

The Effect of Inclusion of MSCI Index on the Stock Price Credit Content of Selected A-Share Constituents: An Empirical Study Based on the PSM-DID Method

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Abstract: This paper uses propensity matching score method and double difference model to measure the impact of this event on stock information content by means of the natural experimental platform of A-shares incorporating MSCI index. By comparing the excess returns of matching stocks and underlying stocks before and after the announcement day, it is found that compared with the underlying stocks, the excess returns of matching stocks are not significant, and the market reaction is not obvious. Moreover, the excess return of the underlying stocks that cannot be matched by propensity score matching method is lower than that of the matching stocks, which is similar to the results of Ni et al. (2020), and supports the inclusion of the underlying index events. It is through the information-driven channel rather than the demand-driven channel that leads to excess return. Next, in order to verify this hypothesis, this paper uses the difference-in-difference model to explore the impact of MSCI index on stock information quality by using sample stocks (underlying stocks and control stocks) from May 2016 to May 2019. The results show that the event significantly improves the information content of stocks and reduces the synchronization between stocks and markets, that is, the information-driven hypothesis wins. Load forecasting is very important for power dispatching. Accurate load forecasting is of great significance for saving energy, reducing generating cost and improving social and economic benefits. In order to accurately predict the power load, based on BP neural network theory, combined with the advantages of Clementine in dealing with big data and preventing overfitting, a neural network prediction model for large data is constructed.

1. Introduction

With the advancement of economic globalization, China's financial market opening to foreign countries has gradually increased, and the level of capital market internationalization has improved. With the continuous improvement of China's stock market policy system, international investors widely recognized China's A-share market access. Shanghai-Hong Kong Stock Connect was officially opened on November 17, 2014, which is a milestone in the two-way opening of China's capital market. The improvement of the interconnection mechanism between mainland China and Hong Kong also creates positive conditions for A shares to be included in the MSCI index. On June 21, 2017, MSCI officially announced that China's A-shares will be included in the MSCI emerging market index. Based on the 5% inclusion factor, 222 large-cap A-shares will be added, which accounts for about 0.73% of the MSCI index. The list of A-share large-cap enterprises included in the MSCI index was officially announced on May 15, 2018. After closing on May 31, 2018, MSCI officially included 224 shares in its index.

MSCI (Morgan Stanley Capital International) emerging market index is the world's largest index provider. By the end of 2015, more than 790 ETFs were tracked by the MSCI index, and 95% of the investment equity pensions in the United States were based on the MSCI. The merger of A shares means that overseas index funds will buy a large number of A shares. The addition of these 'smart' money is expected to accelerate the process of internationalization of A shares, and then have a profound impact on the structure of market investors, transaction style and product ecology.

Since the event contributes to the internationalization of China's capital market, this paper uses propensity matching score method and double difference model to measure the impact of this event on stock information content by means of the natural experimental platform of A-shares incorporating MSCI index. By comparing the excess returns of matching stocks and underlying stocks before and after the announcement day, it is found that compared with the underlying stocks, the excess returns of matching stocks are not significant, and the market reaction is not obvious. Moreover, the excess return of the underlying stocks that cannot be matched by propensity score matching method is lower than that of the matching stocks, which is similar to the results of Ni et al. [1], and supports the inclusion of the underlying index events. It is through the information-driven channel rather than the demand-driven channel that leads to excess return. Next, in order to verify this hypothesis, this paper uses the difference-in-difference model to explore the impact of MSCI index on stock information quality by using sample stocks (underlying stocks and control stocks) from May 2016 to May 2019. The results show that the event significantly improves the information content of stocks and reduces the synchronization between stocks and markets, that is, the information-driven hypothesis wins.

2. The background and significance of A-share in MSCI

A share into the MSCI index road is quite tortuous. In 2013, MSCI announced the launch of its review and consultation of China's A-share market into the MSCI Emerging Market Index. However, in the following three years, due to multiple factors, A shares have passed the opportunity to be included in the MSCI Emerging Market Index for three consecutive times. In June 2014, MSCI decided not to include A shares in the emerging market index, but remained in the audit list. In June 2015, MSCI once again indicated that it would not include A-shares, and proposed three requirements to be improved, namely capital flow restrictions, quota allocation of qualified foreign institutional investors / qualified foreign institutional investors in RMB and investment income rights. In April 2016, MSCI company again proposed China's A-share evaluation consultation. On the basis of the three problems in the previous year, it puts forward three problems: the limitation of QFII export quota, the unclear effect of the new regulations for the suspension of A-share companies, and the limitation of the establishment of A-share derivatives abroad. Eventually A-shares were again delayed by MSCI. However, this tortuous process has also prompted many reforms of A-shares. The Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect have been opened successively. The CSRC has also clarified the legal relationship between securities equity owners (customers) and QFII, RQFII nominal holders (asset managers), and reformed the suspension system of A-share listed companies. The suspension system of listed companies has been reformed. In addition, the State Administration of Foreign Exchange has also reformed the QFII foreign exchange management system.

