The Impact of Short Selling Constraints on Stock Pricing Efficiency

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Abstract: As an important market transaction mode, the impact of short selling transactions on the securities market has attracted widespread attention in the academic and practical circles as early as the last century. In this paper, by directly constructing indicators to measure the efficiency of stock pricing, we examine the changes in the pricing efficiency of the underlying stocks before and after the opening of the margin trading business. The results show that the relaxation of short selling transactions significantly improves the efficiency of the price of the underlying stocks in reflecting negative market information, and improves the pricing efficiency of the underlying stocks.

1. Introduction

Short selling is an important market transaction mode. It is the behavior that investor borrow securities from market participants and sell them to get profit within the agreement time, and it has a certain leverage effect due to the margin trading. The short selling, however, originated in the 17th century Amsterdam stock market. In the 1970s, Miller's (1977) "overvaluation of stock price "hypothesis set off an upsurge in research on the impact of short selling on stock pricing. In the meantime, the effect of short selling on the efficiency of stock pricing has also received widespread attention. However, it was not until 2010 that China started to open the short selling market, so, its development of credit trading is severely falling behind.

Considering the different market efficiency and the level of economic development between China and developed countries, we choose to study the relationship between short selling and stock pricing efficiency. In particularly, we study it from the perspective of the effect of short selling constraint on stock pricing efficiency. With the rapid development of credit trading, the effect of short selling transactions will be different, but this research can provide a basis for the further study.

2. Model Construction and Variable Selection

2.1 Model Construction

Hypothesis 1: After the opening of the pilot business of margin financing and securities lending, the pricing efficiency of the underlying stock market has been significantly improved.

Hypothesis 2: Relaxing short selling restrictions improves the efficiency of the underlying stocks' response to negative market information.

This paper will use the double difference model to test hypotheses 1 and 2, The double difference model was first proposed by Ashenfelter and Card in 1985 when evaluating the impact of CETA program training on trainees' income. Because the model considers the difference of policy influence before and after and the relative difference between experimental group and control group, it can not only control the influence of some other factors besides the policy to a certain extent, but also effectively solve the universal endogeneity problem.

The margin trading business was officially opened on March 31, 2010, and the first batch of 90 stocks was selected as the target of margin trading. On November 29, 2011, the Shanghai and Shenzhen stock exchanges issued an announcement, announcing that the underlying stocks of margin trading and securities lending would be expanded from the previous 90 to 278 on December 5, 2011.

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The orderly expansion of the underlying stocks of margin trading and securities lending provides good conditions for the use of the double difference model to test hypotheses 1 and 2. This paper mainly selects the experimental group stocks from the margin trading targets selected on March 31, 2010, and the newly added margin trading targets in the first expansion are selected as the scope of selecting the control group stocks. Based on the above description, this article establishes the following double difference model:

$$Y_{i,t} = \beta_0 + \beta_1 Treated_i + \beta_2 Post_t + \beta_3 Treated_i \times Post_t + controls + Firm_{fixed\_effect} + Time_{fixed\_effect} + \varepsilon_{i,t} \quad (1)$$

Among them, $Y_{i,t}$ is the stock pricing efficiency index of stock i in period t. $Ttreated_i$ is a dummy variable of the experimental group. If the stock i belongs to the experimental group, the value of this variable is 1, otherwise the value is 0. $Post_t$ is a dummy variable identified during the experimental period. If the time t is in the experimental period, the value of this variable is 1, otherwise the value is 0. $Ttreated_i \times Post_t$ is the interaction term of the two. In order to improve the effectiveness, this paper also adds a series of control variables to the formula (1), including Illiquid, Turnover, Lnmcap, BM, Leverage, ROE, PE, Top10 and Instown.

For the selection of control variables, this article mainly refers to relevant domestic and foreign literature. Kyle (1985) and Sadka and Scherbina (2007) both found that the liquidity of securities has a correlation with their pricing efficiency. This article uses illiquidity indicators and quarterly average daily turnover rates to measure the liquidity of stocks, the illiquidity indicators are an inverse indicator of stock liquidity. Fama (1992) believes that company size and book-to-market value ratio will affect stock prices. Brown and Kapadia (2007) and Hou Yu and Ye Dongyan (2008) believe that company fundamental indicators such as financial leverage and profitability may affect stock pricing efficiency. Xu Hongwei and Chen Xin (2012) believe that the P/E ratio is related to the efficiency of stock pricing. Li Zengquan (2005) believes that there is a significant correlation between equity concentration and stock pricing efficiency.

