

# The Impact of ESG on Earnings Volatility of Manufacturing Companies in China

Kudzai Patricia Nyahuma

School of Economics and Management, Management Science and Engineering Master Pro-gram, Chongqing University of Post and Telecommunication, Chongqing, 400060, China

**Abstract:** This study examines how environmental, social, and corporate governance (ESG) performance influences a firm's earnings volatility, considering the mediating role of financial constraints and the moderating effects of supply chain concentration. Drawing on stakeholder theory and resource dependency theory, the research model was proposed and hypotheses were developed to address the research questions. The study employs fixed effects regression analysis, conducted using STATA 18.0, on data from 603 manufacturing companies listed in China's A-shares market from 2013 to 2022. The results reveal that ESG significantly impacts earnings volatility, with financial constraints partially mediating this relationship, and supply chain concentration serving as a moderator. These findings have important implications for managers, policymakers, and investors.

**Keywords:** ESG, Earnings volatility, Financial constraints, Supply chain concentration.

## 1. Introduction

In recent years, the inclusion of Environmental, Social, and Governance (ESG) factors has garnered significant attention from the corporate world due to increased pressure from everyone to embrace sustainable practices, lessen their environmental and social footprints, and improve transparency through the implementation of ESG disclosure standards [1, 2]. Investors, shareholders, creditors, regulatory authorities, government agencies and other stakeholder's interests are growing day by day in ESG matters [3]. In satisfying the informational needs of investors, policy makers, and stakeholders, financial transparency alone is insufficient which implies that there is need for non-financial disclosure such as integrated reports, social reports, sustainability reports, and environmental reports in satisfying these demands [4]. Global investors are becoming more interested in resolving ESG issues and exploring sustainable investment opportunities as a result of this growing knowledge [5]. By 2050, countries such as: China, Germany, the United States, and the European Union want to attain carbon neutrality [6]. The governments of each of these nations are using laws and regulations to enforce the use of Environmental, Social, and Governance (ESG) principles in order to achieve this goal [7]. These actions lead to a positive effect towards the increased integration of UN Sustainable Development Goals in financial investments [8]. According to Statista, China witnessed a significant increase in the number and market capitalization of ESG funds in 2021. There were 160 of these funds, a significant increase in number, and their combined market capitalization reached almost 400 billion yuan.

Despite various studies that have been conducted to test the impact of ESG and other financial performance. Few researchers have focused on the impact of ESG performance on the firm's earnings volatility. The few studies that have studied the impact of earnings volatility was done by [9] when they used it as a control variable. The results showed that earnings volatility mitigates the relationship between earnings quality and sustainability disclosure quantity. Some other researchers stated that regardless of the absence of a complete literature on ESG firms and earnings volatility,

social and environmental ventures undertaken by ESG firms can contribute to earnings volatility [10]. Based on the literature on ESG and financial performance there exist various limitations which require more studies to be conducted. Firstly, more studies are conducted in developed economies due to attention paid by various stakeholders such as investors, lenders, and the media whereas very limited studies are conducted for emerging economies. Part of the reason why there is a limit in the research for emerging economies is that they focus more on economic development, paying less attention to the ESG practices [11]. Secondly, ESG information disclosure varies widely between economies and industries, making it hard for researchers who would want to conduct comparative analysis of ESG performance between different countries and industries [12]. Thirdly, the data for ESG scores that is provided by ESG agencies is old, difficult to find and doesn't include many developing countries which is a problem for researchers who would want to conduct their studies targeting those countries [13, 14].

However, as we mentioned that the impact of ESG performance on earnings volatility is scarce regardless of its importance not only to the firm but also to the stakeholders such as shareholders, investors, lenders, creditors who consider risk before investing their capital into the company [3]. Since investors are considering ESG scores of firms before investing, earnings volatility as another important financial performance measure may be influenced by the firm's ESG performance. Therefore, to fill this gap this study proposed the following research questions: How does the ESG score impact Earnings Volatility? Does Financial Constraints mediate the relationship between ESG score and Earnings Volatility? To what extent does Supply Chain Concentration moderate the relationship between combined ESG score and Earnings Volatility?

The remainder of this paper is structured as follows: Section 2 presents the literature review and theoretical foundation. Section 3 discusses hypothesis development. Section 4 describes the methodology. Section 5 provides the study's results. Section 6 includes the discussion and conclusion. Finally, Section 7 outlines the implications,

limitations, and directions for future research.

