The Impact of ESG Ratings on Stock Liquidity Risk: Evidence from the Chinese Market

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ABSTRACT

In recent years, environmental, social, and governance (ESG) has gradually become a hot topic to which Chinese society attaches great importance. This research investigated the influence of ESG rating on Chinese listed firms' stock liquidity from 2015 to 2019 by collecting their daily stock price, trading volume, and annual indicators used to measure performance and firm characteristics, such as return on asset and market value. By dividing companies into high- and low-ESG companies, we find that high or low ESG has no significant effect on stock liquidity risk. Using year-fixed effect analysis on various industries, we find that ESG rating results significantly negatively impact stock liquidity risk for agriculture and other industries. In addition, the mitigating effect of ESG on stock liquidity risk is more potent for smaller firms than larger ones. This study guides listed firms to make decision-makings and weigh the importance of social contribution.

Keywords: ESG rating; stock liquidity risk; industry analysis; corporate social responsibility.

1   INTRODUCTION

Recently, the Chinese government has started focusing on environmental and social problems, such as prioritizing the construction of a green financial system described in the Thirteenth Five-Year Plan of China. Also, investors pay increasing attention to the Environmental, Social, and Governance (ESG) and Corporate Social Responsibility (CSR) aspects of a firm, as both ESG and CSR are creating a positive impact on the firm performance (Zumente & Bistrova, 2021). Thus, ESG is gradually becoming a firm's fundamental strategy, further impacting the company's stock performance.

As the recent COVID-19 pandemic threatened people's health and social stability, people have paid more attention to corporate social awareness (Ji & Zhang, 2022; Yang & Zhang, 2022). Besides, society's awareness of environmental protection is generally

increasing (Rousseau & Deschacht, 2020), advancing the development and application of ESG ratings. There are many academic studies on the impact of ESG rating on stocks, but most are for global data or other countries except China. In 2015, a third-party institution called SynTao Green Finance issued the first ESG rating for China (Tan & Zhu, 2022). Since then, China has started building its own ESG data. Today, the Chinese government and investors are increasingly aware of the green economy and are committed to a long-term transition to a green economy (Yi & Liu, 2015). The Chinese companies' ESG ratings are also gradually developing towards a regular company performance appraisal, which impacts stocks and investor preferences. At the same time, studies have shown a positive correlation between ESG indexes of Chinese companies and their stock market performance (Deng & Cheng, 2019), and good ESG performance can improve financial performance (Zhao et al., 2018). However, stock liquidity is a critical determinant of stock returns (Li et al., 2014). In this study, we employ Chinese datasets to examine the impact of ESG rating on stock liquidity risk.

Our research focuses on companies in the Chinese A-share market with ESG rating scores in SynTao Green Finance. We obtained daily data on the stock's liquidity risk according to Amihud's (2002) stock illiquidity measure and combining with the ESG rating data of the corresponding company. We split firms into high-ESG and low-ESG ones and compared their descriptive results. The result shows that the high-ESG firms do not have a lower stock liquidity risk. In the second step, we divide our sample by industry. We use the fixed effect model, run the regression for each industry, and compare their results. The result shows that in some industries, such as the agriculture industry, ESG greatly influences stock liquidity risk and has a significant negative relationship, while the retail industry has a positive relationship. The results suggest that ESG impacts a firm's stock liquidity risk differently in various industries.

Since China's ESG rating appears later than the United States and other regions, the data is relatively new. The number of relevant literature, such as research on stock performance and returns, is increasing, but there is little research on liquidity risk for the time being. This paper aims to study ESG and stock liquidity risk in China. It enriches the influence of predecessors on the relationship between ESG and the stock market and also provides specific ideas for the future choices of Chinese investors and company managers. It will also help the government further to promote the implementation of ESG ratings in Chinese companies.

The remainder of our paper proceeds as follows. Section 2 reviews relevant literature and develops hypotheses. Section 3 describes the data and methodology. Section 4 presents empirical results and performs robustness checks. Section 5 concludes.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 ESG AND FIRM RISK

The United Nations Environment Programme Initiative proposed to measure the ESG performance of companies and provide managers and investors with indicators for reference in 2014. In recent years, more and more scholars have begun to pay attention to enterprises' social and environmental contributions. The literature focused on the changes in corporate responsibility to the whole economic system, while more recently, they paid more attention to enterprises' internal development and risks.

