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GREEN INNOVATION AND FIRM'S INTERNATIONALISATION

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Purpose: Green innovation and internationalization have gained the attention of scholars and practitioners around the world. However, research on the relationship between green innovation and internationalization are still fragmented and scant. Therefore, this study aims to explore the relationship between green innovation and internationalization.
Design/methodology/approach: This is a quantitative study that uses survey data from large and innovative firms in Poland. It uses the cross-tabulation analysis and Kruskal-Wallis test to verify if there are differences in green innovation between domestic, international and global firms.
Findings: The study confirm the mutual interdependence of internationalization and green innovation showing that there are differences between firms with different scope of geographical operations. Our study shows that global companies focus more on green innovation than domestic ones. Unfortunately, the differences between domestic and multinational companies as well as multinational and global companies are not found.
Research limitations/implications: Findings from this study extend knowledge both in the field of international business and innovation showing the positive relationship between green innovation and internationalization of firms, but not in case of all companies. Our study has limitation as it focuses only on large and innovative companies in Poland, and it uses the simple scale of internationalization.
Practical implications: Our study shows that green innovation in not only a necessity for firms around the world, but it might positively impact the internationalization of firms. Simultaneously, internationalization can enhance green innovation as international companies have more opportunities to create collaborating network and source knowledge.
Originality/value: This study builds and extends previous research on the breadth of internationalization and green innovation. It confirms the positive relationship between green innovation and international scope of operation of a firm, but it shows that these differences are only between domestic and global firms.
Keywords: green innovation, internationalization, global firms, international firms, domestic firms.
Category of the paper: research paper.

1. Introduction

Environmental challenges have become central to firms' strategies in the 21st century. Both regulations and market forces have played a role in that. Responsible management seems to have contributed to a competitive advantage as it influences costs and the firms' reputation, and green innovation is perceived as a critical element of corporate and business strategies to gain and sustain a competitive advantage. Additionally, stakeholder pressure, government regulation, and customer needs have grown, and firms must comply with environmental rules. Green innovation related to products and processes mitigates a firm's negative environmental impacts and comes at the forefront of innovation solutions and studies (Barforoush et al., 2021).

Green innovation has been gaining the attention of scholars and practitioners (Zhang et al., 2020). The existing body of knowledge explores green innovation in the context of internal and external drivers (Cao, Chen, 2019; Alnaim et al., 2022) and firm performance (Zhang et al., 2022; Eiadat et al., 2008). There has been much less research on the relationship between green innovation and firm's internationalization (Martínez-Ros, Merino, 2023; Tsai et al., 2021; Šūmakaris et al., 2020). Prior studies on green innovation and internationalization deliver arguments on the positive relationship between green innovation and internationalization. However, they are still fragmented and scant (Anjum et al., 2024; Chiarvesio et al., 2015). The significance of topic in contemporary business environment as well as relatively limited number of research on green innovation and internationalization encourage us to focus on this issue.

This study aims to explore the relationship between green innovation and internationalization. The key question is if there is the significant difference among firms' green innovation activity and their breadth of internationalization. The research results show that internationalized firms focus on green innovation more than those ones which sell only in the national market. Therefore, our findings support those ones which concluded the correlation between green innovation and firm internationalization.

The paper is organized as follows. First, we deliver the literature review and, on this basis, formulate hypotheses. Second, we describe the methodology of empirical research, including sample description and measures. Next, the research results are presented. The final part of the paper is a discussion of the research results followed by concussion, limitations, and direction of further research.

2. Literature review

Green innovation as a topic of firm level research has been evolving. Next to the market driven forces, social factors and international and national regulations are shaping the behavior of the firms and raise novel scientific questions. At first the impetuses to green innovations and then the green innovation and internationalization relationships are discussed by the literature.