## 2. Literature Review

### 2.1. Environmental, Social and Corporate Governance (ESG)

In recent years, ESG aspects have attracted a lot of attention from shareholders, investors, lenders and other stakeholders in the corporate world for decision making [4]. It has strengthened companies in gaining good reputation and improving their financial performances. This survey of literature aims to give a thorough summary on the body of knowledge on ESG. ESG is an acronym which stakeholders frequently use to assess firms based on environmental factors, social responsibilities and corporate governance. ESG standards are regarded as non-financial performance parameters which are used in business sectors to see how firms deal with issues related to social responsibility, ethics, and corporate governance [4]. These three dimensions place a strong emphasis on balancing all the elements without ignoring the other and they were initially created to cater for financial companies and investors [15] but gained popularity and spread to the rest of other stakeholders. According to [16], the elements covered by Environmental (E) in ESG comprise of emission, waste management, biodiversity, resource consumption. The resource consumption measures the ability to reduce by how much energy, water, or other resources that are being used. It also covers the company's capacity to enhance supply chain management and apply more ecologically friendly solutions. The emission component evaluates how well the business has changed its operating and manufacturing procedures to cut down the emissions that are harmful to the environment. Lastly the handling of waste materials includes gathering, moving, processing, recycling, disposing of, and keeping track of them.

Secondly, the factors covered by S (Social) in ESG include the community, working conditions, and human rights management. The element measures the firm's performance in providing good working conditions e.g. equal opportunities, safety, workplace equality and healthiness of the employees. It also assesses whether the basic human rights practices in the firm are or not. Social component considers the employee's job fulfillment and opportunities for expert development. Lastly, it also addresses that the firms are dedicated to maintaining commercial ethics, protecting public health, and functioning in a responsible manner as a citizen. Lastly, G (Governance) in the ESG considers how transparent is the organization in terms of business conductions and how strong is the relationship between owners of the business and its managers as well as other stakeholders. It also considers fair treatment of shareholders without any bias.

ESG has proved to be important to the investors and other parties concerned in the sense that, according to [17] it mitigates risks faced by companies because it's a future assessor of risks that can be faced by firms. Businesses that handle ESG concerns very well, they typically outperform their competitors in the long run due to sustainable growth and resilience that are facilitated by strong corporate governance, moral business conduct, and environmental care [2]. As a result, these businesses will appeal more to investors looking for steady returns. Furthermore, companies that perform excellent in ESG performance can attract a large number of investors due to better access to capital and lower borrowing costs. According to [16], ESG practices improve

the company's reputation which in turn attracts a pool of investors because most investors value company reputation. Moreover, businesses that place a high priority on ESG aspects are frequently better able to endure and bounce back from a variety of shocks, like natural disasters, societal unrest, or scandals involving the administration of the company [1]. This will attract investors because they would like to invest their funds in a company that is capable of handling external and internal forces. Some of the existing studies which are already conducted by researchers to deal with ESG are to do with profitability, cost of debt, firm value, cost of equity, customer brand choice and stock price volatility [3, 18, 19].

### 2.2. Earnings Volatility

One of the main factors determining risk and the subsequent market price of a stock is earnings volatility. It is referred to the degree to which a firm's earnings fluctuate over a specific period of time. Earnings volatility measures how a company's profitability varies over time [20]. A company's profit is frequently impacted by a range of internal factors which includes: operational efficiency which talks about companies that have efficient operational processes and effective cost control measures typically have fewer volatile earnings than those that are experiencing operational difficulties [21]. Furthermore, financial leverage is the degree to which a business depends on debt financing that may have an effect on the volatility of its earnings. The fluctuation of earnings is usually increased by higher leverage ratios because of interest costs and debt servicing requirements [22]. Market condition is the rapid changes in the competitive environment, market trends, disruptive inventions, or other industry dynamics that can cause a company's profitability to become unpredictable and volatile. This is an external factor that can cause earnings volatility in a firm. It is said that if earnings volatility increases, it is so hard to predict the earnings of a company [23].

Earnings volatility is a crucial financial performance that needs to be studied because investors, analysts and other stakeholders consider when making investment decisions [24]. Investors who are risk averse would consider to invest in companies with lower earnings volatility because it was found that higher earnings volatility are riskier and they lower market values [25]. They also lead to financial distress of a company that may lead to financial bankruptcy. Higher earnings volatility makes it hard for a corporation to borrow funds from any other lenders. Financial bankruptcy is when a business declines in financial conditions or fails to pay its debt or meet its obligations to its creditors [26].

Earnings volatility is an important financial aspect as mentioned before that has attracted many scholars to research about it, in recent years. Some of the studies include earnings autocorrelation, earnings volatility, and audit fees [23] which states that there is a positive association between earnings volatility and audit fees. [27] found that there is a negative relationship between risk aversion and earnings volatility on CEO risk aversion and earnings volatility analysis. A significant negative relationship between crisis period stock returns and prior earnings volatility was discovered according to [28]. Last but not least earnings volatility is positively related to earnings management in the sense that as the firm's earnings become more volatile, the level of earnings management increases [29].