Early studies have shown that ESG rating levels positively impact companies. For some investors, a firm's ESG is highly related to its performance (Hendratama & Huang, 2022). Still, there are also some critical comments in the literature, such as focusing on corporate social responsibility may lead to errors in earnings forecasting (Becchetti et al., 2013). The statement that ESG ratings enhance corporate returns in many works of literature is not rigorous enough. Rating companies may produce different results toward the same company (Halbritter & Dorfleitner, 2015).

Similarly, some works of literature have a positive attitude toward ESG development based on global economic trends and perceptions of the general environment. Research on European countries shows that companies concerned and favorable toward ESG ratings are more likely to achieve this. A high score, even helping a company reduce its credit risk, can lower domestic credit risk for countries advancing corporate ESG ratings (Stellner et al., 2015; Attig et al., 2013).

As ESG ratings become more popular and time-honored, the literature focuses more on details and small-scale impacts. The literature shows that most CEOs consider ESG-related issues critical to their business success, and even ignoring ESG risks has led to stock price declines and bankruptcy (Khan, 2022). CSR disclosure increases investors' interest (Kim & Jung, 2020). Studies have shown that ESG ratings positively impact company performance using proxies such as return on asset and Tobin's Q (Khan, 2022; Gillan et al., 2021; Yoo & Managi, 2022).

In addition, media disclosure is critical for companies to improve profits, while CSR actions are critical for long-term financial performance (Yoo & Managi, 2022). We see that the factors that motivate companies to invest in CSR are not only concerned with the environment and corporate reputation but may also be how executives enhance the company's attractiveness to high-quality employees and customers, as well as personal reputation (Borghesi et al., 2014). Moreover, due to the positive relationship between ESG activities and company financial performance (Tsai & Wu, 2021), research has broken it down and conducted an in-depth study of the cash flow part (Gregory, 2022) and found that ESG reduces the cost of capital and thereby increases the value of the business.

In some cases, a company's commitment to social responsibility spending explicitly creates value for its shareholders (Fatemi et al., 2015), consistent with previous research (Borghesi et al., 2014). Some researchers believe that ESG increases company value, while others believe that ESG reduces company value. ESG disclosure may reduce valuation, but exposure plays a vital role in adjusting the negative or positive impact of ESG rating results on companies, such as the moderating effect shown by Fatemi et al. (2018). Similarly, by exploring the impact of ESG certification on Malaysian companies, Wong et al. (2021) demonstrated that ESG-conscious companies positively impact stakeholders. The findings also show that the equity market is more receptive to ESG ratings than the debt market. In addition, a better ESG rating can enhance company value by motivating employees, strengthening relationships with customers or suppliers, promoting long-term growth, increasing dividends, and reducing financing costs (Chang et al., 2022). CSR also has a significant positive impact on corporate credit ratings. By improving a company's credit rating, investment in CSR activities can reduce a company's financing costs, further enhancing corporate value (Attig et al., 2013).

ESG ratings also have an impact on corporate risk and stock performance. Early literature suggests that different dimensions of social performance might affect enterprise risk differently. Bouslah et al. (2013) argue that the social aspect positively impacts enterprise risk, while the environmental aspect plays a negative role. Other studies claim

that objective ESG disclosure can enhance a company's reputation and generate benefits among its key stakeholders, contribute to corporate transparency, and reduce a company's idiosyncratic or business risk (Becchetti et al., 2015; Benlemlih et al., 2018). He et al. (2022) further confirm that companies with ESG disclosures have lower traits than their peers' risk.

Furthermore, if a company focuses on long-term profits, implementing ESG-friendly actions can reduce risk and increase the business's future profitability (Yoo & Managi, 2022) while reducing the incidence of tail risk (Gregory, 2022). Overall, CSR minimizes the risk of a stock market crash (Feng et al., 2022b). Empirical results show that companies that disclose CSR reports generate higher and corrected mid- to long-term abnormal returns than those that do not (Chiu et al., 2020).

