Management Accounting Research xxx (xxxx) xxx

Contents lists available at ScienceDirect

Management Accounting Research

journal homepage: www.elsevier.com/locate/mar

# Understanding the relationship between environmental management accounting and firm performance: The role of environmental innovation and stakeholder integration – Evidence from a developing country☆

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ARTICLE INFO

*Keywords:*
Developing economy
Environmental innovation
Environmental management accounting
Pakistan
Small and medium-sized enterprises
Stakeholder integration

ABSTRACT

This study examines the role of environmental management accounting (EMA) as a mechanism for enhancing firm performance. Primary data were collected by means of a questionnaire survey of chief executive officers and finance managers of SMEs in Pakistan. Analysis of the responses received from 204 firms confirms a significant direct relationship between EMA and firm performance. We find that this effect is attributable to the mediating impact of environmental innovation. Our findings also suggest that stakeholder integration positively moderates the association between environmental innovation and firm performance, and so leverages the impact of EMA. The findings are robust to several checks and are further explored at the level of the individual dimensions of some of the constructs used. Thus, we contribute novel evidence regarding the relationship between EMA and firm performance, in the form of both environmental and financial performance. The findings offer practical implications for managers and accountants, and we make several suggestions for future research that could build on our study.

## 1. Introduction

In recent decades, environmental degradation has become a serious concern due to rapid industrial development and the growth of the world's population (Wang et al., 2019, Bansal and Kistruck, 2006, Zheng et al., 2014, Obeidat et al., 2020). Consequently, key stakeholders – including customers, suppliers, investors, non-governmental organizations (NGOs) and government agencies – are increasingly concerned about environmental problems, including climate change. This has led to widespread calls for businesses to reduce their adverse impact on the environment (Kassinis and Vafeas, 2006, Yu et al., 2017, Schmitz et al., 2017). To implement substantial change, businesses need not only a change in attitude but also new management strategies, systems and tools (Welford, 1999).

Based on existing accounting tools, environmental management accounting (EMA) has emerged as a significant approach to support the translation of firms' environmental strategies into firm performance (Qian et al., 2018, Endenich and Trapp, 2020). Practical guidance has been provided by the International Federation of Accountants (IFAC, 2005; Burritt, Schaltegger and Christ, 2021), and a thought leadership paper published by the Chartered Institute of Management Accountants, a leading professional body headquartered in the UK, suggests that EMA is vital for the sustainability of corporations, as it acts as an interface between traditional, inward-focused management accounting and environmental management strategies (CIMA, 2019). EMA provides information that supports managers in planning, making decisions, and controlling firms' environmental practices and impacts (Lee and Schaltegger, 2018, Tashakor et al., 2019). The information provided by EMA is of two types: financial information related to costs, revenues, etc., and physical information about resources and impact (Chaudhry and Amir, 2020). Such information can help control environmental costs, support the realization of environmental-related revenue and profit

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https://doi.org/10.1016/j.mar.2023.100865
Received 5 February 2021; Received in revised form 24 August 2023; Accepted 12 September 2023

opportunities, and generally improve firm performance (Le et al., 2019; Gunarathne et al., 2021). In line with traditional management accounting, EMA comprises both forward-looking analysis and backwards-looking score-keeping (Tayles and Drury, 2021).

Although not published in accounting journals, some previous empirical studies have suggested a positive relationship between EMA and firm performance, implying that EMA is a useful development. The earliest study known to the authors (Phan et al., 2017) merely tested for the association, but subsequent research has attempted to provide some explanation by including other factors, as recommended by Chaudhry and Amir (2020). However, the existing literature possesses some shortcomings, which can be summarized by considering the structure of a typical empirical model.

First, we find that some studies employ independent variables that fail to capture EMA adequately (da Rosa et al., 2020; Fuzi et al., 2019a, 2019b, 2020), so their findings do not actually provide reliable insight into the link with firm performance.

Second, none of the other studies captures the impact on both environmental and financial performance. Phan et al. (2017) and Zandi et al. (2019) focus on environmental performance, but only Sari et al. (2021) examine the impact on financial performance – which would be expected to affect the uptake of EMA.

Third, not only do no existing studies both use an adequate proxy for EMA and capture the two key dimensions of firm performance, but also the evidence on intervening variables is limited, with poor explanations of their rationale, thus impeding understanding of the EMA-firm performance link. We develop a conceptual model that includes a relatively comprehensive measure of environmental innovation (EI) as a mediator and stakeholder integration (SI) as a moderator of the relationship between EI and both dimensions of firm performance.

Environmental innovation, which has been investigated extensively as an important phenomenon in its own right (e.g. Aldieri et al., 2020; Liao, 2018; Watson et al., 2018), refers to actions that generate value in products, processes, and organizations by protecting the environment (Konadu et al., 2020). The use of EMA is expected to support the adoption of appropriate environmental innovations, which in turn should influence firm performance.

Stakeholder integration, which has emerged as an important strand within stakeholder theory (Danso et al., 2020; Waheed & Yang, 2019), may be defined as the ability to establish positive collaborative relationships with a variety of stakeholders (Amankwah-Amoah et al., 2019). The drivers of stakeholder integration can be classified into push factors (i.e., expected benefits for the focal firm) and pull factors (i.e., expected benefits for the stakeholders) (Vaquero Martín et al., 2016). For a firm, stakeholder integration can be viewed as consisting of three dimensions: knowledge of stakeholders, interaction with stakeholders, and adaptation to stakeholder demands (Plaza-Úbeda et al., 2010). It may take many forms, including joint arrangements with trade associations (Hiatt and Park, 2012; Julian et al., 2008), strategic alliances with industrial peers (Fassin et al., 2017; Thorne et al., 2017), collaborative arrangements with business customers, and engagement with other groups such as NGOs, communities and local authorities (Dentoni et al., 2016; Doh and Quigley, 2014; Rivera-Santos and Rufín, 2010). The expectation is that when stakeholder integration is higher, the environmental innovations that firms undertake are more likely to be appropriate and successful because the firms acquire superior knowledge and understanding of the environmental concerns and priorities of stakeholders. Thus, we posit that stakeholder integration can play a moderating role through its effect on the second element of the indirect link between EMA and firm performance via environmental innovation.

In terms of empirical testing, most studies have investigated large-scale business enterprises or have mixed together businesses of very different sizes (e.g., da Rosa et al., 2020; Fuzi et al., 2020; Phan et al., 2017; Sari et al., 2021). However, small and medium-sized enterprises (SMEs) might display different behaviour, given their inherent characteristics and the constraints they typically face. For example, SMEs have to cope with their liabilities of smallness and resource constraints (Gimenez-Fernandez et al., 2020), and they can struggle with the cost and technological complexity of innovation processes (Triguero et al., 2016; Zhang and Walton, 2017), especially environmental innovation (Cainelli et al., 2015). Perhaps, then, there might not be a significant relationship between EMA and firm performance.

Nevertheless, collectively, SMEs are major contributors to economic activity and to the total environmental impact of business, sometimes as part of the supply chains of large firms. They are being affected by environmental laws and regulations (Woodard, 2021; Mallett et al., 2019), and environmentally-concerned stakeholders are increasingly taking an interest in them (Ahinful et al., 2019, Johnstone, 2020). However, EMA in the context of SMEs is little studied (cf. Zandi et al., 2019), even though it is capable of contributing to the management of SMEs' environmental impact, as well as their growth (Pelz, 2019). Our study, therefore, focuses on SMEs.

As a result of the above considerations, the aim of the study is to understand the effect of EMA on firm financial and environmental performance, taking into account the mediating effect of environmental innovation and the moderating effect of stakeholder integration. Specific hypotheses are developed in the next section.

We test our hypotheses using a sample of manufacturing SMEs in Pakistan. Developing countries are highly appropriate for such studies because of the disproportionately high environmental costs that they bear, often as a result of their position in global supply chains. SMEs constitute approximately 90% of the total number of businesses in Pakistan, utilize 80% of the non-agricultural workforce, and contribute 40% to the annual GDP (SMEDA, 2020). Manufacturing is one of Pakistan's largest industrial sectors, making an 18.3% contribution to GDP in 2019 (Plecher, 2020). Manufacturing firms in Pakistan are under pressure to reduce waste and pollution, promote sustainable production technologies, ensure environmental compliance, etc. (Ikram et al., 2019).

Based on our regression analysis of questionnaire responses from the CEOs and finance managers of 204 manufacturing SMEs in Pakistan, our findings suggest that the direct relationship between EMA and firm performance is significant. Furthermore, we find that the influence of EMA on firm performance is significantly and positively mediated by environmental innovation to such an extent that the direct relationship becomes insignificant. Our findings also suggest that stakeholder integration positively moderates the association between environmental innovation and firm performance, thus leveraging the impact of EMA. These findings are robust to several checks and are explored further at the level of the individual dimensions of some of the constructs used.

