The impact of board characteristics on environmentally friendly production: A cross country study in Asia and Europe

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ABSTRACT

The present study investigates the impact of board characteristics on environmentally friendly production. The current research uses secondary data extracted from the Refinitiv Eikon database. The data is extracted from the database for a sample of 8094 corporates from 2 continents, Asia and Europe, from 2016 to 2021. Panel data analysis with fixed effect models is used to estimate the results. The findings reveal that board size, independence, and industry expertise significantly impact environmentally friendly production. The results also indicate that board diversity correlates positively with environmentally friendly production in European corporates but negatively in Asian corporates. Findings show that the moderating role of environmental teams has a greater interaction effect with board characteristics in Europe than in Asia. Finally, the results also show that higher environmental performance and environmental, social, and governance scores lead to higher levels of environmentally friendly production. The study has valuable insights and implications for board members, practitioners, academicians, and policymakers. Further, the study contributes to the strand literature by investigating the role of environmental teams on the relationship between board characteristics and environmentally friendly production. The findings are supported by agency, legitimacy, and stakeholder theories, which contribute to a better understanding of the relationship between board characteristics and environmentally friendly production. The evidence about this issue is still unknown and critical, particularly in the context of developing countries where there is a lack of regulatory enforcement related to environmental, social, and governance disclosures.

1. Introduction

Growing concerns about environmental sustainability have resulted in a plethora of environmental regulations (Homroy and Slechten, 2016). Environmental degradation caused by unfriendly production puts pressure on the environment and impedes environmental sustainability. One way to hinder this impact is by reducing production patterns from unfriendly to environmentally-friendly (Wijekoon and Sabri, 2021). Environmentally friendly production (EFP) is a critical issue motivated by the concern of increasing environmental deterioration. EFP entails incorporating environmental considerations into several aspects of product design, material selection, production processes, consumer delivery and support, and product end-of-life management after its useful life has ended (Ghodrati et al., 2016). Though production

systems generate material wealth for humans, a great number of resources are consumed while producing a large amount of waste. Thus, minimizing resource consumption and decreasing the environmental influence of manufacturing systems has become increasingly important (Posinasetti, 2018). Therefore, it is critical that manufacturing firms seek EFP on their part.

Many studies have paid great attention to environmental issues and have discussed environmental governance from different aspects. For example, Ezhilarasi (2019) and Corvino et al. (2020) discussed the impact of corporate governance (CG) on environmental disclosure. Similarly, Dixon-Fowler et al. (2017) explored the role of board committees in corporate environmental performance. In the same context, Oware and Awunyo-Vitor (2021) examined the effect of chief executive officer characteristics on environmental disclosure. Likewise, Biçer and

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Feneir (2019) explored the influence of audit committee attributes on environmental and social disclosures. Meanwhile, Jacoby et al. (2019) investigated how internal CG impacts environmental information transparency. In the same vein, Gerged et al. (2021a,b) highlighted the effect of country-level governance quality on environmental disclosure, while Moalla et al. (2021) studied the association between CG and the quality of environmental reporting. Finally, Lai and Sohail (2022) debated the influence of CG on green investment and environmental innovation. They concluded that CG positively impacts green investment and innovation in China. On the other hand, other studies have examined the influence of corporate board characteristics on environmental issues, such as environmental disclosure (Khaireddine et al., 2020; Rabi, 2021; Kilincarslan et al., 2020; Campanella et al., 2021), environmental disclosure quantity (Ofoegbu et al., 2018), environmental performance (De Villiers et al., 2011; García Martín and Herrero, 2020; Khan et al., 2021; Nguyen and Thanh, 2021; Kumari et al., 2022), environmental sustainability performance (Peng and Zhang, 2022), environmental accounting information disclosure (Agyemang et al., 2020), environmental reporting (Aliyu, 2019), environmental sustainability reporting performance (Masud et al., 2018), and environmental innovation (Farza et al., 2022). All these studies have generally emphasized the importance and role of CG, including board characteristics, in promoting environmental issues. This is due to the fact that sustainability issues, including environmental, corporate social responsibility (CSR), and governance issues, depend on several factors, such as social, institutional, and legal. Recently, customer awareness of environmental issues has been increasing, which has increased institutional pressure on companies to be environmentally conscious (Fargnoli et al., 2013). The majority of nations have now released good governance guidelines for environmental sustainability (Homroy and Slechten, 2016). Furthermore, environmental laws have been established as a component of the legal landscape in the world's developed and industrialized countries and many developing countries (Speight, 2016). Accordingly, most of the industrial products on the market today have received a certain improvement from the environmental point of view because of guidelines, legal obligations, and customer expectations, as stressed by Fargnoli et al. (2013).

Yet, there is still a research gap regarding how board characteristics affect EFP, which has been largely ignored. Hence, studying such an impact would fill this research gap and enhance our knowledge of the governance mechanism that businesses are increasingly employing to respond to environmental concerns. This study aims at providing insight into the impact of board characteristics on EFP. The current paper argues that in order to comprehend environmental production governance, we should comprehend the role of board characteristics and improve the levels of non-financial information disclosures represented by ESG issues. Another aim and scope of this research are to investigate whether environmental teams' presence and higher scores can strengthen board effectiveness to increase EFP levels. This study significantly contributes to the environmental governance literature. For the first time, this research examines the impact of board characteristics on EFP. Thus, it broadens the research in environmental governance by providing empirical evidence for the role of board characteristics in promoting EFP. There is no empirical research comparing Asia and Europe within the framework of the impact of board characteristics on EFP. In addition, the considered period from 2016 to 2021 is critical as it can be affected by many international initiatives related to climate change. Therefore, this research documents its unique contribution, which will augment contemporary literature. Indeed, it adds to empirical literature related to EFP and board characteristics in developed and developing countries. Despite the fact that research studies document EFP (Cheah and Phau, 2011; Ding et al., 2014; Felix et al., 2022; Hartmann et al., 2018; Haws et al., 2014; Kim and Seock, 2019; Kurane, 1997; Laroche et al., 2001; Li et al., 2018; Marakanon and Panjakajornsak, 2017; Moser, 2016; Qiao and Dowell, 2022; Roozen, 1997; Shim et al., 2018; Trivedi et al., 2015; Yan and Hu, 2022) however, these

studies explored this issue either from a consumer perspective or some other pure environmental issues. Thus, this research work assesses how certain board characteristics may contribute to EFP in developed and developing countries. Evidence from prior research related to environmental and sustainability issues carried out in developed countries may be less relevant for emerging countries (Behl et al., 2021; Deswanto and Siregar, 2018; Khlif et al., 2015; Yu and Luu, 2021). It is argued that in emerging markets with different cultural, regulatory, governance, and institutional contexts, voluntary compliance with CG codes will differ from what has been observed in developed countries (Al-Bassam et al., 2015). This is due to that sustainability issues, including environmental, CSR, and governance issues, depend on several factors, such as legal, institutional, and social, which are shaped by country-level governance elements (Kostka and Nahm, 2017; Matuszak and Różańska, 2021).

The current research relies on Refinitiv Eikon database based on a sample from two continents, Asia and Europe, for the period from 2016 up to 2021. This study employs a sample of 8094 companies distributed as 5141 from Asia and 2953 from Europe. The present study utilizes panel data analysis with fixed-effect models to estimate the results. Moreover, several additional, sensitivity, and robustness tests are estimated using sub-samples and different statistical tools to ensure rigorous estimation. The results reveal that board characteristics associate significantly and positively with the level of EFP. Furthermore, the results indicate that the presence of environmental teams strengthens the relationship between board effectiveness and EFP. Overall, the results remain robust and consistent across the different analysis settings.

This research is divided as follows: It begins with the introduction, then a literature review and hypotheses development. Thereafter, it provides the methodology, then analysis and discussion. Section 5 reports the conclusion and implications. Finally, the conclusion is presented in Section 6.

2. Literature review and hypotheses development

As identified in the prior section, companies are under growing pressure to be environmentally responsible, and many countries have now released good governance guidelines and laws for environmental sustainability (Homroy and Slechten, 2016; Fargnoli et al., 2018). However, there needs to be more research on internalizing these pressures or how board characteristics affect EFP. In this study, we look at how board characteristics affect EFP. The determinant variables include six board characteristics which are: board size, board independence, board diligence, board expertise, board diversity, and board tenure. The study also used the environmental teams and ESG performance. Accordingly, the study developed a research framework that illustrates the pathways of the relationship between board characteristics and EFP.

2.1. Board size

The board size refers to the number of inside and outside directors who serve on a corporate board (Khaireddine et al., 2020). Board size is a significant determinant of board effectiveness (Okere et al., 2021), likely affecting different aspects of businesses. Several studies reveal that board size impacts environmental issues (De Villiers et al., 2011; Liao et al., 2015; Khaireddine et al., 2020; Pucheta-Martínez and Gallego-Álvarez, 2019; Ofoegbu et al., 2018; Agyemang et al., 2020; Aliyu, 2019; Nguyen et al., 2021; Elsheikh et al., 2022a,b). Similarly, Agyemang et al. (2020) investigated the impact of board characteristics on environmental accounting information disclosure. They found that board size positively affects environmental information disclosure degree. Rabi (2021) and Kumari et al. (2022) also confirmed the positive role of board size in environmental disclosure and environmental performance, respectively. Further, prior studies provide evidence of a positive and significant linkage between board size and ESG performance (Aksoy et al., 2020; Birindelli et al., 2018; Chams and García-Blandón, 2019; Husted and Sousa-Filho, 2019). In this regard, it

is reported that better ESG practices and enhanced ESG performance are linked with greater board size. This is because a larger board size is considered more effective in terms of diversity, responsibility allocation, and workload, thus, better stakeholder representation (Cheng and Courtenay, 2006; Jizi et al., 2013). Moreover, the larger board size and the existence of a sustainability committee are significantly and positively linked with environmental disclosures (Kumari et al., 2022). Accordingly, a larger board size is more representative of stakeholders (Jizi et al., 2013) and more conscious and effective in compliance with environmental responsibilities (Kumari et al., 2022). Therefore, larger boards are expected to be more linked to environmental disclosures and protection, including environmentally friendly production. Based on this background, we formulate the following hypothesis.

H1. Board size associates positively and significantly with EFP

2.2. Board independence

It is widely acknowledged that a board with a higher percentage of independent directors can more efficiently monitor management (Liao et al., 2015). Boards with a higher proportion of independent directors put pressure on managers to disclose more information (Shamil et al., 2014). In general, independent directors are viewed as authorities who can monitor and supervise the management and offer valuable recommendations and counsel on environmental disclosure (Masud et al., 2018; Ofoegbu et al., 2018; Khaireddine et al., 2020). Previous research has found an essential positive correlation between board independence and environmental issues, like performance, disclosure, and innovation (De Villiers et al., 2011; Khan et al., 2021; Ofoegbu et al., 2018; Farza et al., 2022; Almaqtari et al., 2022). Further, Aliyu (2019) found a significant positive relationship between board independence and environmental reporting. Meanwhile, there is a positive and significant association between board independence and environmental performance; greater board independence contributes to the growth of a firm's environmental sustainability (Ortiz-de-Mandojana et al., 2016). Several studies also report that environmental and corporate sustainability performance are positively and significantly linked with a higher proportion of independent directors on the board (Aksoy et al., 2020; Husted and Sousa-Filho, 2019; Kumari et al., 2022). However, Nguyen et al. (2021) and Kumari et al. (2022) concluded an insignificant association between board independence and environmental performance. Among several board categories, independent directors are more likely to play a critical role in board effectiveness (Ammer et al., 2020). Accordingly, environmentally friendly products and environmental protection are more likely to be attained on board with a greater proportion of independent directors. We propose that.

H2. Board independence associates positively and significantly with EFP

2.3. Board diligence

Board diligence is one of the initiatives undertaken by the board to carry out its control function. It acts as a platform for experts to share their knowledge and information (Aliyu, 2019). In the context of environmental issues, Khaireddine et al. (2020) conclude a positive relationship between board diligence and environmental disclosure. Aliyu (2019), Campanella et al. (2021), and Nguyen et al. (2021) also confirmed such a positive association. However, García Martín and Herrero (2020) hypothesized that a high and frequent meeting number is linked with improved environmental performance, but they did not support this hypothesis. Birindelli et al. (2018) consistently indicate that board meetings have an insignificant influence on ESG performance. Ofoegbu et al. (2018) also found that board meetings have no significant impact on the extent of environmental disclosure. However, Disli et al. (2022) reveal that frequently held board meetings contribute positively and significantly to reducing ESG controversies. In the same context, it is

indicated that more frequent board meetings, larger boards, and a sustainability committee are strongly and positively related to environmental disclosure (Kumari et al., 2022). Accordingly, environmentally friendly production, environmental protection initiatives, and environmental disclosures are expected to be served on boards with greater diligence. This is because frequent board meetings are considered better oversight and reflect board effectiveness (Birindelli et al., 2018). Thus, they are more likely to be linked with environmental issues in the board agenda. Therefore, the current study defends the positive association and develops the following proposition.

H3. Board diligence associates positively and significantly with EFP

2.4. Board expertise

Board expertise is critical to achieving sound CG (Masud et al., 2019). Masud et al. (2019) stated that the presence of experts on the board enhances the credibility of the disclosure process and significantly affects the disclosure of corporate corruption. Several studies have investigated the relationship between audit committee expertise and environmental issues (Bepari and Mollik, 2015; Pozzoli et al., 2022; Rupley et al., 2012; Shaukat et al., 2016). However, there is a dearth of studies that assess the relationship between board members' expertise and environmental issues. Umukoro et al. (2019) found that the low experience of board executives on environmental issues leads to an insignificant impact on environmental sustainability reporting. Board and audit committee expertise is significantly and positively linked with ESG performance (Pozzoli et al., 2022). Shaukat et al. (2016) indicate that better environmental and social performance are associated with board members' financial expertise. The level of corporates' environmental and social performance is strongly influenced by the board's commitment to CSR strategy and orientation. Hillman and Dalziel (2003) consistently indicate that several critical significant functions of the board include providing expertise and consultancy, stakeholders representation, and enhancing legitimacy. As a result, board expertise is considered a critical factor in formulating strategic decisions, green initiatives, and environmental products. Homroy and Slechten (2019) showed that the market recognizes directors' environmental competence. Through their advising roles, these directors significantly impact adopting effective corporate ethical practices, such as investing in green technologies. Based on this background, the following hypothesis has been developed.

H4. Board expertise associates positively and significantly with EFP

2.5. Board diversity

Due to the traditional, cultural, and societal differences between men and women, gender is a very contentious aspect of board diversity (Liao et al., 2015; Elsheikh et al., 2022). Promoting gender diversity on boards continues to be a key topic in literature since having female directors on boards is crucial (Shamil et al., 2014). Numerous previous studies imply that women are generally more concerned than men about environmental issues (Liao et al., 2015; Khaireddine et al., 2020; García Martín and Herrero, 2020; Farza et al., 2022). García Martín and Herrero (2020) reported that women on corporate boards positively impact environmental performance. A greater proportion of gender board diversity can influence a company's sensitivity to social and environmental issues (Birindelli et al., 2018). Several studies provide evidence that a greater proportion of women on the board are positively connected with better sustainability and environmental performance (Al-Shaer and Zaman, 2016; Chams and García-Blandón, 2019; Disli et al., 2022). Female representation in the boardroom is significantly and positively linked with sustainability performance (Chams and García-Blandón, 2019). Contrarily, Kumari et al. (2022) and Onyali et al. (2022) found an insignificant impact, while Bøhren and Staubo (2014) revealed a negative impact. However, Ben-Amar et al. (2017) report that

female representation in the boardroom positively affects GHG emission voluntary disclosure levels and climate change-related strategies. Hence, the likelihood of better environmental performance and environmentally friendly products increases with a greater proportion of female representation in the boardroom. As such, the following hypothesis has been formulated.

