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Goal heterogeneity at start-up: are greener start-ups more innovative?

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ABSTRACT

Start-ups differ in the extent to which they introduce innovations to markets and, hence, in their potential contribution to society. Understanding the heterogeneous character of start-ups is key to explaining the variability in innovation. In this study, we explore whether start-ups that place more emphasis on environmental value creation versus economic value creation ('greener start-ups') are more innovative. We also examine how environmental regulations at the country level affect this relationship. We theorize that the fundamental difference between economic value creation (private wealth generation, i.e., self-regarding interest) and environmental value creation (environmental gains for society, i.e., other-regarding interest) influences entrepreneurial opportunity identification and exploitation. When considering the regulatory context, we draw on the innovation inducement effect of environmental regulations and expect these regulations to be most effective for entrepreneurs with a strong emphasis on economic value creation. Performing multi-level ordered logit regressions with 2,945 start-up entrepreneurs in 31 countries (Global Entrepreneurship Monitor data), we find that 'greener start-ups' are more likely to engage in product and process innovations. We find some evidence of a positive moderation effect for environmental regulations. We advance research on innovative entrepreneurship by theorizing and finding evidence that other-regarding goals are relevant in explaining start-up innovativeness.

1. Introduction

Innovation is a central aspect of entrepreneurship (Schumpeter, 1934) and an important goal for policymakers. Start-ups have been recognized as the engine behind innovative behaviour, leading to increased competition, employment generation, and, ultimately, economic growth (Hébert and Link, 1989; Schumpeter, 1934). Recently, there is increased interest on the potential contribution of start-ups in bringing solutions to environmental challenges such as climate change and biodiversity loss (Shevchenko, Lévesque, and Pagell, 2016; York and Venkataraman, 2010). However, entrepreneurial firms, particularly start-ups, differ in the extent to which they introduce innovations to markets (Davidsson and Wiklund, 2001; Bhave, 1994). Understanding heterogeneity among start-ups is the key to explaining their variability in innovation and, subsequently, their potential contribution to the economy and society (Colombelli, Krafft, and Vivarelli, 2016). The central question of this study is whether the goals pursued by start-ups, in particular their drive to realize environmental gains for society, influence their innovativeness. In other words: are greener start-ups more innovative?

Previous research has addressed why some firms are more innovative than others by focusing on contextual, firm, and individual-level factors (Autio et al., 2014; Block, Fisch, and Van Praag, 2017; Cohen, 2010; Galende, 2006), with particular interest on the regulatory context where environmental innovations[1] are concerned (Jaffe et al., 2002 and 2005; Rennings, 2000). A fundamental assumption underlying this literature is that organizations are singularly driven by economic self-interest (Van de Ven et al., 2007; Cohen et al., 2008). However, by assuming economic self-interest, the existing research neglects the possibility that entrepreneurs are motivated by other-regarding interests such as the drive to contribute to a better environment. Differences in pursued goals may have consequences on

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[1] Environmental innovations can be defined as those innovations that "consist of new or modified processes, techniques, systems, and products to avoid or reduce environmental damage" (Kemp et al. (2001) in Horbach (2008: 163)). In this study, we consider innovativeness in general terms without explicitly referring to the impact of these innovations on the natural environment.

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entrepreneurial judgement, behaviour, and outcomes such as innovation (Shane et al., 2003; Van de Ven et al., 2007). For instance, an entrepreneur who is determined to improve the quality of the environment may decide to invest in sustainable energy sources despite a negative business case. Therefore, considering heterogeneity in goals may increase our understanding of what drives variability in innovation.

This study examines the relationship between start-up goals and innovativeness and how environmental regulations affect this relationship. In particular, we consider a start-up's drive to create environmental value relative to economic value as a source of goal heterogeneity. Our argumentation draws on the fundamental difference between economic value creation, which concerns private wealth generation (i.e., self-regarding interest), and environmental value creation, which relates to environmental gains for society (i.e., other-regarding interest) (Van de Ven et al., 2007). Although it has been stressed that environmental entrepreneurs are driven by economic (self-regarding) and environmental (other-regarding) motives (Thompson et al., 2011; Leno and York, 2011; York et al., 2016), few studies have examined the *consequences* of this combined logic.

We argue that the relative importance of environmental value creation over economic value creation influences the entrepreneur's opportunity identification and incentive to innovate. In line with previous research on other-regarding behaviour (De Dreu and Nauta, 2009; Grant and Berry, 2011; Meglino and Korsgaard, 2004), we reason that pursuing other-regarding goals requires empathy for others' viewpoints, which demands a full understanding of the preferences and needs of others and encourages the development of useful and innovative ideas. In addition, the drive to contribute to environmental improvement is likely to be fuelled by dissatisfaction with prevailing practices, which serves as an additional motivator to discover innovative opportunities (Cliff, Jennings, and Greenwood, 2016; Shepherd and DeTienne, 2005). In addition to opportunity identification, pursuing environmental goals other than economics ones may help overcome the appropriation problem inherent in the process of innovating when expected private returns are low but expected societal returns are prevalent. When considering the effect of environmental regulations, we draw on the inducement effect of such regulations on innovation (Jaffe et al, 2005; Porter and Van der Linde, 1995) and argue that environmental regulations appeal to economic incentives to innovate (i.e., innovating to avoid increased costs of production and profit from increased customer demand and reduced risk) (Ambec et al., 2013; Wagner, 2003).

We make use of the 2009 round of the Global Entrepreneurship Monitor (GEM) that provides information about entrepreneurs' goals including environmental value creation goals or "green goals." Performing multi-level regressions for 2,945 start-up entrepreneurs in 31 countries, we find that the value-creating goals of start-ups are important for the probability of adopting innovations. That is, start-ups that place stronger emphasis on environmental value creation relative to economic value creation ("greener start-ups") are more likely to be involved in product innovation and in process innovation than start-ups that focus primarily on the creation of economic value. Furthermore, this relationship between start-up goals and innovation is rather uniform across economies. We find some evidence of a moderating role for environmental regulations in that greener start-ups are more likely to innovate at the product level in countries with stricter environmental regulations.

Our study makes the following contributions. *First*, we advance research on entrepreneurship by addressing the consequences of other-regarding motives as a source of heterogeneity among start-ups. Although the pursuit of other-regarding goals is increasingly addressed in non-traditional forms of entrepreneurship such as social, sustainable, and environmental entrepreneurship, the *consequences* of pursuing such goals are less well-researched. Whereas others have studied the consequences in terms of organizational challenges, organizational design principles, and start-up success (Battilana and Lee, 2014; Renko, 2013; Parrish, 2010), we explore the consequences of other-regarding goals for a start-up's innovativeness. We predict and find a significant and positive relationship between environmental (relative to economic) value-creation goals and innovativeness such that "greener start-ups" are indeed more innovative.

Second, we contribute to the discussion on the inducement effect of environmental regulations on innovation; we theorize that the inducement effect may play out differently for different types of firms. Past research assumes that environmental regulations are needed to push profit-maximizing firms to overcome market failures, behavioural shortcomings, or organizational inertia to address overlooked profitable opportunities for innovation (Ambec et al., 2013; Kozluk and Zipperer, 2015). We theorize that non-economic motives, such as the pursuit of environmental value creation, may alter the inducement mechanism. Entrepreneurs who pursue other-regarding motives may innovate without the additional economic incentives from regulatory interventions. While we did not find convincing moderation effects across the board, we did find some evidence for a moderating role of sturdier environmental regulations. We believe our sample of start-ups drives this result and more research is warranted to explore the inducement effect for different types of firms.

Third, this study adds to our understanding of the influence of environmental regulations by investigating the relationship between environmental regulations, goal heterogeneity among start-ups, and different types of innovation in interaction. Other studies on this intersection are mainly single-country and single-sector studies (Kammerer, 2009; Horbach, 2008; Cleff and Renning, 1999) or lack a hierarchical structure (Triguero et al., 2013). Our multi-level approach addresses the point that "individual differences (as well as cultural contexts) are likely to influence the relative balance between self- and collective interests in explaining entrepreneurial behaviour" (Van de Ven et al., 2007, p. 367). Our results suggest that in countries with sturdier environmental regulations, greener start-ups are more likely to innovate at the product level.

This paper is structured as follows. The next section provides a literature background, followed by an introduction to our hypotheses. The paper continues with a description of our data and the methods applied. After the results are presented, a discussion and conclusion follow in the final section.

2. Literature review

We first introduce the concept of environmental entrepreneurship relative to traditional entrepreneurship and to other forms of entrepreneurship characterized by other-regarding start-up motives (i.e., social and sustainable entrepreneurship). Subsequently, we discuss the innovativeness of new enterprises and in particular how entrepreneurs' individual characteristics shape the process of opportunity identification and exploitation. After discussing the regulatory environment and its inducement effect on innovation, we theorize how heterogeneity in goals, opportunity identification, and the regulatory environment combine to affect start-up innovativeness by formulating hypotheses in the subsequent section.

2.1. Environmental entrepreneurship and other-regarding goals

The scholarly field of entrepreneurship concerns "how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited" (Shane and Venkataraman, 2000, pp. 218). The entrepreneur, defined here as someone who starts, owns, and leads a business on his or her own account and risk (Reynolds et al., 2005; Sternberg and Wennekers, 2005), is a central agent in the entrepreneurial process of identifying and exploiting these opportunities and introducing innovations. The dominant assumption that prevails in the entrepreneurship literature is that the entrepreneur is driven by self-interested profit-seeking motives

(Van de Ven et al., 2007; Cohen et al., 2008). Although it is widely acknowledged that the motives of individual agents to start and run a venture are multiple (Shane et al., 2003; Hessels et al., 2008), they mainly reflect self-regarding interests. There is convincing support for non-economic start-up motives such as lifestyle considerations, being independent, and gaining status (see Parker, 2009 for an overview). However, people are driven by both self- and other-regarding goals (Piliavin and Charng, 1990), and they differ in the extent to which they pursue these goals (Meglino and Korsgaard, 2004). Nevertheless, pursuing other-regarding interests is less well-researched and increasingly finds its expression in social, environmental, and sustainable entrepreneurship literature (Dacin et al., 2010; Thompson et al., 2011; Van de Ven et al., 2007).

