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Integration of green finance with ESG compliance to enhance the firm value: Managerial approach to determining the level of liquidity

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Abstract

The purpose of this study is to reveal the integration of green finance with environmental, social, and governance (ESG) compliance in firm liquidity. We also explore the non-financial channels like social capital and green innovation through which ESG compliance influences the firm's liquidity. The study employs two-stage Least Squares (2SLS) and Generalized Method of Movements (GMM) regression analysis to address the endogeneity issues. The results obtained through 2SLS and GMM regression analysis indicate that firms engagement in green finance and ESG compliance help them keep their liquidity low. The findings indicate that firms operating in high-ESG regions have lower liquidity than firms operating in low-ESG regions. Green finance plays an essential role in designing the firm's long-term strategy to promote sustainable development and address climate change. Green finance helps mobilize funds for sustainable environmental projects and reduces the risk of green investment. It may also improve the firm's performance and reduce financial constraints. The government should introduce the clear legislation, incentives, and standards to promote the green finance for sustainable investment. The private sector can implement the green finance practices by integrating ESG disclosures with firm investment decisions, and innovation processes. This research study contributes to the existing corporate literature by analyzing the integration of ESG disclosures with green finance in the presence of social capital and green innovation in firm liquidity.

Keywords: Chinese firms, ESG compliance, Green finance, Green innovation, Liquidity, Social capital.

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1. Introduction

In this study, we investigate whether the integration of Environmental, Social, and Governance (ESG) compliance with Green Finance impacts the firm liquidity. We also identify and examine non-financial indicators such as Social Capital (SC) and Green Innovation (GI) through which ESG disclosures may explain firm liquidity [1]. Including ESG disclosure with Green Finance (GF) means that a company's environmental, social, and governance practices are in line with green finance in order to meet the legal and moral needs of all stakeholders [2].

The bulk of corporate literature discusses and examines the effect of ESG compliance on firm performance and investment [3, 4]. Existing research studies have analyzed the impact of ESG disclosures on firm value, investment, and board size [5, 6]. In this context, we recognize and analyze the integration of ESG compliance with Green Finance GF by incorporating the role of SC and GI on firm liquidity of firms operating in different regions. Wang [7] finds that the amount of liquidity has significantly increased over the period for firms operating in different geographic locations. However, the fundamental question of maintaining more liquidity despite the financing and agency costs of liquidity is still under consideration. A large number of research studies have evaluated and analyzed the consequences of liquidity on firm performance [8, 9]. By examining the integration of ESG disclosures with GF in the presence of SC and GI on firm liquidity, this research study adds to the existing literature, addressing an important aspect that the growing literature has not yet addressed.

Corporate finance literature has extensively explained the purpose of maintaining liquidity. Firstly, firms maintain liquidity to run day-to-day business transactions without external financing, or to convert assets into cash to meet liquidity requirements Dotsey and Ireland [10]. Denis [11] finds the optimal level of liquidity to pay off short-term obligations and payments to suppliers on time. Secondly, the precautionary motive of liquidity highlights that firms maintain liquidity to reduce market frictions and overcome adverse market reactions to firm performance [12]. Meanwhile, the agency motive of liquidity explains that firms hold liquidity to overcome the agency costs of financing and negative reactions of investors to firm performance [13].

Liquidity theories attempt to explain the various purposes of maintaining liquidity, but they ignore environmental and social aspects such as integrating ESG disclosures with green finance in the presence of non-financial indicators such as SC and GI, which play an important role in determining the level of liquidity for long-term sustainability [14]. The integration of ESG with GF has characteristics of an informal obligation to invest in environmental protection, societal well-being, and the long-term growth of stakeholders [2]. Firms that integrate ESG compliance with GF have better governance structures, superior environmental practices, and sustainable growth to finance externally [15]. ESG with GF improves liquidity, which, as discussed above, is important for the long-term sustainability.

Firms that integrate ESG with GF are expected to work for the welfare of society and actively engage in environmental development by proposing a high degree of philanthropy, a society-caring attitude, and trust for all stakeholders [16]. ESG compliance with GF is characterized by introducing a strong mechanism to address the grievances of different stakeholders [17]. It is expected that firms complying with ESG and GF are doing business in a socially responsible and trustworthy way, supporting financing at lower costs, which reduces the need to hoard more liquidity [18]. This concept aligns with the precautionary objective of holding liquidity.

The corporate literature also investigates firms that integrate ESG compliance with GF, as they often have strong and consistent networks with different stakeholders that support the development of social networks and green innovation [19]. This helps overcome the need to hoard more liquidity. The notion that integrating ESG compliance with GF supports maintaining lower liquidity is also linked to agency motives [20]. Firms that integrate ESG compliance with GF perceive that the opportunity cost of green innovation and social capital significantly and positively influence the impact of ESG on firm performance [21]. ESG practices with GF, when implemented in a socially responsible way, help firms introduce more green innovation and hold less liquidity [15]. Thus, integrating ESG compliance with GF assists in financing externally at a lower cost, which again reduces the need for more liquidity [22].

However, the discussion above does not highlight the potential sources of integrating ESG disclosures with GF that can reduce the need for more liquidity. This study also identifies and reveals non-financial indicators, such as SC and GI, through which integrating ESG compliance with GF may influence firm liquidity. Firms that introduce ESG compliance with GF face fewer financial constraints and can raise financing externally at a lower financing cost [23]. Since integrating GF with ESG compliance facilitates more green innovation and social capital and reduces the firm's opportunity biases of social cost of liquidity, green finance with ESG compliance helps firms make investments in green innovation that facilitate the development of valuable relationships with stakeholders [24]. Thus, green finance with ESG compliance reduces the need for more liquidity by investing in green innovation [23].

