I. ESG Disclosure Alleviates Bond Price Delay

(Ⅰ) Theoretical Analysis and Research Hypothesis

Bond price delay refers to the phenomenon where bond prices lag in reflecting market information, which reflects the speed at which market information is incorporated into bond prices and is also one of the important indicators for measuring the efficiency of the capital market. Similar to stock price delay, the phenomenon of bond price delay also affects the function of China's capital market in serving the real economy to a certain extent, and to a certain extent, it restricts the high-quality development of China's economy. Studying the relationship between ESG disclosure and stock price delay is of great practical significance for promoting the stability and development of China's financial market and promoting the high-quality development of China's economy.

From a theoretical perspective, the announcement of corporate ESG ratings can reduce the information asymmetry between enterprises and investors. By releasing non-financial information about the enterprise, it may attract more investor attention and investment, thereby enhancing bond liquidity. Moreover, the disclosure of ESG ratings is conducive to improving corporate image and attracting more media attention, thereby helping investors to grasp company dynamics in a timely and accurate manner, reducing information search costs, and improving bond trading efficiency, ultimately alleviating bond price delay.

Additionally, ESG ratings encompass a more diverse range of corporate governance information. The non-financial information released can assist analysts in providing better reports and forecasts, thereby helping investors make investment decisions more quickly and accelerating the impact of market information on bond price fluctuations, ultimately alleviating bond price delay.

Lastly, companies with better ESG performance may be more willing to disclose their ESG ratings earlier, and thus are more inclined to have good operating conditions and comprehensive levels. The announcement of ESG ratings demonstrates the company's confidence in coordinating the relationships among environment, society, and governance, and aligns with the company's internal control and sustainable development goals. Good internal control can to some extent ensure the reliability and accuracy of financial information, thereby helping bond prices to absorb more objective and accurate market information, ultimately alleviating bond price delay.

Based on the above theoretical reasoning, this paper makes the following hypothesis:

H1: The announcement of corporate ESG ratings can effectively alleviate bond price delay.

Compared with the impact of ESG disclosure on bond prices, there have been some academic achievements on the impact of ESG disclosure on stock prices. This paper mainly refers to the methods in (Bi Peng 2024) and below establishes a reasonable measure of bond price delay and the corresponding DID model.

(Ⅱ) Model Specification

1. Baseline Regression

This paper selects A-share listed companies that disclosed ESG ratings from 2015 to 2020 as the statistical objects. Referring to (Bi Peng 2024) to construct a method for ESG performance to alleviate stock price delay, a multi-period, a multi-period difference-in-differences model for the impact of ESG ratings on corporate bond price delay is established:

(1)

In which, represents bond price delay, represents whether the company has disclosed ESG ratings. If the company has not disclosed ESG ratings at the specified time point, the variable value is 0, otherwise it is 1. represents a series of control variables, represents the fixed effect of the company, represents the fixed effect of time, and is the random error of the model. is the ESG impact coefficient that this paper focuses on. If its value is significantly negative, it proves that the announcement of ESG ratings can effectively alleviate bond delay.

Regarding the measurement of bond delay, this paper refers to (Hou 2005) to calculate the research on stock price delay, using the individual weekly bond return and the lagged four-week market return for regression to calculate bond price delay. The specific calculation steps are as follows:

(2)

(3)

(4)

In models (2) and (3), represents the weekly return of the bond, and represents the weekly market return. If the bond price can reflect market information in a timely manner, then the coefficient should be significantly different from 0, and the expectation is almost equal to 0. Model (2) considers the impact of lagged four-week market returns on individual bond returns, while model (3) only considers the impact of current market information on individual bonds. Therefore, model (2) is called the "Unrestricted Model," and when all in model (2) are equal to 0, model (3) is called the "Restricted Model."

Model (4) is the formula for calculating bond price delay, in which is the determination coefficient of the Restricted Model, is the determination coefficient of the Unrestricted Model, and is the measurement of bond price delay. The larger its value, the lower the efficiency of the bond market.