We contribute to the existing literature in several ways. First, we confirm the findings from a limited number of studies that EMA is positively related to firm environmental performance, and we also show that it is also positively related to firm financial performance. We provide this supportive evidence in a context that is focused solely on SMEs in a developing economy – which might have been expected to be unsophisticated and hence less likely to show such relationships. Second, we provide insights into the role of environmental innovation as a mediating mechanism through which EMA influences firm performance – an issue that has not been adequately addressed by previous studies, which did not examine *environmental* innovation or did not examine the effect on *financial* performance. An interesting feature of our findings is that, once the environmental innovation mediator is taken into account, the direct association between EMA and firm performance becomes insignificant. Third, we demonstrate that environmental innovation's role in driving firm performance is strengthened when stakeholder integration is greater.

The remainder of the paper is structured as follows. Section 2 outlines the theoretical framework, reviews key literature, and formulates the hypotheses. Section 3 explains the research design and research methods used for the study. Section 4 presents the main empirical findings, together with robustness checks and further analyses of the

empirical data. Section 5 concludes the paper with a summary of the contributions, the limitations of the study, implications for policy and practice, and recommendations for further research.

## 2. Literature review and hypothesis development

In this section, we develop our hypotheses, drawing on appropriate literature. We review previous empirical studies, shown in Table 1, that have examined (or purport to have examined) the relationship between EMA and firm performance.

Panel A contains the key papers, where EMA is the independent variable. Panel B contains studies that have considered EMA as a mediator variable between some other independent variable and firm performance, thus providing additional empirical evidence regarding EMA's relationship with firm performance. It is noteworthy that none of the papers, most of which have appeared in recent years, has been published in an accounting journal.

We develop three hypotheses. First, we examine the independent variable (EMA), the dependent variable (firm performance) and the relationship between then. We raise some significant concerns about the existing literature. Then, we turn our attention to two intervening variables that might help to explain that relationship: environmental innovation and stakeholder integration. Having developed the three hypotheses, our conceptual model is presented, with the hypotheses mapped onto it. The final subsection considers whether agency costs might challenge our hypotheses and the account that underpins them.

### 2.1. Environmental management accounting and firm performance

EMA involves advancing and applying an appropriate accounting system to manage firms' environmental and operational activities (IFAC, 2005). EMA can consist of various resources, planning activities, and processes that help develop, implement, evaluate, and sustain environmental policies (Wilmshurst and Frost, 2001), in both financial, physical and non-financial terms (Chaudhry and Amir, 2020; Christ and Burritt, 2013). It can be used for planning, control and decision-making as a business pursues its environmental agenda (Gunarathne et al., 2021; Lee and Schaltegger, 2018; Tashakor et al., 2019). EMA is especially likely to be implemented for making decisions when diverse environmental activities are undertaken (Christ and Burritt, 2013; Schaltegger and Burritt, 2010). EMA can lead to more efficient production processes and less material waste (Papagiannakis et al., 2019), and it can be used to reduce the environmental impact of firms' activities (Burritt et al., 2019; Phan et al., 2017), including through the identification of environmental costs and liabilities (Asiaei et al., 2021; Schaltegger et al., 2017).

Advocates highlight how EMA provides firms with a platform to evaluate their current position, recognize key environmental concerns, and identify environmental opportunities associated with the use of resources (Porter and van der Linde, 1995) or related to markets for new products with environmental characteristics (Hart, 1997), and generally improve firm performance (Le et al., 2019, Gunarathne et al., 2021).

Panel A of Table 1 lists seven empirical papers apparently concerned with the relationship between EMA and firm performance. However, we note that the three papers by Fuzi and various co-authors all seem to be based on the same dataset. Therefore, the body of empirical research is smaller than might at first appear. Furthermore, in each of the three Fuzi et al. papers, the purported operationalization of EMA does not align with other studies, and it is questionable whether it is even related to EMA. For example, two of the five dimensions referred to are 'environmental regulation' and 'customer focus'. Fuzi et al.'s items seem more relevant to corporate environmental practices than EMA (see Ferreira et al., 2010).

The paper by da Rosa et al. (2020) displays a similar problem. Background information about EMA, consistent with our own account, is provided, but the two items that supposedly operationalize the EMA variable are, first, whether companies have implemented 'organizational innovations/management techniques' and, second, whether they have implemented 'organizational innovations/environmental management techniques'. We would suggest that this independent variable does not measure EMA in any meaningful sense.

Given that their independent variables appear not to represent suitable measures of EMA, notwithstanding the ostensive focus of the papers, we are removing da Rosa et al. (2020) and Fuzi et al. (2019a; 2019b; 2020) from further discussion in this literature review.

That leaves three papers from Panel A (Phan et al., 2017; Sari et al., 2021; Zandi et al., 2019), all of which found a significantly positive relationship between EMA and firm performance when EMA was the independent variable. Furthermore, the papers in Panel B found a similar association when EMA was treated as a mediator (Asiaei et al., 2021; Appiah et al., 2020; Chaudhry & Amir, 2020; Gunarathne et al., 2021; Latan et al., 2018). Based on these previous findings and our earlier reasoning, we therefore propose that:

**Hypothesis 1.** *Environmental management accounting is positively related to firm performance.*

The implementation of EMA is expected to influence not only environmental performance but also more traditional forms of firm performance. We, therefore, conceive firm performance as composed of both environmental and financial dimensions, which can be examined separately. Of the three studies in Panel A of Table 1 that remain within our purview, two examined only environmental performance (Phan et al., 2017; Zandi et al., 2019), whereas Sari et al. (2021) also considered 'organizational' performance. Panel B shows a similar pattern, with only Gunarathne et al. (2021) considering financial performance, yet the impact on financial performance is expected to be an important factor in the implementation of EMA.

### 2.2. Environmental innovation

The earliest study cited in Panel A of Table 1 (Phan et al., 2017) simply examined the direct relationship between EMA and environmental performance. However, the two other studies that remain within our purview recognized that the relationship with firm performance might be mediated by some other factor. In both cases, they identified the importance of innovation.

Sari et al. (2021) focus on one type of innovation, namely process innovation. Rather than making their measures explicit, they cite Ferreira et al. (2010) as their source. Sari et al. indicate that they are interested in 'green' innovation processes, but the measures used by Ferreira et al. related to more general process and product innovation, adapted from Bisbe and Otley (2004). Similarly, Zandi et al. (2019) do not make their green innovation measure explicit, although they refer to Chen et al. (2006) as their main source, who measured green process and product innovation according to the definitions provided by ISO 14031. Neither Sari et al. (2021) nor Zandi et al. (2019) provide a clear account of the mediating role of eco-innovation.

Environmental innovation is likely to act as a mediator between EMA and financial performance because it is through changes to products and processes that firms adapt to the environmental agenda (Danso et al., 2020, Aragón-Correa and Sharma, 2003), and EMA will promote the chances of successfully advancing such innovations (IFAC, 2005; Christ and Burritt, 2013; Schaltegger and Burritt, 2010).

Environmental innovation refers to actions that may generate value in products, processes, and organizations by protecting the environment (Konadu et al., 2020). The key types of product and production process

**Table 1**
Studies examining the relationship between environmental management accounting and firm performance.

| Authors | Independent variable | Performance construct (dependent variable) | Mediator variable | Moderator variable | Context |
|---|---|---|---|---|---|
| ***Panel A:*** *Where EMA is the independent variable* | | | | | |
| Current study | EMA | EP & FP | Environmental innovation | Stakeholder integration | SMEs in Pakistan |
| da Rosa et al. (2020) | EMA | EP | Process and product innovation via environmental management techniques | - | Large companies in Brazil |
| Fuzi et al. (2019a) | EMA | FP | EMS | - | Manufacturing industry in Malaysia |
| Fuzi et al. (2020) | EMA | FP | EMS | - | Manufacturing industry in Malaysia |
| Fuzi et al. (2019b) | EMA | FP | Information system | - | Manufacturing industry in Malaysia |
| Phan et al. (2017) | EMA | EP | - | - | Various industries in Australia |
| Sari et al. (2021) | EMA | FP & non-FP | Process innovation: (production or transportation methods) | - | Large manufacturing companies in Indonesia |
| Zandi et al. (2019) | EMA | EP | Green innovation and knowledge transfer | - | Indonesian small and medium enterprises sector |

| Panel B: Where EMA is a mediator variable | | | | | |
|---|---|---|---|---|---|
| Asiaei et al. (2021) | Green intellectual capital | EP | EMA | - | Publicly listed companies in Iran |
| Chaudhry & Amir (2020) | Institutional pressures | EP | EMA | Environmental proactivity | Manufacturing firms in Pakistan |
| Gunarathne, Lee, Hitigala & Kaluarachchilage (2021) | EMS | EP & FP | EMA | - | Listed firms in Sri Lanka |
| Appiah, Donghui, Majumder & Monaheng (2020) | Environmental strategy, perceived environmental uncertainty and top management commitment. | EP | EMA Environmental MCS | - | Manufacturing sector in China |
| Latan, Jabbour, Jabbour, Wamba, Shahbaz (2018) | Environmental strategy, perceived environmental uncertainty and top management commitment. | EP | EMA | - | ISO 14001-certified listed companies in Indonesia |

