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One size does not fit all: Sustainable innovation, climate policy, and startups' growth aspirations

Mirko Hirschmann

Interdisciplinary Centre for Security, Reliability and Trust (SnT), University of Luxembourg, 29, Avenue John F. Kennedy, 1855, Luxembourg, Luxembourg

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ABSTRACT

Prior research suggests that the growth aspirations of startups are critical to their success. Meanwhile, as concerns about our natural environment and social injustices grow, sustainable innovations from startups seeking to address these issues become more urgent. Thus far, however, previous research has paid little attention to how the successful introduction of sustainable innovations affects the development of startups, in particular, in the form of their resulting growth aspirations. In this study, we empirically explore the relationship between sustainable innovation and startups' growth aspirations, and, drawing on institutional theory, how climate policy moderates this relationship. By investigating a sample of 1430 startups from 32 countries from the Flash Eurobarometer, we find that startups that have introduced a sustainable innovation in the past 12 months have higher growth aspirations. Additionally, our results show that stronger climate policy negatively moderates this relationship. Our findings offer a set of concrete implications for research and practice.

1. Introduction

Previous research demonstrates that the growth aspirations of startups influence their later development, shaping their long-term success and contribution to economic growth (e.g., Van Gelderen et al., 2005; Wiklund and Shepherd, 2003). Various factors, such as entrepreneur characteristics (e.g., gender, education) (Estrin et al., 2013; Kolvereid, 1992) and the degree of innovation within startups, have been shown to impact these growth aspirations (e.g., Rypestøl and Aarstad, 2018; Wiklund et al., 2009). Overall, the prevalence of ambitious startups in a country is crucial for the country's economic growth and innovation ecosystem (Stam et al., 2009).

Today, in response to major societal challenges such as human-induced climate change and increasing inequality, startups are more frequently developing sustainable innovations that aim to address these issues while also generating financial returns. These sustainable innovations refer to the development and implementation of new products, services, and processes that generate environmental and social impact, while also being financially viable (Schaltegger and Wagner, 2011). This shift has prompted a growing body of research that examines the unique characteristics and trajectories of startups engaged in sustainability aspects, distinguishing them from traditional startups (e.g., Bergset and Fichter, 2015; Kuckertz and Wagner, 2010). Moreover, recognizing the societal value of sustainable innovation, governments worldwide have implemented policies and support mechanisms to encourage startups to focus on sustainability (Doblinger et al., 2019).

However, despite the increasing focus on sustainable entrepreneurship, there remains a critical gap in the literature on how startups' successful introduction of sustainable innovations shapes their growth aspirations. Most existing studies have concentrated on the factors that drive startups to engage in sustainable innovation (e.g., Horne and Fichter, 2022; Todeschini et al., 2017) or the outcomes of these innovations in terms of financial performance and environmental impact (e.g., Aguilera-Caracuel and Ortiz-de-Mandojana, 2013; Arfi et al., 2018; Costantini et al., 2017). What is missing is a deeper understanding of how the successful implementation of sustainable innovations influence the growth aspirations of these startups. It is important to address this gap because growth aspirations are a key determinant of a startup's strategy and resource allocation, ultimately affecting its ability to scale, attract investments, and contribute to broader economic and environmental goals (e.g., Wiklund and Shepherd, 2003). Furthermore, findings in this regard can inform policymakers and investors who seek to support startups in ways that maximize both economic and societal impact. Therefore, the first research question of this study is: *How does the introduction of sustainable innovations affect the growth aspirations of startups?*

E-mail address: mirko.hirschmann@uni.lu.

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A significant body of research has examined the role of institutions and their policies in shaping the growth aspirations of startups (e.g., Estrin et al., 2013; Troilo, 2011). Institutional theory focuses on how institutions—defined as the formal and informal rules, norms, and practices that shape social behavior—affect organizational actions and outcomes (North, 1991). According to institutional theory, organizations, including startups, operate within a broader institutional environment that exerts pressures and influences on their strategic decisions (e.g., Boudreaux et al., 2019). These pressures can come from various sources, including regulatory frameworks, cultural norms, and social expectations, all of which can significantly impact entrepreneurial behavior. Hence, institutional theory provides a framework for understanding how external environmental factors shape the strategic decisions of startups, including their growth aspirations. For instance, Estrin et al. (2013) show that stronger protection of intellectual property rights (IPRs) leads to higher entrepreneurial growth aspirations. This demonstrates how regulatory institutions can either encourage or constrain entrepreneurial aspirations depending on the nature of the policies in place.

More recently, research has started to investigate the specific role of institutions in sustainable innovations by startups. Thus, Khatami et al. (2022) demonstrate that entrepreneurial sustainable innovations are more common in countries with strong infrastructure and administrative support. At the same time, climate policies might also impact the growth aspirations of startups. These policies, which are designed to mitigate the negative effects of climate change, can create new opportunities for startups with sustainable innovation, but they can also bring threats and uncertainties if they are perceived as strong pressure (e.g., Howard-Grenville et al., 2014; Nill and Kemp, 2009; Schmitz et al., 2019). Specifically, these policies can open up new markets and drive demand for green technologies, but they can also introduce uncertainties and compliance burdens that may affect a startup's growth aspirations. However, despite the growing body of research on the role of institutions in fostering sustainable innovation (e.g., Fabrizi et al., 2018; Yoon et al., 2024), there is still a gap in understanding how climate policy specifically influences the growth aspirations of startups that engage in sustainable innovation. Institutional theory suggests that these policies could exert significant coercive pressures, which may either stimulate or stifle growth aspirations depending on how these policies are perceived and enacted. Understanding this dynamic is crucial, as the ability of these startups to scale their operations and bring their innovations to market is essential for addressing broader societal challenges such as climate change. This study, therefore, seeks to address the following second research question: *How does climate policy influence the relationship between sustainable innovation and growth aspirations in startups?*

To answer our research questions, we use a multilevel approach with individual-level data on startups and country-level data on climate policies. The data for this study stems from the European Commission's Flash Eurobarometer (Nr. 486) survey, which includes over 17,000 telephone interviews conducted with enterprises from 39 countries, encompassing both the EU27 and 12 non-EU countries. Our final sample consists of 1430 startups from 32 countries, selected based on their establishment within the past five years. We expand startup-level data from the Flash Eurobarometer with several country-level datasets that capture the institutional environment relevant to our study. These additional datasets include the Climate Change Performance Index (CCPI) from Germanwatch e.V. that includes a climate policy index. By controlling for a variety of startup-level controls (e.g., age, size, internationalization) and country-level variables (e.g., culture, labor market conditions), our multilevel ordered logistic regression results show that the introduction of sustainable innovations by startups relates positively to their growth aspirations. Furthermore, our moderation analysis indicates that stronger climate policy negatively moderates this relationship. Finally, we conduct robustness checks and further analysis to strengthen the validity and generalizability of our findings, showing, for example, that internal sustainable innovations drive our moderation results.

Our study makes three main contributions. First, it advances our understanding of entrepreneurial growth aspirations (e.g., Douglas, 2013; Estrin et al., 2013; Kolvereid, 1992) showing that sustainable innovations are associated with higher growth aspirations among startups. This builds on previous research on the growth aspirations of sustainable enterprises (Cornelissen et al., 2021; Vickers and Lyon, 2014) and adds nuance to our understanding of the relationship between innovation and growth aspirations (Wiklund et al., 2009) by showing that the introduction of sustainable innovation positively relates to startup's growth aspirations. In addition, our findings contribute to the literature on the role of policy in shaping entrepreneurial growth aspirations, especially in times of climate change (e.g., Darnihamedani and Terjesen, 2022; Ye et al., 2023), showing that strong climate policy has a negative impact on the relationship between startups with sustainable innovation and their growth aspirations. This extends previous research indicating the relevance of IP policies on growth aspirations (Estrin et al., 2013; Troilo, 2011) and provides initial insights on the influence of climate policy.

Second, our study adds to the growing body of research on sustainable innovation in startups (DiVito and Ingen-Housz, 2021; Hockerts and Wüstenhagen, 2010). While previous research has explored how sustainable innovations by startups contribute to technological development (Doblinger et al., 2019) and societal challenges (George et al., 2021), our study provides new quantitative evidence on how sustainable innovation positively impacts the development of startups themselves. In this sense, we extend the findings of Hoogendoorn et al. (2020), who found that sustainable startups are more innovative. To the best of our knowledge, we are also among the first to investigate the role of sustainable innovation in startups' growth aspirations using a sample of startups from a variety of countries, which offers a methodological contribution as well.

Third, our study contributes to institutional theory by examining the consequences of formal institutions on startup development (e.g., Aidis et al., 2008; Boudreaux et al., 2019). We show that strict climate policy can reduce some (economic) goals of startups having introduced a sustainable innovation, providing a new perspective on the role of formal institutions in shaping startups' growth aspirations. Thus, intensive climate policy may help encourage established companies to consider climate issues (e.g., Dubini, 1989; Rugman and Verbeke, 1998), while they can hinder startups that also want to contribute with their sustainable innovations. These findings are not only of theoretical importance but also have practical implications for the stakeholder of startups. In particular, policymakers can learn from these findings as they seek to support the scaling of sustainable innovations in startups to increase their societal impact. Our moderation results highlight the importance of balancing climate policy stringency especially for startups with sustainable innovations to not limit their entrepreneurial growth. While promoting sustainable innovation can be critical for economic growth and sustainable development, overly stringent policies might unintentionally reduce the growth aspirations in startups.

2. Literature review

2.1. Sustainable innovation and the creation and development of startups

Prior innovation research intensively studies its importance for startup development. Hence, different empirical studies suggest that higher innovativeness of startups relates to firm survival (e.g., Audretsch, 1995), better access to external funding (e.g., Dushnitsky and Lenox, 2005), stronger customer relationships (e.g., Blank, 2013), and overall performance of startups (e.g., Pena, 2002).

