

Driving Green Innovation: How Family Management and Generational Stage Shape Sustainable Strategies in Family SMEs

Impulsando la innovación verde: cómo la gestión familiar y la etapa generacional configuran las estrategias sostenibles en las pymes familiares

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Abstract

Amid intensifying climate crises and regulatory pressures, green innovation has shifted from an optional initiative to a core strategic imperative for business survival. While crucial for global sustainability, research on green innovation in family SMEs remains limited. This study aims to measure the degree of green innovation adoption among these firms. Moreover, it embraces family firm heterogeneity by examining how family management and generational stage shape green innovation. Using primary survey data integrated with secondary financial data from the SABI database, we analyze a stratified random sample of 183 family SMEs. Grounded in socioemotional wealth theory, our empirical findings reveal that family management acts as a significant catalyst for green innovation, driven by long-term investment horizons, reputational preservation, and a desire for sustainable visibility. Conversely, generational stage has no significant direct effect, which may reflect neutralizing counterforces inherent in both founder and non-founder dynamics. This study advances the literature by moving beyond the traditional family versus non-family dichotomy to uncover nuanced internal governance drivers of green innovation.

Keywords: green innovation; family SMEs; family management; generational stage.

JEL Classification: M10; M14; O32; Q56

Resumen

En un contexto marcado por la intensificación de las crisis climáticas y de las presiones regulatorias, la innovación verde ha pasado de ser una iniciativa opcional a convertirse en un imperativo estratégico fundamental para la supervivencia empresarial. Aunque resulta crucial para la sostenibilidad global, la investigación sobre innovación verde en las pymes familiares sigue siendo limitada. Este estudio tiene como objetivo medir el grado de adopción de la innovación verde entre estas empresas. Además, aborda la heterogeneidad de la empresa familiar analizando cómo la gestión familiar y la etapa generacional configuran la innovación verde. A partir de datos primarios obtenidos mediante encuesta, integrados con datos financieros secundarios procedentes de la base de datos SABI, analizamos una muestra aleatoria estratificada de 183 pymes familiares. Sobre la base de la teoría de la riqueza socioemocional, nuestros resultados empíricos muestran que la gestión familiar actúa como un catalizador significativo de la innovación verde, impulsada por horizontes de inversión a largo plazo, la preservación de la reputación y el deseo de reforzar una imagen orientada a la sostenibilidad. Por el contrario, la etapa generacional no presenta un efecto directo significativo, lo que puede reflejar la existencia de fuerzas contrapuestas que se neutralizan entre sí tanto en las empresas dirigidas por sus fundadores como en aquellas gestionadas por generaciones posteriores. Este estudio contribuye a la literatura al superar la tradicional dicotomía entre empresas familiares y no familiares y revelar los matices de los factores internos de gobierno que impulsan la innovación verde.

Palabras clave: innovación verde; pymes familiares; gestión familiar; etapa generacional.

Clasificación JEL: M10; M14; O32; Q56

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1. Introduction

In an era defined by intensifying climate crises, biodiversity loss, pollution, global warming, and shifting regulatory landscapes (Bolan et al., 2024; Miroshnychenko & De Massis, 2022), sustainable strategies have shifted from an optional corporate social responsibility initiative to a core strategic imperative for business survival (Aparicio & Iturralde, 2023; Martínez-Alonso et al., 2025).

Currently, governments, consumers and investors are demanding a stronger commitment from firms, promoting the adoption of more responsible and sustainable business models (Aftab et al., 2024). Corporate sustainability has gained prominence, driven by the adoption of more responsible environmental and social policies (Du & Cao, 2023).

A key strategy in this context is green innovation, which helps reduce environmental impact without compromising competitiveness (Nguyen et al., 2025). This includes practices such as waste reduction, pollution prevention, and the implementation of environmental management systems (Yu et al., 2017).