H5. Board diversity associates positively and significantly with EFP

2.6. Board tenure

Longer tenure as a director can be viewed as a source of reputation and organizational knowledge (De Villiers et al., 2011). Longer board tenure will result in promoted experience and knowledge of the corporate business environment, resulting in improving long-term strategy and policy for corporate sustainability (Handajani et al., 2014). Research on board tenure is still finite and provides contradictory evidence (De Villiers et al., 2011; Deschênes et al., 2015; Handajani et al., 2014). In particular, prior studies report mixed evidence on the relationship between board tenure and ESG issues (Bravo and Reguera-Alvarado, 2019; Cucari et al., 2018; Pozzoli et al., 2022; Setiany, 2018). For example, Pozzoli et al. (2022) indicated a negative and significant relationship between tenure and ESG performance. However, Cucari et al. (2018) discovered that board tenure does not affect ESG. In contrast, Bravo and Reguera-Alvarado (2019) reported that tenure is positively associated with the comprehension and relevance of ESG disclosures. Setiany (2018) consistently advocates that the significant and inverse association between board tenure and ESG performance confirms that long board tenure fosters familiarity, reducing control activities' effectiveness. As a result, longer board tenure may undermine board members' ability to be more familiar with better environmental performance and environmentally friendly products. Therefore, the following hypothesis has been formulated.

H6. Board tenure associates positively and significantly with EFP

2.7. Environmental teams

Nowadays, firms appoint a specified team of the board to address environmental issues. This team's purpose is to plan, carry out, and evaluate sustainability-related policies and initiatives (Liao et al., 2015). Many studies found a positive effect of environmental teams on environmental performance (e.g., Dixon-Fowler et al., 2017; Peters and Romi, 2014). Meanwhile, a few researchers concluded that environmental teams have an insignificant relationship with environmental performance (Masud et al., 2018). In our context, the environmental teams are expected to pay more proactive attention to EFP and thus will be more likely to comply with stakeholder requests for EFP-related disclosures. Accordingly, the absence of board expertise on environmental and sustainability issues could be assisted by the existence of an environmental team.

Prior sustainability and environmental issues have investigated the existence of sustainability committees rather than environmental teams. It is reported that the presence of a sustainability committee has a significant and positive relationship with environmental disclosures (Kumari et al., 2022). The sustainability committee significantly impacts the firm's environmental and social performance (Hussain et al., 2018). As a result, firms are encouraged to establish and empower sustainability committees (Arayssi et al., 2020), which positively impacts ESG disclosures. In fact, the existence and function of a sustainability committee were debatable. Whether the role of the sustainability committee is to implement and adopt sustainable practices or is it simply a matter of the firm's public image and reputation (Chams and García-Blandón, 2019)? Environmental disclosures require effective monitoring, which can be accomplished through the board's focused approach in the form of specialized committees, such as the sustainability committee or environmental committee (Kumari et al., 2022). The presence of a

sustainability committee is associated with a higher environmental disclosure score. As a result, the firm's environmental strategy will be improved by a dedicated sustainability committee that will enhance awareness and improves disclosure levels. In the pursuit of achieving a balance between profit maximization and environmental concerns, a sustainability committee avoids board oversight tendencies and conflicting expectations of various stakeholders. As a result, the existence of a sustainability committee indicates a greater willingness towards more and better environmental performance (Kumari et al., 2022). The formation of a board-level sustainability committee can be viewed as an effective monitoring tool for ensuring the quality of the stakeholder engagement process and improving the range of sustainability disclosures, such as product safety and environmental health (Michelon and Parbonetti, 2012). As such, this study hypothesizes that.

H7. Environmental teams associate positively and significantly with EFP

H8. There is a significant moderation effect of environmental teams on the relationship between board characteristics EFP

2.8. Environmental, social, and governance (ESG) performance

Performance in terms of ESG has gained popularity in recent years. Globally, firms adopt ESG measures to remain competitive in the dynamic environment (Yadav and Prashar, 2022). Firms that consider ESG measures when making decisions will be cautious of a set of things at the forefront of its environmental aspects. For example, when launching fresh products and services on the market, they must minimize any detrimental effect on the environment while aligning their strategic objectives with the community's needs. This can ultimately assist them in gaining a competitive advantage (Zaman and Ellili, 2022). Prior studies revealed that ESG performance boosts positive corporation values toward environmental issues (García Martín and Herrero, 2020; Chang et al., 2021). Accordingly, we propose that corporates with better and higher ESG performance will likely have EFP. Based on the preceding discussion, the following hypothesis has been proposed.

H9. Companies with better ESG performance have EFP

3. Methodology

This section describes the empirical research design and methodology followed in assessing the association between board characteristics, environmental teams, and EFP. Due to the complex and comprehensive nature of governance and ESG issues, prior studies followed multi-criteria approaches in this regard (Escrig-Olmedo et al., 2017; Garcia et al., 2017; Husted and Sousa-Filho, 2017; Liu et al., 2022; Ortas et al., 2015; Pozzoli et al., 2022, 2022, 2022; Tseng et al., 2020; Yuan et al., 2022). However, the majority of prior studies that investigate EFP, ESG issues, and governance practices follow a panel data analysis approach (Alrashidi et al., 2021; Hussain et al., 2018; Khaoula and Moez, 2019; Roozen, 1997; Van Hoang et al., 2021; Wong et al., 2021). More specifically, when multi countries are investigated, panel data analysis is the appropriate approach to estimate the results (Cremona and Passador, 2019; Husted and Sousa-Filho, 2017; Khaoula and Moez, 2019; Almaqtari et al., 2022). Accordingly, the description of the sample used, the variables investigated, and the econometric tools used by the current study are provided in the following sub-section.

3.1. Data collection and sampling

The current research relies on secondary data extracted from the Refinitiv Eikon database. The "Refinitiv Database (also known as Refinitiv Eikon and hosted by Thomson Reuters)" is a globally trusted data source that provides wide and comprehensive details for financial and non-financial variables, including ESG issues. The Database also

provides a detailed and comprehensive approach for scoring ESG dimensions (Agnese et al., 2022; Refinitiv, 2022). The use of data provided by the Database is well documented by prior studies (Abdi et al., 2020; Agnese et al., 2022; Alsayegh et al., 2020; Chen et al., 2022; Shakil, 2021). This study's data is drawn from the Database and covers a sample from two continents, Asia and Europe, from 2016 to 2021. In the initial stage, the data is extracted for 29,206 corporates from 2011 to 2021. This initial sample was subjected to rigorous processing and a variety of criteria to select the final sample.

First, systematic processing was conducted for the sample selection, which started with the extraction of all listed companies in the stock market of the respective country. Second, we eliminated all companies that did not have data for the whole period of the study. We also observed that many corporates had poor data disclosure before 2016, especially for ESG, environmental performance, and EFP. Accordingly, we decided to limit our investigation period from 2016 to 2016. This period is also critical and justified by adopting the Paris Agreement on climate change. Third, the data across each variable has been checked for each company, ensuring the availability of the data across all variables. We have deleted some companies that have missing values in some variables. This yielded a final sample of 8094 companies distributed as 5141 from Asia and 2953 from Europe. The rationale behind choosing Asia and Europe is to provide empirical evidence based on different countries' institutional and regulatory settings. We intend to

provide evidence comparing countries with strong regulatory settings with others with weak regulatory environments, especially in terms of non-financial information disclosure. In the case of the European countries, the "European Commission" has proposed a "Directive of the European Parliament and of the Council" requiring a class of European corporates to disclose non-financial information. This case is not the same for the majority of Asian countries where the disclosure of ESG issues is still immature. Table 1 describes the data and sample.

3.2. Operational definition of variables

Table 2 provides the measurement and definition of the variables used by the present study. The research framework of the current study includes EFP as the dependent variable, which is regressed by three categories of independent, moderating, and control variables. The first category of independent variables includes board categories in which board size, independence, diligence, expertise, diversity, and tenure. The second category comprises the moderating variable; environmental teams. Finally, the third category consists of firm specifics as control variables: size, revenue growth, and profitability. Table 2 and Fig. 1 demonstrate the operational definition of the variables, and the research framework, respectively.

Table 1
The sample of the study.

Country	Initial Sample					Final Sample					
	Service	Trading	Industrials	Total	% of Region	Service	Trading	Industrials	Total	% of Region	% of Total Sample
China	1683	968	2074	4725	19.05%	538	285	534	1357	26.40%	16.77%
Japan	1505	1110	1359	3974	16.02%	301	229	300	830	16.14%	10.25%
Hong Kong	1012	704	660	2376	9.58%	273	173	127	573	11.15%	7.08%
S. Korea; Republic	1145	500	719	2364	9.53%	186	94	132	412	8.01%	5.09%
Taiwan	1125	380	474	1979	7.98%	247	72	92	411	7.99%	5.08%
India	1441	1179	1540	4160	16.77%	119	92	117	328	6.38%	4.05%
Thailand	322	214	280	816	3.29%	90	74	73	237	4.61%	2.93%
Singapore	229	135	263	627	2.53%	84	32	61	177	3.44%	2.19%
Malaysia	302	245	397	944	3.81%	58	48	70	176	3.42%	2.17%
Turkey	154	136	143	433	1.75%	47	46	37	130	2.53%	1.61%
Indonesia	283	206	268	757	3.05%	37	26	30	93	1.81%	1.15%
Philippines	114	69	73	256	1.03%	40	17	32	89	1.73%	1.10%
Saudi Arabia	102	57	80	239	0.96%	30	16	25	71	1.38%	0.88%
Pakistan	118	208	124	450	1.81%	23	21	14	58	1.13%	0.72%
Qatar	28	6	15	49	0.20%	27	5	14	46	0.89%	0.57%
United Arab Emirates	83	17	34	134	0.54%	32	2	9	43	0.84%	0.53%
Kuwait	98	17	36	151	0.61%	27	2	8	37	0.72%	0.46%
Egypt	96	59	63	218	0.88%	13	7	10	30	0.58%	0.37%
Oman	38	39	33	110	0.44%	17	8	4	29	0.56%	0.36%
Bahrain	27	8	5	40	0.16%	12	2	0	14	0.27%	0.17%
Asia	**9905**	**6257**	**8640**	**24,802**	**100%**	**2201**	**1251**	**1689**	**5141**	**100%**	**64%**
United Kingdom	679	267	495	1441	32.72%	408	196	302	906	30.68%	11.19%
Germany	401	139	178	718	16.30%	201	84	116	401	13.58%	4.95%
France	386	165	193	744	16.89%	171	74	103	348	11.78%	4.30%
Italy	174	103	97	374	8.49%	104	59	57	220	7.45%	2.72%
Switzerland	140	29	66	235	5.34%	122	28	60	210	7.11%	2.59%
Poland	353	153	226	732	16.62%	73	42	60	175	5.93%	2.16%
Norway	143	51	168	362	8.22%	44	16	59	119	4.03%	1.47%
Spain	104	37	49	190	4.31%	48	26	36	110	3.73%	1.36%
Denmark	97	23	51	171	3.88%	53	19	35	107	3.62%	1.32%
Finland	83	31	61	175	3.97%	42	20	35	97	3.28%	1.20%
Netherlands	51	21	37	109	2.48%	36	17	29	82	2.78%	1.01%
Greece	38	44	69	151	3.43%	20	23	26	69	2.34%	0.85%
Romania	24	33	56	113	2.57%	5	11	15	31	1.05%	0.38%
Portugal	20	11	14	45	1.02%	8	8	9	25	0.85%	0.31%
Cyprus	27	23	11	61	1.39%	6	14	3	23	0.78%	0.28%
Croatia	14	41	23	78	1.77%	4	12	6	22	0.75%	0.27%
Bulgaria	69	39	38	146	3.32%	3	2	3	8	0.27%	0.10%
Europe	**2124**	**943**	**1337**	**4404**	**100%**	**1348**	**651**	**954**	**2953**	**100%**	**36%**
Total	**12,029**	**7200**	**9977**	**29,206**		**3549**	**1902**	**2643**	**8094**		**100%**
	41%	**25%**	**34%**	**100%**		**44%**	**23%**	**33%**	**100%**		

Table 2
Operational definition of the variables of the study.

Variable	Symbol	Formula
Dependent Variables		
Environmentally friendly production	*EFP*	"Does the company report on at least one product line or service that is designed to have positive effects on the environment or which is environmentally labeled and marketed? In focus are the products and services that have positive environmental effects, or marketed as which solve environment problems"
Independent and Moderate Variables		
Board Size	*BS*	The total number of board members at the end of the fiscal year.
Board Independent	*BI*	Percentage of independent board members as reported by the company.
Board Diligence	*BD*	The average overall attendance percentage of board meetings as reported by the company.
Board Expertise	*BE*	Percentage of board expertise members in accounting and finance areas.
Board Diversity	*BDIV*	Percentage of female directors on the board.
Board tenure	*BT*	The average number of years each board member has been on the board.
Environmental teams	*ENVTEAM*	"Score of environmental directors on the board. Does the company have an environmental management team? - in scope are any team that performs the functions dedicated to environmental issues - an individual or team at any level composed of employees, even if the name of the team is different, performing implementation of the environmental strategy - it is important to understand that the members of the team include employees of the company, who are operational on a day to day basis and are not the board committees (directors)"
Control Variables		
Firm Size	*FSIZE*	Total assets of a firm
Revenue Growth	*REV*	The year-over-year change in revenue
Profitability	*PROF*	The net profit after tax of a firm

3.3. Econometric tools and model specification

Following prior studies with panel structure or cross-country and time series data (e.g., Narwal and Pathneja, 2016; Salike and Ao, 2017; Rjoub et al., 2017), the present study adopts panel data analysis with fixed and random models. In the first analysis stage, we estimated our analysis with pooled and panel data. Data analysis using a redundant fixed effects model has been conducted to determine the proper analysis structure for the data. The results of this test indicate that panel data with fixed and random effect models are more proper for estimating the results of the present study. Accordingly, we conducted a panel data analysis using Hausman Test with fixed and random effect model choices, which yielded that the fixed effect model is the proper choice for the data set (P-value <0.05). The following models are designed to investigate the effect of board characteristics, environmental teams, and firms' specifics on EFP:

$$EFP_{it} = \alpha + \beta_1 \sum_{j=1}^{7} CG_{it} + \beta_2 ESG_{it} + \beta_3 ENV_{it} + \beta_4 \sum_{j=1}^{3} Controles_{it} + \varepsilon_{it}$$

(1)

Where C_{it} represents the environmental dimensions, i, t and ε_{it} measure the individual effect, the temporal effect, and the stochastic error, respectively. Where;

$$\sum_{j=1}^{7} CG_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it} + \varepsilon_{it}$$

(2)

$$\sum_{j=1}^{3} Controles_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 REV_{it} + \beta_3 PROF_{it} + \varepsilon_{it} \quad (3)$$

Accordingly, *EFP* is functioned by $\sum_{j=1}^{7} CG_{it}$ as an indicator of board characteristics and $\sum_{j=1}^{3} Controles_{it}$ as control firm specifics. Based on these equations, the following main models are formulated:

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it} + \beta_7 ENVTEAM_{it} + \beta_8 SIZE_{it} + \beta_9 REV_{it} + \beta_{10} PROF_{it} + \varepsilon_{it}$$

(Model 1)

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it} + \beta_7 ENVTEAM_{it} + \beta_8 SIZE_{it} + \beta_9 REV_{it} + \beta_{10} PROF_{it} + \beta_{11} CD_{it} + \varepsilon_{it}$$

(Model 2)

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it} + \beta_7 ENVTEAM_{it} + \beta_8 SIZE_{it} + \beta_9 REV_{it} + \beta_{10} PROF_{it} + \beta_{11} CD_{it} + \beta_{12} ESG_{it} + \varepsilon_{it} \,'$$

(Model 3)

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it} + \beta_7 ENVTEAM_{it} + \beta_8 SIZE_{it} + \beta_9 REV_{it} + \beta_{10} PROF_{it} + \beta_{11} CD_{it} + \beta_{12} ENVP_{it} + \varepsilon_{it} \,'$$

(Model 4)

4. Analysis and discussion

4.1. Descriptive statistics

The results in Table 3 provide descriptive statistics for the study's variables. The results provide that environmental production has an average of 14.24 with a maximum score of 99.32 and a minimum of nil. This means that, on average, about 14% of the sampled companies from Asia and Europe produce environmental products and some companies have the majority of their products which are EFP; however, some other companies have no environmental production. European corporates exhibit a higher average score of environmental production (15.36) than Asian corporates (13.59). The results also show that the overall average score of environmental teams is 13.74 with a minimum of (0.00) and a maximum of 94.83. European corporates have a greater average (17.92) and maximum scores (94.83) than Asian corporates (mean = 13.07, Max. = 92.86). In the same respect, both ESG and environmental pillar scores indicate that European corporates have better sustainability (ESG) and environmental performance. This is indicated by an average score of 20.98 and 19.70 for ESG and environmental pillar for European corporates against 15.99 and 14.74 for Asian corporates, respectively.

