets("CODE").[a1].Resize(d1.Count, 1) = Application.Transpose(d1.keys)
End Sub
Sub LASTSTEP()
On Error Resume Next
Application.ScreenUpdating = False
Dim d, sh As Worksheet, arr, brr, i&, j&, k&
Set d = CreateObject("scripting.dictionary")
arr = Sheets("CODE").[a1].CurrentRegion
    For i = 1 To UBound(arr)
        d(arr(i, 1)) = ""
    Next
    For Each sh In Worksheets
        If sh.Name <> "SUMTOTAL" And sh.Name <> "CODE" Then
            With sh
                brr = .[a1].CurrentRegion
                For i = 2 To UBound(brr)
                    If Not d.exists(brr(i, 1)) Then
                        brr(i, 1) = ""
                    End If
                Next
                .[a1].Resize(UBound(brr), UBound(brr, 2)) = brr
                r = .[a1].CurrentRegion.Rows.Count

                For k = 2 To .[b65536].End(3).Row
                    If .Cells(k, 1) = "" Then
                        .Cells(k, 1).ClearContents
                    End If
                Next
                .Range("A2:a" & r).SpecialCells(4).EntireRow.Delete
            End With
            Erase brr
        End If
    Next
Application.ScreenUpdating = True
End Sub
Sub hh()
With Sheet71

```