Initially, research began investigating the influence of sustainable innovations on general company growth, focusing on their role in enhancing economic and sustainability performance (i.e., environmental or social). For economic performance, most studies indicate a positive influence of sustainable innovation (for a comprehensive review, see Aguilera-Caracuel and Ortiz-de-Mandojana, 2013), particularly when introduced voluntarily (Kunapatarawong and Martínez-Ros, 2016). Recent studies differentiate between types of sustainable innovation, with findings such as Vasileiou et al. (2022), who show green organizational innovation strongly relates to profitability, and Wang et al. (2021), who demonstrate that green product innovation (external) has a stronger impact on economic performance than green process innovation (internal). This highlights the importance of market visibility for external innovations, while internal innovations, though critical for efficiency, often face challenges in stakeholder recognition. Survey-based studies further indicate that sustainable innovations can simultaneously enhance social, environmental, and economic growth (e.g., Fernando et al., 2019). Finally, on a country level, they drive reductions in toxic emissions, emphasizing their societal relevance (Carrión-Flores and Innes, 2010).

At the beginning of the last century, innovation research started to focus on sustainable innovations in startups (e.g., Hockerts and Wüstenhagen, 2010). Unique aspects of sustainable innovations are that they aim for social or environmental contributions beside financial ones (e.g. Ramzan et al., 2023). Thus, they can be directed towards different stakeholder groups compared to commercial innovations. Overall, prior research has investigated them in different forms such as social innovations (e.g., Calderini et al., 2023), green innovations (e.g., Vasileiou et al., 2022), or responsible innovations (e.g., Voegtlin and Scherer, 2017). Furthermore, sustainable innovations are introduced in the form of new products, services, internal processes, or business models. Although there is mature research that investigates how sustainable innovations are created and promoted in startups (e.g., DiVito and Ingen-Housz, 2021; Phillips et al., 2019), the impact of sustainable innovation on startup development is still in its infancy.

First studies investigated how sustainable innovations relate to the creation of startups (e.g., Giudici et al., 2019). Initial empirical evidence of Kuckertz and Wagner (2010) from this area suggests that innovativeness and sustainability aspiration relate to a higher entrepreneurial intention of individuals, but the authors do not find a significant interaction effect between innovativeness and sustainability aspiration. Compared to traditional innovation capability, sustainable innovation could therefore be associated with a higher number of established startups based on it.

Recently, initial studies have started to examine how sustainable innovation relates to startup growth. Specifically, this research differentiates between sustainability and economic growth (e.g., Cornelissen et al., 2021). For example, Chapman and Hottenrott (2022) indicate that some personality traits of startup founders indicate the development of green innovation and in turn the environmental impact of the startups. Also noteworthy is the study by Vasileiou et al. (2022), which focuses on incumbent Italian companies as a whole and not just startups and finds that sustainable innovation is positively related to financial performance. Furthermore, Hirschmann and Block (2022) demonstrate that sustainable startups with filed trademarks, which often relate to innovation behavior (e.g., Mendonça et al., 2004), relate to both sustainable startups' economic and sustainability outcomes. Thus, unique to sustainable innovations is again that they contribute to the sustainable development of countries besides economic growth.

To date, however, there have been, to the best of our knowledge, no empirical studies examining whether the existence of sustainable innovations influences the financial growth aspirations of startups and what role institutions might take in this context.

2.2. Institutions and growth aspirations of startups

During the early 21st century, scholars focused on studying the role of institutions in supporting the development of startups (e.g., Aidis et al., 2008; Boudreaux et al., 2019). The institutional context captures differences between countries that can affect entrepreneurial behavior (Baumol, 1993). Formal and informal institutions have been addressed in academic studies. For example, research on formal institutions explored the role of corruption (e.g., Boudreaux et al., 2019), IP protection (e.g., Estrin et al., 2013), and bureaucracy (e.g., Sørensen, 2007) that influence whether individuals engage in entrepreneurial activities or not.

Prior empirical research suggests that the institutional context influences the growth aspirations of startups. Specifically, Autio and Acs (2010) show that IP protection defines a contextual moderator between entrepreneurs' individual characteristics and their growth aspirations. The authors argue that "… strategic entrepreneurial behaviors cannot be fully understood without giving attention to the context in which those behaviors are observed" (p. 234). Besides the relevance of IP protection, Estrin et al. (2013) demonstrate that the level of corruption in a country can pose an institutional deficit limiting startups' growth aspirations. Regarding the bureaucracy in a country, Troilo (2011) suggests that the number of procedures to enforce a contract as well as number of days and procedures to start a business negatively relates to growth and market expansion aspirations.

In recent years, an increasing number of studies have focused on the role of climate policy, as a formal institutional characteristic, on entrepreneurial behavior (e.g., Crecente et al., 2021; Schmitz et al., 2019). One stream of studies focuses on the impact of climate policy on sustainable innovation. For instance, empirical studies by Niu et al. (2023) and Huang (2023) in China and the US, respectively, demonstrate that climate policy uncertainty—reflecting institutional ambiguity—negatively affects companies' green technology innovation. This conclusion is further supported by Teeter and Sandberg (2017), whose qualitative research on Australian firms indicates that climate policy uncertainty encourages short-term investments, which hinder the development of green capabilities. Another stream of research investigates the relationship between climate policy and entrepreneurial opportunities and resources. Crecente et al. (2021), using data from 22 European countries, show that the effects of climate policy changes on entrepreneurial opportunities manifest over the long term. Additionally, rising climate policy uncertainty has been linked to reduced venture capital investments in cleantech startups (Noailly et al., 2022). Conversely, stringent climate policy has been found to reduce the entry of regional brown ventures while playing a pivotal role in financing green startups (Cojoianu et al., 2020). Together, these research streams underscore the significance of climate policy as a key institutional framework characteristic that influences entrepreneurial behavior in diverse ways, from shaping innovation strategies to affecting resource availability and opportunity creation.

However, while climate change risks seem to influence entrepreneurial growth aspirations (Ye et al., 2023), research misses an understanding of how climate policy, which aims to mitigate these risks, influences startups' growth aspirations that aim to contribute to the sustainable development goals (SDGs) by introducing sustainable innovations to the markets. Only at a general level the study by Albrizio et al. (2017) shows that a tightening of environmental policy is associated with short-term productivity growth in technologically advanced countries and Shui et al. (2024) suggest that it increases sustainability performance of multinational enterprises. This study aims to close the gap of understanding the role of climate policy stringency for startups' growth aspirations by examining how it serves as a moderator for sustainable innovation and the growth aspirations of start-ups.

3. Hypotheses

3.1. Sustainable innovation and startups' growth aspirations

Sustainable innovation by startups encompasses different types that create societal value. If these innovations are successfully introduced by startups there are a number of reasons that can foster their growth aspirations compared to those of other startups. In particular, we explain in the following the reasons for a greater competitive advantage, better access to resources, and a superior reputation that might result in higher growth aspirations of startups.

First, sustainable innovations can provide startups with various *competitive advantages* that can drive their growth aspirations. In terms of differentiation as a competitive advantage, startups could benefit from customers' increased willingness to pay due to sustainable innovations (e.g., Ambec and Lanoie, 2008). This is because customers are increasingly concerned about social and environmental issues (e.g., Leonidou et al., 2010). Especially new and unique products and services that are sustainable help startups differentiate themselves from their competitors and thereby attract new customers looking for sustainable solutions (e.g., Gupta et al., 2013). This might be reflected in startups' growth aspirations when they successfully introduce sustainable innovations. In addition, there are also some cost-benefit reasons for sustainable innovation that can lead to competitive advantages for startups. Specifically, startups with sustainable innovations could expect to achieve cost advantages in the long term, as prices for non-sustainable innovations are getting higher (e.g., Horbach et al., 2012). These expectations for reduced costs for sustainability reasons can free up capital that can then be reinvested to achieve higher growth. Also, new sustainable innovations, if implemented internally, can improve efficiency and processes, which in turn can reduce costs through increased productivity (e.g., Hellström, 2007). Finally, a startup's sustainable innovation can help mitigate its risks, which can also become a competitive advantage. This is because the risks of supply chain disruptions and regulatory changes are less likely to affect sustainable products and services (e.g., Gupta et al., 2020). We assume that increased stability and predictability is also reflected in the growth aspirations of a startup.

Second, we argue that startups with sustainable innovation might have *greater access to resources* nowadays, which in turn influence their growth aspirations. Specifically, startups with sustainable innovations can benefit from a greater access to financial resources. This is the reason since traditional investors are more frequently including sustainability criteria to their investment decisions (e.g., Bauer et al., 2021; Pollmeier et al., 2025) and startups with innovation that address societal progress besides financial goals have new funding possibilities. These funding opportunities include private capital alternatives in the form of impact investing (e.g., Block et al., 2021) or governmental funding programs that address sustainable solutions (e.g., Song et al., 2022). Impact investing, for example, is increasing in market size year by year (GIIN, 2022) and the importance of government partnerships for innovative cleantech startups is also demonstrated by prior empirical research (Doblinger et al., 2019). Furthermore, prior crowdfunding research demonstrates that campaigns of startups with sustainable innovations are more likely to be successful (e.g., Calic and Mosakowski, 2016). Besides this range of financial advantages that can positively influence sustainable startups' growth aspirations, there are also a couple of non-financial programs that specifically search for sustainable startups. For example, on a global scale impact incubators and accelerators have been established (e.g., the Impact Hubs) that support startups with sustainable innovations in their early stages (e.g., Hirschmann et al., 2022b). Also, the mentioned impact investors provide startups with important networks and other non-financial support. Overall, according to these studies startups with sustainable innovation might have a greater access to resources as they can rely on new forms of support particularly directed towards the sustainable development of countries.