Notes:
EMA is environmental management accounting; EMS is environmental management system; EP is firm environmental performance; FP is firm financial (or related) performance; and MCS is the management control system.

innovations that benefit the natural environment (Papagiannakis et al., 2019) include pollution prevention, resource reduction, waste recycling, energy-saving, and positioning in eco-product markets (Schiederig et al., 2012). However, it can also include organizational innovations (Liao, 2018), such as the ISO 14000 family of Environmental Management Standards.[1]

Prior research has suggested that environmental innovation is indeed a driving force of firms' performance (Doran and Ryan, 2016; Hizarci-Payne et al., 2020; Zhang and Walton, 2017), including through the strengthening of their reputation (Bammens and Hünermund, 2020; Stekelorum et al., 2020; Tamayo-Orbegozo et al., 2017). However, if it is to mediate the relationship between EMA and financial performance, environmental innovation must not only influence financial performance but also be influenced by EMA.

Various studies indicate that EMA can influence environmental innovation (Agustia et al., 2019; He and Shen, 2019; Inoue et al., 2013; Kawai et al., 2018; Montobbio and Solito, 2018; Papagiannakis et al., 2019; Rasit et al., 2020; Rehfeld et al., 2007). EMA can support environmental innovation in several ways. For example, the expenditure of money and resources on environmental innovations is much more likely to be deemed attractive when the accounting system is configured to recognise environmental dimensions (Zandi et al., 2019; Ferreira et al., 2010) and EMA takes account of some of the physical features of corporate action that are often lost or hidden in traditional accounting. Thus, there does seem to be a case for positing that EMA is positively related to environmental innovation.

[1] EMA might be viewed as an organizational innovation for some purposes, but it will be treated independently in our study, in line with the body of previous literature on EMA, which it is our primary aim to contribute to. Various robustness checks will be deployed to ensure the soundness of our statistical results.

Given that EMA is expected to be positively related to environmental innovation and that environmental innovation is expected to be positively related to firm performance, we propose that:

**Hypothesis 2.** *Environmental innovation mediates the relationship between environmental management accounting and firm performance.*

### 2.3. Stakeholder integration

Our argument for suggesting a relationship between environmental innovation and firm performance aligns with stakeholder theory (Freeman, 1984; Freudenreich et al., 2020). Freeman (1984) states that stakeholders are representatives of any entity – groups or individuals – that can substantially influence, or be influenced by, a given firm's operations. Although stakeholder theory can take a normative, ethical form, it can also be interpreted as a strategic or instrumental perspective (Donaldson and Preston, 1995), according to which firms seek to satisfy salient stakeholders (Mitchell et al., 1997), reactively or proactively, and thereby improve firm performance (Laplume et al., 2008).

Conventional lists of possible stakeholders, although useful for general discussions and educational purposes, can be viewed as little more than a heuristic at the level of the firm. Who or what a particular firm's stakeholders are and how they should best be categorized and dealt with is likely to be context-specific. For example, 'customers' might appear on a standard list of stakeholders, but a firm will tend to think about different customers in different ways. Some might even have a hybrid status, for example, through having an equity stake in the firm. What matters at the level of the firm, for its performance, is the quality of its relationships with key stakeholders (Desai, 2018). This is captured by the concept of stakeholder integration.

Stakeholder integration may be defined as the ability to establish positive collaborative relationships with stakeholders (Amankwah-Amoah et al., 2019; Plaza-Úbeda et al., 2014). Firms often engage with

external stakeholders to achieve gains that would not otherwise be easy to attain internally (Leonidou et al., 2020), sometimes through including stakeholders in a firm's decisions and activities (Greenwood, 2007). Prior studies suggest that stakeholder integration can allow SMEs to achieve competitive gains, to the benefit of their performance (Alt et al., 2015; Danso et al., 2020; Inam et al., 2015; Ommen et al., 2016).

Stakeholder integration can come in a wide range of forms, depending on the stakeholder. For example, it can include joint arrangements with trade associations (Hiatt and Park, 2012; Julian et al., 2008), strategic alliances with industrial peers (Fassin et al., 2017; Thorne et al., 2017), and engagements with other groups such as customers, suppliers, NGOs, communities, and local authorities (Dentoni et al., 2016; Doh and Quigley, 2014; Rivera-Santos and Rufín, 2010). Stakeholder integration allows SMEs to gain insights into the best ways to manage and coordinate environmental innovation activities conducive to firm performance (Garcés-Ayerbe et al., 2019; González-Moreno et al., 2019). It can be viewed as consisting of three dimensions: knowledge of stakeholders, interaction with stakeholders, and adaptation to stakeholder demands (Plaza-Úbeda et al., 2010).

Thus, a firm that records information about its relationships with stakeholders interacts with them (e.g. informal or formal meetings, consultation when making decisions) and adapts to their demands is more likely to acquire the resources it needs to implement environmental innovations (Gimenez-Fernandez et al., 2020; Triguero et al., 2016; Zhang and Walton, 2017) and to use them effectively, and thus more likely to achieve good financial and non-financial performance (Grama-Vigouroux et al., 2020; Veronica et al., 2020). Furthermore, those environmental innovations are more likely to be successful because they will be more attuned to stakeholder expectations. Therefore, organizations that are engaged in environmental innovation may have better firm performance if they have higher stakeholder integration. Thus, we propose that:

**Hypothesis 3**. *Stakeholder integration positively moderates the relationship between environmental innovation and firm performance.*

### 2.4. The conceptual model

Having explained the key concepts of the study and having proposed the hypotheses, it is now possible to present the full conceptual model, with the hypotheses mapped onto it.

### 2.5. Agency cost considerations

Before explaining how the hypotheses were tested, we note that they display a consistently positive narrative regarding the impact of the identified variables. However, a strand of literature that examines CSR (corporate social responsibility) in agency theoretic rather than functionalist organizational terms should be acknowledged and its relevance to our study considered. Some researchers have suggested that CSR can be at least partially explained by managers' own personal motives and characteristics. For example, Petrenko et al. (2016) found evidence that CSR can be a response to CEO narcissism, and Gul et al. (2020) found a similar association for CEO over-confidence.

Such studies do not appear to be of immediate relevance to our study because they are concerned with the antecedents of pro-social/pro-environmental behaviour, not its consequences for firm performance – which is our focus and the focus of the studies cited in Table 1. Nevertheless, if such actions are intended to benefit managers rather than the firm, then it is possible that the consequences for the firm financial performance could be negative.

However, we consider EMA an unlikely focus for such behaviour compared to higher-profile components of CSR. Indeed, not only are we not aware of EMA being one of the CSR components considered by researchers in the agency theoretic tradition, but Al-Shammari et al. (2019) found that, although there was a positive relationship between CEO narcissism and 'external' CSR, the relationship with 'internal' CSR – which EMA would fall within if deemed to be part of CSR – was insignificant.

We acknowledge, though, that if CEO narcissism were a key driver in the context of our study, it could lead to environmental innovation and stronger environmental performance. However, unlike most previous studies (see Table 1), we also examine firm financial performance. Therefore, we have a check in place. Thus, we take a similar approach to Asiaei et al. (2021)'s CSR study, which, although it refers to both the 'stakeholder value view' (which is consistent with our theorizing) and the 'agency cost model', focused empirically on the former.

## 3. Methodology

### 3.1. Research design

Primary data were obtained via a questionnaire survey of small and medium-sized manufacturing firms in Pakistan. This approach has the advantage of permitting a large sample and rigorous statistical analysis. However, it should be noted that the limited interaction with respondents and the advisability of restricting the length of the questionnaire to encourage responses means that the degree of insight into the details of practices is more limited than might be accessible via qualitative methods.

The main questionnaire was targeted at firms' CEOs, with a subsidiary questionnaire on firm performance provided later for the firms' finance managers to complete. The data were analysed by means of regression analysis, accompanied by a set of robustness checks.

