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Are greener start-ups of superior quality? The impact of environmental orientation on innovativeness, growth orientation, and international orientation

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Abstract

This paper merges the literature on green and high-quality entrepreneurship by introducing environmental orientation as an unrecognised characteristic of start-up quality and the three quality dimensions innovativeness, growth orientation, and international orientation. Entrepreneurship literature argues that only high-quality start-ups contribute to sustainable development and that a better understanding of what determines the quality of start-ups is required. Empirical research has recently shown that the environmental orientation of start-ups is one such determinant, as it significantly predicts their innovativeness. This paper pursues this novel research avenue on the importance of environmental orientation for start-up quality in two ways. First, this paper evaluates and extends this initial evidence on environmental orientation and innovativeness by examining a three times larger sample, covering additional countries and entrepreneurial stages. Second, this paper also analyses the impact of environmental orientation on the quality dimensions of growth orientation and international orientation. Investigation using Global Entrepreneurship Monitor data on 9650 entrepreneurs from 51 countries revealed that start-ups with a higher environmental orientation are of superior quality regarding their innovativeness, growth expectations, and exports. These results remain robust for start-ups at different entrepreneurial stages, and tests employing different methodological approaches and variable definitions. However, the categorisation into factor-driven, efficiency-driven, and innovation-driven countries showed that greener start-ups are more innovative in countries at all three levels of development, while the relationships with growth orientation and international orientation remained significant for only two of the three categories. The findings of this paper provide a new approach for practitioners to identify the small number of high-quality start-ups and an economic reason warranting intensified efforts to support green start-ups.

Keywords: Entrepreneurship, Startup, Developing countries, Innovation, International, Nascent entrepreneurship, Environmental orientation

Introduction

The relevance of entrepreneurship to sustainable development, commonly defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, p. 43), is of remarkable political and academic interest. Entrepreneurs are not only expected to be key drivers of economic development (e.g., Acs et al., 2012; Fritsch & Mueller, 2007), but are also seen as solutions to pressing social and environmental challenges (e.g., Cohen & Winn, 2007; Endris & Kassegn, 2022; Patzelt & Shepherd, 2011). However, the extent to which entrepreneurs contribute to economic, social, and environmental development varies.

A considerable body of research shows that "the typical start-up is not innovative, creates few jobs, and generates little wealth" (Shane, 2009, p. 143) and that only a tiny proportion of start-ups that distinguish themselves through superior quality actually contribute to the sustainable development of countries (Neumann, 2021a). Hence, Shane (2009) recommends that development policies should focus only on those few start-ups which create the most value for society. The entrepreneurship literature refers to these vital start-ups as high-expectation (Valliere & Peterson, 2009), high-potential (Wong et al., 2005), high-aspiration and high-impact (Acs, 2010), or high-quality start-ups (Giotopoulos et al., 2017). Empirical research investigating these start-ups, henceforth called high-quality start-ups, has found that especially innovative (e.g., ben Youssef et al., 2018; Du & O'Connor, 2018; Mueller, 2007), growth-oriented (e.g., Acs & Mueller, 2007; Stam et al., 2009, 2011) and internationally operating start-ups (e.g., de Clercq et al., 2008; González-Pernía & Peña-Legazkue, 2015; Hessels & van Stel, 2011) stimulate economic and sustainable development. However, empirical evidence for potential characteristics of high-quality start-ups and their three quality dimensions innovativeness, growth orientation, and international orientation is still scarce—especially evidence on the question on whether (non-economic) entrepreneurial motivations determine start-up quality (Hermans et al., 2015; Stam et al., 2012; van Praag & Versloot, 2007).

The entrepreneurial motivation to contribute to sustainable development by remedying environmentally relevant market failures has attracted significant attention in academia (Dean & McMullen, 2007; Johnson & Schaltegger, 2020; Terán-Yépez et al., 2020). Hoogendoorn et al., (2020, p. 4) assumed that the motivation of start-ups to prioritise environmental values over economic ones positively influences their opportunity identification and incentive to innovate. The literature assumes that these environmentally oriented start-ups, called green, eco, sustainable, or environmental start-ups,[1] stimulate economic as well as social and environmental development (e.g., Cohen & Winn, 2007; Dean & McMullen, 2007). This academic expectation is confirmed by recent evidence (a) that green start-ups outperform their conventional counterparts (Neumann, 2021b; Shrivastava & Tamvada, 2019), and (b) that green- and social-orientations among start-ups are positively related to all three pillars of sustainable development (Méndez-Picazo et al., 2021). It is reasonable to assume that these superior performance and sustainability impacts of green start-ups are the result of a higher level of start-up quality in terms of innovativeness, growth orientation, and international orientation. Hoogendoorn

[1] These terms are often used synonymously. Henceforth, environmentally oriented start-ups are referred to as green start-ups.

et al. (2020) provided the first empirical evidence for this assumption by showing that greener start-ups are indeed more likely to be innovative. However, there is no empirical research yet on the link between the environmental orientation of start-ups and the quality dimensions of growth orientation and international orientation.

This paper addresses this research gap by extending Hoogendoorn et al.'s (2020) research question[2] and asking whether greener start-ups are of higher quality. For this purpose, this paper brings together the research streams on both green and high-quality entrepreneurship and investigates the role of entrepreneurs' environmental orientation as an unrecognised characteristic of the three entrepreneurial quality dimensions innovativeness, growth orientation, and international orientation. In doing so, three contributions to the literature are made.

First, this paper provides empirical evidence for the quality differences between green and conventional start-ups. Previous research on green entrepreneurship was primarily qualitative and conceptual, focusing on the drivers and business practices of green start-ups (Gast et al., 2017). Therefore, and due to its academic and practical relevance, several recent literature reviews (Anand et al., 2021; Gast et al., 2017) have called for more large-scale empirical work on green entrepreneurship and its outcomes. The special issue of the Global Entrepreneurship Monitor (GEM) from 2009 includes data on green entrepreneurship and allows for an examination of the quality of green start-ups with a large and cross-country dataset.

