Organisational resources as facilitators and inhibitors of green performance: non-linearities, interactions and international differences

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Abstract: While firms face pressure to improve their green (i.e., environmental) performance, little is known about how adapting their resources can help them to more successfully implement green practices and improve their green performance. Drawing on the resource-based view, this study develops novel hypotheses about the effects of a firm's non-financial and financial resources on its green performance. These hypotheses are tested with hierarchical linear modelling of international, multi-source objective data. Regarding non-financial resources, this study finds a *U*-shaped effect of female board-of-directors representation on green performance, which is moderated by the directors' education level. Moreover, the directors' education level positively influences green performance in Asian countries, but not in Western countries. Regarding financial resources, financial slack and R&D intensity exert non-linear effects on green performance. These original findings help firms to maximise their green performance by resource adjustments, and help public policy makers spread knowledge to develop their economy sustainably.

Keywords: green performance; female board representation; board education; financial slack; R&D intensity; international differences.

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1 Introduction

Industrial activities impose an immense burden on the natural environment. Owing to the natural resource constraints, growing environmental problems and increasing pressure from stakeholders, green performance has become an area of strategic importance for organisations (Albino et al., 2012; de Villiers et al., 2011; Haque, 2017). Such developments challenge firms to change their way of doing business and to focus on improving their green performance.

Since a firm's performance depends largely on its resources (Andersén, 2011), it is important to explore the role of specific resources in helping some firms outperform others in terms of green performance. The Resource-Based View (RBV) of the firm is the most commonly used theory to explain variations in firm performance (Galbreath, 2016; Hart and Dowell, 2011), and is widely recommended for use in research about environmental management (López-Gamero et al., 2009). It suggests that an organisational resource can be anything that would be considered a strength or a weakness of a firm (Wernerfelt, 1984) and that not all resources create a competitive advantage for the firm (Barney, 1991). However, in a green context, the literature does not provide a clear answer to whether different organisational resources have positive, negative, or even non-linear effects on green performance (Latan et al., 2018). Thus, we seek to answer the research question of how non-financial and financial organisational resources affect a firm's green performance. The RBV best applies to our research as it recognises the importance of both financial and non-financial resources (Barney, 1991) and enables us to explore how the availability of such resources affects a firm's green performance.

Prior studies claim that the relationship between the firm's resources and green performance lacks conclusive empirical evidence. They suggest several limitations in our understanding of this literature (Amato and Amato, 2007; Berrone et al., 2013; Haque, 2017; Latan et al., 2018; Post et al., 2011). First, most studies on the performance impact of a firm's resources consider only financial (e.g., George, 2005; Lee and Min, 2015) or only non-financial (e.g., Darmadi, 2013; Joecks et al., 2013) resources and do not consider the interactions between resources that belong to the same category (e.g., between non-financial resources). The literature thus still lacks a coherent picture of the relationship between a firm's resources and green performance. We rely on the RBV and address the limitations of previous studies by holistically considering the firm's *non-financial* and *financial* resources and the possible interactions within a category to examine their influence on the firm's green performance. Second, several studies rely on subjective measures of green performance (Haque, 2017; Latan et al., 2018; Post et al., 2011), which may not accurately reflect the green performance. To overcome the limitations of subjective measures, such as the omission of information, biases, inconsistency and less reliability (Waddock and Graves, 1997), we use an objective measure of green performance, the green revenue score published in Newsweek's green rankings 2016. Compared to subjective measures, this measure can be considered a better proxy because it is verified by a third party and is a more objective, independent, holistic and outcome-related measure of green performance (Albino et al., 2012; Cordeiro and Tewari, 2015). Moreover, it has also been widely used in the recent literature due to its methodological rigor (Gao and Tran, 2020; Olsen et al., 2014; Rosete et al., 2020). Third, most studies on the relationship between resources and green performance use data from Anglo-Saxon and West European countries (Tariq et al., 2017). However, there is a consensus among researchers that Asian firms differ from Western firms in the way they manage their resources (Chandra, 2012). Asian firms still lag behind Western firms in adopting proactive environmental practices (Li et al., 2017) because the differences in social, political and economic institutions (Ali et al., 2017; Baughn et al., 2007; Chen and Miller, 2011) constitute obstacles in their adoption. Thus, we study both Western and Asian firms listed among the world's largest 500 firms. These firms are rich in organisational resources and have a large environmental footprint (Prado-Lorenzo and Garcia-Sanchez, 2010). Therefore, our sample makes an ideal case for studying the effect of organisational resources on green performance in a context of industrial and institutional diversity.

To examine the effects of the firm's non-financial and financial resources and of their interactions on green performance, we develop hypotheses and test them with hierarchical linear modelling of multi-source data from the world's largest publicly traded companies. Our results suggest a *U*-shaped effect of female board-of-director representation on green performance, which is moderated by the directors' education level. Moreover, our results show that the director's education level positively influences green performance in Asian, but not Western, countries. Regarding financial resources, we find that financial slack and R&D intensity exert non-linear effects on green performance.

Thereby, we aim to extend the theoretical knowledge about the role of the RBV in explaining a firm's green performance. The RBV assumes that different resources have either a positive effect or no effect on the creation of a competitive advantage that leads to a superior green performance (Hart and Dowell, 2011). However, we theorise that some resources may also have a negative effect on green performance. A resource that sometimes appears beneficial may, under certain circumstances, have a negative effect.

For example, some resources may have a non-linear, *U*-shaped effect on green performance, which includes a section where the resource has a negative effect (i.e., the initial part of a *U*-shaped effect). Moreover, a resource may interact with another resource in influencing green performance, such that the presence of the other resource causes the effect of the focal resource to become negative. Furthermore, a resource may interact with national institutions such that the resource has a positive effect on green performance in one country, but not in a different country with different institutions. Thus, we examine the non-linearity (e.g., *U*-shaped effect pattern), resource interactions, and international differences in the effects of different, partially hitherto unexplored resources on green performance. The presence of such effects may provide an explanation to the mixed results of previous studies (Amato and Amato, 2007; Berrone et al., 2013; Haque, 2017; Latan et al., 2018; Post et al., 2011) on the relationship between resources and green performance. Moreover, knowing such effects may enable firms to develop and adapt their resources in order to maximise their green performance, which would be beneficial to firms and public policy.

2 Theoretical background and hypothesis development

2.1 Green performance

Despite a compelling body of literature, the concept of corporate green performance still lacks a clear and generalised definition (Trumpp et al., 2015). According to Nawrocka and Parker (2009, p.602), the ISO standard defines green performance as the "measurable results of an organisation's management of its environmental aspects." Walls et al. (2012) define green performance as how well a firm's strategic activities manage its environmental impact. Similarly, López-Gamero et al. (2009, p.3111) define green performance as "the output of environmental management." Salo (2008) defines green performance based on the financial value of the firm's environmental management activities. These definitions are similar in terms of their focus on corporate environmental aspects and the outcome of such activities, whereas they differ in terms of the attributes and notions considered (Trumpp et al., 2015). For instance, Walls et al. (2012) considered both proactive and reactive approaches that a firm adopts to manage its impact on the natural environment, whereas López-Gamero et al. (2009) looked at both environmental management and environmental performance aspects. Moreover, the ISO standard defines green performance as the result of environmental management systems, where the differences in such systems may affect the way the green performance is defined. Salo (2008) has taken a completely different view by considering the factors that are important in creating or protecting financial value. Drawing on these definitions and capturing their essential properties, we define green performance as the outcome of how well the firm manages its overall environmental impact throughout the life cycle of its product and/or service offerings, that is, as how environmentally sustainable the firm's revenue is (Newsweek, 2016).