Social, environmental, and sustainable entrepreneurship all offer an alternative paradigm to traditional entrepreneurship. Compared to traditional for-profit entrepreneurship, they represent other-regarding motives and outcomes that exist in the exploitation of opportunities that relate to societal relevant issues (Cohen et al., 2008). What distinguishes environmental entrepreneurs from social and sustainable entrepreneurs are (1) their environmentally relevant motivations, (2) their seizing of opportunities that render both economic and environmental benefits, and (3) their exclusive focus on environmentally relevant market failures (Thompson et al., 2011). Environmental entrepreneurs address environmental degradation through the creation of financially profitable organizations while social and sustainable entrepreneurs exploit these opportunities through for-profit, community-based, and nonprofit organizations (York et al., 2016, p. 695).[2] Environmental entrepreneurs are, next to self-regarding profit motives, directly driven by the motivation to contribute to environmental gains for others in the society even when there is no sound "business case" (Hockerts and Wüstenhagen, 2010; Pachecoet al., 2010; Shepherd and Patzelt, 2011).

Although environmental entrepreneurs combine economic and environmental goals, and thereby pursue self- and other-regarding interests, they do so to varying degrees. Hence, environmental entrepreneurs form a diverse group that entails individuals who aim to change the world and improve the quality of the environment at the expense of economic objectives and individuals who seize environmental opportunities primarily for private wealth generation purposes (Anderson and Leal, 2001; York et al., 2016). The line between "green" and "non-green" entrepreneurs is empirically difficult to draw. Therefore, we treat environmental value creation as a continuum and explore the relative emphasis on environmental versus economic value creation at start-up as our variable of interest.

2.2. Innovative entrepreneurship and individual characteristics

Firms differ in the extent to which they introduce innovations to markets (Bhave, 1994; Davidsson and Wiklund, 2001). Various perspectives that explain this variation exist including the resource-based view, with a focus on internal resources and capabilities (Barney, 1991; Teece, 2006); industrial organization, which stresses market and industry characteristics (Douma and Schreuder, 1992); and the evolutionary approach, which emphasizes accumulation of knowledge and path-dependency over time (Nelson and Winter, 1977).[3] The innovativeness of new enterprises finds its expression in the entrepreneurship literature and, more specifically, the innovative entrepreneurship literature (Block et al., 2017), which traditionally stresses the characteristics of entrepreneurs and sources of opportunities (Autio et al., 2014; Shane, 2003).

New enterprises are more likely to be innovative when the entrepreneur possesses certain personality characteristics. Notably, Schumpeter (1934) stresses individual creativity, and Kirzner (1973) emphasizes the importance of entrepreneurial alertness in the process of opportunity recognition. The entrepreneurs' individual characteristics that have been addressed more recently are experiences, beliefs, capabilities, and socio-economic characteristics (Block et al., 2017). For example, Koellinger (2008) demonstrates that self-confidence and educational attainment relate to innovative entrepreneurship, and Cliff et al. (2006) show that entrepreneurs with greater experience in other industries are more likely to act as innovative entrepreneurs.

Entrepreneurs' individual characteristics shape the process of opportunity identification and exploitation (Shane, 2003). Put differently, the act of identifying opportunities and the extent to which resources and capabilities are allocated to innovation are acts of individual judgement and decision-making (Cliff et al., 2006). Changing market conditions (e.g., consumer preferences, available technologies, and demographics) produce new information that serves as a source of entrepreneurial opportunity (Eckhardt and Shane, 2003). However, individuals differ in their access to such information (e.g., effort put into acquisition or networking), beliefs about the information, and their ability to cognitively process the information for opportunity identification (Dyer et al., 2008; Shepherd and DeTienne, 2005).

The pursuit of other-regarding interests affects how individuals acquire and process information and, hence, how entrepreneurial opportunities are identified (Grant and Berry, 2011; Van de Ven et al., 2007). The desire to help or contribute to others in society encourages empathy for others' viewpoints. Being sensitive to the needs of others requires the consideration of the perspectives of multiple others and stimulates the understanding of the preferences, needs, and values of others (Grant and Berry, 2011; Meglino and Korsgaard, 2004). Taking multiple perspectives influences one's information-acquiring behaviour by intensely observing, questioning, and maintaining diverse social networks to assess what others need and value (De Dreu and Nauta, 2009). Being open to the viewpoints of others, as generated by the desire to benefit others, has been found to stimulate creativity and results in ideas that are novel and useful to others (Grant and Berry, 2011). Additionally, questioning prevailing practices, perceptions of what is considered appropriate, and dissatisfaction with existing conditions motivate the discovery of innovative opportunities (Shane and Venkataramen, 2000; Shepherd and DeTienne, 2005). Empirical evidence suggests that "founders who more strongly question the functional or ethical legitimacy of prevailing practices are also more likely to do things differently" (Cliff et al., 2006, p. 634).

2.3. Innovation, appropriation, and regulation

In addition to individual characteristics and opportunities is the context of influence on the innovativeness of new enterprises, with two prevailing foci: clusters, networks, and alliances; and the regulatory environment (see Block et al., 2017 for a review).

The regulatory environment legitimizes enterprise behaviour and provides incentives that influence the direction of industrial sectors and the creation of new enterprises (Audretsch et al., 2007; Meek et al., 2010). In the realm of environmental challenges, the importance of the regulatory environment is twofold. First, severe environmental damage to society resulting from market failures (i.e., public goods, externalities, monopoly power, inappropriate government intervention, and imperfect information) (Dean and McMullen, 2007) provides a strong economic rationale for public intervention (Rennings, 2000; Jaffe et al, 2002 and 2005). Second, market failures in the innovation process stimulate governments to adopt policies to encourage the development and adoption of environmentally beneficial innovations (Jaffe et al., 2005; Stenholm et al., 2013). A prominent market failure concerns the existence of positive externalities in terms of *knowledge spillovers* inherent in the entrepreneurial process of innovation due to

[2] See Lenox and York (2011); Thompson, Kiefer, and York (2011); and Belz and Binder (2015) for an extensive description of the distinctions and commonalities among social, environmental, and sustainable entrepreneurship.

[3] See Galende (2006) and Cohen (2010) for an overview of these approaches.

the public good characteristics of the assets produced (new knowledge) (Aghion et al., 2005; Audretsch et al., 2007). Knowledge spillovers (i.e., other firms benefitting from such new knowledge) imply that the private returns to innovation are smaller than the social returns. Moreover, the adoption of (environmental) innovations that gradually replace older, less environmentally friendly products and processes produce large societal benefits; however, the entrepreneur can only capture a small portion of the value created for private gains (Jaffe et al., 2002). Empirical studies establish that the social returns to innovation are generally at least twice as high as the private returns (Teece, 2018). Due to knowledge spillovers, appropriation (i.e., the degree to which a firm is able to capture rents from its innovations) is almost always problematic despite the existence of value-capture mechanisms such as patenting and licensing (Teece, 2006 and 2018)[4]. Hence, the prospect of low private returns to innovation results in a lack of incentive to invest and justifies government intervention.

Market failures associated with environmental damage interact with market failures associated with innovation (Jaffe et al., 2005). Environmental regulations directly reduce environmental damage and indirectly induce firms to innovate (Porter, 1991; Porter and Van der Linde, 1995). The introduction of environmental regulations, such as a carbon tax, increases a firm's cost of production. This increase in costs induces the firm to substitute inefficient and costly environmentally unfriendly production methods and stimulates the development of new products and services. Porter and Van der Linde (1995) were among the first to suggest that the returns of such innovations might partially or even more than fully offset the costs of compliance.[5]

Environmental regulations serve as a trigger to overcome market failures in the innovation process and to alter the appropriability of innovations (Ambec, et al., 2013; Kozluk and Zipperer, 2015; Wagner, 2003). For example, whereas *knowledge spillovers* cause entrepreneurs to be reluctant to invest in innovation due to low appropriation, sufficiently stringent environmental regulations may trigger entrepreneurs to introduce new environmentally superior technologies or replace existing production processes to overcome the cost of compliance (Ambec et al., 2013). Additionally, environmental regulations may serve to overcome *asymmetric information* that hinders consumers' ability to correctly value environmentally superior offerings (Ambec and Barla, 2002). As "the result of the state's selection and enforcement of acceptable or preferred practices" (Meek et al., 2010, p. 495), environmental regulations signal the legitimization of environmental issues as a broad societal goal, increase environmental consciousness among consumers and, as a result, influence home market demand and appropriation (Kostova and Roth, 2002; Scott, 1995). Entrepreneurs can reduce the uncertainties involved in introducing innovations by addressing these broadly accepted environmentally relevant goals (Meek et al., 2010; Aguilera-Caracuel and Ortiz-de-Mandojana, 2013). Abundant empirical literature confirms that environmental regulations stimulate innovation, although the results depend, at least in part, on the proxy used for innovation (mostly measured as research and development (R&D) expenditures or (green) patents), on the sector analysed and on the environmental regulations under scrutiny (Ambec et al., 2013; Barbieri et al., 2016; Ghisetti and Pontoni, 2015).

In the next section, we hypothesize how heterogeneity in goals at start-up (i.e., economic and environmental goals) relates to opportunity identification and exploitation and how the regulatory context influences this relationship.

3. Hypotheses

3.1. Heterogeneity in goals and innovativeness

We now theorize how heterogeneity in goals and the act of identifying and exploiting opportunities combine to affect start-up innovativeness. Environmental entrepreneurs seize opportunities that render both economic benefits for private gains as well as environmental gains for society (Thompson et al., 2011). We argue that the motivation to contribute to environmental gains for others in the society (i.e., serving other-regarding interests) stimulates entrepreneurs to take multiple perspectives (Van de Ven et al., 2007). In line with previous research (Grant and Berry, 2011; Meglino and Korsgaard, 2004), taking multiple perspectives results in different and more complete views of opportunities and stimulates opportunity identification.