2.1. Impetuses to green innovation

In all business consideration customers come first. The increasing ecological awareness of customers is one of the driving factors of changes in companies' behavior. Customers influence companies directly by choosing or not certain products and by pushing governments to set up coercive and incentive policies, thus making companies greener (Cao, Chen, 2019). To respond these challenges, companies introduce more environment-friendly practices in producing, marketing and delivery goods and services (Wang et al., 2020). Those practices refer to energy and water saving, recycling waste, reuse of components, more ecological supply chain management, changes in products at each stage of their life cycle, etc. The new products and processes introduced and/or transformed by companies are described in the literature as green, environmental or eco-innovation. We use green innovation in this paper.

Studies on green innovation emphasize its difference from other types of innovation (Chiarvesio et al., 2015; De Marchi, 2012). Green innovation is more complex than other types of innovation as it includes an additional component: natural environment orientation. Some researchers classify green innovation into three categories: pollution prevention, product management, and the use of clean technology (Hart, 1997). These categories of green innovation are also related to reducing resource consumption, waste recycling, and implementing an appropriate environmental management system (Eiadat et al., 2008; Chen et al., 2006). The aim is to reduce the negative environmental impact of both products and processes by implementing new technologies and ways of operations (García- Sánchez et al., 2020). Green innovators change their business models and improve resource productivity. However, companies apply different approaches to defining themselves as green (Barforoush et al., 2021).

Nowadays, becoming green and implementing environmental innovation are required as it is perceived as a critical element of a competitive advantage. According to Porter and van der Linde (1995), ecology and economy are not mutually exclusive, and adequately designed environmental standards, along with green innovation, make companies more competitive, not less. Prior studies found that green innovation improves production efficiency and the image of a company, which enhances its competitive advantage (Tu, Wu, 2021; Gürlek, Tuna, 2018; Barforoush et al., 2021; Ge et al., 2018). Thus, green innovation is perceived as a strategic choice and response of a company to increasing market dynamics, including government

regulations and stakeholder pressure (Yu et al., 2016). Companies that do not focus on being green can lose opportunities in their markets (Esty, Winston, 2009). Therefore, more and more companies pay attention to internal and external factors of and promote behaviors toward green innovation. Some focus on green products, and some on green upgrading processes.

2.2. Green innovation and internationalization

Prior studies investigate the relationship between green innovation and geographical expansion from the perspective of sustainability and internationalization theories (Aguilera-Caracuel et al., 2012; Anjum et al. (2024). Unfortunately, the research findings do not deliver convincing conclusions on the relationship between green innovation and the geographical scope of activity (Chiarvesio et al., 2015). On the one hand, internationalization should trigger green innovation through flows of knowledge and experience across different markets. On the other hand, a fragmented and geographically dispersed production process is a potential threat to the environment and generates a higher probability of negative environmental consequences because of the cost and regulation arbitrage opportunities. The contradictory findings show positive (Aguilera-Caracuel et al., 2012), nonlinear (Chen, 2022) and no relation (Sterlacchini, 1999) between internationalization and green innovation. However, most of the empirical research outcomes suggest positive relationship between internationalization and green innovation (Ding et al., 2024).

The main argument for the positive relationship between internationalization and green innovation refers to knowledge flows. Geographical expansion enables sourcing knowledge from local partners, which enhances environmental performance. Prior studies indicate that green innovation requires networking, especially with local partners, to acquire knowledge, enabling improved environmental performance. Cainelli et al. (2012) prove the importance of networking in increasing environmental performance and adopting green innovation. However, according to Chen (2022), the positive externalities of internationalization related to green innovation, like staff communication, knowledge flows or cross-regional exchange, are disclosed when internationalization exceeds a certain threshold. Thus, the relationship between internationalization and green innovation is U-shaped.

Internationalization may also induce green innovation as firms must adjust their products or processes to local requirements. The interactive process of selling abroad enables companies to develop a set of best environmental practices that can be transferred across national markets (Bansal, 2005). Even simple exporting may induce firms to implement green innovation to overcome trade barriers related to specific markets. Aguilera-Caracuel et al. (2012) argue that firms, through export activities, acquire and develop knowledge that enables better responses to international demand for green products or processes. Also, Galbreath (2019) found that export intensity is positively associated with green innovation. However, Cainelli et al. (2012) did not find a relationship between export propensity and environmental innovation activities.

