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The Next “G” On ESG: The Strategic Thinking of Businesses Towards Supply Chain Fraud

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Abstract

Supply Chain Management is in the core of businesses' operational activities worldwide. Its main purpose is the proper management of resources and the assurance of the sustainable operation of the economic entities. However, Supply Chain Management is exposed to breaches related to the code of conduct as well as fraud. Integrating the principles of Environmental, Social and Corporate Governance (ESG) can help build a healthy, sustainable, and resilient supply chain. The purpose of the research is twofold and refers to: (i) highlight those factors of the ESG that contribute to the decrease and mitigation of the fraud in supply chain and (ii) the business strategies that can be developed from businesses and can be based on ESG factors. In this context, a log-log model of multiple linear regression was proposed. Secondary data were extracted from the Thomson Reuters database. The model was based on 681 observations concerning companies operating in Europe. The results have led to the conclusion that the existence of policies related to human resources and technology contribute significantly to tackling supply chain fraud. Regarding the first factor, Human Resource is important to feel safe and their rights should be protected by companies. Securing their rights can lead individuals to their commitment to the work environment, as well as to their protection from threats and violations. Finally, the role of technology is fully consistent with transparency in the supply chain. For this reason, the adoption of reliable solutions and technologies, which turn to the green economy, offer visibility and optimization of processes.

1. Introduction

Driven by globalization and customers' demands, Supply Chain Management (SCM) plays a key role in creating competitive advantage for businesses. So, it is vital to develop a complete and responsive supply chain that meets customer's requirements and ensures both market share and profitability (Gardas, Raut, and Narkhede 2019). SCM reflects not only the flow of materials, but also the flow of information between members in the supply chain (Yang, Fu, and Zhang 2021). The availability of information has been increasing exponentially over the last decade. The explosion of this available information and the various changes in the business environment have provided the opportunity for improvements and changes in the supply chain (Zhang, Chen, and Chen 2021). Therefore, companies and organizations are called upon to redefine their business models and focus on the optimal dissemination of information. Proper and effective information sharing helps fight supply chain fraud and can enable the company to meet the fiercest competition, succeed in a more complex business environment and increase their efficiency and effectiveness (Köhler et al. 2021; Shi and Geng 2021).

In recent years a rising number of corporations focus not only on a supply chain that will ensure economic benefits for them, but to a sustainable supply chain management that adhere to social and environmental standards too (Thorlakson, Hainmueller, and Lambin 2018). The aim of companies is to create a cascade of sustainable practices that flows smoothly throughout the supply chain (Bhutta et al. 2021). The ESG factors is not an exception to this rule. Without that standards, and proper strategies to implement into daily supply chain activities, supply chain risks would materialize a lot more often than

they do (Gillan, Koch, and Starks 2021a; Ragazou 2021). ESG factors serve as a guideline for environmentally, socially, and ethical supply chain and they apply as much internally, as they do externally (Broadstock et al. 2021).

In this paper, we highlight: (i) the ESG factors that plays a key role in managing fraud in supply chain management and (ii) business strategies that can be developed to base don these factors. Our results identify workforce, resource use and environmental innovation as the strongest factors in mitigating fraud in supply chain management. We contribute to the sustainability performance of supply chain management debate by showing that an increase in each of these factors will increase ESG score, while ESG is crucial for ensure transparency and sustainability in supply chain management. So, businesses should develop strategies, oriented to the ESG factors that highlighted from the research, to manage fraud and achieve sustainability.

This article is organized as follows. Section 2 highlights the transition from supply chain management to sustainable supply chain management, the link between sustainable supply chain management and ESG and finally, the role of ESG in ensuring transparency in Sustainable Supply Chain Management. In Section 3 is defined the study method which includes research design, data collection and framework analysis, while in Section 4 the qualitative study details and results are presented. Lastly, we conclude with Section 5.

2. Literature Review

2.1 Supply Chain Management moving to Sustainability

Sustainability is a dynamic process based on three "pillars": the economy, society and the environment and emerged around 1987, where it was introduced as one of the key concepts in the management of the production process. According to the WCED (World Commission on Environment and Development), sustainability refers to the protection of the environment and natural resources, as well as ensuring social and economic welfare for present and future generations (WCED 1987).