Meanwhile, the impact of CSR is relatively short-term, and the hedging effect of ESG ratings on stock return fluctuations is short-lived but has a positive impact on the company's future performance and long-term development (Andriosopoulos & Deepty, 2022). Some researchers argue that ESG disclosure damage the stock returns of most companies, but others found that the impact of ESG on stock returns is closely related to corporate profitability (Feng et al., 2022a). Still, downgrades damage stock performance consistently, resulting in statistically and economically significant negative abnormal returns. Therefore returns that indicate abnormal returns are not necessarily related to ESG levels but may be related to changes in them (Shanaev & Ghimire, 2022).

2.2 ESG AND STOCK LIQUIDITY RISK

Liquidity is an essential consideration for market participants, regulators, and academia. There are many determinants of stock liquidity, and some studies have shown that essential factors include corporate governance, information disclosure, legal system, and future business information (Chung et al., 2012; Ali et al., 2016; Utami et al., 2020). ESG is a new indicator measuring a firm's environmental, social, government, and information disclosure strategies.

It is generally believed that better corporate governance leads to higher stock (Berglund, 2020). Corporate governance typically includes processes that improve board efficiency and enhance transparency disclosure, which also improves the quality and quantity of information provided to investors, as well as reduces information asymmetry and improves market liquidity. The relationship between corporate governance and liquidity is examined worldwide (Prasanna & Menon, 2012; Sidhu & Kaur, 2019; Karmani et al., 2015; Ali, 2016; Al-Jaifi et al., 2017; Prommin et al., 2014). Against the background of the current internationalization trend, there is also literature confirming that corporate governance promotes stock liquidity (Hussain et al., 2021) for a specific industry (Biswas, 2020) and pure order-driven companies (Ali et al., 2017). At the same time, corporate governance also affects stock liquidity through default risk. Some studies have shown that corporate governance negatively correlates with default risk and affects stock liquidity (Ali et al., 2018).

In addition, information disclosure has a significant impact on stock liquidity. Firms can ease information-based trading and improve stock market liquidity by adopting corporate governance standards that mitigate information asymmetry (Chung et al., 2010). With the increase in corporate information disclosure, stock liquidity increases for small and large trades (Palumbo et al., 2013). Voluntary disclosure of the information is to reduce the information asymmetry between traders actively. In theory, actively growing

disclosure will increase stock liquidity and bring a more significant positive impact (Schoenfeld, 2017). Similar research on credit ratings shows that when credit ratings are poor, transactions decrease, and stock liquidity reduces (Odders-White & Ready, 2006).

In addition, concerning stock liquidity in the Chinese market, the existing research shows that when market returns are positive, stock market trading activity increases more. This change in liquidity is because retail investors dominate the Chinese stock market (Ma et al., 2018). Furthermore, the uncertainty of economic policy in the Chinese stock market can significantly reduce the stock's liquidity, which is less transparent in the information environment. It will be more evident in companies with less attention and weaker anti-risk ability (Zhang et al., 2021).

As an emerging rating indicator, ESG ratings have attracted the attention of investors and corporate managers, and even government agencies. ESG quantifies a company's commitment to social responsibility and environmental protection. It is a high-profile project in the era of promoting green finance. Studies have mentioned that improvements in ESG ratings can improve stock liquidity and reduce information asymmetry (Wu et al., 2022). In addition, a previous study based on the UK portfolio investment results from 2003 to 2020 shows that ESG composite scores significantly impact stock returns. They speculate that this rating affects stock liquidity, and more liquid stocks have higher ESG scores than illiquid stocks (Luo, 2022). The latest literature shows that recent ESG disclosure plays a visible role in improving the liquidity of Chinese stocks. Also, stock liquidity and ESG positively affect the capital market reaction (Meng-tao et al., 2023). Thus, investors in the stock market desire to pay attention to the firm's ESG.

In general, stock liquidity risk is an essential indicator for judging the management status of a company. Since stock liquidity is affected by factors such as corporate governance and information disclosure, ESG ratings also involve corporate strategy choices and information disclosure. Therefore, we propose the first hypothesis.