Concerning board characteristics, the results demonstrate that the average board size of European corporates is 5.81, with a maximum board size of 30 and a minimum of 4 board members against an average of 7.61, a maximum of 41, and a minimum of 4 board members for Asian corporates. European corporates have a greater proportion of independent board members (average = 19.44) than Asian corporates (average = 17.23); however, Asian corporate exhibit a higher maximum proportion of independent board members (Max. = 99.92) than European corporates (Max. = 99.74). Further, the results show that the average board meetings of European corporates are 28.46 against 16.19 for Asian corporates. European corporates exhibit better board diversity
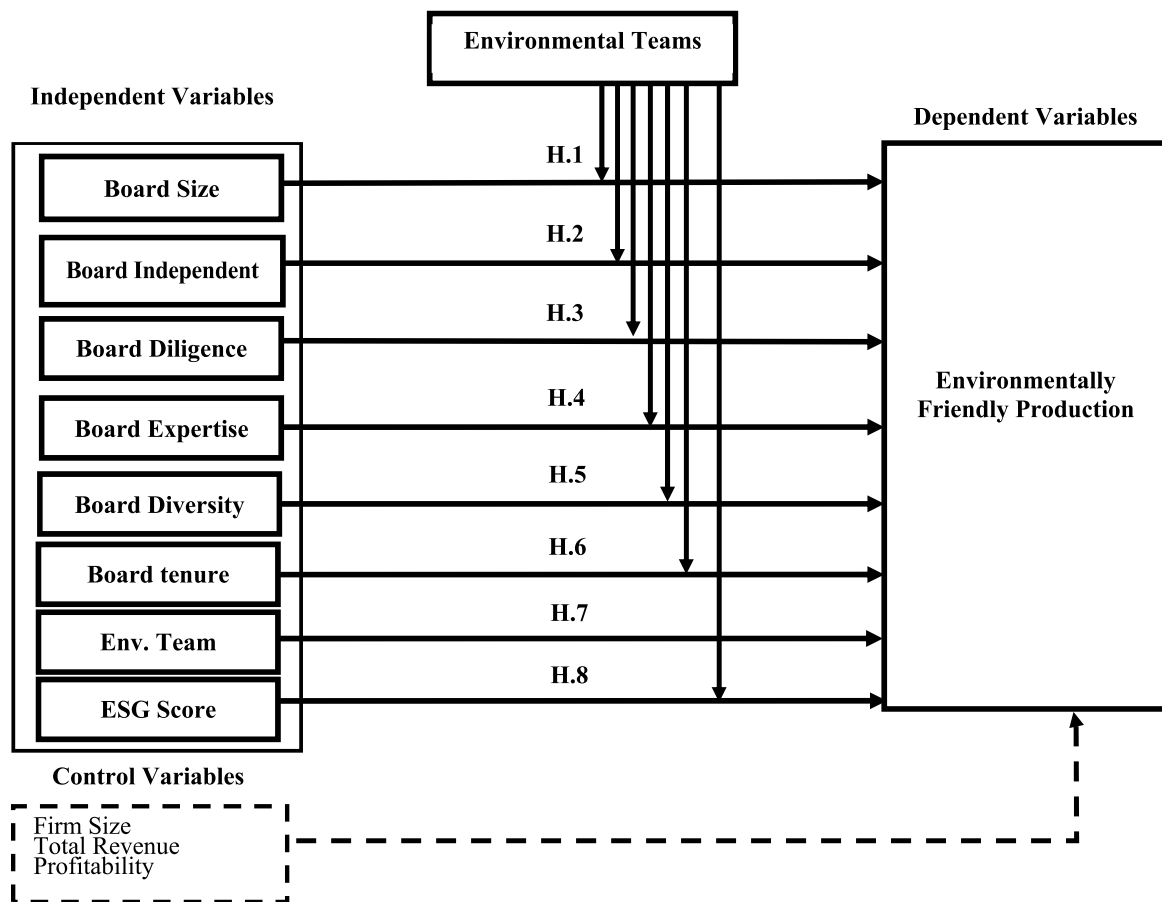
Figure (1). The research Framework.

Table 3
Descriptive statistics.

Variables	Min.	Max	Mean	Median	SD	Min.	Max	Mean	Median	SD	Min.	Max	Mean	Median	SD
	Overall Sample (No. of Observation = 48,563)					Asia (No. of Observation = 30,845)					Europe (No. of Observation = 17,718)				
EFP	0.00	99.32	14.24	19.12	29.64	0.00	99.26	13.59	18.89	28.96	0.00	99.32	15.36	22.56	30.76
ENVTEAM	0.00	94.83	13.74	21.59	29.93	0.00	92.86	13.07	21.02	29.17	0.00	94.83	14.92	24.78	31.18
ESG	0.00	94.48	20.98	27.81	25.80	0.00	94.48	15.99	23.47	24.29	0.00	94.26	20.98	26.16	27.95
ENVP	0.00	99.20	19.70	26.56	27.18	0.00	98.39	14.76	24.23	25.57	0.00	99.20	19.70	32.22	29.52
BS	4	41.00	6.68	12.18	5.26	4	41.00	7.61	15.44	5.27	4	30.00	5.81	11.75	5.24
BI	14	99.92	18.03	48.48	29.11	14	99.92	17.23	34.73	28.80	21	99.74	19.44	47.13	29.60
BD	0.00	100.00	26.19	43.27	42.83	0.00	100.00	24.88	36.26	42.09	15	100.00	28.46	49.23	44.01
BE	0.00	99.93	18.55	34.73	29.55	0.00	99.93	17.52	40.25	28.75	0.05	99.92	20.34	47.11	30.82
BD IV	0.00	99.89	15.49	21.67	28.12	0.04	99.89	14.79	18.61	27.73	0.11	99.79	16.71	32.16	28.75
BT	1	99.92	17.48	19.22	29.33	1	99.92	16.49	23.89	28.88	1.3	99.92	19.22	20.29	30.01
FSIZE	7.05	29.36	21.15	23.52	2.42	7.05	29.36	21.15	23.02	2.29	9.92	28.74	21.51	26.89	2.63
REV	7.2	26.79	20.06	22.08	2.49	7.2	26.79	20.06	21.85	2.28	7.5	26.69	19.55	25.57	2.78
PROF	4.63	25.43	18.19	19.10	1.85	4.63	25.43	18.19	19.76	1.84	7.25	24.33	18.08	21.19	1.85

(mean = 20.34) than Asian corporates (17.52). Similarly, European corporates have a greater average of board industry-specific expertise (mean = 16.71) than Asian corporates (mean 17.79). Furthermore, the results indicate that the average board tenure in Asian corporates is 16.49 against 19.22 for European corporates, which indicates that board members of European corporates have greater tenure than Asian corporates. Finally, firms specifically show that Asian corporates have greater average revenues and profitability than (20.06 and 18.19, respectively) European corporates (19.55 and 18.08, respectively). However, European corporates have greater assets (21.51) than Asian corporates (21.15). Overall, the results of both the mean and median values of the variables indicate some variations in these values. This indicates that the standard deviation values could not be the proper value that conveys the dispersion between the actual and mean values. Accordingly, each variable's median values could better express these variables' values.

4.2. Correlation analysis

Table 4 shows a correlation analysis for the study's variables. The results show statistically significant positive and negative correlations between the independent and dependent variables. The results show that all independent and control variables have statistically significant P-values (P-values <0.01) and positive correlations (R+) with

Table 4
Correlation analysis and multicollinearity diagnostics.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
Panel A: Correlation Analysis													
(1) *EFP*	1												
(2) BS	0.55 ***	1.00											
(3) BI	0.45 ***	0.51 ***	1.00										
(4) BD	0.40 ***	0.43 ***	0.67 ***	1.00									
(5) BDIV	0.43 ***	0.37 ***	0.70 ***	0.67 ***	1.00								
(6) BE	0.42 ***	0.67 ***	0.52 ***	0.56 ***	0.57 ***	1.00							
(7) BT	0.41 ***	0.41 ***	0.62 ***	0.61 ***	0.62 ***	0.62 ***	1.00						
(8) ENVTEAM	0.44 ***	0.46 ***	0.39 ***	0.33 ***	0.38 ***	0.36 ***	0.36 ***	1.00					
(9) SIZE	0.41 ***	0.55 ***	0.44 ***	0.44 ***	0.45 ***	0.40 ***	0.40 ***	0.33 ***	1.00				
(10) REV	0.42 ***	0.56 ***	0.46 ***	0.45 ***	0.46 ***	0.42 ***	0.43 ***	0.39 ***	0.54 ***	1.00			
(11) PROF	0.31 ***	0.45 ***	0.37 ***	0.37 ***	0.38 ***	0.34 ***	0.34 ***	0.29 ***	0.63 ***	0.51 ***	1.00		
(12) ESGSCORE	0.55 ***	0.61 ***	0.54 ***	0.46 ***	0.52 ***	0.47 ***	0.48 ***	0.42 ***	0.49 ***	0.53 ***	0.42 ***	1.00	
(13) ENVP	0.58 ***	0.59 ***	0.49 ***	0.42 ***	0.47 ***	0.45 ***	0.44 ***	0.46 ***	0.47 ***	0.51 ***	0.39 ***	0.93 ***	1.00
Panel B: Multicollinearity Diagnostics													
VIF	3.4	2.7	2.5	2.9	2.0	2.3	2.2	2.4	2.0	1.9	7.8	8.3	

environmental production. This signifies a positive relationship between the independent variables and environmental production.

It also means that better environmental and sustainability performance and greater board effectiveness lead to higher environmental production. Further, the results indicate that greater firms' size, profitability, and revenuers associate with higher environmental production. In the other situations, the results show that the highest correlation value among the independent and control variables is 0.67, which is less than 0.70. This indicates that there are no multicollinearity issues in the current study. Further, Panel (b) shows that variance inflation factor (VIF) values have a maximum value of 3.4, that is, in the case of board size. However, VIF values of ESG and environmental pillar are 7.8 and 8.3, respectively, which are estimated in separate regressions. This signifies the absence of multicollinearity problems in the reported results.

4.3. Results estimation

4.3.1. Direct effect

Based on the description of the econometric tools and model specification, the direct effect of board characteristics, environmental teams, ESG, and environmental performance on EFP are estimated using panel fixed effect models. Models 1 to 4 are tested to estimate this effect. While Model 1 examines the direct effect of board characteristics, environmental teams, ESG, and environmental performance on EFP for the whole sample, Model 2 assesses the same relationship based on a country dummy effect. Meanwhile, Model 3 investigates this relationship considering the effect of ESG performance; Model 4 estimates the same controlling for the influence of environmental performance.

Table 5 estimates the results for the overall sample with a continent dummy. The results show that board size and independence have a statistically significant (þ-Value <0.01) positive (+β) influence on EFP. This leads to accepting hypotheses H1 and H2. These results are consistent with those of (Khaireddine et al., 2020; Ofoegbu et al., 2018; Agyemang et al., 2020; Aliyu, 2019; Umukoro et al., 2019). This indicates that greater board size is associated with higher levels of EFP. This could be because the larger board size includes more independent,

diversified, and expertized members contributing positively to EFP. The results are in line with (Agyemang et al., 2020; Rabi, 2021; Kumari et al., 2022), who indicate that board size positively affects environmental information disclosure degree. Larger boards are considered more effective in terms of diversity, responsibility allocation, and workload, thus, better stakeholder representation (Jizi et al., 2013). Larger boards are expected to be more linked to environmental disclosures and protection (Kumari et al., 2022), including environmentally friendly production.

Further, the results signify that a greater proportion of board independence and industry-expertized members positively influence the level of EFP. The results are consistent with those of (De Villiers et al., 2011; Khan et al., 2021; Ofoegbu et al., 2018; Farza et al., 2022; Aksoy et al., 2020; Husted and Sousa-Filho, 2019; Kumari et al., 2022) that reveal that there is a significant positive correlation between board independence and environmental issues such as performance, disclosure, and innovation. Independent directors are more likely to play an important role in board effectiveness (Ammer et al., 2020). As a result, in boards with a higher proportion of independent directors, environmentally friendly products and environmental protection are more likely to be achieved. However, the findings contradict the findings of Nguyen et al. (2021) and Kumari et al. (2022), who concluded that there is no significant relationship between board independence and environmental performance.

The findings reveal that board industry expertise exhibits a statistically significant (þ-Value <0.01) positive (+β) influence on EFP. Hence, H4 is accepted. This indicates a positive and significant association between a greater number of board industry expertise members and the level of EFP. These findings are consistent with (Hillman and Dalziel, 2003; Pozzoli et al., 2022; Shaukat et al., 2016; Homroy and Slechten, 2019). Hillman and Dalziel (2003) find that board expertise is important in developing strategic decisions, green initiatives, and environmental products. Consistently, Pozzoli et al. (2022) and Shaukat et al. (2016) indicate that the expertise of the board and audit committee is significantly and positively related to ESG performance. According to Homroy and Slechten (2019), directors' environmental competence positively

Table 5
Results estimation – overall sample.