2. Parallel Trend Test

Similar to the parallel trend test discussed earlier for the impact of ESG ratings on bond credit spreads, a parallel trend test model for the impact of ESG announcements on bond price delay is constructed here:

In which represents company as the treatment group, and represents company as the control group; is the indicator function, is the ESG rating period, indicating the relative monthly time from the ESG rating announcement, and is the regression process; the remaining variables have the same meaning as in equation (1). In this model, we are concerned with the change in , which reflects the dynamic impact of the announcement of ESG ratings on the company's bond credit spread. If the regression coefficients and are not significantly different from 0, and the regression coefficients and are significantly different from 0, the model passes the parallel trend test.

(Ⅲ) Variable and Data Selection

1. Data Source and Preprocessing

This paper selects the same sample company group as the bond credit spread discussion in the previous text, and selects the China Bond Composite Index from 2015 to 2020 to represent market conditions, and calculates the weekly market return based on this. The company-level data comes from the Wind database.

First, export the daily closing price of each company's bonds and other control variable information on the year of ESG rating disclosure, then calculate the weekly closing price at each time point, and use models (2) to (4) in the previous text to calculate the bond price delay for each date. After multiple tests, select a sliding window of 21 days before and after to calculate the R-squared of the two groups of models.

The following data cleaning steps are carried out:

(1) Remove observations with missing closing prices due to bond non-listing or maturity.

(2) Remove observations with missing Delay for each bond over two periods.

(3) Remove outliers that are more than three standard deviations from the mean.

Finally, obtain company-level sample data from Wind.

2. Variable Selection and Descriptive Statistics

Referencing (Bi Peng 2024) and the previous discussion on bond credit spreads, this paper controls important variables affecting bond price delay: company size (), debt-to-asset ratio (), return on total assets (), operating income growth rate (), listing age (), net fixed assets per capita (), cash flow ratio (), board size (), and industry category (), as shown in Table 1.

Table 1：Variable Definition

|  |  |  |
| --- | --- | --- |
| **Type** | **Variable** | **Description** |
| Dependent variable | *Delay* | A measure of the informational efficiency of the capital market, indicating the speed at which market information is incorporated into bond prices. |
| Independent variable | *ESG* | Whether the SynTao Green disclose the ESG rating of the firm |
| Control variables | *Size* | The natural log of total assets (in CN￥) plus 1 as of the end of year t |
| *Lev* | Total liabilities divided by total assets, as of the end of year t |
| *ROA* | Return on Assets, defined as net income for year t divided by total assets at the end of year t. |
| *ROE* | Return on Equity (ROE), defined as net profit after taxes for year t divided by total assets at the end of year t. |
| *Growth* | The difference of operating income for year t and that of year t-1, divided by the operating income for year t-1 |
| *ListAge* | The natural log of listing time plus 1 |
| *PFixA* | The natural log of net fixed assets, divided by the total number of staff |
| *Cash* | Net cash flow from operating activities divided by current liabilities |
|  | *BoardScale* | The natural log of the number of Board Members |
|  | *Industry* | Industry dummy variables. |

Table 2 presents the statistical description of all relevant variables in this paper. Regarding bond price delay, the sample mean is 0.664, the standard deviation is 0.279, and the minimum and maximum values are -0.174 and 1, respectively, indicating significant variation in bond price delay among companies. The descriptive statistical results for the remaining variables measuring company characteristics are all within reasonable value ranges.

Table2: Descriptive Statistics

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | N | Mean | SD | p50 | Min | Max |
| Delay | 59766 | 0.664 | 0.279 | 0.723 | -0.174 | 1 |
| ESG | 59766 | 0.166 | 0.372 | 0 | 0 | 1 |
| Size | 57799 | 23.68 | 0.984 | 23.59 | 20.67 | 26.44 |
| Lev | 57657 | 58.36 | 15.91 | 57.88 | 7.503 | 120.6 |
| ROA | 57831 | 1.822 | 2.313 | 1.337 | -13.37 | 19.95 |
| ROE | 57788 | 4.237 | 4.552 | 3.747 | -10.14 | 37.05 |
| Growth | 47650 | 0.00600 | 0.524 | 0 | -0.988 | 83.64 |
| ListAge | 49379 | 3.110 | 0.298 | 3.178 | 2.079 | 3.555 |
| PFixA | 28663 | 13.05 | 1.601 | 13.03 | 8.533 | 16.62 |
| Cash | 57621 | 0.135 | 0.388 | 0.142 | -43.79 | 1.246 |
| BoardScale | 58602 | 2.219 | 0.213 | 2.197 | 0 | 2.708 |
| Industry | 56281 | 4.918 | 2.476 | 5 | 1 | 13 |