Moreover, entrepreneurs strongly driven by the desire to achieve environmental improvements are likely to be dissatisfied with the current conditions of the natural environment or the detrimental behaviour of prevailing business practice (Pinkse and Groot, 2015; Meek et al., 2010) including prevailing ethical and moral standards (York and Venkataraman, 2010). Hence, we expect that environmental entrepreneurs, more so than traditional entrepreneurs, question prevailing practices, have deviating perceptions of what is considered appropriate, and are more dissatisfied with existing circumstances. These conditions motivate the discovery of innovative opportunities (Shane and Venkataramen, 2000; Shepherd and DeTienne, 2005).

Next, we argue that an entrepreneur's drive to create environmental value relative to economic value also influences his or her incentive to innovate. The decision to allocate resources to innovation activities depends on the expected degree to which economic value or private rents can be captured by the investing firm (Audretsch et al., 2007; Jaffe et al., 2002). However, the existence of knowledge spillovers poses appropriation problems and decreases the likelihood that a profit-maximizing entrepreneur will invest in innovative activities (Jaffe et al., 2002 and 2005). Moreover, entrepreneurs with a strong drive to create environmental value differ in their effort to appropriate economic value from their entrepreneurial activities (Van de Ven et al., 2007) and may strive to improve the quality of the environment at the expense of economic objectives. A strong drive to create environmental value as an integrated part of the business logic will reduce reluctance to invest when, despite appropriation problems, societal benefits can be realized, resulting in a stronger incentive to innovate.

Hence, entrepreneurs who are characterized by a strong drive to create environmental gains for others in the society deviate in their opportunity identification and their incentive to innovate. Based on these arguments, we formulate the following hypothesis:

H1: Start-ups that pursue environmental (relative to economic) value-creation goals are more innovative.

3.2. The moderating role of environmental regulations

We argue that environmental regulations appeal to the economic incentives of appropriation. As costs of production increase due to environmental regulations, firms will seek to offset such cost increase by innovating into less costly ways of production or alternative production methods. Environmental regulations also create opportunities as the demand for more efficient and environmentally friendlier products and services is likely to increase (Meek et al., 2010; Aguilera-Caracuel, and Ortiz-de-Mandojana, 2013). Avoiding increased production costs, turning a profit on increased demand, and reducing uncertainty all

[4] The appropriation of innovations differs across sectors and industries. It is beyond the scope of this study to elaborate on this. See Breschi, Malerba, and Orsenigo (2000) and Teece (1986, 2006, 2018) for appropriation conditions and regimes.

[5] The relationship between environmental regulations and innovation is also known as the Porter hypothesis (Porter and van der Linde, 1995). Three versions of this hypothesis can be distinguished: a "weak" version (where environmental regulation does not have a predetermined effect on competitiveness but always stimulates certain types of innovations), a "narrow" version (where only certain types of environmental policies are actually able to stimulate innovations and overall competitiveness) and a "strong" version (where efficiency gains due to induced innovation effects are able to completely offset the loss of competitiveness) (Jaffe and Palmer, 1997). In this study, we mainly focus on the weak version of the Porter hypothesis.

relate to economic incentives and profit maximization. Hence, we expect that environmental regulations mainly induce economically motivated firms to innovate while environmentally motivated firms may be motivated to innovate without the additional economic incentive. Therefore, we expect the relationship between a start-up's environmental drive (relative to its economic drive) and innovativeness to be weaker in countries with sturdier environmental regulations. In a context characterized by sturdy environmental regulations, economically driven start-ups and environmentally driven start-ups innovate, albeit for different reasons.

Hence, the difference in the likelihood of innovating between economically and environmentally driven start-ups is expected to be smaller in countries with strict environmental regulations than in countries with lax environmental regulations. Therefore, we hypothesize the following moderation effect:

H2: Environmental regulations negatively moderate the positive relationship between a start-up's environmental (relative to economic) value-creation goals and innovativeness.

Next, we explore the relationship among environmental regulations, goal heterogeneity among start-ups, and two types of innovation: product innovation and process innovation.

The decision-making process for product or process innovations are based on different reasoning (Halme and Laurila, 2009; Hockerts and Wüstenhagen, 2010). Product innovations are mainly driven by market demand while process innovations are more motivated by cost-savings (Horbach, 2008; Triguero et al., 2013). Product innovations with a reduced environmental impact not only result in societal benefits but most likely also translate into benefits for the consumer. Although for environmental product innovations, this may not always be the case (e.g., green energy) (Krammerer, 2009), the market will reward additional investments in new or supplementary product features through the consumers' willingness to pay a premium. Contrary to product innovation, innovations at the process level are less likely to confer additional benefits for the consumer and, hence, rewards in the market are limited or absent (Cleff and Rennings, 1999; Kammerer, 2009). However, this argument is less likely to hold for services where process innovations result in more efficient and better service delivery that directly benefits customers. Nevertheless, process innovations tend to be internally motivated by cost savings through, for example, more efficient use of resources.

As product and process innovations are based on different reasoning, the influence of environmental regulations on decision-making processes for both types of innovation are also likely to differ. Most environmental regulations, although they can be very diverse, directly appeal to cost savings (Coglianese and Anderson, 2012). For example, the introduction of performance standards, as well as environmental taxes and emission trading, puts a price on the release of pollution and hence, demands firms to limit their emission levels to save on costs. The same regulations only *indirectly* influence market demand for product innovation through increased environmental consciousness and consumers' willingness to pay a premium for environmental benefits. Therefore, we expect that environmental regulations directly influence process innovation whereas the same regulations only indirectly influence market demand for product innovation. The differing effects of environmental regulations on product and process innovations are also reflected in empirical literature, albeit with mixed results (Triguero et al., 2013; Horbach, 2008; Rehfeld et al, 2007; Cleff and Rennings, 1999; Green et al., 1994).

Hence, based on the above reasoning, we not only expect the relationship between a start-up's environmental (relative to economic) value-creation goals to be weaker in countries with sturdier environmental regulations, but we also expect this effect to be stronger for process innovation compared with product innovation. Thus, we hypothesize the following:

H3: The moderation effect of environmental regulations on the relationship between a start-up's environmental (relative to economic) value-creation goals and innovativeness is weaker for process innovation than for product innovation.

4. Data and method

4.1. Data sources

Individual-level data are used from the 2009 round of the GEM (Schøtt and Jensen, 2016). GEM is the largest international data collection effort on entrepreneurial activity. GEM conducts interviews with representative samples of the adult population to obtain information about their entrepreneurial propensity, attitudes, and opinions (Reynolds et al., 2005). Bosma et al. (2012) provide details on GEM and country-specific information such as sample sizes and sampling methodologies. We focus on the 2009 GEM data because this is the only year when GEM included specific questions about green entrepreneurial activity.

These individual-level data have been supplemented with country-level data that reflect a country's institutional arrangements regarding green entrepreneurship. That is, we use data from the Organization for Economic Co-operation and Development (OECD) concerning environmental taxes, and we use data from the World Economic Forum on the stringency of environmental legislation (see below).

Our estimation sample contains 2,945 start-up entrepreneurs from 31 countries. An overview of the countries is provided in Table 1 together with the average values of the innovation variables (columns 1 to 3), the average value of the dependent variable (column 4), and the values of the country-level variables (columns 5 to 7). See below for an elaboration on the independent, dependent, and country variables.

4.2. Variables

4.2.1. Goals

We focus on owner-managers, that is, respondents who answer affirmatively to the following question: "Are you, alone or with others, currently the owner of a company you help manage, self-employed, or sell any goods or services to others?" We concentrate on a specific subsample: start-ups, that is, owner-managers of relatively "young businesses." For this purpose, we include owner-managers who have a business that is at least three months old but no more than 42 months old. We follow GEM's convention in using the thresholds of three and 42 months.

To measure the goals pursued by these start-ups, we use the 2009 GEM question asking respondents to allocate 100 points according to three organizational goals of value creation, namely, environmental, societal, and economic. The exact wording of this question is as follows: "Organizations may have goals according to the ability to generate economic value, societal value, and environmental value. Please allocate a total of 100 points across these three categories as pertaining to your goals." We define our independent variable as the difference in allocated points between environmental and economic goals. A positive (negative) value of this variable means that a start-up entrepreneur allocated more points to environmental (economic) goals than to economic (environmental) goals. This implies that the higher the score, the greener we consider the start-up to be. Table 1, column 4, reveals that on average, start-up entrepreneurs allocate more points to economic goals than to environmental goals in each country (given the negative signs).

4.2.2. Innovation

We use a subjective measure of innovation that "… is fully in line with the Oslo Manual on collecting and interpreting innovation data" (Horbach et al., 2012, p. 113). Thus, whether activities qualify as innovative depends on the perspective of the entrepreneur. This is in line with the measure used by Koellinger (2008) who claims that "[f]rom an economic point of view, a product, service, or production process does

Table 1
Overview of countries and key characteristics.