Second, this paper evaluates Hoogendoorn et al.'s (2020) research on the relationship between environmental orientation and the innovativeness of start-ups by replicating and extending it. Hoogendoorn et al. argue that start-ups have heterogenous goals (e.g., environmental and economic goals) and that this heterogeneity influences their ability to recognise entrepreneurial opportunities and thus their potential to innovate. They provide empirical evidence for their theory by showing that environmentally oriented start-ups are more likely to implement both product and process innovation. The present paper sets out to evaluate Hoogendoorn et al.'s results in three ways. First, due to difficulties arising from the ordinal structure of the dependent variables, this paper tests the robustness of their results by estimating alternative binomial logistic regressions. Second, this paper extends Hoogendoorn et al.'s research by not only including new entrepreneurs who already own or manage a start-up, but also nascent entrepreneurs. Third, this paper follows Hoogendoorn et al.'s research recommendation and increases the number of included countries from 31 to 51. These two sample size expansions result in a tripling of observations, which considerably improves the robustness of the estimations and allows for a comparison of results between countries at different levels of development.

Third, this paper answers multiple calls for research by also investigating the entrepreneurial quality dimensions growth orientation (Hechavarría, 2016) and international orientation (Galkina & Hultman, 2016; Manesh & Rialp-Criado, 2019). However, despite the macroeconomic importance of growth orientation and international orientation (Acs & Mueller, 2007; Stam et al., 2009; Wong et al., 2005), pertinent literature reviews

[2] „[…] are greener start-ups more innovative?" (Hoogendoorn et al., 2020, p. 1).

(e.g., Anand et al., 2021; Gast et al., 2017; Terán-Yépez et al., 2020) illustrate that both quality dimensions have so far been neglected by empirical green and sustainable entrepreneurship research. This paper addresses this research gap by extending Hoogendoorn et al.'s theory on goal heterogeneity and argues that environmental orientation is not only a characteristic of innovativeness but also of growth orientation and international orientation.

The structure of the paper is as follows: Section "Theoretical foundations and hypotheses" reviews the literature on high-quality start-ups and green entrepreneurship and then derives hypotheses for the impact of entrepreneurs' environmental orientation on the three quality dimensions. Section "Methodology" elaborates the datasets, variables, and empirical models employed to test these hypotheses. Section "Empirical analysis" describes the estimated results. Section "Discussion and conclusion" concludes with the discussion of the results and limitations of the paper and derives implications and future research opportunities.

Theoretical foundations and hypotheses

Stam et al. (2012) define a high-quality start-up as one founded by an ambitious entrepreneur "who engages in the entrepreneurial process with the aim to create as much value as possible" (p. 40). While this interpretation of high-quality centres on the dimension of growth orientation, the authors emphasise that the quality dimensions of innovativeness and international orientation are also implied. They argue that "innovation is at the very heart of the well-established Schumpeterian tradition in entrepreneurship" (Stam et al., 2012, p. 40) and that corporate growth ambitions can be both domestic and international. Although the three quality dimensions of start-ups are interrelated and can also be considered as elements of a quality composite (Hermans et al., 2015; Stenholm et al., 2013), this paper follows a more widespread practice (Acs et al., 2017; Giotopoulos et al., 2017; Wong et al., 2005) and investigates the quality of start-ups individually, based on their degree of innovativeness, growth orientation, and international orientation.

Entrepreneurship literature (e.g., Acs, 2010; Giotopoulos et al., 2017; Hermans et al., 2015) argues that engaging in high-quality entrepreneurial activity is an occupational choice that is based, inter alia, on entrepreneurs' motivations. Entrepreneurship research confirms this argument by showing that start-up quality is predicted by entrepreneurs' financial motivations (Cassar, 2007), achievement motivations (Kolvereid, 1992), and opportunity- and necessity-driven start-up motivations (Giotopoulos et al., 2017). However, only a few studies (Hoogendoorn et al., 2020; Wiklund et al., 2003) have examined the relevance of non-economic motivations, such as environmental orientation, in this context.

This thesis adopts the argumentation that the quality of start-ups is determined by entrepreneurs' motivations. It argues that green entrepreneurs' non-economic motivations to find innovative solutions to global environmental problems and to scale their sustainable impact worldwide through growth and exports (Cohen & Winn, 2007; Dean & McMullen, 2007), lead to innovative, growth-oriented, and international behaviour typical of high-quality start-ups. In the following sections, this thesis is substantiated with further arguments, and hypotheses are derived for the links between entrepreneurs'

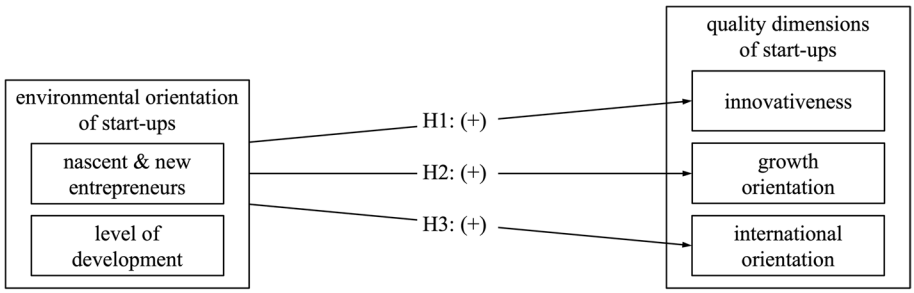

Fig. 1 Overview of hypotheses

environmental orientation and their degree of innovativeness, growth orientation, and international orientation (see Fig. 1).

Impact of environmental orientation on innovativeness

Research on innovative entrepreneurship goes back to Schumpeter's (1942) theory of creative destruction, which states that innovative start-ups accelerate structural change, leading to more efficient economies. Innovative start-ups exploit new knowledge by introducing new services, products, and markets, thereby increasing competition, and stimulating economic development (Fritsch & Mueller, 2004; Mueller, 2007). Accordingly, the process of identifying pivotal innovative start-ups has attracted considerable interest in academia.[3]

This paper builds on Hoogendoorn et al. (2020), who recently made a significant contribution to this topic by analysing the relationship between the environmental orientation of start-ups and their innovativeness. The authors hypothesised that green start-ups which put environmental value (other-regarding non-economic interests) over economic value (self-regarding economic interests) are more likely to be innovative. Hoogendoorn et al., (2020, p. 4) presented two key arguments which support this hypothesis. Their first argument, which builds on previous findings (van de Ven et al., 2007), is that intrinsic (environmental) motivations stimulate creativity and ideation and thus positively influence how start-ups recognise innovative opportunities. This argument is supported by empirical research (del Giudice et al., 2019; Renko, 2013), showing that non-economic motivations are indeed positively related to innovativeness. Hoogendoorn et al.'s second argument is based on research findings (Cliff et al., 2006; Shane & Venkataraman, 2000) which indicate that entrepreneurs, who are dissatisfied with prevailing business practices, are more likely to identify alternative solutions. Hoogendoorn et al. thus argue that green entrepreneurs, driven by a strong dissatisfaction with environmental conditions, insufficient environmental market offerings, and unsustainable behaviour, should be more likely to identify and exploit innovative opportunities. A third argument in support of Hoogendoorn et al.'s hypothesis, drawn from the importance of prior knowledge for opportunity identification and innovativeness (Shepherd & DeTienne, 2005), is that environmentally oriented start-ups tap into a raw potential for innovation that economically oriented