Hypothesis 1: ESG rating negatively impacts stock liquidity risk for Chinese companies.

2.3 ESG AND STOCK LIQUIDITY RISK IN DIFFERENT INDUSTRIES

According to the literature review above, ESG rating might impact stock liquidity. More detailed research shows that the effects of ESG in the Chinese market vary in different industries and locations. Meng-tao et al. (2023) analyzed the differences in the degree of impact of ESG ratings on companies in different industries and different geographic locations. They briefly introduce the impact of ESG in several industries, showing the importance of ESG to companies in different industries or the degree of impact on stock liquidity is different. Although the authors did not analyze all industries, apparent differences between industries can be seen. For example, ESG has the most significant impact on stock liquidity for the manufacturing and mining industries, while the impact on agriculture, forestry, fishing, transportation, and postal industries is less significant. There is also a significant relationship between the real estate industry. There is no significant relationship between ESG and liquidity in construction, retail, and other industries.

Since China has only started to conduct ESG ratings in recent years, the data is relatively new, and the relevant policies are still under development. Therefore further research and exploration are highly desired. Based on the above literature, this paper further verifies the stock liquidity of all A shares with ESG ratings in China in the Chinese market. Our second hypothesis is as follows:

Hypothesis 2: The impact of ESG rating on stock liquidity risk varies in different industries.

3. DATA AND METHODOLOGY

3.1 DATA

Our data sources include SynTao Green Finance and China Stock Market and Accounting Research Database (CSMAR). We selected the sample period from January 1, 2015, to December 31, 2019, as the SynTao database ended in 2019.

From SynTao Green Finance, we obtain ESG rating data as our independent variable. From CSMAR, we obtain daily stock returns and calculate stock illiquidity as our dependent variable. We also retrieve popular control variables in the literature. Our control variables include firm size, leverage (debt/assets), return on asset (ROA), earning per share (EPS), market value, cash/income, R&D expenditure, and book-to-market ratio.

3.2 METHODOLOGY

We use panel data regression models to investigate the relationship between ESG and stock illiquidity. The primary pooling panel data OLS regression is:

$$Illiquidity_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 Fsize_{it} + \beta_3 Leverage_{it} + \beta_4 ROA_{it} + \beta_5 EPS_{it} + \beta_6 CI_{it} + \beta_7 MV_{it}$$
$$+ \beta_8 RD_{it} + \beta_9 BM_{it} + \beta_{10} Intangible_{it} + \beta_{11} Debt_{it} + \beta_{12} Dividend_{it} + \varepsilon_{it}$$

(1)

The subscript *i* represent firm *i* and the subscript *t* represents year *t*. *Illiquidity* refers to the stock's liquidity risk, which refers to the ability to liquidate stocks at a fair price in a short period. *ESG* is the indicator of firms' performance in environmental, social, and governance. ESG has three components: environment, social, and governance pillars. *Fsize* refers to firm size and denotes the natural logarithm of total assets; *Leverage* is the firm's *equity*-to-liability ratio; *ROA* is a financial performance measure; *EPS* is earnings per share, which can serve as a stock performance measure; *CI* is the firm's cash to income*; MV* is the natural logarithm of the market value of the firm; *R&D* is the natural logarithm of the firm's expense on research and development; *BM* is the book-to-market ratio. *Intangible, Debt,* and *Dividend* refer to the natural logarithm of the firm's annual intangible asset, debt, and dividend. ε is the error term. We use STATA software to perform all the statistical analyses.

We employ the Amihud illiquidity indicator as a measure of stock liquidity risk:

$$ILLIQ = Avg_t \left(\frac{|R_t|}{VOL_t} \right)$$

(2)

R_t is the daily stock return based on the daily opening price and closing price in day *t*; VOL_t is the daily trading volume in day *t*. We average the daily price impact measures over a year to get annualized illiquidity measure.