Regarding the social compliance channel, studies on social capital explain that highly socially compliant firms reduce information asymmetry and adverse selection costs, allowing firms to hoard less liquidity [25]. Since integrating green finance with ESG compliance facilitates the development of social networks [26]. We anticipate that liquidity will be lower for firms with high social capital. Research studies find that higher social compliance investments reduce the negative effects of adverse selection and hazard costs, which, in turn, reduces the need for more liquidity [27]. Hence, green finance with ESG compliance obliges firms to secure higher social capital, which, in turn, reduces the level of liquidity for firms investing in developing more social networks.

2. Literature Review and Hypothesis Development

Corporate literature extensively documents that firms hold a significant amount of liquidity in the form of cash and near-cash assets [28-30]. Theories of capital financing, such as the trade-off theory, pecking order theory, and agency

theory, explain firms' propensity to hold liquidity despite the opportunity cost of doing so [31]. The trade-off theory proposes an optimal level of liquidity that balances the costs and benefits of holding liquidity. Firms reap the benefit of liquidity by lowering transaction costs, reducing the cost of the uncertainty of financial distress (transaction motive) [12] and providing an opportunity to invest in higher Net Present Value(NPV) projects, particularly for firms that are not in a position to finance externally (precautionary motive) [32]. The main cost of holding liquidity for firms is the opportunity cost, which increases when investing in alternative assets that can earn a positive return instead of more liquid or near-liquid assets [33].

Meanwhile, the pecking order theory places a hierarchy of financing, providing the opportunity to finance externally at a lower cost of financing after using internal funds [33]. Because the asymmetrical information costs of external finance are higher than those of internal financing, firms prefer internal financing to invest in positive NPV projects [34].

The agency theory of liquidity proposes that firms prefer to maintain liquidity to distribute dividends because holding liquidity permits managers to increase their control over firm resources and ignore the stakes of other stakeholders Hussain and Akbar [35]. Zhang, et al. [17] argue that firms maintaining higher liquidity are involved in overinvestment, which may negatively affect firm value. The basic theme of these theories highlights that financing new investments is a critical decision due to the stemming of information-asymmetrical costs, which may be caused by managers' opportunistic behavior or weak financial reporting [36]. However, a generous green finance with an ESG compliance mechanism may assist in reducing the asymmetrical information problem of holding liquidity.

Firm integration of green finance with ESG compliance involves formal and informal engagement to protect the environment, increase investment in corporate social activities for the welfare of society, and implement governance standards to protect the stakes of all stakeholders [37]. In the cost and benefits analysis of liquidity, we perceive that firms integrating ESG compliance with green finance need to hold less liquidity. Firms with a sufficient amount of liquidity can invest in positive NPV projects and reduce the uncertainty of financial distress [27]. However, liquidity benefits are lower for firms that combine green finance with ESG compliance to finance investment opportunities [38]. Firms that combine green finance with ESG compliance have lower liquidity risk and fewer financial constraints because they have mutual trust and the ability to finance externally to acquire investment opportunities [14].

Firms that integrate green finance with ESG compliance face lower idiosyncratic and systematic risk due to insurance-like firms' strong network of relationships with key stakeholders at all levels of the organization [39]. Hence, integration of green finance with ESG compliance does not require hoarding more liquidity against adverse shocks [40]. Therefore, holding liquidity for transaction and precautionary purposes is less important for firms that integrate green finance with ESG compliance, and we propose the first hypothesis.

Hypothesis 1: Firms that integrate green finance initiatives with high ESG compliance standards may not require higher levels of liquidity.

We categorize and examine non-financial channels like GI and SC through which ESG compliance manipulates liquidity [41]. Several studies report that firms that introduce more GI and operate in a socially responsible way maintain lower liquidity [42]. Similarly, Maji and Lohia [6] find that firms operating in high ESG compliance regions hold lower levels of liquidity because these firms engage in ESG compliance and have to develop relationships with customers, improve societal values, and build social networks with stakeholders by introducing more green innovations to retain potential stakeholders in future business prospects [12].

ESG-compliant firms use GI as a tool to encounter moral hazard problems in debt financing and minimize the cost of financing [6]. A bulk of literature affirms that financial institutions, a vital source of finance, charge a lower rate of interest on debt financing of firms operating in high ESG compliance and introducing more GI for long-term sustainability[12]. Furthermore, Khan [5] and Zhang, et al. [17] argue that GI reduces the negative setbacks of moral hazards and adverse selection costs, allowing firms to maintain less liquidity. Moreover, Falcone, et al. [20] explain that fund providers are more comfortable financing firms with high environmental, social, and governance characteristic categorized by introducing more GI, dense norms, and networks, which help the firms sustain economic shocks and, therefore, endure business risks [25]. Since firms operating in high ESG compliance regions introduce more Green Innovations and maintain lower liquidity, we propose:

Hypothesis 2. A: Firms operating in high ESG compliance regions introduce more Green Innovations (GI) and maintain a lower level of liquidity.

We argue that ESG compliance affects the level of liquidity through supply chain [2]. According to Tang [22] firms operating in regions with high ESG compliance have more investment in their supply chains. Wang, et al. [21] explain that ESG compliance encourages firms to adopt the philanthropic norms, develop social networks, and promote introduction of societal norms. Lins, et al. [28] argue that sharing information in high ESG compliance regions stimulates managers to act in a more socially responsible way for long-term sustainability. Further, Shin, et al. [16] indicate that socially responsible firms have strong ethical and social network with numerous stakeholders, which enables them to arrange short-term financing at lower cost and stimulate managers to maintain lower liquidity.