The successful incorporation of A-shares will bring about wide participation of 'smart investors', which is conducive to forcing the reform of China's capital market and further improving the investor structure [2]. To reverse the long-term investment style of A-shares, such as individual investors, overall investment, immature concept and strong speculative atmosphere [3]. Similarly, the opening up of capital markets could further exacerbate market volatility, implying the possibility of increased systemic risk. As Xie Zhengyu [4] found, after the implementation of the QFII system, China's stock market and international stock market trends in the same direction, while the main international stock market yields linkage than before the introduction of QFII significantly improved.

3. Literature review

There are two main views on the mechanism of stock announcement effect caused by events such as inclusion index: information-driven hypothesis and demand-driven hypothesis.

According to the information-driven hypothesis, the information that the inclusion (exit) index itself represents the positive (negative) development prospects of the underlying stock has the following theoretical support [5].

(1) Information Hypothesis: Joining the main index is a proof of the company's position as an 'industry leader', that is, the authority of the index itself gives firm value affirmation.

(2). Liquidity hypothesis: when the index is added, the liquidity of the constituent stocks increases, the utilization of analysts' information decreases, the risk of information asymmetry between buyers and sellers decreases, thus narrowing the spread, so the normal yield decreases and the stock price increases.

(3) Investor Consciousness Hypothesis: Joining index can encourage companies to create better performance, resulting in sustained stock price growth.

The information conveyed by domestic empirical research is that events such as inclusion index can promote informed trading to transmit information about stocks, so that valuable characteristic information of companies can be absorbed by stock prices. Ni Xiaoran et al. (2020)[1] research shows that adding MSCI index can transfer the prospect information of the component enterprises, promote the active trading of local smart investors, help the value investment index to transfer the prospect information of the component enterprises, promote the active trading of local smart investors, help the development of value investment and improve the pricing efficiency of the capital market. Zhong Qinlin et al. (2018)[6] found that Shanghai-Hong Kong Stock Connect can improve the stock price information content of the underlying stocks from information channels and optimizing corporate governance channels; Shang Xingxing (2020) [7]found that the operation of Shanghai-Hong Kong Stock Connect promoted the enthusiasm and intensity of foreign investors' information mining, but did not find its significant role in corporate governance. Based on the demand hypothesis, this paper proposes Hypothesis 1 that the inclusion of A-shares in the MSCI index can improve the information content of underlying stocks.

Demand-driven hypothesis argues that after the inclusion of new shares, index trackers' demand for new shares increases, leading to higher share prices. Its theoretical support is classified into two categories :

(1) As the short-term demand curve of stocks inclines downwards, the purchase of index trackers leads to short-term supply and demand imbalances of stocks, followed by short-term rise in stock prices[8].

(2) Due to the incomplete substitution of stocks, the long-term demand curve of stocks inclines downwards and the price effect of constituent stocks will last for a long time.

Overall, most domestic studies support the information-driven hypothesis. According to the demand theory, the stock prices of the underlying stocks will rise, and the herd effect leads to an increasingly fierce co-movement. Yang Fan and Zhu Bangyi (2007)) The study found that the average increase in the underlying index of stock index futures exceeded the non-target index in most countries. Therefore, we propose Hypothesis 2, contrary to Hypothesis 1, that the inclusion of A-shares in the MSCI index will reduce the information content of underlying stocks. The large data prediction model for the user's electricity consumption is implemented in the Clementine software.

4. Research design

4.1. Sample selection and data source

This paper selects the disclosure date of the first batch of A-shares listed in the MSCI index on May 15, 2018 as the announcement date. The financial data and stock price information used in this paper are from the Rethinks database. Referring to the practice of Ni and Gu, this paper excludes the financial industry (CSRC industry category code : J), the production and supply of electricity, gas and water (CSRC industry category code : D) of the 234 constituent stocks published on the same day, and the four stocks that were not traded on the same day (ZTE, TISCO stainless steel, Donghua software, China Railway), and obtains 168 underlying stocks.