Variable	Model (1)	Model (2)	Model (3)	Model (4)
C	−28.373***	−30.211***	−11.732***	−18.890***
	1.373	1.437	1.425	1.456
	−20.665	−21.025	−8.230	−12.978
BS	1.613***	1.619***	1.251***	1.502***
	0.042	0.042	0.041	0.042
	38.228	38.360	30.279	35.914
BI	0.122***	0.122***	0.095***	0.096***
	0.006	0.006	0.006	0.006
	20.264	20.223	16.229	16.086
BD	−0.035***	−0.036***	−0.026***	−0.033***
	0.004	0.004	0.004	0.004
	−8.903	−9.008	−6.737	−8.515
BDIV	−0.003	−0.004	−0.007	−0.013**
	0.006	0.006	0.006	0.006
	−0.449	−0.597	−1.171	−2.140
BE	0.072***	0.071***	0.059***	0.058***
	0.005	0.005	0.005	0.005
	13.353	13.299	11.409	10.814
BT	0.010*	0.009	0.012***	0.007
	0.006	0.006	0.005	0.006
	1.729	1.572	2.314	1.252
ENVTEAM	0.189***	0.188***	0.000	0.087***
	0.004	0.004	0.005	0.005
	44.799	44.546	−0.080	17.205
SIZE	0.784***	0.731***	0.606***	0.649***
	0.068	0.069	0.067	0.068
	11.528	10.578	9.074	9.516
REV	0.867***	0.916***	0.385***	0.579***
	0.059	0.060	0.059	0.060
	14.693	15.249	6.550	9.639
PROF	−0.128	−0.091	−0.364***	−0.263***
	0.081	0.081	0.079	0.081
	−1.582	−1.122	−4.620	−3.261
CD		1.001***	−0.664***	−0.038
		0.231	0.225	0.230
		4.329	−2.947	−0.166
ENVP			0.381***	
			0.007	
			58.069	
ESGSCORE				0.239***
				0.007
				35.015
R-squared	0.35	0.35	0.40	0.37
Adjusted R-squared	0.35	0.35	0.39	0.37
F-statistic	2660.713	2421.418	2654.745	2377.807
Prob (F-statistic)	0.000	0.000	0.000	0.000

impacts the adoption of corporate ethical practices.

The results also indicate that board meetings have a negative (-β) significant (þ-Value <0.01) association with the level of EFP. This leads to accepting H3, which signifies that greater board meetings are adversely linked with the level of EFP. The results contradict Nguyen et al. (2021) and Aliyu (2019), who support a positive association. The findings are also inconsistent with Disli et al. (2022), who discovered that frequent board meetings contribute positively and significantly to reducing ESG controversies. This could be because, in some companies, a larger number of meetings denotes inefficiency of the board and higher compensations rather than effectiveness. However, Ofoegbu et al. (2018) concluded that board meetings have no significant impact on the extent of environmental disclosure. According to Birindelli et al. (2018), board meetings have an insignificant impact on ESG performance.

In the same respect, the results exhibit that board diversity has a statistically insignificant (þ-Value >0.10) negative (-β) effect on environmental production except in the case of the ESG model, which shows a significant negative effect on environmental production. Therefore, H5 is rejected in the context of the overall model. This is consistent with Kumari et al. (2022), and Onyali et al. (2022) who discovered an insignificant impact, whereas Bøhren and Staubo (2014) discovered a negative impact. This could be because a larger number of companies

have a low proportion of female directors, which in turn does not associate positively with the level of EFP.

Board tenure demonstrates a positive but significant effect on environmental products in the case of models (1 and 3) but an insignificant effect in the case of models (2 and 4). Furthermore, the results reveal that environmental teams have a statistically significant (þ-Value <0.01) positive (+β) influence on EFP. Thus, H6 and H7 are partially accepted. Compared to prior research, Dixon-Fowler et al. (2017) found a positive effect of the environmental teams on environmental performance. This means that the existence of environmental teams and a greater score of these environmental teams associate significantly and positively with higher levels of EFP.

Regarding firms' specifics, the results show that greater firm size and revenues associate significantly and positively with higher levels of EFP. However, firms' profitability shows that there is an insignificant relationship with environmental products in the case of the models (1 and 2) but insignificant in the case of the models (3 and 4). Importantly, the continent dummy exhibits a statistically significant (þ-Value <0.01) and positive (+β) influence on EFP. This indicates that European corporates are better than Asian corporates in terms of the overall effect of the independent variables on EFP. Moreover, both ESG and environmental pillars indicate a statistically significant positive impact on EFP. This means that corporate with better ESG and environmental pillar scores have greater levels of EFP.

Table 6 estimates the findings based on continent-wise results. The findings reveal that board size, independence, and industry expertise are consistent with the earlier findings. They all show a statistically significant positive effect on EFP in Asia and Europe. This confirms that greater board size, independence, and industry expertise influence significantly and positively the level of EFP. Similarly, board meetings show a negative and significant effect on the level of EFP. This leads to accepting H1, H2, and H4 and rejecting H3 in the contexts of Europe and Asia.

This indicates that greater board meetings do not associate with environmental production. This necessitates that board meetings' agenda towards sustainability issues be disclosed. Further, the results show that board diversity has a statistically significant negative effect on environmental products in the case of Asian corporates. However, it indicates an insignificant positive effect on environmental production except in the case of the model (1), which has a significant effect at the level of 10% (P value < 0.010). This indicates that board diversity in European corporates associates positively with environmental production; however, it has a negative effect in the case of Asian corporates.

Therefore, H5 is accepted in the context of European countries. However, it is rejected in the context of Asian countries. The results are consistent with prior studies (Al-Shaer and Zaman, 2016; Chams and Garca-Blandón, 2019; Disli et al., 2022). They indicate that female boardroom representation is significantly and positively related to sustainability performance. Consistently, Ben-Amar et al. (2017) report that female representation positively affects GHG emission voluntary disclosure levels and climate change-related strategies. Accordingly, a higher proportion of female representation increases the likelihood of better environmental performance and environmentally friendly products.

The results also show that board tenure has a negative influence on environmental products in the case of Asian corporates. Still, it reveals a significant positive effect on environmental products in the case of European corporates. This leads to accepting H6 in the case of European countries. However, it is rejected in the context of Asian countries. This means that greater board tenure in European corporates leads to greater levels of environmental production.

The findings in the context of Asian countries are consistent with Pozzoli et al. (2022), who found a negative and significant relationship between tenure and ESG performance. In contrast, Bravo and Reguera-Alvarado (2019) found that tenure is positively related to ESG disclosure. This supports our proposition in the context of European

Table 6
Results estimation – Asia and Europe.

Variable	Asia	Europe	Asia	Europe	Asia	Europe
	Model (1)		Model (3)		Model (4)	
C	−34.386***	−22.253***	−17.526***	−6.383**	−21.695***	−15.143***
	1.748	2.264	1.721	2.251	1.764	2.287
	−19.669	−9.829	−10.181	−2.836	−12.300	−6.623
BS	1.690***	1.487***	1.305***	1.114***	1.542***	1.398***
	0.052	0.072	0.051	0.070	0.052	0.071
	32.273	20.774	25.539	15.812	29.836	19.622
BI	0.103***	0.158***	0.075***	0.133***	0.070***	0.142***
	0.007	0.011	0.007	0.010	0.007	0.011
	14.142	14.897	10.715	12.865	9.768	13.375
BD	−0.035***	−0.039***	−0.022***	−0.035***	−0.029***	−0.040***
	0.005	0.007	0.005	0.006	0.005	0.007
	−7.127	−5.785	−4.533	−5.362	−5.888	−6.076
BDIV	−0.020**	0.017*	−0.018**	0.009	−0.030***	0.010
	0.008	0.010	0.007	0.010	0.008	0.010
	−2.630	1.653	−2.362	0.894	−3.980	0.955
BE	0.079***	0.056***	0.066***	0.046***	0.067***	0.041***
	0.007	0.009	0.006	0.009	0.007	0.009
	11.826	6.144	10.168	5.217	10.140	4.573
BT	−0.011	0.041***	−0.007	0.044***	−0.016***	0.042***
	0.007	0.009	0.007	0.009	0.007	0.009
	−1.516	4.373	−1.031	4.941	−2.294	4.519
ENVTEAM	0.207**	0.160***	0.005**	0.002**	0.080**	0.089***
	0.005	0.007	0.007	0.008	0.006	0.008
	39.615	22.281	0.722	0.292	12.450	10.772
SIZE	1.227***	0.296***	0.961***	0.240**	0.993***	0.284**
	0.096	0.116	0.093	0.112	0.095	0.115
	12.781	2.560	10.357	2.135	10.481	2.470
REV	0.652***	0.950***	0.241**	0.406***	0.374***	0.659***
	0.090	0.086	0.087	0.086	0.089	0.087
	7.256	11.001	2.765	4.744	4.215	7.527
PROF	−0.075	0.032	−0.334***	−0.315**	−0.286***	0.117
	0.093	0.162	0.090	0.157	0.092	0.161
	−0.807	0.195	−3.708	−2.002	−3.107	0.726
ENVP			0.414***	0.338***		
			0.009	0.010		
			48.311	32.803		
ESGSCORE					0.293***	0.176***
					0.009	0.011
					32.278	16.681
R-squared	0.36	0.34	0.41	0.38	0.38	0.35
Adjusted R-squared	0.36	0.34	0.40	0.38	0.38	0.35
F-statistic	1760.038	929.129	1933.280	993.768	1748.765	883.185
Prob (F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000

countries that long board tenure may limit board members' ability to become more acquainted with better environmental performance and environmentally friendly products. Consistently, Setiany (2018) argues that the significant and negative relationship between board tenure and ESG performance confirms a long board tenure.

Furthermore, the results show that environmental teams have a statistically significant positive impact on EFP across the models in Asia and Europe. This confirms the earlier estimation, which leads to denote that the existence of environmental teams and a greater score of these environmental teams associate significantly and positively with higher levels of EFP. Firm size and revenues exhibit similar results compared to Table 5 findings. They exhibit significant and positive effects in Asia and Europe; however, profitability demonstrates a negative effect on EFP in the case of Asian corporates, but it is positive in respect of European corporates. Finally, the results reveal that both ESG and environmental pillars indicate a statistically significant positive impact on EFP in Asia and Europe, indicating that greater ESG and environmental performance lead to greater levels of EFP.

4.3.2. The moderating effect of environmental teams

The moderating effect of environmental teams on the relationship between board characteristics and EFP is investigated using four-panel fixed effect moderating models. While Model 5 investigates the

moderating effect of environmental teams on the relationship between board characteristics and EFP for the whole sample, Model 6 assesses the same moderating effect based on a country dummy effect. However, Model 7 and Model 8 examine this relationship with the consideration of ESG and environmental performance, respectively. The results are estimated based on the following models:

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BS_{it} * ENVTEAM_{it} + \beta_3 BI_{it} + \beta_4 BI_{it}$$
$$* ENVTEAM_{it} + \beta_5 BD_{it} + \beta_6 BD_{it} * ENVTEAM_{it} + \beta_7 BE_{it} + \beta_8 BE_{it}$$
$$* ENVTEAM_{it} + \beta_9 BDIV_{it} + \beta_{10} BDIV_{it} * ENVTEAM_{it} + \beta_{11} BT_{it}$$
$$+ \beta_{12} BT_{it} * ENVTEAM_{it} + \beta_{13} ENVTEAM_{it} + \beta_{14} SIZE_{it} + \beta_{15} REV_{it}$$
$$+ \beta_{16} PROF_{it} + \varepsilon_{it}$$

(Model 5)

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BS_{it} * ENVTEAM_{it} + \beta_3 BI_{it} + \beta_4 BI_{it}$$
$$* ENVTEAM_{it} + \beta_5 BD_{it} + \beta_6 BD_{it} * ENVTEAM_{it} + \beta_7 BE_{it} + \beta_8 BE_{it}$$
$$* ENVTEAM_{it} + \beta_9 BDIV_{it} + \beta_{10} BDIV_{it} * ENVTEAM_{it} + \beta_{11} BT_{it}$$
$$+ \beta_{12} BT_{it} * ENVTEAM_{it} + \beta_{13} ENVTEAM_{it} + \beta_{14} SIZE_{it} + \beta_{15} REV_{it}$$
$$+ \beta_{16} PROF_{it} + \beta_{17} CD_{it} + \varepsilon_{it}$$

(Model 6)

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BS_{it} * ENVTEAM_{it} + \beta_3 BI_{it} + \beta_4 BI_{it}$$
$$* ENVTEAM_{it} + \beta_5 BD_{it} + \beta_6 BD_{it} * ENVTEAM_{it} + \beta_7 BE_{it} + \beta_8 BE_{it}$$
$$* ENVTEAM_{it} + \beta_9 BDIV_{it} + \beta_{10} BDIV_{it} * ENVTEAM_{it} + \beta_{11} BT_{it}$$
$$+ \beta_{12} BT_{it} * ENVTEAM_{it} + \beta_{13} ENVTEAM_{it} + \beta_{14} SIZE_{it} + \beta_{15} REV_{it}$$
$$+ \beta_{16} PROF_{it} + \beta_{17} CD_{it} + \beta_{18} ESG_{it} + \varepsilon_{it}$$

(Model 7)

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BS_{it} * ENVTEAM_{it} + \beta_3 BI_{it} + \beta_4 BI_{it}$$
$$* ENVTEAM_{it} + \beta_5 BD_{it} + \beta_6 BD_{it} * ENVTEAM_{it} + \beta_7 BE_{it} + \beta_8 BE_{it}$$
$$* ENVTEAM_{it} + \beta_9 BDIV_{it} + \beta_{10} BDIV_{it} * ENVTEAM_{it} + \beta_{11} BT_{it}$$
$$+ \beta_{12} BT_{it} * ENVTEAM_{it} + \beta_{13} ENVTEAM_{it} + \beta_{14} SIZE_{it} + \beta_{15} REV_{it}$$
$$+ \beta_{16} PROF_{it} + \beta_{17} CD_{it} + \beta_{18} ENVP_{it} + \varepsilon_{it}$$

(Model 8)

Table 7 demonstrates the moderating effect of environmental teams on the relationship between board characteristics and environmental production. The results exhibit that environmental teams strengthen the relationship between board characteristics and EFP. This leads to accepting H8, which indicates that environmental teams' presence and higher score improve board effectiveness to attain higher EFP levels. The results are consistent with those of (Arayssi et al., 2020; Birindelli et al., 2018; Bravo and Reguera-Alvarado, 2019; Chams and García-Blandón, 2019; Imperiale et al., 2023; Kumari et al., 2022; Mahmood et al., 2018). They advocate that forming a sustainability committee or a specialized team or committee can enhance environmental disclosure and performance. According to Kumari et al. (2022), specialized sustainability committees foster environmental sensitivity culture throughout businesses, accelerating the process of critical decision-making and disseminating information to various stakeholders. Arayssi et al. (2020) consistently indicate that establishing an effective and efficient sustainability committee that supports the development of an effective board structure can help improve the urgency of corporate social involvement and disclosure.

Similarly, Kumari et al. (2022) advocate that the existence of a sustainability committee is strongly associated with the environmental disclosure score. As a result, the firm's environmental strategy will be developed and overseen by a dedicated sustainability committee, enhancing awareness and disclosure scores. Our findings also are in line with Hussain et al. (2018), who find that the sustainability committee has a significant positive impact on firms' environmental and social performance. Accordingly, in the presence of both ESG strengths and ESG concerns, sustainability committees increase disclosure Fatemi et al. (2018).

Thus, the firm must hire qualified executives to create a sustainability committee and ensure that this committee meets regularly so that agency problems do not take over and the board achieves its environmental strategies Kumari et al. (2022). The results show that all board characteristics and firms' specifics exhibit consistent findings compared to the earlier findings in the direct model of Table 5, except for profitability. Corporate profitability shows a statistically significant positive effect on environmental production. This signifies that with the moderating role of environmental teams, profitability changed to have a positive and significant impact on environmental production. This also denotes that environmental teams play a moderating role, indirectly affecting corporate profitability. Concerning the moderating role of environmental teams, the results show that environmental teams moderate positively and significantly the relationship between board size, independence, diversity, industry expertise, and board tenure on the one hand and EFP on the other. The interaction effect of environmental teams exhibits a statistically significant positive effect at the level of 1% (P value < 0.01) in the case of board size, independence, industry expertise, and board tenure; however, it shows a weak but positive interaction in the case of board diversity.