## 2.3. Financial Constraints

According to the Resource dependency theory by [30] firms depend on external resources to survive and thrive. Resources include but are not limited to financial, technology, raw materials, customers and many others. However, financial resources are an important asset in the day to day operations of the business, meaning, lacking access to these resources can be detrimental. In recent years, researchers have looked into finding more about financial constraints. Most if not all companies in various countries have at some point in their operations faced financial constraints (Kim, Minjung).

Financial constraints refer to the difficulties or restrictions in obtaining external financing. These restrictions to access financial resources are caused by various factors which include firm size, lack of collateral or sufficient internal funds, information asymmetry and profitability [31, 32]. Small and emerging enterprises face financial constraint due to limited access to capital because of their size than larger and established firms. Small and emerging firms are riskier to invest into than large and established firms which have a track record or history that investors can look into before deciding to invest (Bakhtiari, Sasan). Additionally, lack of collateral or sufficient internal funds to present to the lenders and investors to guarantee the safety for investing in the enterprise is another determinant for financial constraints. Without collateral or viable cashflows it is impossible for enterprises to have access to financial resources [32].

## 2.4. Supply Chain Concentration

Supply chain has garnered significant attention from various scholars due to the supply chain resilience, sustainability and competitiveness [33]. It is defined as the degree to which the chain of supply is dominated by several numerous companies or depends on limited sources for materials or services [34]. Supply chain concentration plays a pivotal role in a firm, which makes it an important characteristic of the supply chain framework. The framework includes two elements which are, supply concentration (SUP) and customer concentration (CUS) [35]. Supply concentration refers to the extent to which a company relies on a small number of suppliers for their services, good and materials for it to commence its business whilst customer concentration refers to the extent to which accompany relies on a small number of customers for it to gain revenue from their sales [36]. When supply chain concentration of a firm increases, customers or supplier's bargaining power increases [37] and this will have a negative impact on the firm [38]. According to [39, 40] talked a lot about how supply chain concentration can make an organization more vulnerable to shocks, including natural disasters. These studies highlight how serious global supply chain vulnerabilities might result from interruptions in concentrated supply chains. Expanding inventory, diversifying the supply base, and creating new supplier options can help to mitigate the above actions [39, 40]. Supply chain concentration can influence environmental and social sustainability in both ways, positively and negatively.

Some scholars have studied supply chain concentration and found some of the following results, [41] discovered a U-shaped association between customer concentration and supplier profitability, which becomes weaker as the percentage of insiders in firm management's equity increases. [42] discovered that retailers who have a more centralized supplier base receive more trade credit than those who have a

more dispersed supplier base, these are economic consequences (supply chain concentration and corporate performance) of the firm. Capital market performance includes these stock prices and supply chain concentration. [43] examined Chinese businesses during the COVID-19 crisis and discovered that, immediately following the crisis, more severe stock price drops over the short- and medium-term windows were associated with a higher degree of supply concentration.

## 2.5. Theoretical Foundations

### 2.5.1. Stakeholder theory

In recent years, organizations and business environments are facing increasing pressure to not only consider shareholders' interests but various stakeholder's interests such as customers, government and many others [3]. Stakeholder theory was developed by [44] and this theory's groundwork was established by Freeman's influential 1984 book "Strategic Management: A Stakeholder Approach" which argues about how businesses should consider the stakeholder's interest and needs not only focusing on maximizing shareholder's wealth. Stakeholder theory is more sustainable because it puts forwards that successful companies are able to align the interests of all stakeholders. The theory emphasizes the value of interacting with and managing relationships with a wide range of stakeholders, including suppliers, communities, consumers, and employees. This approach provides a comprehensive view of organizational management. The notion of stakeholder, as proposed by [45] posits that there is a better chance of resolving issues if we use the relationships that exist between a business and groups or individuals that can either affect or can be affected by the organization's actions or decisions. In addition, one should know how relationships work and how they change over the course of time. If stakeholder's interest differs, managers should find a way to solve these conflicts, satisfy the various groups of stakeholders, and create value and strategies of the business. Stakeholder theory criticizes companies that only prioritizes the interest of shareholders without considering other stakeholder's views in their decision making.

Stakeholder theory was initially developed for business and management, but it gained popularity and has been applied in many different disciplines including, education, health care, law, public policies, information and technology, ethics, CSR and environmental policy. According to [46], stakeholder theory encompasses different theoretical perspectives that enlightens the relationship between the organization and its stakeholders, for example normative, talks about ethics and morals, descriptive, talks about various stakeholders who are affected or involved in the organization's activities and instrumental, highlights how crucial it is to strategically interact with stakeholders in order to improve long-term sustainability, competitiveness, and organizational success. Stakeholder theory also involves discussions on power dynamics, stakeholder legitimacy, and other topics. The arguments that stakeholder theory proposed, that is, for companies to value the interest of all the stakeholders makes it the ideal theoretical foundation to support our research on the influence of environmental, social and corporate governance (ESG) on earnings volatility since it touches immensely the interest of the stakeholders.