Similarly, De Marchi and Grandinetti (2012) found that firms' exporting does not matter in green innovation introduction.

Multinational enterprises (MNEs) are special group of research. Internationalization can also be perceived as a driving force of green innovation implementation (Juniati et al., 2019) as it can generate knowledge spillovers and diffusion of best environmental practices, especially among foreign subsidiaries of MNEs. However, according to Zhang et al. (2024) internationalization breadth (geographic scope) positively, while internationalization depth (intensity) negatively impacts MNE green innovation activity. Kennelly and Lewis (2002) found a positive relation between the degree of internationalization and environmental performance, and they argue that MNEs may be proactive agents of positive environmental performance. MNEs are equipped with capabilities and resources that are out of reach of non-MNE related local firms. They can diffuse adopted environmental standards among subsidiaries through incorporated practices and policies. Thus, participation in the global knowledge flows as a part of a MNE can stimulate the development of green innovation (Chiarvesio et al., 2015; De Marchi,Grandinetti, 2012).

Following the theoretical argumentation and considering that there are contradictory findings about the relationship between a firm's internationalization breadth and green innovation, we aim to investigate whether international firms have a greater focus on green innovation than domestic firms and address the following hypotheses:

H1: There are differences in innovation activity among companies with different internationalization breadth.

H1a: Multinational companies focus more on green innovation than domestic companies.

H1b: Global companies focus more on green innovation than multinational companies.

H1c: Global companies focus more on green innovation than domestic companies.

3. Research method

This is a quantitative study that used a questionnaire to collect data. The online survey was conducted among large (more than 250 employees) and innovative firms in Poland (at least one product or process innovation within the 3-year period (OECD/Eurostat, 2018)). Data from 259 respondents, responsible for and knowledgeable about the firm's green innovation, was collected from 7th to 16th November 2023.

The research sample is dominated by large firms with employment exceeding 500 people (76.4%), while the number of firms with employment between 250 and 500 is smaller (23.6%). Firms studied are manufacturing (41.3%) and service businesses (58.7%) and among them 55.6% have been on the market over 26 years, while 44.4% are younger firms. In the research sample, 46.3% of firms studied sell their product in more than one country but within one

continent (multinational firms), while 37.1% are classified as global businesses and 16.6% as domestic firms (Table 1).

Table 1.
Number of domestic, multinational and global firms in the sample

	Numbers of firms	% of firms
Domestic firms	43	16.6
Multinational firms	120	46.3
Global firms	96	37.1

Source: own elaboration.

This study uses two variables that were drawn from the literature. The first variable is a green innovation measured with the use of the seven-item revised instrument based on Chan (2005) and Zhang et al. (2022). Green innovation is understood as a type of innovation activity that a firm has carried out to implement green (product and process) innovation with the goal of environmental protection (Chan, 2005l Zhang et al., 2022). The scale of green innovation has good reliability (Cronbach's alpha = 0.951; CR = 0.949) and it passed the convergence validity test (AVE = 0.773). We also tested the construct validity with the exploratory factor analysis (EFA) using the principal component extraction with varimax rotation. The pre-test analyses confirm that the data is suitable for the factor analysis. Factor loadings range from 0.849 to 0.907. Therefore, EFA analysis replicates the model of the original construct.

The second variable is the internationalization breadth understood as a scope of international activity of a firm allowing us to identify domestic (selling only domestic market; domestic scope), multinational (selling foreign markets in one continent; multinational scope) and global firms (selling foreign markets in at least two continents; global scope). The internationalization breadth was evaluated by respondents in the questionnaire. Respondents marked whether their company sells only on the domestic market (domestic company), on foreign markets in one continent (multinational company) or on foreign markets in at least two continents (global company). We used the following coding: 0 – domestic firms, 1 – multinational firms and 2 – global firms.