Table 7
The overall moderating role of environmental teams.

Variable	Model (5)	Model (6)	Model (7)	Model (8)
C	−55.615***	−58.758***	−42.957***	−50.580***
	1.431	1.493	1.449	1.481
	−38.854	−39.367	−29.653	−34.158
BS	0.630***	0.671***	0.174*	0.102
	0.102	0.102	0.098	0.102
	6.191	6.582	1.773	1.001
BS*ENVTEAM	0.057***	0.055***	0.067***	0.088***
	0.006	0.006	0.006	0.006
	8.709	8.415	10.749	13.642
BI	0.024**	0.029*	0.075***	0.104***
	0.017	0.017	0.016	0.017
	1.426	1.673	4.556	6.126
BI*ENVTEAM	0.002***	0.002***	0.002***	0.002***
	0.000	0.000	0.000	0.000
	8.422	8.669	9.200	9.873
BD	−0.073***	−0.076***	−0.062***	−0.042**
	0.021	0.021	0.020	0.020
	−3.518	−3.649	−3.103	−2.058
BD*ENVTEAM	−0.003***	−0.003***	−0.003***	−0.003***
	0.000	0.000	0.000	0.000
	−6.747	−6.915	−7.356	−6.689
BDIV	−0.043**	−0.044**	−0.064***	−0.087***
	0.018	0.018	0.018	0.018
	−2.323	−2.376	−3.624	−4.790
BDIV*ENVTEAM	0.002	0.003	0.002*	0.001**
	0.000	0.000	0.000	0.000
	1.633	1.603	1.837	2.429
BE	0.139***	0.136***	0.141***	0.137***
	0.014	0.014	0.013	0.014
	10.014	9.799	10.665	10.089
BE*ENVTEAM	0.001***	0.001***	0.001***	0.001***
	0.000	0.000	0.000	0.000
	6.474	6.289	6.528	6.732
BT	0.184***	0.178***	0.096***	0.113***
	0.015	0.015	0.014	0.015
	12.358	11.913	6.674	7.672
BT*ENVTEAM	0.003***	0.003***	0.002***	0.002***
	0.000	0.000	0.000	0.000
	13.490	13.129	7.936	9.281
ENVTEAM	0.213***	0.212***	0.036***	0.124***
	0.005	0.005	0.005	0.005
	44.573	44.358	6.730	23.937
SIZE	0.937***	0.844***	0.752***	0.799***
	0.070	0.071	0.068	0.070
	13.458	11.935	11.113	11.494
REV	1.694***	1.778***	1.330***	1.527***
	0.060	0.061	0.059	0.060
	28.226	29.124	22.593	25.298
PROF	0.582***	0.645***	0.437***	0.540***
	0.083	0.083	0.080	0.082
	7.019	7.745	5.477	6.594
ENVP		1.750***	−0.176	0.300
		0.237	0.229	0.236
		7.384	−0.769	1.274
ESGSCORE			0.515***	0.423***
			0.008	0.010
			66.445	41.068
R-squared	0.33	0.32	0.381	0.35
Adjusted R-squared	0.32	0.32	0.380	0.34
F-statistic	1450.495	1369.885	1656.689	1432.398
Prob (F-statistic)	0.000	0.000	0.000	0.000

This indicates that environmental teams moderate the relationship between board characteristics and environmental production positively and significantly. This also signifies that the existence and the greater score of corporates' environmental teams enhance board effectiveness and board role towards EFP. The findings in Table 8 present the moderating effect of environmental teams on the relationship between board characteristics and environmental production in Asia and Europe. The results reveal that the moderating role of environmental teams in the case of European corporates exhibits a greater interaction effect with board characteristics than in the case of Asian corporates. While it is

Table 8
The moderating role of environmental teams – Asia and Europe.

Variables	Asia			Europe		
	Model (5)	Model (7)	Model (8)	Model (5)	Model (7)	Model (8)
C	−58.214***	−44.274***	−49.431***	−55.080***	−41.356***	−50.231***
	1.813	1.750	1.785	2.381	2.305	2.367
	−32.108	−25.304	−27.689	−23.135	−17.939	−21.220
BS	1.091***	0.182**	0.327**	0.043***	1.167***	1.018***
	0.129	0.124	0.127	0.171	0.166	0.176
	8.472	1.465	2.566	0.250	7.033	5.789
BS*ENVTEAM	0.020**	0.044**	0.053**	0.111***	0.119***	0.151***
	0.008	0.008	0.008	0.011	0.010	0.011
	2.419	5.554	6.549	10.282	11.536	13.921
BI	0.016**	0.055**	0.086***	0.039***	0.082***	0.116***
	0.021	0.020	0.021	0.029	0.028	0.029
	0.755	2.761	4.168	1.335	2.901	3.955
BI*ENVTEAM	0.002**	0.002***	0.002**	0.003***	0.003***	0.004***
	0.000	0.000	0.000	0.000	0.000	0.000
	5.389	5.832	5.628	7.105	6.748	8.087
BD	−0.066**	−0.058**	−0.006	0.030*	−0.008	0.029**
	0.024	0.023	0.023	0.040	0.039	0.040
	−2.738	−2.555	−0.238	0.740	−0.210	0.724
BD*ENVTEAM	−0.004*	−0.004***	−0.003*	0.001**	0.001	0.001**
	0.001	0.000	0.001	0.001	0.001	0.001
	−7.181	−7.917	−6.134	0.908	0.478	1.458
BDIV	−0.004	0.012	−0.043*	0.127***	0.198***	0.174***
	0.024	0.022	0.023	0.029	0.028	0.029
	−0.185	0.550	−1.881	4.316	7.003	5.947
BDIV*ENVTEAM	−0.001	−0.001*	−0.002	0.002***	0.003***	0.003***
	0.000	0.000	0.000	0.000	0.000	0.000
	−1.629	−2.406	−1.218	5.565	6.792	6.317
BE	0.089***	0.119***	0.112***	0.208***	0.177***	0.185***
	0.017	0.016	0.017	0.024	0.023	0.023
	5.198	7.334	6.703	8.807	7.813	7.907
BE*ENVTEAM	0.001**	0.001**	0.001**	0.003***	0.002***	0.002***
	0.000	0.000	0.000	0.000	0.000	0.000
	2.379	3.880	3.755	6.891	5.624	6.333
BT	0.199***	0.113***	0.120***	0.137***	0.086***	0.106***
	0.018	0.017	0.018	0.027	0.025	0.026
	11.136	6.610	6.825	5.160	3.367	4.019
BT*ENVTEAM	0.004**	0.002***	0.003***	0.002***	0.001**	0.001***
	0.000	0.000	0.000	0.000	0.000	0.000
	13.339	8.541	9.389	4.027	2.589	3.046
ENVTEAM	0.226***	0.020***	0.103***	0.182***	0.046***	0.132***
	0.006	0.007	0.007	0.008	0.009	0.008
	38.462	2.907	15.637	22.227	5.395	15.624
SIZE	1.491***	1.287***	1.322**	0.285***	0.186***	0.244***
	0.098	0.094	0.096	0.118	0.113	0.117
	15.199	13.726	13.781	2.413	1.639	2.083
REV	1.283***	0.910***	1.069***	1.982***	1.575***	1.793***
	0.091	0.088	0.089492	0.087	0.084	0.087
	14.029	10.390	11.94356	22.677	18.692	20.624
PROF	−0.575***	0.380***	−0.415***	0.914***	0.622***	0.833***
	0.095	0.091	0.093	0.165	0.158	0.163
	−6.038	4.176	−4.457	5.528	3.924	5.097
ENVP		0.530***			0.541***	
		0.010			0.014	
		54.707			40.059	
ESGSCORE			0.492***			0.368***
			0.013			0.018
			38.659			19.920
R-squared	0.38	0.40	0.368	0.32	0.37	0.33
Adjusted R-squared	0.37	0.39	0.367	0.31	0.37	0.33
F-statistic	979.446	1187.339	1054.404	513.341	621.316	517.289
Prob (F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000

statistically significant at the level of 1% (P-Value <0.01) in the case of European corporates, it has a variation in its significance level in the case of Asian corporates. It shows a moderation effect at the level of 1% with board size, independence, industry expertise, and tenure in the case of European corporates. However, for Asian corporates, it demonstrates a moderating effect with board size, independence, industry expertise, and tenure at the level of 5% in the majority of the cases.

The results also show that environmental teams have improved the effect of board meetings to be positive and significant in the majority of the cases of European corporates; however, no significant moderating effect is observed in the case of Asian corporates.

Similarly, the results indicate that the interaction effect of environmental teams in European corporates moderates significantly and positively the relationship between board diversity and EFP, but this moderating effect is reported to be weak in the case of Asian corporates. Notably, in the context of the moderating effect of environmental teams, all firm specifics exhibit a significant positive effect on EFP in the case of European corporates; however, this was not the case for Asian

corporates. Finally, ESG and environmental performance show a statistically significant effect on EFP in the context of the moderating effect of environmental teams. This denotes that environmental teams enhance the relationship between ESG and environmental performance on the one hand and environmental production on the other.

4.3.3. Endogeneity concerns and additional analyses

4.3.3.1. Lead-lag approach. Guest (2008) indicated that endogeneity problems might arise when firm-specific indicators are influenced by board structure. Further, endogeneity problems occur when both board structure and firm-specific indicators are jointly investigated by unobservable heterogeneity. Nadarajah et al. (2018) indicated that CG variables might have possible endogeneity issues with leverage. In order to address this issue, the current study follows (Dhaliwal et al., 2011; Christensen, 2016) and re-estimates the direct effect models in an instrumental variables framework by using lagged values of the independent variables. The results in Table 9 show that some variables have a slightly lower or higher significance level, but the direction (sign) and relative significance have not changed. As a result, we concluded that endogeneity does not affect the findings of our study (Ioannou and Serafeim, 2017; Chiu and Wang, 2015; Reverte, 2009). This indicates that the findings of the main analysis of the direct models in Table 5 are consistent with those of the lead-lagged approach models. Interestingly, these results are also in line with the findings of the moderating effect presented in Table 7.

4.3.3.2. Two-stage least squares (2SLS) approach. In addition to the lead-lagged approach for addressing endogeneity problems, we also re-analyze the same using various tools, including 2SLS (Christensen, 2016). Several other studies have also used 2SLS regressions to tackle endogeneity problems (e.g., AL-Qadasi et al., 2018; Cairney and Stewart, 2019). Guest (2008) highlighted that another endogeneity problem that might arise is reverse causality, whereby firm-specific explanatory variables are determined by board structure rather than vice versa. This study uses the following equation to address this endogeneity issue:

Table 9
Endogeneity tests.

Variable/Test	Robust	Fixed	2SLS	Lagged fixed
C	−117.761***	−2.107***	−65.593***	−10.508***
	6.310	3.002	2.202	3.124
BS	0.652***	1.072***	1.533***	0.395***
	0.094	0.052	0.055	0.047
BI	0.096***	0.149***	0.094***	0.032***
	0.013	0.005	0.006	0.006
BD	−0.058***	0.030***	−0.079***	−0.016***
	0.009	0.004	0.004	0.003
BDIV	−0.249	0.050**	−0.045*	−0.035***
	0.017	0.007	0.007	0.006
BE	0.082***	0.052***	0.045***	0.008**
	0.012	0.004	0.006	0.004
BT	1.717**	0.084***	0.018***	0.043***
	0.726	0.007	0.006	0.006
ENVTEAM	0.162***	0.091***	1.190***	0.031***
	0.010	0.005	0.295	0.005
SIZE	2.597***	0.364**	0.706***	0.759***
	0.325	0.135	0.088	0.141
REV	3.851***	0.135	1.988***	0.308***
	0.312	0.094	0.087	0.098
PROF	−0.150	0.069	0.711***	0.161
	0.366	0.099	0.090	0.103
R-squared	0.20	0.84		0.83
Adjusted R-squared	0.20	0.80		0.79
Prob (Rn-squared stat.)	0.00	0.00		0.00
Wald chi2 (11)			21328.10	
R-squared			0.28	
Root MSE			25.21	
Prob > chi2			0.00	

$$EnvProd_{it} = \beta_0 + \beta_1 y_{it} + \beta_2 Z_{it} + \varepsilon_{it} \tag{4}$$

A 2SLS regression model consisting of five steps is conducted in which firms' specifics (y_{it} = $FSIZE_{it}$, REV_{it}, and $PROF_{it}$) are treated as endogenous variables and treat board characteristics variables (Z_{it} = $BSIZE_{it}$, $BIND_{it}$, $BMEET_{it}$, $BDIV_{it}$, $BSKIL_{it}$, $BTENUR_{it}$, and $ENVTeam_{it}$) as exogenous variables. The lagged variables of the dependent variables and the fitted values of the main models are used as instrumental variables, where $y_{it} = \pi_0 + \pi_1 Z_{it} + v$. The findings yielded from the 2SLS model are robust and consistent with the findings of the main models. This implies that our analysis of the direct and moderating effects is robust, and no endogeneity problems are associated with our estimation. The outcomes presented in Table 9 demonstrated robust and consistent findings, concluding identical results across the estimated models.

4.3.3.3. Firm fixed effects approach. Hamed et al. (2022) indicate that a firm fixed effect approach can be opted to control for endogeneity problems and mitigate the issues of some persistent, correlated omitted variables. Therefore, we estimate the main model controlling for firm fixed effects as another step to control for endogeneity issues. Table 6 demonstrates identical and robust results using firm fixed effects. This is indicated by the significance level of the variables and the coefficients, which remain consistent across the models. Hence, our results are consistent with the main findings provided in Table 5.

4.3.3.4. Robustness test. Table 9 shows that, except for some variations in the significance power, all variables exhibit similar findings to the results presented in the main models in Table 5. Importantly, the coefficients and standard error values are not significantly inflated or deflated. Overall, the regression results are robust and consistent with the earlier models' findings (Hamed et al., 2022).

4.3.4. Additional analysis - subsample tests on environmental and non-environmental teams

We conduct additional analysis to validate the findings provided in the direct effect model and investigate whether those outcomes hold when splitting the sample into different groups. Following Hamed et al. (2022), the main sample is divided into two sub-samples. Accordingly, in this test, we divided the dependent variable into two categories: companies with environmental production, which assigned the value of "1" and "0" otherwise. Further, we divided the moderating variables of environmental teams into two categories "1" for companies with environmental teams and "0" otherwise. The following models are estimated:

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it}$$
$$+ \beta_7 ENVTEAM_{it} + \beta_8 SIZE_{it} + \beta_9 REV_{it}$$
$$+ \beta_{10} PROF_{it} + \beta_{11} CD_{it} + \beta_{12} ENVPDummy_{it} + \varepsilon_{it}$$
$$\text{(Model 9)}$$

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it}$$
$$+ \beta_7 ENVTEAMDummy_{it} + \beta_8 SIZE_{it} + \beta_9 REV_{it}$$
$$+ \beta_{10} PROF_{it} + \beta_{11} CD_{it} + \varepsilon_{it}$$
$$\text{(Model 10)}$$

$$EFP_{it} = \alpha + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BD_{it} + \beta_4 BE_{it} + \beta_5 BDIV_{it} + \beta_6 BT_{it}$$
$$+ \beta_7 SIZE_{it} + \beta_8 REV_{it} + \beta_9 PROF_{it} + \beta_{10} CD_{it} + \varepsilon_{it}$$
$$\text{(Model 11)}$$

The results in Table 10 reveal consistent and similar outcomes provided in the main models. Importantly, the environmental products dummy and environmental teams dummy show a significant positive effect. This indicates that companies that have environmental

Table 10
Additional tests with sub-samples.