2.2 Variable Selection

Hou and Moskowitz (2005) proposed to use the relative efficiency of asset prices to reflect market information to measure asset pricing efficiency, and constructed corresponding price lag indicators. This paper draws on the practice of Hou and Moskowitz (2005), and uses market return as a proxy variable of public information to examine the ability of historical market information to explain individual stock returns after controlling current market factors. To this end, this article builds the following model:

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \sum_{\tau=1}^{n} \delta_{i,\tau} r_{m,t-\tau} + \varepsilon_{i,t} \quad (2)$$

Among them, $r_{i,t}$ and $r_{m,t}$ respectively represent the current return rate of individual stocks and the market; and $r_{m,t-\tau}$ represents the market return rate of the lag period τ.In order to more fully and accurately examine how the prices of individual stocks in China's stock market reflect market information, this paper chooses the five-period lagging historical market rate of return as the explanatory variable of the model, that is, let n equal 5.

In order to further measure the degree to which individual stock prices reflect historical market information separately, this article first needs to separate the current market factors' explanatory power for individual stock returns from the overall explanatory power, and use this as a benchmark for comparison, that is, let $\delta_{i,\tau}$ =0(τ=1, 2, ..., n), the following model is obtained:

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \varepsilon_{i,t} \tag{3}$$

Compared with the coefficient of determination $R^2_{i,U}$, the coefficient of determination $R^2_{i,U}$ obtained from the regression of model formula (3) only reflects the explanatory power of the current market rate of return on the rate of return of individual stocks. The larger the $R^2_{i,U}$, the stronger the explanatory power of current market information on individual stock returns.

After obtaining the coefficients of determination $R^2_{i,U}$ and $R^2_{i,R}$ of the above two models, this paper refers to Hou and Moskowitz (2005) to construct the following indicators:

$$PD_i = 1 - R^2_{i,R} \big/ R^2_{i,U} \tag{4}$$

It can be seen from equation (4) that the size of the index PD_i is mainly determined by the ratio $R^2_{i,R} / R^2_{i,U}$ of the coefficients of determination in equations (2) and (3), and it is negatively related to it. PD_i is an inverse indicator of the efficiency of stock pricing, the problem of heteroscedasticity may also occur when directly using this indicator for cross-sectional comparison. In order to solve this problem, this article makes certain adjustments to the above indicators, and then constructs the first price lag indicator in this study. The specific construction method of the indicator is as follows:

$$D_{1i} = \ln(1/PD_i) = \ln R^2_{i,U} - \ln(R^2_{i,U} - R^2_{i,R}) \tag{5}$$

It can be seen from equation (5) that the main difference between index D_{1i} and PD_i is that D_{1i} is the logarithmic value of the reciprocal of PD_i .Since the indicator D_{1i} measures the overall effect of the development of margin trading and securities lending on the efficiency of stock pricing, in order to isolate the impact of short-selling transactions, this article mainly refers to Boehmer and Wu (2013) to construct a measure of the efficiency of stock prices on negative market information. The specific measures are as follows.

First, adjust the equations (2) and (3) to:

$$r^-_{i,t} = \alpha_i + \beta_i r^-_{m,t} + \sum_{\tau=1}^{n} \delta_{i,\tau} r^-_{m,t-\tau} + \varepsilon^-_{i,t} \tag{6}$$

$$r^-_{i,t} = \alpha_i + \beta_i r^-_{m,t} + \varepsilon^-_{i,t} \tag{7}$$

Among them, $r^-_{i,t}$ and $r^-_{m,t-\tau}$ refer to the daily return of stock i on day t and the historical market return when the market return is negative, and when the market rate of return is positive, make the daily return rate of individual stocks and historical market return rate 0. According to the coefficient of determination obtained by regression of model formulas (6) and (7). And in accordance with the method and steps of constructing indicator D_{1i}, this paper constructs a price lag indicator that measures the negative market information reflected by stock prices, denoted as D_{1i}^-.