[3] An overview on this research is provided by Block et al. (2017).

start-ups neglect. This argument is supported by sustainable entrepreneurship literature which highlights that environmental market imperfections provide significant opportunities for entrepreneurial innovations (Carayannis et al., 2012; Cohen & Winn, 2007; Dean & McMullen, 2007) and that green start-ups can foresee these opportunities through their superior environmental knowledge (Patzelt & Shepherd, 2011; Schaltegger & Wagner, 2011).

Hoogendoorn et al. (2020) empirically tested their hypothesis that environmental orientation is a characteristic of innovativeness by analysing GEM data from 2009. Their results confirm that entrepreneurs' environmental orientation is significantly positively related to product innovativeness, process innovativeness, and a combination of both types. Furthermore, Hoogendoorn et al. found evidence of inducement effects from environmental regulations at the macro-level that positively moderate this relationship. This paper evaluates these preliminary findings on the relationship between environmental orientation and the innovativeness of start-ups by addressing three follow-up hypotheses.

First, due to their focus on new entrepreneurs and countries for which data on environmental legislation were available, Hoogendoorn et al.'s (2020) sample was limited to 2945 observations. This paper evaluates whether the positive relationship still holds when a significantly larger sample size is used, and potential biases are eliminated by additional robustness tests. Based on the two arguments of Hoogendoorn et al., the third novel argument, and the promising empirical evidence presented in the previous paragraph, it is hypothesised here that:

> **H1a**: The environmental orientation of start-ups is positively related to their innovativeness.

Second, this paper acknowledges that while new and nascent entrepreneurship are qualitatively distinct phenomena (Bergmann & Stephan, 2013) characterised by different levels of environmental orientation (Hörisch et al., 2018), both are important for sustainable development (Carree et al., 2002; Wennekers et al., 2005). This paper thus extends the research of Hoogendoorn et al. (2020) by also including nascent start-up projects. First empirical evidence on social entrepreneurship suggests that the relationship between non-economic goals and innovativeness also applies to nascent start-up projects (Renko, 2013). Hence, it is hypothesised here that:

> **H1b**: The environmental orientation of both nascent entrepreneurs and new entrepreneurs is positively related to their innovativeness.

Third, this paper follows recent calls (e.g., Anand et al., 2021; Barrera-Verdugo, 2021; Hoogendoorn et al., 2020) for more research that recognises that entrepreneurship differs between countries at different levels of development. Since Hoogendoorn et al. (2020) focused on the moderating impact of environmental legislation and the availability of data on environmental legislation in developing countries is limited, their sample is biased towards developed countries. This paper thus expands their research by investigating a more balanced sample containing groups of countries at different development levels. Drawing on evidence from the social entrepreneurship

literature, showing that non-economic goals and innovativeness are also positively related in developing countries (del Giudice et al., 2019), it is hypothesised here that:

> **H1c**: The environmental orientation of start-ups is positively related to their innovativeness, independent of the level of development of the country they are located in.

Impact of environmental orientation on growth orientation

While research highlights that economic growth is mainly initiated by highly growth-oriented start-ups (Acs, 2010; Stam et al., 2009, 2011), it is not easy to identify which start-ups will successfully scale (Acs & Mueller, 2007). Researchers investigating the future growth of start-ups have applied various labels and concepts to measure it, such as growth willingness, growth intentions, growth aspirations, and growth expectations (Hermans et al., 2015; Verheul & Mil, 2011). The underlying assumption that these growth intentions, aspirations, and expectations lead to actual growth is supported by the argument that (non-economic) motivations of start-ups determine their quality (introduction of Sect. "Theoretical foundations and hypotheses") and empirical evidence (Bosma et al., 2004; Cassar, 2007; Stam & Wennberg, 2009). Therefore, start-ups with high growth orientations are defined here as those who have concrete expectations of organisational growth without necessarily having already achieved it.

For green start-ups, the decision to pursue organisational growth is only one of many strategic trade-offs that must be considered when balancing their economic and environmental interests (Kirkwood & Walton, 2014). For example, green entrepreneurs often prioritise the quality of growth over quantity (Rodgers, 2010) and are more likely to choose organic growth (Melay et al., 2017). Moreover, they are less interested in financial success (Kirkwood & Walton, 2010a, 2014). Although financial motivations are common among growth-oriented entrepreneurs (Cassar, 2007; Hessels et al., 2008), this does not automatically imply that prioritising environmental goals over financial ones precludes high-growth ambitions. On the contrary, green start-ups might be particularly interested in scaling their organisational growth to reach more stakeholders and thereby scale their positive societal impact. Indeed, many start-ups have proven that growth is possible without sacrificing environmental ambitions (Hockerts & Wüstenhagen, 2010). First quantitative evidence confirms the importance of non-economic motivations for high-growth and suggests that green entrepreneurs are characterised by high-growth expectations—despite their low financial interest (Kirkwood & Walton, 2014). This finding implies that lower financial motivations, which are defined as extrinsic (Ryan & Deci, 2000), do not reduce growth ambitions when substituted by intrinsic environmental motivations. This argument is supported by previous evidence showing that intrinsically motivated entrepreneurs have higher growth expectations than those motivated by extrinsic financial interests (Guzmán & Javier Santos, 2001) and that green start-ups implementing substantial greening strategies experience higher growth in terms of achieved turnover development (Neumann, 2021b).

Hence, it is hypothesised here, based (a) on the idea of scaling organisational growth as a strategy to maximise societal impact, (b) the importance of intrinsic motivations for high-growth expectations, and (c) on the positive relationship between the

implementation of greening strategies and turnover growth achieved, that entrepreneurs with stronger environmental orientation are more likely to have high-growth expectations.

> **H2**. The environmental orientation of start-ups is positively related to their high-growth expectations.