Corporate literature proposes the numerous views regarding the effect of supply chains on firm liquidity [14]. Firstly, firms operating their businesses in high ESG compliance regions are expected to perform in a more socially responsible way, and such firms may retain higher liquidity to avoid the inverse effects of asymmetric information costs moral hazards, and adverse selection [40]. Further, Luo [15] explains that highly socially responsible firm may need to maintain liquidity to protect the confidence of capital providers, as they perceive that firm is investing their funds for societal well-being at the risk of fund providers. Furthermore, Amiraslani, et al. [26] explain that firm with high ESG compliance are less vulnerable to external financial shocks and have stable cash flows.

Xie, et al. [24] which reduces the effect of idiosyncratic risk. Luo [15] explains that ESG compliant firms invest to protect societal norms, the environment, and implement sophisticated measures to reduce the harmful effects of their operations on the environment and society. Moreover, Xie, et al. [24] found that ESG compliant firms have a high reputation and close relations with stakeholders, making it easier to generate funds for investment. It is also argued that high-social investment firms may raise finance at a reasonable cost to fund sustainable investment projects [28]. Hence, firms operating in high ESG compliance regions run their operations in a more socially responsible way, which may affect the firm liquidity. We then proposed our next hypothesis.

Hypothesis 2B: Firms operating in high ESG compliance regions have higher social capital, and this may affect the level of liquidity.

3. Data Collection

This study uses Wind Syntao Green Finance database to collect the data on independent and channel variables. Wind Syntao Green Finance is a third-party agency recognized by the international credit rating agency for assessing ESG rating in China [43]. The database is used to extract data on ESG ratings, Green Finance, and Social Capital. The National Intellectual Property Administration database is used to collect the data on Green Innovation (GI), while Chinese Stock Market and Accounting Research (CSMAR) database is used to extract the data on other economic variables [25].

4. Research Design

The following regression equation is used to test our hypothesis by following the Heider, et al. [41].

$$\text{Liquidity}_{it} = C + \beta_1 \text{ESG}_{it} + \beta_2 \text{GF}_{it} + \beta_3 \text{ESG}_{it} * \text{GF}_{it} + \beta_4 (\text{FS}_{it}) + \beta_5 \text{CXP}_{it} + \beta_6 \text{LEV}_{it} + \beta_7 \text{DIV} + \beta_8 \text{Industry FE}_{it} + \beta_9 \text{Year FE}_{it} + \beta_{10} \text{Country FE}_i + \mu_{it}(1)$$

4.1. Dependent Variable

This study employs three distinct parametric models to evaluate the firm liquidity. Firstly, liquidity is assessed by dividing the cash and cash equivalent by the firm's current assets, which is basically the representation of Liquidity Ratio (LR) [12]. Secondly, the liquidity is evaluated by dividing the current assets by the current liabilities, which is the proxy for Current Ratio (CR) [44]. Lastly, the ratio of Earning before Interest Tax, Depreciation and Amortization to total assets is used as a measure of liquidity and reflects the firm's Operating Cash Flows (OCF) [23].

4.2. Independent Variable

The purpose of this research study is to investigate the impact of firm ESG compliance and its environmental score on firm liquidity. The ESG compliance score range exists between 0 and 100, where 0 represents no correlation and 100 indicates entire correlation between ESG compliance and firm liquidity [6]. We also take into account overall Environmental Score (ENT) to examine its effect on firm liquidity. Further, Windo Syntato Green Finance database is used to access firm Social Capital (SC) based on firm values, norms, and networks that promote societal engagement and facilitate improved firm performance [1].

Additionally, the green bonds issued by the Chinese firms during this period, divided by total assets, are used as proxy for green finance [24].

4.3. Control Variables

This study also included a set of control variables to examine the impact of ESG compliance on firm liquidity and enhance the reliability and robustness of the analysis [5]. The control variables for firms size are measured as logarithm of total assets, as large firms tend to hold less liquidity [34]. The firm's capital expenditure (CXP) is measured by the firms long term investment divided by total assets use as proxy for firm investment opportunities [27]. The firms Leverage (LEV) is measured as its total debt divided by its total assets [38]. Firms maintain liquidity to pay off the debt and reduce financial constraints; therefore, an inverse relationship is expected between leverage and liquidity [7]. Dividend (DIV) payout ratio is a proxy of firm dividend paid to common shareholders to net income [29]. Firms that regularly pay dividends have lower level of risk and maintain lower level of liquidity [35].

WE used the Wang, et al. [21] econometric model to explore the direct and indirect effects of ESG compliance on firm liquidity by incorporating GI and SC, respectively.

$$\text{Liquidity}_{it} = C + \beta_1 \text{GI}_{it} + \beta_2 \text{SC}_{it} + \beta_3 \text{ESG}_{it} + \beta_4 \text{GF}_{it} + \beta_4 \text{Control}_{it} + \mu_{it}(2)$$

The model-2 demonstrates how non-financial indicators like GI and SC affect liquidity [36]. The ESG compliance in Model 2 is used to investigate the direct effect of ESG compliance on cash holdings. We use models 3 and 4 to investigate how non-financial indicators manipulate the effect of ESG compliance on firm liquidity [29].

$$\begin{aligned} \text{GI}_{it} &= \alpha + \beta_1 \text{ESG} + \beta_2 \text{Control}_{it} + \mu_{it}(3) \\ \text{SC}_{it} &= \alpha + \beta_1 \text{ESG} + \beta_2 \text{Control}_{it} + \mu_{it}(4) \end{aligned}$$

The 2SLS and GMM uses to probe the above matter by controlling the endogeneity problem [45].