Past research highlights various antecedents and consequences of the firm's green practices (Aragón-Correa et al., 2008; Dangelico, 2015; Humphrey et al., 2012). As antecedents of corporate green performance, studies identify the availability of strategic opportunities (Babiak and Trendafilova, 2011), green strategic intent (Jirakraisiri et al., 2021), inter-organisational collaboration (Albino et al., 2012; Jirakraisiri et al., 2021), the

quality of environmental disclosure (Brunnermeier and Cohen, 2003), and institutional and stakeholder pressure (Babiak and Trendafilova, 2011; Berrone et al., 2013). As consequences of corporate green performance, studies identify objectives such as gaining legitimacy, taking advantage of new market opportunities for green products and services (Babiak and Trendafilova, 2011), improving customers' satisfaction and value perceptions (Frank, 2018; Herbas Torrico et al., 2018), enhancing customers' purchase intentions (Frank, 2021), improving employee performance (Tariq et al., 2017), and enhancing profits (Gallego-Álvarez et al., 2015; Tariq et al., 2019) and firm value (Cordeiro and Tewari, 2015). Thus, investors today look at green performance ratings (Waddock and Graves, 1997) when evaluating a firm's value and making an investment decision. Given these consequences, green performance has come to be viewed as a source of competitive advantage (Prado-Lorenzo and Garcia-Sanchez, 2010) in today's dynamic environment. Despite its importance, the literature still lacks conclusive evidence of its dependency on the firm's non-financial and financial resources and has several limitations (Amato and Amato, 2007; Berrone et al., 2013; Haque, 2017; Latan et al., 2018; Post et al., 2011).

First, most studies focus on the influence of organisational resources on the firm's adoption of green initiatives (Ben-Amar et al., 2017; Liao et al., 2015; Post et al., 2011) and use these initiatives as a proxy for green performance. Their tacit assumption is that the adoption of green practices may ultimately lead to better green performance. However, the adoption of green initiatives does not automatically lead to higher green performance (López-Gamero et al., 2009), and the proxy assumption may not hold in reality. Indeed, firms may engage in green initiatives for image improvement and publicity purposes (Tariq et al., 2017), while the performance outcome of these activities may not be a priority (Thorlakson et al., 2018).

Second, several studies rely on subjective measures of green performance (e.g., content analysis of corporate documents, corporate environmental disclosures and adoption of environmental initiatives) (Haque, 2017; Latan et al., 2018; Post et al., 2011), which may not reflect the actual green performance. Third, most studies on the performance impact of a firm's resources consider only financial (e.g., George, 2005; Lee and Min, 2015) or only non-financial (e.g., Darmadi, 2013; Joecks et al., 2013) resources, but not both together. While these studies improved our understanding, the literature still lacks a coherent picture of the relationship between a firm's resources and green performance. Moreover, due to considering only a limited scope of resources, prior studies do not examine the interactions among resources. The resource perspective of the firm suggests that there is a strong complementary relationship among individual resources and that the type of clustering and interaction of these resources significantly influences performance (Foss, 1998; Galbreath, 2016; Hart and Dowell, 2011). Such interactions among resources may be particularly important with regards to non-financial resources and, in particular, aspects of human decision-making, which frequently exhibit interdependencies due to their complex psychological nature (Frank, 2021; Jirakraisiri et al., 2021).

Fourth, most studies on the relationship between resources and green performance use data from Anglo-Saxon and West European countries (Tariq et al., 2017). However, there is a consensus among researchers that Asian firms and Western firms differ in the way they manage their resources (Chandra, 2012). These differences can be attributed to the unique characteristics and challenges faced by each group of firms. Compared with Western firms, Asian firms face more resource constraints (Hermawan and Mulyawan,

2014; Van Essen et al., 2012), lack of established corporate governance mechanisms (Van Essen et al., 2012), weaker environmental law enforcement (Ali et al., 2017; Puppim de Oliveira and Jabbour, 2017; Hermawan and Mulyawan, 2014; Oehmichen, 2018), high levels of ownership concentration (Ali et al., 2017; Oehmichen, 2018; Van Essen et al., 2012), and lack of stakeholder awareness and pressure (Ali et al., 2017; Baughn et al., 2007). In addition to these factors, social, political and economic institutions (Ali et al., 2017; Baughn et al., 2007; Chen and Miller 2011) may slow down their adoption of environmental practices. These differences may explain why Asian firms still lag behind Western firms in adopting proactive environmental practices (Li et al. 2017). Thus, it is important to explore international differences in the formation of green performance.

2.2 Resource-based view of the firm

Anything that is a strength or weakness of a firm can be considered as a resource (Wernerfelt, 1984). Barney (1991) classified these resources into the three categories of physical capital (e.g., plant, equipment), human capital (e.g., skills, relationships, experience) and organisational capital resources (e.g., formal reporting structure, coordinating systems), which enable a firm to implement its key strategies for better performance. However, not all resources are strategically relevant and create a competitive advantage (Barney, 1991). Only resources that are valuable, rare, non-substitutable and difficult to replicate can lead to a sustainable competitive advantage (Barney, 1991; Hart and Dowell, 2011).

Several strategy scholars rely on the RBV to explain performance differentials among firms (Aragón-Correa et al., 2008; Galbreath, 2016; Hitt et al., 2001; Lee and Min, 2015; López-Gamero et al., 2009; Padgett and Galan, 2010). Thus, to answer our research question on the relationship between organisational resources and green performance, we rely on the RBV of the firm as proposed by López-Gamero et al. (2009). Based on Wernerfelt's (1984) and Barney's (1991) views of resources, we classify organisational resources into non-financial resources (i.e., director education, female board representation, location of headquarters) and financial resources (i.e., financial slack, R&D intensity) and examine how they affect green performance. By examining the impact of such different types of resources on a firm's green performance, we aim to extend the RBV as follows.

First, we examine the green performance impact of hitherto unexplored resources and of hitherto unexplored interactions among resources. Second, we make the new proposition that the green performance impact of some resources is non-linear, thus providing an explanation to the mixed results of past studies (Amato and Amato, 2007; Berrone et al., 2013; Haque, 2017; Latan et al., 2018; Post et al., 2011) on the relationship between resources and performance. Third, our study is the first to explore international differences in the formation of green performance. Thus, in summary, our study extends the knowledge of RBV mechanisms by newly examining the non-linearity, interactions and international differences in the effects of resources on green performance.

2.3 The firm's non-financial resources: composition of the board of directors

Board of directors (BOD): The BOD can be defined as an important element of governance that oversees the business activities of a firm (Fernández-Gago et al., 2016).

From a RBV, the BOD, which acts as an interface between the organisation and its external environment, is an important *non-financial resource* (Barney, 1991; Michelon and Parbonetti, 2012; Shaukat et al., 2016). It plays two important roles: monitoring the activities of the management and providing resources for the firm (Ben-Amar et al., 2017; Hillman and Dalziel, 2003). Since today's stakeholders pressure firms to improve their green performance, which in turn affects these firms' financial performance (Tariq et al., 2017), it has become an important task for the BOD to ensure that the firm addresses such environmental concerns (Ben-Amar et al., 2017; Hillman and Dalziel, 2003) and meets the stakeholders' green expectations (de Villiers et al., 2011). From a RBV of the firm, the BOD can be considered a valuable (Barney, 1991) resource as it helps the firm to exploit environmental opportunities while addressing environmental challenges posed by stakeholders (Hillman and Dalziel, 2003). Moreover, according to Shaukat et al. (2016), the BOD is a tacit, people-intensive and "socially complex organisational resource," which makes the BOD an imperfectly imitable resource, for which there is no strategically equivalent substitute (Barney, 1991). Thus, from a RBV, the BOD is a valuable, unique, imperfectly imitable and non-substitutable resource of a firm, which can create a sustainable competitive advantage to the firm in pursuing a better green performance. For instance, an ideal BOD can provide the firm with information about environmental opportunities, better environmental advice, access to financial resources and links to access environmental expertise (de Villiers et al., 2011), which may ultimately help to influence green performance.

Previous research suggests that the BOD matters (Galbreath, 2016) and influences the firm's adoption of specific strategies (Hillman et al., 2000), including green strategies. However, despite its importance and the rapid, recent increase in using the BOD as a corporate governance mechanism to address environmental concerns (Peters and Romi, 2014), limited research has examined the influence of the BOD as a firm's non-financial resource on its green performance (Post et al., 2011).

Recently, there has been much interest in whether female directors trigger different firm behaviours (Gupta et al., 2020). This is because research suggests that a firm's performance outcome may differ depending on the decision-maker's gender (Faccio et al., 2016). Scholars suggest that women tend to have different life experiences compared to their male counterparts, which lead to different ways of viewing various psycho-social qualities (Ridgeway, 2011), such as ethics (Eagly and Carli, 2003), which drives a firm's green strategy development (Ben-Amar et al., 2017). In line with this view, several studies establish a link between female board representation and the firm's disclosure of environmental information (Liao et al., 2015; Prado-Lorenzo and Garcia-Sanchez, 2010). As another aspect of BOD, the directors' level of education has been linked to the firm's innovation outcomes, strategy changes (e.g., adoption of green practices) and performance (Goll et al., 2001).