The needs of society in economic, social, and environmental level have forced organizations to integrate in their strategy the concept of sustainable development, but also to develop this kind of strategies for achieving a competitive advantage in the global market (Fritz et al. 2021; Silva and Figueiredo 2020). Businesses have linked sustainability with different operational departments, such as administration and Supply Chain Management too (Moshood et al. 2021). The supply chain is characterized by several weaknesses and challenges, which cannot be solved and addressed only by individual efforts, but by a set of actions based on cooperation. Some of the best practices that can be adopted by companies in supply chain are the development of more accurate forecasting and scheduling systems, close cooperation with suppliers and customers, real-time monitoring of the chain with the use of technology and ensuring a high degree of flexibility (Khan et al. 2021). All these methods and practices can lead to a Sustainable Supply Chain Management for businesses globally.

Regards Sustainable Supply Chain Management (SSCM) reflects the management of sources, information, and capital flows, as well as the development of cooperation between companies along the supply chain, considering the objectives from all dimensions of sustainable development (economic, environmental and social), which come from the requirements of customers and stakeholders (Seuring and Müller 2008; Silva and Figueiredo 2020). The main goal of SSCM is to minimize the waste of hazardous chemicals, gas emissions and energy used along the supply chain for product design, collection and resource selection, construction, and delivery and finally the life cycle management of the product (Kumar et al. 2020; Roy, Schoenherr, and Charan 2020). Sustainable Supply Chain Management is divided into four categories: (i) the inbound, (ii) operational, (iii) the outbound and (iv) the reverse (Allen, Zhu, and Sarkis 2021; Kirchoff and Falasca 2022; Wang et al. 2015).

As for the first category, this includes the purchases and the acquisition of raw materials, which are made according to the needs of the company in line with the fact that the suppliers follow environmentally ideas for the transport process of the goods (Prasad et al. 2020). In this way, an effort is made to reduce waste at the procurement stage and more specifically of raw materials and harmful materials and resources. The operational SSCM highlights the green design of the products, which includes the reuse, the recycling, the reconstruction of them. Also, it refers to the green production where the main concern is the reduction of quantities of materials, energy, and resources as well as green packaging (Bhutta et al. 2021). The third category of SSCM, which is called outbound, includes the delivery of the products to customers and requires a well-structured and organized distribution network. Reduction of carbon emissions and better fuel management are considered too (Gardas et al. 2019). Lastly, reverse category of SSCM means that a company has to manage the repair, reuse and recycling of materials, products and components back in the supply chain instead of being destroyed and end up in waste (Jia et al. 2018).

However, the above categories of Sustainable Supply Chain Management have differences, there is one common point: to ensure sustainability for businesses. To achieve that, an organization should take care not only of its "internal" sustainable performance, but also of that of its suppliers (Menon and Ravi 2021). Despite existing criteria of achieving sustainability in the supply chain like control market cost and timely delivery, it is crucial for businesses to consider the environmental and social impact of their suppliers. The adoption and development of Environmental, Social and Corporate Governance practices from businesses can contribute on that goal (Broadstock et al. 2021; Saygili, Arslan, and Birkan 2021).

2.2 The role of ESG in the assurance of transparency in Sustainable Supply Chain Management

Businesses are investing in being better global citizens with an Environmental, Social and Governance (ESG) model, which is a great aspiration even more in sustainable supply chain management. ESG factors can renew the way that supply chain operates and are characterized for their dynamic and immediate results (Adams and Abhayawansa 2021). Moreover, ESG can help businesses to confront with risks like fraud.

Given the complexity of the supply chain, fraud is not a surprise for businesses, but one of the biggest threats they should face immediately. Often covering an extensive network of third parties around the world, including agents, intermediaries, resellers, distributors and partners, results in systems becoming recipients of misconduct (Manning 2018). Usually, this risk occurs in communities that are less strict in law enforcement or do not systematically monitor inappropriate behavior (van Ruth et al. 2018; Yan et al. 2020). Also, several different business policies and procedures, codes of conduct and information systems used by each third party are intertwined in the supply chain, creating a prime environment for fraud (Ryan 2016).