In addition, referring to Hou and Moskowitz (2005), this paper also constructs a second price lag indicator as a supplement to the indicator D_{1i}, which is defined as follows:

$$D_{2i} = \sum_{\tau=1}^{5} \left| \delta_{i,\tau} \right| \Big/ \left(\left| \beta_i \right| + \sum_{\tau=1}^{5} \left| \delta_{i,\tau} \right| \right) \tag{8}$$

It can be seen from the above formula that the index D_{2i} is constructed using the coefficient relationship obtained from the regression of model formula (2). Among them, the denominator represents the sum of the explanatory power of current market factors and historical market factors on individual stock returns, and the numerator only represents the explanatory power of historical market factors. This indicator represents the proportion of the sum of historical market factors explanatory power in the overall explanatory power, and is an inverse indicator of stock pricing efficiency.

In the same way, this paper refers to the construction method and steps of D_{1i}^{-} to get the index D_{2i}^{-}. This indicator is also an inverse indicator of pricing efficiency, which is used to measure the efficiency of stock prices to reflect negative market information.

3. Sample data and Descriptive statistics

On March 31, 2010, the pilot business of margin trading and securities lending in China was officially launched. The Shanghai and Shenzhen Stock Exchange announced the first batch of stocks for margin trading and securities lending, totaling 90 stocks. With the development of margin trading and securities lending business, the underlying stock has undergone several expansions. Among them, the first expansion of the target took place on November 25, 2011, and the number of target stocks was adjusted from the original 90 to 278. Due to the exogenous nature of the time of the event, the opening and expansion of the margin trading and securities lending business provides a rare natural opportunity for this article to use the double difference model to test the relevant hypotheses.

First, this article takes the first batch of 90 stocks selected for margin trading and securities lending as the selection range of the experimental group's stocks, and the first expansion of 189 stocks newly selected for margin trading and securities lending as the control group's stocks. According to the pilot business development of margin trading and securities lending and the time of the first expansion of margin trading and securities lending (about 6 quarters apart), this paper sets the research period from 2008 to 2012, and the specific sample period is March 31, 2010 6 quarters before and after(Including the first quarter of 2010).There are 12 quarters in total, and each quarter is regarded as a period; among them, the first 6 periods are non-experimental periods, and the last 6 periods are experimental periods. The data used in this article comes from the RESSET database.

Then, in order to reduce the estimation error, this article removes the following stocks from the initial sample:

(1) Stocks of listed companies in the financial industry;

(2) Specially processed stocks during the sample period;

(3) The stocks that have been excluded from the scope of margin financing and securities lending during the experimental period;

(4) Stocks whose listing time is less than one year from the sample period;

(5) Stocks whose quarterly trading days during the sample period are less than 45 days.

After the above processing, a total of 175 sample stocks were obtained in this paper, of which 45 were in the experimental group and 130 were in the control group. Finally, we extract the daily return rate and the weighted average market daily return rate of the 175 stocks during the sample period to calculate the sample observation value of the stock price lag indicator, and extract the daily trading value, daily turnover rate, daily circulation of the stock and other financial data of the stock to calculate the sample observation value of the control variable. The specific descriptive statistics are shown in Table 1.

Table 1. Description of main variables

NAME	GROUP	MEAN	MID	MIN	MAX	STD
D_1	T	2.4168	2.2652	0.1309	7.2840	1.0819
	C	2.2815	2.1634	0.0350	8.5361	1.0013
D_1^-	T	1.2417	1.1219	0.0013	7.9115	0.8487
	C	1.2919	1.1616	0.0001	7.3234	0.8645
D_2	T	0.3710	0.3619	0.1096	0.8399	0.1261
	C	0.3843	0.3734	0.0687	0.9952	0.1263
D_2^-	T	0.5817	0.5951	0.0711	0.8828	0.1418
	C	0.5238	0.5054	0.1143	0.9942	0.1707
Illiquid	T	0.0088	0.0055	0.0009	0.3057	0.0158
	C	0.0241	0.0130	0.0010	1.1451	0.0478
Turnover	T	1.7938	1.4455	0.0349	8.6163	1.4634
	C	2.3976	1.9596	0.1220	11.1222	1.7399
Lnmcap	T	24.1124	24.0292	21.9279	27.4355	0.9133
	C	22.9682	22.9749	19.7841	25.5406	0.7957
Leverage	T	0.5596	0.5867	0.0249	0.8685	0.1849
	C	0.5456	0.5536	-0.1332	0.9587	0.1898
BM	T	0.3537	0.3003	0.0454	1.4286	0.2257
	C	0.3139	0.2801	0.0365	1.0870	0.1729
ROE	T	3.9163	3.9434	-94.5570	25.1319	6.2754
	C	3.5114	3.0952	-94.6304	36.0537	5.2421
PE	T	0.2608	0.2304	-3.5224	3.8219	0.4862
	C	0.5865	0.2946	-11.3875	43.2608	2.0785
Top10	T	0.6100	0.6130	0.2201	0.9609	0.1665
	C	0.5540	0.5618	0.0775	0.9352	0.1610
Instown	T	0.2109	0.1742	0.0121	0.8821	0.1520
	C	0.1574	0.1117	0.0000	0.7413	0.1405