Country	Innovation (1)	Product innovation (2)	Process innovation (3)	Environmental value creation (4)	GDP per capita (5)	Environmental taxes (6)	Stringency legislation (7)
Argentina	0.53	0.67	0.23	-39.63	17.71	1.13	3.2
Belgium	0.51	0.49	0.56	-38.69	38.13	2.17	6.1
Brazil	0.44	0.34	0.63	-78.86	13.26	0.93	5.1
Chile	0.83	0.99	0.51	-42.72	16.55	0.93	5.1
China	0.57	0.60	0.50	-42.78	7.64	0.81	3.0
Colombia	0.46	0.41	0.55	-48.21	10.13	0.98	4.3
Denmark	0.58	0.76	0.23	-35.63	41.28	4.35	6.6
Dominican Republic	0.46	0.56	0.27	-44.98	10.04	2.59	3.6
Finland	0.33	0.37	0.24	-48.22	39.97	2.62	6.4
France	0.56	0.58	0.50	-36.72	35.16	1.85	5.8
Germany	0.38	0.44	0.27	-62.72	38.03	2.14	6.7
Greece	0.46	0.51	0.36	-47.96	30.86	1.89	4.1
Guatemala	0.70	0.73	0.64	-53.47	6.52	0.79	3.4
Hungary	0.23	0.28	0.15	-95.51	20.68	2.89	5.1
Iceland	0.42	0.47	0.31	-43.16	42.68	1.95	5.7
Israel	0.45	0.48	0.38	-60.58	27.40	3.05	4.7
Italy	0.46	0.56	0.24	-34.88	35.40	2.56	5.0
Japan	0.54	0.56	0.50	-10.00	34.80	1.61	6.0
Korea	0.34	0.42	0.19	-43.12	28.66	2.81	4.6
Malaysia	0.40	0.39	0.42	-35.53	20.16	0.24	5.3
Netherlands	0.49	0.62	0.22	-40.37	45.84	3.49	6.2
Norway	0.39	0.54	0.10	-49.32	61.76	2.35	6.3
Peru	0.62	0.74	0.37	-57.61	8.96	0.50	3.8
Slovenia	0.42	0.48	0.32	-24.73	29.62	3.01	5.3
South Africa	0.84	0.76	1.00	-19.29	11.52	1.50	4.8
Spain	0.42	0.42	0.44	-46.62	33.46	1.68	4.6
Switzerland	0.37	0.41	0.29	-55.92	52.58	1.82	6.5
Tunisia	0.44	0.52	0.28	-92.09	9.61	1.28	5.2
United Kingdom	0.41	0.48	0.25	-37.09	36.26	2.25	5.9
United States	0.33	0.39	0.22	-49.34	48.40	0.79	5.4
Uruguay	0.62	0.65	0.56	-47.47	14.71	1.60	4.2

not need to be new to the world to have economic impact" (Koellinger, 2008, p. 22). Our measures focus on the novelty of the products, services, and processes introduced by the start-up. The innovation measures in our study have been included in many earlier studies (e.g., Koellinger, 2008; Stephan and Uhlaner, 2010; Schøtt and Jensen, 2016; Young et al., 2018).

We consider three types of innovation: 1) an overall innovation index, 2) product innovation, and 3) process innovation. Thus, we follow a large set of earlier studies and the often-used Community Innovation Survey that distinguishes between product and process innovations (Lee et al, 2015; Morris, 2018; Schøtt and Jensen, 2016). An overall innovation index, being a combination of product and process innovation, has also been used in earlier research (Schøtt and Sedaghat, 2014; Morris, 2018).

The three types of innovation are constructed based on the following items included in the GEM questionnaire:

Item 1: "Do all, some, or none of your potential customers consider this product or service new and unfamiliar?" with answers all (value 2), some (value 1), or none (value 0).

Item 2: "Right now, are there many, few, or no other businesses offering the same products or services to your potential customers?" with answers no (value 2), few (value 1), or many (value 0).

Item 3: "Have the technologies or procedures required for this product or service been available for less than a year, between one to five years, or longer than five years?" with answers less than a year (value 2), between 1 to 5 years (value 1), or longer than 5 years (value 0).

Items 1 and 2 reflect the newness of the product/service and basically distinguish between innovations that are new to the firm (but already available on the market) and innovations that are new to the market (before competitors introduced the product). This two-dimensional approach to measuring product innovation is also captured by the Community Innovation Survey (see also Lee et al. (2015) and De Jong and Vermeulen (2006)). The two product innovation items are averaged to construct an index of product innovation (column 2, Table 1).

Item 3 reflects process innovation. We use the original questionnaire item and corresponding answer categories (with values 0, 1, and 2; column 3, Table 1).

We construct a general index of innovation, and this index is calculated as the average of the three items (following Schøtt and Sedaghat, 2014; column 1, Table 1). For our three innovation measures it holds that larger values indicate higher propensities to innovate.

4.2.3. Country variables

We focus on environmental taxes (source: OECD) and the stringency of environmental legislation (source: Global Competitiveness Report, World Economic Forum). Environmental taxes reflect environmentally related tax revenue as a percentage of a country's GDP. The environmental aspect of legislation is captured by the question "How stringent is your country's environmental regulation?" This question originates from the World Economic Forum's Executive Opinion Survey and has been assessed by a panel of experts in each country. More information about the sampling methodology of the Executive Opinion Survey and the composition of the panel of experts is revealed in Chapter 3.1 of the Global Competitiveness Report (Schwab et al., 2006, pp. 125-135). Low (high) values indicate a relatively lax (stringent) environmental regime. The advantage of this measure is clearly its availability for multiple years. There are few alternatives, of which one is an OECD measure that reflects "the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behaviour." However, this measure is available for only 20 countries in our sample. The correlation coefficient between this OECD measure and the measure used in the present study is 0.79. To avoid issues of reverse causality, we use lagged measures for these two country-level environmental variables (2008 data for environmental taxes and 2007

data for the environmental legislation variable).

4.2.4. Control variables

We control for an individual's gender (1 = male; 0 = female) and his or her age (at least 18 years old), which are common controls to take into account when studying the individual-level determinants of innovativeness (Baron and Tang, 2011; Ahlin et al., 2014; Schøtt and Jensen, 2016). Educational attainment is also included. Several studies find that education is positively related to innovation (Koellinger, 2008; Schøtt and Jensen, 2016). Education is defined as the highest level of education an individual has completed.

We also include a proxy for wealth by retrieving information about whether someone is a business angel: "*You have, in the past three years, personally provided funds for a new business started by someone else excluding any purchases of stocks or mutual funds.*" A value of 1 is assigned when an individual has provided funds and 0 otherwise.[6]

Entrepreneurial experience may be important for the firm's level of innovativeness (Cliff et al., 2006). Although we do not have specific experience measures, for example, in terms of industry experience, we include a general experience measure (see also Koellinger, 2008). That is, we control for whether the entrepreneur recently experienced an entrepreneurial exit, where the exact questionnaire item reads as follows: "*You have, in the past 12 months, shut down, discontinued, or quit a business you owned and managed, any form of self-employment, or selling goods or services to anyone.*"

An individual's motivation to start a business is also controlled for, which can be either opportunity-based – someone started a business because of a lucrative business opportunity – or necessity-based in a case in which someone did not have alternative options for work. Opportunity-based motivation seems to be related to innovativeness, particularly in terms of product innovation rather than process innovation (Schøtt and Jensen, 2016).

Furthermore, we include the firm's size in terms of the number of employees working for the business (a logarithmic transformation is applied). Firm size has been found to be positively associated with innovativeness (Baron and Tang, 2011; Ahlin et al., 2014). Reichstein and Salter (2006) find that firm size is positively related to process innovation.

Another characteristic at the firm level, sector orientation (De Jong and Vermeulen, 2006), has not been included as a control variable because of the substantial reduction in the estimation sample (there are too many missing values for this variable in the GEM dataset). An analysis with sector orientation included as a control variable is provided in the section with robustness checks.

At the country level, we control for a country's GDP per capita, based on Purchasing Power Parity, in US dollars (2008 data), with the World Bank as data source. We refer to earlier work that includes GDP per capita as a control variable (e.g., Koellinger, 2008).

An overview of all variables is provided in Table 2. The descriptive statistics are shown in Table 3. Table 3 reveals that the average allocated difference between environmental and economic points amounts to -48.06. This means that, on average, start-up entrepreneurs allocate substantially more points to economic value than to environmental value. Additional calculations reveal that start-up entrepreneurs allocate 14.54 points, on average, to environmental value, and 62.61 points, on average, to economic value.

Table 4 shows the Pearson correlation coefficients between all micro-level variables. No concerns for multicollinearity are detected. This is confirmed on the basis of an inspection of the (non-reported) variance inflation factors (VIFs). That is, the VIFs do not exceed 1.78, and this is well below the common threshold value of 10 (Hair et al., 2010). The country-level correlations – based on 31 observations (countries) – are 0.49 between GDP per capita and environmental taxes ($p = .01$), 0.77 between GDP per capita and stringency of environmental legislation ($p < .001$), and 0.46 between environmental taxes and stringency of environmental legislation ($p = .01$). The VIFs for the country-level variables do not exceed 2.66.

4.3. Method

Van de Ven et al. (2007, p. 367) acknowledge that "individual differences (as well as cultural contexts) are likely to influence the relative balance between self- and collective interests in explaining entrepreneurial behaviour." Hence, in the current research, we integrate two levels of analysis into one framework, that is, the micro level – the start-up entrepreneur with his or her entrepreneurial endeavour – and the country level. In other words, in answering our research question, we make use of hierarchical (nested) data and, thus, we explicitly recognize that start-up entrepreneurs – at the micro level – are nested within countries – at the highest level (Aguinis et al., 2013). A multilevel analytical approach allows for such research designs.

Given the ordered nature of our three innovation variables, we make use of multi-level ordered logistic regressions. The innovation index contains 7 categories, product innovation contains 5 categories, and process innovation contains 3 categories. To enhance our interpretation, we also show the marginal effects (averaged across all observations in the estimation sample) corresponding to our main independent variable.

To compare a multi-level regression framework with a conventional regression framework, one usually assumes in the ordered logit case that the probability of Y_{ij} taking value k depends on $\beta_{0j} + \beta_1 X_{1ij} + \ldots + \beta_p X_{pij}$, where j is a subscript for countries, and i for start-up entrepreneurs; k ($k = 1, \ldots, K$) represents the category of the dependent variable; p denotes the number of independent variables. The difference with the usual regression model is that we assume that each country j has a different intercept coefficient β_{0j}. One may specify $\beta_{0j} = \gamma_{00} + u_{0j}$ to indicate the variation across countries (country-level variables can be added as well; see below), u_{0j} being a residual term at the country level.