### 2.5.2. Resource dependency theory

Without resources such as human resources, financial

resources, technological resource and many others, firms cannot thrive in their day to day operations. In light of these considerations, the resource dependence theory was developed by [30, 47] and made available to the public through a published book titled “The External Control of Organizations: A Resource Dependence Perspective”. Since its inception, the resource dependence theory (RDT) has become one of the most influential theories in organizational theory and strategic management [48]. Resource dependence theory (RDT) states that all organizations depend on each other in the external environment for provision of important resources. Resource dependency theory (RDT) highlights the importance of the external environment in the operation of the business. [30, 47] gives various contributions about theory’s perspective and interorganizational relations which includes,

Firstly, understanding of the society is vital for organizations since organizations do not exist in isolation but are surrounded by a social structure which includes networks of relationships, cultural values and norms. Understanding society helps in getting to know where the resources are and how they can be acquired. Another perspective is that organizations are not autonomous, but rely on other organizations for survival [30, 47]. Additionally, uncertainties about the actions the organization that the business relies on, makes the success and survival of the business also uncertain [48]. It is due to such uncertainties that organizations take measures to manage the external dependencies through joint venture, mergers and acquisition etc [30, 47, 48]. It is through managing the external dependencies that organization get the power to influence other organizations in the external environment and minimize dependence on other organizations.

Moving on, managing external dependencies as highlighted in the previous paragraph is the goal of many businesses. Organization’s aim is to avoid depending on other organizations for resources. Inasmuch as it is difficult to be autonomous, managing the external dependencies minimizes uncertainties that come with depending on other organizations. Some of the uncertainties for depending on external factors include price fluctuations, technological changes, delays in the production process, market changes and many more. Therefore, to minimize these adverse outcomes, [47] proposed these five possible actions which include,

Mergers, resource dependency theory (RDT) posits that companies make mergers and acquisitions to reduce competition by acquiring a significant competitor, to manage external independencies by absorbing key actors in the supply chain and diversification to also reduce dependence [49]. More so, joint ventures, the formation of joint ventures helps in acquisition of resources to lessen interdependence and uncertainty. [47] stated that a joint venture and other interorganizational relationship only allow a partial absorption unlike mergers and acquisitions which goes for a full absorption. [47] also suggest that boards of directors in a company are another way of minimizing environment dependence. Board of directors are not only capable of distributing information informed by counsel but also information with regards to access of resources that a firm needs, which includes financial resources. Political actions, firms engage in political activities such as lobbying, or supporting political campaigns to gain access to policy-makers or decision-makers to create policies that support their

business, thus reducing uncertainties or interdependencies. Lastly, executive succession contributes in minimizing uncertainties and interdependencies. A change of the administrators or executives can be vital in reducing organizational problems, resulting in reduced uncertainties. Based on this understand the resource dependency theory (RDT) is used as an underlying theory for financial constraints as a mediator in our study.

### **3. Hypotheses Development**

#### **3.1. ESG and Earnings Volatility**

Stakeholder theory stated that the company should consider not just its shareholders but the external stakeholders since they affect and are affected by the firm directly or indirectly [45]. Various stakeholders such as investors, lenders and customers are impacted by the environmental, social and corporate governance (ESG) performance of the company due to its impact on the company’s earnings volatility. According to studies, investors and lenders pay more attention to how firms perform with regards to environmental, social and corporate governance (ESG) practices. Companies with a good ESG score are able to attract investors, experience a reduction in cost of debt and equity which in turn gives the company enough capital to operate efficiently, manage risk, attract customers thus lowering earnings volatility [4, 50]. In contrast, companies with a poor ESG performance experience high cost of debt, bad publicity and may face regulatory fines which disruption organizational operations. Therefore, our hypothesis states that:

H1: There is a negative relationship between a favorable ESG performance and earnings volatility.

#### **3.2. ESG and Financial Constraints**

The resource dependency theory asserts the importance of resources to the operations of the business [47]. In our case, financial resources are known in the business world that firms need investors and lenders to inject financial resources into the business in order to thrive. Restrictions to these finance contributors is counterproductive. Debt and equity from the investor and lenders play an important role in the operation of a firm. Companies with higher ESG scores attract financial resources from investors and lenders with lower cost of capital [51]. However, companies with poor ESG scores are restricted from access to these financial resources which eventually drive them out of business. Therefore, we propose that:

H2: High ESG score alleviates financial constraints.