Taking measures to differentiate companies for reducing the phenomenon of fraud in supply chain is one of the main ways to react towards that. Also, the adoption of best practices such as the integration of ESG factors contributes to mitigate the risk of fraud in the supply chain. Environmental, social, and corporate governance (ESG) practices determine a company's strategy, business model and behavior as these practices are related to sustainability (Saygili et al. 2021). The three aspects of ESG practices encompass a wide range of concepts, including environmental factors such as renewable energy and waste management, social factors such as community involvement and labor management, and governance factors such as business ethics and danger management. ESGs have been the subject of increasing debate and research on company performance, productivity, industry trends and the impact on sustainable investment strategies (Gillan et al., 2021a; Yang et al., 2021a). This growing attention has also been shown in the appearance and popularity of sustainability reports published by companies, as well as various indicators and ratings. Understanding the raison d'être of ESG factors is essential to objectively assess the importance that is attached to sustainable business practices over time.

Mainly, ESGs transforms decision making process as well as the composition of workforce and highlights new needs in terms of data management process to ensure transparency in supply chain. In terms of transparency, this is a priority for businesses and the supply chain (Yang et al., 2021a). Reporting on the impact of ESGs and business risk, which are referred to as "essential", is increasingly important for business stakeholders and especially for business investors. This is because ESG transparency is directly related to business performance. The volume and type of data that companies need to disclose will continue to grow. This trend is expected to accelerate as technology evolves. These advances will produce more information about the operations and impact of business (Gillan, Koch, and Starks 2021b). Businesses will need new data management capabilities that will enable the collection, management, analysis and reporting of ESG data from the immediate activities of supply chain partners (Lööf, Sahamkhadam, and Stephan 2021). In the past, companies used data collection tools to reduce supply chain fraud, that today can be characterized as less efficient. Businesses now use tools based on advanced technology, which helps to integrate and streamline data to provide the transparency that is required. ESG data management platforms have tools that automate data management (Yu and Luu 2021). They are constantly analyzing data that identifies compliance issues and monitors progress, which makes reporting and monitoring much more effective.

Fraud in supply chain management remains a threat for the business world. However, constant vigilance and strong internal controls help to reduce fraud and detect these “red flags” as soon as it possible.

3. Study Method

3.1. The Dataset

Data on ESG were retrieved from the Refivitiv Eikon platform powered by Thomson Reuters. Refinitiv Eikon is an open-technology solution for academics who would like to exam deeply the ESG performance and capacity of businesses in different sectors globally, as provides access to industry-leading data, insights, and exclusive and trusted news (Refinitiv Eikon, 2021; Gaganis et al., 2021). The database of Thomson Reuters captures and calculates ESG measures, of which a subset of the most comparable and material per industry, power the overall company assessment and scoring process (Milner, Ham, and Hur 2014; Refinitiv Eikon 2021). These are grouped into different categories that reformulate the three pillar scores and the final ESG score, which reflects the company’s ESG performance, commitment and effectiveness based on publicly reported information. Based on the objective of this study, ESG score is used as the dependent variable (Landis and Skouras 2021; Refinitiv Eikon 2021).

The category scores are rolled up into three pillar scores – environmental, social, and corporate governance (Achim and Borlea 2015; Paltrinieri et al. 2020). The ESG pillar score is a relative sum of the category weights, which vary per industry for the environmental and social categories (Mohammad and Wasiuzzaman 2021).

A company's ESG scoring is the numerical expression of the way that its performance is perceived over a wide range of environmental, social and governance (ESG) issues. An ESG score can be characterized as a tool that: (i) helps businesses to be alert regards the continuous changes in the market and (ii) motivate them to reconsider their corporate strategy by setting in the core ESG performance. There are many reasons besides understanding why a business needs to know its ESG score. One of the most critical refers to the rapid growth of ESG investments, with investors looking for portfolios of sustainable assets. With a reliable link between strong performance on key ESG issues and financial performance, ESG score is used by institutional and independent investors to identify companies that may offer good returns. Executives equate a good ESG score with healthy earnings (Giannarakis, Konteos, and Sariannidis 2014). In terms of ESG score reliability, the more reliable an ESG rating is, the more consistently it is calculated and reported, the greater the impact it will have on long-term performance, by managing ESG risks and opportunities, encouraging impact investment and pushing corporate governance to create a more sustainable business. The Refinitiv Eikon ESG scoring is calculated on a scale between 0.0 to 1 and can provide comparable scores for businesses across sectors and regions. The calculation of the scores was defined by Thomson Reuters as following (Refinitiv Eikon 2021):

$$\text{ESG Scores} = \frac{\text{no. of companies with a worse value} + \frac{\text{no. of companies with the same value included in the current score}}{2}}{\text{no. of companies with a value}}$$