```
If .[a54] = "" Then
    .Rows("54").Delete
End If
End With
End Sub
```

Appendix2: The Classification of Industries

(Note: The list here shows the number of companies in the specific industries.)

Name of Industry	Numbers	SUB/TOTAL%
Chemical Raw Materials and Products Manufacturing	107	6.67%
Pharmaceutical Manufacturing	102	6.36%
Electrical Machinery and Equipment Manufacturing	94	5.86%
Computer Application Service	91	5.67%
Specialized Equipment Manufacturing	84	5.24%
Electronic Components Manufacturing	73	4.55%
Real Estate Development and Operation	72	4.49%
Transportation Equipment Manufacturing	66	4.11%
General Machinery Manufacturing	58	3.62%
Production and Supply of Electricity, Steam and Water	42	2.62%
Non-Metallic Mineral Products	42	2.62%
Retail	42	2.62%
Manufacturing of Communications and Related Equipment	42	2.62%
Nonferrous Metal Smelting and Rolling Processing	41	2.56%
Civil Engineering Construction	33	2.06%
Textile	29	1.81%
Metal Products	27	1.68%
Food Processing	27	1.68%
Plastic Manufacturing	25	1.56%
Computer and Related Equipment Manufacturing	24	1.50%
Ferrous Metal Smelting and Rolling Processing	23	1.43%
Beverage Manufacturing	21	1.31%
Transportation Support	19	1.18%
Biological Products	19	1.18%
Other Electronic Equipment Manufacturing	18	1.12%
Other Social Services	18	1.12%
Professional and Scientific Research Services	18	1.12%
Food Manufacturing	17	1.06%
Paper Making and Paper Products	17	1.06%
Wholesale of Energy, Materials, Mechanical and Electronic Equipment	16	1.00%
Chemical Fiber Manufacturing	15	0.94%
Telecommunication Service	15	0.94%
Coal Mining	14	0.87%
Radio, Film and Television	13	0.81%

Tourism	13	0.81%
Apparel and Other Fiber Products Manufacturing	12	0.75%
Road Transportation	12	0.75%
Instrumentation and Cultural, Office Machinery Manufacturing	12	0.75%
Public Services	11	0.69%
Nonferrous Metal Mining	11	0.69%
Daily Electronic Appliance Manufacturing	10	0.62%
Wholesale Trade of Food, Beverage, Tobacco and Household Goods	10	0.62%
Commercial Brokerage and Agency	9	0.56%
Health, Health Care and Nursing Services	8	0.50%
Information Dissemination Services	8	0.50%
Decoration Industry	8	0.50%
Agriculture	7	0.44%
Extractive Services	6	0.37%
Gas Production and Supply Industry	6	0.37%
Rubber Manufacturing	6	0.37%
Printing Industry	6	0.37%
Production and Supply of Tap Water	6	0.37%
Publishing	5	0.31%
Animal Husbandry	5	0.31%
Air Transport Industry	5	0.31%
Wood Processing and Bamboo, Rattan, Brown, Grass Products Industry	5	0.31%
Petroleum Processing and Coking Industry	5	0.31%
Education and Sports Goods Manufacturing	5	0.31%
Hotel Business	4	0.25%
Other Communication and Cultural Industries	4	0.25%
Oil and Gas Exploration	4	0.25%
Water Transportation	4	0.25%
Rental Services	4	0.25%
Warehousing	3	0.19%
Ferrous Metal Mining Industry	3	0.19%
Furniture Manufacturing	3	0.19%
Railway Transportation	3	0.19%
Fishery	3	0.19%
Restaurants	2	0.12%
Agriculture, Forestry, Animal Husbandry and Fishery Services	2	0.12%
Catering Industry	2	0.12%
Arts	2	0.12%

Real Estate Management	1	0.06%
Real Estate Intermediary Service Industry	1	0.06%
Forestry	1	0.06%
Manufacturing of Leather, Fur, Down and Products	1	0.06%
Postal Service	1	0.06%
Entertainment Service	1	0.06%
TOTAL	1604	100.00%

Appendix 3: The List of Firms

(The lists showed below are the firms selected by magic formula strategy in a quarter basis in 2012.)

Quarter1: The list is shown in 3.1

Quarter2:

Security Code	Security Name	EY	Rank1	ROIC	Rank2	SUM RANK	FINAL RANK
600835.SH	Shanghai Electromechanical	1.9670	1	-0.1118	11	12	1
600012.SH	Wantong Highspeed	0.0735	10	-1.3889	2	12	2
000417.SZ	Heifei Department Store	0.0843	4	-0.4361	9	13	3
600167.SH	Lianmei Holdings	0.0759	8	-0.2971	10	18	4
002277.SZ	Hoa Shares	0.0825	5	2.8338	19	24	5
601107.SH	Sichuan Chengyu	0.0610	20	-0.6113	6	26	6
002051.SZ	China Engineering International	0.0568	25	-0.0644	13	38	7
000900.SZ	Modern Investment	0.1205	2	0.4052	39	41	8
002187.SZ	Guangbai Shares	0.0716	12	0.5716	31	43	9
600785.SH	Xinhua Department Store	0.0518	38	-0.5537	8	46	10
000568.SZ	Luzhou Laojiao	0.0522	33	7.0109	16	49	11
002242.SZ	Joyoung Shares	0.0793	7	0.3842	42	49	12
600271.SH	Aerospace Information	0.0580	24	0.4616	34	58	13
600216.SH	Zhejiang Medicine	0.0793	6	0.2647	56	62	14
600035.SH	Chutian High Speed	0.0420	60	-0.7603	5	65	15
002489.SZ	Zhejiang Yongqiang	0.0522	34	0.5268	33	67	16
000564.SZ	Supply and Marketing Large Set	0.0424	58	3.3833	18	76	17