4.4. Sample and Industry Selection

The study used data collected from Wind Syntao Green Finance, which is a third-party agency recognized by international credit rating agencies for conducting ESG ratings in China [6]. The data collected from the agency included ESG ratings, Green Finance, and Social Capital from 2014 to 2022. The National Intellectual Propert Administration provided data on GI, and CSMAR database provided data on other economic variables [46]. Table 1 shows the sample

selection process and summary statistics of the data used in this study to examine the cash holding behavior of the firm considering ESG practices. Initially, we extracted the 95000 yearly observations spanning from 2014 to 2022. Out of these, 23,000 are from financial industry and 11,000 from regulated industry. Further, 14,000 observations do not meet our criteria, and 6,824 have incomplete information or do not match the control variables. After excluding data about the financial and regulated industries, as well as missing observations, we obtain a final sample consisting of 40176 yearly observations.

Table 1.
Sample and summary statistics.

Panel 1-sample selection	
Yearly observations of firms from 2014-2022	95000
Less yearly observations of financial industry	23000
Less yearly observation of regulated industry	11000
Less firms do not match with ESG compliance and ESG score	14000
Less firms incomplete data of control variables and not match	6824
Final sample to analyze the cash holding with ESG compliance	40176

The study focused on the period from 2014 onward, marking the time when most companies began implementing ESG compliance [22]. We target the 372-companies listed on the Shanghai and Shenzhen stock exchanges operating in environmentally impactful sectors, such as Oil & Gas Extraction, Mining (Except Oil & Gas), Automobiles, Energy, Plastic, Chemical, Furniture, Food Manufacturing, Textile Companies, Wood Product Manufacturing, and Tobacco. The purpose of this study is to analyze the influence of ESG compliance on firm liquidity [11].

5. Results and Discussion

5.1. Descriptive Statistics

Table 2.A presents the descriptive statistics of variables used to test the hypotheses proposed in this study. The three measures of the dependent variables, LR (mean: 0.331 and median: 0.178), CR (mean: 0.374 and median: 0.153), and OCF (mean: 0.273 and median: 0.110) demonstrate a normal distribution of our dependent variable [15]. The ESG rating score (mean: 5.344 and median: 1.673) and ENT Score (mean: 6.572 and median: 2.641), respectively, indicate that both indexes are normally distributed with small standard deviations [6]. The lower mean (0.021) and median (0.001) values of GF suggest that GF is still a secondary source of finance. The mean and median values of channel variables like GI (mean: 0.241 and median: 0.0722) and SC (mean: 0.0472 and median: 0.0183) demonstrate a normal distribution with lower standard deviations from their averages [5]. The mean and median values of control variables like FS (mean: 3.762 and median: 2.941), Capital Expenditures (CXP) (mean: 0.097 and median: 0.053), LEV (mean: 0.453 and median: 0.223), and DIV (mean: 0.079 and median: 0.035), respectively, indicate that all control variables are smoothly distributed [11].

Table 2A.
Descriptive statistics.

Variables	Observations	Mean	Median	St. dev
LR	76825	0.331	0.178	0.293
CR	76825	0.374	0.153	0.224
OCF	76825	0.273	0.110	0.285
ESG score	76825	5.344	1.673	2.441
ENT score	76825	6.572	2.641	1.372
GF	76825	0.021	0.001	1.392
FS	76825	3.762	2.941	2.673
CXP	76825	0.097	0.053	0.153
LEV	76825	0.453	0.223	1.134
DIV	76825	0.079	0.035	0.225
GI	76825	0.241	0.0722	1.062
SC	76825	0.0472	0.0183	0.049

Note: GF = Green finance; CXP = Capital expenditure; OCF= Operation cash flow; Liquidity ratio (LR); Current ratio (CR); Operating cash flows (OCF).

5.2. Regional Distribution of Cash Holding and ESG Compliance

Table 2.B presents the distribution of cash holdings and ESG compliance in different regions of China, including the provinces and independent states. The data shows that 40% of the population comes from states like BJ, FJ, HB, and HE, which have more ESG disclosures for long-term sustainability, respectively [3]. The results indicate that firms located in regions with high ESG compliance tend to hold less cash, with a few exceptions. However, significant variations are found in the state-level distribution of cash holdings and ESG compliance [16].

Table 2B.

Regional distribution of cash holding and ESG compliance.