Different studies have analyzed the drivers of green innovation, distinguishing between external factors, such as environmental regulations, and internal factors, such as leadership characteristics (Huang et al., 2025). Regulation allows pollution to be measured and controlled through mandatory reviews that assess the effectiveness of mitigation practices (Zheng & Xu, 2022). On the other hand, the type of leadership also influences the adoption of these practices. A positive leadership style, such as sustainable leadership, fosters an informative environment within the organization, strengthening knowledge acquisition and facilitating the implementation of green innovation. In contrast, hostile or exploitative leadership styles inhibit the flow of information, hindering the adoption of innovative and sustainable strategies (Ur Rehman et al., 2024). The adoption of green innovation strategies not only optimizes business models, but also transforms management toward a more sustainable identity (Song & Yu, 2018).

Small and medium-sized enterprises (SMEs) collectively account for a substantial portion of global economic output and environmental impact, making their engagement in green innovation crucial for achieving macro-level sustainability goals (Özbay, 2025). Furthermore, in an environment of increasing competition and technological transformation, SMEs must continuously enhance their green innovation performance to remain competitive with larger firms (Abdul Basit et al., 2024). However, despite their global prevalence and these pressing competitive demands, research on green innovation in SMEs remains limited (Herrero et al., 2024; Martínez-Romero et al., 2025). To address this gap, it is necessary to recognize that, within SMEs, family firms are the predominant group (Family Firm Institute, 2018; IEF & Red de Cátedras de Empresa Familiar, 2018). As such, they constitute a unique setting for investigating green innovation because of their specific characteristics, such as their socioemotional wealth (hereafter, SEW) endowment (Berrone et al., 2012; Gómez-Mejía et al., 2007; Martínez-Romero & Rojo-Ramírez, 2016). This SEW endowment in family firms contributes to a long-term orientation and the intergenerational transfer of values, which influence their strategic decision-making processes (Garcés-Ayerbe et al., 2022; Herrero et al., 2024; Martínez-Romero et al., 2023).

Current research on family SMEs' environmental practices remains complex and strongly debated in the academic literature (Gómez-Mejía et al., 2025; Häußler & Ulrich, 2024; Kavadis & Thomsen, 2023). While some scholars argue that family firms' long-term orientation and stewardship logic naturally foster proactive green initiatives (e.g., Bauweraerts et al., 2022), others contend that risk aversion, resource constraints, and rigid adherence to tradition can hamper green innovation initiatives. To reconcile these conflicting perspectives, recent research has called for a departure from treating family businesses as a monolithic entity and has urged scholars to investigate the deep-rooted heterogeneity that drives distinct strategic choices (Daspit et al., 2021, 2023; Rovelli et al., 2022). Specifically, two critical dimensions of family firm heterogeneity that deserve further attention with regard to green innovation are family involvement in management and family firm generational stage (Aparicio & Iturralde, 2023; Bauweraerts et al., 2022; Fiorillo et al., 2025; Martínez-Alonso et al., 2025).

Therefore, we address this critical gap by examining the influence of family management and generational stage on green innovation within family SMEs. To address this gap, we combined primary data collected through a survey administered to the CEOs of Spanish family SMEs with secondary data from the SABI database managed by Bureau van Dijk. After applying a stratified random sampling approach and excluding cases with missing financial data, we obtained a final sample of 183 family SMEs.

This study makes several contributions to the existing literature. First, it addresses a critical research gap by focusing explicitly on the drivers of green innovation within family SMEs, an economically dominant yet overlooked type of organization (Veiga, 2025). Second, it advances the debate on family firm heterogeneity by moving beyond the traditional family versus non-family dichotomy (Daspit et al., 2021, 2023; Duong et al., 2025). In this vein, family management is found to be a relevant catalyst for green innovation (Bauweraerts et al., 2022). Specifically, family managers' long-term investment horizons, their commitment to protecting

and preserving the family's reputation, and their desire to enhance the visibility of the family firm as a sustainability-minded enterprise foster a unique predisposition toward green innovation. By contrast, generational stage has no significant direct effect on green innovation. This lack of a direct effect may be explained by neutralizing counterforces in founder family SMEs, which are characterized by agile but risk-averse decision-making processes, and non-founder family SMEs, which are generally supportive of green innovation but may experience decision-making paralysis caused by conflict.

The rest of the paper is organized as follows. Section 2 provides the theoretical literature review and formulates the proposed hypotheses. Sections 3 and 4 cover the methodology and results, respectively. Conclusions are provided in Section 5.