The main variables we studied were stock illiquidity and ESG, along with the control variables mentioned above, all of which we explain in the Appendix. For control variables, we use company performance indicators such as ROA. We include firm size and market value to control for other factors that may affect the company's stock liquidity risk. Table 1 shows the summary statistics of all variables. The minimum illiquidity is 0.00188, and the maximum value is 2.901, showing a wide span. The mean ESG score is 48.06, and the

minimum and maximum values are 30.88 and 67.63, respectively. We also collect the three ESG pillars for analysis

Table 1. Descriptive Statistics

Variable	N	Mean	Std.Dev.	Min	P25	Median	P75	Max
Illiquidity	1,611	0.0784	0.145	0.00188	0.0282	0.0492	0.0874	2.901
ESG	1,606	48.06	5.402	30.88	44.38	47.25	51.25	67.63
Escoring	1,606	17.58	2.932	9.500	15.63	17.13	19	29.63
Sscoring	1,606	17.36	2.101	8.250	16.25	17.25	18.50	25.38
Gscoring	1,606	13.13	2.375	4	11.50	13	14.50	22.75
Fsize	1,611	24.92	1.736	20.97	23.66	24.62	25.91	31.04
Leverage	1,611	0.556	0.228	0.0305	0.391	0.574	0.728	2.579
ROA	1,611	0.0468	0.117	-3.911	0.0148	0.0337	0.0753	0.384
ROE	1,611	0.103	0.122	-2.307	0.0572	0.102	0.152	0.566
EPS	1,611	0.996	1.870	-4.558	0.276	0.625	1.234	35.00
CI	1,611	0.911	1.861	0	0.135	0.292	0.607	24.14
MV	1,593	11.02	0.624	9.866	10.59	10.88	11.30	13.47
RD	1,611	2.298	3.575	0	0	0	6.740	9.760
BM	1,605	0.712	0.292	0	0.479	0.779	0.964	1.308
Intangible	1,602	8.967	0.810	5.876	8.450	8.932	9.525	11.35
Debt	1,611	10.52	0.919	7.745	9.900	10.44	11.09	13.44
Dividend	1,611	3.363	3.664	0	0	0	7.192	9.835

4. RESULTS AND DISCUSSIONS

In Table 2, we performed an OLS regression analysis. Column (1) shows our regression result using ESG and all the control variables. The ESG rating has no apparent impact on stock illiquidity. In Column (2), we change the control variable ROA into ROE. The result still holds. For columns (3), (4), and (5), respectively, we replace ESG with its three ESG components. Thee is still no apparent evidence that ESG rating is related to stock illiquidity.

Table 2. OLS Regression Results

	(1) Illiquidity	(2) Illiquidity	(3) Illiquidity	(4) Illiquidity	(5) Illiquidity
ESG	0.000349 (0.000480)	0.000324 (0.000484)			
Escoring			-0.000838 (0.000966)		
Sscoring				0.00116 (0.00141)	
Gscoring					0.00223 (0.00145)

Fsize	0.0137	-0.00620	0.0123	0.0136	0.0115
	(0.0298)	(0.0272)	(0.0294)	(0.0300)	(0.0304)
Leverage	0.179**	0.103*	0.170*	0.178*	0.176**
	(0.0890)	(0.0624)	(0.0874)	(0.0910)	(0.0896)
ROA	0.0950**		0.0909*	0.0947**	0.0922*
	(0.0473)		(0.0466)	(0.0479)	(0.0476)
ROE		0.0654**			
		(0.0269)			
EPS	0.00291***	0.00236**	0.00299***	0.00290***	0.00315***
	(0.00109)	(0.00103)	(0.00111)	(0.00108)	(0.00109)
CI	0.000973	0.00149	0.000756	0.000806	0.000838
	(0.00567)	(0.00562)	(0.00576)	(0.00578)	(0.00558)
MV	-0.00937	-0.00405	-0.00975	-0.00895	-0.0103
	(0.0328)	(0.0317)	(0.0325)	(0.0328)	(0.0326)
RD	-0.000430	-0.000310	-0.000290	-0.000414	-0.000391
	(0.00124)	(0.00126)	(0.00125)	(0.00121)	(0.00122)
BM	0.222***	0.228***	0.221***	0.223***	0.222***
	(0.0316)	(0.0322)	(0.0313)	(0.0323)	(0.0315)
Intangible	0.00269	0.00133	0.00302	0.00289	0.00285
	(0.00555)	(0.00548)	(0.00563)	(0.00557)	(0.00554)
Debt	-0.129**	-0.0826*	-0.123**	-0.128**	-0.125**
	(0.0553)	(0.0445)	(0.0542)	(0.0568)	(0.0565)
Dividend	-0.00291**	-0.00298**	-0.00297**	-0.00292**	-0.00282**
	(0.00125)	(0.00127)	(0.00125)	(0.00123)	(0.00127)
Constant	0.895***	0.897***	0.908***	0.887***	0.909***
	(0.117)	(0.118)	(0.119)	(0.107)	(0.115)
Observations	1,579	1,579	1,579	1,579	1,579
R-squared	0.109	0.109	0.109	0.109	0.110