#### **3.3. Financial Constraints and Earnings Volatility**

Restrictions to accessing financial capital negatively affects business flow. Companies experiencing financial constraint may struggle to acquire technology used in the operation of the business, face challenges to innovate, expand the business. Acquiring technology, Innovation, expansion, meeting short-term debts requires access to capital yet financial constraints stifles companies plans to achieve those objectives thus increasing earnings volatility [52]. Also, surviving a competitive environment, market volatility with financial restriction is difficult which in turn impacts cash flows and earnings volatility. Therefore, we presume that:

H3: The alleviation of financial constraints is associated with a lower level of earnings volatility.

### 3.4. Moderating Effect of Supply Chain Concentration

Supply chain concentration has a moderating effect on the relationship between the firm's environment, social and corporate governance (ESG) and earnings volatility. A high concentration of the enterprise suppliers (customers) means a company relies on few big suppliers and customers. [35] showed that any disruption of the production due to environmental or social issues on the supplier's side or decrease in customers can affect the earnings of firms which have high supply chain concentration despite its favorable ESG performance. On the other hand, diversified supply chain concentration helps in preventing these disruptions of production, rise in prices, losing bargaining power and others. Based on the above assertions we hypothesize that:

H4: Supply Chain Concentration strengthens the relationship between ESG and earnings volatility.

### 3.5. Mediating Effect of Financial Constraints

The impact of environmental, social and corporate governance (ESG) scores may indirectly affect earnings volatility through the mediation of financial constraints. This argument arises due to the importance of not being restricted to access financial resources for firms with a good ESG score as compared to those with a poor ESG score. A good ESG score gives the company access to financial resources needed to attain its objectives at a lower cost than those with a poor ESG score [4, 53]. Once the company is able to acquire financial support, it will be able to lower its earnings volatility through acquiring technology needed in production, diversification, joint-venture, acquisition and mergers and many others that will increase its market share, lower its stock price volatility and attract more investors and build its reputation. Conversely, companies with a poor ESG score experience financial constraints and fail to attain their objectives. Therefore, we hypothesize that:

H5: Financial Constraints mediates the relationship between ESG score and earnings volatility.

## 4. Methodology

### 4.1. Data and Sample

This study investigates the impact of ESG performance on earnings volatility in China's manufacturing sector during the period from 2013 to 2022. The data for the analysis were obtained from the China Stock Market Accounting Research (CSMAR), a widely recognized and reliable resource for financial and accounting data in China and Wind databases, a prominent financial database in China providing comprehensive data across various sectors, including stocks, funds, and bonds. After applying exclusion criteria; such as firms with incomplete data, companies issuing non-standard share types, and special treatment (ST) companies. The final dataset includes a total of 603 manufacturing firms listed on

the stock market. This yields a comprehensive sample of 6,030 firm-year observations, providing robust data for analysis.

### 4.2. Variables

#### 4.2.1. Dependent variable

The dependent variable examined in our study is earnings volatility (EVOL). The data utilized to measure earnings volatility was sourced from the China Stock Market Accounting Research (CSMAR) database. Consistent with methodologies employed in prior research [28, 54-56], earnings volatility is determined by calculating the standard deviation of earnings before interest and tax (EBIT). This figure is then normalized by dividing it by the firm's total assets, providing a standardized measure that accounts for differences in firm size and enables meaningful comparisons across firms.

#### 4.2.2. independent variable

ESG performance was the independent variable in this study. Consistent with extant literature [11, 57], the Wind database was used to obtain data on ESG performance. The weights of key indicators under the three pillars; environmental, social, and corporate governance were assigned based on the industry, specifically the manufacturing industry in this case. The ESG evaluation index was categorized into nine levels: C, CC, CCC, B, BB, BBB, A, AA, and AAA. Corresponding values from 1 to 9 were assigned as ESG scores, ranging from low to high.

#### 4.2.3. Moderating variable

Supply chain concentration (SCC) served as a moderating variable in this study. Following the methods outlined by [34, 35], data on supply chain concentration was gathered using the China Stock Market and Accounting Research (CSMAR) database. Supply chain concentration is calculated as the average of supplier concentration and customer concentration. Supplier concentration refers to the proportion of purchases from the five largest suppliers, while customer concentration represents the proportion of sales to the five largest customers.

#### 4.2.4. Mediating variable

Financial constraints (FC) acted as the mediator of this study. The KZ index developed by [58] was used to measure the financial constraints. The KZ index data was obtained from the China Stock Market and Accounting Research (CSMAR) database. The formula used to calculate KZ index is:  $-1.002 \times (\text{Cash Flow} / \text{Total Assets}) + 0.283 \times \text{Market-to-book ratio} + 3.139 \times \text{Leverage} - 39.368 \times (\text{Dividends} / \text{Total Assets}) - 1.315 \times (\text{Cash} / \text{Total Assets})$ .

#### 4.2.5. Control variables variable

The study employs sales revenue rate (SRR), return on assets (ROA), financial leverage (FL), firm size (FS), firm age (FA), liquidity level (LL) and market-to-book ratio (MK) as control variables [13, 59-63]. Table 1 shows how each variable is measured.