From a RBV, female directors and highly educated directors can improve the conditions (i.e., valuable, rare, imperfectly imitable and non-substitutable) under which the BOD is considered a resource, as they can bring in a diverse range of skills, capabilities and perspectives that can help improve a firm's green performance (Seierstad, 2016). Owing to the growing presence of women in corporate leadership roles (Gupta et al., 2020) and the influence of the directors' education level on the firm's innovation and performance (Goll et al., 2001), we examine the influence of the firm's BOD in terms of both female representation and the directors' education level, and the complementarity between these aspects, on the firm's green performance. Moreover, according to Barney

(1991), physical capital resources, such as a firm's geographical location, can be considered resources, which may allow or hinder a firm's adoption of environmental strategies. Thus, relying on the RBV and given the lack of empirical evidence exploring international differences in the formation of green performance, we identify the location of a firm's headquarters where the BOD operates, as a non-financial resource.

Female board representation: Over the past years, the notion of female board representation has gained attention and interest from policy makers, society and the academic community (Ben-Amar et al., 2017; Pucheta-Martínez et al., 2018; Seierstad, 2016). From a RBV, females in organisations are important and can be recognised as a resource as they bring in a diverse range of skills, capabilities and perspectives that can help improve a firm's performance (Seierstad, 2016). For instance, female directors can bring in unique human resources and social ties that encourage the firm to go green and improve its performance. Compared to males, females are said to depict more commitment and a less self-oriented behaviour (Ben-Amar et al., 2017). In addition, female directors can provide additional valuable strategic inputs by embracing different points of view (Ben-Amar et al., 2017; Haque, 2017). Incorporating females into the BOD can thus improve the strategic decision-making process (Haque, 2017; McGuinness et al., 2017; Pucheta-Martínez et al., 2018). Compared to males, females can help avoid potential conflicts, perform effective supervision, and help other members be more independent (Pucheta-Martínez, et al. 2018). Such qualities are important in controlling potential opportunistic behaviour of the management and in ensuring that the firm addresses environmental issues effectively.

Moreover, females are recognised to be more sensitive towards the environment and the stakeholders' interests, thereby being more attentive to environmentally friendly practices (Haque, 2017). Given their ability to make ethical judgments and their sensitivity to environmental issues, incorporating women may encourage an organisation to make decisions that support environmental sustainability. This feature of women may contribute significantly to strategic issues and organisational practices related to green performance.

Although some studies examine the link between female board representation and a firm's corporate social responsibility, only a few focus on the environmental dimension and most of these studies use unidimensional proxies or subjective measures of green performance. According to Ben-Amar et al. (2017) and Liao et al. (2015), firms with more females on the BOD are more likely to disclose carbon information. Haque (2017) found a positive effect of gender diversity on a firm's efforts, but not on its success, in reducing carbon emissions. Similarly, Post et al. (2011) found that firms with more than two female directors are more environmentally responsible. In this article, we focus specifically on green performance as an outcome variable because this outcome, rather than intermediate processes, affects the firm's success. We make the original proposition that female board representation has a *U*-shaped effect on green performance.

According to Nemeth (1986), in a group, the majority is capable of exerting more influence than the minority, as the majority's judgment is perceived to be correct and the minority tends to confirm the majority's view since they want to be accepted by the group. However, in the corporate world, this might not be true, given the struggle a female makes to get onto the board. Despite being a minority, females may make their voice heard, actively participate to make a difference and prove the importance of their existence on the BOD. For instance, Konrad et al. (2008) pointed out that regardless of being the only female member on the board, female members can become thick-skinned

and work hard and smart to prove themselves. According to their arguments, even one woman can have a significant impact on the decisions of the BOD and make a substantial contribution. Moreover, in situations with only limited female board representation, these females will likely receive empathy from the majority of a male-dominated board, which may less be the case when there is a balance between male and female members. Social research indicates that empathy leads to more favourable attitudes and help for the minority (Batson et al., 1997; Stephan and Finlay, 1999). Thus, when female representation is at a low level, we expect that the BOD pays attention to women's environmental views, deploys their female representation as a strategic resource, and thus succeeds in helping the firm to exhibit a higher green performance.

As female board representation increases and reaches a moderate level, the directors may start alliances based on gender, whereby in-groups or out-groups can be created (Richard et al., 2004). In such situations, directors may attempt to confirm the views of their respective in-group while being against the views of the out-group. Such situations create limitations in the communication process and the firm's decision-making, resulting in potential conflicts within the BOD, which negatively affect the relationship between the two groups (Hillman and Dalziel, 2003). The extent of the existence of such sub-groups and conflicts within the BOD may hinder the effectiveness of female directors as an important resource and may limit the benefits of having female directors in addressing the firm's environmental concerns. Thus, we expect the firm's green performance to be lower when female board representation is at a moderate level.

According to the arguments on the benefits of having female members on the BOD as an important non-financial resource, females are more sensitive towards environmental issues, add human and relational capital (Haque, 2017), create a culture of innovation and open communication (Pucheta-Martínez et al., 2018), promote participative decision-making (Haque, 2017), and establish the board's independence (Pucheta-Martínez et al., 2018). Thus, from a RBV, when female board representation is high, women will willingly express their opinions and influence the board's culture and decision-making, which may ultimately help improve the firm's green performance. Joecks et al. (2013) found that gender diversity exerts a *U*-shaped effect on a firm's return on equity. Furthermore, their findings reveal that this female representation needs to reach a certain level to realise the benefits of having gender diversity that results in higher performance. Thus, based on these arguments, we expect a firm's green performance to be higher when there is a higher level of female board representation.

H1: Female board representation has a U-shaped effect on the firm's green performance.

Directors' education level: An individual's level of education reflects his or her knowledge, skills, leadership style, ability to tolerate ambiguity, attitude and behaviour (Hambrick and Mason, 1984; Westphal and Zajac, 1995; Wiersema and Bantel, 1992). Post et al. (2011) found that the education level of directors on a firm's BOD influences environmental responsibility only among electronic firms, but not for the majority of contexts. They measure environmental responsibility only in terms of corporate environmental disclosures and environmental practices, whereas no study has explored the effect of director education on actual green performance. To fill this gap, we develop the hypothesis that director education positively affects the firm's green performance. We argue that director education influences the firm's adoption of green initiatives, the generation of creative green ideas and the effective implementation of these ideas. Strategy research shows that director education enhances innovation (e.g., generating and

implementing creative green ideas) and the willingness to adopt strategic changes (e.g., a change from a non-green to green strategy) (Bantel and Jackson, 1989; Westphal and Zajac, 1995; Wiersema and Bantel, 1992). These outcomes may lead to better green performance, which requires firms to change their traditional, non-sustainable strategies and to address environmental challenges in novel, more effective ways.

According to the RBV, the BOD provides critical organisational resources and thus contributes to firm-level performance outcomes (Hillman and Dalziel, 2003), which may include the adoption of green initiatives and both the generation and effective implementation of creative green ideas. Regarding the adoption of green initiatives, the BOD plays a crucial role in directing the firm to respond to relevant stakeholder demands, which nowadays include environmental concerns (Herbas Torrico et al., 2018). As the concept of environmental sustainability is abstract and difficult to understand, education enables individuals to understand and pay more attention toward environmental sustainability (Post et al. 2011). Hence, we posit that more highly educated directors direct the firm toward the adoption of green initiatives. Regarding the generation and effective implementation of creative green ideas, firms with more highly educated directors can leverage these directors' skills, knowledge and relationship network into better organisational performance (Darmadi, 2013). Specifically, from a RBV, these educated directors will play their role as a strategic resource by stimulating the generation of green ideas while providing more diverse and innovative ideas and a broader perspective on resolving environmental issues (Lee et al., 2005). Highly educated directors can also more effectively question the firm's direction and monitor the firm's implementation of important initiatives (Badir et al., 2020). They thus can ensure the firm's progress towards environmental sustainability and green performance.

H2: The director education level has a positive effect on the firm's green performance.