2. Literature Review

2.1. Green Innovation in SMEs

Green innovation focuses on developing solutions that reduce environmental impact and generate social benefits (Huang et al., 2025). This approach involves firms taking greater environmental responsibility in their production processes and operations. Green innovation aims to balance economic returns with social and environmental benefits.

A recent study defines green innovation as "new or modified products and processes, including technological, managerial and organizational innovations that help sustain the surrounding environment" (Ilvitskaya & Prihodko, 2018). From this definition, two main sources of green innovation are identified: green product innovation, which introduces environmentally friendly goods, and green process innovation, which optimizes the sustainability of business practices (Tang et al., 2018).

On the one hand, green product innovation considers the entire product life cycle, minimizing environmental risks (Zhang et al., 2020) while enabling firms to identify green opportunities and access sustainable markets (Dangelico & Pujari, 2010). On the other hand, green process innovation consists of optimizing existing production processes and implementing environmentally sustainable technologies to manufacture goods and offer services with zero or significantly reduced environmental impact (Tang et al., 2018).

Companies that adopt green innovation strategies integrate sustainability into their operations, aligning it with their corporate objectives. Their approach focuses on minimizing environmental impact throughout all stages of production, prioritizing environmental protection. To this end, they implement measures such as pollution prevention, optimization of natural resources, waste reduction and promotion of responsible practices. In this context, energy management plays a fundamental role by monitoring consumption, implementing reduction projects and exploring alternative sources to improve productivity in a sustainable manner. These actions not only ensure compliance with environmental regulations, but also strengthen business competitiveness, reduce operating costs and improve market reputation (Dangelico & Pujari, 2010).

In this sense, green innovation has become an essential pillar for SMEs, which play a key role in economic development by generating a significant share of employment and GDP in many countries (Toromade & Chiekiezie, 2024). The adoption of sustainable practices allows SMEs to respond to growing demand from environmentally conscious consumers while optimizing operational efficiency and reducing long-term costs through energy savings and waste reduction (Duran et al., 2016; Herrero et al., 2024). In addition, green innovation gives SMEs a sustainability-based competitive advantage, strengthening their brand image and fostering consumer loyalty by differentiating greener products and processes (Laari et al., 2018). As a result, the positive effect of green innovation on business performance may increase as consumers increasingly prefer products aligned with environmental sustainability (Sudirman et al., 2024).

By adopting innovative approaches, SMEs can foster a culture of continuous improvement, generating both environmental and economic benefits and ensuring their profitability and resilience in a highly competitive global marketplace (Toromade & Chiekiezie, 2024). However, integrating sustainable practices into their business models poses significant challenges. One of the main obstacles is the lack of financial resources, as these initiatives require initial investments in technology, infrastructure and training. Despite these challenges, the integration of sustainable practices in SMEs offers significant benefits, such as more efficient production processes, higher quality products and the development of innovative goods and services with a sustainable approach (Toromade & Chiekiezie, 2024).

For these reasons, green innovation has become increasingly important in the business arena, driving the integration of sustainable practices into corporate strategies (Tang et al., 2018; Zhang & Ma, 2021). Investing in green initiatives not only strengthens market competitiveness but also facilitates access to capital from socially responsible investors and can support firms' strategic objectives (Bauweraerts et al., 2022; Brunelli et al., 2024).

2.2. Green Innovation in Family SMEs: How Family Management and Generational Stage Affect Green Practices

Within SMEs, family firms are the predominant group (IEF & Red de Cátedras de Empresa Familiar, 2018). Family firms, defined as firms controlled predominantly by a family with the intention of maintaining family control across generations (Zellweger, 2017), constitute a unique setting for investigating green innovation. This is because of specific characteristics, such as their socioemotional wealth (hereafter, SEW) endowment, which contributes to a long-term orientation and the intergenerational transfer of values and thus influences strategic decision-making processes (Berrone et al., 2012; Garcés-Ayerbe et al., 2022; Herrero et al., 2024; Martínez-Romero & Rojo-Ramírez, 2016). Therefore, when examining green innovation within family SMEs, it is important to consider that SEW constitutes a primary reference point for decision-making (Gómez-Mejía et al., 2007; Martínez-Romero & Rojo-Ramírez, 2016).