Third, *reputational reasons* due to sustainable innovations can increase startups' growth aspirations. For example, new sustainable products or services can boost the reputation of startups, as a focus on sustainability helps build trust and credibility with customers through their benefits to society (e.g., Chang and Chen, 2013). This can lead to positive word-of-mouth marketing and an increased customer loyalty (e.g., Mandhachitara and Poolthong, 2011), which in turn can drive the growth aspirations of startups. Another important factor of reputation gains due to the introduction of sustainable innovations is that this can lead to better access to human resources. Specifically, a strong sustainability reputation can help attract highly (often intrinsically) motivated employees, giving startups an advantage in the highly competitive market for skilled labor (e.g., Bos-Brouwers, 2010). Also, startups could benefit from lower costs through lower salaries or volunteering by having employees who are intrinsically motivated to contribute to sustainability, as has been demonstrated in the field of social entrepreneurship, for example (e.g., Overgaard and Kerlin, 2022). Finally, sustainable innovations can increase brand awareness, allowing startups to reach new markets or customer segments (e.g., Varadarajan, 2017) which can increase visibility for new investors or the likelihood of forming new partnerships. Again, all these potential reputational advantages might result in higher growth aspirations of startups.

In summary, sustainable innovations can result in increased growth aspirations of startups by creating competitive advantages, facilitating access to resources, and enhancing their reputation. This argumentation is in line with the results of the meta-analysis by Dixon-Fowler et al. (2013), which suggest that small firms such as startups benefit from environmental performance as much or even more than large firms. Thus, we argue that the introduction of sustainable innovations is perceived as a milestone for startups which in turn influences their growth aspirations. Consequently, we predict:

H1. : Startups that have successfully introduced a sustainable innovation have higher growth aspirations to those that have not.

3.2. Moderating institutional characteristic: Climate policy

The literature strand on how climate policy affects startups is still small (e.g., Khatami et al., 2022; York et al., 2018) and has not yet explored the growth aspirations of startups. As such, Schaltegger and Wagner (2011) call for further investigation into the effect of strict climate policy on startups that offer sustainable innovations. In this vein, we propose that climate policy demonstrates a formal institutional characteristic that affects the growth aspirations of startups with sustainable innovations.

Ultimately, institutions influence the "functioning of markets and the competitive advantages of its participants" (Baron, 2001, p. 47) through new climate policies. However, climate policies are largely directed at individuals (e.g., Ingold et al., 2019), incumbent small and medium-sized enterprises (SMEs), and large companies that need to become more sustainable (e.g., Åhman et al., 2017). As an example, the upcoming European "Corporate Sustainability Reporting Directive" (CSRD) will require companies with >500 employees to prepare sustainability reports starting in 2025, which must include greenhouse gas emissions data (European Parliament, 2022).

As formal institutional changes are mainly focused on incumbent companies, we suspect that strict climate policy measures could limit the growth aspirations of startups. This is because these startups may anticipate increased competition in the future due to larger incumbent companies' efforts to comply with the new regulations or investments in sustainable innovation prompted by the policies (e.g., Afeltra et al., 2023). Startups with sustainable innovations may also recognize the advantages incumbent companies hold in terms of resources (e.g., access to financing) and infrastructure (e.g., Zahra, 2021), which can make it easier for them to adapt to new climate policies and scale their own sustainable innovations. This way, strong climate policy might demonstrate formal institutional characteristics that especially benefit incumbent companies and encourage them to engage in sustainable innovations. Again, this makes it more difficult for the startups to compete in the market and in turn could inhibit their growth aspirations.

Next, climate policies create institutional uncertainty as future policies in this area are likely to become more stringent (e.g., Bylund and McCaffrey, 2017). For example, climate policy uncertainty reduces future sustainable innovation practices of companies (Niu et al., 2023). Furthermore, Teeter and Sandberg (2017) find that institutional uncertainty due to climate policy increases short-term investments and thereby limit company development. Overall, these institutional uncertainties due to new climate policies may be even more significant for organizations than expectations about the effects of climate change argue Howard-Grenville et al. (2014) while empirical evidence on this relationship is missing to date. We assume that startups with sustainable innovations can be particularly affected by these uncertainties, as stricter climate policy may encourage competitors to develop similar sustainable innovations, which could in turn hinder the startup's growth aspirations. Also, startups do not have as many capacities as incumbent firms have, which make it even harder for them to navigate in an institutional environment characterized by a high uncertainty. Our argumentation is strengthened by the findings of Noailly et al. (2022) showing that greater climate policy uncertainty is correlated with a reduced likelihood of obtaining financial resources in the form of venture capital for cleantech startups.

For these reasons of institutional uncertainty and competitive advantages of incumbent firms in new formal institutional environments due to stronger climate policy, we propose:

H2. : The stringency of climate policy in a country negatively moderates the relationship between sustainable innovation in startups and their growth aspirations.

4. Method

4.1. Data and sample

Most of our data stems from the European Commission's Flash Eurobarometer (Nr. 486) *SMEs, startups, scale-ups and entrepreneurship* report (European Commission, 2020). This survey encompasses >17,000 telephone interviews with enterprises from 39 countries (including the EU27 and 12 non-EU countries), conducted from February 19th to May 5th, 2020. The European Commission states that most of these interviews were completed prior to the COVID-19 outbreak, which reduces the likelihood of a bias due to environmental changes. Topics covered in the survey include growth, sustainability, innovation, and digitalization, among others. In the past, data from the Flash Eurobarometer has been widely used in entrepreneurship research (e.g., Block et al., 2019; Kleinhempel et al., 2022; Walter and Block, 2016).

We merge the startup-related data with several country-level datasets to assess the institutional environment of startups. Specifically, we include information on climate policy (Germanwatch e.V., *Climate Change Performance Index (CCPI)*, 2019), economic growth (World Bank, 2019), culture (Hofstede, 2017), and labor market policy (Schwab, *Global Competitiveness Report*, 2019) at the country level. Except for the culture dimensions, which are considered relatively static, all data are from 2019, the previous year of the survey. By combining these country-level data with venture-level data from startups, we were able to predict startups' growth aspirations from both micro and macro perspectives.

In line with the definition of the report of the European Commission (2020) as well as prior research on startups (e.g., Sedláček and Sterk, 2017), we define startups as enterprises that have been in existence for no more than five years and hence limited our sample to companies that have been established since 2015. After applying this criterion our sample included 1437 startups. Next, we eliminated 7 startups due to missing values on the size of the startup (number of employees). In total, our sample therefore consists of 1430 startups (level 1) from 32 countries (level 2). Table A1 provides an overview of the number of participating startups per country.

4.2. Variables

4.2.1. Dependent variables

Based on the Flash Eurobarometer 486 data, we create our dependent variable (economic) *growth aspirations*. Specifically, we capture growth aspirations by their intended employment growth over the next five years (Question 6). This approach is widely recognized in prior startup growth research (e.g., Appel et al., 2019; Estrin et al., 2013; Hirschmann and Block, 2022). The ordinal variable growth aspirations includes four categories that were included in the Eurobarometer survey:

- (1) No desire to grow: This category includes startups who do not intend to increase the number of employees over the next five years. It might reflect a preference for stability or potential constraints in resources or market opportunities.
- (2) Low growth aspirations (annual growth <10 %): Startups in this category aim for modest expansion, seeking to grow their employee base at an annual rate of <10 %.
- (3) Moderate growth aspirations (annual growth 10 %–20 %): This group targets a more aggressive expansion, aiming for a 10 % to 20 % increase in employees annually.
- (4) High growth aspirations (annual growth >20 %): Startups who aim for >20 % annual employee growth demonstrate the highest level of growth aspirations, indicating a strong intent to scale rapidly.

This classification allows us to capture the varying degrees of growth aspirations among startups, aligning with established methodologies in the literature (e.g., Darnihamedani and Terjesen, 2022). By focusing on employment growth, we align our measure with the practical and observable outcomes that reflect an startups' broader economic growth aspirations (e.g., Hirschmann and Block, 2022; Wiklund and Shepherd, 2003).

4.2.2. Independent variable

We use Question 19 of the European Commission's survey to create a *sustainable innovation* variable. This binary variable captures whether the startup has introduced a green innovation that creates an environmental benefit, which also includes an innovation with an energy or resource efficiency benefit, or a social innovation, which can be new products, services, or processes that aim to create societal value, within the past 12 months. Furthermore, startups in our dataset may have implemented either internal or external sustainable innovations, as indicated by their self-reported introduction of such innovations in the previous year. Both types are designed to achieve social or environmental benefits but differ in their focus. Internal sustainable innovations aim to enhance production processes or implement new business models within the organization, resulting in improved efficiency or reduced environmental externalities (e.g., Ghobakhloo et al., 2021; De Marchi, 2012). In contrast, external sustainable innovations involve the development and market introduction of sustainable products or services that address societal or environmental needs (e.g., Fabrizi et al., 2018; Smith et al., 2014). Given the potential for these two types of innovations to influence startups' growth aspirations in distinct ways, we conduct additional analyses to explore their differential impacts.

In addition to IPRs and R&D expenditures as common indicators of sustainable innovation (e.g., Fabrizi et al., 2018; Ketata et al., 2015), prior research has extensively employed surveys to assess sustainable innovation activities within firms (e.g., Block et al., 2025; Rogge and Schleich, 2018), including startups (e.g., Abdesselam et al., 2024; Huang et al., 2020). Surveys are particularly valuable as they provide direct, firm-level insights into innovation activities, capturing nuanced dimensions such as the types, motivations, and outcomes of innovation efforts that are not easily observable through financial or patent data alone (e.g., Cirera and Muzi, 2020). This approach is especially important in the context of startups, which may not yet hold extensive patents or allocate significant R&D budgets but often engage in agile and creative innovation practices that surveys can effectively capture (e.g., Grimpe et al., 2019).