Moreover, a set of cut-points $\kappa_1, \ldots, \kappa_{K-1}$ is estimated. Specifically, the probabilities can be denoted as $\text{Prob}(Y_{ij} = k) = F(\kappa_k - \beta_{0j} - \beta_1 X_{1ij} - \ldots - \beta_p X_{pij}) - F(\kappa_{k-1} - \beta_{0j} - \beta_1 X_{1ij} - \ldots - \beta_p X_{pij})$, where $F(\cdot)$ is the logistic cumulative distribution function. The model can also be extended to have different slope coefficients $\beta_{1j}, \ldots, \beta_{pj}$ (we impose such a country-dependent slope for our independent variable below).[7]

There are two major advantages of performing multi-level regressions compared with conventional multiple regressions. First, multi-level regressions take into account the data's hierarchical structure. If this higher level in the data is ignored, standard errors would be too small, resulting in spuriously significant results (Peterson et al., 2012) and an increase in the risk of making Type I errors (Stephan et al., 2015). Second, conventional regression models assume independence across observations. However, in our hierarchical set-up, we expect interdependence across individuals within countries, for example, as individuals within a country share similar cultural values. Below, we show that a considerable amount of the total variance in our dependent variables resides between countries; this indeed justifies the use of multi-level modelling (Hox et al., 2017).

Hypotheses 2 and 3 focus on moderation effects. Specifically, they form expectations about how the relationship between environmental value creation and innovation – lower level variables in our multi-level setup – change as a function of higher-order moderator variables

[6] Adding household income to the regressions rather than the current proxy would lead to a substantial reduction of our estimation sample (from 2,945 to 2,381 observations, a reduction of almost 20%).

[7] Covariance terms between the random parts can also be included. Note that the ordered logit model does not contain a residual term e_{ij} at the individual level.

Table 2
Definitions of variables.

Variable	Data source and questionnaire item	Coding
Dependent variables (micro level)		
Innovation	Combination of 3 items: 1) Do all (value 2), some (value 1), or none (value 0) of your potential customers consider this product or service new and unfamiliar? (GEM) 2) Right now, are there many (value 0), few (value 1), or no (value 2) other businesses offering the same products or services to your potential customers? (GEM) 3) Have the technologies or procedures required for this product or service been available for less than a year (value 2), between one to five years (value 1), or longer than five years (value 0)? (GEM)	Average of items 1, 2, and 3.
Product innovation	Combination of item 1 and 2 above.	Average of items 1 and 2.
Process innovation	Item 3 above.	Item 3.
Independent variable (micro level)		
Environmental value creation (points difference)	Organizations may have goals according to the ability to generate economic value, societal value and environmental value. Please allocate a total of 100 points across these three categories as pertaining to your goals. (GEM)	Points allocated to environmental value minus points to economic value.
Control variables (micro level)		
Gender	What is your gender? (GEM)	1 if male, 0 if female.
Age	What is your current age (in years)? (GEM)	Age in years.
Education	What is the highest level of education you have completed? (GEM)	None or some secondary education (reference); secondary education; post-secondary education.
Business angel	You have, in the past three years, personally provided funds for a new business started by someone else, excluding any purchases of stocks or mutual funds. (GEM)	1 if Yes, 0 if No
Entrepreneurial experience	You have, in the past 12 months, sold, shut down, discontinued or quit a business you owned and managed, any form of self-employment, or selling goods or services to anyone. (GEM)	1 if Yes, 0 if No.
Opportunity-based	Are you involved in this firm to take advantage of a business opportunity or because you have no better choices for work? (GEM)	1 if "to take advantage of a business opportunity", 0 otherwise
Firm size	Right now how many people, not counting the owners but including exclusive subcontractors, are working for this business? (GEM)	Log(number of employees + 1)
Variables at the country level		
GDP per capita	Purchasing Power Parity, in US dollars (2008 data). (World Bank)	Continuous
Environmental taxes	Environmentally related tax revenue, as a percentage of a country's GDP. (OECD)	Continuous
Stringency legislation	How stringent is your country's environmental regulation? (World Economic Forum)	Continuous

Table 3
Descriptive statistics individual-level and country-level variables.

	Mean	SD	Minimum	Maximum
Dependent variables				
Innovation	0.47	0.44	0	2
Product innovation	0.52	0.53	0	2
Process innovation	0.38	0.64	0	2
Micro level variables				
Environmental value creation (points difference)	-48.06	37.68	-100	100
Male	0.59	0.49	0	1
Age	39.75	11.28	18	82
None/some secondary education	0.25	0.43	0	1
Secondary education	0.34	0.47	0	1
Post-secondary education	0.41	0.49	0	1
Business angel	0.09	0.28	0	1
Entrepreneurial experience	0.08	0.26	0	1
Opportunity-based	0.48	0.50	0	1
Firm size (log)	0.79	0.97	0	10.88
Country level variables				
GDP per capita (divided by 1,000)	26.37	13.51	6.52	61.76
Environmental taxes	1.76	0.78	0.24	4.35
Stringency legislation	4.90	1.05	3.00	6.70

Table is based on 2,945 observations in 31 countries. Reference category education in regressions: none/some secondary education. Values for environmental value creation and the country-level variables are shown before standardization.

(Aguinis et al., 2013). Interaction terms are added to the model specifications to test for such cross-level moderation effects; a random slope for environmental value creation is included to properly model the cross-level interactions (Heisig and Schaeffer, 2019).

We follow Hox et al. (2017, p. 52) in that "… grand mean-centering of variables that have random slopes or that are involved in an interaction is always helpful." Given that we add interaction terms between our independent variable and country-level variables in Hypotheses 2 and 3, and the fact that the country level variables are also included, we use standardized versions for our environmental variable and country-level variables (Stephan et al., 2015).

We show the deviance, which is a measure of model fit, in our regression tables. Model specifications with a lower value for the deviance have a better fit than models with a higher deviance value.

5. Results

First, we determine the amount of variation of the dependent variables at the country level. Multi-level ordered logistic regressions without control variables are performed for three dependent variables: our innovation index, our measure of product innovation, and our measure of process innovation (the results are not tabulated). The intra-class correlations (the ICC values) are 0.07 for the innovation index and product innovation and 0.08 for process innovation.[8] These values are sufficiently high to justify the use of multi-level modelling (Hox et al., 2017) – usually a threshold value of 0.05 is taken in earlier research (Heck et al., 2010).

Table 5 shows the estimated coefficients of our control variables for the three innovation measures. Higher probabilities of displaying

[8] Note that the first-level variances are fixed at $\pi^2/3$ in the multi-level ordered logit case. Given that the variances at the country level are estimated at 0.25, 0.24, and 0.28 for the innovation index, product innovation, and process innovation, respectively, we arrive at ICC values of 0.07 for the innovation index and product innovation, and 0.08 for process innovation.

Table 4
Correlation matrix micro-level variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1.Innovation	1.00											
2.Product innovation	0.88*	1.00										
3.Process innovation	0.62*	0.17*	1.00									
4.Environmental value creation	0.12*	0.13*	0.04*	1.00								
5.Male	-0.08*	-0.08*	-0.03	-0.03	1.00							
6.Age	-0.04*	-0.00	-0.08*	0.07*	0.01	1.00						
7.None/some secondary educ.	-0.03*	-0.05*	0.01	-0.02	-0.06*	0.05*	1.00					
8.Secondary education	0.04*	0.04*	0.02	-0.01	-0.01	-0.08*	-0.42*	1.00				
9.Post-secondary education	-0.01	0.01	-0.02	0.03	0.06*	0.03*	-0.48*	-0.59*	1.00			
10.Business angel	0.03*	0.03*	0.02	0.05*	0.04*	0.02	-0.05*	-0.00	0.05*	1.00		
11.Entrepreneurial experience	0.06*	0.04*	0.06*	0.00	0.03	-0.01	0.03	-0.01	-0.02	0.04*	1.00	
12.Firm size	0.04*	0.03*	0.02	0.05*	0.12*	0.04*	-0.07*	-0.01	0.07*	0.14*	0.07*	1.00
13.Opportunity-based	0.04*	0.03*	0.04*	0.03	0.06*	0.02	-0.13*	0.02	0.10*	0.04*	0.01	0.07*

* $p<0.10$. Table is based on 2,945 observations in 31 countries. Reference category education in regressions: none/some secondary education.

Table 5
Multi-level ordered logit regressions with innovativeness as the dependent variable; control variables only.

	Innovation (1)		Product innovation (2)		Process innovation (3)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Micro level						
Male	-0.255***	0.069	-0.302***	0.071	-0.071	0.085
Age	-0.002	0.003	0.0007	0.003	-0.007*	0.004
Secondary education	0.231**	0.094	0.211**	0.096	0.177	0.114
Post-secondary education	0.261***	0.092	0.285***	0.094	0.173	0.113
Business angel	0.182	0.121	0.169	0.122	0.134	0.142
Entrepreneurial experience	0.311**	0.126	0.161	0.128	0.416***	0.147
Opportunity-based	0.210***	0.069	0.182**	0.071	0.234***	0.085
Firm size	0.042	0.035	0.041	0.036	0.053	0.042
Country level						
GDP per capita	-0.328***	0.087	-0.234**	0.095	-0.371***	0.095
Random part						
Variance country level	0.158		0.201		0.155	
Diagnostics						
Deviance	9,012		7,679		4,478	

SE = standard error. Table is based on 2,945 observations in 31 countries. Reference category education: none/some secondary education. The cutpoint estimates are available upon request.