4. Research Results and Analysis

First, Figure 1 shows the price lagging indicators of the experimental group and the control group's stocks and the changes in the difference between the two during the entire sample period, which to a certain extent reflects the impact of margin trading on stock pricing efficiency. Among them, subgraphs a) and c) show that when the price lagging indicator represents the overall effect of margin trading, the difference between the experimental group and the control group during the sample period is not obvious. The former shows that the average difference between the two sample groups (D_1) is not significantly different before and after the opening of the margin trading business, while the latter shows that the average difference of the index (D_2) has decreased to a certain extent, which indicates that the overall effect of the initial opening of margin financing and securities lending business on the efficiency of stock pricing is currently unclear, and further studies need to be conducted by using regression analysis.

However, in contrast, subgraphs b) and d) show that when the price lagging indicator measures the response of stock prices to negative market information (the separate effect of short selling), the difference between the corresponding index values of the experimental group and the control group changed significantly before and after the opening of the margin trading business. The former shows that the average difference of the indicator (D_1^-) between the two sample groups has increased after the pilot business of margin trading and securities lending, while the latter shows that the average difference of the indicator (D_2^-) has decreased to a certain extent. Since D_1^- is a positive indicator of pricing efficiency and D_2^- is an inverse indicator, the above analysis results preliminarily indicate

that the development of the pilot margin trading business may improve the efficiency of the underlying stock's response to negative market information, that is, relaxing short selling constraints may increase the efficiency of stock pricing.