### 3.2. Sampling and data collection

The sampling frame was obtained from the Business Directory of Pakistan, the Chamber of Commerce & Industry, and the Pakistan Bureau of Statistics databases. Given the study context and following prior studies (Boso et al., 2013; Wiklund and Shepherd, 2011), we adopted the following criteria to identify the sampling frame: (1) firms that are independently owned or not part of any bigger group; (2) firms with a maximum of 250 employees; (3) firms that are involved in innovation activities; and (4) firms operating in the manufacturing industry. Of the 6230 SMEs that met the criteria, 10% (623) were randomly selected and contacted to solicit their participation; 398 agreed to take part (63.9%).

The main questionnaire was sent to CEOs as the individuals best positioned to provide the necessary responses. A wide range of questions was asked on, inter alia: EMA; product, process, and organizational environmental innovations; and four aspects of stakeholder integration. However, to avoid the effect of common method bias (Podsakoff et al., 2003) on the dependent variables, the CEOs were not asked about the performance of their firm. Instead, a questionnaire was sent to their finance managers. This was sent eight months after the first questionnaire, to provide some time for any recent practices reported by the CEO to have an impact on performance. Further details can be seen in the Appendix, which reproduces the two questionnaires.

The study data were collected using hand delivery and telephone (Song et al., 2010). Postal distribution was not used because of the unreliability of the postal system in Pakistan and the benefits of personal contact to generate responses in the local culture. Completed responses were received from 228 CEOs, representing a response rate of 57.3% of those who originally agreed to participate (36.6% of the original sample). Of the 228 questionnaires sent to finance managers, 204 were completed, representing a response rate of 82.9%. The 24 completed questionnaires received from CEOs where we did not receive a response from their finance manager were set aside because of incomplete information. Thus, the overall effective response rate based on the original sample of 623 firms is 32.7%.

We assessed the competency of respondents on a 7-point Likert scale in terms of (1) knowledge about study issues, (2) confidence in

answering the study questions, and (3) accuracy of information provided. The results suggest a minimum score of 6.03 on three questions, confirming that respondents had sufficient knowledge and confidence in giving accurate answers to questions. Furthermore, we checked for non-response bias issues by comparing early and late respondents (Armstrong and Overton, 1977). There was no significant difference between the two groups in terms of firm size, industry, and firm performance. Thus, we found no sign that non-response bias is a problem in our study.

The sample characteristics are provided in Table 2. On average, the firms are 12 years old and have 110 full-time employees. 60% are involved in high-technology manufacturing (such as pharmaceutical, electronics, optical products, air and spacecraft, and machinery), and 40% engage in 'non-technology' manufacturing (such as rubber and plastic goods, paper production, food and tobacco, textile and garments, and wood products).

### 3.3. Measures

We used multi-item constructs to measure the study variables. All the measures were adopted from previous studies. Table 3 presents the measures of variables and the results of validity and reliability tests.

#### 3.3.1. Environmental management accounting

We used a six-item scale from Wang et al. (2019) to measure EMA. The six items are related to examining whether the accounting system (1) records all the physical inputs and outputs (energy, water, materials, waste, and emissions), (2) carries out product environmental impact analysis, (3) uses environmental performance targets for physical inputs and outputs, (4) identifies environmental-related costs and liabilities, (5) creates and uses environmental cost accounts, and (6) allocates environmental-related costs to products.

#### 3.3.2. Environmental innovation

We measured the environmental innovation construct with the scale developed by Cheng and Shiu (2012). This scale captures environmental product innovation (three items), environmental process innovation (four items), and environmental organizational innovation (three items). We thus examine more dimensions of eco-innovation than Sari et al. (2021), which focused on one particular type of general innovation in line with Ferreira et al. (2010), and Zandi et al. (2019), which

**Table 2**
Sample characteristics.

| | Frequency | Percentage |
|---|---|---|
| *Firm size* | | |
| Small firms (1–49 employees) | 123 | 60.3% |
| Medium-sized firms (50–250 employees) | 81 | 39.7% |
| *Firm age* | | |
| 0–5 years | 23 | 11.3% |
| 6–10 years | 61 | 29.9% |
| 11–15 years | 65 | 31.9% |
| Over 15 years | 55 | 27.0% |
| *Industry* | | |
| High-technology manufacturing | 123 | 60.3% |
| 'Non-technology' manufacturing | 81 | 39.7% |
| *CEO education level* | | |
| High school | 104 | 51.0% |
| Associate degree | 33 | 16.2% |
| Bachelor's degree | 31 | 15.2% |
| Master's degree | 17 | 8.3% |
| Doctoral degree | 19 | 9.3% |
| *CEO tenure* | | |
| 0–5 years | 83 | 40.5% |
| 6–10 years | 58 | 28.3% |
| 11–15 years | 25 | 12.2% |
| Over 15 years | 39 | 19.0% |
| *CEO gender* | | |
| Male | 174 | 85.3% |
| Female | 30 | 14.7% |

**Table 3**
Constructs, measurement items, and reliability and validity tests.

| Description of items | Factor loadings |
|---|---|
| ***Environmental management accounting (CA = 0.90; CR = 0.90; AVE = 0.59)*** | |
| Our firm's accounting system records all physical inputs and outputs (such as energy, water, materials, wastes, and emissions). | 0.73 |
| Our firm's accounting system can carry out product inventory analyses, product improvement analyses, and product environmental impact analyses. | 0.77 |
| Our firm uses environmental performance targets for physical inputs and outputs. | 0.73 |
| Our firm's accounting system can identify, estimate, and classify environmental-related costs and liabilities. | 0.84 |
| Our firm's accounting system can create and use environmental-related cost accounts. | 0.78 |
| Our firm's accounting system can allocate environmental-related costs to products. | 0.76 |
| ***Environmental innovation*** | |
| ***Environmental product innovation (CA = 0.82; CR = 0.80; AVE = 0.57)*** | |
| Our firm often places emphasis on developing new environmentally efficient products through new technologies to simplify their packaging. | 0.73 |
| Our firm often places emphasis on developing new environmentally friendly products through new technologies to simplify their construction. | 0.77 |
| Our firm often places emphasis on developing new environmental products through new technologies to easily recycle their components. | 0.76 |
| ***Environmental process innovation (CA = 0.89; CR = 0.88; AVE = 0.66)*** | |
| Our firm often innovatively updates manufacturing processes to protect against contamination. | 0.70 |
| Our firm often innovatively updates manufacturing processes to meet the standards of environmental law. | 0.90 |
| Our firm often uses innovative technologies in manufacturing processes to save energy. | 0.82 |
| Our firm often innovatively updates manufacturing equipment in manufacturing processes to save energy. | 0.81 |
| ***Environmental organizational innovation (CA = 0.90; CR = 0.90; AVE = 0.74)*** | |
| Our firm's management often uses novel management systems to manage environmental innovation. | 0.84 |
| Our firm's management often actively engages in environmental innovation activities. | 0.91 |
| Our firm's management often invests a high ratio of R&D in environmental innovation. | 0.83 |
| ***Stakeholder integration*** | |
| ***Knowledge of stakeholders (CA = 0.94; CR = 0.93; AVE = 0.78)*** | |
| The firm keeps documented information on previous relationships with stakeholders. | 0.88 |
| The firm obtains feedback on its repercussions on stakeholders. | 0.96 |
| There is a lack of information and documentation on stakeholders' demands (r). | 0.88 |
| The firm dedicates little time and few resources to knowing the characteristics of its stakeholders (r). | 0.79 |
| ***Interaction with stakeholders (CA = 0.90; CR = 0.90; AVE = 0.70)*** | |
| The firm frequently has meetings with stakeholders. | 0.81 |
| The firm consults with the stakeholders and asks them for information before making decisions. | 0.84 |
| The firm's formal or informal cooperation with the stakeholders is intense. | 0.89 |
| Stakeholders participate in the company's decision-making process. | 0.80 |
| ***Adaptation to stakeholder demands (CA = 0.94; CR = 0.94; AVE = 0.75)*** | |
| The firm makes a special effort to prepare the information for the different stakeholders. | 0.81 |
| There is frequent managerial debate about the demands of the stakeholders. | 0.85 |
| The firm is willing to change its objectives in line with stakeholders' demands. | 0.89 |
| The firm dedicates little time and few resources to adapting to stakeholders' demands (r). | 0.89 |
| The firm's policies and priorities are adapted to stakeholders' demands. | 0.87 |

(continued on next page)

**Table 3** (*continued*)

| Description of items | Factor loadings |
|---|---|
| ***Firm performance*** | |
| ***Financial performance (CA = 0.90; CR = 0.90; AVE = 0.70)*** | |
| Profitability | 0.89 |
| Return on assets | 0.86 |
| Return on investment | 0.87 |
| Market share | 0.72 |
| ***Non-financial performance (CA = 0.81; CR = 0.81; AVE = 0.58)*** | |
| Employee morale and satisfaction | 0.77 |
| Reputation/growth of employment | 0.79 |
| Satisfaction of customers | 0.73 |

Fit indices: $\chi 2/DF = 1.07$; SRMR = 0.04; RMSEA = 0.02; IFI = 0.99; and CFI = 0.99.