* $p<0.10$
** $p<0.05$
*** $p<0.01$

innovative behaviour are found for female start-up entrepreneurs and those with more education, at least for our innovation index and product innovation. Entrepreneurial experience is positively associated with the innovation index and with process innovation but not with product innovation. Furthermore, opportunity-motivated entrepreneurs are significantly more likely to bring innovative products and services to the market than necessity-motivated entrepreneurs (Schøtt and Jensen, 2016). Surprisingly, firm size has a non-significant coefficient across the board for which earlier research found a positive relationship (Baron and Tang, 2011; Ahlin et al., 2014; Reichstein and Salter; 2006). At the country level, we note that GDP per capita is negatively associated with each innovation measure.

Table 6 adds the environmental variables to the specification of Table 5. Note that our independent variable at the individual-level measures the difference in allocated points between environmental goals and economic goals and that the variable has been standardized. We observe a significant and positive relationship between environmental value creation and our measure of innovativeness in column 1 of Table 6. Indeed, column 1 of Table 6 reveals that start-ups that pursue environmental (relative to economic) value-creation goals are significantly more innovative, thereby supporting H1. Columns 2 and 3 of Table 6 show that environmental value creation is also significantly and positively related to product innovation and process innovation, respectively.

Regarding the country-level environmental variables in Table 6, we do not observe significant relationships between the environmental policy variables and our innovation index (column 1 of Table 6). For process innovation, we find – in addition to the significant and negative coefficient of GDP per capita – a significant negative relationship for environmental taxes. That is, in countries with high environmental taxes, start-ups are significantly less likely to engage in process innovation than start-ups in countries with relatively low environmental taxes. With respect to process innovation, Cleff and Rennings (1999) and Green et al. (1994) find a positive correlation with environmental regulations. We, however, do not find a significant relationship for the stringency variable in our study. The relationship between environmental regulation and product innovation remains disputed (Cleff and Rennings, 1999; Kammerer, 2009; Triguero et al., 2013). For example, Kammerer (2009) indicates that regulatory stringency is positively related to environmental product innovations that are novel to the firm; however, this result cannot be supported when these innovations are new to the market. All in all, we find tentative evidence that

Table 6
Multi-level ordered logit regressions with innovativeness as the dependent variable; control variables and environmental variables included.

	Innovation (1)		Product innovation (2)		Process innovation (3)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Micro level						
Environmental value creation	0.220***	0.037	0.213***	0.037	0.160***	0.043
Male	-0.255***	0.069	-0.298***	0.071	-0.066	0.084
Age	-0.003	0.003	0.0002	0.003	-0.008**	0.004
Secondary education	0.252***	0.094	0.236**	0.096	0.198*	0.114
Post-secondary education	0.274***	0.092	0.304***	0.094	0.183	0.113
Business angel	0.156	0.121	0.144	0.123	0.109	0.143
Entrepreneurial experience	0.326***	0.126	0.173	0.128	0.419***	0.147
Opportunity-based	0.210***	0.069	0.182**	0.071	0.234***	0.085
Firm size	0.038	0.035	0.036	0.036	0.053	0.042
Country level						
GDP per capita	-0.343***	0.121	-0.223	0.142	-0.326***	0.125
Environmental taxes	-0.111	0.091	-0.014	0.106	-0.291***	0.097
Stringency legislation	0.062	0.115	-0.033	0.136	0.116	0.113
Random part						
Variance country level	0.109		0.168		0.085	
Diagnostics						
Deviance	8,975		7,647		4,458	

SE = standard error. Table is based on 2,945 observations in 31 countries. Reference category education: none/some secondary education. The cutpoint estimates are available upon request.

* $p<0.10$
** $p<0.05$
*** $p<0.01$

environmental regulation is more strongly related to process innovation than to product innovation (see also Cleff and Rennings, 1999; Rennings, 2000). In our discussion below, we elaborate more on the relationships of our two country-level variables with innovation. We can also measure the "explanatory power" (R^2) of the environmental country-level variables, measured in terms of the proportion of variance explained at the country (Hox et al., 2017). When comparing the country-level variances for each dependent variable in Tables 5 and 6, we conclude that the explanatory power is approximately 31% for our general innovation variable, approximately 16% for product innovation, and 45% for process innovation.

Table 7 shows the average marginal effects corresponding to our main independent variable at the individual level (i.e., environmental value creation) and the country-level environmental variables. Hence, these marginal effects inform us about the estimated change in the probability of belonging to each category of the dependent variable as the result of a one-standard deviation change of the environmental variable. To assess the magnitude of the marginal effects, we also report the predicted probabilities of belonging to each category of the dependent variable. This way, the marginal effects can be denoted as a percentage of this predicted probability. For example, when focusing on environmental value creation for our innovation index (panel 1), the marginal effects are 1.6, 1.9, 1.1, 0.3, and 0.1 percentage points for categories 3, 4, 5, 6, and 7, respectively. Although these marginal effects may not seem substantial, their magnitudes are approximately 8%, 15%, 20%, 21%, and 22% of the predicted probability, which is substantial. Additionally, for product innovation (panel 2) and process innovation (panel 3), we find several sizeable marginal effects for environmental value creation, and also for the environmental taxes variable in case of process innovation.

Finally, Table 8 adds the interaction terms between environmental value creation and the three country-level variables. Generally, we do not observe significantly different relationships between environmental value creation and innovation across countries given the non-significance of the interaction terms in column 1 of Table 8. Thus, H2 is not supported. However, we find a significant and positive coefficient of the interaction term for stringency of environmental legislation in case of product innovation (column 2 of Table 8). In countries with a strict environmental regime, environmental value creation is more strongly associated with product innovation than in countries with a more lax regime. We find non-significant coefficients of the interaction terms for process innovation.

Note that each specification in Table 8 includes a random slope for environmental value creation (Heisig and Schaeffer, 2019) because we allow for a country-dependent relationship between environmental value creation and innovativeness. In general, we find that random slope specifications for environmental value creation do not have a better fit than specifications without the random slope (as in Table 6, likelihood ratio tests result in $\chi^2=4.33$; $p=.50$ for the innovation index and $\chi^2=6.01$; $p=.31$ for product innovation), indicating a relatively stable relationship between environmental value creation and innovation across countries. However, there is one exception. We find that there is unexplained variance at the country level in terms of the between-country relationship between environmental value creation and *process innovation* (LR $\chi^2=18.35$; $p=.002$). We are not able to explain this unexplained variance across countries for process innovation with our specification in column 3 of Table 8 given the non-significant interaction terms. Future research should thus focus on an extended array of environmental regulation variables to further investigate the between-country relationship between environmental value creation and process innovation.

5.1. Robustness checks

Industry. The analyses above do not include industry orientation as a control variable. Adding this variable would reduce the estimation sample substantially (from 2,945 observations in 31 countries to 2,039 observations in 21 countries). Table 9 repeats the exercises of Table 8 but with a SIC-1 industry variable added. In general, the conclusions are qualitatively similar to those in Table 8. A model formulation without the cross-level interactions included reveals a significant and positive relationship between environmental value creation and our three

Table 7
Marginal effects corresponding to ordered logit regressions from Table 6.

	Innovation (1)				Product innovation (2)				Process innovation (3)			
	Predicted probability	ME Environmental value creation	ME Environmental taxes	ME Stringency legislation	Predicted probability	ME Environmental value creation	ME Environmental taxes	ME Stringency legislation	Predicted probability	ME Environmental value creation	ME Environmental taxes	ME Stringency legislation
Category 1	0.312***	-0.045***	0.023	-0.012	0.381***	-0.047***	0.003	0.007	0.710***	-0.031***	0.057***	-0.022
		(-14.8%)	(7.5%)	(-4.2%)		(-12.7%)	(0.8%)	(2.0%)		(-4.6%)	(8.3%)	(-3.3%)
Category 2	0.253***	-0.006***	0.003	-0.002	0.304***	0.004***	-0.0002	-0.001	0.206***	0.019***	-0.035***	0.014
		(-2.6%)	(1.3%)	(-0.7%)		(1.3%)	(-0.1%)	(-0.2%)		(9.8%)	(-17.8%)	(7.1%)
Category 3	0.223***	0.016***	-0.008	0.004	0.213***	0.024***	-0.002	-0.004	0.084***	0.012***	-0.022***	0.009
		(7.5%)	(-3.8%)	(2.1%)		(11.9%)	(-0.8%)	(-1.8%)		(14.6%)	(-26.5%)	(10.5%)
Category 4	0.133***	0.019***	-0.010	0.005	0.075***	0.013***	-0.001	-0.002				
		(15.3%)	(-7.7%)	(4.3%)		(18.2%)	(-1.2%)	(-2.8%)				
Category 5	0.057***	0.011***	-0.006	0.003	0.027***	0.006***	-0.0004	-0.001				
		(19.6%)	(-9.9%)	(5.5%)		(20.7%)	(-1.3%)	(-3.2%)				
Category 6	0.016***	0.003***	-0.002	0.001								
		(21.4%)	(-10.8%)	(6.0%)								
Category 7	0.005***	0.001***	-0.001	0.0003								
		(21.9%)	(-11.1%)	(6.2%)								

ME = Marginal Effect (averaged across all observations). Numbers between parentheses represent marginal effects as a percentage of the predicted probability for each category. Innovation contains 7 categories; product innovation contains 5 categories; process innovation contains 3 categories.

*$p < 0.10$

**$p < 0.05$

*** $p < 0.01$

Table 8
Multi-level ordered logit regressions with innovativeness as the dependent variable; interaction terms included.