Robust standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

In Table 3, we split the sample into two subsamples: one with ESG scores less than or equal to 48 and the other with ESG scores greater than 48 (48.06 is the average value of all ESG data). We performed OLS regression analysis on the two subsamples separately.

Table 3. High- and Low-ESG Firms

	(1)	(2)
	Illiquidity	Illiquidity
ESG	0.00305	0.000249
	(0.00217)	(0.000942)
Fsize	-0.0204	-0.0105
	(0.0570)	(0.0443)
Leverage	0.204**	0.106

	(0.103)	(0.0672)
ROA	0.101*	0.195**
	(0.0597)	(0.0976)
EPS	0.00420	0.000530
	(0.00418)	(0.00191)
CI	-0.00240	0.00573***
	(0.00344)	(0.00203)
MV	0.0394	0.00315
	(0.0796)	(0.0718)
RD	0.000425	-0.00139
	(0.00170)	(0.00106)
BM	0.346***	0.169***
	(0.0755)	(0.0559)
Intangible	0.0152*	-0.0107*
	(0.00885)	(0.00643)
Debt	-0.146*	-0.0495
	(0.0797)	(0.0573)
Dividend	-0.00370**	-0.000649
	(0.00165)	(0.00106)
Constant	1.059***	0.716***
	(0.196)	(0.0965)
Observations	864	715
R-squared	0.116	0.166

Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The results in Table 3 show no significant relationship between ESG rating and stock illiquidity, consistent with Table 2. Therefore, it suggests that Hypothesis 1 is not supported. A company with a high ESG does not mean its stock liquidity risk is low.

Table 4. Interaction Terms

	(1) Illiquidity	(2) Illiquidity	(3) Illiquidity
ESG	0.000122	-0.0335***	0.000379
	(0.000752)	(0.0128)	(0.000797)
Fsize	0.0144	0.00746	0.0136
	(0.0370)	(0.0370)	(0.0371)
Leverage	0.180***	0.186***	0.179***
	(0.0643)	(0.0642)	(0.0644)
ROA	0.0954**	0.106**	0.0944**
	(0.0421)	(0.0422)	(0.0428)

EPS	0.00288	0.00292	0.00453
	(0.00206)	(0.00205)	(0.0219)
CI	-0.0139	0.00141	0.000983
	(0.0203)	(0.00205)	(0.00205)
MV	-0.00967	-0.153**	-0.00928
	(0.0548)	(0.0769)	(0.0548)
RD	-0.000403	-0.000474	-0.000428
	(0.00105)	(0.00104)	(0.00105)
BM	0.222***	0.233***	0.222***
	(0.0478)	(0.0479)	(0.0478)
Intangible	0.00253	0.00337	0.00272
	(0.00577)	(0.00576)	(0.00578)
Debt	-0.130**	-0.125**	-0.128**
	(0.0513)	(0.0512)	(0.0514)
Dividend	-0.00290***	-0.00246**	-0.00291***
	(0.00102)	(0.00103)	(0.00102)
ESG × CI	0.000309		
	(0.000419)		
ESG × MV		0.00305***	
		(0.00115)	
ESG × EPS			-0.00003
			(0.000436)
Constant	0.904***	2.594***	0.893***
	(0.0865)	(0.645)	(0.0896)
Observations	1,579	1,579	1,579
R-squared	0.110	0.113	0.109

Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4 adds the interaction terms between ESG and a few vital control variables. We analyze the effects of the intersection terms formed by CI, MV, and EPS, with ESG on the regression results in Columns (1), (2), and (3), respectively. Column (2) of Table 4 shows that the coefficient on ESG is significantly negative, suggesting that ESG rating has a negative impact on stock illiquidity. Moreover, the coefficient on the interaction term between ESG and MV is significantly positive, indicating that the negative relationship between ESG and illiquidity is mitigated for large firms. The above two results suggest that ESG ratings mitigate stock illiquidity in small firms; however, the counter effect in large firms buries this effect for the entire sample.

In Table 5, we perform OLS regression with year-fixed effects (FE) separately for different industries. We classify firms into 13 broad industries. The results show that ESG negatively correlates with stock illiquidity in agriculture and other industries. The wholesale industry exhibits a weak positive correlation. All other industries do not exhibit significant relationships. Overall, different industries have different impacts of ESG on stock liquidity risk, supporting Hypothesis 2.

Table 5: Industry Analysis

	ESG	Constant	Observa tions	R-squared	Year FE
Manufacture	0.001	1.907**	528	0.041	YES
Agriculture/Forest/Fishing	-0.021***	-0.149	30	0.943	YES
Metal & Energy Processing Industry	0.001	1.959	114	0.074	YES
Energy and Electricity Service	-0.003	-7.774	69	0.264	YES
Wholesale/retail	0.005*	0.125	50	0.506	YES
Transportation/postal storage	-0.007	1.247	84	0.042	YES
Business Service	-0.001	0.948	285	0.322	YES
Communications & Technology	0	1.561***	151	0.314	YES
Mining	0	3.672***	84	0.458	YES
Construction	0.001	-0.275	66	0.083	YES
Real Estate&Rental	-0.003	1.291	83	0.552	YES
Other	-0.044**	4.006	35	0.924	YES

To confirm the results in Table 5, we run OLS regression with year FE for the other industry. We employ ESG and three ESG components (environment, social, and governance). In Column (1), we use the total score of ESG, and in columns (2), (3), and (4), using the scores of E, S, and G to replace ESG to measure stock liquidity risk for regression analysis.

The results show that for the other industry, including ecological protection, sanitation, and research, there is a significant negative relationship between ESG and stock illiquidity risk; the scores of environment and governance are not significantly correlated with stock liquidity risk. Interestingly, the scores of the social part show a robust negative correlation with the stock liquidity risk, indicating that when considering different industries, the social score of ESG might greatly influence a firm's stock liquidity risk.

Table 6. Fixed Effect Analysis

VARIABLE	(1) model6_1	(2) model6_2	(3) model6_3	(4) model6_4
ESG	-0.037*** (0.006)			
Escoring		-0.045 (0.169)		
Sscoring			-0.087*** (0.003)	
Gscoring				-0.046 (0.125)
Fsize	-0.230 (0.506)	-0.465 (0.242)	-0.215 (0.519)	-0.420 (0.288)
Leverage	-4.131*** (0.001)	-4.501*** (0.002)	-5.241*** (0.000)	-2.787* (0.052)
ROA	-0.447 (0.776)	0.757 (0.671)	-1.313 (0.416)	0.593 (0.737)
EPS	0.019	0.012	0.033	0.000

	(0.385)	(0.624)	(0.140)	(0.987)
CI	-0.223	-0.240	-0.241*	-0.171
	(0.111)	(0.146)	(0.076)	(0.286)
MV	-1.422**	-1.211	-1.810**	-0.789
	(0.036)	(0.120)	(0.011)	(0.281)
RD	-0.013	-0.009	-0.005	-0.017
	(0.239)	(0.479)	(0.600)	(0.211)
BM	-0.439	-0.108	-0.724	0.160
	(0.397)	(0.856)	(0.181)	(0.772)
Intangible	-0.096*	-0.127*	-0.122**	-0.036
	(0.070)	(0.068)	(0.023)	(0.589)
Debt	2.224***	2.531***	2.780***	1.637*
	(0.006)	(0.009)	(0.001)	(0.089)
Dividend	0.004	0.001	0.023	0.002
	(0.784)	(0.952)	(0.106)	(0.911)
		(0.169)		
Constant	3.530	3.155	2.513	4.450
	(0.296)	(0.426)	(0.440)	(0.263)
Observations	35	35	35	35
R-squared	0.722	0.615	0.741	0.625
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES

Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

5. CONCLUSIONS

Using the ESG rating data of Chinese listed companies from 2015 to 2019, this paper studies how ESG ratings affect companies' stock liquidity risk and the differences in this impact across different industries. In response, we tackle this problem step-by-step by employing various regression models. Our main findings can be summarized as follows.

First, we perform OLS regression on the entire sample. The results show that companies' ESG ratings have no apparent relationship with stock illiquidity. This finding holds even after we split our sample into high- and low-ESG firms. However, after we add the interaction term between ESG and market value, we find a significantly negative relationship between ESG and stock illiquidity. Moreover, the coefficient on the interaction term is significantly positive. These results suggest that ESG rating might mitigate stock illiquidity in small firms but not large firms.

In addition, by dividing our sample according to different industries, we find that the impact of ESG on stock liquidity is significantly different in various industries. For example, for agriculture, since the direction of the industry is closely related to the environment and society, investors may pay more attention to the degree to which companies attach to environmental and social-related policies. Therefore, in agriculture and other industries, the impact of ESG on stock liquidity becomes significant. In most industries, ESG ratings are not the most crucial factor in measuring corporate performance, and company management can also make appropriate adjustments to corporate strategies to meet investor preferences.

Our results interest business managers, investors, policymakers, and other stakeholders. From a manager's perspective, ESG ratings can be used as a reference for estimating stock liquidity risk in the future. In addition, the management can also judge the importance of ESG rating to the current company development strategy according to the impact of ESG in the company's industry on stock liquidity risk to adjust the

company's development direction and performance evaluation standards. For investors, this article can be used as a reference for the importance of ESG in the industry and whether it is reliable enough to judge the performance of companies in a particular industry based on ESG ratings. Again, our findings have important policy implications. As society pays more and more attention to environmental and social issues, relevant policies are gradually being implemented. Based on these data, policymakers can adjust the assessment standards for ESG ratings of companies in different industries. Since the Chinese government plans to implement comprehensive ESG ratings in the future, there are specific differences in the ESG scores that can be achieved for companies in different industries, and the criteria for passing inspections should also be different. Our research can also provide a certain degree of reference for relevant departments. With relatively little data and research, China is starting to build its ESG rating system today. Our findings provide important context for recent empirical and theoretical work showing that ESG rating scores benefit companies' development in the financial market. In particular, our results provide preliminary insights and fundamental directions and ideas to aid the further development of future theoretical and empirical studies.

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APPENDIX

Variable	Explanation	Data resource
Illiquidity	Annualized Amihud's illiquidity measure	CSMAR daily data
ESG	Firm's ESG scores rated by SynTao Green Finance, ranges from 0 to 100	SynTao Green Finance
Escoring	Firm's ESG score of environment part rated by SynTao Green Finance	SynTao Green Finance
Sscoring	Firm's ESG score of social part rated by SynTao Green Finance	SynTao Green Finance
Gscoring	Firm's ESG score of governance part rated by SynTao Green Finance	SynTao Green Finance
Fsize	Logrithmic of total assets	CSMAR
Leverage	Liability/Asset	CSMAR
ROA	Net income/Asset	CSMAR
ROE	Net income/Shareholder's equity	CSMAR
EPS	Net income/Number of common shares	CSMAR
CI	Cash/Income	CSMAR
MV	Logrithmic of market value	CSMAR
RD	Logrithmic of R&D expenditure	CSMAR
BM	Book-to-market ratio	CSMAR
Intangible	Logrithmic of intangible assets	CSMAR
Debt	Logrithmic of total debt	CSMAR
Dividend	Logrithmic of dividends	CSMAR

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