Impact of environmental orientation on international orientation

This paper follows previous research and defines the international orientation of start-ups based on their export activities (e.g., de Clercq et al., 2008; González-Pernía & Peña-Legazkue, 2015; Hessels & van Stel, 2011). Empirical evidence shows that start-ups with high international orientation, which strive to scale their value and impact globally, are of higher quality than domestic start-ups in several respects. By identifying and exploiting opportunities across borders, they benefit from aggregating resources, knowledge, and networks and are characterised by higher innovativeness (Giotopoulos & Vettas, 2018; Oviatt & McDougall, 2005). The high quality of internationally operating start-ups is reflected at the macro-level, where a start-ups international orientation is positively related to the emergence of new start-ups (de Clercq et al., 2008) and economic growth (González-Pernía & Peña-Legazkue, 2015; Hessels & van Stel, 2011).

Horbach and Janser (2016) were among the first researchers to highlight the importance of international orientation for green start-ups. They argued that green start-ups would benefit from networking with foreign firms and universities and should therefore adopt a global orientation. This paper goes one step further and argues that green entrepreneurs also have a strong intrinsic motivation to engage internationally. Green entrepreneurs who want to make the world a better place (Kirkwood & Walton, 2010a, 2014; Manesh & Rialp-Criado, 2019) address environmental problems around the world (Dean & McMullen, 2007), and many of these environmental problems are inherently global in nature (e.g., marine pollution or climate change). Addressing these problems thus inevitably requires international efforts (Chen et al., 2018; Zahra et al., 2014). Although green entrepreneurs might want to produce locally (Kirkwood & Walton, 2010b), it is hypothesised here that their motivation to solve environmental problems of global concern increases their willingness to distribute solutions not only to local customers but also worldwide. That green firms are indeed more likely to internationalise is supported by empirical research demonstrating that US manufacturers of environmental products (Becker & Shadbegian, 2009) and entrepreneurs driven by non-economic motivations (Chen et al., 2018) are significantly more likely to export. The first evidence of the international orientation of green start-ups was recently provided by Manesh and Rialp-Criado (2019). In interviews with six Spanish start-ups, they found that internationalisation is a common strategy among start-ups in the renewable energy industry (Manesh & Rialp-Criado, 2019).

It is thus hypothesised here, building (a) on the intrinsic motivations of green start-ups to scale their impact internationally, (b) promising quantitative evidence on green firms, and (c) the first qualitative interview results on the internationalisation strategies of green start-ups, that start-ups characterised by higher environmental orientation are more likely to establish themselves internationally:

Table 1 Overview of countries included in the analysis, grouped according to their level of development

Classification	Country
Innovation-driven	Belgium, Denmark, Finland, Germany, Greece, Hong Kong, Iceland, Israel, Italy, Japan, Korea, Netherlands, Norway, Slovenia, Spain, Switzerland, United Arab Emirates, United Kingdom, United States
Efficiency-driven	Argentina, Bosnia and Herzegovina, Brazil, Chile, China, Colombia, Croatia, Dominican Republic, Ecuador, Hungary, Iran, Jordan, Latvia, Malaysia, Panama, Peru, Romania, Russia, Serbia, South Africa
Factor-driven	Uruguay, Algeria, Guatemala, Jamaica, Lebanon, Morocco, Saudi Arabia, Tonga, Uganda, Venezuela, West Bank & Gaza Strip, Yemen

H3. The environmental orientation of start-ups is positively related to their international orientation.

Methodology

Data source

The investigation of the relationship between environmental orientation and the quality of start-ups utilised entrepreneurship data from the GEM adult population survey from 2009. The GEM research project provides the most extensive collection of cross-country entrepreneurship data with representative samples of at least 2000 adults per country. Periodically, the GEM survey features specific topics, such as the special issue on social and green entrepreneurship in 2009. To date, this particular survey provides the only international, large-scale sample of data allowing the study of green entrepreneurship across a wide range of countries at different levels of development. Despite its advanced age, the uniqueness of the dataset justifies its continued use here and in other recent empirical green entrepreneurship research (e.g., Hechavarría et al., 2017; Hoogendoorn et al., 2020; Hörisch et al., 2017). For this paper, the sample was limited to 9650 entrepreneurs from 51 countries, who had completed all questions pertinent to the research objective and reported that they were currently planning to launch a start-up (nascent entrepreneurs) or currently owned or managed a start-up which was less than 3.5 years old (new entrepreneurs). The countries included in the analysis are listed in Table 1, grouped according to the GEM classification of innovation-driven, efficiency-driven, and factor-driven countries (Bosma & Levie, 2010). The data were enriched with country-level data compiled by the World Bank's World Development Indicators (WDI) to control cultural and institutional effects.

Dependent variables

Innovativeness. The variable *innovativeness* is a replica of the innovation index used by Hoogendoorn et al. (2020) and Schott and Sedaghat (2014). They calculated it as the average of three GEM survey items concerning product and service innovation, market innovation, and process innovations. These items are consistent with the Oslo manual guidelines for collecting and interpreting innovation data (OECD/Eurostat 2005) and are widely used to measure entrepreneurial innovation (Du & O'Connor, 2018; Giotopoulos et al., 2017; Koellinger, 2008).