Moderating role of director education: Board members do not act individually, but rather act in collaboration with other members to affect the firm's outcomes (Galbreath, 2016). Their personal characteristics, such as their education, are important for achieving effective outcomes of their collaboration (Bunderson, 2003). From a RBV, it is expected that highly educated directors can become a better strategic resource as they are more open-minded (Darmadi, 2013) and can better understand and pay more attention to environmental sustainability (Post et al., 2011), while leveraging their skills, knowledge and relationship network more effectively to create better environmental performance. As we explain below, we expect that higher director education, as a better strategic resource, shifts the *U*-shaped effect of female board representation on green performance (H1) to the left, whereas lower director education shifts it to the right. That is, we predict that higher director education lowers the minimum threshold from which female board representation starts positively affecting a firm's green performance.

As previously explained, both female board representation (H1) and director education (H2) can indicate a board's openness to change, initiative, risk-taking, creativity and innovation. Moreover, highly educated individuals tend to be more open-minded (Darmadi, 2013) and "have an ability for integrative complexity" (Wiersema and Bantel, 1992). Research also shows that education inspires receptivity and openness to new ideas (Damanpour and Schneider, 2006), which may both increase the acceptance of female directors' green ideas by their male colleagues and help in implementing these ideas, thus improving the firm's green performance.

Such education-facilitated openness and innovativeness can enable the BOD to embrace and integrate different perspectives when making decisions (Wiersema and Bantel, 1992). The ability and willingness of educated directors to acknowledge and integrate different perspectives from other board members is essential to embrace the merits of having a gender-diverse board. It may enable them to appreciate the distinctive green ideas (Damanpour and Schneider, 2006) of female directors and integrate these ideas when making decisions impacting their firm's green performance. Thus, a higher level of director education may enable the BOD to realise the benefits of having female members even if these are a minority, indicating a shift to the left in the *U*-shaped effect from female board representation on green performance.

H3: Higher director education lowers the minimum threshold from which higher female board representation translates into improved green performance. That is, it causes a left-shift of the U-shaped effect of female board representation on green performance.

Moderating effect of Asian (vs. Western) home country on the effect of director education: Owing to the growing attention to environmental impacts, firms around the world face greater expectations to address their corporate environmental issues (Baughn et al., 2007). However, firms may exhibit unique characteristics and face distinctive challenges with regard to the country in which they are headquartered. From a resource perspective, a firm's geographical location can be considered an important strategic resource of a firm (Barney, 1991), as it may allow or hinder a firm's adoption of environmental strategies. Compared to Western firms, Asian firms have more limited access to resources (Chandra, 2012; Hermawan and Mulyawan, 2014; Van Essen et al., 2012). Moreover, they exhibit a more authoritative management style and different strategic management approaches when making decisions on the allocation of such resources (Haley and Tan, 1999). For instance, according to Haley and Tan (1999), Asian firms tend to be more reactive and make more ad-hoc decisions with little or no consultancy. Moreover, Asian firms face weaker environmental law enforcement (Ali et al., 2017; Puppim de Oliveira and Jabbour, 2017; Hermawan and Mulyawan, 2014; Oehmichen, 2018) and lower stakeholder awareness and pressure for green performance (Ali et al., 2017; Baughn et al., 2007).

Many Asian firms still lag behind their Western counterpart in adopting proactive environmental practices (Li et al., 2017), due to the difference in social, political and economic institutions (Ali et al., 2017; Baughn et al., 2007; Chen and Miller, 2011). While Western firms already share a consensus on the benefits of green performance (Jalal et al., 2013; Rezaee et al., 2019), the notion of environmental sustainability is still less established among Asian firms (Li et al., 2017). As firms engage in environmental practices to gain legitimacy by conforming to regulatory and normative pressures (Berrone et al., 2013), firms with lower pressure from their stakeholders and weaker institutional fields will be less compelled to adopt environmental practices and improve their green performance (Berrone and Gomez-Mejia, 2009).

In such a context, where the notion of environmental sustainability is less established and the institutions for environmental protection are weak, education may become essential to encourage individuals to understand both the importance and benefits of green performance, motivating them to pay more attention to environmental sustainability (Post et al., 2011). As education enhances the willingness to adopt strategic changes (e.g., a change from a non-green to green strategy) (Bantel and Jackson, 1989; Westphal and Zajac, 1995; Wiersema and Bantel, 1992) and facilitates openness, educated directors

may influence the board to address environmental challenges and promote green performance, irrespective of the weak environmental institutions. As argued in the RBV, a complementary relationship among resources matters in achieving superior performance. Thus, a higher level of director education may exhibit a positive effect on green performance among the firms headquartered in Asian countries. On the other hand, Western firms, who share a consensus on corporate benefits of environmental sustainability (Jalal et al., 2013; Rezaee et al., 2019), face well-established natural environmental regulations (Ali et al., 2017), and under strong pressure from stakeholders may not essentially require higher education to understand the importance of green performance.

H4: The positive effect of director education on green performance is stronger for firms headquartered in Asian countries than for firms headquartered in Western countries.

2.4 The firm's financial resources

Achieving a higher green performance may require large financial investments, while the outcome is uncertain. Drawing on insights from the RBV (Barney, 1991), we identify financial slack and R&D intensity as *financial resources* and examine whether these resources matter in achieving a superior green performance. Financial slack is a type of a financial resource that acts as a buffer enabling an organisation to implement strategic changes (Bourgeois, 1981). It provides the organisation with the ability to develop, or have access to, better and up-to-date knowledge and technologies to improve green performance (Yang et al., 2014). However, there is still a lack of conclusive empirical evidence on the relationship between financial slack and green performance (Amato and Amato, 2007; Berrone et al., 2013). Similarly, a firm's long-term commitment and investment towards R&D is another important financial resource which can help create its technical capital (Ho et al., 2005) to improve its green performance. Although some studies explore the effect of a firm's R&D on organisational outcomes (Huang et al., 2016; Lee and Min, 2015; McWilliams and Siegel, 2000; Padgett and Galan, 2010), its effect on green performance still lacks evidence.

Financial slack: Despite the immense pressure from various stakeholder groups, the availability of financial slack is a crucial factor that allows the firm to undertake commitments toward the environment (Amato and Amato, 2011; Miles and Covin, 2000; Waddock and Graves, 1997). Slack resources are resources that an organisation has in excess (Nohria and Gulati, 1997). In this study, we focus specifically on financial slack, which allows firms to smooth their operation even during difficult periods by acting as a buffer (George, 2005). Thus, from a RBV, it also helps firms to initiate and implement strategic changes (Bourgeois, 1981) while maintaining competitive advantage.

Singh (1986) classifies financial slack into absorbed (i.e., excess costs in an organisation) and unabsorbed (i.e., uncommitted liquid resources which are available in excess) slack. Although absorbed financial slack is considered recoverable in theory, actual attempts to retrieve it tend to result in organisational resistance (Herold et al., 2006). Such absorbed financial slack is mostly recovered in emergency situations and is thus used to survive a crisis, rather than to improve performance. Comparatively, unabsorbed financial slack can be used to meet external stakeholder pressure, such as for promoting environmentally friendly organisational behaviour (Xu et al., 2015). Therefore, we focus on unabsorbed financial slack.

Opponents of slack resources view them as a waste, an unnecessary cost and a result of ineffective use of organisational resources and operations (Chiu and Liaw, 2009; Nohria and Gulati, 1997). However, as argued by Berrone et al. (2013) and in line with the RBV, a firm with more resources may use them to address environmental challenges and exploit green opportunities. Thus, the availability of slack resources affects the firm's ability to go green.

Although some studies explore the effect of financial slack on environmental behaviours, the findings are ambiguous (Berrone et al., 2013) and suffer from the use of proxy measures (Amato and Amato, 2011; Waddock and Graves, 1997), which is problematic (Arora and Dharwadkar, 2011). Given the lack of solid evidence for a linear effect of financial slack on green performance, we expect this relationship to be *U*-shaped based on Bromiley's (1991) model of the relationship between slack levels and a firm's risk-taking – measured as the "ex-ante uncertainty of a firm's earnings stream." In his view, the effect of slack on risk-taking depends largely on a comparison between actual slack and the target level of slack set by the firm. If the slack level falls significantly below its target level, managers are likely to take risks in order to create additional slack. If slack is around the target level, managers may take fewer risks since they see their organisation as operating in a satisfactory manner and continue with their usual routines. If the slack level is well above the target level, managers likely engage in slack search by trying out new ideas.