000970.SZ	CYC	0.0520	35	0.3663	43	78	18
000785.SZ	Unexpected Home	0.0462	47	0.5277	32	79	19
002588.SZ	Stanley	0.0412	64	0.6624	28	92	20
600060.SH	Hisense Image	0.0515	39	0.2717	53	92	21
600361.SH	Hualian Comprehensive Store	0.0382	81	-0.0961	12	93	22
002393.SZ	Lisheng Medicine	0.0539	28	0.2406	67	95	23
000780.SZ	Pingzhuang Energy	0.0475	44	0.2671	55	99	24
000715.SZ	ZTE Commercial	0.0450	50	0.2863	51	101	25
000915.SZ	Sandahuate	0.0531	30	0.2320	72	102	26
600066.SH	Yutong Bus	0.0379	85	1.7368	20	105	27
600199.SH	Gold Seed Wine	0.0380	83	1.0584	22	105	28
000028.SZ	National Medicine	0.0641	15	0.1748	92	107	29
002641.SZ	Yonggao Shares	0.0627	17	0.1770	91	108	30

Quarter3:

Security Code	Security Name	EY	Rank1	ROIC	Rank2	SUM RANK	FINAL RANK
000156.SZ	Huashu Media	0.4529	1	-0.7025	6	7	1
600835.SH	Shanghai Machinery	0.1710	2	-0.0383	18	20	2
600012.SH	Wantong High Speed	0.0384	20	-0.7043	5	25	3
000415.SZ	Bohia Rental	0.0385	19	-0.7020	7	26	4
000417.SZ	Hefei Department Store	0.0433	15	-0.1762	14	29	5
000552.SZ	Jingyuan Coal Electricity	0.1438	3	1.5031	28	31	6
600361.SH	Hualian Comprehensive Store	0.0374	22	-0.0524	17	39	7
600066.SH	Yutong Bus	0.0440	14	1.5244	27	41	8
002051.SZ	China Engineering International	0.0354	28	-0.0725	16	44	9
002116.SZ	China Haicheng	0.0351	29	-0.1249	15	44	10
601107.SH	Sichuan Chengyu	0.0324	39	-0.3008	11	50	11
002588.SZ	Stanley	0.0378	21	0.4582	39	60	12
000603.SZ	Shengda Resources	0.0275	59	-1.2143	3	62	13
000564.SZ	Supply and Marketing Large Set	0.0303	46	2.5025	26	72	14
002444.SZ	Juxing Technology	0.0513	8	0.1899	75	83	15
002242.SZ	Joyoung Shares	0.0447	12	0.2006	72	84	16
000900.SZ	Modern Investment	0.0446	13	0.1798	78	91	17
600035.SH	Chutian Highway	0.0238	97	-0.4124	9	106	18
300159.SZ	Xinyan Shares	0.0356	26	0.1732	83	109	19
600271.SH	Aerospace Information	0.0286	51	0.2456	60	111	20
002641.SZ	Yonggao Shares	0.0490	10	0.1555	101	111	21
002008.SZ	Dazu Jiguang	0.0527	6	0.1479	105	111	22
000413.SZ	Dongxu Solar Energy	0.0268	67	0.2947	52	119	23
600060.SH	Hisense Image	0.0343	33	0.1724	87	120	24
000568.SZ	Luzhou Laojiao	0.0235	100	3.3972	24	124	25
002628.SZ	Chengdu Road and Bridge	0.0346	32	0.1618	93	125	26
600248.SH	Yancheng Huajian	0.0258	77	0.2981	51	128	27
600785.SH	Xinhua Department Store	0.0218	119	-0.2281	13	132	28
002563.SZ	Puma Clothes	0.0343	35	0.1565	100	135	29
300145.SZ	Zhongjin Environment	0.0277	58	0.1729	84	142	30

Quarter4:

证券代码	证券简称	EY	Rank1	ROIC	Rank2	SUM RANK	FINAL RANK
600658.SH	Electronic City	0.1462	4	-1.7978	3	7	1
600988.SH	Chifeng Gold	0.1525	3	3.7338	22	25	2
002187.SZ	Guangbai Shares	0.0588	20	-0.3931	7	27	3

002041.SZ	Denghai Agriculture	0.0630	14	0.4861	32	46	4
000011.SZ	Shenzhen Management A	0.0764	11	0.4206	36	47	5
000537.SZ	Guangyu Development	0.0836	7	0.3163	41	48	6
600012.SH	Wantong High Speed	0.0368	49	-11.6896	2	51	7
000715.SZ	ZTE Commercial	0.0581	21	0.4702	33	54	8
002013.SZ	Zhonghao Electronic	0.1874	2	0.2420	54	56	9
000552.SZ	Jingyuan Coal Electricity	0.0692	12	0.2797	46	58	10
000062.SZ	Shenzhen Huaqiang	0.0530	26	0.3676	38	64	11
000417.SZ	Hefei Department Store	0.0360	50	-0.0957	16	66	12
000151.SZ	Zhongcheng Shares	0.0322	62	-0.2626	9	71	13
601107.SH	Sichuan Chengyu	0.0318	65	-0.4314	6	71	14
002400.SZ	Shengguang Corporation	0.0393	44	0.7507	28	72	15
600266.SH	Chengjian Development	0.0866	6	0.1957	72	78	16
000568.SZ	Luzhou Laojiao	0.0342	56	2.0783	23	79	17
002305.SZ	Nanguo Zhiye	0.0941	5	0.1858	78	83	18
600060.SH	Hisense Image	0.0786	9	0.1895	77	86	19
002546.SZ	Xinlian Electronic	0.0430	39	0.2668	49	88	20
000856.SZ	Jidong Equipment	0.0535	25	0.2133	66	91	21
002035.SZ	Huadi Shares	0.0514	28	0.2161	65	93	22
300251.SZ	Guangxian Media	0.0442	38	0.2313	59	97	23
000006.SZ	Shenzhen Management A	0.0607	19	0.1848	80	99	24
600167.SH	Lianmei Holding	0.0266	93	-0.1867	11	104	25
600057.SH	Xiamen Xiangyu	0.0395	43	0.2177	62	105	26
600361.SH	Hualian Comprehensive Store	0.0269	89	-0.0226	20	109	27
002628.SZ	Chengdu Road and Bridge	0.0318	64	0.2720	48	112	28
002096.SZ	Nanling Minbao	0.0482	29	0.1760	85	114	29
300074.SZ	Huaping Shares	0.0344	54	0.2166	64	118	30

IMPORTANT: We do not recommend people to navigate the companies by English Names. If readers want to find details, they can use SECURITY CODES directly to find the companies in SSE or SZSE.

Appendix 4: R Codes Used in 5.2.2

(Note: The Codes Presented Here Can Be Used to Construct the Correct Logarithm and Difference Model in the Section 5.2.2.)

1. Deal With PEG- AVGROE