*Notes:* CA = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted. $\chi 2/DF$ = chi-square/degrees of freedom; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation; IFI = incremental fit index; CFI = comparative fit index.

measured only green process innovation and green product innovation, in a similar fashion to Chen et al. (2006).

#### 3.3.3. Stakeholder integration

Following Plaza-Úbeda et al. (2010), stakeholder integration was measured as a three-dimensional construct consisting of firms' knowledge of stakeholders (four items), interaction with stakeholders (four items), and adaptation to stakeholder demands (five items). The mean value of the three dimensions was considered to represent a composite measure.

#### 3.3.4. Firm performance

Firm performance was conceptualized as a two-dimensional construct, comprising financial and non-financial performance over the last three years (Keh et al., 2007). Finance managers provided a qualitative assessment on a 7-point Likert scale that ranged from very unsatisfied to very satisfied (Li and Zhang, 2007; Wiklund and Shepherd, 2005). For financial performance, we adopted a four-item scale (profitability, return on assets, return on investment, and market share) from previous studies (Lai et al., 2016; Tang and Tang, 2012). The non-financial performance was utilized to capture the quality of a firm's offering and unique competitive profile (Gilley et al., 2004), with likely implications for future financial performance. Following previous studies (Courrent et al., 2018; González-Cruz and Cruz-Ros, 2016), we used a three-item scale, which covered employee morale and satisfaction, reputation/growth of employment, and customer satisfaction. A composite of the two dimensions constitutes the variable score for firm performance.

#### 3.3.5. Control variables

Several control variables (firm size, firm age, R&D intensity, industry, and CEO education level) were included to account for their impact on dependent variables. Firm size was measured as a logarithm of the number of full-time employees. Firm age was measured using a logarithm of the number of years since a firm was founded (Gupta and Batra, 2015). The ratio of the number of R&D employees to full-time employees measured R&D intensity (Kang and Park, 2012). The industry was measured with a dummy variable, with '1′ indicating a high-technology manufacturing industry and '2′ indicating a 'non-technology' manufacturing industry. CEO education level was measured using a categorical variable ('1′ = high school, '2′ = associate degree, '3′ = bachelor's degree, '4′ = master's degree, and '5′ = doctoral degree).

## 4. Findings

In this section, we present the results of our analysis of the primary data that we collected. First, we report some further tests of the quality of the data. Then, we present the main results of our analyses and hypothesis testing. After that, we report the results of some robustness checks. Finally, we present some further analysis that examines the individual dimensions of some of the constructs.

### 4.1. Common method bias, validity and reliability tests

The validity and reliability of multi-item constructs were checked by performing confirmatory factor analysis (CFA) using the maximum likelihood estimation in AMOS 26.0. The model fit was assessed using the traditional chi-square ($\chi^2$) and other fit heuristics. Following Adomako et al. (2019), we assessed the subsets' scales by estimating four competing models (see Table 4). First, model 1 estimated environmental innovation involving three dimensions (environmental product, process, and organizational innovation). Second, stakeholder integration involving the three dimensions (knowledge of shareholders, interaction with shareholders, and adaptation to stakeholders' demands) was estimated in model 2. Third, model 3 assessed firm performance, including the two dimensions (financial and non-financial performance). Finally, model 4 involved environmental management accounting along with modelling all items simultaneously retained in model 1 to model 3.

We statistically tested potential common method bias using the approaches recommended by Carson (2007) and Lindell and Whitney (2001). First, following Carson (2007), we estimated a combined CFA congeneric measurement model with all the multi-item constructs with an additional common factor to load all the items. In the process, we estimated two competing models: model 1 was a trait-only model in which each item was loaded on its respective latent construct: $\chi 2/DF = 1.07$; SRMR = 0.04; RMSEA = 0.02; IFI = 0.99; and CFI = 0.99.; and model 2 was a trait method model involving a common factor linking all the items in model 1: $\chi 2/DF = 1.07$; SRMR = 0.04; RMSEA = 0.02; IFI = 0.99; and CFI = 0.99. The comparison of the two competing models revealed that model 2 is not substantially superior to model 1. Second, utilizing the approach recommended by Lindell and Whitney (2001), we introduced a marker variable and analyzed the correlation between the marker variable and the main variables. The marker variable was 'decisions affected by the use of power and influence among group members', which is a measure of politicization, a variable theoretically unrelated to firm performance. We found a non-significant relationship between the marker variable and the study's main variables, ranging from − 0.06–0.03. Overall, the results suggest that common method bias is not a major concern in this study.

Next, we assessed the validity and reliability of multi-item constructs. As evident in Table 3, we obtained very good to excellent fit indices. The convergent validity of the measures was supported due to significant factor loadings for all the items (Anderson and Gerbing, 1988). The Cronbach's alpha and composite reliability values exceeded the threshold of 0.70 and 0.60, respectively (Bagozzi and Yi, 2012), thus supporting the reliability of the measures. Furthermore, the factor loading exceeded the threshold of 0.40 (Kline, 2015), thereby confirming the constructs' convergent validity. Discriminant validity was assessed by following the procedure suggested by Fornell and Larcker (1981).

Additionally, we inspected whether the squared average variance extracted (AVE) for each construct was greater than each pair of constructs' correlations. The discriminant validity was established because the squared AVE for each construct was greater than the correlation between each pair of constructs. Table 5 shows the correlations, means and standard deviations for the study variables.

### 4.2. Empirical results

The study used hierarchical regression analysis to test the hypothesized relationships. In the main analysis, we used the mean values for the multi-item constructs to reduce the analysis complexity, while the dependent variable (i.e., firm performance) was modelled with its

**Table 4**
Fit indices for the measurement models.

| CFA models | χ2 | DF | χ2/DF | p-value | RMSEA | SRMR | IFI | CFI |
|---|---|---|---|---|---|---|---|---|
| Measurement model 1 | 32.43 | 24 | 1.35 | 0.12 | 0.04 | 0.04 | 0.98 | 0.99 |
| Measurement model 2 | 63.99 | 58 | 1.10 | 0.27 | 0.02 | 0.03 | 0.99 | 0.99 |
| Measurement model 3 | 17.92 | 13 | 1.38 | 0.16 | 0.04 | 0.03 | 0.99 | 0.99 |
| Measurement model 4 | 574.21 | 539 | 1.07 | 0.14 | 0.02 | 0.04 | 0.99 | 0.99 |

*Notes:* Measurement model 1: environmental innovation (environmental product, process, and organizational innovation); measurement model 2 = stakeholder integration (knowledge of shareholders, interaction with shareholders, and adaptation to stakeholders' demands); measurement model 3 = firm performance (financial and non-financial performance); measurement model 4 = environmental management accounting and all the items retained in model 1 to model 3.

**Table 5**
Descriptive statistics and inter-construct correlations.

| Variables | M | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Environmental management accounting | 5.07 | 1.00 | **0.77** | | | | | | | | | | | | | |
| 2. Environmental product innovation | 4.73 | 1.02 | 0.14† | **0.76** | | | | | | | | | | | | |
| 3. Environmental process innovation | 4.83 | 0.93 | 0.19** | 0.51*** | **0.81** | | | | | | | | | | | |
| 4. Environmental organizational innovation | 4.61 | 1.20 | 0.29*** | 0.24** | 0.45*** | **0.86** | | | | | | | | | | |
| 5. Knowledge of shareholders | 4.52 | 1.57 | -0.11 | -0.06 | -0.03 | 0.00 | **0.88** | | | | | | | | | |
| 6. Interaction with shareholders | 4.84 | 1.32 | 0.05 | -0.09 | -0.05 | 0.03 | 0.16* | **0.84** | | | | | | | | |
| 7. Adaptation to stakeholders' demands | 4.94 | 1.52 | 0.13 | 0.01 | 0.03 | 0.15* | 0.12† | 0.16* | **0.86** | | | | | | | |
| 8. Financial performance | 4.60 | 1.14 | 0.16* | 0.28*** | 0.29** | 0.25** | -0.07 | -0.14* | 0.09 | **0.84** | | | | | | |
| 9. Non-financial performance | 4.46 | 1.02 | 0.14* | 0.15* | 0.08 | 0.16* | 0.01 | -0.13† | -0.02 | 0.09 | **0.77** | | | | | |
| 10. Firm size‡ | 1.94 | 0.33 | 0.08 | 0.13 | 0.05 | 0.05 | -0.01 | -0.05 | -0.04 | 0.22** | 0.15* | 1 | | | | |
| 11. Firm age‡ | 1.02 | 0.23 | 0.08 | 0.13 | 0.05 | 0.05 | -0.01 | -0.05 | -0.04 | 0.22 ** | 0.15 * | 0.00 | 1 | | | |
| 12. R&D intensity | 0.17 | 0.23 | -0.01 | 0.02 | 0.05 | 0.04 | -0.02 | 0.07 | 0.07 | 0.08 | -0.10 | -0.46*** | 0.12† | 1 | | |
| 13. Industry# | 1.40 | 0.49 | -0.01 | 0.02 | 0.05 | 0.04 | -0.02 | 0.07 | 0.07 | 0.08 | -0.10 | -0.03 | -0.06 | 0.00 | 1 | |
| 14. CEO education level# | 2.09 | 1.35 | 0.08 | 0.08 | 0.18* | 0.05 | 0.03 | 0.10 | 0.06 | 0.03 | 0.07 | 0.00 | 0.07 | 0.08 | 0.02 | 1 |