Following Bromiley's logic, we argue that when the financial slack is at a lower level, firms may take risks and explore new opportunities to create more slack to protect themselves from the uncertainties in the external environment (Bromiley, 1991; Martinez and Artz, 2006). Based on the RBV, firms then use their scarce resources more wisely to create a competitive advantage through different means such as green performance. Thus, too low levels of financial slack may encourage firms to improve their productivity and reduce costs by minimising consumption of resources (e.g., energy), minimising waste generation and ensuring optimal utilisation of scarce natural resources, resulting in a higher green performance. This also may encourage firms to engage more wisely in green product innovation to expand their market coverage, and in green process innovation to improve their efficiency and reduce waste. When there is a higher level of financial slack, it may provide the firm with more flexibility to respond to stakeholder pressure to address environmental concerns. Such higher levels of financial slack may act as an incentive to take risks and explore new opportunities to improve the firm's green performance. When the slack is at a moderate level, it may provide little incentive for firms to improve their green performance or engage in radical changes (to fully go green) as they regard their operations as satisfactory. In such situations, firms may focus on managing their current strategy rather than exploring environmental opportunities.

H5: Financial slack has a U-shaped effect on the firm's green performance.

R&D intensity: Investments in R&D reflect a firm's commitment to developing its technical capital (McWilliams and Siegel, 2000), which enhances its distinctive knowledge and capabilities. Regardless of the industry, firms need to invest in R&D to gain a sustainable competitive advantage (Krishnan et al., 2009). R&D intensity is among the determinants of innovation that have received the most attention from researchers (Raymond and St-Pierre, 2010). Therefore, firms are constantly investing in R&D to boost their innovation and long-term performance (Lin et al., 2006).

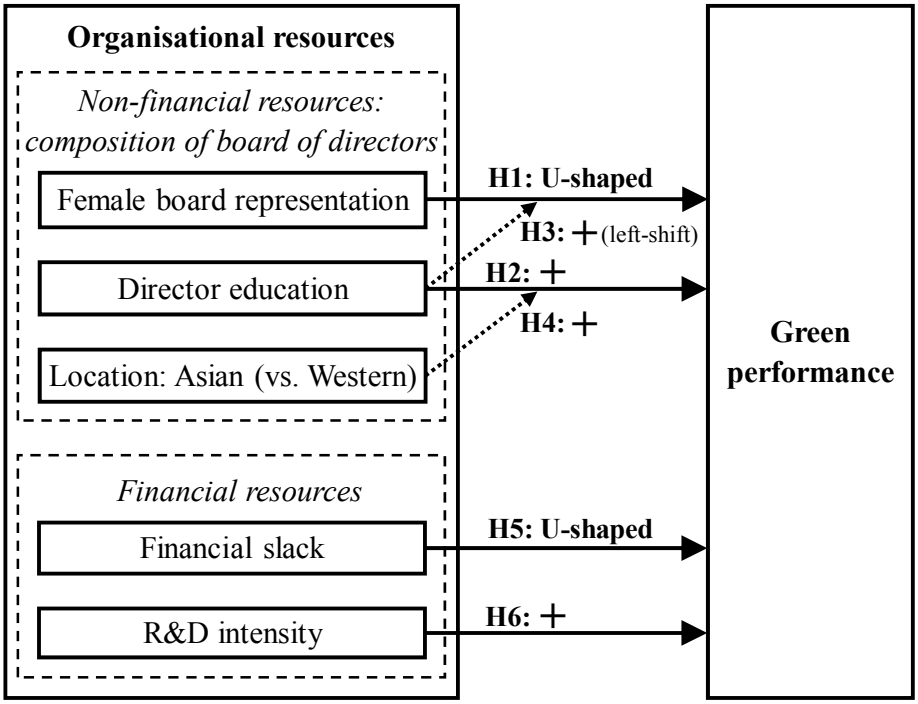
In the light of increased demand from stakeholders for environmental sustainability, firms face pressure to adopt green practices such as green innovation, which refers to innovation in products and processes that involve energy-saving, pollution prevention, waste recycling and zero toxicity (Chen et al., 2006). Green product and process innovation results from a firm's investment in, and commitment to, the R&D function (Lee and Min, 2015). Unique resources and green capabilities developed through a firm's R&D help it to develop green products and processes, in order to both meet the stakeholders' demands and improve green performance.

While past research finds that investment in R&D contributes positively to green product innovation (Huang et al., 2016) and to carbon performance (Lee and Min, 2015; Padgett and Galan, 2010), such evidence is limited to manufacturing firms. We extend this research by hypothesising that R&D intensity drives green performance more generally across different contexts such as both service and product industries.

H6: R&D intensity has a positive effect on the firm's green performance.

According to the hypotheses developed, we examine how non-financial (i.e., director education, female board representation, home country location) and financial resources (i.e., financial slack, R&D intensity) affect green performance, as shown in Figure 1.

Figure 1 Research model



3 Methodology

3.1 Sample selection and data sources

In choosing our sample, we use data on the environmental performance of firms in 2014 from Newsweek's 2016 Green Rankings (Newsweek, 2016). Owing to their methodological rigor (Olsen et al., 2014), these data are used by many scholars (Aggarwal and Dow, 2012; Albino et al., 2012; Dangelico, 2015). This data source contains data on the world's largest 500 firms, which are rich in organisational resources and thus make an ideal case for studying the effect of resources on green performance. Following previous studies (Fernández-Gago et al., 2016; Haque, 2017), we removed firms in the financial industry sector (142 firms) from the sample because of their distinct characteristics (i.e., financial reporting standards and formation of the financial variables used in our study) from an accounting point of view (Fernández-Gago et al., 2016; Prado-Lorenzo and Garcia-Sanchez, 2010). Also, we eliminated firms with unavailable data for any of the variables in our model, which resulted in a final sample of 156 firms.

We obtained data on green performance from Newsweek's (2016) green revenue score; data on firm industries and countries from Newsweek (2016); data on boards of directors from publicly available company reports and websites; and data on R&D intensity, financial slack and firm size from firms' financial statements. Table 1 shows the distribution of the sample composition according to the global industry classification standard.

Table 1 Sample composition

Sector	*Frequency*	*Percentage*
Automobiles and components	14	9.0
Capital goods	18	11.5
Consumer durables and apparel	5	3.2
Energy	10	6.4
Food, beverage and tobacco	13	8.3
Health care equipment and services	6	3.8
Household and personal products	7	4.5
Materials	15	9.6
Pharmaceuticals, biotechnology and life sciences	25	16.0
Semiconductors and semiconductor equipment	4	2.6
Software and services	10	6.4
Technology hardware and equipment	10	6.4
Telecommunication services	14	9.0
Utilities	5	3.2
Total	156	100.0

3.2 Operationalisation of variables

Dependent variable: We use the firm's green performance as the dependent variable. Drawing on various definitions of green performance (e.g., Nawrocka and Parker, 2009;

Walls et al., 2012; López-Gamero et al., 2009; Salo, 2008) and capturing their essential properties, we define green performance as the outcome of how well the firm manages its overall environmental impact throughout the life cycle of its product and/or service offerings, that is, as how environmentally sustainable the firm's revenue is (Newsweek, 2016).

The literature operationalises green performance by measures such as environmental disclosure, adoption of green initiatives (Ben-Amar et al., 2017; Haque, 2017), content analysis of firm documents (Amato and Amato, 2011; Post et al., 2011), unidimensional measures (Haque, 2017; Lee and Min, 2015), Asset4 environmental ratings (Shaukat et al. 2016), and KLD ratings (Arora and Dharwadkar, 2011; de Villiers et al., 2011; Post et al., 2011; Walls et al., 2012). Despite their merits, these measures have some limitations. Corporate environmental performance reports can be biased because firms can strategically choose to either include or omit certain information (Waddock and Graves, 1997), which may affect the reliability of content analysis. Moreover, unidimensional proxies can be limited in their ability to assess the overall level of environmental performance. In addition, the KLD ratings use a binary scoring system to evaluate environmental strengths and concerns, thus limiting the ability to identify and compare performance levels across firms and industries (Humphrey et al., 2012).

To overcome these limitations, we use Newsweek's (2016) green revenue score as a comprehensive, objective measure of green performance. It is calculated by Human Impact + Profit Investor Inc., a leader in impact investing, ratings and portfolio management (Newsweek, 2016). This score reflects the overall environmental impact throughout the life cycle of products and services offered by the firm under each respective business unit, which is weighted by its revenues. Thus, it provides a more detailed assessment of a firm's green performance than other measures.