S.No	Province	Obs.	Log-cash	Cash/N A	Cash/ TA	ESG score	ENT score	S. No	Province	Obs.	Log- cash	Cash/ NA	Cash/ TA	ESG score	ENT score
1	Anhui (AH)	878	0.17	0.22	0.15	11.34	12.34	17	Jiangsu (JS)	964	0.36	0.34	0.37	3.14	5.07
2	Beijing (BJ)	2160	0.13	0.17	0.08	8.09	9.08	18	Jiangxi (JX)	844	0.41	0.29	0.34	2.36	6.19
3	Chongqing (CQ)	1340	0.26	0.32	0.25	5.07	4.65	19	Liaoning (LN)	1336	0.32	0.41	0.27	3.89	3.07
4	Fujian (FJ)	1788	0.44	0.36	0.32	3.14	4.09	20	Macau (MO)	1572	0.24	0.27	0.24	6.12	8.74
5	Guangdong (GD)	1654	0.25	0.28	0.24	4.65	3.77	21	Inner Mongolia (NM)	556	0.23	0.35	0.25	15.71	12.07
6	Gansu (GS)	1180	0.27	0.27	0.23	4.21	5.43	22	Ningxia (NX)	1382	0.15	0.27	0.16	9.66	14.25
7	Guangxi Zhuang (GX)	1390	0.24	0.31	0.26	3.39	3.02	23	Qinghai (QH)	612	0.17	0.18	0.14	16.00	17.03
8	Guizhou (GZ)	1422	0.22	0.20	0.23	5.98	4.06	24	Sichuan (SC)	1044	0.21	0.24	0.12	8.52	9.67
9	Hainan (HA)	2045	0.23	0.26	0.19	4.14	5.66	25	Shandong (SD)	1396	0.19	0.22	0.15	9.23	7.54
10	Hebei (HB)	1736	0.18	0.27	0.17	7.70	11.21	26	Shanghai (SH)	1740	0.17	0.17	0.13	4.70	5.08
11	Henan (HE)	1822	0.19	0.23	0.15	24.53	15.44	27	Shaanxi (SN)	378	0.13	0.20	0.16	13.25	10.43
12	Hubei (HI)	1095	0.17	0.28	0.17	7.80	10.09	28	Tianjin (TJ)	598	0.32	0.34	0.27	4.74	4.06
13	Hong Kong (HK)	1162	0.14	0.24	0.18	11.67	14.11	29	Xinjiang (XJ)	786	0.24	0.27	0.22	6.85	5.19
14	Heilongjiang (HL)	1560	0.17	0.25	0.15	8.67	9.14	30	Tibet (XZ)	1608	0.16	0.16	0.16	15.42	14.37
15	Hunan (HN)	878	0.15	0.18	0.09	17.54	18.52	31	Yunnan (YN)	1098	0.44	0.29	0.34	5.63	4.73
16	Jilin (JL)	2160	0.13	0.16	0.07	17.00	16.88	32	Zhejiang (ZJ)	846	0.18	0.18	0.15	15.84	14.81

Note: GF = Green finance; NPV= Net present value; CSMAR= Chinese stock market & accounting research; CXP = Capital expenditure; VIF= Variance inflation factor; OCF= Operating cash flow; Liquidity ratio (LR); Current ratio (CR); Operating cash flows (OCF).

5.3. Univariate Test

Tables 2.C and 2.D report the results of a one-sample t-test comparing the mean difference between regions with high and low ESG compliance. The results show that the LR and CR outcomes are significantly lower in high ESG compliance states [44]. Firms operating in high ESG compliance states tend to have better quality financial reports, lower financial constraints, and face lower levels of systematic and idiosyncratic risks compared to those operating in lower ESG compliance states [45].

Table 2C.
One sample T-test of difference in mean.

Variables	ESG >= Median	ESG <= Median	T-test of difference in mean
LR	0.23	0.29	10.78***
CR	0.29	0.36	13.42***
OCR	0.19	0.23	9.30***
FS	4.67	4.56	13.56***
CXP	0.09	0.12	9.07***
LEV	0.39	0.44	7.42***
DIV	0.12	0.07	15.69***
GI	-3.08	-2.81	17.04***
SC	0.07	0.11	11.32***
GF	0.89	0.93	8.03***

Note: *** significant at 1%.

Table 2D.
Univariate test.

Variables	LR			CR			OCR		
	Coefficient	T	VIF	Coefficient	T	VIF	Coefficient	T	VIF
ESG score	-0.006***	2.37	1.67	-0.004***	2.43	1.85	-0.005***	2.44	1.87
ENT score	-0.004***	2.28	1.71	-0.003***	2.33	1.80	-0.002***	2.39	1.91
GF	-0.002***	2.54	1.74	-0.002***	2.55	1.76	-0.001***	2.67	1.72
FS	-0.024***	2.49	1.83	-0.025***	2.39	1.96	-0.034***	2.33	1.97
CXP	0.082***	2.29	1.84	0.076***	2.25	1.88	0.041***	2.33	1.86
LEV	-0.064**	2.66	1.95	-0.061***	2.67	1.99	-0.042***	2.72	1.83
DIV	-0.004**	2.45	1.78	-0.003***	2.44	1.74	-0.002**	2.44	1.69
Industry	0.011*	2.77	1.26	0.010*	2.74	1.27	0.013*	2.91	1.33
Yearly	0.005*	2.46	1.29	0.004*	2.39	1.32	0.001*	2.58	1.46
R-Square	0.34			0.33			0.31		

Note: *** significant at 1%, ** significant at 5%, * significant at 10%.
VIF: Variance inflation factor.

5.4. Correlation Analysis

The correlation analysis presented in Table 3 indicates that ESG compliance is negatively correlated with liquidity proxies such as LR, CR, and OCR, with correlation coefficients of (-0.15), (-0.21), and (-0.26), respectively [22]. Correlation coefficients of (-0.19), (-0.22), and (-0.24) for LR, CR, and OCR, respectively, show a negative correlation between ENT Score and liquidity measures [1]. These significant negative correlations imply that as firms increase their investment in ESG compliance, they may tend to decrease their investment in liquidity.

Moreover, the analysis shows a significant negative correlation between GF and liquidity measures such as LR, CR, and OCR, with correlation coefficients (-0.14), (0.18), and (-0.13), respectively. Conversely, GF is significantly positively associated with ESG compliance measures like ESG Score (0.18) and ENT Score (0.15) [47]. These results suggest that green finance can be used to support firms' ESG compliance efforts while reducing their liquidity levels [25].

Table 3.
Correlation analysis.