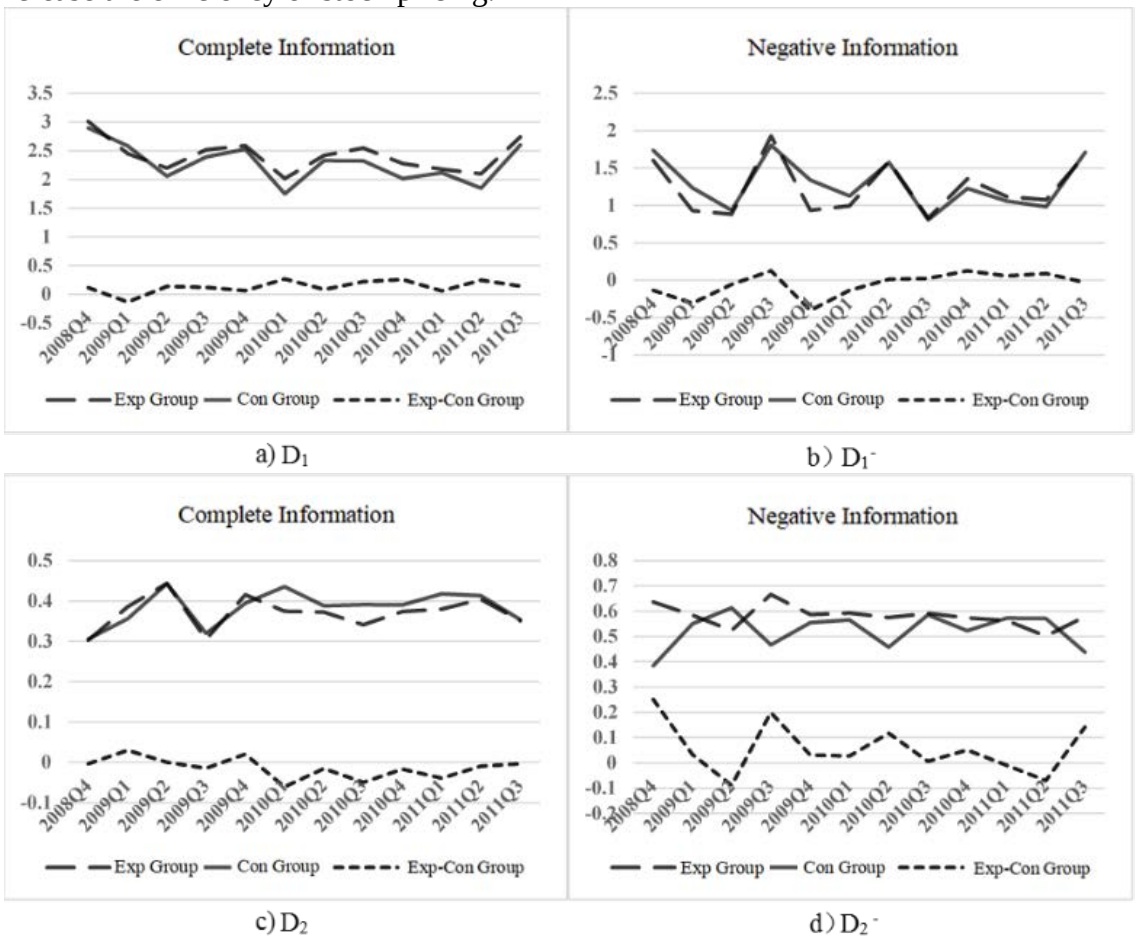

Figure 1. Margin trading and Stock pricing efficiency

In order to test the hypotheses 1 and 2, this paper uses the balanced panel data to perform the double difference model regression analysis. The specific results are shown in Tables 2 and 3. No matter in Table 2 or Table 3, columns (2) and (4) are the results of individual time-fixed effects model regression, which is the focus of this study; the columns (1) and (3) are the results of the mixed model regression, which are mainly used for comparative analysis. Table 3 shows the regression results of the model when the explained variables are price lag indicators D_1 and D_1^-. As shown in columns (1) and (2), the coefficients of the interaction term Treated post are not significant, indicating that regardless of whether the individual and time effects are controlled in the model, the efficiency of the stock price's response to the overall market information does not increase significantly with the development of the pilot margin trading business. It shows that the overall effect of margin trading on stock pricing efficiency is not significant. This may be because the volume of margin trading and securities lending was relatively small at the initial stage of the pilot business of margin trading and securities lending, which did not have a significant impact on stock prices. It does not conform to Hypotheses 1. In contrast, columns (3) and (4) show that the coefficients of the interaction terms are both significantly positive, indicating that no matter whether the individual and time effects are controlled or not, after the opening of the margin trading and securities lending business, the changes in the efficiency of stocks reflecting negative market information are significant, and the changes are positively improved. On average, margin trading and securities lending increased the efficiency of the underlying stock price in absorbing negative market information by 17.64%, which means that relaxing the short selling constraint can significantly improve the efficiency of stock pricing, which supports Hypothesis 2.

Table 2. Margin financing and stock pricing efficiency 1

variable	COMPLETE(D_1)		NEGATIVE(D_1^-)	
	(1)	(2)	(3)	(4)
constant	1.2544 (1.30)	12.5690*** (5.72)	0.7842 (1.03)	7.1107*** (3.95)
treated	0.0397 (0.47)	-1.1035* (-1.91)	-0.2255*** (-3.28)	-0.3707 (-0.80)
post	-0.1542*** (-2.71)	-0.1336 (-0.89)	-0.1819*** (-3.87)	0.1662 (1.35)
Treated×post	0.0722 (0.71)	0.0507 (0.56)	0.2103** (2.50)	0.1764** (2.31)
illiquid	1.0366 (1.19)	-1.3825 (-1.46)	0.9895* (1.90)	0.0826 (0.15)
turnover	-0.0330** (-1.99)	-0.1187***(-5.94)	-0.0687***(-5.10)	-0.1101***(-6.73)
lnmcap	0.0625(1.51)	-0.3174***(-3.76)	0.0423(1.29)	-0.2171***(-3.14)
bm	0.5482***(9.50)	0.0628(0.59)	0.4039***(8.74)	0.0971(1.14)
leverage	-0.0650 (-0.54)	-1.0643***(-2.81)	0.0039(0.04)	-0.0762 (-0.24)
roe	-0.0148*** (-3.53)	-0.0025 (-0.60)	-0.0094***(-2.68)	0.0010(0.27)
pe	-0.0018 (-0.15)	0.0115(0.96)	-0.0125 (-1.21)	-0.0086 (-0.83)
top10	-0.6500***(-4.13)	-1.0285 (-1.590)	-0.6182***(-4.78)	-0.1411 (-0.28)
instown	-0.5702***(-3.54)	-0.7582**(-2.570)	-0.2974**(-2.28)	-0.1224 (-0.51)
Time Fixed	NO	YES	NO	YES
Firm Fixed	NO	YES	NO	YES
R-squared	0.0795	0.3494	0.0735	0.3225
N	1969	1969	2036	2036