*Note:* † $p < 0.10$; * $p < 0.05$, * * $p < 0.01$, and * ** $p < 0.001$ respectively; ‡ = natural logarithm transformation of the original values; # = dummy variables; M = mean; SD = standard deviation; ‡ = dummy variables.

specified items. As we used the interaction-term analysis to test the moderation hypothesis, we created a multiplicative term for EI x SI to test Hypothesis 3. The multiplicative term was then used to estimate the structural term. The introduction of a multiplicative term can raise the multicollinearity problem, so we orthogonalized the two variables involved in the multiplicative term. The variance inflation factors (VIF) for all the regression models were calculated. The highest VIF value was 1.34, which is well below the recommended threshold of 10 (Aiken et al., 1991). Hence, the results confirmed that multicollinearity is not a severe issue in the study's data.

Next, we estimated seven hierarchical models. In model 1 and model 2, environmental innovation was included as a dependent variable. Model 1 was a baseline model with only control variables, whereas model 2 estimated the independent variable (i.e., EMA) along with control variables. From model 3 to model 7, firm performance was modelled as a dependent variable. Model 3 was a baseline model with the control variables, whereas model 4 assessed the direct relationship between EMA and firm performance. In model 5, the direct effect of environmental innovation on firm performance was examined. EMA and environmental innovation were concurrently added in model 6. The interaction term for the moderating effect of stakeholder integration was added in model 7. Table 6 presents the results for all seven models.

Hypothesis 1 examines the direct association between EMA and firm performance. Model 4 of Table 6 indicates that EMA is positively and significantly related to firm performance ($\beta = 0.19$, $p < 0.01$), meaning that Hypothesis 1 is accepted. This finding is in line with prior evidence on the relationship between EMA and firm performance (e.g., Asiaei et al., 2021; Gunarathne et al., 2021; Phan et al., 2017; Sari et al., 2021; Zandi et al., 2019).

Recently, though, it has been suggested that other factors that might affect or explain this association should be investigated (Sari et al., 2021; Zandi et al., 2019), which prompted the development of our conceptual model and further hypotheses. We report the results of examining the indirect effect of EMA on firm performance through environmental innovation in the following paragraphs.

Hypothesis 2 posits that environmental innovation mediates the effect of EMA on firm performance. To test this hypothesis, we follow Baron and Kenny's (1986) mediation procedure, which requires four conditions to be met: (1) a significant effect of the independent variable on the mediator variable; (2) a significant effect of the independent variable on the dependent variable; (3) significant effect of the mediator variable on the dependent variable; and (4) insignificant or reduced effect of the independent variable on a dependent variable with the inclusion of the mediator variable.

As shown in Table 6, the first condition is met, because EMA is positively and significantly associated with environmental innovation in model 2 ($\beta = 0.26$, $p < 0.001$). The second condition is met because we have already accepted the first hypothesis, that EMA is positively and

**Table 6**
Regression results.

| Independent variables | Dependent variables | | | | | | |
|---|---|---|---|---|---|---|---|
| | Environmental innovation | | Firm performance | | | | |
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
| ***Direct effect paths*** | | | | | | | |
| EMA | | 0.26 * ** (3.75) | | 0.19 * * (2.76) | | 0.11 (1.61) | |
| Environmental innovation | | | | | 0.34 * ** (5.19) | | 0.36 * ** (5.55) |
| ***Mediation path*** | | | | | | | |
| Environmental innovation | | | | | | 0.31 * ** (4.62) | |
| ***Moderating effects*** | | | | | | | |
| Environmental innovation x stakeholder integration | | | | | | | 0.17 * (2.51) |
| ***Control paths*** | | | | | | | |
| Stakeholder integration | 0.00 (0.01) | -0.01 (−0.09) | -0.07 (−1.00) | -0.07 (−1.09) | -0.07 (−1.06) | -0.07 (−1.12) | -0.09 (−1.33) |
| Firm size‡ | 0.08 (0.96) | 0.06 (0.73) | 0.01 (0.17) | -0.00 (−0.02) | -0.01 (−0.17) | -0.02 (−0.26) | -0.01 (−0.14) |
| Firm age‡ | 0.09 (1.20) | 0.07 (0.97) | 0.24 * * (3.45) | 0.23 * * (3.30) | 0.21 * * (3.22) | 0.21 * * (3.14) | 0.20 * * (3.00) |
| R&D intensity | 0.06 (0.78) | 0.06 (0.76) | -0.03 (−0.32) | -0.03 (−0.35) | -0.05 (−0.62) | -0.05 (−0.62) | -0.08 (−1.03) |
| Industry# | 0.01 (0.19) | 0.01 (0.17) | -0.04 (−0.54) | -0.04 (−0.57) | -0.04 (−0.62) | -0.04 (−0.66) | -0.05 (−0.83) |
| CEO education level# | 0.11 (1.60) | 0.10 (1.38) | 0.06 (0.80) | 0.04 (0.62) | 0.02 (0.26) | 0.01 (0.19) | 0.03 (0.45) |
| ***Goodness-of-fit statistics*** | | | | | | | |
| F-value | 0.99 | 2.92 * * | 2.51 * | 3.31 * * | 6.28 * ** | 5.86 * ** | 6.43 * ** |
| $R^2$ | 0.03 | 0.09 | 0.07 | 0.11 | 0.18 | 0.19 | 0.21 |
| Adjusted $R^2$ | 0.00 | 0.06 | 0.04 | 0.07 | 0.15 | 0.16 | 0.18 |
| Mx VIF | 1.30 | 1.29 | 1.31 | 1.31 | 1.31 | 1.31 | 1.34 |

Note: † $p < 0.10$; * $p < 0.05$, * * $p < 0.01$, and * ** $p < 0.001$ respectively; ‡ = natural logarithm transformation of the original values; # = dummy variables; T-values are reported in parentheses.

significantly associated with firm performance (model 4, $\beta = 0.19$, $p < 0.01$). The results in model 5 confirm the positive and significant effect of environmental innovation on firm performance ($\beta = 0.34$, $p < 0.001$), thus satisfying the third condition for mediation. Finally, model 6 includes both EMA and environmental innovation as independent variables. Results suggest that the influence of environmental innovation on firm performance ($\beta = 0.31$, $p < 0.001$) is positive and significant, while the effect of EMA on firm performance is no longer statistically significant ($\beta = 0.11$, $p > 0.10$). Thus, the fourth of Baron and Kenny's (1986) conditions for mediation is confirmed, thereby providing support for Hypothesis 2, that EMA affects firm performance via environmental innovation. This implies that the apparent direct effect of EMA on firm performance, found in several previous studies and confirmed in this, is attributable to the mediating impact of environmental innovation. It is notable, regarding Baron and Kenny's fourth condition, that the effect of EMA is not just reduced with the inclusion of the mediator variable, which would be sufficient to meet the condition but becomes insignificant.

Our final hypothesis posits that stakeholder integration moderates the relationship between environmental innovation and firm performance. As evident from model 7 in Table 6, the interaction coefficient between environmental innovation and stakeholder integration is statistically significant and positively related to firm performance ($\beta = 0.17$, $p < 0.05$). Hence, this finding confirms Hypothesis 3. It represents the first investigation of stakeholder integration, or indeed any moderator, in the literature on the EMA-firm performance link. .

To further interpret the significance of the interaction effect, we followed recommended practices (Aiken et al., 1991; Cohen et al., 2013) and plotted the moderating effect of stakeholder integration on environmental innovation-firm performance nexuses. Fig. 2 shows the analysis results graphically and further confirms Hypothesis 3.