A relative percentile ranking is only applied if a numeric data point is reported by a company, while all the companies in an industry group report that respective data point. Each measure has a polarity indicating whether a higher value is positive or negative. For instance, more water recycled is positive, but more emissions are negative (Landis and Skouras 2021; Refinitiv Eikon 2021). Percentile rank scoring methodology is adopted to calculate scores of the categories included in the three pillars of ESG.

3.2. The Variables

The main objective of the study is to highlight the factors that are related to ESG score and contribute to the prediction of fraud on supply chain. Regression analysis was used in this study, as the common tool to use for forecasting and prediction (Topliss and Costello 1972). Specific, a multiple log-log regression model was developed to determine if exists a relationship between at least two or more explanatory variables (Clifford et al. 2013; DeFries and Fulker 1985). Furthermore, the first step of creating a multiple regression model is to choose the factors (Pan et al. 2021; Wilkie and Galasso 2021). The factors that were chosen in the current study was ESG score, Resource Use Score, Emissions Score, Environmental Innovation Score, Workforce Score, Human Rights Score, Management Score, Policy Water Efficiency Score, Policy Environmental Supply Chain Score, where the ESG score is the dependent variable. Both the dependent variable and the independents are listed and fully described in Table 1.

Global complexity is increasing as supply chains become more interconnected, economies grow and develop, weather patterns change, and societies experience and acquire more sophisticated technology. ESG factors is an attempt to capture more of this complexity in business decision-making and to assess potential for continued viability in a world that increasingly requires more sustainable outcomes. Based on that point, **dependent variable** ESG score was selected as it plays a key role on the prediction of fraud in supply chain.

The **independent** variables were defined as in Table 1 The choice was due to the strong relationship between these factors and the ESG score. In addition, this group of indicators are part of the three main pillars of ESG and present the highest contribution on the prediction of the supply chain from disruptions (Alda 2021). Firstly, the way that a company uses the resource to achieve a better performance and capacity leads to the improvement and sustainability of its supply chain (Alonso-Fradejas 2021; Tseng, Bui, and Lim 2021). So, the role of Resource Use Score plays a vital role in the study. Moreover, organizations are progressively thoughtful and responsive to the carbon emission in today's world, which relates to their organizational operations (Molthan-Hill et al. 2020; Tseng et al. 2021). In their main priorities is to calculate their Carbon Footprint, which is called as CFP, because they want to maintain and

reduce it (Firoozi Nejad et al. 2021). This can be act as the initial step for any firm to maintain carbon emissions and create an efficient environmental management system and as a result a sustainable supply chain. Emissions Score which measures a company's commitment to and effectiveness in reducing environmental emission in the production and operational processes was selected as independent variable in this study based on the above statement (Magerakis and Habib 2021). Following to the Emissions Score, Environmental Innovation Score was included too, as independent variable, because it reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thus creating new market opportunities through new environmental technologies and processes or eco-designed products (Fuente, Ortiz, and Velasco 2021). Management Score was selected for the development of the model of the current study and measures a company's commitment to and effectiveness in following best practice corporate governance principles, while Workforce score was included too (DasGupta 2021). Workforce is vital for any business and is one of the most important assets of it. Providing a range of growth opportunities to employees can positively impact wellbeing (Rajesh and Rajendran 2020). Purpose is one of the most powerful drivers of engagement. An engaged employee will feel as though they are contributing towards something that matters to them. Similarly, promoting sustainable behavior at work can indirectly impact on wellbeing (Sakun et al. 2020). For example, by encouraging sustainable travel (eg walking and cycling) this can improve workforce's health, reduce stress and decrease air pollution. Based on that, workforce Score was selected as independent variable in this study as it measures a company's effectiveness towards job satisfaction, healthy and safe workplace, maintaining diversity and equal opportunities, and development opportunities for its workforce (Dorfleitner, Kreuzer, and Laschinger 2021). Also, Human Rights Score was added and measures a company's effectiveness in respecting the fundamental human rights conventions. Lastly, policy factors were selected for the model like the Policy Environmental Supply Chain Score and the Policy Water Efficiency Score (Naffa and Fain 2020). The first reflects a company's efforts to include in the supply chain measures to reduce their environmental impact, while the second reflects a company's policy to improve its water efficiency by using various forms of processes/mechanisms/procedures and a system or a set of formal documented processes for efficient use of water and driving continuous improvement.