```
> rm(list = ls(all = TRUE))
> graphics.off()
>
> setwd("d://桌面文件//桌面//DATA//GAIN_ROE_PEG")
>
> library(car)
> data = read.csv("Gain_AVGROE_PEG.csv")
> head(data)
  GAINRATE.  AVGROE  PEG.2011.12.30.
1    7.610390    10.36061          1.4128
2    4.473856    24.41188          0.6847
3    4.026385    11.43797          0.1273
4    4.103326    10.73467          2.3824
5    3.829749    21.64126          0.7697
6    3.821340    15.04252          0.5076
>
> names(data) = c('y','x1','x2')
> y = data$y
> x1 = data$x1
> x2 = data$x2
> head(data)
      y      x1      x2
1 7.610390 10.36061 1.4128
2 4.473856 24.41188 0.6847
3 4.026385 11.43797 0.1273
4 4.103326 10.73467 2.3824
5 3.829749 21.64126 0.7697
6 3.821340 15.04252 0.5076
> #DATADEALING
> yy = diff(log(y))
> x1x1 = diff(log(x1))
> x2x2 = diff(log(x2))
>
> da = data.frame(yy,x1x1,x2x2)
>
```

```
> #write.csv(da,"AfterDEALING.csv")
>
> model = lm(yy~x1x1+x2x2)
> summary(model)
```

Call:

```
lm(formula = yy ~ x1x1 + x2x2)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.51023	-0.01971	0.00183	0.02071	0.14233

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.005792	0.001719	-3.370	0.000802 ***
x1x1	-0.016542	0.002544	-6.503	1.69e-10 ***
x2x2	0.001469	0.001593	0.922	0.357021

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04161 on 583 degrees of freedom

Multiple R-squared: 0.07107, Adjusted R-squared: 0.06788

F-statistic: 22.3 on 2 and 583 DF, p-value: 4.65e-10

#Formula:

```
yy = -0.0165*x1+0.0015*x2-0.005
```

```
>
```

```
> model_res = residuals(model)
```

```
> # Auto-correlation
```

```
> durbinWatsonTest(model)
```

lag	Autocorrelation	D-W Statistic	p-value
1	-0.2393019	2.220594	0.006

Alternative hypothesis: rho != 0

Note: The DW Test Statistic approaches to 2 so we have eliminated auto-correlation. However, the P-value showed above suggests that X2 is insignificant.

2. Deal With PEG- AVGROA

```
> rm(list = ls(all = TRUE))
```

```
> graphics.off()
```

```
>
```

```
> setwd("d://桌面文件//桌面//DATA//GAIN_ROA_PEG")
```

```

>
> library(car)
> data = read.csv("GAIN_AVGROA_PEG.csv")
> head(data)
  GAINRATE.  AVGROA  PEG.2011.12.30.
1    7.610390    6.28397          1.4128
2    4.473856   15.97859          0.6847
3    4.026385    1.95646          0.1273
4    4.103326    4.62885          2.3824
5    3.829749   11.20674          0.7697
6    3.821340   11.44592          0.5076
>
> names(data) = c('y','x1','x2')
> y = data$y
> x1 = data$x1
> x2 = data$x2
> head(data)
      y      x1      x2
1 7.610390  6.28397 1.4128
2 4.473856 15.97859 0.6847
3 4.026385  1.95646 0.1273
4 4.103326  4.62885 2.3824
5 3.829749 11.20674 0.7697
6 3.821340 11.44592 0.5076
>
> # DATADEALING
> yy = diff(log(y))
> x1x1 = diff(log(x1))
> x2x2 = diff(log(x2))
>
> da = data.frame(yy,x1x1,x2x2)
>
> # write.csv(da,"RATE_ROA_PEG_AFTERDEALING.csv")
>
> model = lm(yy~x1x1+x2x2)
> summary(model)

```

Call:

```
lm(formula = yy ~ x1x1 + x2x2)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.51517	-0.01819	0.00243	0.02093	0.14416

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.005797	0.001754	-3.305	0.00101 **
x1x1	-0.008609	0.002058	-4.184	3.31e-05 ***
x2x2	0.003127	0.001628	1.921	0.05526 .

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04246 on 583 degrees of freedom

Multiple R-squared: 0.03272, Adjusted R-squared: 0.0294

F-statistic: 9.86 on 2 and 583 DF, p-value: 6.147e-05

#Formula:

$Y = -0.008609 \cdot x_1 + 0.003127 \cdot x_2 - 0.005797$

>

> model_res = residuals(model)

> # Auto-correlation

> durbinWatsonTest(model)

lag	Autocorrelation	D-W Statistic	p-value
-----	-----------------	---------------	---------

1	-0.2497418	2.246931	0.006
---	------------	----------	-------

Alternative hypothesis: $\rho \neq 0$

Note: The DW Test Statistic approaches to 2 so we have eliminated auto-correlation. However, the P-value showed above suggests that all coefficients are significant.

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