### 4.3. Robustness tests

To check the robustness of our results, we performed three additional tests. First, we followed the bootstrapping approach suggested by Preacher et al. (2007) to test Hypothesis 2 formally. Using model 4 in PROCESS macro, we estimated the hypothesized mediation mechanism

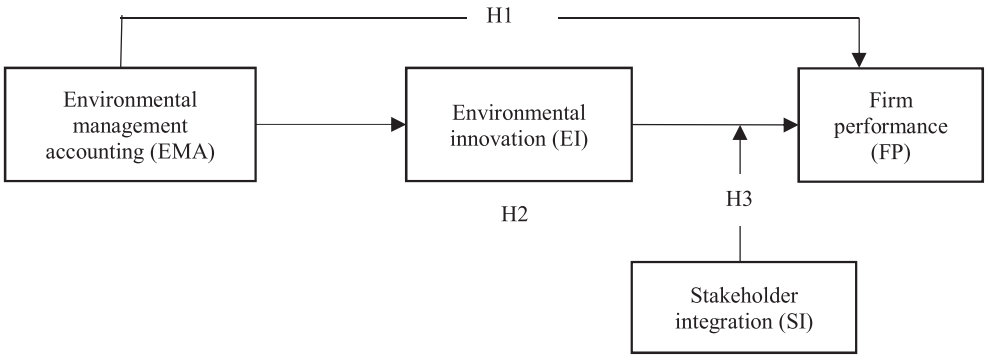


**Fig. 1.** Conceptual model.

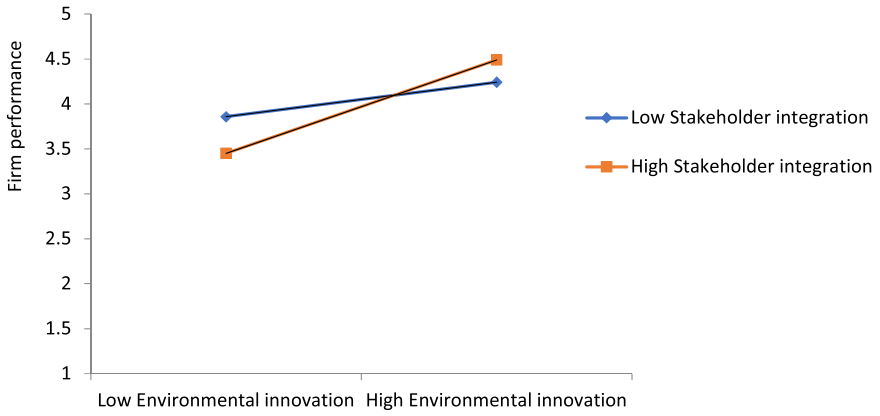


**Fig. 2.** Interaction effect, stakeholder integration and environmental innovation.

at a 95% confidence interval. The results suggest a positive and significant effect of EMA on environmental innovation ($\beta = 0.26$, $p < 0.01$) and of environmental innovation on firm performance ($\beta = 0.31$, $p < 0.001$). More importantly, we assessed the significance of EMA's indirect effect on firm performance through environmental innovation. We find a significant indirect effect of environmental innovation (effect = 0.08), a lower bound of 0.02 and an upper bound of 0.14. Thus, it is concluded that environmental innovation mediates the relationship between EMA and firm performance, thereby confirming Hypothesis 2.

Hypothesis 3 was explored further by evaluating the moderation effect at ± 1 standard deviation from the environmental innovation and stakeholder integration. To do this, we used model 1 in PROCESS macro at a 95% confidence interval. The results indicate that the relationship between environmental innovation and firm performance is contingent on stakeholder integration ($\beta = 0.16$, $p < 0.05$). Specifically, this effect is stronger at high rather than low stakeholder integration levels, as the effect increases from 0.19 (low stakeholder integration) to 0.51 (high stakeholder integration). The results of mediation and moderating effects and their associated 99% confidence level intervals are presented in Table 7, which confirms that stakeholder integration significantly leverages the impact of EMA on firm performance through environmental innovation.

Next, we retested our hypotheses using the structural equation modelling (SEM) approach. The SEM results supported the indirect effect of EMA on firm performance via environmental innovation and the moderating effect of stakeholder integration. Furthermore, the fit indices for the effect of EMA through environmental innovation for firm performance indicated very good mode fit ($\chi^2$/DF = 1.12; SRMR = 0.04; RMSEA = 0.02; IFI = 0.99; and CFI = 0.99; terms as defined in notes to Table 3).

Finally, we tested for endogeneity, because SMEs might engage in environmental innovation when their firm performance is high, having the discretionary resources to do so. In other words, environmental innovation might be driven by, and so endogenous to, firm performance.

**Table 7**
Moderation effect of stakeholder integration on firm performance.

| | Conditional effect of stakeholder integration | | | |
|---|---|---|---|---|
| | Stakeholder integration | Effect | LLCI99% | ULCI99% |
| **Environmental innovation** | -0.97 | 0.20 | 0.04 | 0.37 |
| **Environmental innovation** | 0.00 | 0.36 | 0.22 | 0.48 |
| **Environmental innovation** | 0.97 | 0.51 | 0.33 | 0.70 |

*Notes:* LLCI = lower level confidence interval; ULCI = upper-level confidence interval.

We addressed the issue of potential endogeneity by performing a two-stage least squares (2SLS) regression analysis, instrumenting environmental innovation with two instruments. The two instruments were 'separate innovation unit' and 'innovation opportunities'. The separate innovation unit was measured by asking CEO respondents where innovation activities take place (Blindenbach-Driessen and van den Ende, 2014). Innovation opportunities were captured by asking CEO respondents whether technological changes provide big innovation opportunities in their industry.

First, the results of the Durbin-Wu-Hausman test indicated that environmental innovation is unlikely to be endogenous (Durbin $\chi 2 = 0.20$, $p = .66$; Wu-Hausman F-statistic = 0.19, $p = .66$). This suggests that endogeneity is not a threat in this study. Second, the results of 2SLS suggested a significant relationship between environmental innovation and firm performance ($\beta = 0.45$, $t = 2.37$), indicating endogeneity bias has limited consequences for our findings. Third, we used split-sample analysis using two theoretically relevant variable, namely industry and age.

The sample respondent firms consisted of two industry groups: high-technology manufacturing (N = 123) and non-technology manufacturing (N = 81). The results suggest no difference in the indirect effect of EMA on firm performance via environmental innovation between high-technology manufacturing firms (estimate = 0.17; 95% CI [−0.05, 0.20]) and non-technology manufacturing firms (estimate = 0.10, 95% CI [−0.01, 0.22]). We further examined our research model by decomposing the SMEs into younger firms (1–11 years) and older firms (12–25 years). The results again suggest no difference in the indirect effect of EMA on firm performance via environmental innovation between younger SMEs (estimate = 0.13, 95% CI [0.01, 0.30]) and older firms (estimate = 0.10; 95% CI [0.01, 0.19]). Thus, the findings remain consistent irrespective of the method used.

### 4.4. Further analyses

Given the multi-dimensional nature of environmental innovation and stakeholder integration, we conducted additional analyses using each dimension of both constructs. The results are shown in Table 8.

The analysis of the mediation effect of EMA on environmental innovation reveals differences between the three dimensions. All the effects are positive, but the effect is much more pronounced in the case of environmental organizational innovation ($\beta = 0.29$, $p < 0.001$) than in environmental process innovation ($\beta = 0.17$, $p < 0.05$), and it is only marginally significant in the case of environmental product innovation ($\beta = 0.12$, $p < 0.10$). It is difficult, given the nature of our data, to be certain of the underlying reasons for this, but it is pertinent to speculate whether the context of SMEs in Pakistan has a role to play. Many of the firms that participated in the research may be at an early of responding to the environmental agenda, which may be reflected in the ordering of

**Table 8**
Mediation and moderation analyses based on individual dimensions.

| Paths | Effect |
|---|---|
| ***Mediation effect of environmental management accounting on environmental innovation dimensions*** | |
| Environmental management accounting → Environmental product innovation | 0.12† (1.68) |
| Environmental management accounting → Environmental process innovation | 0.17* (2.47) |
| Environmental management accounting → Organizational environmental innovation | 0.29*** (4.20) |
| ***Moderation effect of stakeholder integration dimensions on firm performance*** | |
| Environmental innovation * Knowledge of stakeholders | 0.09** (3.11) |
| Environmental innovation * Interaction with stakeholders | 0.12* (2.27) |
| Environmental innovation * Adaptation to stakeholder demands | 0.02 (0.48) |

*Notes:* Significance levels: † $p < 0.10$; * $p < 0.05$, * * $p < 0.01$, and * ** $p < 0.001$ respectively; T-values in parentheses.

the three dimensions: they are doing some initial organizational things (including investing in R&D, which has the highest score), but this has not yet impacted so much on products. In any case, many Pakistani manufacturing firms do not sell in final product markets but are part of supply chains that service larger firms. It is the latter organizations that determine the nature of the final product, although they are increasingly being called to account for processes within their supply chains and, hence, try to manage related environmental risks (Chen and Lee, 2017; Plambeck and Taylor, 2016). In that regard, it is noteworthy that saving energy features highly within the environmental process innovation dimension – though not as highly as updating manufacturing processes to meet the standards of environmental law, which are increasingly affecting SMEs (Woodard, 2021, Mallett et al., 2019). Collectively, we confirm the finding of Zandi et al. (2019) that EI mediates the relationship between EMA and FP.