Table 1
Selected variables that have been used in the model

Variable	Type	Description
ESG Score	Dependent	ESG score reflects the overall score of companies based on information from their internal environment and focusing on the pillars of environmental, social and corporate governance.
Resource Use Score	Independent	Resource Use Score highlights the ability of a businesses to rationally manage their materials and energy and to focus on solutions that are more environmentally friendly, thus improving supply chain management.
Emissions Score		Emission Score represents the degree of commitment and efficiency of a company, in terms of reducing its environmental emissions that come of its production and operation processes.
Environmental Innovation Score		Environmental Innovation Score reflects a company's ability to reduce its environmental footprint as well as its customer burdens, thus creating new market opportunities through new environmental technologies and processes or eco-friendly products.
Management Score		Management Score measures a company's commitment and effectiveness in terms of the best practices of corporate governance principles.
Workforce Score		Workforce Score measures the effectiveness of a company in terms of Human Resources. This rating expresses employee's satisfaction with the work, the implementation of safety and quality systems, respect for diversity of individuals, while it ensures equal development opportunities.
Human Rights Score		Human Rights Score measures a company's effectiveness in respecting fundamental human rights principles.
Policy Environmental Supply Chain Score		Supply Chain Environmental Policy Score highlights all the actions of the company to integrate in the supply chain measures and practices, regarding the reduction of their environmental impact.
Policy Water Efficiency Score		Policy Water Efficiency Score indicates the intention of businesses to improve water efficiency by adopting various forms of processes and systems.

3.3. Descriptive Statistics

In Table 2 are presented the descriptive statistics of the dependent and all independent variables that are included in the regression analysis. As it can be seen, there are 681 observations were retrieved from the Eikon database for the Fiscal Year 2020 and included in the sample. These observations represented companies that are headquartered in Europe. The company with the highest score has an ESG Score of 94.073, and the company with the lowest ESG Score rating has a score of 21.359. The mean of ESG Score for companies is 68.107. This indicates that companies in Europe have a good relative ESG performance and above-average degree of transparency in reporting material ESG data publicly.

Table 2
Descriptive statistics of all variables included in the regression analysis

Variable	N	Minimum	Maximum	Mean	Std. Deviation
ESG Score	681	21.359	94.073	68.107	14.120
Rersource Use Score	681	18.508	99.895	78.095	18.275
Emissions Score	681	0.215	99.876	73.603	21.207
Environmental Innovation Score	681	0.811	99.865	55.608	26.110
Workforce Score	681	14.486	99.940	78.220	18.319
Human Rights Score	681	3.438	98.264	72.561	21.817
Management Score	681	1.190	99.919	61.746	27.385
Policy Water Efficiency Score	681	57.692	95.652	72.381	7.971
Policy Environmental Supply Chain Score	681	57.143	90.385	72.366	7.013

The maximum scores observed on Resource Use Score, Emissions Score, Environmental Innovation Score, Workforce Score and Management Score were exceeded 99 points, which was supposed to be close to the maximum possible score. This indicates that variables are compatible with the scoring method. As for the minimum score, Emission Score, Environmental Innovation Score, Management Score and Human Rights Score were far lower than the minimum scores for the other variables of the model. Regards the average, that of Resource Use Score and Workforce Score, as well as, Human Rights Score, Policy Water Efficiency Score and Policy Environmental Supply Chain Score were very close. Environmental Innovation Score had the lowest average score of the independent variables but had the second highest standard deviation in scores.