Variable/ Model	Env. Products dummy	Env. Teams dummy	No env. Teams	With env. Teams
	Model (9)	Model (10)	Model (11)	Model (11)
C	−12.790***	−0.666***	−26.274***	−87.499***
	1.165	0.152	1.351	6.699
BS	0.378***	1.765***	1.515***	1.392***
	0.035	0.029	0.049	0.097
BI	0.025***	0.112***	−0.096***	0.157***
	0.005	0.004	0.007	0.014
BD	−0.048***	−0.083***	−0.015***	−0.044***
	0.003	0.002	0.004	0.009
BDIV	−0.013**	−0.043***	−0.006	0.026*
	0.005	0.004	0.007	0.014
BE	0.071***	0.070***	0.049***	0.127***
	0.004	0.004	0.006	0.012
BT	0.015***	0.018***	−0.021***	0.022**
	0.005	0.003	0.006	0.013
ENVTEAM Dummy	0.086***	49.460***		
	0.003	2.341		
SIZE	0.372***	0.016***	−0.557***	3.338***
	0.056	0.004	0.064	0.368
REV	0.427***	0.021***	0.785***	2.868***
	0.049	0.005	0.055	0.341
PROF	−0.109*	−0.002	−0.016*	1.648***
	0.066	0.003	0.076	0.357
CD	0.688***	0.017	1.453***	1.602**
	0.187	0.013	0.227	0.752
ENVP Dummy	48.572***			
	0.301			
R-squared	0.60	0.58	0.22	0.22
Adjusted R-squared	0.57	0.55	0.21	0.21
F-statistic	5573.589	5091.182	1113.452	232.960
Prob (F-statistic)	0.000	0.000	0.000	0.000

production and environmental teams are better than other companies that do not have.

5. Discussion and implications

The findings show that board characteristics are related to the level of EFP. This is supported by the background of the multi-theory underpinning such as signaling theory (Friske et al., 2022; Siddique et al., 2021; Wong and Zhang, 2022), voluntary disclosure theory (Shaukat et al., 2016), institutional theory (Geerts et al., 2021), agency theory (Huang, 2011; Kumari et al., 2022), and stakeholders' theory (Pérez-Calderón et al., 2012). This also has its implication for theory based on (Suddaby, 2014; Whetten, 1989). Our investigation helps theory developers and practitioners evaluate the trade-off between frugality and completeness. We attempted to ensure that what passes for these theories includes a plausible explanation for why certain associations in our data should be expected (Suddaby, 2014). Further, the present study's findings provided evidence of some variations in the effect of board characteristics on the level of EFP from European to Asian countries. These variations arise from these companies' governance practices and ESG and environmental disclosure practices. This is also supported by legitimacy theory (Agnese et al., 2022; Holland and Foo, 2003; Husted and Sousa-Filho, 2017; Ortas et al., 2015), voluntary disclosure theory (Fontana et al., 2015; Holland and Foo, 2003; Imperiale et al., 2023), and stakeholders' theory (Aksoy et al., 2020; Baalouch et al., 2019; Geerts et al., 2021; Gerged et al., 2020, 2021; Mohammad and Wasiuzzaman, 2021; Pérez-Calderón et al., 2012; Qureshi et al., 2020). Based on the findings, policy interventions need to consider the alignment of governance effectiveness with corporates' environmental performance. This could be based on the legitimacy of companies disclosing sustainability information to stakeholders to reaffirm an organization's commitment to society (Behl et al., 2021).

Companies are the main source of environmental pollution. Thus, environmental legitimacy pressure should be exercised by various stakeholders (Boutry and Nadel, 2020). Accordingly, the engagement of relevant stakeholders is necessary to foster a constructive environment that may lead to continuous improvements in ESG disclosures (Camilleri, 2015). Further, the broad adoption of environmental sustainability will positively impact society (Green et al., 2012). Policymakers may enact and improve corporate governance regulations to enhance EFP levels. In particular, certain board characteristics such as larger board size, a greater proportion of board independence, the existence of industry expertise in the board, greater board gender diversity, and the existence of environmental teams are more likely to contribute to higher EFP and ESG levels. Accordingly, regulations in this regard should be encouraged and enforced. The empirical findings of the current study open useful insights for policymakers and corporates' board members to strengthen corporate boards' practices and strategies. Accordingly, firms can benefit from the construction of strong and efficient environmental teams or sustainability committees. Such teams or committees can effectively enhance board effectiveness and oversight function. In the presence of both ESG strengths and ESG concerns, environmental teams or sustainability committees could increase the disclosure levels and attain EFP and green initiatives (Fatemi et al., 2018).

6. Conclusion

The present study investigates the impact of board characteristics on EFP. It also examines the moderating effect of environmental teams on the relationship between board characteristics and EFP. The current research relies on secondary data extracted from the Refinitiv Eikon database. Our study offers empirical evidence based on a cross-country study of 8094 companies from 2 continents, Asia and Europe, from 2016 to 2021. This period is particularly important, which could be affected by several international initiatives related to climate change like the "Kyoto Protocol, International Carbon Action Partnership, and Paris Agreement." The investigation of this issue may help the international community to control climate change and the overall sustainable development goals of the United Nations. We propose and assess a comprehensive EFP collaboration that is based on firms' governance levels. This is crucial because overall sustainability and the achievement of SDGs are built based on a complementary approach and collaboration from all stakeholders. The extent to which a corporation has EFP is functioned by three categories: independent, moderating, and control variables. The first category of independent variables includes board categories in which board size, independence, diligence, expertise, diversity, and tenure are comprised. The second category comprises the moderating variable; environmental teams. Finally, the third category consists of firm specifics as control variables: size, revenue growth, and profitability.

The findings indicate that board characteristics associate positively and significantly with the level of EFP. The results reveal that a larger board size, a greater proportion of board independence, and the existence of industry expertise on the board have a significant and positive influence on the level of EFP. In the same context, the results demonstrate that board diversity correlates positively and significantly with EFP. However, the influence of board diversity in European corporates is significant and positive but negative in Asian corporates. Similarly, the findings also find that while board tenure has a significant positive impact on EFP in European corporates, it has a negative effect on EFP in Asian corporates. Importantly, the findings report that environmental teams have a statistically significant positive impact on the level of EFP across Asian and European corporates. Moreover, the results reveal that a corporate's ESG and environmental performance have a statistically significant positive impact on the level of EFP in Asia and Europe, implying that higher levels of ESG and environmental performance lead to higher levels of EFP.

Concerning the moderating role of environmental teams, the findings

indicate that the existence and the higher score of environmental teams have a significant and positive moderating influence on the relationship between EFP and board characteristics. This indicates that greater board size, a higher proportion of board independence, greater board diversity, a higher percentage of board industry expertise, and long board tenure. The interaction effect of environmental teams reveals a statistically significant positive influence on board size, independence, industry expertise, and board tenure. However, it has a weak positive interaction with board diversity. This suggests that environmental teams moderate the relationship between board characteristics and environmental products positively and significantly. This also implies that the existence and higher scores of corporate environmental teams improve the board's effectiveness and role in attaining higher levels of EFP. Importantly, the findings show that the moderating role of environmental teams in European corporates has a greater interaction effect with board characteristics than it is in Asian corporates.

As a result, the current study adds to the strand literature in several ways. It contributes to the empirical literature on EFP and board characteristics in developed and developing countries. This study examines how specific board characteristics may contribute to EFP in both developed and developing countries. Prior research on environmental and sustainability issues conducted in developed countries may be less relevant for emerging countries. We empirically respond to several calls for EFP studies from prior research that there is a need to investigate the determinants of EFP (Felix et al., 2022; Moser, 2016; Roozen, 1997; Shim et al., 2018). Unlike previous studies, the current study assessed the influence of environmental teams on the relationship between board characteristics and EFP. Further, a unique contribution of this study is that it investigates the effect of board characteristics on EFP, considering the level of ESG and environmental performance. The study proposed that corporates with high ESG and environmental performance have better levels of EFP.

This study has some limitations that shed light on possible future research directions. First, the study investigates a sample comprised of Asian and European countries. A comparison between Asian and European countries was conducted. However, prior studies may control for the differences between developed and developing countries in this regard. Further, future studies may extend the sample to include other regions or countries like America and others. Second, the study is limited to board characteristics. Therefore, it is suggested that future studies consider other governance characteristics, including the audit committee, auditing assurance, ownership structure, and other characteristics. Finally, the current study is also limited to firms' specific variables; hence, another possible stream of research for future studies is the consideration of the cultural differences based on Hofstede's cultural dimensions (1984) or country-level governance of the World Bank.

Credit author statement

Faozi A. Almaqtari: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Writing – original draft, Writing – review & editing; Tamer Alshikh: Data curation, Visualization, Writing – review & editing; Hamood Mohammed Al-Hattami: Conceptualization, Formal analysis, Investigation, Resources, Validation, Writing – original draft, Writing – review & editing; Nanditia Mishra: Investigation, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

Abdi, Y., Li, X., Càmara-Turull, X., 2020. Impact of sustainability on firm value and financial performance in the air transport industry. Sustainability 12 (23), 1–22. https://doi.org/10.3390/su12239957.

Agnese, P., Battaglia, F., Busato, F., Taddeo, S., 2022. ESG controversies and governance: evidence from the banking industry. Finance Res. Lett. October, 103397 https://doi.org/10.1016/j.frl.2022.103397.

Agyemang, A.O., Yusheng, K., Ayamba, E.C., Twum, A.K., Chengpeng, Z., Shaibu, A., 2020. Impact of board characteristics on environmental disclosures for listed mining companies in China. Environ. Sci. Pollut. Control Ser. 27 (17), 21188–21201. https://doi.org/10.1007/s11356-020-08599-2.

Aksoy, M., Yilmaz, M.K., Tatoglu, E., Basar, M., 2020. Antecedents of corporate sustainability performance in Turkey: the effects of ownership structure and board attributes on non-financial companies. J. Clean. Prod. 276 (124284), 1–11. https://doi.org/10.1016/j.jclepro.2020.124284.

Al-Bassam, W.M., Ntim, C.G., Opong, K.K., Downs, Y., 2015. Corporate boards and ownership structure as antecedents of corporate governance disclosure in Saudi. Arabian Publicly Listed Corporates 57 (2), 335–377. https://doi.org/10.1177/0007650315610611.

Aliyu, U.S., 2019. Board characteristic and corporate environmental reporting in Nigeria. Asian Journal of Accounting Research 4 (1), 2–17. https://doi.org/10.1108/AJAR-09-2018-0030.

Almaqtari, F.A., Elsheikh, T., Tawfik, O.I., Abd, El-Aziz, Mayada, Y., 2022a. Exploring the impact of sustainability, board characteristics, and firm-specifics on firm value: a comparative study of the United Kingdom and Turkey. Sustainability 14 (24), 16395. https://doi.org/10.3390/su142416395.

Almaqtari, F.A., Farhan, N.H.S., Al-Hattami, H.M., Elsheikh, T., 2022b. The moderation role of board independence change in the relationship between board characteristics, related party transactions, and financial performance. PLoS One 17 (12), e0279159. https://doi.org/10.1371/JOURNAL.PONE.0279159.

AL-Qadasi, A.A., Abidin, S., Al-Jaifi, H.A., 2018. The puzzle of internal audit function budget toward specialist auditor choice and audit fees: does family ownership matter? Malaysian evidence. Manag. Audit J. 34 (2), 208–243.

Alrashidi, R., Baboukardos, D., Arun, T., 2021. Audit fees, non-audit fees and access to finance: evidence from India. J. Int. Account. Audit. Taxat. 43 https://doi.org/10.1016/J.INTACCAUDTAX.2021.100397.

Alsayegh, M.F., Rahman, R.A., Homayoun, S., 2020. Corporate economic, environmental, and social sustainability performance transformation through ESG disclosure. Sustainability 12 (9). https://doi.org/10.3390/su12093910.

Al-Shaer, H., Zaman, M., 2016. Board gender diversity and sustainability reporting quality. J. Contemp. Account. Econ. 12 (3), 210–222. https://doi.org/10.1016/J.JCAE.2016.09.001.

Ammer, M.A., Aliedan, M.M., Alyahya, M.A., 2020. Do corporate environmental sustainability practices influence firm value? The role of independent directors: evidence from Saudi Arabia. Sustainability 12 (22), 1–21. https://doi.org/10.3390/su12229768.

Arayssi, M., Jizi, M., Tabaja, H.H., 2020. The impact of board composition on the level of ESG disclosures in GCC countries. Sustainability Accounting, Management and Policy Journal 11 (1), 137–161. https://doi.org/10.1108/SAMPJ-05-2018-0136.

Baalouch, F., Ayadi, S.D., Hussainey, K., 2019. A study of the determinants of environmental disclosure quality: evidence from French listed companies. J. Manag. Govern. 23 (Issue 4) https://doi.org/10.1007/s10997-019-09474-0. Springer US.

Behl, A., Kumari, P.S.R., Makhija, H., Sharma, D., 2021. Exploring the relationship of ESG score and firm value using cross-lagged panel analyses: case of the Indian energy sector. Ann. Oper. Res. 313 (1), 231–256. https://doi.org/10.1007/s10479-021-04189-8.

Ben-Amar, W., Chang, M., McIlkenny, P., 2017. Board gender diversity and corporate response to sustainability initiatives: evidence from the carbon disclosure project. J. Bus. Ethics 142 (2), 369–383. https://doi.org/10.1007/S10551-015-2759-1/TABLES/7.

Bepari, M.K., Mollik, A.T., 2015. Effect of audit quality and accounting and finance backgrounds of audit committee members on firms' compliance with IFRS for goodwill impairment testing. J. Appl. Account. Res. 16 (2), 196–220. https://doi.org/10.1108/JAAR-05-2013-0038.

Biçer, A.A., Feneir, I.M., 2019. The impact of audit committee characteristics on environmental and social disclosures: evidence from Turkey. International Journal of Research in Business and Social Science 8 (3), 111–121. https://doi.org/10.20525/ijrbs.v8i3.262, 2147-4478.

Birindelli, G., Dell'Atti, S., Iannuzzi, A.P., Savioli, M., 2018. Composition and activity of the board of directors: impact on ESG performance in the banking system. Sustainability 10 (12), 1–20. https://doi.org/10.3390/su10124699.

Boutry, O., Nadel, S., 2020. Institutional drivers of environmental innovation: evidence from French industrial firms. Journal of Innovation Economics Management. https://doi.org/10.3917/jie.034.0135, 183-133.

Bøhren, Ø., Staubo, S., 2014. Does mandatory gender balance work? Changing organizational form to avoid board upheaval. J. Corp. Finance 28, 152–168. https://doi.org/10.1016/j.jcorpfin.2013.12.005.

Bravo, F., Reguera-Alvarado, N., 2019. Sustainable development disclosure: environmental, social, and governance reporting and gender diversity in the audit

committee. Bus. Strat. Environ. 28 (2), 418–429. https://doi.org/10.1002/BSE.2258.

Cairney, T., Stewart, E.G., 2019. Client industry characteristics and auditor changes. Rev. Account. Finance 18 (2), 245–267. https://doi.org/10.1108/RAF-01-2017-0017.