Independent variables: We operationalise female board representation as the percentage of female directors on the BOD (Ben-Amar et al., 2017; McGuinness et al., 2017), which we obtained from publicly available corporate publications (e.g., annual reports, proxy statements and corporate governance reports). Using the same and other sources (firm websites, Bloomberg executive profiles and biographies), we operationalise director education as the percentage of directors on the BOD with postgraduate degrees (Post et al. 2011). Using a dummy variable, we operationalise the location of the firm's headquarters as being in an Asian (1) versus Western (0) country.

Based on data from firms' financial statements, we operationalise financial slack as the current ratio, that is, the ratio between current assets and current liabilities (Chen and Miller 2007). Following the studies of Chen and Miller (2007) and Padgett and Galan (2010), we calculate R&D intensity by dividing total R&D expenditure by total sales.

Following Albino et al. (2012) and McGuinness et al. (2017), we use lagged data from the previous year for all independent and control variables to ensure causality in the estimations.

Control variables: We control for confounding effects of a firm's context by including four control variables: firm size, developing (1; versus developed: 0) country, environmentally sensitive industry (1; otherwise: 0), and service (1; versus product: 0) industry. Specifically, we consider energy, healthcare equipment and services, software and services, telecommunication services and utilities as service industries. Including this variable accounts for differences between products and services in the nature of both environmental sustainability and innovation. Following Fernández-Gago et al. (2016) and Halme and Huse (1997), we classify pharmaceuticals, chemicals, multi-utilities,

electricity utilities, oil, gas, consumable fuels, metals and mining as environmentally sensitive industries. As in past studies (Ben-Amar et al., 2017; Fernández-Gago et al., 2016; McGuinness et al., 2017; Shaukat et al., 2016), we operationalise firm size by the natural logarithm of total assets (in USD) of the firm.

Table 2 Description of variables

Type of variable	*Name*	*Description*	*Source*
Dependent variable	Green performance	Green revenue score: the proportion of revenue derived from green products or services	Global 500 Newsweek's green ranking 2016
Independent variables	Female board representation	Percentage of females on the BOD	Company publications
	Director education	Percentage of directors with postgraduate degrees	Firm publications and websites
	Asian (versus Western) country	Whether a firm is headquartered in an Asian (1) or Western (0) country	Global 500 Newsweek's green ranking 2016
	Financial slack	Current ratio	Firm financial statements
	R&D intensity	R&D expenditure / total sales	Firm financial statements
Control variables	Firm size	Natural logarithm of the total assets	Firm financial statements
	Developing (versus developed) country	Whether a firm is headquartered in a developing country (1; otherwise: 0)	Global 500 Newsweek's green ranking 2016
	Environmentally sensitive industry	Belongingness to an environmentally sensitive industry (1; otherwise: 0)	Global 500 Newsweek's green ranking 2016
	Service (versus product) industry	Belongingness to a service industry (1; otherwise: 0)	Global 500 Newsweek's green ranking 2016

3.3 Method of data analysis

Common method variance is not a problem in our dataset, as our dependent variable and our multiple independent variables derive from distinct data sources. For our hypothesis tests, we use cross-classified Hierarchical Linear Modelling (HLM) with restricted maximum likelihood estimation to account for the nested structure of our data, where firms (i) at level 1 are nested in both countries (j) at level 2a and industries (k) at level 2b. Our HLM model includes the firm's green performance (H1–H6) as the dependent variable. The independent (level 1) variables are female board representation (H1), the director education (H2) and Asian (1; Western: 0) country (level 2a) as non-financial resources of firms; financial slack (H5) and R&D intensity (H6) as financial resources; and additional squared terms (H1, H5) and interaction terms (H3, H4). As control variables, our HLM model includes firm size at level 1 and dummy variables for developing (1; developed: 0) country at level 2a and for environmentally sensitive (1; else: 0) industry and service (1; product: 0) industry at level 2b. In addition, our HLM model includes intercept (γ_{00}) and error terms at levels 1 (ε_{ijk}), 2a (u_{0j}) and 2b (v_{0k}). We

standardised all variables prior to calculating the interaction effects. Below, we specify the model structure in equation format.

Level 1 (firm *i*):

$$\begin{aligned}(\text{Green performance})_{ijk} = {} & \beta_{0jk} + \beta_{1jk}\left(\text{Firm size}_{ijk}\right) \\ & + \beta_{2jk}\left(\text{Female board representation}_{ijk}\right) \\ & + \beta_{3jk}\left(\text{Female board representation}_{ijk}\right)^2 \\ & + \beta_{4jk}\left(\text{Director education}_{ijk}\right) \\ & + \beta_{5jk}\left(\begin{matrix}\text{Director education}_{ijk} \\ \times\ \text{Female board representation}_{ijk}\end{matrix}\right) \\ & + \beta_{6jk}\left(\text{Financial slack}_{ijk}\right) + \beta_{7jk}\left(\text{Financial slack}_{ijk}\right)^2 \\ & + \beta_{8jk}\left(\text{R\&D intensity}_{ijk}\right) + \varepsilon_{ijk}\end{aligned}$$

Level 2 (country *j*, industry *k*):

$$\begin{aligned}\beta_{0jk} = {} & \gamma_{00} + \gamma_{01}\left(\text{Asian country}_j\right) + \gamma_{02}\left(\text{Developing country}_j\right) \\ & + \gamma_{03}\left(\text{Environmentally sensitive industry}_k\right) \\ & + \gamma_{04}\left(\text{Service industry}_k\right) + u_{0j} + v_{0k} \\ \beta_{1jk} = {} & \gamma_{10} \\ \beta_{2jk} = {} & \gamma_{20} \\ \beta_{3jk} = {} & \gamma_{30} \\ \beta_{4jk} = {} & \gamma_{40} + \gamma_{41}\left(\text{Asian country}_j\right) \\ \beta_{5jk} = {} & \gamma_{50} \\ \beta_{6jk} = {} & \gamma_{60} \\ \beta_{7jk} = {} & \gamma_{70} \\ \beta_{8jk} = {} & \gamma_{80}\end{aligned}$$

4 Results

4.1 Descriptive statistics and hypothesis tests

Table 3 lists the descriptive statistics and correlations of our variables. Table 4 shows the results of our hypothesis tests, and Figure 2 visualises all non-linear and moderating effects. As shown by the information on variance components in Table 4, most of the unexplained variance of our HLM model is at the industry level (level 2b), indicating the high relevance of the HLM specification for estimating the effects. None of the unexplained variance is at the country level (level 2a). Removing this level from the analysis does not alter our conclusions.

Table 3 Correlations and descriptive statistics

		Correlations					
Independent variables		*1*	*2*	*3*	*4*	*5*	*6*
1	Green performance						
2	Firm size	–.29					
3	Female board representation	.05	–.04				
4	Director education	.08	–.14	.30			
5	Financial slack	.32	–.36	–.19	.13		
6	R&D intensity	.49	–.24	–.04	.28	.50	
Descriptive statistics:							
	Mean	11.32	24.67	19.36	58.97	1.65	.06
	Standard deviation	4.32	1.05	11.00	23.97	.90	.07