The data from the European Commission's Flash Eurobarometer survey aligns closely with studies utilizing the Community Innovation Survey (e.g., Frenz and Ietto-Gillies, 2009; Hashi and Stojčić, 2013), which similarly asks firms whether they have introduced improved products or processes internally or to the market in recent years. This question on innovation outcomes of companies is designed in accordance with the OECD Oslo Manual (OECD, 2005). Andries et al. (2019) extended the scope of this survey to capture social innovation aspects, a concept closely related to the sustainable innovation variable used in this study. The structured design of the Flash Eurobarometer survey ensures comparability across countries and firms, making it well-suited for cross-national research and particularly relevant for assessing startup activities in the European context (e.g., Hoogendoorn et al., 2019).

Finally, the exact variable and data from the Flash Eurobarometer (Nr. 486) have been employed in recent research by Ardito (2023), Arroyabe et al. (2024), Avelar et al. (2024), and Cattani et al. (2023) to explore firm digitalization and sustainable innovation performance. Similarly, Labella-Fernández et al. (2021) used this data to investigate firm growth and sustainable innovativeness and Marnoto et al. (2024) used it to explore ESG-driven innovation in family businesses. These broad applications underscore the validity of the survey question as a reliable measure for capturing sustainable innovation activities.

4.2.3. *Moderating institutional factor*

We use a country's degree of climate policy to examine whether this institutional country-level factor serves as a moderator in the relationship between startups having sustainable innovation and their growth aspirations. We lag the climate policy by one year since the survey of the Flash Eurobarometer already took place at the beginning of 2020, which is also in line with prior research (e.g., Estrin et al., 2013).

To assess the climate policy in countries, we use data from the CCPI report of Germanwatch e.V. that captures how well a country engages against climate change. The CCPI is published on a yearly basis since 2006 together with the NewClimate Institute and the Climate Action Network, is one of the best-established indices for measuring climate policy (e.g., Bernauer and Böhmelt, 2013), and consists of four categories “GHG Emissions”, “Renewable Energy”, “Energy Use”, and “Climate Policy”. Because we are particularly interested in climate policy between countries, as this could have an impact on how the sustainable innovations introduced by startups lead to their growth aspirations, we use the *CPI 2019* (Climate Policy Index) as our moderation variable. We investigate the interplay of sustainable innovations and climate policy as prior research demonstrates that the variables are strongly connected (e.g., Foxon and Pearson, 2008; Nill and Kemp, 2009). Regarding the CCPI, climate policy accounts for 20 % of the overall CCPI score. This index, which ranges from 0 to 100, captures recent changes in national climate policy (10 %) and international climate policy (10 %). While the national part includes aspects such as promotion of renewable energies or regulations to increase energy efficiency, the international part assesses recent performance of countries in international fora. Taken together, the strength of this climate policy might, in interplay with introduced sustainable innovations, influence the growth aspirations of startups. The ratings in each of these areas stem from a comprehensive survey with policy experts from universities, non-governmental organizations (NGOs), and other think tanks around the world (Germanwatch e.V., 2019) and cover recent climate policy developments.

The CCPI and its climate policy index offer specific advantages over other climate policy data sources. First, prior research has also utilized data from the Climate Policy Radar (e.g., Eskander and Fankhauser, 2020; Schaub et al., 2022), which captures the sheer number of laws or policies enacted in specific years. However, this approach primarily reflects the quantity of policies rather than their effectiveness or enforcement strength. In contrast, the CCPI provides expert evaluations of the strength and quality of these policies, offering more nuanced and comprehensive information.

Second, a possible alternative data source would have been SDG 13 country performance data which focuses on high-level national progress towards climate action goals, such as integrating climate measures into policies and plans, building resilience, and fostering international cooperation (for more information see publications of the Sustainable Development Report[1]). However, while this framework is essential for understanding overarching progress, it does not provide detailed, timely, or expert-based evaluations of specific legal changes or the effectiveness of newly enacted climate policies. Instead, it primarily captures outcomes or aspirations, which may lag behind the actual legislative and regulatory adjustments that shape the innovation and entrepreneurship landscape.

Third, data of the Climate Disclosure Project (CDP) captures some climate-related data on the regional level. Specifically, this data includes information on emissions, climate actions, and climate risks.[2] Since the data relies on self-reported information from governments, it may lack the objectivity and expert evaluation needed to assess the strength, enforcement, and impact of legal frameworks. Additionally, the CDP's emphasis on local climate action and voluntary reporting makes it less tailored to capturing national-level legislative changes. Thus, the data is less suitable for research focused on assessing the evolution and effectiveness of national climate policy changes.

In contrast, the CCPI climate policy index provides expert evaluations of the strength, ambition, and implementation of national climate policies. These evaluations based on a survey are specifically designed to capture the quality and effectiveness of regulatory and legislative measures, offering a granular view of how governments adapt and innovate within the legal sphere to meet climate challenges (Burck et al., 2024). By focusing on expert assessments, the CCPI goes beyond mere numerical counts of laws or policies—like those provided by the Climate Policy Radar—and instead evaluates the real-world impact and enforceability of these changes. This makes it especially relevant for studying the effects of climate policies on startups and sustainable innovation, where the legal environment plays a pivotal role in shaping opportunities and constraints.

For these reasons, the CCPI, along with other data provided by Germanwatch e.V., such as the Climate Risk Index, has been widely utilized in high-impact research published in leading climate change journals, including *Nature Climate Change* (e.g., Ćetković and Hagemann, 2020; Guy et al., 2023; Puertas and Marti, 2021; Victor et al., 2022). Additionally, it has been employed in top-tier entrepreneurship, management, and finance journals, such as the *Journal of Business Venturing*, *Research Policy*, and *Journal of Finance* (e.g., Bingler et al., 2024; Bolton and Kacperczyk, 2023; Shui et al., 2024; Steffen et al., 2022; Ye et al., 2023; Yoon et al., 2024). For example, Bolton and Kacperczyk (2023) leverage the CCPI's climate policy index to investigate the global pricing of carbon-transition risks,[3] while Shui et al. (2024) analyze how regulatory pressures influence corporate environmental sustainability performance. The latter study aligns closely with our approach, as we examine sustainability-driven innovations as a subset of environmental performance. In summary, by focusing on expert-based evaluations of climate policies and their enforcement, the CCPI provides robust data for exploring the relationship between regulatory environments and firm-level responses, making it a valuable resource for studies on sustainable innovation and entrepreneurship.

4.2.4. *Control variables*

We include a set of control variables at the startup's venture-level as well as at the country-level that can influence growth aspirations. At the venture-level, we controlled for several possible confounding variables. First, we control for startups' *company age* which reaches from 0 to 5

[1] https://dashboards.sdgindex.org/downloads.

[2] For more information see https://www.cdp.net/en/data.

[3] The study was cited over 500 times within a year of its publication.

(Question 1). Controlling for company age is necessary since growth aspirations of startups can change over time (e.g., Darnihamedani and Block, 2024). Second, we control for *company size*, which we include since growth aspirations can differ regarding the size of a startup (e.g., Wiklund and Shepherd, 2003). We measure company size by the current number of employees and logarithmize the variable (Question 2a). Third, as another frequently used innovation-related control variable, we use a *patent* dummy that captures whether a startup has a patent or a patent application (Question 9). Research suggests that IPRs, which capture innovativeness, and startup growth are closely linked (e.g., Hirschmann and Block, 2022). Fourth, we include *internationalization*, a binary variable that captures whether a startup is already active in foreign markets (Question 11), which is consistent with research showing the connection between internationalization and startup growth (e.g., Verheul and Van Mil, 2011). Fifth, prior research also shows that in large cities, startups can have more support and larger networks (e.g., Pan and Yang, 2019), which in turn could result in higher growth aspirations. Therefore, we include a *large city* dummy variable (Question 8). Sixth, single-owned and team-owned startups differ (e.g., Brinckmann et al., 2011), so we include a *single ownership* dummy variable to account for these differences (Question 13). Finally, we include 15 *sector dummies* based on the startups' NACE codes, which stem from the sample information of the Flash Eurobarometer 486, as the growth aspirations of startups can vary depending on the sector in which they operate (e.g., Darnihamedani and Block, 2024; Wiklund and Shepherd, 2003).

At the country-level, we control for *GDP* per capita, the *culture*, and the *LMI 2019* (Labor Market Index) in a country. GDP is measured in U.S. dollars in a logged form, obtained from the World Bank, captures the economic status in a country, and has been applied by prior studies investigating growth aspirations of startups (e.g., Hessels et al., 2008). Furthermore, we include a set of culture control variables of Hofstede (one of the most widely used measures) to account for cross-culture differences, as a country's culture can affect the aspirations of startups (e.g., Freytag and Thurik, 2007). In particular, we decided to use the three continuous culture scores for power distance, uncertainty avoidance, and long-term aspiration as these cultural dimensions seem to relate most closely to our investigated relationship between sustainable innovation and growth aspirations of startups (Hofstede, 2017). Finally, we account for labor market policy, which includes factors such as flexibility in hiring and firing in a country, which has been shown to be relevant in the context of the growth aspirations of startups as well (e.g., Darnihamedani and Block, 2024).

5. Results

5.1. Descriptive statistics

In addition to providing a brief description of our variables, Table 1 presents descriptive statistics.

Regarding our dependent variable, the table shows that, on average, the startups in our sample aim for annual growth of 10 % to 20 %. This objective is consistent with prior research, which has found that only a minority of startups set high growth aspirations (e.g., Van Gelderen et al., 2005). The fact that our sample's average growth aspirations fall within this moderate range indicates that the startups in our sample

Table 1
Variables, descriptive statistics, and descriptions.