Camilleri, M.A., 2015. Environmental, social and governance disclosures in Europe. Sustainability Accounting, Management and Policy Journal 6 (2), 224–242. https://doi.org/10.1108/SAMPJ-10-2014-0065.

Campanella, F., Serino, L., Crisci, A., D'Ambra, A., 2021. The role of corporate governance in environmental policy disclosure and sustainable development. Generalized estimating equations in longitudinal count data analysis. Corp. Soc. Responsib. Environ. Manag. 28 (1), 474–484.

Chams, N., García-Blandón, J., 2019. Sustainable or not sustainable? The role of the board of directors. J. Clean. Prod. 226, 1067–1081. https://doi.org/10.1016/j.jclepro.2019.04.118.

Chang, H.Y., Liang, L.W., Liu, Y.L., 2021. Using environmental, social, governance (ESG) and financial indicators to measure bank cost efficiency in Asia. Sustainability 13 (20), 11139.

Cheah, I., Phau, I., 2011. Attitudes towards environmentally friendly products: the influence of ecoliteracy, interpersonal influence and value orientation. Market. Intell. Plann. 29 (5), 452–472. https://doi.org/10.1108/02634501111153674/FULL/PDF.

Chen, H.-M., Kuo, T.-C., Chen, J.-L., 2022. Impacts on the ESG and financial performances of companies in the manufacturing industry based on the climate change related risks. J. Clean. Prod. 380 (P1), 134951 https://doi.org/10.1016/j.jclepro.2022.134951.

Cheng, E.C.M., Courtenay, S.M., 2006. Board composition, regulatory regime and voluntary disclosure. Int. J. Account. 41 (3), 262–289. https://doi.org/10.1016/j.intacc.2006.07.001.

Chiu, T.K., Wang, Y.H., 2015. Determinants of social disclosure quality in Taiwan: an application of stakeholder theory. J. Bus. Ethics 129 (2), 379–398.

Christensen, D.M., 2016. Corporate accountability reporting and high-profile misconduct. Account. Rev. 91 (2), 377–399. https://doi.org/10.2308/accr-51200.

Corvino, A., Doni, F., Bianchi Martini, S., 2020. Corporate governance, integrated reporting and environmental disclosure: evidence from the South African context. Sustainability 12 (12), 4820.

Cremona, B.M., Passador, M.L., 2019. What about the future of European Banks? Board characteristics and ESG impact. Securit. Regul. Law J. 47 (4), 319–364.

Cucari, N., Esposito De Falco, S., Orlando, B., 2018. Diversity of board of directors and environmental social governance: evidence from Italian listed companies. Corp. Soc. Responsib. Environ. Manag. 25 (3), 250–266. https://doi.org/10.1002/CSR.1452.

De Villiers, C., Naiker, V., Van Staden, C.J., 2011. The effect of board characteristics on firm environmental performance. J. Manag. 37 (6), 1636–1663. https://doi.org/10.1177/0149206311411506.

Deschênes, S., Rojas, M., Boubacar, H., Prud'homme, B., Ouedraogo, A., 2015. The impact of board traits on the social performance of Canadian firms. Corp. Govern. 15 (3), 293–305. https://doi.org/10.1108/CG-08-2014-0097.

Deswanto, R.B., Siregar, S.V., 2018. The associations between environmental disclosures with financial performance, environmental performance, and firm value. Soc. Responsib. J. 14 (1), 180–193. https://doi.org/10.1108/SRJ-01-2017-0005.

Dhaliwal, D.S., Li, O.Z., Tsang, A., Yang, Y.G., 2011. Voluntary nonfinancial disclosure and the cost of equity capital: the initiation of corporate social responsibility reporting. Account. Rev. 86 (1), 59–100.

Ding, H., He, M., Deng, C., 2014. Lifecycle approach to assessing environmental friendly product project with internalizing environmental externality. J. Clean. Prod. 66, 128–138. https://doi.org/10.1016/J.JCLEPRO.2013.10.018.

Disli, M., Yilmaz, M.K., Mohamed, F.F.M., 2022. Board characteristics and sustainability performance: empirical evidence from emerging markets. Sustainability Accounting, Management and Policy Journal 13 (4), 929–952. https://doi.org/10.1108/SAMPJ-09-2020-0313.

Dixon-Fowler, H.R., Ellstrand, A.E., Johnson, J.L., 2017. The role of board environmental committees in corporate environmental performance. J. Bus. Ethics 140 (3), 423–438.

Elsheikh, T., Hashim, H.A., Mohamad, N.R., Almaqtari, F.A., Ettish, A.A., 2022a. CEO facial masculinity, characteristics and earnings management. Management and Accounting Review 21 (3), 253–282. https://doi.org/10.24191/MAR.V21I03-11.

Elsheikh, T., Hashim, H.A., Mohamad, N.R., Hussainey, K., Almaqtari, F.A., . The moderating role of CEO race on the relationship between CEO masculinity and company financial performance. Int. J. IJBGE 1 (1), 1. https://doi.org/10.1504/IJBGE.2022.10050891.

Escrig-Olmedo, E., Rivera-Lirio, J.M., Muñoz-Torres, M.J., Fernández-Izquierdo, M.Á., 2017. Integrating multiple ESG investors' preferences into sustainable investment: a fuzzy multicriteria methodological approach. J. Clean. Prod. 162, 1334–1345. https://doi.org/10.1016/j.jclepro.2017.06.143.

Ezhilarasi, G., 2019. Does corporate governance index impact on environmental disclosure? Evidence from India. Int. J. Corp. Govern. 10 (3–4), 275–310. https://doi.org/10.1504/IJCG.2019.103228.

Fargnoli, M., Costantino, F., Di Gravio, G., Tronci, M., 2018. Product service-systems implementation: a customized framework to enhance sustainability and customer satisfaction. J. Clean. Prod. 188, 387–401.

Fargnoli, M., Costantino, F., Tronci, M., Bisillo, S., 2013. Ecological profile of industrial products over the environmental compliance. Int. J. Sustain. Eng. 6 (2), 117–130.

Farza, K., Ftiti, Z., Hlioui, Z., Louhichi, W., Omri, A., 2022. The Effect of Corporate Board Characteristics on Environmental Innovation. Environmental Modeling & Assessment, pp. 1–22. https://doi.org/10.1007/s10666-022-09836-3.

Fatemi, A., Glaum, M., Kaiser, S., 2018. ESG performance and firm value: the moderating role of disclosure. Global Finance J. 38 (November), 45–64. https://doi.org/10.1016/j.gfj.2017.03.001.

Felix, R., González, E.M., Castaño, R., Carrete, L., Gretz, R.T., 2022. When the green in green packaging backfires: gender effects and perceived masculinity of environmentally friendly products. Int. J. Consum. Stud. 46 (3), 925–943. https://doi.org/10.1111/IJCS.12738.

Fontana, S., D'Amico, E., Coluccia, D., Solimene, S., 2015. Does environmental performance affect companies' environmental disclosure? Measuring Business Excellence 19 (3), 42–57. https://doi.org/10.1108/MBE-04-2015-0019.

Friske, W., Hoelscher, S.A., Nik, A., 2022. The impact of voluntary sustainability reporting on firm value : insights from signaling theory. J. Acad. Market. Sci., 0123456789 https://doi.org/10.1007/s11747-022-00879-2.

García Martín, C.J., Herrero, B., 2020. Do board characteristics affect environmental performance? A study of EU firms. Corp. Soc. Responsib. Environ. Manag. 27 (1), 74–94. https://doi.org/10.1002/csr.1775.

Garcia, A.S., Mendes-Da-Silva, W., Orsato, R., 2017. Sensitive industries produce better ESG performance: evidence from emerging markets. J. Clean. Prod. 150, 135–147. https://doi.org/10.1016/j.jclepro.2017.02.180.

Geerts, M., Dooms, M., Stas, L., 2021. Determinants of sustainability reporting in the present institutional context: the case of port managing bodies. Sustainability 13 (6), 3148. https://doi.org/10.3390/SU13063148, 2021, Vol. 13, Page 3148.

Gerged, A.M., Albitar, K., Al-Haddad, L., 2021a. Corporate environmental disclosure and earnings management—the moderating role of corporate governance structures. Int. J. Finance Econ. 1–22. https://doi.org/10.1002/ijfe.2564. December 2020.

Gerged, A.M., Al-Haddad, L.M., Al-Hajri, M.O., 2020. Is earnings management associated with corporate environmental disclosure?: evidence from Kuwaiti listed firms. Account. Res. J. 33 (1), 167–185. https://doi.org/10.1108/ARJ-05-2018-0082.

Gerged, A.M., Beddewela, E.S., Cowton, C.J., 2021b. Does the quality of country-level governance have an impact on corporate environmental disclosure? Evidence from Gulf Cooperation Council countries. Int. J. Finance Econ. 1–22. https://doi.org/10.1002/ijfe.2469.

Ghodrati, B., Al-Chalabi, H., Hoseinie, H., 2016. Environment–Friendly manufacturing and support—issues and challenges. In: Application of Materials Science and Environmental Materials (AMSEM2015) Proceedings of the 3rd International Conference, pp. 157–163.

Green, K.W., Zelbst, P.J., Bhadauria, V.S., Meacham, J., 2012. Do environmental collaboration and monitoring enhance organizational performance? Ind. Manag. Data Syst. 112 (2), 186–205. https://doi.org/10.1108/02635571211204254.

Guest, P.M., 2008. The determinants of board size and composition: evidence from the UK. J. Corp. Finance 14 (1), 51–72. https://doi.org/10.1016/j.jcorpfin.2008.01.002.

Hamed, R.S., Al-Shattarat, B.K., Al-Shattarat, W.K., Hussainey, K., 2022. The impact of introducing new regulations on the quality of CSR reporting: evidence from the UK. J. Int. Account. Audit. Taxat. 46, 100444 https://doi.org/10.1016/j.intaccaudtax.2021.100444.

Handajani, L., Subroto, B., Sutrisno, T., Saraswati, E., 2014. Does board diversity matter on corporate social disclosure? An Indonesian evidence. J. Econ. Sustain. Dev. 5 (12), 8–16. http://eprints.unram.ac.id/id/eprint/17307.

Hartmann, C., Ruby, M.B., Schmidt, P., Siegrist, M., 2018. Brave, health-conscious, and environmentally friendly: positive impressions of insect food product consumers. Food Qual. Prefer. 68, 64–71. https://doi.org/10.1016/J.FOODQUAL.2018.02.001.

Haws, K.L., Winterich, K.P., Naylor, R.W., 2014. Seeing the world through GREEN-tinted glasses: green consumption values and responses to environmentally friendly products. J. Consum. Psychol. 24 (3), 336–354. https://doi.org/10.1016/J.JCPS.2013.11.002.

Hillman, A., Dalziel, T., 2003. Boards of directors and firm performance: integrating agency and resource dependence perspectives. Acad. Manag. Rev. 28 (3), 383–396. https://doi.org/10.5465/amr.2003.10196729.

Hofstede, G., 1984. Culture's Consequences: International Differences in Work-Related Values. Sage Publications, Los Angeles.

Holland, L., Foo, Y.B., 2003. Differences in environmental reporting practices in the UK and the US: the legal and regulatory context. Br. Account. Rev. 35 (1), 1–18. https://doi.org/10.1016/S0890-8389(02)00127-0.

Homroy, S., Slechten, A., 2019. Do board expertise and networked boards affect environmental performance? J. Bus. Ethics 158 (1), 269–292. https://doi.org/10.1007/s10551-017-3769-y.

Homroy, S., Slechten, A.C.D., 2016. Board Expertise, Networked Boards and Environmental Performance. Working Paper. Lancaster University, Department of Economics, Lancaster. Available at: https://eprints.lancs.ac.uk/id/eprint/83174/. (Accessed 19 August 2022).

Huang, M.H., 2011. Popular discontent, divided perceptions, and political polarization in Taiwan. Int. Rev. Sociol. 21 (2), 413–432. https://doi.org/10.1080/03906701.2011.581809.

Hussain, N., Rigoni, U., Orij, R.P., 2018. Corporate governance and sustainability performance: analysis of triple bottom line performance. J. Bus. Ethics 149 (2), 411–432. https://doi.org/10.1007/s10551-016-3099-5.

Husted, B.W., Sousa-Filho, J. M. de, 2017. The impact of sustainability governance, country stakeholder orientation, and country risk on environmental, social, and governance performance. J. Clean. Prod. 155, 93–102. https://doi.org/10.1016/j.jclepro.2016.10.025.

Husted, B.W., Sousa-Filho, J. M. de, 2019. Board structure and environmental, social, and governance disclosure in Latin America. J. Bus. Res. 102, 220–227. https://doi.org/10.1016/j.jbusres.2018.01.017. November 2016.

Imperiale, F., Pizzi, S., Lippolis, S., 2023. Utilities Policy Sustainability reporting and ESG performance in the utilities sector. Util. Pol. 80 (November 2022), 101468 https://doi.org/10.1016/j.jup.2022.101468.

Ioannou, I., Serafeim, G., 2017. The Consequences of Mandatory Corporate Sustainability Reporting. Harvard Business School research working paper, pp. 11–100. https://ssrn.com/abstract=1799589.

Jacoby, G., Liu, M., Wang, Y., Wu, Z., Zhang, Y., 2019. Corporate governance, external control, and environmental information transparency: evidence from emerging markets. J. Int. Financ. Mark. Inst. Money 58, 269–283. https://doi.org/10.1016/j.intfin.2018.11.015.

Jizi, M.I., Salama, A., Dixon, R., Stratling, R., 2013. Corporate governance and corporate social responsibility disclosure: evidence from the US banking sector. J. Bus. Ethics 125 (4), 601–615. https://doi.org/10.1007/s10551-013-1929-2.

Khaireddine, H., Salhi, B., Aljabr, J., Jarboui, A., 2020. Impact of board characteristics on governance, environmental and ethical disclosure. Soc. Bus. Rev. 15 (3), 273–295. https://doi.org/10.1108/SBR-05-2019-0067.

Khan, M.K., Zahid, R.A., Saleem, A., Sági, J., 2021. Board composition and social & environmental accountability: a dynamic model analysis of Chinese firms. Sustainability 13 (19), 10662. https://doi.org/10.3390/su131910662.

Khaoula, F., Moez, D., 2019. The moderating effect of the board of directors on firm value and tax planning: evidence from European listed firms. Borsa Istanbul Review 19 (4), 331–343. https://doi.org/10.1016/j.bir.2019.07.005.

Khlif, H., Guidara, A., Souissi, M., 2015. Corporate social and environmental disclosure and corporate performance. J. Account. Emerg. Econ. 5 (1), 51–69. https://doi.org/10.1108/jaee-06-2012-0024.

Kilincarslan, E., Elmagrhi, M.H., Li, Z., 2020. Impact of governance structures on environmental disclosures in the Middle East and Africa. Corp. Govern.: The international journal of business in society 20 (4), 739–763. https://doi.org/10.1108/CG-08-2019-0250.

Kim, S.H., Seock, Y.K., 2019. The roles of values and social norm on personal norms and pro-environmentally friendly apparel product purchasing behavior: the mediating role of personal norms. J. Retailing Consum. Serv. 51, 83–90. https://doi.org/10.1016/J.JRETCONSER.2019.05.023.

Kostka, G., Nahm, J., 2017. Central-local relations: recentralization and environmental governance in China. China Q. 231 (August 2017), 567–582. https://doi.org/10.1017/S0305741017001011.