3.4. Multiple linear regression analysis

The main purpose of the multiple linear regression analysis is to investigate the relationship between a dependent variable (in the current research the dependent variable is ESG score) and two or more independent variables in the following form:

$$y = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + \ldots + \beta_n\chi_n + \varepsilon_i$$

In the above equation the terms of β0 ... βn are called as the coefficients of the regression and their estimation is based on a record of observations. This is done by curve fitting based on the least square method with the aim of minimizing the difference between the observed and estimated values. The predictors should have little or no correlation with each other. For example, the correlation coefficient should be less than 0.7 to evade from problems like multicollinearity. The last term of the equation is εi and is mainly referred to as the residual. Also, residuals can be used about testing the general

significance (F-test) of the equation and the significance of each regression coefficient (t-test). For obtaining valid results from the above tests, the residual εi should be distributed independently, with a mean of zero and a constant variance of σ2. This is described by a residual analysis and can also lead to the elimination of the data outliers. Another way of estimating the interpretive power of a linear model is the coefficient of determination, which is called R2. This coefficient measures which part of the variance of the dependent variable can interpret by independent variables Essentially, it is a simpler coefficient that measures the ability of a set of factors to interpret a phenomenon.

However, a regression model will have unit changes between the χ and y variables, where a single unit change in χ will coincide with a constant change in y. Taking the log of both variables will effectively change the case from a unit change to a percent change. This is especially important when using medium to large datasets, as happens in the current research. Usually, logarithmic transformation is a convenient means of transforming a highly skewed variable into a more normalized dataset. In theory, we want to produce the smallest error possible when making a prediction, while also considering that we should not be overfitting the model. Overfitting occurs when there are too many dependent variables in play that it does not have enough generalization of the dataset to make a valid prediction. By using the logarithm of one or more variables this can improve the fit of the model by transforming the distribution of the features to a more normally shaped bell curve. Based on the reasoning above, the second-order model was adopted as the following:

$$\log(y) = \beta_o + \beta_1 \log\chi_1 + \beta_2 \log\chi_2 + \ldots + \beta_n \log\chi_n + \varepsilon_i$$

Moreover, by taking the logarithm of both dependent variable and all independent variables and creating a log-log functional form can contribute to overcome the problem of non-linearity. A log-log function is suitable when a unit percentage change in one of the independent variables is expected to respond to a percentage change in dependent variable. Also, another problem that can occur in multiple regression analysis is that of the imperfect multicollinearity (Shrestha 2020). Perfect multicollinearity occurs when an independent variable is a perfect linear relationship of one or more independent variables and is something that can happen very rare. However, the occurrence of severe imperfect multicollinearity is more common (Mansfield and Helms 1982). When severe imperfect multicollinearity occurs, there is a linear functional relationship between two of more independent variables, which is so strong that the estimation of coefficients of the variables in the regression model is significantly affected (Haitovsky 1969). The VIF test examines the degree to which an independent variable can be explained by the other independent variables in the model. The VIF test reflects the degree to which multicollinearity has increased the variance of the estimated coefficient (Jou, Huang, and Cho 2014). If the VIF value range between 1-10, then there is no multicollinearity. On the other side, if the VIF <1 or VIF > 10, then there is the problem of multicollinearity (Dias Curto and Castro Pinto 2011; Jou et al. 2014). In the current study, results from VIF test that displayed in Table 3 shows no sign of multicollinearity in the regression model.

Table 3
VIF test showing no signs of multicollinearity

	Collinearity Statistics	
	Tolerance	VIF
ESG score (Dependent Variable)		
Policy Water Efficiency Score	0.485	2.063
Human Rights Score	0.848	1.179
Environmental Innovation Score	0.897	1.114
Management Score	0.92	1.087
Emissions Score	0.578	1.729
Workforce Score	0.66	1.516
Rersource Use Score	0.547	1.828
Policy Water Efficiency Score	0.511	1.959