Table 2 Descriptive statistics and variable description

Variables	Mean	S.D	Min	Max	Description	Source
Dependent variables						
Innovativeness (ordinal)	1.56	0.48	1.00	3.00	Average of three items, each indicating product, market, and process innovativeness of a start-up on a three-point scale	GEM 2009
Growth orientation (ordinal)	1.90	0.92	1.00	4.00	Difference between the current and expected number of employees: ≤ 0 (= 1), 1–5 (= 2), 6–19 (= 3), > 19 (= 4)	GEM 2009
International orientation (ordinal)	1.59	0.83	1.00	4.00	Proportion of customers from other countries: 0% (= 1), 1–25% (= 2); 26–75% (= 3); > 75% (= 4)	GEM 2009
Independent and control variables						
Environmental orientation (continuous)	0.200	0.205	0	1	Share of points allocated to environmental value creation compared to all points allocated to environmental and economic value creation	GEM 2009
Gender (binary)	0.600	0.489	0	1	Entrepreneur's self-reported sex: female (= 0), male (= 1)	GEM 2009
Age (continuous)	37.2	11.5	18	64	Entrepreneur's current age	GEM 2009
Education (ordinal)	2.07	0.79	1	3	Highest educational level: none or some secondary education (= 1), secondary education (= 2), post-secondary education (= 3)	GEM 2009
Network (binary)	0.645	0.479	0	1	Entrepreneur knows someone who started a firm in the past two years: no (= 0), yes (= 1)	GEM 2009
Entrepreneurial skills (binary)	0.864	0.343	0	1	Entrepreneur indicates to have the required knowledge, skill, and experience to launch a start-up: no (= 0), yes (= 1)	GEM 2009
Entrepreneurial stage (binary)	0.502	0.500	0	1	Nascent entrepreneur actively involved in launching a start-up (= 0) or new entrepreneur managing or owning a start-up that is up to 42 months old (= 1)	GEM 2009
Entrepreneurial motivation (binary)	0.720	0.451	0	1	Necessity-driven (= 0) or opportunity-driven (= 1) entrepreneurial activity	GEM 2009
Fear of failure (binary)	0.280	0.447	0	1	Fear of failure would prevent entrepreneur from starting a business (= 1) or not (= 0)	GEM 2009
GDP per capita (continuous)	0.18	0.18	0.080	8.82	Gross domestic product per capita in constant 2010 US$ divided by 10,000	WDI 2009
Population growth (continuous)	1.30	1.68	− 1.65	11.04	Annual population growth in percent	WDI 2009

Growth orientation. Consistent with the definition in Sect. "Impact of environmental orientation on international orientation", the variable *growth orientation* is measured here based on entrepreneurs' growth expectations. In the GEM survey, the entrepreneurs stated their current number of employees and estimated the number of people they expected to employ in five years. Following previous GEM-related research (Capelleras et al., 2018; Estrin et al., 2013), expected growth was calculated here as the difference between the projected and current headcount. Similar to Giotopoulos et al. (2017), the number of additional

Table 3 Examples for calculations of environmental orientation

Points allocated to value type				Calculation approach	
Economic	Environmental	Social	Sum	Absolute difference	Relative share*
10	10	80	100	0	50%
0	10	90	100	10	100%
5	15	80	100	10	75%
45	55	0	100	10	55%

*Based on Eq. (1)

jobs created was then categorised into four ordinal groups (see Table 2) to reduce the effect of outliers and unrealistic projections.

International orientation. Due to low capital requirements (Erramilli & D'Souza, 1993), exporting is usually the first step towards growing internationally (Hessels & van Stel, 2011; Zahra et al., 1997) and has, therefore, become a standard indicator for start-up international orientation (Acs et al., 2017; de Clercq et al., 2008; González-Pernía & Peña-Legazkue, 2015). Following this approach, international orientation is measured here as the export orientation of start-ups. In the GEM survey, the entrepreneurs were asked to indicate what proportion of their customers were from abroad. This paper is consistent with previous research (Giotopoulos & Vettas, 2018; Giotopoulos et al., 2017; González-Pernía & Peña-Legazkue, 2015) in that it codes the entrepreneurs' responses into a variable comprising four ordinal groups (see Table 2).

Independent variable

Environmental orientation. This paper replicates Hoogendoorn et al.'s (2020) approach and measures the variable environmental orientation as a continuum between entrepreneurs' emphasis on economic and environmental goals. In the GEM survey, the entrepreneurs had to allocate 100 points to the business goals of economic value creation, environmental value creation, and social value creation, depending on how important these were to their start-ups (see Table 2). Hoogendoorn et al. calculated environmental orientation in two ways: (i) as the absolute difference between the points allocated to environmental and economic points and (ii) using the following calculation of a relative variable:

$$\text{environmental orientiation} = \frac{\text{environmental points}}{\text{environmental points} + \text{economic points}} \tag{1}$$

As the examples in Table 3 illustrate, the relative shares differ according to the points allocated to social value creation, while the absolute differences remain the same. The unbiased relative calculation approach from Eq. (1) is used here, as it is considered to be more appropriate to test the hypotheses formulated in Sect. "Theoretical foundations and hypotheses".

Control variables

The following widespread micro-level and macro-level control variables are adopted from Hoogendoorn et al. (2020): *gender*, *age*, *education*, *entrepreneurial motivation*, and *GDP per capita*.

Furthermore, seven additional control variables are introduced. First, the variable *network* acknowledges the importance of networking (Estrin et al., 2013; Horbach & Janser, 2016; Hörisch et al., 2017). Second, the variable *fear of failure* considers previous research (Arafat et al., 2022; Giotopoulos et al., 2017; Verheul & Mil, 2011), which outlines the importance of entrepreneurs' risk tolerance. Third, expanding the sample to include nascent entrepreneurs, makes it necessary to control for possible differences with new entrepreneurs (Chen et al., 2018; Estrin et al., 2013; Verheul & Mil, 2011), which is done by adding the variable *entrepreneurial stage*. Fourth, in addition to *GDP pc*, the variable *population growth* is introduced to control for potential differences between social development levels of countries, which is consistent with previous research (Capelleras et al., 2018; Delfmann et al., 2014; Hunt & Levie, 2003). Finally, the significant interdependencies between the three dependent variables (Hermans et al., 2015; Verheul & Mil, 2011) require that *innovativeness*, *growth orientation*, and *international orientation* are added as control variables (Capelleras et al., 2018; Giotopoulos et al., 2017; Lecuna et al., 2017).

However, five control variables used by Hoogendoorn et al. (2020) are omitted or replaced. First, Since the variable *growth orientation* already controls for expected start-up size, the measure of current firm size implemented by Hoogendoorn et al. would be redundant and is therefore excluded. Second, this paper does not control whether the entrepreneurs have experience as business angels, as this is neither a common approach in the related literature nor did Hoogendoorn et al. find a significant relationship with *innovativeness*. Third, entrepreneurial experience and skill (*entrepreneurial skill*) are not measured according to whether entrepreneurs have recently experienced an entrepreneurial exit but directly based on whether the entrepreneurs stated to have the knowledge, skill and experience required to start a new business, which is a more common approach (Capelleras et al., 2018; Koellinger, 2008; Lecuna et al., 2017). Finally, two variables used by Hoogendoorn et al. to control for environmental legislation are excluded as they unduly limit the number of available observations. An overview of all control variables is presented in Table 2.