Variable	Mean	SD	Min	Max	Description	Source
Dependent variables						
Growth aspirations	2.335	1.130	1	4	Ordinal variable that captures the startups' economic growth aspirations for the next five years (1 = no growth plans, 2 ≤ 10 % per year, 3 = 10 %–20 % per year, 4 ≥ 20 % per year).	European Commission (2020)
Independent variable						
Sustainable innovation	0.324	0.468	0	1	Dummy variable that equals one if the startup has introduced a sustainable (social or green) innovation in the past 12 months.	European Commission (2020)
Individual controls						
Company age	3.431	1.312	0	5	Continuous variable that captures the startups' age in years.	European Commission (2020)
Company size (log)	1.938	1.119	0.693	8.010	Continuous variable that captures the natural logarithm of the startups' number of employees.	European Commission (2020)
Patent	0.060	0.238	0	1	Dummy variable that equals one if the startup has a patent or patent application.	European Commission (2020)
Internationalization	0.304	0.460	0	1	Dummy variable that equals one if the startup is active in foreign markets.	European Commission (2020)
Large city	0.559	0.497	0	1	Dummy variable that equals one if the startup stems from a large city.	European Commission (2020)
Single ownership	0.461	0.499	0	1	Dummy variable that equals one if the startup has a single owner.	European Commission (2020)
Sector dummies	–	–	–	–	Set of dummy variables that capture the startups' sector by its NACE code (15 dummies included)	European Commission (2020)
Country controls						
GDP 2019 (log)	26.510	1.549	23.446	30.696	Continuous variable that captures the natural logarithm of a country's GDP in 2019.	World Bank (2019)
Culture: Power distance	50.246	19.421	11	104	Continuous variable that captures a country's cultural power distance.	Hofstede (2017)
Culture: Uncertainty avoidance	70.399	21.091	23	112	Continuous variable that captures a country's cultural uncertainty avoidance.	Hofstede (2017)
Culture: Long-term orientation	57.309	18.536	24.433	87.909	Continuous variable that captures a country's cultural long-term orientation.	Hofstede (2017)
LMI 2019	66.113	7.158	52.4	78.2	Continuous variable that captures a country's Labor Market Index.	Schwab (2019)
CPI 2019	53.848	28.138	0	98.4	Continuous variable that captures a country's Climate Policy Index.	Germanwatch e.V. (2019)

Notes: $N = 1430$ (Level 1), Number of groups (Level 2) = 32. The following countries (groups) are included: Austria, Belgium, Brazil, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Turkey, United States.

pursue rather sustainable and realistic growth rather than overly aggressive expansion. This moderate growth target could reflect the inherent risks associated with high growth strategies, such as resource constraints or market saturation, which many startups might be cautious of. Also, it is in line with research demonstrating that people start entrepreneurial endeavors for a variety of reasons and not only to maximize growth and profits (e.g., Kolvereid, 1992; Wiklund et al., 2009).

The descriptive statistics of our independent variable show that on average 32.4 % of the startups introduced a sustainable innovation in the past year. This is particularly noteworthy because it suggests that nearly one-third of startups in our sample are actively engaged in innovation activities that have environmental or social benefits. Compared to other studies, such as Boyer and Blazy (2014), which reported that only 22.2 % of micro-startups were innovative, and Jensen et al. (2020), who found that 25 % of cleantech startups included innovation in their business strategy, our sample thus shows a higher propensity for sustainable innovation. This higher percentage may be indicative of a broader shift towards sustainability in entrepreneurship, reflecting increased awareness and demand for environmentally responsible business practices (e.g., Yoon et al., 2024). This trend is crucial for understanding the evolving landscape of startup activities and the potential for sustainable innovations to drive future growth and sustainability achievements.

Regarding our venture-level control variables, Table 1 shows that on average the startups are 3.4 years old and have around 20 employees (log = 1.9, median = 5). Also, 6.0 % of the startups have applied for or registered a patent, 30.4 % are already active in foreign markets, 55.9 % are located in a large city, and 46.1 % are single-owned. The country controls demonstrate mean values for the three Hofstede culture dimensions, GDP (log), as well as two country-level indices. More specifically, the LMI is on average 66.1 and the CPI 53.8.

Table 2 displays our correlation matrix. Furthermore, we calculated the variance inflation factors. As the results are all lower than 5, we do not seem to have a multicollinearity issue.

5.2. Multilevel analyses results

To examine the relationship between sustainable innovation and startups' growth aspirations, we employ a multilevel approach to analyze our two-level data structure, comprising startups at level 1 and their respective countries at level 2 (e.g., Hox et al., 2017). We use a mixed-effects ordered logistic regression, which allows us to account for potential variations across national contexts, particularly in our interaction analyses, by including random intercepts and random slopes (e.g., Aguinis et al., 2013). We rely on this methodology because it allows us to estimate effects of sustainable innovation on the individual startup level and changes in climate policy on the macro level. Prior entrepreneurship research has applied this approach to investigate similar conceptual frameworks (e.g., Boudreaux et al., 2019; Wei et al., 2024). Furthermore, we control for time differences regarding growth aspirations by including year dummies in all our analyses.

In accordance with prior multilevel research, we conduct a three-step estimation in our analyses (e.g., Autio and Acs, 2010; Boudreaux et al., 2019). First, we assess between-group variation at level 1 and level 2 by estimating the inter-class correlations (ICCs) using two null models of our main analyses with both dependent variables (e.g., Estrin et al., 2013). These null models only include intercepts, with all independent and control variables omitted. Our results indicate that we have the most variance at the venture-level, at 97.4 %. This relatively high variance at the venture-level may result out of the small number of observations in some of our 32 countries (level 2). As such, we also perform a robustness check in the following section, using a clustered ordered logistic regression. Second, we examine the effects of all our startup-level and country-level control variables (Model 1 of Table 2). Third, we include our independent variables stepwise and test our hypotheses (Model 2 and Model 3 of Table 2).

Table 3 displays the results of our main multilevel analysis. Model 1 shows the results of our control variables only. This in line with prior multilevel studies that explore the role of controls before entering the independent variables stepwise (e.g., Boudreaux et al., 2019). We find that the patent dummy (coeff. = 0.643, $p = 0.002$), internationalization dummy (coeff. = 0.276, $p = 0.015$), and being from a large city (coeff. = 0.519, $p = 0.000$) positively relates to startups' growth aspirations while the company age presents a negative effect (coeff. = −0.068, $p = 0.068$).

In Model 2 and Model 3, we test our hypotheses. Model 2 demonstrates our findings regarding our main effects hypothesis using sustainable innovation. We find that introducing a sustainable innovation in the past year positively relates to startups' growth aspirations (coeff. = 0.450, p = 0.000), supporting H1. Furthermore, we calculated the average marginal effects showing that the introduction of a sustainable innovation is associated with a 7.1 percentage point increase in the highest level of the dependent variable (growth aspirations >20 % per year). While the average marginal effect is slightly smaller than the one of a patent (8.3 percentage points) or being from a large city (7.6 percentage points), it is larger than that of the company age (1.1 percentage points), company size (0.6 percentage points), or being internationalized (3.9 percentage points). Model 3 also supports H2, showing that a stronger climate policy in a country negatively moderates the relationship between sustainable innovation and the growth aspirations of startups (coeff. = −0.007, $p = 0.047$). This suggests that in countries with more stringent climate policy, startups that engage in sustainable innovation tend to have lower growth aspirations compared to similar startups in countries with less stringent climate policy.

To further explore this moderation effect, we graphically illustrate the interaction by examining the marginal effects of sustainable innovation on growth aspirations at different levels of climate policy stringency. Specifically, we used marginal effects analysis with the climate policy index set at +/−1 standard deviation from the mean, along with 95 % confidence intervals, following best practices in moderation analysis (e.g., Murphy and Aguinis, 2022). Fig. 1 displays our moderation effect of H2 with high economic growth aspirations (>20 % per year) as the outcome variable on the vertical axis. The graph shows two lines representing startups with sustainable innovations at high and low levels of climate policy stringency. The line representing startups in countries with more stringent climate policy (−1 SD) slopes downward more steeply, indicating that as climate policy become stricter, the growth aspirations of startups engaging in sustainable innovation decrease. Importantly, the confidence intervals of the lines do not overlap significantly, especially between −1 SD and the mean, which strengthens the evidence for a significant interaction effect.

5.3. Robustness checks and further analyses

We conducted a set of robustness tests and further analyses to validate and nuance our findings.

First, our multilevel approach, which takes into account observations at both the startup level and country levels, may be limited by the small number of observations in some countries. This limitation raises concerns about the reliability of our results due to potential country-level biases. To address this, we conducted a robustness check using ordered logistic regression with clustered standard errors at the country level (see Table A2). The results from this analysis were consistent with our main multilevel model, indicating that our key hypotheses hold

Table 2
Pairwise correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Growth aspirations													
(2) Sustainable innovation	0.13												
(3) Company age	−0.04	0.05											
(4) Company size (log)	0.05	0.10	0.05										
(5) Patent	0.12	0.16	0.00	0.09									
(6) Internationalization	0.09	0.07	0.03	0.15	0.15								
(7) Large city	0.14	0.03	0.03	0.05	0.05	−0.01							
(8) Single ownership	−0.07	−0.10	−0.02	−0.25	−0.12	−0.12	−0.02						
(9) GDP 2019 (log)	0.04	0.08	−0.03	0.02	0.10	−0.12	−0.03	−0.12					
(10) Culture: Power distance	−0.01	−0.04	−0.12	−0.02	−0.03	−0.05	−0.11	0.03	0.10				
(11) Culture: Uncertainty avoidance	−0.02	0.03	0.09	0.01	−0.01	0.02	0.06	0.00	−0.09	−0.66			
(12) Culture: Long-term orientation	−0.04	0.01	0.10	0.02	−0.01	0.06	0.08	−0.01	−0.10	−0.73	0.62		
(13) LMI 2019	−0.07	−0.10	−0.04	0.02	−0.11	0.05	−0.03	0.17	−0.35	0.04	0.05	0.04	
(14) CPI 2019	0.04	0.02	−0.08	−0.03	−0.02	−0.02	−0.05	−0.09	0.04	0.29	−0.30	−0.28	0.09

Notes: $N = 1430$.