Regards the interpretation of the results of the model, this can be given as an expected percentage change in y when χ increases by some percentage (Hinckson and Hopkins 2005). Such relationships where both y and χ are log-transformed are commonly referred to as elastic in econometrics and the coefficient of log χ is referred to as an elasticity (Kitali et al. 2018). So in terms of effects of changes in χ on y (both unlogged): (i) multiplying χ by *e* will multiply expected value of y by e^{β} and (ii) to get the proportional change in y associated with a p percent increase in χ calculate $\beta_o = \log([100 + p]/100)$and take $e^{\beta o \beta}$. These treated data sets yielded the following equation:

log (ESG Score) = 1.393 + 0.160 log(Resource Use Score) + 0.091 log(Emissions Score) + 0.069

(0.165) (0.017) (0.018) (0.007)

log(Environmental Innovation Score) + 0.194 log(Workforce Score) + 0.127 log(Human Rights

(0.021) (0.013)

Score) + 0.132 log(Management Score) + (-0.206) log(Policy Water Efficiency Score) + 0.103

(0.008) (0.044) (0.05)

log(Policy Environmental Supply Chain Score) + ε_i

4. Results

This study focuses on the investigation of the ESG factors that can contribute on the limitation or elimination of the fraud in supply chain of companies headquartered in Europe. To fulfil the purpose of the study, two research questions were stated: (i) which of the ESG factors present the highest correlation to ESG Score and (ii) which of these factors that were highlighted can contribute mostly to the prevention of fraud in supply chain.

Results of the multiple regression analysis on log-log transformed data, which was performed iteratively with the software package IBM SPSS Statistics version 26 (George and Mallery 2019), highlighted a significant model of prediction with an explanation power reaching 85% (coefficient of determination R2 = 0.852. adjusted R2 = 0.850 with an F = 484.191, Durbin-Watson = 2.034). Also, the R value is substantially higher than any individual predictor which indicates the contribution of the proposed model. Such high value of explanation of the variance in ESG Score is considered an important result and indicates the robustness of the model (Norton and Dowd 2018). Table 4 are summarized the results of the model.

Table 4
Model summary

R	R Square	Adjusted R Square	F	Sig.	Durbin-Watson
0.923	0.852	0.850	484,19	0,00	2,03

a. Dependent Variable: ESG Score

b. Predictors: (Constant), Resource Use Score, Emissions Score, Environmental Innovation Score, Workforce Score,

Human Rights Score, Management Score, Policy Water Efficiency Score,

Policy Environmental Supply Chain Score

Table 5shows the coefficients and indicates the value of beta (standardized or unstandardized) for each variable. Results indicate that all variables are important and significantly predict ESG Score.

Table 5
The coefficient table of the regression analysis

	Unstand. coefficients					
Construct	B	Std. error	t	Sig.	[95% Conf. Interval]	
(Constant)	1.393	0.165	8.428	0.000	1.074	1.713
Resource Use Score	0.16	0.017	9.158	0.000	0.128	0.192
Emissions Score	0.091	0.018	5.028	0.000	0.072	0.111
Environmental Innovation Score	0.069	0.007	10.55	0.000	0.058	0.08
Workforce Score	0.194	0.021	9.434	0.000	0.166	0.223
Human Rights Score	0.127	0.013	9.968	0.000	0.111	0.143
Management Score	0.132	0.008	15.761	0.000	0.122	0.142
Policy Water Efficiency Score	-0.206	0.044	-4.656	0.000	-0.293	-0.119
Policy Environmental Supply Chain Score	0.103	0.05	2.071	0.039	0.002	0.205

ESG Score is the dependent variable

Based on the interpretation of the estimated coefficients, the influence of the Workforce and Resource Use is the highest positive to ESG Score. Specifically, a unit percentage increase in Workforce can multiple ESG by 19.4 percentage, while a unit percentage increase in Resource Use can multiply ESG by 16 percentage. The rest of independent variables, except of Policy Water Efficiency Score, have a positive impact on ESG (dependent variable) and affect it between a range of 6.9 to 13.2 percentage. As for the Policy Water Efficiency Score, this variable has an inverse relationship, which means that a unit percentage increase of this variable will affect negatively the dependent.

Related to the variable Workforce, this is the one that affects mostly the dependent variable ESG Score. This means that companies considering, mostly issues related to their Workforce. Corporate's workforce contributes to a strong governance that ensures the smooth operation and prospects of companies.