When calculating the stock price information content, taking into account that May 15,2018 is the announcement day, Friday, May 18,2018 is used as the discriminant boundary of the virtual variable

in the subsequent double difference model regression, and the weekly stock returns and market returns from May 5,2016 to May 20,2019 are calculated.

4.2. Definition of variables

(1)The excess return rate. Firstly, this paper explores the market reaction of underlying stocks and matching stocks before and after the announcement date according to the event study method, that is, the excess return rate is used for analysis. Excess rate of return refers to the rate of return that exceeds the normal (or expected) rate of return, which is equal to the rate of return of one day minus the normal (or expected) rate of return required by investors (or market) on the day. Stock yield is:

$$R_{it} = (P_{it} - P_{it-1})/P_{it-1}$$

P_i is the closing price of stock i on day t. The weighted average excess return calculation method is: $AR_{it} = R_{it} - M_{it}$

M_{it} is t-day market value weighted average market yield. The three-day excess cumulative return rate is centered on the announcement day, that is, $t = 0$, the cumulative excess return rate in the period of two days (-1,1), that is:

$$CAR(-1, +1) = \sum_{t=-1}^{+1} AR_{it}$$

(2) Stock price information content (Infor)

Secondly, this paper discusses the impact of the inclusion of MSCI index on the information content of sample stocks. Referring to the practice of Morck et al. (2000), this paper constructs the variable of stock price information content (Infor) according to the following steps:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + e_{it}$$

R_{it} is the weekly return of stock i in t week R_{mt} is the weekly market return weighted average of circulation market value in t week. The goodness of fit R^2 of the equation represents the degree of explanation of market volatility on individual stock returns. $(1 - R^2)$ is the non-systematic risk content that cannot be explained by market volatility, that is, the ability of stock price to reflect individual stock characteristic information. Since the range of R^2 is [0, 1], this paper converts it to a normal distribution.

$$Infor_i = \log\left(\frac{1 - R_i^2}{R_i^2}\right)$$

$Infor_i$ means the characteristic information content of stock price.

4.3. Research methods and ideas

(1) Score of matching tendency

In order to compare the excess returns of non-component stocks and constituent stocks in the announcement day window, and to analyze the impact of the inclusion of MSCI index on stock price information content by using the difference-in-differences method, this paper uses the Propensity Score Matching PSM to screen the control group corresponding to the underlying stock constituent stocks. The use of PSM is to explore the relationship between treatment factors and outcomes. It is necessary to set up a control group for comparison. The purpose is to control the interference of non-treatment factors and highlight the net effect of treatment factors. The main idea is to score the individuals in the control group and the experimental group according to the characteristics of multiple dimensions (covariate set), that is, the multidimensional covariate set is compressed into one-dimensional variables, and then the samples with similar covariates in the control group and the experimental group are matched according to the method of similar scores. This makes the matched individuals have no significant difference except whether they are treated or not, and reduces the net effect of non-treatment factors mixed with the final treatment factors, which alleviates the self-

selection bias to a certain extent. In this paper, A-share stocks are used as the preliminary control group, and the control group samples are selected with the matching ratio of 1: 1. Finally, 148 control group samples were selected, that is, 20 of the underlying stocks did not match the appropriate non-underlying stocks. Referring to the covariates used by Shang Xingxing, Zhong Qinlin and Huang Jun, and taking into account the availability of data, the covariates used for matching are annual turnover of tradable shares, return on assets, growth rate of operating income, asset-liability ratio, net market rate and end-of-year market value of circulation.

(2) Difference-in-difference model(DID)

In order to explore whether the MSCI index improves the information content of the underlying stock, this paper designs the following differential model. The covariate used by propensity matching score method is the control variable of the model.

$$Infor_{it} = \alpha + \alpha_1 Infor \times After + \alpha_2 Post + \alpha_3 After + \sum \alpha_k Control_k + \mu_{it}$$

where *Infor* is the proxy variable of stock price information, *Post* is the dummy variable of whether to include MSCI index, if included, *Post* = 1, otherwise *Post* = 0. *After* is a virtual variable before and after the judgment announcement date. If on May 18,2018 (due to the weekly data used in the calculation of *Infor*, the first Friday after May 15,2018 is May 18, set to the discriminant date of the double difference model regression), then it is 1, otherwise it is 0. *Infor* × *After* is the interaction term. If the coefficient α_1 is significantly greater than 0, it is considered that the inclusion of the MSCI index can improve the information content of the stock price and reduce the synchronous volatility of the underlying stock price, that is, Hypothesis 1.