Table 3
Main results.

Model	(1)	(2)	(3)
Hypotheses	–	1	2
Statistic	Coeff./(SE)/[p]	Coeff./(SE)/[p]	Coeff./(SE)/[p]
Individual controls			
Company age	−0.068* (0.037) [0.068]	−0.074** (0.037) [0.048]	−0.0763* (0.037) [0.051]
Company size (log)	0.052 (0.046) [0.251]	0.040 (0.046) [0.381]	0.041 (0.046) [0.372]
Patent	0.643*** (0.211) [0.002]	0.556*** (0.212) [0.009]	0.554*** (0.212) [0.009]
Internationalized	0.276** (0.114) [0.015]	0.261** (0.114) [0.022]	0.262** (0.114) [0.021]
Large city	0.519*** (0.103) [0.000]	0.516*** (0.103) [0.000]	0.508*** (0.103) [0.000]
Single ownership	−0.096 (0.106) [0.365]	−0.079 (0.106) [0.456]	−0.081 (0.106) [0.446]
Sector dummies	Yes	Yes	Yes
Country controls			
GDP 2019 (log)	0.037 (0.037) [0.326]	0.033 (0.038) [0.388]	0.036 (0.038) [0.340]
Culture: Power distance	0.000 (0.004) [0.959]	0.000 (0.004) [0.995]	0.000 (0.004) [0.932]
Culture: Uncertainty avoidance	−0.006 (0.004) [0.149]	−0.006 (0.004) [0.160]	−0.005 (0.004) [0.165]
Culture: Long-term orientation	−0.005 (0.003) [0.113]	−0.004 (0.003) [0.186]	−0.005 (0.003) [0.146]
LMI 2019	−0.010 (0.012) [0.406]	−0.009 (0.012) [0.460]	−0.008 (0.012) [0.527]
CPI 2019	0.003 (0.002) [0.109]	0.003 (0.002) [0.186]	0.005** (0.002) [0.028]
Independent variables			
Sustainable innovation		0.450*** (0.107) [0.000]	0.852*** (0.229) [0.000]
Sustainable innovation × CPI 2019			−0.007** (0.004) [0.047]
Number of groups (L2)	32	32	32
Observations (L1)	1430	1430	1430
Chi^2	107.6	122.9	127.3
Log Likelihood	−1895.9	−1887.3	−1885.0

Notes: Standard errors (in parentheses). p-values are in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

across different analytical approaches. The fact that our moderation analysis became slightly more significant ($p = 0.016$) when using this method suggests that the interaction between climate policy and sustainable innovation is robust, even when accounting for potential country-level heterogeneity. This consistency strengthens our confidence in the validity of our findings, as it demonstrates that the relationships observed are not artifacts of the specific modelling approach used in the main analysis.

Second, to ensure that our findings are robust to any fixed, unobserved country-specific factors that may not be fully captured by our multilevel model, we conducted an additional robustness check. Specifically, we ran an ordered logistic regression that included country fixed effects (i.e., we controlled for each country individually by including country dummies).[4] This approach allows us to account for any country-level characteristics that might systematically influence growth aspirations but were not explicitly modelled. The results of this analysis remain consistent with our original findings. Notably, the *p*-value became slightly more significant ($p = 0.000$), suggesting that our model is not only robust but also that the inclusion of country fixed effects strengthens the statistical significance of our results.

Third, we conducted a robustness check to address our independent climate policy variable. Specifically, instead of using the CCPI data, we re-ran our analyses using data from the Climate Policy Radar, which also captures climate policies at the country level. In this analysis, we replaced the CCPI's climate policy index with the logarithmized number of climate policies approved in 2019 in each country. As shown in Table A3, the results in Model 3 show that while the interaction effect between sustainable innovation and climate policy remains negative, it becomes insignificant (coeff. $= -0.221$, $p = 0.232$). This suggests that the mere quantity of climate policies may be less effective in capturing their impact on startups. Instead, qualitative evaluations of the strength, ambition, and implementation of policies, such as those provided by the CCPI, might be better suited to explain the influence of climate policy on startups. Fourth, to test whether the positive relationship between the introduction of sustainable innovations and startups' growth aspirations varies based on the type of sustainable innovation, we conducted further analyses differentiating between internally and externally introduced sustainable innovations. Specifically, we used Questions 19.1 to 19.3 of the Flash Eurobarometer to determine whether the innovation was classified as "a new or significantly improved product or service to the market" (external) or as "a new or significantly improved production process or method" or "a new organization of management or a new business model" (internal). Prior to the analysis, we excluded 124 startups with sustainable innovations that could not be clearly categorized as either internal or external, ensuring a more precise dataset.

[4] For the sake of brevity, the results are only described in the text.

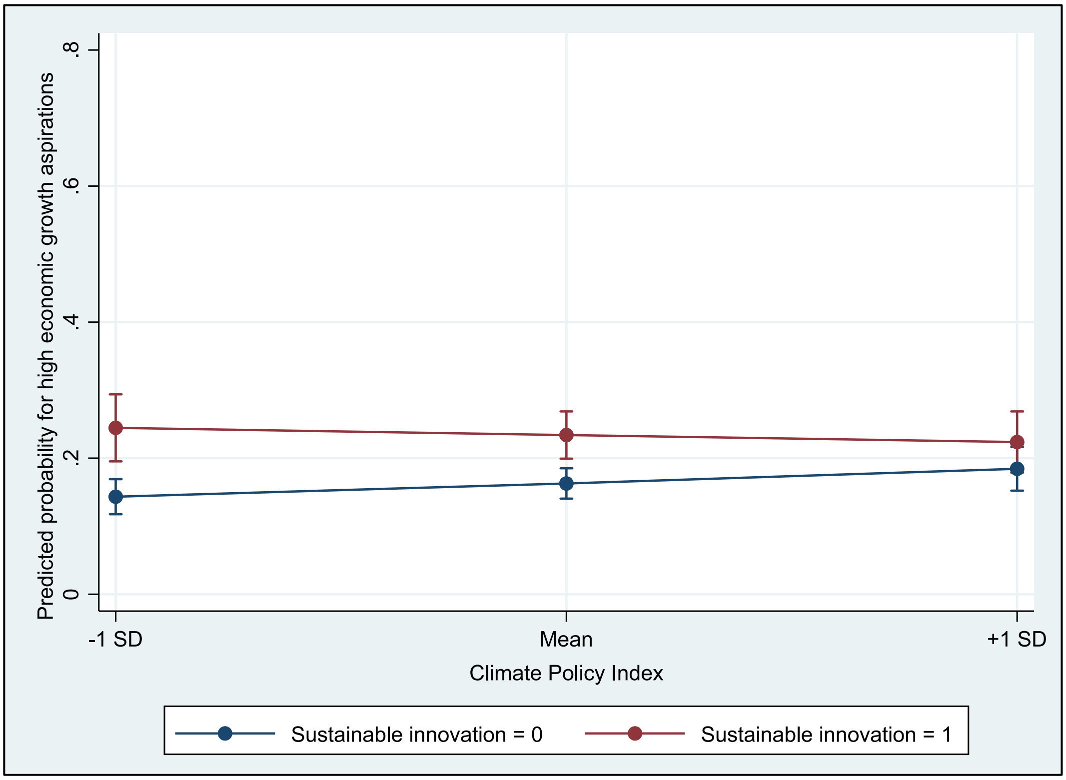

Fig. 1. Cross-level interaction plot of sustainable innovation × CPI on high growth aspirations.

Table 4 presents the results of these analyses. Models 1 and 3 reveal that both internal and external sustainable innovations are positively associated with startups' growth aspirations. However, small differences emerge in the interaction effects with climate policy stringency (Model 2 and Model 4). While the relationship between internal sustainable innovations and growth aspirations is negatively moderated by stronger climate policy (coeff. = −0.011, p = 0.016), the interaction effect for external sustainable innovations is also negative but insignificant (coeff. = −0.005, p = 0.227). These results suggest that the negative moderation observed in our main analysis is more likely to be due to the effects of internal sustainable innovations.

Finally, we extended our analysis to the complete sample of the Flash Eurobarometer, which includes 13,592 SMEs, to test whether the effects observed in startups are generalizable to the broader population of SMEs. As shown in Table 5, our main hypothesis (H1) remains robust across all models, reinforcing the conclusion that sustainable innovation

Table 4
Further analysis differentiating between internal and external sustainable innovation.