Variables	LR	CR	OCR	ESG score	ENT score	GF	SIZE	CXP	LEV	DIV	GI	SC
LR	1											
CR	0.11 ^a	1										
OCR	0.14 ^a	0.16 ^a	1									
ESG score	-0.15 ^a	-0.21 ^a	-0.26 ^b	1								
ENT score	-0.19 ^a	-0.22 ^a	-0.24 ^c	0.14 ^a	1							
GF	-0.14 ^a	-0.18 ^a	-0.13 ^b	0.18 ^a	0.15 ^a	1						
SIZE	-0.21 ^a	-0.18 ^a	-0.20 ^b	0.07 ^a	-0.05 ^a	0.22 ^a	1					
CXP	0.16 ^a	0.18 ^b	0.19 ^a	-0.05 ^a	0.04 ^a	-0.06 ^a	-0.04 ^a	1				
LEV	-0.09 ^a	-0.08 ^a	0.08 ^a	-0.06 ^b	-0.03 ^a	-0.22 ^a	-0.39 ^a	0.12 ^a	1			
DIV	-0.12 ^a	-0.14 ^a	-0.08 ^b	0.05 ^b	0.03 ^a	0.19 ^a	0.06 ^b	-0.04 ^a	-0.03 ^a	1		
GI	-0.14 ^a	-0.12 ^b	-0.10 ^a	0.03 ^a	0.03 ^b	0.21 ^a	0.37 ^b	-0.08 ^a	-0.06 ^a	0.09 ^a	1	
SC	-0.17 ^a	-0.16 ^a	0.19 ^a	0.09 ^c	0.05 ^a	0.22 ^b	-0.08 ^a	0.11 ^a	0.27 ^b	-0.21 ^b	-0.33 ^a	1

Note: ^a significant at 1%, ^b significant at 5%, ^c significant at 10%.

Additionally, the correlation analysis of control variables with liquidity indicates that large firms, high-leverage firms, firms with higher dividend payout ratios, and firms with high capital expenditures tend to hold more liquidity [44]. The study also found a significant negative correlation between liquidity and channel variables like GI and SC, while a significant positive correlation exists between ESG compliance measures like ESG Score and ENT Score and channel variables like GI and SC [25].

The findings of this study indicate that firm’s trade-off between ESG compliance and liquidity increases as more ESG compliance firms reduce their investment in liquidity [3]. Further, the results indicate that green finance increases firm engagement in ESG compliance, which helps reduce firm liquidity. The study highlights the significance of controlling for firm specific factors and channel variables in analyzing the relationship between liquidity and ESG compliance [17].

5.5. Cluster Regression Analysis

Table 4.A shows the results of a cluster regression analysis to examine the impact of ESG compliance on firm liquidity while controlling firms’ characteristics like industry and year effect. The study proposes that firms operating in high ESG compliance region hold less liquidity and tests this hypothesis using LR, CR and OCR as a measure of liquidity. The finding indicates that ESG compliance significantly negatively affects all measures of liquidity LR (-0.006), CR (-0.004), and OCR (-0.005) [15]. Likewise, ENT score is also significantly negatively affects all measures of liquidity: LR (-0.004), CR (-0.003), and OCR (-0.002) [47] respectively.

Table 4A.
Cluster regression analysis of ESG compliance and liquidity.

Variables	LR			CR			OCR		
	Coefficient	T	VIF	Coefficient	T	VIF	Coefficient	T	VIF
ESG score	-0.002***	2.37	1.67	-0.002***	2.43	1.85	-0.001***	2.44	1.87
ENT score	-0.002***	2.28	1.71	-0.001***	2.33	1.80	-0.001***	2.39	1.91
GF	-0.001***	2.51	1.73	-0.001***	2.58	1.75	-0.001***	2.68	1.70
GF*ESG	-0.032***	2.44	1.69	-0.031***	2.49	1.72	-0.021***	2.61	1.76
GF* ENT	-0.022***	2.54	1.77	-0.021***	2.59	1.73	-0.020***	2.67	1.77
FS	-0.023***	2.45	1.81	-0.024***	2.37	1.95	-0.031***	2.32	1.94
CXP	0.082***	2.29	1.84	0.076***	2.25	1.88	0.041***	2.33	1.86
LEV	-0.064**	2.66	1.95	-0.061***	2.67	1.99	-0.042***	2.72	1.83
DIV	-0.003**	2.42	1.78	-0.002***	2.41	1.70	-0.002**	2.42	1.67
Industry	0.011*	2.76	1.25	0.012*	2.73	1.26	0.013*	2.92	1.34
Yearly	0.004*	2.45	1.27	0.003*	2.37	1.35	0.003*	2.57	1.45
R-square	0.35			0.34			0.29		

Note: *** significant at 1%, ** significant at 5%, * significant at 10%

The findings indicate the firms that engage in ESG activities maintain lower levels of liquidity. ESG-compliant firms can generate funds externally at a lower cost to reduce agency and asymmetric costs of capital [20]. ESG-compliant firms address the stakes of numerous stakeholders and introduce corporate policies that are helpful in addressing environmental, social, and governance problems associated with business practices [20]. The integrating variable GF is also significantly negatively influencing firm liquidity (LR: -0.002, CR: -0.002, and OCR: -0.001), respectively. Shaikh [4] elucidates the connection between green finance policies and ESG corporate policies for ensuring long-term sustainability.

Table 4.B presents the estimated results testing the impact of ESG compliance on firm liquidity in the presence of GF. The results indicate that integration terms of ESG compliance and GF, such as ESG score GF (LR: -0.032, CR: -0.031, and OCR: -0.021) and ENT score GF (LR: -0.022, CR: -0.021, and OCR: -0.020), significantly and negatively affect all versions of liquidity [44]. The negative effect of the interaction term of ESG*GF suggests that green finance supports firms in reducing liquidity, as proposed in hypothesis-1. We note that combined effect of ESG and GF on firm liquidity outweighs the individual effect of ESG compliance [45]. This finding suggests that GF accelerates the influence of ESG compliance on firm liquidity. This can be explained by the fact that green finance assists firms in implementing ESG compliance to address all stakeholders and improve the governance structure of the firm [26].