Empirical approach

Contrary to the micro–macro-level study of Hoogendoorn et al. (2020), no complex multi-level analytical approach is required in this paper. Given the ordinal properties of the dependent variables, one of the most common ordinal logistic regression (OLR) models (McCullagh, 1980) was used instead, namely the cumulative proportional odds OLR model. While ordered logit models and ordered probit models produce very similar results, an ordered logit model is used here because of its computational simplicity and prevalence. The corresponding OLR equation for the dependent variable Y and its j categories can be written as:

$$logit\left[P\left(Y \geq j|X\right)\right] = ln\left(\frac{P(Y \leq j|X}{P(Y > j|X}\right) = \alpha_j - \beta X, \tag{2}$$

where α_j represents the intercept, X are the independent and control variables and β their regression coefficients. The negative sign before β enables a more intuitive

Table 4 Correlations

Variables		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Innovativeness	1												
2	Growth orientation	0.217**	1											
3	International orientation	0.146**	0.189**	1										
4	Environmental orientation	0.123**	0.064**	0.124**	1									
5	Gender	− 0.008	0.125**	0.072**	− 0.002	1								
6	Age	− 0.034**	− 0.086**	− 0.003	0.048**	− 0.005	1							
7	Education	0.086**	0.125**	0.161**	0.088**	0.061**	0.026**	1						
8	Network	0.045**	0.084**	0.046**	− 0.003	0.069**	− 0.120**	0.082**	1					
9	Entrepreneurial skill	0.003	0.045**	0.049**	0.017	0.054**	0.011	0.069**	0.108**	1				
10	Entrepreneurial stage	− 0.167**	− 0.250**	− 0.105**	− 0.077**	− 0.003	0.020*	− 0.053**	− .040**	− 0.006	1			
11	Entrepreneurial motivation	0.084**	0.109**	0.100**	0.041**	0.075**	− 0.021*	0.200**	0.096**	0.103**	− 0.031**	1		
12	Fear of failure	− 0.011	− 0.043**	− 0.003	− 0.022*	− 0.064**	− 0.011	− 0.052**	− 0.005	− 0.141**	0.008	− 0.063**	1	
13	GDP per capita	− 0.022*	− 0.039**	0.163**	0.154**	0.052**	0.203**	0.329**	− 0.030**	0.060**	0.006	0.165**	− 0.049**	1
14	Population growth	0.050**	0.166**	0.008	− 0.081**	0.053**	− 0.129**	− 0.089**	− 0.001	0.005	− 0.013	0.009	− 0.005	− 0.092**

*$p < 0.05$; **$p < 0.01$

Table 5 OLR results

	(1) Innovativeness		(2) Growth orientation		(3) International orientation	
	Coeff.	**SE**	**Coeff.**	**SE**	**Coeff.**	**SE**
Independent variables:						
Environmental orientation	0.965***	0.091	0.301***	0.097	0.666***	0.101
Control variables:						
Innovativeness			0.577***	0.042	0.424***	0.044
Growth orientation	0.289***	0.022			0.322***	0.024
International orientation	0.221***	0.023	0.279***	0.024		
Gender: male	− 0.145***	0.038	0.378***	0.041	0.147***	0.044
Gender: female[a]						
Age	0.000	0.002	− 0.009***	0.002	− 0.002	0.002
Education: post-secondary	0.297	0.051	0.531***	0.054	0.526***	0.059
Education: secondary	0.283	0.048	0.332***	0.051	0.409***	0.057
Education: none or some secondary[a]						
Network: yes	0.045	0.039	0.185***	0.042	0.075*	0.045
Network: no[a]						
Entrepreneurial skill: yes	− 0.089	0.055	0.103*	0.059	0.149**	0.064
Entrepreneurial skill: no[a]						
Entrepreneurial stage: new entrepreneur	− 0.416***	0.038	− 0.883***	0.040	− 0.178***	0.043
Entrepreneurial stage: nascent entrepreneur[a]						
Entrepreneurial motivation: opportunity	0.251***	0.042	0.314***	0.045	0.180***	0.050
Entrepreneurial motivation: necessity[a]						
Fear of failure: yes	0.004	0.042	− 0.117***	0.044	0.138***	0.047
Fear of failure: no[a]						
GDP per capita	− 0.092***	0.012	− 0.100***	0.012	0.141***	0.012
Population growth	0.030***	0.011	0.195***	0.012	− 0.002	0.012
Goodness-of-fit:						
Pseudo (McFadden) R2	.030		0.080		0.051	
LR Chi2	965***		28,417***		1008***	
Test of parallel lines:						
LR Chi2	115***		305***		51.2***	
Observations:						
Total	9572		9572		9572	

***$p < 0.01$; **$p < 0.05$: *$p < 0.10$

[a] Reference category

interpretation of the regression coefficients. Higher coefficients of the independent variables indicate higher predicted values.

Empirical analysis

Multicollinearity, proportional odds assumption, and model fit

Spearman correlation coefficients between all variables were calculated to identify potential multicollinearity issues and are listed in Table 4. Additionally, linear regressions were estimated to investigate variance inflation factors (VIF). The correlations (max. 0.329) are comfortably below the threshold of 0.80 (Kennedy, 2003), and all VIFs (max. 1.761) are well below the threshold of 5 (Hair et al., 2014) indicating that multicollinearity is not a concern here.