SEW serves as a lens for understanding family firms' approach to green innovation (Martínez-Alonso et al., 2025; Martínez-Romero et al., 2025; Samara et al., 2018). Specifically, this perspective suggests that family firms, because of SEW-related characteristics such as family members' identification with the firm or transgenerational intentions (Berrone et al., 2012), may pay particular attention to green and sustainable practices (Samara et al., 2018). The strong desire to preserve SEW and maintain an enduring family legacy reinforces the integration of sustainable strategies as a path to lasting success (Berrone et al., 2010; Gómez-Mejía et al., 2007; Samara et al., 2018). The greater the importance attached to SEW, the more sustainable initiatives family firms may undertake (Berrone et al., 2010). Thus, as SEW concerns increase, family firms may be more inclined to implement green innovations (Bendell, 2022; Herrero et al., 2024). Accordingly, family firms can be important actors in the development of sustainable strategies (Berrone et al., 2010, 2013), including green innovations.

However, family firms are a heterogeneous group (Chua et al., 2012; Daspit et al., 2021, 2023), and therefore, different types of family firms might have different behaviors toward green innovation. Specifically, family management and generational stage are considered two important sources of heterogeneity within family firms.

On the one hand, family management, understood as the participation of family members in managerial positions, is one of the most influential variables in family business strategy (Martínez-Alonso et al., 2025; Martínez-Romero et al., 2023). Indeed, family managers, rather than family owners, determine the firm's outcomes (Gallucci et al., 2015; Martínez-Romero et al., 2020). Therefore, the role of family managers is particularly relevant, as it is often linked to a management style focused on legacy protection and continuity of family control (Cambrea et al., 2021; Gómez-Mejía et al., 2007). Strategic decisions are thus deeply conditioned by the need to protect the affective and symbolic capital of the organization.

Excessive involvement of family members in management may negatively influence green innovation strategies. This negative orientation toward green innovation can be explained by family managers' conservative behavior toward such strategies, which are often perceived as uncertain or risky (Block et al., 2022; Martínez-Alonso et al., 2024). Family managers may exhibit cautious strategic behavior when evaluating green innovation-related initiatives because green innovation often involves high uncertainty, collaboration with external partners, and disclosure of firm-specific knowledge, raising concerns about knowledge leakage and opportunistic behavior (Feranita et al., 2017; Martínez-Alonso et al., 2022). Moreover, family managers may lack the professional skills and qualifications, such as green knowledge or technical resources, needed to manage green innovations appropriately (Kraiczky et al., 2014).

Contrary to this negative view, different studies have found that family-managed firms, because of their SEW priorities, may positively affect green innovation strategies (e.g., Garcés-Ayerbe et al., 2022). Several arguments support this positive influence.

First, family managers are characterized by long-term investment horizons. Green innovations usually have high initial costs, and the payback periods associated with these investments are relatively long. However, this longer investment horizon should not be an impediment for family managers, who typically exhibit a long-term orientation that supports sustainability strategies. Additionally, family managers often have long managerial tenures, and short-term outcomes may therefore be less salient because they are more focused on strategies with potential benefits for the future of the firm (Herrero et al., 2024). Family firms' intrinsic transgenerational orientation allows family managers to prioritize long-lasting green strategies over short-term financial gains (Dangelico et al., 2019; Duong et al., 2025).

Second, family managers are concerned with protecting and perpetuating the family image and reputation, given their high level of identification with the family firm (Martínez-Romero et al., 2023). Sustainable strategies, such as green innovation, can help improve both the firm's image and reputation among different stakeholders (Berrone et al., 2010). Therefore, family managers may act in a socially responsible manner,

promoting green innovations to enhance reputational capital and build trust among stakeholders (Gu, 2023; Martínez-Romero et al., 2025; Samara et al., 2018).

Finally, the presence of more family managers may increase the visibility of a family firm as a sustainability-oriented organization (Martínez-Alonso et al., 2025). This improved perception of the family firm may facilitate the development of long-lasting relationships with different stakeholders to achieve green innovations (Dangelico et al., 2019). Furthermore, this green perception may favor family firms' legitimacy within society and their long-term success (Debicki et al., 2017).