The existing literature on corporate investment and sustainability also explains that increasing investment in CSR activities, introducing corporate governance policies, and addressing stakeholder ownership can assist in reducing the firm’s financial constraints for external financing [14]. The transaction motive of liquidity explains that ESG-compliant firms do not need to maintain higher liquidity for routine business transactions due to lower risk of external financing at a reasonable cost [6]. ESG-compliant firms are also in a better position to encounter adverse market shocks and do not need to hold more liquidity to deal with precautionary motives for liquidity. The results are consistent with earlier studies showing that firms that invest in ESG compliance provide insurance to manage idiosyncratic risks, external market shocks, and short-term bankruptcy costs that are important for determining liquidity to run the business smoothly [3, 12]. The control variables FS (-0.023), CXP (0.082), LEV (-0.064), and DIV (-0.003) also significantly affect the dependent variable LR [21].

Table 4B.
Green finance and ESG compliance on firm liquidity.

Variables	LR	CR	OCR	GI	SC
GI	0.044***	0.042***	0.032***	-	-
SC	0.032***	0.031***	0.031***	-	-
ESG score	-0.033***	-0.031***	-0.033***	-0.024***	-0.023***
ENT score	-0.032***	-0.030***	-0.033***	-0.014***	-0.012***
SIZE	-0.023***	-0.032***	-0.031***	-0.021***	-0.020***
GF	-0.022***	-0.021***	-0.020***	0.021***	0.022**
CXP	0.043***	0.033***	0.033***	-0.021***	0.021**
LEV	-0.032***	-0.031***	-0.031***	-0.030***	0.020***
DIV	-0.003**	-0.002**	-0.002**	-0.001***	0.001**
OCF	-0.004**	-0.002**	-0.005**	-0.022***	-0.132***
Industry	0.012*	0.012*	0.011*	0.002*	0.002*
Yearly	0.004*	0.003*	0.003*	0.002*	0.001*
R-square	0.36	0.34	0.31	0.29	0.26

Note: *** significant at 1%, ** significant at 5%, * significant at 10%.

5.6. Direct and Indirect Effect of ESG Compliance on Cash Holding

Table 5.A presents the results obtained from the GMM regression analysis conducted to examine the direct impact of ESG compliance and two non-financial channels on the level of liquidity using Equations 3 and 4 [29]. The analysis revealed that a significant negative effect exists between ESG score and liquidity, as evidenced by the LR, CR, and OCR values of (-0.033), (-0.031), and (-0.033), respectively. Similarly, the ENT Score finds a significant negative impact on all liquidity measures, with LR, CR, and OCR values of (-0.032), (-0.030), and (-0.033), respectively [6, 48].

The non-financial factors, such as GI (LR: 0.044, CR: 0.42, OCR: 0.032) and SC (LR: 0.032, CR: 0.31, OCR: 0.031) have a significant positive relationship with all measures of firm liquidity [22]. On the other hand, ESG compliance measures, such as ESG score (GI: -0.024 and SC: -0.23) and ENT score (GI: -0.014 and SC -0.12), have a significant negative impact on firm liquidity through indirect effects. This finding is consistent with previous studies [4] which also reported a negative relationship between ESG compliance and firm liquidity.

Table5A.
Direct and indirect effect of ESG.

Depet/Indeptvar	LR	CR	OCR	GI	SC
GI	0.044***	0.042***	0.032***		
SC	0.032***	0.031***	0.031***		
ESG score	-0.033***	-0.031***	-0.033***	-0.024***	-0.023***
ENT score	-0.032***	-0.030***	-0.033***	-0.014***	-0.012***
SIZE	-0.023***	-0.032***	-0.031***	-0.021***	-0.020***
GF	-0.022***	-0.021***	-0.020***	0.021***	0.022**
CXP	0.043***	0.033***	0.033***	-0.021***	0.021**
LEV	-0.032***	-0.031***	-0.031***	-0.030***	0.020***
DIV	-0.003**	-0.002**	-0.002**	-0.001***	0.001**
OCF	-0.004**	-0.002**	-0.005**	-0.022***	-0.132***
Industry	0.012***	0.012***	0.011***	0.002**	0.002***
Yearly	0.004**	0.003**	0.003**	0.002***	0.001**
R-square	0.36	0.34	0.31	0.29	0.26

Note: *** significant at 1%, ** significant at 5%.

ESG compliance has a notable impact on firm liquidity through the channels of governance and societal concerns. ESG-compliant firms tend to maintain lower levels of liquidity [26] by investing in projects that prioritize environmental protection, societal issues, and governance policies [2]. This investment strategy can enable ESG-compliant firms to secure funding from government and open market operations on favorable terms, which can serve as a precautionary measure for liquidity transactions [24].

Table 5B.
Test of direct and indirect effect of ESG compliance.

Variables	LR	CR	OCR
Direct effect			
ESG index	-0.042***	-0.033***	-0.044***
ESG score	-0.032***	-0.031***	-0.031***
GF	-0.022***	-0.022***	-0.020***
Indirect effect			
GI	-0.003***	-0.002***	-0.002***
SC	-0.004**	-0.003**	-0.002***

Note: **p<0.05 and *** significant at 1%

The findings presented in Table 5.B demonstrate that non-financial channels of liquidity play a significant role in hypothesis testing. To be more specific, the study shows how ESG compliance affects liquidity measures LR, CR, and OCR [3] through GI and SC. The results indicate that these indirect effects have a notable impact, with coefficients of (-0.003) on LR, (-0.002) on CR, and (-0.002) on OCR for GI, and (-0.004) on LR, (-0.003) on CR, and (-0.002) on OCR for SC. This highlights the importance of considering the indirect effects of ESG compliance on a firm's cash holdings, as emphasized by Xie, et al. [24].