**Table 1.** Variable measurements

Type	Variable	Symbol	Measurement
Dependent variable	Earnings volatility	EVOL	Standard deviation of earnings before interest and tax divided by total assets
Independent variable	ESG performance	ESG	According to Wind ESG rating, the value 1-9 from low to high
Mediating variable	Financial constraints	FC	KZ index
Moderating variable	Supply chain concentration	SCC	Average of supplier and customer concentration
Control variables	Sales growth rate	SGR	Previous year's sales/current year's sales -1
	Return on assets	ROA	Net profit/total assets
	Financial leverage	FL	Total Debt/Equity
	Firm size	FS	Natural logarithm of total assets
	Firm age	FA	Natural log of age of company(i) in time (t)
	Liquidity level	LL	Current Assets/Current Liabilities
	Market-to-book ratio	MK	Ratio of market value (sum of equity market value across share classes, adjusted for liabilities) to book value (shareholder's equity)

### 4.3. Model Setting

Model (1) tests the impact of ESG on earnings volatility (EVOL). Model (2) examines the influence of ESG on financial constraints (FC). Model (3) tests the moderating

effect of supply chain concentration (SCC). Model (4) evaluates the influence of alleviating financial constraints (FC) on earnings volatility (EVOL). Model (5), together with Models (1) and (2), tests the mediation effect of financial constraints (FC).

$$EVOL_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 SGR_{it} + \beta_3 ROA_{it} + \beta_4 FL_{it} + \beta_5 FS_{it} + \beta_6 FA_{it} + \beta_7 LL_{it} + \beta_8 MB_{it} + \varepsilon_{it} \text{ (Model 1)}$$

$$FC_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 SGR_{it} + \beta_3 ROA_{it} + \beta_4 FL_{it} + \beta_5 FS_{it} + \beta_6 FA_{it} + \beta_7 LL_{it} + \beta_8 MB_{it} + \varepsilon_{it} \text{ (Model 2)}$$

$$EVOL_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 SCC_{it} + \beta_3 ESG_{it} \times SCC_{it} + \beta_4 SGR_{it} + \beta_5 ROA_{it} + \beta_6 FL_{it} + \beta_7 FS_{it} + \beta_8 FA_{it} + \beta_9 LL_{it} + \beta_{10} MB_{it} + \varepsilon_{it} \text{ (Model 3)}$$

$$EVOL_{it} = \beta_0 + \beta_1 FC_{it} + \beta_2 SGR_{it} + \beta_3 ROA_{it} + \beta_4 FL_{it} + \beta_5 FS_{it} + \beta_6 FA_{it} + \beta_7 LL_{it} + \beta_8 MB_{it} + \varepsilon_{it} \text{ (Model 4)}$$

$$EVOL_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 FC_{it} + \beta_3 SGR_{it} + \beta_4 ROA_{it} + \beta_5 FL_{it} + \beta_6 FS_{it} + \beta_7 FA_{it} + \beta_8 LL_{it} + \beta_9 MB_{it} + \varepsilon_{it} \text{ (Model 5)}$$

## 5. Results

### 5.1. Descriptive Statistics and Correlation Analysis

The results of the descriptive statistics are presented in Table 2. It includes the variables, the total number of observations for each variable, as well as the mean, standard deviation, minimum, maximum, and VIF values. Based on the descriptive statistics, the data show a low mean value of 0.027 and a standard deviation of 0.043, indicating that earnings volatility is generally low across firms. Additionally, the ESG

mean score is 4.19, ranging from 1 to 7, with 1 being the lowest and 7 being the highest, suggests diverse ESG practices. The range of -5.797953 to -2.762161 for financial constraints indicates minimal or no financial challenges across the firms. The mean of 28.568, along with a wide range between the minimum and maximum values for supply chain concentration, suggests that, on average, the companies rely on a moderate proportion of their purchases from the top five suppliers and sales to their top five customers. Furthermore, the VIF results in Table 2 show low multicollinearity between variables and EVOL, with the highest VIF value being 2.50, which is below the threshold of 10 [64].

**Table 2.** Descriptive statistics

Variable	Obs.	Mean	SD	Min	Max	VIF
EVOL	6030	0.0277573	0.0435697	0.000217	1.32272	
ESG	6030	4.191459	1.037025	1	7	1.20
FC	6030	0.6181712	2.15808	-5.797953	-2.762161	2.05
SCC	6030	59.56819	10.246	5.89	95.41	1.11
SGR	6030	0.1769628	0.9150813	-0.800653	55.04443	1.03
ROA	6030	0.0429552	0.0626454	-0.846986	0.758564	1.55
FL	6030	0.4032946	0.1788105	0.007969	0.988959	2.50
FS	6030	9.769747	0.5125027	8.507946	11.99568	2.47
FA	6030	19.76002	5.883657	4.5	67	1.11
LL	6030	2.508086	3.854363	0.106457	144.0001	1.29
MB	6030	4.076716	20.06915	0.846479	1493.491	1.03

Table 3 presents the Pearson correlation coefficients of all the variables. The table shows a negative correlation between ESG and EVOL, as well as with FC. All the Pearson

correlation coefficient values are below 0.90, indicating no multicollinearity issues among the variables [65].