	Innovation (1)		Product innovation (2)		Process innovation (3)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Micro level						
Environmental value creation	0.243***	0.047	0.231***	0.038	0.146*	0.074
Male	-0.251***	0.069	-0.291***	0.071	-0.054	0.085
Age	-0.003	0.003	0.0006	0.003	-0.008**	0.004
Secondary education	0.243***	0.094	0.232**	0.097	0.212*	0.115
Post-secondary education	0.270***	0.092	0.299***	0.095	0.200*	0.114
Business angel	0.156	0.121	0.150	0.123	0.109	0.144
Entrepreneurial experience	0.330***	0.127	0.175	0.128	0.409***	0.149
Opportunity-based	0.212***	0.069	0.185***	0.071	0.234***	0.086
Firm size	0.034	0.035	0.037	0.036	0.054	0.043
Country level						
GDP per capita	-0.340***	0.121	-0.238*	0.141	-0.288**	0.124
Environmental taxes	-0.107	0.091	-0.021	0.105	-0.245**	0.096
Stringency legislation	0.052	0.113	-0.027	0.135	0.062	0.111
Cross-level interactions						
Env. value × GDP/capita	-0.025	0.083	-0.064	0.064	-0.001	0.125
Env. value × Env. taxes	0.059	0.061	0.040	0.055	-0.030	0.096
Env. value × Stringency legislation	0.050	0.073	0.113**	0.057	0.003	0.113
Random part						
Variance country level	0.101		0.164		0.066	
Variance env. value creation	0.012		0.0004		0.074	
Covariance	0.019		-0.008		0.008	
Diagnostics						
Deviance	8,971		7,641		4,440	

SE = standard error. Table is based on 2,945 observations in 31 countries. Reference category education: none/some secondary education. The cutpoint estimates are available upon request.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

measures of innovativeness, as is also found in Table 6. These results are available from the authors upon request.

Social value creation as a control variable. Our main results do not take into account the third objective that is included in the original GEM questionnaire (points allocated to social goals next to environmental and economic goals). As a robustness check, we add the points allocated to social value creation to our model formulations. To do so, it is necessary to subtly change the definition of our independent variable. Rather than subtracting the points allocated to environmental value from the points allocated to economic value, we take the fraction of environmental points (environmental points/(environmental points + economic points)). We do so because the *ceteris paribus* condition inherent in regression models is satisfied when including this adjusted variable. It is indeed possible for the adjusted variable to increase by 1 while social value creation is held constant (because the total number of points allocated to both environmental and economic value does not necessarily change). Table 10 repeats the exercises of Table 8 but with social value creation added (and the revised version of our independent variable incorporated). The results remain qualitatively similar. In a model formulation without the cross-level interactions (results not shown) we find that environmental value creation again has a significant and positive relationship with each innovation measure (available upon request).

System estimation. The specifications for product and process innovation are estimated separately, not jointly. Because the set of independent and control variables is identical for product and process innovation, system estimations (seemingly unrelated regressions) would result in similar estimates in the traditional linear regression case. In multi-level ordered logistic regressions, the estimates are not necessarily the same. Nevertheless, because of the inability to reach computational convergence for the system estimation – including interaction terms and the random slope – in Table 8, we decided to perform separate regressions for product and process innovation throughout. We feel comfortable with this decision because system estimations were performed as an alternative to the results in Tables 5 and 6 (without interactions and random slopes), and non-significant covariances were found between the country-level intercepts of product innovation and process innovation (0.031, $p = .49$ in Table 5; -0.005, $p = .87$ in Table 6). In addition, the coefficient estimates deviated only slightly from the present results in Tables 5 and 6. For example, environmental value creation is significantly and positively associated with product innovation ($\beta = 0.214$; $p < 0.001$) and process innovation ($\beta = 0.161$; $p < .001$).

6. Discussion and conclusion

Start-ups differ in the extent to which they introduce innovations to markets and, hence, in their potential contribution to society. Understanding the heterogeneous character of start-ups is key to explaining this variability in innovation. We investigated whether the goals pursued by start-ups are related to start-up innovativeness. In particular, we studied if the motivation of start-ups to create environmental value for society relative to economic value influences their innovativeness. Additionally, we studied how environmental regulations influence this relationship. In other words: are greener start-ups more innovative, and how does this relationship differ across regulatory contexts?

We theorized how the relative importance of environmental value creation (i.e., other-regarding interest) over economic value creation (i.e., self-regarding interest) influences the entrepreneur's opportunity identification and incentive to innovate. We predicted and found a significant and positive relationship between environmental (relative to

Table 9
Multi-level ordered logit regressions with innovativeness as the dependent variable; interaction terms included. Including SIC-1 industry information.

	Innovation (1)		Product innovation (2)		Process innovation (3)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Micro level						
Environmental value creation	0.269***	0.059	0.240***	0.051	0.171*	0.094
Male	-0.259***	0.087	-0.319***	0.089	-0.068	0.104
Age	-0.003	0.004	0.001	0.004	-0.009**	0.005
Secondary education	0.289**	0.113	0.318***	0.117	0.101	0.137
Post-secondary education	0.272**	0.115	0.369***	0.118	0.072	0.140
Business angel	0.057	0.145	0.047	0.146	0.042	0.170
Entrepreneurial experience	0.437***	0.150	0.205	0.153	0.484***	0.174
Opportunity-based	0.251***	0.084	0.260***	0.086	0.176*	0.102
Firm size	0.033	0.042	0.029	0.043	0.052	0.050
Mining, construction	-0.324	0.242	-0.403	0.251	-0.177	0.296
Manufacturing	0.429*	0.223	0.382*	0.225	0.187	0.264
Transport, storage, communications	-0.043	0.224	0.015	0.228	-0.376	0.280
Wholesale trade	-0.600**	0.264	-0.653**	0.272	-0.207	0.332
Retail trade, hotels, restaur.	0.159	0.182	0.095	0.183	0.146	0.217
Financial services	0.407	0.259	0.313	0.258	0.314	0.306
Business services	-0.150	0.286	-0.204	0.293	0.100	0.341
Social services	0.033	0.204	-0.084	0.207	0.090	0.248
Personal/consumer service	0.229	0.242	0.135	0.248	0.173	0.289
Country level						
GDP per capita	-0.370**	0.146	-0.205	0.180	-0.364**	0.148
Environmental taxes	-0.102	0.135	-0.063	0.160	-0.142	0.138
Stringency legislation	0.090	0.134	-0.024	0.170	0.109	0.124
Cross-level interactions						
Env. value × GDP/capita	-0.074	0.106	-0.081	0.084	-0.136	0.150
Env. value × Env. taxes	0.131	0.092	0.067	0.088	0.148	0.136
Env. value × Stringency legislation	-0.015	0.085	0.073	0.068	-0.055	0.131
Random part						
Variance country level	0.106		0.199		0.053	
Variance env. value creation	0.008		0.0005		0.072	
Covariance	0.014		-0.010		0.044	
Diagnostics						
Deviance	6,127		5,162		3,119	

SE = standard error. Table is based on 2,039 observations in 21 countries. Reference category education: none/some secondary education. Reference category industry: Agriculture, forestry, hunting, fishing. The cutpoint estimates are available upon request.

* $p < 0.10$
** $p < 0.05$
*** $p < 0.01$

economic) value creation and innovativeness such that "greener entrepreneurs" are indeed more innovative. Moreover, we theorized that the inducement effect of environmental regulations on innovation mainly appeals to economic incentives (i.e., costs-savings, increased demand, and reduced risk) with different effects for product and process innovation. We argued that sturdier environmental regulations are especially effective for economically driven start-ups, thereby weakening our main relationship. Except for the role of the stringency of environmental regulation for product innovation, our predictions are not confirmed. Given the country-level regulatory variables at hand, we did not find convincing moderation effects across the board (see below for a nuanced discussion).

Our findings contribute to the entrepreneurship and innovation literature in several ways. *First*, we advance research on entrepreneurship by addressing the consequences of other-regarding motives as a source of heterogeneity among start-ups. Taking both self- and other-regarding interests into account acknowledges the natural instincts of human beings (Piliavin and Charng, 1990; Meglino and Korsgaard, 2004) and thus is more accurate in explaining entrepreneurial behaviour and outcomes. The pursuit of other-regarding goals is increasingly addressed in non-traditional forms of entrepreneurship such as social, sustainable, and environmental entrepreneurship. However, the *consequences* of pursuing such goals are less well-researched. Where others have focused on the consequences of other-regarding goals in terms of organizational challenges (Battilana and Lee, 2014), organizational design principles (Parrish, 2010), and start-up success (Renko, 2013), we extend this research to the consequences for start-up innovativeness. The idea that being open to the viewpoints of others stimulates creativity, cognitive processing, and hence, innovativeness has been applied to organizational behaviour (Grant and Berry, 2011; De Dreu and Nauta, 2009). Extending this approach to entrepreneurship is still rare (Cohen et al., 2008). An exception is a study by Renko (2013), which, based on a sample of nascent social entrepreneurs, arrives at similar conclusions: the pursuit of other-regarding goals at start-up positively relates to entrepreneurial innovativeness. Thus, our study demonstrates that other-regarding motives have consequences for entrepreneurial outcomes and are not restricted to the context of social entrepreneurship. We extend this idea to environmental entrepreneurship characterized by a focus on both economic profit and provisioning environmental benefits (Thompson et al., 2011). Our findings confirm that future research is warranted on how other-regarding motives are related to entrepreneurial cognition and the consequences for opportunity identification, venture creation, growth, and social impact (Mitchell et al.,

Table 10
Multi-level ordered logit regressions with innovativeness as the dependent variable; interaction terms included. Social value creation added as control variable.