Table 6 Results of additional OLRs on the dependent variable *innovativeness*

	Entrepreneurial stage				Level of development					
	(1) Nascent		(2) New		(3) Factor-driven		(4) Efficiency-driven		(5) Innovation-driven	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Independent variables:										
Environmental orientation	0.900***	0.128	1.031***	0.131	0.951***	0.223	1.400***	0.155	0.650***	0.137
Control variables:										
Growth orientation	0.337***	0.030	0.234***	0.032	0.252***	0.047	0.242***	0.034	0.300***	0.036
International orientation	0.198***	0.031	0.240***	0.034	0.326***	0.053	0.121***	0.038	0.261***	0.035
Gender: male	− 0.149***	0.054	− 0.140**	0.054	− 0.095	0.074	− 0.235***	0.061	− 0.071	0.066
Gender: female[a]										
Age	0.000	0.002	− 0.001	0.002	0.003	0.003	− 0.003	0.003	− 0.002	0.003
Education: post-secondary	0.176**	0.073	0.396***	0.071	0.501***	0.118	0.060	0.081	0.332***	0.097
Education: secondary	0.074	0.068	0.480***	0.068	0.590***	0.086	0.034	0.075	0.193*	0.103
Education: none / some secondary[a]										
Network: yes	0.040	0.055	0.044	0.055	− 0.142*	0.077	0.157**	0.064	0.023	0.065
Network: no[a]										
Entrepreneurial skill: yes	− 0.070	0.078	− 0.129*	0.078	− 0.139	0.103	− 0.094	0.086	0.074	0.101
Entrepreneurial skill: no[a]										
Entrepreneurial stage: new					− 0.423***	0.079	− 0.404***	0.061	− 0.359***	0.064
Entrepreneurial stage: nascent[a]										
Entrepreneurial motivation: opport	0.185***	0.060	0.327***	0.060	0.422***	0.081	0.163**	0.065	0.265***	0.081
Entrepreneurial motivation: necess.[a]										
Fear of failure: yes	0.063	0.059	− 0.062	0.059	0.325***	0.080	− 0.130*	0.068	− 0.046	0.072
Fear of failure: no[a]										
GDP per capita	− 0.081***	0.016	− 0.105***	0.017	0.020	0.097	0.428***	0.097	− 0.010	0.024
Population growth	0.044***	0.016	0.019	0.016	0.097**	0.042	0.107***	0.028	0.026*	0.014
Goodness-of-fit:										

Table 6 (continued)

	Entrepreneurial stage				Level of development					
	(1) Nascent		(2) New		(3) Factor-driven		(4) Efficiency-driven		(5) Innovation-driven	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Pseudo (McFadden) R2	0.021		0.021		0.050		0.027		0.029	
LR Chi2	353***		350***		415***		329***		324***	
Test of parallel lines:										
LR Chi2	264***		60.3***		43.0		72.1		80.8	
Observations:										
Total	4778		4794		2510		3662		3400	

***$p < 0.01$; **$p < 0.05$: *$p < 0.10$

[a] Reference category

The chosen OLR methodology assumes that each explanatory variable has an identical effect for each cumulative split of the response variable. This assumption was tested by comparing the fit of the proportional odds models to models with varying cumulative splits using full likelihood ratio tests, also known as tests of parallel lines. The significances of the corresponding test results are presented in Tables 5 and 6 and they suggest that this proportional odds assumption might be violated. However, due to the large numbers of observations and explanatory variables, these test results are likely to indicate violations that, in fact, do not exist (Allison, 1999) and thus require further investigation. Therefore, it was examined whether the OLR coefficients of the key explanatory variable *environmental orientation* are similar to the coefficients of additional binomial logistic regressions (BLR) for each cumulative split of the response variables. The comparisons show that all OLR coefficients for *environmental orientation* are well within the 95% confidence intervals of the corresponding BLR regressions of the cumulative splits (dichotomous response variable). This additional in-depth investigation thus confirms that the proportional odds assumption is valid. The VIFs and BLR results are not presented here but are available upon request.

The McFadden's pseudo-R^2 values presented in Tables 5 and 6 are all below 0.1, indicating a low predictive power of all estimated regression models. However, the likelihood ratio tests prove that all models predict the dependent variables significantly better ($p < 0.01$) than the model considering only the intercept. Hence, the estimated models fit the purpose of this paper.

OLR results

In Sect. "Theoretical foundations and hypotheses", it was hypothesised that the environmental orientation of start-ups is positively related to innovativeness (H1a), growth orientation (H2), and the international orientation (H3). Three OLRs were estimated based on Eq. (2) to test these hypotheses. The results are presented in columns (1), (2), and (3) of Table 5. The positive and significant coefficients of *environmental orientation* confirm all three hypotheses.

H1b hypothesised that the positive relationship between *environmental orientation* and *Innovativeness* applies to both nascent and new entrepreneurs. To test this hypothesis, the corresponding OLR presented in column (1) of Table 5 was estimated separately for both entrepreneurial stages. The results for both estimations are presented in columns (1) and (2) of Table 6. The positive and significant coefficients of *environmental orientation* indicate that the relationship indeed holds for both new and nascent entrepreneurs, so H1b is confirmed.

Additionally, H1c predicted that the relationship predicted in H1a also holds for start-ups from countries at different levels of development. This hypothesis was tested by adopting the common approach (e.g., Estrin et al., 2013; Stam et al., 2011; Valliere & Peterson, 2009) of categorising start-ups on the basis of development levels in their home countries. Therefore, this paper adopts the GEM classification of factor-driven, efficiency-driven, and innovation-driven countries shown in Table 1 (Bosma & Levie, 2010). The results are presented in columns (3) to (5) of Table 6. The three coefficients of *environmental orientation* are positive and significant and thus confirm H1c.

Additional analyses and robustness tests

Three additional analyses were conducted to test the robustness of the results presented in Sect. "OLR results". First, the separate OLRs for start-ups in different entrepreneurial stages were repeated for the remaining two dependent variables. The coefficients of *environmental orientation* are positive and significant for both *growth orientation* ($\beta_{nascent} = 0.297$; $p_{nascent} = 0.027$; $\beta_{new} = 0.346$; $p_{new} = 0.015$) and *international orientation* ($\beta_{nascent} = 0.297$; $p_{nascent} = 0.027$; $\beta_{new} = 0.346$; $p_{new} = 0.015$), thus supporting the initial evidence for H2 and H3.

Second, the OLRs on *growth orientation* and *international orientation* were also performed for countries at different levels of development. The results confirm a positive relationship between *environmental orientation* and *growth orientation* in factor-driven countries ($\beta = 0.730$; $p = 0.002$) and efficiency-driven countries ($\beta = 0.743$; $p < 0.001$) but not in innovation-driven countries ($\beta = -0.205$; $p = 0.167$). For *international orientation*, the positive impact of *environmental orientation* is confirmed for start-ups from efficiency-driven countries ($\beta = 1.176$; $p < 0.001$) and innovation-driven countries ($\beta = 0.394$; $p = 0.007$) but not from factor-driven countries ($\beta = -0.027$; $p = 0.917$).