Table 3 gives similar results to Table 2. Columns (1) and (2) show that when the explained variable (D_2) represents the overall effect of margin financing and securities lending, the coefficient of the interaction term Treated post is not significant; and columns (3) and (4) show that when the explained variable (D_2^-) represents the individual effect of short-selling transactions, the coefficient of the interaction term is significantly negative. Since the variables D_2 and D_2^- are inverse indicators of pricing efficiency, the table also shows that the individual effect of short selling on stock pricing efficiency is obvious, while the overall effect of margin trading and securities lending on stock pricing efficiency is not significant. In addition, as can be seen from Table 2 and Table 3, the regression results of the mixed model and the results of the two-way fixed effect are different in the significance of some control variable coefficients. This may be because the two-way fixed effects control the individual and time effects and absorb part of the explanatory power of the controlled variables.

Table 3. Margin financing and stock pricing efficiency 2

variable	COMPLETE(D_2)		NEGATIVE(D_2^-)	
	(1)	(2)	(3)	(4)
constant	0.5770***	-0.6401***	0.6612***	-0.6990**
	(5.3)	(-2.59)	(4.5)	(-2.02)
treated	0.0102	0.0951	0.0515***	0.0631
	(1.03)	(1.46)	(3.86)	(0.69)
post	0.0222***	0.0307*	0.0116	0.0283
	(3.32)	(1.82)	(1.28)	(1.2)
Treated×post	-0.0179	-0.0131	-0.0696***	-0.0638***
	(-1.48)	(-1.23)	(-4.26)	(-4.29)
illiquid	-0.1670**	-0.0271	-0.3192***	0.1072
	(-2.22)	(-0.36)	(-3.14)	(1.01)
turnover	0.0087***	0.0195***	0.0177***	0.0235***
	(4.52)	(8.53)	(6.8)	(7.35)
lnmcap	-0.0107**	0.0328***	-0.0092	0.0424***
	(-2.27)	(3.45)	(-1.46)	(3.19)
bm	-0.0721***	-0.0054	-0.0926***	-0.0280*
	(-10.86)	(-0.45)	(-10.33)	(-1.69)
leverage	-0.0052	0.0940**	-0.0222	0.0483
	(-0.37)	(2.17)	(-1.16)	(0.8)
roe	0.0016***	0.0001	0.0026***	0.0000
	(3.12)	(0.14)	(3.82)	(0.05)
pe	0.0022	0.0012	0.0017	0.0003
	(1.52)	(0.82)	(0.85)	(0.15)
top10	0.0775***	0.0602	0.1313***	0.0061
	(4.2)	(0.87)	(5.27)	(0.06)
instown	0.0767***	0.0533	0.0495*	0.0853*
	(4.09)	(1.6)	(1.95)	(1.83)
Time Fixed	NO	YES	NO	YES
Firm Fixed	NO	YES	NO	YES
R-squared	0.0958	0.3735	0.1109	0.34
N	2100	2100	2100	2100

In summary, the relaxation of short-selling transactions has significantly improved the efficiency of the price of the underlying stocks in reflecting negative market information and improved the pricing efficiency of the underlying stocks in China's stock market. However, the overall effect of the initial stage of the margin trading business on the efficiency of stock pricing is not obvious, which shows that Hypothesis 2 is valid, but Hypothesis 1 is not.

5. Conclusions

This paper mainly uses a combination of theoretical analysis and empirical analysis to investigate whether short-selling constraints affect stock pricing efficiency. The empirical research results show that the price lagging indicators of the underlying stocks have been significantly improved after relaxing the short-sale constraints, while the overall impact of margin trading and securities lending is not significant, which leads to the conclusion: Relaxing short-selling constraints can significantly increase the speed of the price of the underlying stocks in responding to negative market information. That is, from the perspective of market information, China's short-sale transactions can improve the

pricing efficiency of the underlying stocks to a certain extent, and this impact is mainly reflected in the efficiency of the stock price to reflect negative market information.

At the same time, this paper calls for continuing this trend and reducing the entry barriers for short selling transactions, expanding the scope of securities lending and refinancing, and reducing regulatory restrictions on short selling stocks while ensuring that risks are under control.

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