**Table 3.** Pearson correlation analysis

Variables	EVOL	ESG	FC	SCC	SGR	ROA	FL	FS	FA	LL	M/B
EVOL	1.000										
ESG	-0.148***	1.000									
FC	-0.075***	-0.226***	1.000								
SCC	0.096***	-0.159***	0.095***	1.000							
SGR	0.023	-0.013	-0.054***	0.036**	1.000						
ROA	-0.200***	0.248***	-0.545***	-0.119***	0.115*	1.000					
FL	0.023	-0.036**	0.573***	-0.072***	0.021	-0.300*	1.000				
FS	-0.092***	0.290***	0.063***	-0.208***	0.056*	0.104**	0.493*	1.000			
FA	0.070***	-0.003	0.101***	0.053***	-0.009	-0.029*	0.186*	0.229*	1.000		
LL	0.006	-0.015	-0.266***	0.150***	-0.013	0.080**	-0.452*	-0.225*	-0.086*	1.000	
MB	0.065***	-0.044***	0.100***	0.069***	0.011	-0.025	0.090**	-0.049*	0.027*	-0.016	1.000

Correlation is significant at levels: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ .

## 5.2. Model Specification Test

The [66] specification test is employed to choose between a fixed effects model and a random effects model. The Hausman test in table 4 shows a significant p-value, confirming that the fixed effects model is appropriate for panel data regression estimates.

**Table 4.** Hausman test results

Dependent variable	Test results	Chi-square statistic	P-value
Earning volatility	Fixed effects	309.90	0.000

Notes: Significance at levels: \*\*\* $p < 0.001$ .

## 5.3. Regression Analysis

**Table 5.** Fixed effects regression analysis results

Variables	Earnings volatility	Financial constraints	Earnings volatility	Earnings volatility	Earnings volatility
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
ESG	-0.097** (-5.51)	-0.038*** (-3.17)	-0.092** (-5.21)		-0.061** (-5.74)
SCC			0.017 (0.77)		
ESG×SCC			-0.071** (-4.70)		
FC				-0.097** (-4.88)	-0.102** (-5.14)
SGR	0.019 (1.68)	-0.032 (-4.14)	0.018 (1.58)	0.018 (1.57)	0.016 (1.39)
ROA	-0.195*** (-12.92)	-0.211*** (-20.61)	-0.196*** (-12.97)	-0.220*** (-14.05)	-0.217*** (-13.85)
FL	0.104*** (3.80)	0.547*** (29.33)	0.102*** (3.74)	0.169*** (5.74)	0.160*** (5.44)
FS	-0.170*** (-3.83)	-0.252*** (-8.36)	-0.156*** (-3.51)	-0.230*** (-5.18)	-0.196*** (-4.40)
FA	0.269*** (8.21)	0.193*** (0.193)	0.252*** (7.63)	0.298*** (9.02)	0.289*** (8.77)
LL	0.010 (0.64)	-0.071** (-6.56)	0.010 (0.64)	0.000 (-0.05)	0.002 (0.18)
MB	-0.081* (-6.66)	0.011 (1.41)	-0.085*** (-6.97)	-0.079*** (-6.49)	-0.080*** (-6.57)
Constant	0.143*** (4.41)	7.695 *** (7.06)	0.131*** (4.01)	0.167*** (5.13)	0.159*** (4.89)
Observations	6030	6030	6030	6030	6030
R <sup>2</sup>	0.073	0.036	0.077	0.072	0.077
F	53.57***	25.78***	45.37***	52.69***	50.77***

Notes: Significance at levels: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ .

Table 5 shows the results of fixed effects regression analysis. The contents of the column (1) shows that ESG has a significant negative influence on earnings volatility (EVOL) at 1% level, indicating that a favorable ESG score reduces earnings volatility (EVOL); thus, H1 is supported. Column (2) shows the influence of ESG on financial constraints (FC). The results indicate that a good ESG score alleviates financial constraints (FC) at 0.1% level of significance; hence, H2 is supported. The results align with a study conducted by [67-

69], which found that firms with enhanced ESG performance overcome financial constraints. Column (3) tests the moderating role of supply chain concentration (SCC). The coefficient between SCC and EVOL is insignificant, but the interaction term is significant at 1% level. The results indicate that the moderating effect (i.e. interaction of ESG and SCC) strengthen the negative relationship between ESG and EVOL compared to the standalone effect of SCC; therefore, H3 is supported which is corroborates recent findings by [70].