The relevant variables in this article are shown in Table 1.

Table.1. Explanation of the relevant variables

Variable	Implication
Fig. 1. CAR(-1, 1)	Fig. 2. Three-day cumulative excess yield
Fig. 3. Infor	Fig. 4. Stock price information content
Fig. 5. Post	Fig. 6. If concluded, one; Or, 0.
Fig. 7. After	Fig. 8. If after 5.18 2018,1; Or, 0.
Fig. 9. Turnover	Fig. 10. Annual turnover rate of outstanding shares
Fig. 11. ROA	Fig. 12. Return of assets
Fig. 13. Growth	Fig. 14. Revenue growth rate
Fig. 15. Leverage	Fig. 16. Leverage
Fig. 17. PB	Fig. 18. Price-to-book ratio share
Fig. 19. Size	Fig. 20. Year-end circulating market capitalization

5. Research design

5.1. Announcement effect

(1) Announcement effects of underlying stocks

On May 15,2018, the first batch of A-shares included in the MSCI index was officially released as the announcement day. This part preliminarily explores the excess return before and after the announcement, and analyzes the daily excess return rate and three-day excess cumulative return rate CAR (-1,1) during the window period of 168 underlying stocks. It can be seen that on May 14, the market reaction of underlying stocks was not strong, and the average daily excess was only 0.22 % and was not significant (T = 1.477). On the day of announcement, the average daily excess return of underlying stocks was the largest in three days, reaching T value of 4.565, indicating that the underlying stock price significantly increased within the announcement day. On the day after the announcement, although the daily excess return rate is not as good as the previous day, the average value is still significantly higher than that on the day before the announcement, and it has obvious

statistical significance (T value is 4.557). The preliminary results show that the inclusion of MSCI events has a significant positive effect on the price of A-share underlying stocks, and the announcement effect is obvious.

Table.2. Market Reactions on Stock Announcement Day

Fig. 21. Time table	Fig. 22. Sample size	Fig. 23. Mean	Fig. 24. T
Fig. 25. T-1	Fig. 26. 168	Fig. 27. 0.0022	Fig. 28. 1.477
Fig. 29. T	Fig. 30. 168	Fig. 31. 0.0067	Fig. 32. 4.565
Fig. 33. T+1	Fig. 34. 168	Fig. 35. 0.0059	Fig. 36. 4.557
Fig. 37. CAR (-1,1)	Fig. 38. 168	Fig. 39. 0.0148	Fig. 40. 6.672

(2) Comparison of sample announcement effects after PSM screening

In order to ensure that non-processing factors do not interfere with stock price fluctuations, this paper uses propensity matching score method to construct a set of control groups similar to the underlying stock.

Shares are more similar to the control group. The covariates selected in this paper are the annual turnover rate of circulating stocks (Turnover), the return on assets (ROA), the growth rate of operating income (Growth), the asset-liability ratio (Leverage), the market-to-book ratio (PB), and the circulation market value (Size). Using the above data for radius matching, 168 underlying stocks can be matched, and 20 underlying stocks do not match to the non- underlying stocks within the specified distance. Fifteen stocks missing data in the window period on May 16, 2018 are excluded, and 133 control stocks in the control group are obtained. The following table shows the market reactions of the underlying stocks and the control stocks.

By comparison, we can see that, except that the daily cumulative excess return on the day of announcement is not significantly different between the matching target group and the control group, the difference between the matching target group and the control group is significant whether the daily cumulative excess return or the three-day cumulative excess return. In addition, the excess returns of the control sample stocks are smaller than those of the matching target group, indicating that the internal and external events in the window period have a weak impact on the control group. In contrast, the inclusion of the MSCI index makes the matching target stocks have a significantly positive market reaction.

Further, by comparing the excess returns of 20 unmatched underlying stocks with 148 matched scale stocks, it is found that the cumulative excess returns that cannot be matched are small, which is 1.059 %, while the matching group is 1.537 %, which is contrary to the demand-driven hypothesis. According to the demand-driven hypothesis, the market reaction of the underlying stocks that cannot be matched or substitute stocks are scarce should be stronger than that of the matching underlying stocks. In this part, we should continue to verify Hypothesis 1 and analyze the impact of inclusion of MSCI from the perspective of information-driven hypothesis.