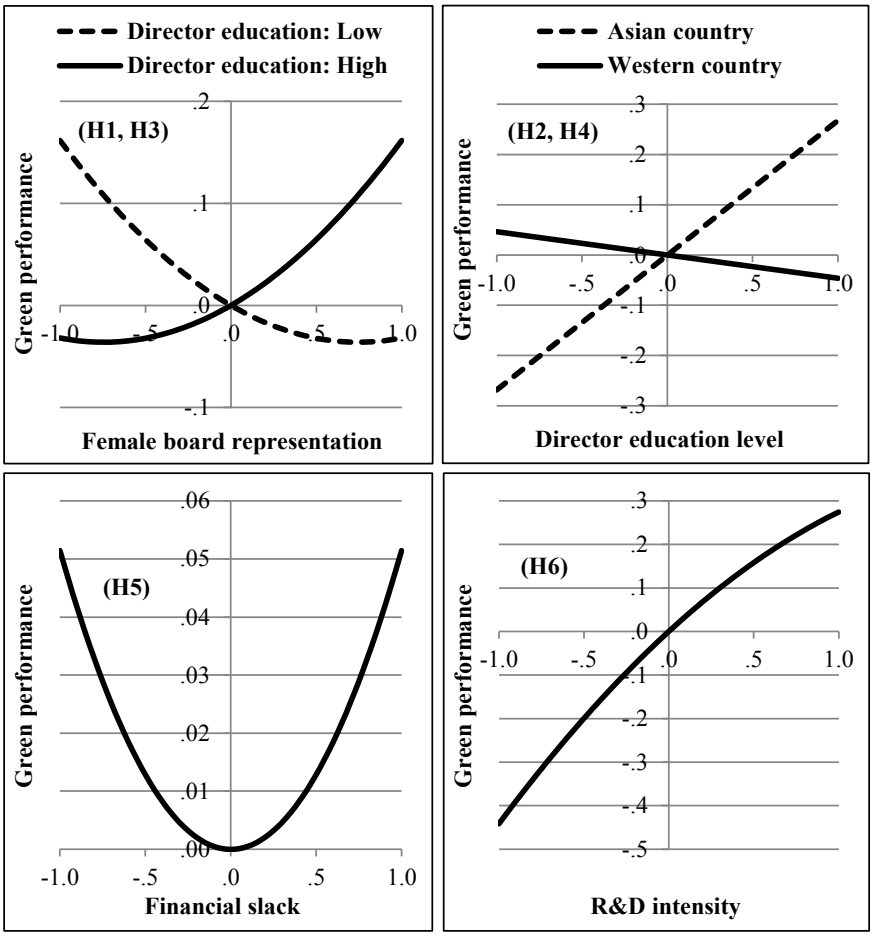
Notes: All correlations of $|r| \geq .19$ significant at $p < .05$. Sample size: 156 firms.

Table 4 Hypothesis tests: effects on the firm's green performance

Variables	*β*
Control variables (levels 1, 2a, and 2b):	
Intercept	–.120
Developing (1; developed: 0) country (level 2a: country)	–.023
Environmentally sensitive industry (1; else: 0) (level 2b: industry)	–.213*
Service industry (1; product industry: 0) (level 2b: industry)	.221
Firm size (level 1: firm)	–.068
Non-financial resources (composition of the board of directors; levels 1 and 2a; levels 1 × 2a):	
Female board representation	.054
(Female board representation)² [H1: +]	.065*
Asian (1; Western: 0) country (level 2a: country)	.054
Director education [H2: +]	–.011
Director education × Female board representation [H3: +]	.097*
Director education × Asian (vs. Western) country [H4: +]	.112*
Financial resources (level 1):	
Financial slack	–.092
(Financial slack)² [H5: +]	.051*
R&D intensity [H6: +]	.212***
Variance components:	
Level 1 (firm)	.150***
Level 2a (country)	.001
Level 2b (industry)	.612*

Notes: Cross-classified hierarchical linear modelling: 156 firms in 21 countries and 14 industries; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Figure 2 Visualisation of non-linear effects and moderating effects



Notes: Axis unit: standard deviation from mean; Moderator unit for high/low: +/– 1 standard deviation from the mean.

Regarding non-financial resources, Table 4 shows that female board representation exerts a *U*-shaped effect on green performance, as indicated by the significant positive effect of its squared term (H1 supported). Green performance is lowest for firms with 19.4% women on the BOD. For such firms, the revenue from green products and services amounts to 11.3% of overall sales volume. Both a positive and a negative deviation from this value of female board representation leads to an increase in green revenue. While small deviations have only a weak influence on green performance, larger deviations have a much stronger influence due to the non-linear nature of this effect. The director education level positively interacts with the linear term of female board representation, meaning that higher director education shifts the *U*-shaped effect of female board representation to the left, as visualised in Figure 2. Therefore, a higher level of the director education lowers the minimum threshold from which higher female board representation translates into improved green performance (H3 supported). Specifically, an increase in the percentage of directors with postgraduate degrees from a mean value of

59% by one standard deviation (24%) up to 83% causes this threshold value of female board representation to decrease from 19.4% down to 12.0%. An analogous decrease in the percentage of directors with postgraduate degrees down to 35% causes this threshold value of female board representation to increase up to 26.7%. The director education does not exert a significant effect on green performance for the average firm in the sample (H2 not supported) or for firms headquartered in a Western country, whereas it has a positive effect on green performance for firms headquartered in Asia (H4 supported), which we visualise in Figure 2.

Regarding financial resources of a firm, Table 4 shows that financial slack exerts a *U*-shaped effect on the firm's green performance (H5 supported), which we visualise in Figure 2. The suboptimal level of financial slack that minimises green performance is a current ratio of 1.65. Both an increase and a decrease from this level of financial slack leads to higher green performance. R&D intensity exerts a positive effect on green performance (H6 supported). On average, an additional 1% of sales volume invested in R&D translates into an additional .14% of total revenues to come from green products and services.

4.2 Robustness tests

Multi-collinearity: In the linear model without any squared terms and interaction effects, all variance inflation factors are 2.0 or below and are thus well below five, which implies that multi-collinearity is not of concern (Mason and Perreault, 1991).

Maximum likelihood estimation: An alternative estimation of our HLM model using maximum likelihood estimation, instead of restricted maximum likelihood estimation, does not alter any of the conclusions drawn from our hypotheses tests.

Removal of control variables: When removing all control variables, the analysis shows similar results and leads to essentially the same conclusions.

Additional squared terms: Using additional squared terms in our HLM model, we tested the non-linearity of effects that we had hypothesised as linear effects. While the director education does not have any non-linear effect, an additional squared term of R&D intensity exerts a significant negative effect ($\beta = -.084$, $p < .05$) on green performance. As visualised in Figure 2, the positive effect of R&D intensity (H6) appears to have decreasing marginal returns, but the functional form differs only slightly from the hypothesised linear shape. However, in this augmented model, the variance component for country (level 2a), which previously was very small (.001, see bottom of Table 4) and non-significant, cannot be calculated as the algorithm does not converge because the variance component is too close to zero. This reduces the analysis to an HLM model with only levels 1 (firm) and 2b (industry), and does not affect any of the conclusions drawn from our hypothesis tests.

5 Discussion

5.1 Theoretical and practical implications

Our study produces a number of new insights into the role of organisational resources as facilitators of the firm's green performance. We examine the non-linear, interactive and context-dependent effects of both non-financial and financial resources on green

performance. Regarding non-financial resources, we focus on characteristics of the BOD that have not yet been examined by similar research. We shed insights into the importance and complicated role of female board representation. As our results support H1, we make an important theoretical contribution by presenting the first evidence to confirm a *U*-shaped effect of female board representation on green performance. This is consistent with the arguments of previous studies (Joecks et al., 2013; Kanter, 2006) that find a *U*-shaped effect of gender diversity on a firm's return on equity. We find that even a single female director can make a significant positive contribution to board decisions affecting the firm's green performance. Green performance is the lowest when the female board representation is around 20%. This may be due to the existence of gender-based in-groups or out-groups, which can hinder the potential benefits of having female directors. However, once the diversity in terms of female representation is sufficiently large, female board representation begins to pay off as female directors are more attentive and sensitive to green concerns, provide human and relational capital, foster creativity and promote participative decision-making (McGuinness et al., 2017; Pucheta-Martínez et al., 2018). Thus, they help the organisation to identify environmental concerns, and make effective strategic decisions to enhance green performance.

Consequently, we advise firms to include women in corporate boards in order to shape the decision-making process so that environmental concerns are addressed effectively. Firms benefit more from either including only a few women (less than 10%) or including many women (more than 30%) in the BOD, whereas a moderate level of women (around 20%) is counterproductive to the achievement of green performance goals.

We also examine the role of director education on green performance. Confirming the findings of Post et al. (2011), we do not find general evidence to support H2. However, our results confirm that director education exhibits a positive effect on green performance among the firms headquartered in Asia (H4 supported), whereas the effect is not significant among firms headquartered in Western countries. This may result from the notion of environmental sustainability being less established in Asia than in Western countries. Since Western societies already tend to share a consensus on the corporate benefits of environmental sustainability (Jalal et al., 2013; Rezaee et al., 2019), having higher education may not be essential for conveying such information. In contrast, most Asian societies still tend to lack such a consensus, as evidenced by the multitude of Asian firms polluting the environment (Kumar et al., 2018; Lu, 2017; Wong, 2017). In these firms, higher education may enhance the likelihood of a director's exposure to mostly Western (Tariq et al., 2017) research results and case studies on the corporate benefits of environmental sustainability, and thus may affect the firm's decision-making process and boost its green performance. This implies the importance of providing environmental education and training to personnel and students in Asian countries. A shared consensus on the corporate benefits of environmental sustainability may encourage firms to adopt green initiatives for ethical, rather than merely financial, reasons.