4. Research results

The research aims to investigate the relationship between green innovation and the breadth of internationalization (a firm's scope of international activity). First, we carried out the cross-tabulation analysis (Table 2). It suggests that global firms focus on green innovation more than domestic and multinational firms. Second, we conducted the non-parametric Kruskal-Wallis test, which shows that these differences are statistically significant (Table 3). The value of the test is 6.274, and the p-value is 0.043. Therefore, at a significance level of 0.05, there is sufficient evidence to confirm the difference between groups. It means that green innovation

differs between at least two groups studied (domestic, multinational, and global firms). Third, the pairwise comparison shows the statistically significant differences between domestic and global firms (Table 4) (p-value = 0.019). However, there is no statistically significant difference between domestic and multinational companies, as well as multinational and global companies.

Table 2.
Descriptive statistics

Descriptive statistics	All firms	Domestic firms	Multinational firms	Global firms
Mean	5.43	5.17	5.37	5.64
Max	7.00	7.00	7.00	7.00
Min	1.00	1.86	1.00	1.57

Source: own elaboration.

Table 3.
Results of the Kruskal-Wallis test

Test statistic	Sig.	Recommendation
6.274	0.043	reject the null hypothesis

Source: own elaboration.

Table 4.
Results of the pairwise comparisons

Groups	Test statistic	Std. error	Std. test statistic	Sig
domestic vs multinational firms	-13.663	12.937	-1.056	0.291
domestic vs global firms	-31.327	13.357	-2.345	0.019
multinational vs global firms	-17.665	9.967	-1.772	0.076

Source: own elaboration.

Fourth, we divided the research sample into two subsamples: (1) manufacturing and (2) service firms to check if the relationship between green innovation and breadth of internationalization holds also when different types of firms are considered. We conducted the non-parametric Kruskal-Wallis test, which shows that differences are statistically insignificant in manufacturing and services firms (manufacturing firms: test statistic = 1.594, p-value = 0.451; service firms: test statistic = 3.049, p-value = 0.218). Thus, at a significance level of 0.05, there is no sufficient evidence to confirm the difference between groups. It means that green innovation does not differ between domestic, multinational, and global firms when the type of a firm is considered.

The research conducted shows statistically significant differences between domestic and global firms, but there is no statistically significant difference between domestic and multinational companies, as well as multinational and global companies. It also points out that differences in green innovation focus in domestic, multinational and global firms are not statistically significant when the relationship is analyzed in manufacturing and service firms separately. Therefore, only H1c is supported, while H1a and H1b are rejected. Consequently, H1 is supported partially.

5. Discussion

This study aimed to investigate whether the breadth of internationalization is a significant factor influencing green innovation. Based on previous studies, we hypothesized a difference in green innovation activity among companies with different internationalization breadth. Thus, the findings of this study aim to extend knowledge on green innovation and international behaviors of companies.

First, the study shows a high level of green innovation implementation among firms studied. It could be explained by the sample, which consisted of large innovative firms operating in Poland. These firms are more mature in innovation implementation, including green innovation. Additionally, current government policies (following EU regulations) encourage firms to be more environmentally friendly. ESG ratings and mandatory non-financial reports for large companies push them to invest more in environmental strategies that relate to green innovation. Therefore, policy and regulations (through ESG rating) foster green innovation (Ravasini, 2024). The high level of green innovation among firms studied in this paper may reflect regulations aiming to improve EU's overall ESG performance.

Second, the study advocates for mutual interdependence of internationalization and green innovation, as we observe a higher mean in green innovation measures among multinational and global firms than domestic companies. Following this observation, we argue that multinational and global firms focus more on green innovation. This aligns with current literature indicating that internationalization and green innovation influence each other and create a virtuous circle (Martínez-Ros, Merino, 2023; Juniati et al., 2019). The ability to be a green innovator promotes a broader scope of geographical activity, and green innovative firms are perceived as more successful in international markets (Ratten, 2018). Moreover, the commitment to green innovation generates a premium for companies internationalizing their business activity (Martínez-Ros, Merino (2023). Simultaneously, internationalization is perceived as a trigger of being green (Juniati et al., 2019; Anjum et al., 202), and exposure to different business models existing in international markets stimulates innovations to achieve and sustain a competitive advantage. Our study supports this view by confirming the higher focus on green innovation among global companies than domestic ones.