Kumari, P.R., Makhija, H., Sharma, D., Behl, A., 2022. Board characteristics and environmental disclosures: evidence from sensitive and non-sensitive industries of India. Int. J. Manag. Finance 18 (4), 677–700. https://doi.org/10.1108/IJMF-10-2021-0547.

Kurane, R., 1997. Environmentally friendly products and processes for the 21st century. Stud. Environ. Sci. 66 (C), 759–769. https://doi.org/10.1016/S0166-1116(97)80088-X.

Lai, Y., Sohail, M.T., 2022. Revealing the effects of corporate governance on green investment and innovation: do law and policy matter? Front. Psychol. 13, 961122 https://doi.org/10.3389/fpsyg.2022.961122.

Laroche, M., Bergeron, J., Barbaro-Forleo, G., 2001. Targeting consumers who are willing to pay more for environmentally friendly products. J. Consum. Market. 18 (6), 503–520. https://doi.org/10.1108/EUM0000000006155/FULL/PDF.

Li, B., Chen, W., Xu, C., Hou, P., 2018. Impacts of government subsidies for environmental-friendly products in a dual-channel supply chain. J. Clean. Prod. 171, 1558–1576. https://doi.org/10.1016/J.JCLEPRO.2017.10.056.

Liao, L., Luo, L., Tang, Q., 2015. Gender diversity, board independence, environmental committee and greenhouse gas disclosure. Br. Account. Rev. 47 (4), 409–424. https://doi.org/10.1016/j.bar.2014.01.002.

Liu, P., Zhu, B., Yang, M., Chu, X., 2022. ESG and financial performance: a qualitative comparative analysis in China's new energy companies. J. Clean. Prod. 379 (P1), 134721 https://doi.org/10.1016/j.jclepro.2022.134721.

Mahmood, Z., Kouser, R., Ali, W., Ahmad, Z., Salman, T., 2018. Does corporate governance affect sustainability disclosure? A mixed methods study. Sustainability 10 (1), 207. https://doi.org/10.3390/su10010207.

Marakanon, L., Panjakajornsak, V., 2017. Perceived quality, perceived risk and customer trust affecting customer loyalty of environmentally friendly electronics products. Kasetsart Journal of Social Sciences 38 (1), 24–30. https://doi.org/10.1016/J.KJSS.2016.08.012.

Masud, M.A.K., Bae, S.M., Manzanares, J., Kim, J.D., 2019. Board directors' expertise and corporate corruption disclosure: the moderating role of political connections. Sustainability 11 (16), 4491. https://doi.org/10.3390/su11164491.

Masud, M., Kaium, A., Nurunnabi, M., Bae, S.M., 2018. The effects of corporate governance on environmental sustainability reporting: empirical evidence from South Asian countries. Asian Journal of Sustainability and Social Responsibility 3 (1), 1–26. https://doi.org/10.1186/s41180-018-0019-x.

Matuszak, Ł., Różańska, E., 2021. Towards 2014/95/EU directive compliance: the case of Poland. Sustainability Accounting, Management and Policy Journal 12 (5), 1052–1076. https://doi.org/10.1108/SAMPJ-02-2020-0042/FULL/PDF.

Michelon, G., Parbonetti, A., 2012. The effect of corporate governance on sustainability disclosure. J. Manag. Govern. 16 (3), 477–509. https://doi.org/10.1007/s10997-010-9160-3.

Moalla, M., Salhi, B., Jarboui, A., 2021. An empirical investigation of factors influencing the environmental reporting quality: evidence from France. Soc. Responsib. J. 17 (7), 966–984. https://doi.org/10.1108/SRJ-02-2020-0065.

Mohammad, W.M.W., Wasiuzzaman, S., 2021. Environmental, Social and Governance (ESG) disclosure, competitive advantage and performance of firms in Malaysia. Cleaner Environmental Systems 2 (January), 100015. https://doi.org/10.1016/j.cesys.2021.100015.

Moser, A.K., 2016. Consumers' purchasing decisions regarding environmentally friendly products: an empirical analysis of German consumers. J. Retailing Consum. Serv. 31, 389–397. https://doi.org/10.1016/J.JRETCONSER.2016.05.006.

Nadarajah, S., Ali, S., Liu, B., Huang, A., 2018. Stock liquidity, corporate governance and leverage: new panel evidence. Pac. Basin Finance J. 50, 216–234. https://doi.org/10.1016/j.pacfin.2016.11.004.

Narwal, K.P., Pathneja, S., 2016. Effect of Bank-specific and Governance- specific variables on the productivity and profitability of banks. Int. J. Prod. Perform. Manag. 65 (8), 1057–1074. https://doi.org/10.1108/IJPPM-09-2015-0130.

Nguyen, L.-T., Thanh, C.-L., 2021. The influence of board characteristics on environmental performance: evidence from East Asian manufacturing industries. Int. J. Emerg. Mark. https://doi.org/10.1108/IJOEM-07-2020-0744.

Nguyen, T.H., Elmagrhi, M.H., Ntim, C.G., Wu, Y., 2021. Environmental performance, sustainability, governance and financial performance: evidence from heavily polluting industries in China. Bus. Strat. Environ. 30 (5), 2313–2331. https://doi.org/10.1002/bse.2748.

Ofoegbu, G.N., Odoemelam, N., Okafor, R.G., 2018. Corporate board characteristics and environmental disclosure quantity: evidence from South Africa (integrated reporting) and Nigeria (traditional reporting). Cogent Business & Management 5 (1), 1551510. https://doi.org/10.1080/23311975.2018.1551510.

Okere, W., Rufai, O., Okeke, O.C., Oyinloye, J.B., 2021. Board characteristics and environmental information disclosure of listed manufacturing firms in Nigeria. Journal of Business And Entrepreneurship 9 (2), 82–93. https://doi.org/10.46273/job&e.v9i2.214.

Onyali, C.I., Eze, M., Okerekeoti, C.U., 2022. Board composition and corporate environmental investment: a study of listed oil and gas firms in Nigeria. Journal of Research in Business and Management 10 (7), 37–47.

Ortas, E., Álvarez, I., Jaussaud, J., Garayar, A., 2015. The impact of institutional and social context on corporate environmental, social and governance performance of companies committed to voluntary corporate social responsibility initiatives. J. Clean. Prod. 108, 673–684. https://doi.org/10.1016/j.jclepro.2015.06.089.

Ortiz-de-Mandojana, N., Aguilera-Caracuel, J., Morales-Raya, M., 2016. Corporate governance and environmental sustainability: the moderating role of the national institutional context. Corp. Soc. Responsib. Environ. Manag. 23 (3), 150–164. https://doi.org/10.1002/CSR.1367.

Oware, K.M., Awunyo-Vitor, D., 2021. CEO characteristics and environmental disclosure of listed firms in an emerging economy: does sustainability reporting format matter? Business Strategy & Development 4 (4), 399–410. https://doi.org/10.1002/bsd2.166.

Peng, X., Zhang, R., 2022. Corporate governance, environmental sustainability performance, and normative isomorphic force of national culture. Environ. Sci. Pollut. Control Ser. 29 (22), 33443–33473.

Pérez-Calderón, E., Milanés-Montero, P., Ortega-Rossell, F.J., 2012. Environmental performance and firm value: evidence from Dow Jones sustainability index Europe. Int. J. Environ. Res. 6 (4), 1007–1014. https://www.sid.ir/paper/301064/en.

Peters, G.F., Romi, A.M., 2014. Does the voluntary adoption of corporate governance mechanisms improve environmental risk disclosures? Evidence from greenhouse gas emission accounting. J. Bus. Ethics 125 (4), 637–666. https://doi.org/10.1007/s10551-013-1886-9.

Posinasetti, N., 2018. Sustainable Manufacturing-Principles, Applications and Directions. publish-industry India Pvt. Ltd. https://www.industr.com/en/sustainable-manufacturing-principles-applications-and-directions-2333598. (Accessed 8 August 2022).

Pozzoli, M., Pagani, A., Paolone, F., 2022. The impact of audit committee characteristics on ESG performance in the European Union member states: empirical evidence before and during the COVID-19 pandemic. J. Clean. Prod. 371 (November 2021), 133411 https://doi.org/10.1016/j.jclepro.2022.133411.

Pucheta-Martínez, M.C., Gallego-Álvarez, I., 2019. An international approach of the relationship between board attributes and the disclosure of corporate social responsibility issues. Corp. Soc. Responsib. Environ. Manag. 26 (3), 612–627. https://doi.org/10.1002/csr.1707.

Qiao, K., Dowell, G., 2022. Environmental concerns, income inequality, and purchase of environmentally-friendly products: a longitudinal study of U.S. counties (2010-2017). Res. Pol. 51 (4), 104443 https://doi.org/10.1016/J.RESPOL.2021.104443.

Qureshi, M.A., Kirkerud, S., Theresa, K., Ahsan, T., 2020. The impact of sustainability (environmental, social, and governance) disclosure and board diversity on firm value: the moderating role of industry sensitivity. Bus. Strat. Environ. 29 (3), 1199–1214. https://doi.org/10.1002/bse.2427.

Rabi, A.M., 2021. Board characteristics and environmental disclosure: evidence from Jordan. Int. J. Bus. Manag. 14 (2), 1–57. https://ideas.repec.org/a/ibn/ijbmjn/v14y2021i2p57.html.

Refinitiv, 2022. Environmental, Social and Governance Scores from Refinitiv. May 2022. https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf.

Reverte, C., 2009. Determinants of corporate social responsibility disclosure ratings by Spanish listed firms. J. Bus. Ethics 88 (2), 351–366. https://link.springer.com/article/10.1007/s10551-008-9968-9.

Rjoub, H., Civcir, I., Resatoglu, N.G., 2017. Micro and macroeconomic determinants of stock prices: the case of Turkish banking sector. Romanian Journal of Economic Forecasting 20 (1), 150–166, 17. https://www.researchgate.net/publication/315896102.

Roozen, I.T.M., 1997. Who are really purchasing environmentally friendly detergents? J. Consum. Stud. Home Econ. 21 (3), 237–245. https://doi.org/10.1111/J.1470-6431.1997.TB00285.X.

Rupley, K.H., Brown, D., Marshall, R.S., 2012. Governance, media and the quality of environmental disclosure. J. Account. Publ. Pol. 31 (6), 610–640. https://doi.org/10.1016/J.JACCPUBPOL.2012.09.002.

Salike, N., Ao, B., 2017. Determinants of bank ' s profitability : role of poor asset quality in Asia. China Finance Rev. Int. 8 (2), 216–231. https://doi.org/10.1108/CFRI-10-2016-0118.

Setiany, E., 2018. Audit committee characteristics and voluntary financial disclosure. Review of Integrative Business and Economics Research 6, 239. https://www.researchgate.net/publication/325558334.

Shakil, M.H., 2021. Environmental, social and governance performance and financial risk: moderating role of ESG controversies and board gender diversity. Resour. Pol. 72 (May), 102144 https://doi.org/10.1016/j.resourpol.2021.102144.

Shamil, M.M., Shaikh, J.M., Ho, P.L., Krishnan, A., 2014. The influence of board characteristics on sustainability reporting: empirical evidence from Sri Lankan firms. Asian Rev. Account. 22 (2), 78–97. https://doi.org/10.1108/ARA-09-2013-0060.

Shaukat, A., Qiu, Y., Trojanowski, G., 2016. Board attributes, corporate social responsibility strategy, and corporate environmental and social performance. J. Bus. Ethics 135 (3), 569–585. https://doi.org/10.1007/s10551-014-2460-9.

Shim, D., Shin, J., Kwak, S.Y., 2018. Modelling the consumer decision-making process to identify key drivers and bottlenecks in the adoption of environmentally friendly products. Bus. Strat. Environ. 27 (8), 1409–1421. https://doi.org/10.1002/BSE.2192.

Siddique, M.A., Akhtaruzzaman, M., Rashid, A., Hammami, H., 2021. Carbon disclosure, carbon performance and financial performance: international evidence. Int. Rev. Financ. Anal. 75 (March), 101734 https://doi.org/10.1016/j.irfa.2021.101734.

Speight, J.G., 2016. Environmental Organic Chemistry for Engineers. Butterworth-Heinemann.

Suddaby, R., 2014. Editor's comments: why theory. Acad. Manag. Rev. 39 (4), 407–411. https://doi.org/10.5465/amr.2014.0252.

Trivedi, R.H., Patel, J.D., Savalia, J.R., 2015. Pro-environmental behaviour, locus of control and willingness to pay for environmental friendly products. Market. Intell. Plann. 33 (1), 67–89. https://doi.org/10.1108/MIP-03-2012-0028/FULL/PDF.

Tseng, M.L., Chang, C.H., Lin, C.W., Nguyen, T.T.H., Lim, M.K., 2020. Environmental responsibility drives board structure and financial and governance performance: a cause and effect model with qualitative information. J. Clean. Prod. 258, 120668 https://doi.org/10.1016/j.jclepro.2020.120668.

Umukoro, O.E., Uwuigbe, O.R., Uwuigbe, U., Adegboye, A., Ajetunmobi, O., Nwaze, C., 2019. Board expertise and sustainability reporting in listed banks in Nigeria. In: IOP Conference Series: Earth and Environmental Science, vol. 331. IOP Publishing. No. 1, p. 012048.

Van Hoang, T.H., Przychodzen, W., Przychodzen, J., Segbotangni, E.A., 2021. Environmental transparency and performance: does the corporate governance matter? Environmental and Sustainability Indicators 10. https://doi.org/10.1016/j.indic.2021.100123.

Whetten, D.A., 1989. What constitutes a theoretical contribution? The academy of management review what constitutes a theoretical contribution? Acad. Manag. Rev. 14 (4), 490–495. https://doi.org/10.2307/258554.

Wijekoon, R., Sabri, M.F., 2021. Determinants that influence green product purchase intention and behavior: a literature review and guiding framework. Sustainability 13 (11), 6219. https://doi.org/10.3390/su13116219.

Wong, J.B., Zhang, Q., 2022. Stock market reactions to adverse ESG disclosure via media channels. Br. Account. Rev. 54 (1), 101045 https://doi.org/10.1016/j.bar.2021.101045.

Wong, W.C., Batten, J.A., Ahmad, A.H., Mohamed-Arshad, S.B., Nordin, S., Adzis, A.A., 2021. Does ESG certification add firm value? Finance Res. Lett. 39 (May 2020), 101593 https://doi.org/10.1016/j.frl.2020.101593.

Yadav, P., Prashar, A., 2022. Board gender diversity: implications for environment, social, and governance (ESG) performance of Indian firms. Int. J. Prod. Perform. Manag. https://doi.org/10.1108/IJPPM-12-2021-0689 (ahead-of-print).

Yan, J., Hu, W., 2022. Environmentally specific transformational leadership and green product development performance: the role of a green HRM system. Int. J. Manpow. 43 (3), 639–659. https://doi.org/10.1108/IJM-05-2020-0223/FULL/PDF.

Yu, E. P. yi, Luu, B. Van, 2021. International variations in ESG disclosure – do cross-listed companies care more? Int. Rev. Financ. Anal. 75 (March), 101731 https://doi.org/10.1016/j.irfa.2021.101731.

Yuan, X., Li, Z., Xu, J., Shang, L., 2022. ESG disclosure and corporate financial irregularities – evidence from Chinese listed firms. J. Clean. Prod. 332 (November 2021), 129992 https://doi.org/10.1016/j.jclepro.2021.129992.

Zaman, S., Ellili, N.O.D., 2022. The effect of ESG disclosure on the financial performance of UAE banks. Available at: SSRN 4043024: https://doi.org/10.2139/ssrn.4043024.