	Innovation (1)		Product innovation (2)		Process innovation (3)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Micro level						
Environmental value creation (*percentage*)	0.689***	0.189	0.566***	0.185	0.666*	0.357
Social value creation	0.154***	0.040	0.175***	0.041	0.054	0.050
Male	-0.248***	0.070	-0.282***	0.071	-0.058	0.085
Age	-0.003	0.003	0.0004	0.003	-0.008**	0.004
Secondary education	0.234**	0.094	0.218**	0.097	0.211*	0.115
Post-secondary education	0.247***	0.093	0.274***	0.095	0.199*	0.114
Business angel	0.155	0.122	0.144	0.124	0.125	0.145
Entrepreneurial experience	0.330***	0.126	0.178	0.128	0.412***	0.149
Opportunity-based	0.214***	0.069	0.187***	0.071	0.225***	0.086
Firm size	0.040	0.035	0.041	0.036	0.057	0.043
Country level						
GDP per capita	-0.320***	0.115	-0.169	0.149	-0.307*	0.179
Environmental taxes	-0.149	0.096	-0.046	0.118	-0.204	0.140
Stringency legislation	0.035	0.108	-0.116	0.143	0.088	0.164
Cross-level interactions						
Env. value × GDP/capita	-0.134	0.325	-0.376	0.318	0.015	0.592
Env. value × Env. taxes	0.118	0.262	0.093	0.258	-0.273	0.447
Env. value × Stringency legislation	0.150	0.288	0.458*	0.272	-0.016	0.534
Random part						
Variance country level	0.069		0.161		0.171	
Variance env. value creation	0.053		0.0006		1.608	
Covariance	0.060		-0.010		-0.413	
Diagnostics						
Deviance	8,921		7,591		4,426	

SE = standard error. Table is based on 2,931 observations in 31 countries (there are 14 observations for which the independent variable in this table is not defined because 0 points are allocated to environmental and economic value). Reference category education: none/some secondary education. The cutpoint estimates are available upon request.

* $p < 0.10$
** $p < 0.05$
*** $p < 0.01$

2007).

Second, we contribute to the discussion on the inducement effect of environmental regulations and the appropriation of rents from innovations by introducing entrepreneurs' non-economic motives. Theoretical explanations for the existence of the inducement effect of environmental regulations assume that profit opportunities are overlooked until the introduction of environmental policy pushes firms to reconsider their production processes and product offerings (Kozluk and Zipperer, 2015). Contrary to arguments on why the inducement effect exists,[9] we argue that non-economic motives, such as the pursuit of environmental value creation, may alter this mechanism. Entrepreneurs who pursue other-regarding motives may innovate without the additional economic incentives from regulatory interventions. We expected that in countries with sturdier environmental regulations the relationship between goals at start-up and innovativeness is weaker. While we did not find moderation effects across the board, we did find that in countries with strict environmental regulations, greener start-ups are more strongly associated with product innovations. We believe that our focus on start-ups may explain these moderate findings. Although we know very little about how the inducement effect of environmental regulations on innovation plays out differently for different types of firms, some authors suggest that the inducement effect is smaller for smaller firms. Aghion et al. (2015) put forward that the positive knowledge spillover inherent in the process of innovation is likely to be smaller in small firms that operate in niches, which seems to be particularly the case for the context of environmental entrepreneurship (Hockerts and Wüstenhagen, 2010). Additionally, Ambec et al. (2013) suggest that organizational failure or inertia due to misaligned incentives or asymmetric information is more likely to occur in large firms compared with small firms. Nevertheless, empirical evidence that firm size or age is relevant for the inducement effect of environmental regulation is scant. Whereas Lanoie et al. (2011) find no effect of size (or age) on the effect of environmental regulations on R&D budget in a sample of 4,200 facilities across seven OECD countries, other studies add size and age as control variables when assessing the effect of regulations on some measure of innovativeness and find mixed results (Kammerer, 2009; Rehfeld et al., 2007; Triguero et al., 2013). Future research could test our expectations more generally and explore how the effect of environmental regulations on innovation may play out differently for other types of firms such as family firms or nonprofit firms. For example, there is some evidence that the regulatory environment has a different effect on family firms compared to non-family firms as the former are willing to sacrifice economic value to preserve non-economic socioemotional value such as image and reputation (Berrone et al., 2010; Cruz et al., 2014).

Third, the present study adds to our understanding of the influence of environmental regulations by investigating the relationship between environmental regulations, goal heterogeneity in terms of environmental and economic value creation among start-ups, and different

[9] Theoretical explanations for overlooking profit opportunities concern the existence of market failures (i.e., knowledge spillovers, asymmetric information, and imperfect competition); behavioral arguments (i.e., managers suffer from shortcomings in rationality such as limited information processing capacity or cognitive abilities, are risk averse, or rely on habits and routines); and organizational failure arguments (e.g., misaligned incentives, imperfect information, moral hazard, and hidden action) (Ambec et al., 2013; Wagner, 2003).

types of innovation. Whereas other studies are predominantly single-country and single-sector (Kammerer, 2009; Horbach, 2008; Cleff and Renning, 1999), or lack a hierarchical structure (Triguero et al., 2013), our multi-level approach enables us to address whether individuals within a country share similar cultural values that may influence the extent to which start-ups pursue environmental over economic goals. Based on differing decision-making logics for process and product innovations (Halme and Laurila, 2009; Hockerts and Wüstenhagen, 2010), we theorize and find that the influence of environmental regulations on decision-making processes for both types of innovations differs. Although we predicted a dampening effect for process innovation compared with product innovation, we find no moderation effect of regulations for process innovation, and, conversely, we find a positive moderation effect for product innovation. This interesting result suggests that in countries with stricter environmental regulations, greener start-ups are more likely to innovate at the product level. This result is in line with Triguero et al., (2013), based on a sample of small and medium enterprises (SMEs) across 27 EU countries, who find a moderately significant positive relationship between existing regulatory standards and product innovation and no relationship with process innovation. A potential explanation is provided by Jaffe et al. (2002) who suggest that environmental regulations have two competing effects: a direct effect on increasing costs as per the induced innovation hypothesis and an indirect one on product output. Higher production costs may result in higher prices, reducing product output and subsequently in the incentive to engage in research and development. Another explanation for our results may be related to the measures we use for environmental regulations. Whereas other studies use self-reported perceived environmental stringency (Cleff and Renning, 1999; Horbach, 2008; Kammerer, 2009; Triguero et al., 2013), we measure the stringency of environmental regulations at the country level by the assessment of a panel of national experts that aims to capture the multidimensionality of regulations (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013). This measure includes aspects such as flexibility, clarity, consistency, stability, enforcement of regulations, and concern for specific pressing environmental issues in a given country. This manner of measuring stringency, more so than perceived stringency, may signal the importance of environmental issues in a society (Kostova and Roth, 2002; Scott, 1995) without necessarily being related to increased production costs at the firm level. This may suggest that the stringency of environmental regulations at the country level is an indicator of market demand for environmental products and services and hence relates to product innovation.

What is evident from all our analyses is that environmental value creation significantly and positively relates to both product and process innovation but that the effects of some other determining factors differ substantially between product and process innovation. For example, the entrepreneur's gender seems to matter for product innovation but not for process innovation while the opposite is true for an entrepreneur's age. These results remain unexplained and warrant further investigation for policy makers to be able to stimulate innovation in a desired direction and with impact on society.

Limitations and future research. The GEM is a rich dataset covering a large set of countries; however, it has some limitations. For example, we controlled for a wide array of micro-level variables; however, some characteristics of the start-up firms are generally not included in the GEM survey such as financial indicators.

While our innovation measures have been used previously, they are not specific to the environmental activities of the firm. For example, being innovative does not necessarily imply contributing substantially to improving the natural environment. In other words, we include general innovation measures but not measures of eco-innovation. In the context of environmental innovations, other types of innovations have been identified to be of importance such as social and institutional innovations (Rennings, 2000). Our dataset does not allow us to include these types of innovation. It would be interesting to assess how start-up goals are related to these types of innovation. In addition, being innovative at start-up does not necessarily imply a substantial or even positive impact on the natural environment. Greener start-ups may choose a particularly small-scale niche that matches their personal environmental standards without having any impact outside their target group ("bioneers") (Hockert and Wüstenhagen, 2010). The impact of innovations on the natural environment and their antecedents offer ample room for future research.

Finally, we could not make use of the full potential of the dataset because country-level data were available for 31 of the 50 countries. Hence, future research may want to extend the present analysis to a set of countries that contain a larger variation in economic development. In general, the findings of this study can serve as a starting point for more quantitative research in the area of green entrepreneurship because the definition of green entrepreneurship is fairly simple to include in future questionnaires.

Policy implications. Start-ups are a particularly interesting target group for policymakers as they have relatively high probabilities of innovating (Huergo and Jaumandreu, 2004), those that innovate have higher survival chances (Colombelli et al., 2016), and their innovations are likely to breed future innovations (Teece, 1986; Galende, 2006). Hence, understanding and stimulating the emergence of innovative start-ups is highly relevant, particularly in the context of current environmental challenges.

Our study offers a few suggestions for policymakers. *First*, the goals pursued at start-up are relevant for the level of novelty introduced by start-ups. Being empathetic to the viewpoints of others and taking multiple perspectives into account are behaviours that can be encouraged. Education, in particular higher education, has been found to have a motivation-shaping effect on start-up entrepreneurs to pursue other-regarding interest relative to self-regarding interest (Estrin et al., 2016). Policymakers could actively stimulate this motivation-shaping effect of education programmes. *Second*, a sharp increase in environmental regulation in the past four decades (United Nations, 2012) indicates a strong conviction on the part of policy makers that their intervention serves as an effective mechanism to curb environmental degradation. Although we acknowledge that, with regard to the moderation effects of environmental regulations, we do not find robust evidence across the board, we see some potential in the relevance of environmental regulations. At the same time, we note that we found a significant cross-country variation of the relationship between environmental value creation and our measure of process innovation. While with the country variables at hand, we could not explain this cross-country relationship, this area provides ample opportunities for future research to analyse policy-relevant country variables that influence the association between environmental value creation and innovation.

Overall, our study is an important step towards understanding variability in innovativeness among start-ups and the relationship between environmental entrepreneurship and innovation. We found robust evidence in our multi-country dataset that greener start-ups are more innovative. We explored the role of environmental regulations and found that they are related mainly to product innovation rather than process innovation. In understanding the relationship between environmental value creation and innovation across countries, we found a stronger positive relationship in countries with strict environmental legislation. Thus, an important source of heterogeneity among start-ups in terms of innovativeness is the entrepreneurs' motivation at start-up, and future research is needed to further understand this relationship.

Declaration of Competing Interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant

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