Next, in this study, we assumed that increasing internationalization breadth would accompany higher green innovation performance as the existing body of knowledge on green innovation points out a positive relation with a firm's internationalization (Chiarvesio et al., 2015; Zhang, Deborah, 2024). Prior studies explained relationship between internationalization and green innovation from a knowledge transfer perspective (Aguilera-Caracuel et al., 2012; Chiarvesio et al., 2015). Companies with higher internationalization breadth can implement new green practices as they acquire knowledge from different markets and spread green practices to other markets (Bansal, 2005; Zhang et al., 2024). Moreover, companies in different

markets are exposed to different environmental policies. Aligning with environmental policy in one country may enhance green innovation spread across subsidiaries in other countries. Thus, international firms are perceived as more innovative (also about green innovation) than those operating only in their domestic market, as they have more significant opportunities to create knowledge networks and cooperations inducing innovation development (Sekliuckiene et al., 2016; Patel et al., 2014; Arvanitis, Bolli, 2013). However, this study only partially confirms this argument. We have observed significant differences only among domestic and global companies. Global companies focus more on green innovation than domestic ones. Unfortunately, the differences between domestic and multinational companies and between multinational and global companies are insignificant. This may indicate that the positive influence of internationalization on green innovation is revealed when the scope of international activity is broader. Positive outcomes of internationalization according to green innovation, like cross-country knowledge flow, are disclosed under higher internationalization breadth, while lower levels of internationalization breadth do not support green innovation. It may also signal a non-linear relationship between green innovation and the international scope of firms. This finding supports the argumentation of Chen (2022), pointing out that positive externalities of internationalization are disclosed when internationalization exceeds a certain threshold.

To sum up, findings of this study show significant differences between domestic and global firms. They point out that green innovation is important in promoting internationalization globally, meaning that a greater focus on green innovation is related to a more global scope of firms.

6. Conclusion

This study contributes both to theory and business practice. The findings from this study extend knowledge in both the field of international business and innovation. The main theoretical contribution is the confirmation of the positive relationship between green innovation and the internationalization of firms. Internationalization is identified as a factor in developing green innovation (Anjum et al., 2024). Our study partially supports previous research findings, which indicate that international firms are more innovative, also in case of environmental innovations (Juniati et al., 2019; Chiarvesio et al., 2015). Our findings suggest some differences between firms by their internationalization into one-continent (multinational) and more-continent (global). The main managerial implication refers to supporting managers' awareness that green innovation is not only a necessity of 21st century firms but also has huge potential to enhance the internationalization of firms. Moreover, we argue that green innovation can be enhanced through internal investments (like R&D investments) and external sourcing.

The promising way to obtain a higher level of green innovation and simultaneously increase internationalization is collaboration with foreign partners.

Our study is not without limitations. First, it covers a sample of large, innovative companies. Those firms are more prone to develop green innovation and implement internationalization strategies. Second, this study was carried out on firms operating in Poland, while the implementation of green innovation is closely related to government regulation and coercive and incentive policy. Third, we measured green innovation without dividing it into product and process innovation. Fourth, the study examined green innovation at a single point in time, which limits to track causality and longtime outcomes. Finally, internationalization was measured with the use of a simple, basic scale.

Considering the limitations of this study, we argue that further research directions should focus on more diverse samples (e.g. two or more countries, as well as large as small and medium enterprises) and more sophisticated and multilevel measures of the degree of internationalization. The implementation of longitudinal analysis would also provide a better insight into the relationship between green innovation and internationalization, especially as those activities are time-consuming. Additionally, it would be interesting to differentiate green innovation into product and process and check its relationship with a firm's internationalization. However, we think that this study can explore interesting insights into a hot and important topic, which is about green innovation and the internationalization of firms.

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