Model	(1)	(2)	(3)	(4)
Statistic	Coeff./(SE)/[p]	Coeff./(SE)/[p]	Coeff./(SE)/[p]	Coeff./(SE)/[p]
Individual controls				
Company age	−0.069* (0.037) [0.063]	−0.065* (0.037) [0.084]	−0.073* (0.037) [0.050]	−0.070* (0.037) [0.062]
Company size (log)	0.031 (0.046) [0.500]	0.034 (0.046) [0.455]	0.039 (0.046) [0.391]	0.039 (0.046) [0.393]
Patent	0.548*** (0.212) [0.010]	0.531*** (0.211) [0.012]	0.481** (0.214) [0.025]	0.488** (0.214) [0.015]
Internationalization	0.264** (0.114) [0.021]	0.265** (0.114) [0.020]	0.259** (0.114) [0.023]	0.262** (0.114) [0.022]
Large city	0.516*** (0.103) [0.000]	0.519*** (0.103) [0.000]	0.512*** (0.103) [0.000]	0.508*** (0.103) [0.000]
Single ownership	−0.092 (0.106) [0.383]	−0.082 (0.106) [0.436]	−0.082 (0.106) [0.438]	−0.080 (0.106) [0.449]
Sector dummies	Yes	Yes	Yes	Yes
Country controls				
GDP 2019 (log)	0.033 (0.038) [0.387]	0.033 (0.037) [0.378]	0.036 (0.038) [0.343]	0.037 (0.037) [0.329]
Culture: Power distance	0.000 (0.004) [0.917]	0.001 (0.004) [0.883]	0.000 (0.004) [0.957]	0.000 (0.004) [0.953]
Culture: Uncertainty avoidance	−0.005 (0.004) [0.180]	−0.005 (0.004) [0.200]	−0.006 (0.004) [0.107]	−0.006 (0.004) [0.109]
Culture: Long-term orientation	−0.004 (0.003) [0.180]	−0.005 (0.003) [0.139]	−0.004 (0.003) [0.175]	−0.004 (0.003) [0.165]
LMI 2019	−0.007 (0.012) [0.540]	−0.006 (0.012) [0.600]	−0.011 (0.012) [0.355]	−0.011 (0.012) [0.373]
CPI 2019	0.003 (0.002) [0.159]	0.005** (0.002) [0.023]	0.003 (0.002) [0.151]	0.004* (0.002) [0.080]
Independent variables				
Internal sustainable innovation	0.589*** (0.130) [0.000]	1.195*** (0.284) [0.000]	–	–
Internal sustainable innovation × CPI 2019		−0.011** (0.005) [0.016]	–	–
External sustainable innovation	–	–	0.579*** (0.132) [0.000]	0.849*** (0.282) [0.003]
External sustainable innovation × CPI 2019	–	–		−0.005 (0.001) [0.277]
Number of groups (L2)	32	32	32	32
Observations (L1)	1430	1430	1430	1430
Chi^2	126.1	132.1	124.9	126.4
Log Likelihood	−1885.6	−1882.8	−1886.3	−1885.7

Notes: Standard errors (in parentheses). p-values are in brackets. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 5
Further analysis including all SMEs.

Model	(1)	(2)	(3)
Hypotheses	–	1	2
Statistic	Coeff./(SE)/[p]	Coeff./(SE)/[p]	Coeff./(SE)/[p]
Individual controls			
Company age	−0.016*** (0.001) [0.000]	−0.016*** (0.001) [0.000]	−0.016*** (0.001) [0.000]
Company size (log)	0.152*** (0.012) [0.000]	0.139*** (0.013) [0.000]	0.139*** (0.013) [0.000]
Patent	0.382*** (0.064) [0.000]	0.319*** (0.064) [0.000]	0.319*** (0.064) [0.000]
Internationalization	0.341*** (0.038) [0.000]	0.326*** (0.038) [0.000]	0.326*** (0.038) [0.000]
Large city	0.199*** (0.035) [0.000]	0.200*** (0.035) [0.000]	0.200*** (0.035) [0.000]
Single ownership	−0.008 (0.036) [0.823]	0.006 (0.037) [0.871]	0.006 (0.037) [0.875]
Sector dummies	Yes	Yes	Yes
Country controls			
GDP 2019 (log)	0.091** (0.041) [0.025]	0.090** (0.040) [0.008]	0.090** (0.040) [0.026]
Culture: Power distance	0.002 (0.004) [0.646]	0.002 (0.004) [0.661]	0.002 (0.004) [0.653]
Culture: Uncertainty avoidance	−0.000 (0.004) [0.982]	−0.000 (0.004) [0.955]	−0.000 (0.004) [0.970]
Culture: Long-term orientation	−0.007* (0.004) [0.076]	−0.006 (0.004) [0.104]	−0.006 (0.004) [0.102]
LMI 2019	0.002 (0.013) [0.867]	0.001 (0.013) [0.922]	0.001 (0.013) [0.906]
CPI 2019	0.001 (0.003) [0.650]	0.001 (0.003) [0.796]	0.001 (0.003) [0.596]
Independent variables			
Sustainable innovation		0.382*** (0.036) [0.000]	0.489*** (0.080) [0.000]
Sustainable innovation × CPI 2019			−0.002 (0.001) [0.135]
Number of groups (L2)	32	32	32
Observations (L1)	13,592	13,592	13,592
Chi^2	733.2	838.2	840.5
Log Likelihood	−15,773.1	−15,716.7	−15,715.6

Notes: Standard errors (in parentheses). p-values are in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

positively influences growth aspirations. However, we did not find a significant interaction effect between climate policy and sustainable innovation in this broader sample (H2). This suggests that the moderating effect of climate policy on the relationship between sustainable innovation and growth aspirations may be unique to startups and does not extend to SMEs in general.

6. Discussion

This study investigates the relationship between sustainable innovation and growth aspiration in startups. Our findings suggest that startups with sustainable innovations have higher growth aspirations compared to those without. Furthermore, drawing on the role of formal institutions, we find that climate policy serves as a moderator of our main relationship. Our analysis demonstrates that stringent climate policy may actually reduce the growth aspirations of startups that have introduced sustainable innovations.

6.1. Contributions to the literature

First, our finding that sustainable innovations in startups relate to higher growth aspirations ties in with other research on growth aspirations in the entrepreneurship field (e.g., Douglas, 2013; Puente et al., 2017). A possible explanation may be that startups with sustainable innovations may gain competitive advantages in customer relationships due to differentiation (e.g., Zhao et al., 2015). Additionally, sustainable innovations may enhance a startup's access to external resources or improve its reputation and brand image (e.g., Chang and Chen, 2013). Finally, the adoption of sustainable innovations can result of a startup's high level of dynamic capabilities, which also can influence its growth aspirations (e.g., Teece, 2007).

While previous studies have extensively examined the characteristics of entrepreneurs (e.g., Kolvereid, 1992; Szerb and Vörös, 2021), we provide a more nuanced understanding of the impact of different types of innovation on startup growth. We, therefore, contribute to the literature demonstrating a positive relationship between innovation and startup growth (e.g., Audretsch, 1995; Pena, 2002) and extend it by highlighting the role of sustainable innovations for growth aspirations of startups. More specifically, our results support the findings of Vasileiou et al. (2022), who show that introduced green innovations by companies positively relate to financial performance. We complement this finding by highlighting that it is transferable to young companies and their growth aspirations. Also, this is in line with Kuckertz and Wagner (2010), who show that sustainability orientation relates to higher entrepreneurial intentions. Next, we contribute closely to the findings of Hirschmann and Block (2022) showing that early registered trademarks of startups correlate with both greater economic (i.e., employment growth) and sustainability outcomes. Our results now suggest that trademarks might be an indicator of innovativeness in startups, which in turn leads to higher growth aspirations and ultimately achieved outcomes. This would be in line with Hirschmann et al. (2022a) who suggest that trademarks serve as indicator for social innovations. Finally, our study aligns with those of Hoogendoorn et al. (2020), who found that sustainable startups tend to be more innovative, which may help explain their higher growth aspirations as identified in our study. Overall, our study responds to calls for further investigation in this area (e.g., Bergset and Fichter, 2015) and add to the literature on the role of sustainable innovation in the formation of startups (e.g., Giudici et al., 2019).

Second, our study adds to the literature on the role of institutions in promoting startup development (e.g., Estrin et al., 2013; Troilo, 2011) and on how institutions aim to create a more sustainable future through new legislation (e.g., Schmitz et al., 2019). By examining the impact of climate policy on the growth aspirations of startups with sustainable innovations, we find that stringent climate policy may inhibit these aspirations, particularly for startups pursuing internal sustainable innovations—those focused on improving production processes or business models. While sustainable innovation generally drives growth aspirations, the presence of strict climate policy may temper these aspirations due to increased compliance costs and complexity. For internal innovations, the benefits—such as efficiency gains or reduced environmental externalities—are often less visible to external stakeholders like investors or customers, limiting their perceived market value and making it harder to attract resources for growth (e.g., Gupta et al., 2020). These innovations may also require significant organizational restructuring, further compounding the challenges posed by stringent regulations. Furthermore, our findings are in line with Noailly et al. (2022) who demonstrate that tighter climate policy relates to lower venture capital investments in cleantech startups. This in turn could explain the lower growth aspirations of startups with sustainable innovations in these circumstances.

Thereby, our findings contribute to prior research investigating how macro-level factors influence startups on the venture-level (e.g., Acs and Szerb, 2007; Boudreaux et al., 2019). In particular, we add to studies that explored how policies foster or hinder high-growth entrepreneurship (e.g., Autio and Acs, 2010; Estrin et al., 2013; Rannikko and Autio, 2016) and respond to the call by Schaltegger and Wagner (2011) to examine climate policy from the perspective of sustainable startups. Specifically, while Rannikko and Autio (2016) show how well created policies can foster entrepreneurial growth, we show how climate policy that is not geared towards startups can hinder their aspirations. Furthermore, while Ye et al. (2023) finds that climate impact in countries positively influences entrepreneurs' growth aspirations, we find that stronger climate policy presents a negative moderator between introduced sustainable innovations and startups' growth aspirations. Thus, while stringent climate policy might serve the goal to create sustainable innovation or at least a more sustainable behavior in incumbent companies (e.g., Foxon and Pearson, 2008), young companies that also aim to contribute to a sustainable future through their innovation activity are restrained by strong climate policy. This finding is supported by our further analysis, which shows that the negative moderation effect disappears for the group of all SMEs. Consistent with the argumentation of Kiefer et al. (2019), our results, therefore, suggest that more nuanced climate policy may be needed that take into account the needs of startups. Finally, our further analyses contribute to the stakeholder salience theory, which has explored how regulations differently affect market participants (e.g., Magness, 2008; Mitchell et al., 1997). In particular, our findings extend the literature strand that investigates how environmental regulations affect startups, SMEs, and MNEs differently (e.g., Sena et al., 2023).