5.7. Regional Distribution of ESG Compliance and Cash Holding

The firms are also categorized into high-and low-ESG compliance regions to investigate the regional influence of ESG compliance on firm liquidity [2]. The Table 6 indicates that firms operating in high ESG compliance regions both in terms of ESG compliance (LR: -0.043, and CR: 0.042 and ENT score (LR: -0.032 and CR:-0.031) significantly influence the liquidity as compared to firms operating in low ESG regions [20]. Specifically, the firms located in low ESG regions have lower significant effect on firms liquidity in terms of ESG score (LR:-0.022 and CR: -0.022) and ENT score (LR: -0.021 and CR: -0.011) respectively [15].

Table 6.
Regional distribution of ESG compliance and firm liquidity.

Variables	LR high ESG region			CR high ESG region			LR low ESG region			CR low ESG region		
	Coefficient	T	VIF	Coefficient	T	VIF	Coefficient	T	VIF	Coefficient	T	VIF
ESG score	-0.043***	2.23	1.77	-0.042***	2.43	1.72	-0.022***	2.44	1.77	-0.022***	2.41	1.78
ENT score	-0.032***	2.27	1.82	-0.031***	2.33	1.87	-0.021***	2.33	1.88	-0.011***	2.34	1.82
GF	-0.021***	2.46	1.84	-0.021***	2.44	1.87	0.032***	2.45	1.80	0.031***	2.48	1.85
SIZE	-0.032**	2.24	1.66	-0.034**	2.64	1.66	0.023***	2.65	1.63	0.022***	2.64	1.65
CXP	0.053***	2.58	1.87	0.051***	2.23	1.86	-0.052***	2.28	1.66	-0.043***	2.34	1.75
LEV	-0.054***	2.67	1.87	-0.067**	2.66	1.98	0.063**	2.67	1.91	0.068***	2.68	1.94
DIV	-0.014***	2.44	1.77	-0.022***	2.45	1.77	-0.034***	2.43	1.78	-0.034***	2.43	1.86
OCF	-0.072***	2.65	1.86	-0.074***	2.38	1.72	-0.066***	2.44	1.76	-0.063***	2.45	1.77
Industry	0.022*	2.96	1.64	0.027	2.82	1.17	0.025	2.82	1.24	0.025	2.74	1.45
Yearly	0.042	2.46	1.38	0.044*	2.47	1.33	0.044*	2.51	1.38	0.033*	2.54	1.43
R-square	0.32	-	-	0.30	-	-	0.34	-	-	0.29	-	-

Note: ***significant at 1%, **significant at 5%, *significant at 10%.

The findings indicate that operate in high ESG compliance regions have better access to raise finance externally at lower costs, which reduces their need to hold excess liquidity [24]. The findings are consistent with the existing studies [4] which find that firms operating in high ESG regions tend to maintain lower liquidity. Fiordelisi, et al. [27] also explain that firms' engagement in ESG compliance can facilitate holding competitive advantages such as optimal working capital management, maintaining lower cash holdings, and financing externally at reasonable costs [6].

6. Conclusion

This study explores how liquidity is affected by a firm's ESG compliance, taking into account non-financial factors like SC and GI that affect the firms' liquidity. We argue that shareholders and investment intermediaries who prioritize ESG compliance create a framework that limits a manager's ability to use liquidity. As a result, firms operating in regions with high ESG compliance can obtain external financing at lower costs, reducing the need for them to hold excess liquidity. Our findings support our hypotheses, indicating that integrating ESG compliance with traditional financing sources reduces the need for firms to hold more liquidity. Additionally, we find that ESG compliance mitigates the negative effects of globalization and supply chain factors on firm liquidity. Firms operating in high ESG compliance regions invest heavily in globalization and supply chain management, enabling them to establish sustainable relationships with stakeholders and reduce financial constraints, as proposed in hypotheses 2 and 3, respectively.

This study provides valuable insights into the impact of ESG compliance on firm liquidity behavior in the corporate literature. Few studies have explored the influence of ESG compliance on firm liquidity in the context of ensuring long-term sustainability through GF. We have combined two contrasting streams of literature on ESG compliance and corporate liquidity to initiate a new debate on corporate liquidity holding. Given the rising global trend of corporate liquidity and its financing costs, it is critical to examine various determinants and channels of liquidity. Our findings suggest that combining green finance with ESG compliance is a viable approach for firms to establish a minimum level of liquidity. In general, this study sheds light on how a firm's social engagement affects its operational behavior.

We have defined the scope of our study to focus on ESG compliance and liquidity behavior among Chinese firms operating in various regions. To provide a new perspective on corporate liquidity, we have limited our analysis to non-financial channels such as GI and SC, while excluding financial channels. Additionally, we believe that China's green policies and international pressure on G-8 economies to reduce carbon emissions could motivate the Chinese government to offer financial assistance for installing advanced equipment and reducing financial constraints for firms. However, it is important to note that our study has some limitations. We have only used Chinese databases, Wind Syntao Green Finance and CSMAR, to obtain a comprehensive overview. We have not cross-referenced our findings with other international databases, such as Bloomberg and Thomson Router Data-Hub, which could have provided additional insights. Therefore, corporate literature should not overgeneralize and apply the findings of our research universally.

One potential avenue for future research involves studying the optimal level of liquidity in both high and low ESG compliance countries. Researchers could investigate additional financial and governance factors, such as financial constraints, systematic risk, and the quality of financial reporting, to determine how they may help firms establish the optimal level of liquidity for long-term sustainability. Incorporating these findings could lead to a more comprehensive understanding of the factors that influence liquidity decisions and their impact on a company's overall financial health.

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