Third, three alternative binary-dependent variables were constructed and tested in additional binomial logistic regressions (BLR) to address potential difficulties arising from the ordinal structure of the original variables (see Sect. "Multicollinearity, proportional odds assumption, and model fit"). Following van Oort and Bosma (2013), the first variable *innovativeness (binary)* defines a start-up as innovative if (a) at least some of its customers see its product or service as new and unfamiliar and (b) not many incumbents offer the same products or services. The second variable *growth orientation (binary)* indicates, consistent with previous research (Hessels et al., 2008; Wong et al., 2005), whether start-ups expect to create more than 19 new jobs in the next five years. The third variable *international orientation (binary)* defines a start-up as international if more than 25% of its customers live abroad, which is consistent with previous empirical work on international start-ups (Chen et al., 2018; de Clercq et al., 2008; Hessels & van Stel, 2011). The BLR results confirm the OLR findings (a) on the impact of *environmental orientation* on *innovativeness*, *growth-orientation*, and *international orientation*, (b) on nascent and new entrepreneurs, and (c) on the impact of *environmental orientation* on the *innovativeness* and *international orientation* of start-ups from countries at different levels of development. However, contrary to the OLR results on *growth orientation* (see previous paragraph), the BLR results suggest that *environmental orientation* is positively related to *growth orientation (binary)* in efficiency-driven countries ($\beta = 0.527$; $p = 0.055$) and innovation-driven countries ($\beta = 0.675$; $p = 0.09$) but not in factor-driven countries ($\beta = -0.071$; $p = 0.890$). The preliminary assumption tests and results of the additional analyses are not shown here but are available upon request.

Discussion and conclusion

Entrepreneurship research has shown that the positive impact of entrepreneurship on economic and sustainable development originates from only a few start-ups, which distinguish themselves by high quality in terms of innovativeness, growth orientation, and international orientation. Despite their importance, however, identifying these high-quality start-ups remains difficult. The present paper pursues a novel research avenue

and introduces entrepreneurs' environmental orientation as an unrecognised characteristic of start-up quality. In doing so, it (a) empirically analyses the quality differences between green and conventional start-ups, (b) evaluates Hoogendoorns et al. (2020) research on the relevance of environmental orientation for start-up innovativeness, and (c) extends their research by also analysing growth orientation and international orientation as potential quality dimensions of green start-ups.

The results reveal that greener start-ups are of superior quality in terms of innovativeness, growth orientation, and international orientation. Furthermore, in-depth analyses and additional tests validate the robustness of the positive relationship between environmental orientation and innovativeness found by Hoogendoorn et al. (2020). Moreover, all relationships between environmental orientation and innovativeness, growth orientation, and international orientation are robust for nascent and new entrepreneurs, confirming previous findings (Renko, 2013). However, categorisation at the country-level revealed that, contrary to innovativeness, growth orientation, and international orientation are not always positively related to environmental orientation in countries at all development levels. However, these findings do not contradict the hypothesis that greener start-ups are of higher-quality as previous research showed that growth orientation (Stam et al., 2009) and international orientation (Hessels & van Stel, 2011) are of minor macroeconomic importance in the corresponding country groups. Thus, the findings fully support all hypotheses and the answer to the initial research question is yes, greener start-ups are of higher quality.

There are four limitations of this paper, which raise theoretical implications and future research avenues. First, when interpreting the findings, the advanced age of the GEM data must be considered, as the entrepreneurial environment has changed significantly since 2009. Green start-ups face additional financial, administrative, market, and legal barriers which might limit their abilities to innovate and grow (Linnanen, 2002; Melay et al., 2017). However, the financial and entrepreneurial support infrastructure for green start-ups has considerably improved over the past decade (Bocken, 2015; Fichter et al., 2016; Lin, 2022). These improvements have recently been found to facilitate the outcomes of green entrepreneurship (Wagner et al., 2021). It thus is reasonable to assume that the hypothesised and measured superior quality of green start-ups still applies today. Nevertheless, there is a need to validate the results as soon as more recent data become available. Second, although frequently used in previous research, the dependent variables were contingent on the data available in the GEM survey and were mostly based on single items. Therefore, future research is encouraged to employ alternative, more specific, and multi-item measures of start-up quality, such as eco-, social, and institutional innovations (Hoogendoorn et al., 2020), impact-oriented growth measures, international networks, internationally raised capital, survival rates (Brixy, 2014; Falck, 2007), and financial indicators (Acs, 2010; Acs et al., 2017; Shane, 2009). Third, while many relevant control variables were included in the conducted regressions, others were neglected due to a lack of data or to maintain a high sample size. Future research could employ mediating or moderating models to investigate the relevance of other contextual factors, such as cultural differences, institutional and legal environment, level of ecological and climate stress. Fourth, due to the quantitative nature of the chosen methodology, no conclusions can be drawn about the mechanisms underlying the identified

relationships. More specifically, this paper does not provide answers as to why and how green start-ups innovate, whether they pursue different growth strategies (e.g., organic growth), why, when, and how they internationalise, how they can best be promoted, or why the quality-gap differs between countries at different development levels. Accordingly, more qualitative research is required to answer these questions and to better understand environmental orientation as a characteristic of entrepreneurial quality.

In addition to these theoretical implications, there are also implications of practical relevance arising from this paper. While it has long been known that only a few start-ups induce sustainable development (Shane, 2009), identifying this desired subset of start-ups is complex and requires that policymakers have a good understanding of the characteristics of start-up quality. The evidence presented for environmental orientation as such a characteristic shows that supporting green start-ups can lead to both environmental achievements and more economically relevant high-quality start-ups. This combined economic and environmental advantage of green start-ups makes them more attractive for private and public investors. This paper thus underlines the call for policymakers to take green start-ups seriously (Hoogendoorn et al., 2019; Kirkwood & Walton, 2014; Melay et al., 2017). This call becomes even more critical when considering that internationalisation and scaling are costly for start-ups and even more so for green start-ups, which are more likely to face financial and administrative barriers (Hoogendoorn et al., 2019; Melay et al., 2017). Therefore, policymakers should consider prioritising green start-ups by establishing dedicated green start-up funds and reducing bureaucratic hurdles for green start-ups applying for public support programmes. Policymakers might also encourage conventional start-ups to adopt greening strategies through incentives and stricter environmental legislation (Astadi et al., 2022). Moreover, as green start-ups tend to be characterised by growth orientation, entrepreneurs and venture capital providers should ensure that their environmental objectives do not suffer when scaling up (Schaltegger et al., 2016). These recommendations apply to green start-ups at different entrepreneurial stages (nascent and new entrepreneurs) and are important to practitioners in countries at all levels of development.

Abbreviations

BLR	Binomial logistic regression
GDP	Gross domestic product
GEM	Global Entrepreneurship Monitor
OLR	Ordinal logistic regression
VIF	Variance inflation factor

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