Column (3) tests the influence of alleviated financial constraints (FC) on earnings volatility (EVOL). The results

show, at the 1% level of significance, that the alleviation of financial constraints reduces earnings volatility, supporting H4. Following [71], column (5) presents the final step in the mediation effect computation. The results indicate that financial constraints (FC) partially mediate the relationship between ESG and earnings volatility (EVOL). Models 1 and 2, in columns (1) and (2) are significant, and the coefficient of ESG in column 5 (model 5) decreased compared to the coefficient of ESG in column 1 (model 1), indicating partial mediation and confirming H5. These findings are consistent with previous research conducted [72, 73], confirming the mediation role played by FC in the relationship between ESG and other financial metrics. Control variables such as ROA, FL, FS, and FA were significant across all models, which is in accordance with previous studies [74-76]. However, some

variables, such as MB, were insignificant in Model 2. Other variables, such as SGR and LL, were generally insignificant across all models, except in Model 2, where LL was significant. The significance of the majority of the control variables shows their impact on earnings volatility, positively or negatively.

To examine the indirect effect of the moderator (FC) and ensure the robustness of the results, the bootstrap method was implemented. Using the bootstrap method (N = 1000), the indirect effect of FC on the relationship between ESG and EVOL was tested. Table 6 shows that, at the 95% confidence level, the confidence interval for the indirect effect of financial constraints (FC) did not contain 0, further confirming the existence of the mediation effect. The results further verify H5.

**Table 6.** Mediation effect test using the bootstrap method

Indirect effect	Observed coefficient	Bootstrap standard error	z-value	p-value	Confidence interval	
FC	0.036	0.012	2.00	0.004	0.0304	0.042

Notes: Significance at levels: \*\*p < 0.01.

## 6. Discussion and Conclusion

This study empirically examined the effect of ESG on earnings volatility, with financial constraints as a mediator and supply chain concentration as a moderator, using data from A-share listed companies from 2013 to 2022. The study found that favorable ESG performance reduces earnings volatility, suggesting that companies with strong ESG practices prioritize sustainability, ethical operations, and social impact. Environmentally, they minimize carbon emissions, waste, and excessive resource consumption. Socially, they promote diversity, equality, good working conditions, and respect for human rights. In governance, they ensure accountability, transparency, and ethical decision-making aligned with the interests of shareholders and stakeholders. By adhering to ESG principles, companies attract investors, reduce costs of debt and equity, and foster strong relationships with suppliers and customers, leading to lower earnings volatility, as shown in this study [4, 50-52].

The significant mediating effect of financial constraints highlights the importance of resources for firms in achieving favorable earnings. This supports [47] resource dependence theory, showing that firms with unconstrained access to resources due to good ESG performance experience lower earnings volatility. The moderating effect of supply chain concentration reveals that the interaction term strengthens the negative impact of ESG on earnings volatility. The findings suggest that high supply chain concentration enhances ESG's effects, further reducing earnings volatility. However, the literature presents mixed results on whether high or low supply chain concentration influences financial metrics. Some studies find high supply chain concentration influential, others low concentration, and some both or none [35, 77, 78]. Additionally, all control variables, except the sales growth rate, showed at least one significant relationship with either earnings volatility or financial constraints, contrary to prior studies [14, 59].

## 7. Implications, Limitations and Direction of Future Research

The study on the influence of ESG on earnings volatility

has significant implications. To begin with, the findings encourage managers to invest in ESG practices to achieve favorable earnings volatility. Sufficient resources need to be mobilized to align with the requirements of ESG practices, attracting investors and building good relationships with creditors and other stakeholders [75, 76]. Moreover, the study also encourages investors to integrate ESG factors into investment analyses to make informed decisions and avoid risks. Additionally, the research provides evidence for policymakers to continue developing policies that support ESG practices for the benefit of corporations, the environment, and the societies in which they operate [3, 74].

This study has some limitations, presenting opportunities for future research. First, the study focuses solely on Chinese manufacturing listed companies. Future studies could examine the effect of ESG on the earnings volatility of Chinese companies in other industries and overseas. Second, the study incorporated only financial constraints as a mediator and supply chain concentration as a moderator. Future research could explore other mediators, such as firm reputation and operational efficiency, and moderators, such as industry type and institutional environment. Third, this research used a combined ESG score to measure the impact of ESG performance on earnings volatility. Future studies could investigate the effects of individual ESG dimensions (i.e., environmental, social, and corporate governance) on earnings volatility. Lastly, this study used combined supply chain concentration as the moderator. Future research could analyze individual dimensions of supply chain concentration, such as supply concentration and customer concentration.

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