In examining the interactive effects of the firm's non-financial resources, we show that higher director education lowers the minimum threshold from which higher female board representation translates into higher green performance (H3). That follows the arguments of Darmadi (2013) and Wiersema and Bantel (1992) that education helps people to become more open and to embrace and integrate diverse perspectives when making a decision. More specifically, from a resource-based perspective, a board with a higher level of director education is a unique, valuable resource, which cannot be

perfectly imitated or substituted. Such boards are more open to diverse opinions coming from female directors. Without education, male directors may intuitively consider their own opinions right, whereas education may enable them to appreciate the merits of diverse ideas coming from a minority of female directors and to integrate those ideas into decisions affecting the firm's green performance. This implies the importance of having a diverse BOD, as a distinctive resource that drives open communication, creativity and better decision-making. However, these merits of diversity can be realised only if the board members are willing to learn from each other. While we emphasise the importance of including more females and educated directors in the BOD, several other behavioural and cultural factors (e.g., differences in individual behaviour, moral reasoning and organisational culture), which are beyond the scope of our study, might also affect the firm's ability to enhance its green performance.

Regarding the financial resources of the firm, we find a *U*-shaped effect of financial slack on green performance (H5). We build on the seminal work by Bromiley (1991), who hypothesises, but fails to provide evidence on, the effects of slack on risk taking and financial performance. As an extension of his research, we provide the first set of empirical evidence of how financial slack can affect green performance. A low level of financial slack may encourage firms to take risks and explore new opportunities to create more slack (Bromiley, 1991; Martinez and Artz, 2006). Firms may seek to achieve this by strengthening their green performance, which can help firms to improve their productivity, reduce their costs, exploit new market opportunities and improve their corporate image (Tariq et al., 2017). Thus, low financial slack may lead to high green performance. By contrast, a moderate level of slack may not provide adequate motivation for a firm to focus on environmental concerns. However, high financial slack may provide firms with the necessary means to meet their stakeholders' demands for environmental sustainability (Berrone et al., 2013) and to explore new market opportunities for green products, which helps enhance their green performance. Of relevance to managers and public policy makers, our results show the ability of unabsorbed financial slack to drive environmental performance and thus to create a greener economy. In other words, financial health facilitates the pursuit and implementation of green performance goals.

Furthermore, our results confirm a positive effect of R&D intensity on green performance (H6). These cross-industry results extend the manufacturing-specific findings by Huang et al. (2016) and Lee and Min (2015) on positive effects of R&D on both a firm's green innovation and carbon performance. In addition, while these past studies focus only on linear relationships, we extend these efforts by identifying that the effect of R&D intensity on green performance has decreasing marginal returns and is thus slightly non-linear. In accordance with the RBV, our results highlight the role of R&D as a resource that helps the firm to develop new knowledge and capability, establish a competitive advantage in terms of superior green performance. Therefore, we encourage managers of firms with an environmental strategy to engage in R&D.

Our study makes multiple contributions to theory. First, the extant literature still lacks evidence on the influence of organisational resources on green performance (Latan et al., 2018). The limited existing studies examine the influence of organisational resources on the firm's green initiatives and activities (Ben-Amar et al., 2017; Liao et al., 2015; Post et al., 2011) with the assumption that the mere adoption of such initiatives ultimately leads to better green performance. However, the adoption of green initiatives does not automatically lead to higher green performance (López-Gamero et al., 2009), and firms

may engage in green initiatives for the purpose of publicity (Tariq et al., 2017), while the performance outcome of these activities may not be a priority to them (Thorlakson et al., 2018). Thus, we contribute to this limited literature by focusing specifically on green performance and operationalising it by an objective, independent, holistic and more outcome-related measure of green performance. Moreover, by testing the impact of female board representation, director education, financial slack and R&D intensity on green performance, we fill a major gap in the green performance literature. Second, to the best of our knowledge, this study is among the first to empirically confirm the existence of a *U*-shaped relationship between female board representation and green performance. Furthermore, drawing on the RBV, our study provides the first evidence to support a *U*-shaped relationship between financial slack and green performance.

Third, relying on the RBV, which highlights the importance of unique and valuable organisational strategic resources (Barney, 1991), we contribute to the literature by looking at complementary resources and proposing a moderating effect of the directors' education on the relationship between female board representation and green performance. Fourth, while the extant research about the effects of organisational resources on green performance focuses on single Western countries (Tariq et al., 2017), we provide the first set of evidence of international differences in the relationship between resources and green performance.

5.2 Policy implications

Our study also has important implications for policy makers. First, regarding the public policy on gender quotas, our findings provide new insights into the benefits of including female members. We show that higher female board representation, which may result from policies and regulations on female quotas that exist in many countries, may lead to greater corporate environmental responsibility and thus to a greener economy. These quotas should be either very conservative (i.e., few female directors) or very progressive (many female directors). However, the legal enforcement of such gender quotas needs further investigation, as the inclusion of one or two female members merely for the purpose of compliance may not result in a higher green performance. For instance, according to the RBV of the firm, including a female director who lacks knowledge, skills and the right attitude may not help the firm do any better.

Second, the positive effect of director education on green performance among the firms headquartered in Asia has important implications for the policy makers of Asian countries. It stresses the importance of providing environmental education and training to the people in Asian countries to establish the notion of environmental sustainability. Such policies will help encourage firms to adopt green initiatives for ethical, rather than merely financial, reasons.

Third, our results imply the ability of unabsorbed financial slack to drive environmental performance. Thus, we suggest that public environmental policy makers must consider both financially healthy firms and cash-constrained firms when formulating their national environmental policies to create a greener economy.

Fourth, given the positive effect of R&D on green performance, we recommend policy makers to formulate national R&D policies to encourage R&D and innovation among firms not only to drive economic growth, but also to create a greener economy.

5.3 Limitations and future research opportunities

While our study provides valuable findings on corporate green performance, we acknowledge several limitations. Our investigation is limited to only two sets of resources, non-financial and financial resources. However, there are other organisational and external environmental factors, which are beyond the scope of our study, but may exert an influence on a firm's green performance. Future research can provide better insights into the sources of green performance by exploring the effects of such factors. In particular, we recommend that other studies examine whether a firm's financial resources moderate the effects of other factors on green performance. Furthermore, rather than operationalising a firm's green performance through a composite green revenue score, future research may consider exploring the differential effects of resources on distinct types of green performance related to different environmental problems and different stages of the value chain.

Moreover, we use a sample of the largest publicly traded global companies, which are abundant in resources and have comparable resource structures such as a formal BOD and a certain level of R&D. In small firms and startups, such resource structures are more flexible, dynamic and heterogeneous, which makes research into the effects of resources on green performance more challenging. Future research might consider taking on these challenges in order to identify relationships not present in our sample of large firms.

6 Conclusions

Our research aimed to identify whether organisational resources influence green performance. We developed hypotheses about the non-linear, interactive and internationally diverse nature of the effects of non-financial (female board representation, the directors' education level and home country location) and financial (financial slack and R&D intensity) resources. To test these hypotheses, we operationalised a firm's green performance through the green revenue score of Newsweek's green rankings survey and used cross-classified hierarchical linear modelling of multi-source data from 156 firms included in this survey.

Regarding the firm's non-financial resources, our results showed that female board representation exerts a *U*-shaped effect on green performance and that a higher level of director education lowers the minimum threshold from which higher female representation translates into improved green performance. Moreover, the directors' education level has a positive effect on green performance for firms headquartered in Asia, but not for Western firms. Overall, our study confirmed that having more female directors and educated directors on the board can help a firm to achieve a superior green performance by altering its environment-related decision outcomes. Regarding the firm's financial resources, we found a *U*-shaped effect of unabsorbed financial slack and a marginally decreasing positive effect of R&D intensity on the firm's green performance. With these results, we stress the importance of having a strategic configuration of organisational resources that supports the firm in developing a unique set of human, relational and technical capital and of other capabilities that drives green performance as a key basis of competition in today's corporate world.

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