6.2. Policy implications

Our study offers several implications for stakeholders of startups. First, we provide valuable information to investors, partners, or similar startup stakeholders looking for high-growth, ambitious companies that may be better positioned to succeed in a rapidly changing environment. Thus, looking for sustainable innovations in startups could help stakeholders in their identification and selection process, not only as sustainability orientation can be a key factor for business success in the long run. In addition, these actors could provide special financial and nonfinancial support to startups that develop sustainable innovations, which might be necessary to reduce their unique challenges.

Second, our findings are of particular relevance to policymakers aiming to create supportive environments for sustainable startups. Specifically, our interaction results between sustainable innovation and climate policy highlight the critical need to balance climate policy stringency. While promoting sustainable innovation is essential to fostering growth aspirations in startups, overly stringent policies might inadvertently stifle their growth potential, as navigating complex regulatory environments can be particularly challenging for young firms.

To address this, policymakers could adopt a differentiated approach based on startup type to foster their growth, even as climate policy strengthens. For instance, high-tech startups developing breakthrough sustainable technologies may benefit from targeted R&D support or grants, such as Germany's High-Tech Gründerfonds, which provides seed funding to innovative startups, particularly those in green technology.[5] Meanwhile, sustainable enterprises with a focus on societal impact could be supported through specialized impact investment funds or subsidies that can foster their growth aspirations (e.g., Block et al., 2021), similar to the UK's Big Society Capital,[6] which invests in social impact projects and startups, or France's support systems for ESUS (Entreprise Solidaire d'Utilité Sociale) startups, which have access to unique funding opportunities.[7]

Moreover, our follow-up analysis reveals that internal sustainable innovations—those aimed at improving production processes or business models—may face even greater challenges in navigating stringent climate policies. Policymakers should therefore consider additional tailored measures to support startups with these sustainable innovation types. For example, governments could provide access to subsidized testing and prototyping facilities, allowing startups to refine and validate their internal processes. Additionally, partnerships with technical universities or industry associations, which for example the Technical University of Munich with its MakerSpace provides,[8] could offer specialized training programs or technical consulting services to help startups integrate internal sustainable practices effectively.

Next, policymakers can also introduce incubator or accelerator programs tailored to startups focusing on sustainable innovations (e.g., Hirschmann et al., 2022b). Such programs could provide mentorship, financial support, and networking opportunities, enabling startups to refine their business models and scale more effectively. For example, the Climate-KIC Accelerator, an initiative of the European Institute of Innovation and Technology, offers targeted support to climate-positive startups, helping them accelerate their impact and market readiness.[9] Similar support programs could be implemented in different national forms addressing the local needs of startups with sustainable innovations.

Additionally, startups introducing sustainable innovations with significant societal impact could receive direct support from government agencies through tools like preferential access to public procurement contracts or governmental funding (e.g., Mason and Brown, 2013). This would be in line with the recently established European “Buy Social” campaign, which encourages governments and large companies to support sustainable entrepreneurs in their awarding of contracts.[10] These mechanisms could help bring innovative products to market and facilitate scaling, counteracting the risk that stringent climate policies deter private investment in startups. Without such interventions, investors may otherwise prefer larger, more established firms with greater capacity to absorb regulatory changes.

Finally, location-specific interventions could enhance the practical applicability of these recommendations. In emerging European economies, targeted measures such as tailored training programs for sustainable business models or grants for prototyping and scaling green technologies could address the unique challenges faced by startups, such as limited access to expertise and market exposure. For instance, the Polish GreenEvo Program, initiated by the Ministry of Climate and Environment, supports green technology startups by providing mentoring, promotion in international markets, and connections to potential investors.[11] In more developed European economies, innovation-friendly regulatory frameworks and partnerships with universities or corporations could foster a supportive ecosystem for sustainable entrepreneurship, as seen with Finland's Sitra, a government-funded innovation fund that supports sustainable entrepreneurship through partnerships with research institutions and corporations, while also providing seed funding and regulatory support to accelerate green

[5] See https://www.htgf.de/en/about-us/esg/.

[6] See https://bettersocietycapital.com/our-approach/.

[7] See https://en.impactfrance.eco/nos-actus/pourquoi-et-comment-obtenir-lagrement-esus.

[8] See https://maker-space.de/.

[9] See https://www.climate-kic.org/programmes/climate-entrepreneurship/accelerator/.

[10] See https://buysocialeuropeb2b.eu/en/buysocialb2b/project-overview.

[11] See https://greenevo.gov.pl/en/about-program/.

innovations aligned with national sustainability goals.[12]

By learning from these different forms of intervention across Europe and implementing targeted measures in a locally appropriate way, policy makers can mitigate the negative consequences of stringent climate policies for startups while maximizing the contribution of startups to economic growth and sustainable development.

6.3. Limitations and future research areas

As with any other study, our study has a number of limitations. First, our methodological approach has some limitations that offer future research opportunities. For example, while we conduct a cross-section and cross-country analysis, we are not able to conduct a longitudinal analysis since the Flash Eurobarometer provides survey data at a specific point of time. Thus, future research should replicate our findings and explore how the growth aspirations of startups change over time, for example, because climate policy is nowadays changing frequently. This would enable in-depth investigations of how climate policy changes influence startups' growth aspirations. Additionally, our dataset does not include venture-level data on entrepreneurial characteristics such as age, gender, education, and entrepreneurial experience and macro-level factors such as regional economic conditions which have been shown to be important factors in understanding growth aspirations in entrepreneurship and could thus lead to an omitted variable bias (e.g., Estrin et al., 2013). While these limitations are due to the data used, which other studies suffer in a similar way from (e.g., Block et al., 2019; Kleinhempel et al., 2022), future studies could broaden our findings by applying a founder-based perspective. For example, a future study based on data of Global Entrepreneurship Monitor (GEM) could address this issue as the dataset includes relevant variables on the individual level as well as growth aspirations of these individuals with their startups while it lacks important country level controls that we could include due to the choice of the Flash Eurobarometer data. This approach will only be possible in the near future when more data is published, as the GEM has been collecting data on the social and environmental orientation of startups annually since 2021, but this data is not yet accessible due to the three-year delay in publication (GEM, 2022). It would then be interesting to explore a mediation relationship such as whether, for example, human capital leads to sustainable innovation and ultimately to growth aspirations. Another way to examine these relationships would be if future Flash Eurobarometer surveys began to collect information about respondents at the individual level as well, rather than focusing solely on the company level.

Second, our approach to assess social innovation via survey data has some distinctive limitations, for example due to a potential self-reporting bias. While a large number of published studies rely on survey data and also the specific data used in this study, we still encourage future research to replicate our findings based on other sustainable innovation measures such as sustainable patents, trademarks, or R&D expenses (e.g., Block et al., 2025). This research could also nuance the findings in terms of different types of sustainable innovations and also increase the validity as survey data can suffer from a social desirability bias. Furthermore, we call for new research to explore the factors that drive the growth aspirations of startups with sustainable innovations. Specifically, future studies could create a deeper understanding of whether these higher growth aspirations are mainly driven by competitive advantages, reputational gains, resource advantages, or other factors through a study relying on structural equation modelling.

Third, our study is susceptible to reverse causality, whereby the introduction of a sustainable innovation may not necessarily cause growth aspirations in startups, as we propose. Instead, it is possible that startups with already high growth aspirations are more likely to pursue sustainable innovations, which would mean that the relationship we observe could be driven by pre-existing aspirations rather than the innovation itself. To better establish the direction of causality, future research should consider different other methodological approaches. For example, studies could employ longitudinal studies that track startups over time. This approach would allow researchers to observe changes in growth aspirations before and after the introduction of sustainable innovations, providing clearer evidence of causality. Additionally, experimental designs, such as quasi-experiments (e.g., Banerjee and Duflo, 2009), could be used in settings where new climate policies are introduced. Lastly, instrumental variable analysis, as demonstrated in recent studies (e.g., Fisch et al., 2022; Pollmeier et al., 2025), is another robust method that can be used to address endogeneity by identifying variables that influence the introduction of sustainable innovations but are not directly related to growth aspirations.

Finally, we encourage future studies to delve deeper into the role of climate policy in shaping the relationship between sustainable innovation and growth aspirations for startups. Future research could distinguish between different types of climate policies, investigate the consequences of specific new regulations, and explore time effects of new regulations. It is not yet clear whether sustainable startups are directly aware of stricter climate policy measures or whether this effect is delayed and how long it persists. Furthermore, future studies could shed light on other sustainability policies and how they interact with the introduction of sustainable innovations. For example, the degree of sustainable supply change laws could influence the growth aspirations of startups in conjunction with newly introduced sustainable innovations. Finally, more research is needed that nuances the different implications of climate policy changes for startups, SMEs, and large companies.

CRediT authorship contribution statement

Mirko Hirschmann: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The author declares that he has no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2025.178866.

Data availability

Data will be made available on request.

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[12] See https://www.sitra.fi/en/topics/facts-about-sitra/.

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Mirko Hirschmann is a research associate at the Entrepreneurship, Innovation, and New Technology Research Group of the University of Luxembourg. Previously, he completed his doctorate at the Chair of Management at Trier University. His research delves into the effects of grand societal challenges, such as climate change and social inequalities, on entrepreneurship and explores the characteristics of sustainable entrepreneurship and sustainable innovations aimed at addressing these challenges. His mostly quantitative work has been featured in journals such as the Journal of Corporate Finance, Small Business Economics, and Journal of Business Venturing Insights.