(IV) Analysis of Empirical Results

1. Baseline Regression

Table 3 presents the regression results of whether the disclosure of a company's ESG rating affects bond price delay. Specifically, Column (1) of Table 3 reports the baseline regression model without control variables, where the coefficient for ESG is significantly negative at the 10% level; Column (2) of Table 5-1 reports the regression results after including a series of control variables, showing a greater mitigating effect of ESG rating disclosure on bond price delay, with a coefficient of -0.055, significant at the 10% level, indicating that the disclosure of ESG ratings significantly reduces company bond price delay. Additionally, considering the potential difference in market conditions in the first and second halves of the year, and that ESG ratings are disclosed on June 30th each year, a dummy variable Midyear was added to the regression, with a significantly positive coefficient, suggesting that the mitigating effect of ESG rating disclosure on bond price delay is independent of the market conditions in the first and second halves of the year. Specifically, holding other conditions constant, the initial disclosure of a company's ESG rating can, on average, reduce the company's bond credit spread by 0.055. Given that the majority of the observed samples have a Delay distribution between 0 and 1, the coefficient indicates that the disclosure of ESG ratings can effectively alleviate corporate bond price delay. Hypothesis 1 is confirmed. This may be because ESG ratings require companies to disclose information related to environmental protection, social responsibility, and corporate governance, which on one hand helps reduce the information asymmetry between the company and investors, and on the other hand helps attract the attention and favor of analysts and investors, thereby accelerating the process by which market information affects bond price fluctuations.

Table3：Baseline Results

|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
| VARIABLES | Delay | Delay |
|  |  |  |
| ESG | -0.023\* | -0.055\* |
|  | (0.012) | (0.033) |
| Midyear | 0.023\*\*\* | 0.022\*\* |
|  | (0.006) | (0.009) |
| Size |  | 0.047\*\* |
|  |  | (0.021) |
| Lev |  | -0.002\* |
|  |  | (0.001) |
| ROA |  | -0.008 |
|  |  | (0.007) |
| ROE |  | 0.004 |
|  |  | (0.004) |
| Growth |  | -0.005\*\*\* |
|  |  | (0.001) |
| o.ListAge |  | - |
|  |  |  |
| PFixA |  | 0.025 |
|  |  | (0.018) |
| Cash |  | 0.051\*\* |
|  |  | (0.026) |
| Boardscale |  | -0.219\*\*\* |
|  |  | (0.078) |
| o.Industry |  | - |
|  |  |  |
| Constant | 0.654\*\*\* | -0.195 |
|  | (0.003) | (0.647) |
|  |  |  |
| Observations | 59,766 | 19,623 |
| R-squared | 0.026 | 0.043 |
| Firm FE | YES | YES |
| Year FE | YES | YES |
| r2\_a | 0.0221 | 0.0343 |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(V) Parallel Trend Test

The use of a difference-in-differences (DID) model requires that the bond price delay of the control and treatment groups remains on the same trend before the initial disclosure of the ESG rating results to ensure the credibility of the baseline regression results. This paper uses Model (2) for regression to examine the dynamic impact of ESG on bond price delay.

As shown in Figure 1, before the disclosure of the company's ESG rating, the regression coefficient is not significantly different from 0, indicating that there is no significant difference in the level of bond price delay between the control and treatment groups, passing the parallel trend test. Within two months before and after the disclosure of the ESG rating, the regression coefficient remains not significantly different from 0. The possible reason is that the impact of the rating disclosure has not immediately reflected on the company's bond price fluctuations. Over time, the coefficient of the time variable on bond price delay becomes significantly negative, indicating that the ESG rating can effectively alleviate bond price delay. However, similar to the research on bond credit spreads, this impact is time-limited. As shown in the figure, about three months after the disclosure of the ESG rating, the regression results gradually become not significantly different from 0, indicating that the mitigating impact of the ESG rating disclosure on bond price delay gradually weakens.

Figure 1: Parallel Trend Test