Table.3. Comparison of the market reaction of the matching underlying stock with the stock of the control sample

	Fig. 41. The underlying stock Fig. 42. (Sample Size 148)	Fig. 43. Control Sample Fig. 44. (Sample Size 133)	
Fig. 45. T-1 excess yield average	Fig. 46. 0.0020466	Fig. 47. -0.00122256	
Fig. 48. Significance of the T-test for independent samples	Fig. 49. 0.011	Fig. 50. Sig. (Double tail)	Fig. 51. 0.000
Fig. 52. T Average excess yield	Fig. 53. 0.0069095	Fig. 54. -0.0004474	
Fig. 55. Significance of the T-test for independent samples	Fig. 56. 0.481	Fig. 57. Sig. (Double tail)	Fig. 58. 0.001
Fig. 59. T+1 excess yield average	Fig. 60. 0.0064149	Fig. 61. 0.0033729	
Fig. 62. Significance of the T for independent samples	Fig. 63. 0.407	Fig. 64. Sig.(Double tail)	Fig. 65. 0.123
Fig. 66. CAR (-1,1)	Fig. 67. 0.0153709	Fig. 68. -0.0093000	
Fig. 69. Significance of the T-test for independent samples	Fig. 70. 0.247	Fig. 71. Sig.(Double tail)	Fig. 72. 0.000

Table.4. Three-day excess cumulative returns of matching underlying stocks and stocks without matching underlying stocks

Fig. 73. The underlying stock (148) (148)		Without matching underlying stocks(20)
Fig. 74. CAR(-1, 1)	Fig. 75. 0.0153709	Fig. 76. 0.0105900

5.2. Difference-in-difference model

(1) Descriptive statistics

The following table reports the descriptive statistical results of the main variables of the article. The average value of stock price information content is 0.998, and the standard deviation is 1.079, which is similar to that of Zhong Qinlin et al. [6] (the average value is 0.903, and the standard deviation is 1.106). It shows that the stock price information content between companies is quite different.

Table.5. Descriptive Statistics

Fig. 77.	Fig. 78. Size	Fig. 79. Mean	Fig. 80. Standard deviation	Fig. 81. Minimum	Fig. 82. Maximum
Fig. 83.	642	0.998	1.079	0.000	7.370
Fig. 84. Turnover	642	3.982	2.687	2.052	7.164
Fig. 85. ROA	642	9.155	8.159	-25.454	51.294
Fig. 86. Growth	642	24.384	39.744	-96.386	267.315
Fig. 87. Leverage	642	51.724	20.485	4.240	95.237
Fig. 88. PB	642	4.357	11.887	0.873	215.015
Fig. 89. Size	642	23.757	1.363	21.264	24.532

(2) Analysis of empirical results

Table.6. Regression Results

Variable	Coefficient
Fig. 90. Infor×After	0.1485***
	(3.45)
Fig. 91. Post	0.1054***
	(4.64)
Fig. 92. After	0.4946***
	(29.06)
Fig. 93. After	0.0045
	(0.72)
Fig. 94. Turnover	-0.3079**
	(-2.17)
Fig. 95. Growth	0.2749***
	(8.71)
Fig. 96. Leverage	0.1054
	(0.43)
Fig. 97. PB	0.2846***
	(18.39)
Fig. 98. Size	0.0210
	(0.91)

Table 6 lists the regression results of the difference-in-difference model. The interaction coefficient of Infor × After is 0.1485, and the T value is 3.45, which passes the aboriginality test at 1 % level. The results show that the inclusion of A shares into the MSCI index helps to promote the inclusion of stock trait information into stock prices, reduce the synchronization of constituent stocks, improve the information content of stock prices, improve the efficiency of capital markets, and further support the establishment of the information-driven hypothesis.

6. Research conclusions and implications

Based on the matching propensity score method and the difference-in-difference model, this paper preliminarily verifies the impact of A shares ' inclusion in MSCI index on the stock price information content of constituent stocks. First of all, through the analysis of event study method, it is found that the inclusion of MSCI index has a significantly positive announcement effect on the constituent stocks, and the matching propensity score further demonstrates that the announcement effect comes from the information-driven channel rather than the demand-driven one. Using matching samples, we find that the impact of MSCI index on stock price information content is significantly positive, which has a positive effect on the development of China ' s capital market.

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