Regarding the moderation effect of the three stakeholder integration dimensions, both knowledge of stakeholders ($\beta = 0.09$, $p < 0.01$) and interaction with stakeholders ($\beta = 0.12$, $p < 0.05$) were found to positively moderate the relationship between environmental innovation and firm performance, whereas no impact of adaptation to stakeholder demands was found ($\beta = 0.02$, $p > 0.10$). It is possible that SMEs' knowledge of stakeholders and interaction with stakeholders allows them to better understand what kind of environmental innovations would be most likely to improve firm performance, whereas merely adapting to stakeholder demands would not necessarily be advantageous to firm performance and might even result in a net cost.

Finally, having also conceptualized firm performance as a multidimensional construct, we further tested the mediation and moderation effects for the two individual dimensions, namely financial and non-financial performance. The results are shown in Table 9.

The findings indicate that the direct impact of EMA on financial performance is positive and significant. However, there is no significant impact of EMA on non-financial performance. We also found that environmental innovation mediates the relationship between EMA and financial performance, but it does not mediate the relationship between EMA and non-financial performance. This finding is consistent with the view that SMEs are resource-constrained and dedicate efforts to utilize their EMA and environmental innovation for financial gains rather than non-financial gains (Centobelli et al., 2019; Madrid-Guijarro et al., 2011) or to satisfy CEO narcissism. Together, the results suggest that EMA, through environmental innovation, has more power to influence financial than non-financial performance, at least in the context in which our study was conducted. This finding is consistent with the view that implementing EMA stimulates the efficient use of resources (Schaltegger et al., 2012), which reduces process costs and enhances the quality of products via the implementation of eco-innovation, leading to better financial performance (Davenport, 1993).

In contrast, we found that the moderation effect of stakeholder integration holds true for both financial performance and non-financial performance. As the results in Table 9 indicate, the impact of environmental innovation on both financial and non-financial performance is stronger at high levels of stakeholder integration as compared to low levels of stakeholder integration.

**Table 9**
Mediation and moderation analyses for financial performance vs. non-financial performance.

| Paths | Effect | LLCI | ULCI |
|---|---|---|---|
| ***Mediation effect of environmental innovation*** | | | |
| EMA → Environmental innovation | 0.21** (3.77) | 0.10 | 0.32 |
| EMA → Financial performance | 0.17* (2.14) | 0.02 | 0.32 |
| EMA → Non-financial performance | 0.13 (1.79) | -0.01 | 0.27 |
| Environmental innovation → Financial performance | 0.45*** (4.63) | 0.26 | 0.64 |
| Environmental innovation → Non-financial performance | 0.17 (1.84) | -0.02 | 0.35 |
| *Indirect effect of EMA on financial performance* | 0.09 | 0.03 | 0.17 |
| *Indirect effect of EMA on non-financial performance* | 0.03 | -0.02 | 0.08 |
| ***Moderation effect of stakeholder integration for financial performance*** | | | |
| −1 SD of moderator | 0.34 (2.77) | 0.10 | 0.58 |
| Mean of the moderator | 0.49 (5.34) | 0.31 | 0.68 |
| + 1 SD of moderator | 0.65 (4.60) | 0.37 | 0.92 |
| ***Moderation effect of stakeholder integration for non-financial performance*** | | | |
| − 1 SD of moderator | 0.06 (0.53) | -0.17 | 0.29 |
| Mean of the moderator | 0.22 (2.48) | 0.04 | 0.39 |
| + 1 SD of moderator | 0.37 (2.85) | 0.12 | 0.64 |

*Notes:* †$p < 0.10$, *$p < 0.05$, * *$p < 0.01$, and * **$p < 0.001$ respectively; LLCI = lower level confidence interval; ULCI = upper level confidence interval; T-values in parentheses.

## 5. Conclusion

Environmental management accounting (EMA) has emerged as a promising set of tools and perspectives to help firms respond to environmental challenges and opportunities. A limited number of empirical studies suggest that EMA may be beneficial for firm performance. However, shortcomings in previous studies provide scope for further investigation. Furthermore, as has recently been suggested, other factors should be taken into account when the relationship between EMA and firm performance is investigated.

Using primary data collected via questionnaires from 204 manufacturing SMEs in Pakistan, our analysis reveals, first, that the relationship between EMA and firm performance is significant. Second, we find that the impact of EMA on firm performance is significantly and positively mediated by environmental innovation, especially the organizational and process dimensions of this. The strength of the mediation result suggests that the apparent direct effect of EMA on firm performance is attributable to the mediating impact of environmental innovation, because the direct association becomes insignificant once environmental innovation is added to the analysis. Third, our findings suggest that stakeholder integration positively moderates the association between environmental innovation and firm performance, thus leveraging the impact of EMA on firm performance – chiefly in the form of financial performance. It is knowledge of, and interaction with, stakeholders that bring about this effect, not merely adapting to stakeholder demands. The main findings were robust to several robustness checks.

The findings of our study offer practical implications for managers and accountants. In particular, they suggest that it might be worthwhile for firms to develop an EMA capability. However, that investment will be most worthwhile if the firm also embarks on environmental innovations. Furthermore, those innovations are most likely to have a positive impact on firm performance if, where possible, the firm takes steps to know and interact with its stakeholders.

Our study contributes to the existing literature in several ways. First, setting aside some studies that include EMA measures of poor construct

validity for EMA (da Rosa et al., 2020; Fuzi et al., 2019a, 2019b, 2020), we confirm the findings from a limited number of other studies outside the accounting literature, that EMA is positively related to firm environmental performance (Phan et al., 2017; Sari et al., 2021; Zandi et al., 2019) and firm financial performance (Sari et al., 2021). We derived this supportive evidence from a context that is focused solely on SMEs in a developing economy – which might have been expected to be unsophisticated and hence less likely to show such relationships. Second, we provide insights into the role of environmental innovation as a mediating mechanism through which EMA influences firm performance – an issue that has not been adequately addressed by previous studies, which either did not examine *environmental* innovation (Sari et al., 2021) or did not examine the effect on *financial* performance (Zandi et al., 2019). An interesting finding of our study is that, once the environmental innovation mediator is taken into account, the direct association between EMA and firm performance becomes insignificant. Third, having recognized the importance of stakeholders to firms' responses to the environmental agenda, we demonstrate that environmental innovation's role in driving firm performance, and hence the impact of EMA, is strengthened when stakeholder integration is greater.

Various features of our study's research design – the use of a comprehensive set of measures for environmental management accounting, environmental innovation (product, process and organizational) and firm performance (both environmental and financial) – should be of value to future researchers. Nevertheless, the study also has some limitations that provide opportunities for further research. First, while we examined firm performance in terms of both financial and environmental performance (which we recommend future researchers should do), like previous researchers (cf. Sari et al., 2021; Gunarathne et al., 2021), we relied on finance managers' perceptions, which might be biased. We encourage future studies to use objective data to assess firm performance, on their own or as a complementary set of measures. Second, for our other main variables, we relied on just one set of responses from each firm, the CEO's. The CEO is probably the best-placed person to reply to the range of questions asked. However, in future studies, it might be advisable to try to obtain a second set of replies for at least some of the questions, to provide extra confidence in the validity and reliability of the measures – although the effective firm response rate might consequently be reduced. Third, the study was limited to a sample of SMEs in Pakistan and might not be generalizable beyond that setting. Future studies could employ our model in other developing and developed economies, to produce comparable findings. Fourth, as our study examined the link between EMA and firm performance, it focused on the consequences of EMA. Future studies could also examine EMA's antecedents, to build a complete picture. If so, for methodological reasons related to the conceptual model, it might be sensible to include antecedents of environmental innovation and possibly stakeholder integration. Finally, questionnaires tend to provide limited insight into the richness of practices, but future qualitative research would help deepen our understanding of the relationships examined in our study. For example, field studies (cf. Pfister and Lukka, 2019) provide opportunities to explore how the various dimensions and components of environmental innovation are implicated in the link between different aspects of EMA and firm performance.

## Data Availability

Data will be made available on request.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.mar.2023.100865.

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