5. Discussions And Conclusions

The purpose of this article is to explore those ESG factors that mitigate fraud in supply chain management and the strategies that can be developed from companies based on these factors. Indicators of ESG can be characterized as a "signal" to attract investment interest. The focus on non-financial, Environmental, Social and Governance data and measurements (ESGs) continues to increase in all sectors and regions (Garefalakis and Dimitras 2020; Zopounidis et al. 2020). Even if companies are

public or private, they are under pressure from investors, society, and governments. All these parts drives companies to make ambitious public commitments that will cover all aspects of the ESG, with a focus on carbon emissions, which is directly linked to climate change and its threat for global systemic overthrow. As a result, companies seek immediate compliance with the laws and regulations, while developing and implementing strategies to minimize their impact on the environment and to contribute positively to the diversity of it and the integration in it. However, companies need to dominate in supply chain management. So, it is vital for them to integrate ESG into their overall supply chain strategy if they want to succeed on it (Ho and Park 2019; Zopounidis et al. 2020).

Findings of the current research indicate workforce as a critical factor in ESG and consequently in the assurance of fraud in supply chain. Businesses that adopt supply chain transparency measures operate more efficiently, improve their market image, enjoy less risk of labor fraud, and have better access to capital. As for their employees, transparency is critical for them as they enjoy working in transparent supply chains are thus can contribute on enhancing their loyalty towards to business (Berggren and Bernshteyn 2007). Generally, to mitigate fraud in business and consequently in the supply chain can be characterized, as a philosophy for them, based on the free exchange of information. Usually, workforce share company's information with the rest members of their team. However, setting limits on the dissemination of information is an important factor and a critical aspect of ensuring transparency in the workplace, as well as Human Resources should understand the intent of transparency in it. So, businesses should encourage constructive communication between people, especially those who working on supply chain department, in order to promote and maintain a transparent culture (Dubey et al. 2019).

However, the role of technology, and that of green technology, is critical in mitigating fraud in SSCM too. In our research, the variable that highlights the importance of green technology in order to ensure transparency in SSCM is that of Environmental Innovation Score (Zhang et al. 2017). There are two main reasons that every business in the world want to mitigate fraud. The first one is referred to the legislation as it requires better and more accurate detection of products at all stages of the supply chain. But beyond that, companies want to meet their internal needs and the requirements of their customers to ensure the quality and safety of products (DuHadway, Carnovale, and Hazen 2019). Blockchain technology (BCT) is one of the emerging technologies in the field of supply chain management, as it can ensure a well-organized supply chain as well as security and transparency about it. Based on fraud avoidance, BCT enables authentication, confidentiality, privacy and data access control as well as ensuring integrity of services. It also serves to integrate other green technologies such as Internet of Things (IoT), enhance security, consensus mechanism for dynamic data storage, data transparency and protection, reliability and cost management (Dai, Wang, and Vasarhelyi 2017). Moreover, technologies related to data collection and processing, such as portable terminals, tablets, barcode readers, wireless networks and RFID technology, can have a critical role in the new supply chain trends to ensure transparency. These systems offer great improvement in terms of productivity, error reduction, and large volume data management with high security and low cost (Mishra et al. 2018).

Therefore, it is imperative for businesses to create long-term resilience and flexibility in their supply chain, so that they can meet their future challenges that will arise and transform them into opportunities. At the same time these new demands are created by customers due to digitalization (Boyson, Corsi, and Paraskevas 2021; Wisetsri et al. 2021). To achieve this, a holistic approach is required regards supply chain management and business operations. To ensure the smooth operation and transparency of supply chain, businesses must utilize technology and develop a strong digital framework. To achieve that an agile strategic approach in supply chain management will be an ideal method (Geyi et al. 2020; Raut et al. 2021; Shashi et al. 2020). Based on this, pilot applications are gradually created which evolve into a unified control center. Businesses should start structured and stable, gradually evolving their operations, with the main priority of being next to the customer, while keeping costs low. Among other things, the digital transformation of the supply chain includes the modeling and identification of areas where it creates benefits, through the implementation of revised frameworks (Budak and Çoban 2021; Wisetsri et al. 2021). This forms a broader framework for strategy and optimization of business operations and the assurance of transparency in supply chain management.

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