Thus, although family managers may initially be cautious and risk-averse with respect to green innovation, as these strategies might be perceived as a threat to family control and autonomy (Skorodzyevskiy et al., 2024), their concern for family continuity, reputation, and legitimacy may lead them to adopt green practices aligned with family values. Family managers may develop green strategies with the aim of being perceived by the community as responsible corporate citizens and gaining broader social legitimacy (Berrone et al., 2010; Dekker & Hasso, 2016; Han et al., 2021; Kim et al., 2017). When green strategies are aligned with family values, for example by reinforcing the image of a responsible and environmentally committed firm, family managers may perceive them as a natural and positive extension of their SEW (Berrone et al., 2010; Martínez-Alonso et al., 2025), thus facilitating their acceptance and implementation (Aiello et al., 2024; Garcés-Ayerbe et al., 2022).

According to the reviewed literature, there is a prevailing positive effect of family management on green innovation. Therefore, we propose the following hypothesis:

H1. Family firms with greater family involvement in management exhibit higher levels of green innovation.

On the other hand, generational stage, understood as the generation that controls and manages the firm (Chirico & Kellermanns, 2024), represents another family-specific characteristic that could influence green innovation within family firms. Generational stage is an important factor shaping family firms' strategic priorities (Sánchez-Marín et al., 2020; Sciascia et al., 2014), mainly because of the particular knowledge endowments and patterns of emotional relationships that characterize family members across generations (Alayo et al., 2022; Lansberg et al., 1997). Accordingly, family firms at different generational stages have distinct priorities in terms of SEW (Miller & Le Breton-Miller, 2014), which may affect the adoption of sustainable practices and, consequently, green innovations (Herrero et al., 2024; Martínez-Alonso et al., 2025). Specifically, family firms' preferences usually change as they evolve from the first generation, when they prioritize SEW preferences such as a strong sense of identification and emotional attachment (Gómez-Mejía et al., 2011; Sciascia et al., 2014), to later generations, when financial considerations tend to move to the forefront (Chirico & Kellermanns, 2024; Lansberg et al., 1997).

Generally speaking, founder (first-generation) family firms tend to adopt a control logic aimed at preserving the legacy, maintaining decision-making power, and minimizing risk. This position reflects the need to preserve the internal balance of the family-business system and avoid alterations that could compromise that system (Peláez-León & Sánchez-Marín, 2023). The desire to maintain family control and influence remains paramount in founder family firms, fueled by a long-term orientation and the objective of transferring a robust, resilient legacy to future generations (Gómez-Mejía et al., 2007). Accordingly, founder family firms tend to avoid high-risk maneuvers, such as green innovation strategies, because these practices often require specialized knowledge from external scientists, consultants, or green-tech partners. This dependence on third parties, whether economic or technological, involves ceding part of the innovation process to external agents, with a subsequent loss of family control over the green innovation path (Martínez-Alonso et al., 2024). Additionally, the limited familiarity of these collaborators with the firm's culture and tacit knowledge may constrain the effectiveness of green innovation initiatives (Wang et al., 2019). Furthermore, founder family firms are characterized by a high degree of identification with their businesses (Berrone et al., 2012). For them, maintaining a good reputation over generations is a priority (Cabrera-Suárez et al., 2014). Thus, founder family firms prefer to avoid practices that can damage their image (Alayo et al., 2023), such as potentially unsuccessful green innovation initiatives, because unsuccessful green projects might also damage stakeholders' perceptions of the firm. Additionally, as previously mentioned, green innovations usually require substantial investments, which may put the family's wealth at risk and limit available financial resources (Martínez-Romero et al., 2025). As a result, founder family firms may avoid green innovation strategies (Fiorillo et al., 2025).

By contrast, non-founder (second- and subsequent-generation) family firms usually show a stronger orientation toward green innovation (Fiorillo et al., 2025). Non-founder family firms tend to exhibit a more strategic, adaptive, and institutionalized business orientation (Chirico & Kellermanns, 2024). As family firms evolve from founder to non-founder stages, the overlap between family wealth and firm equity diminishes, with a subsequent reduction in loss aversion and an increased propensity to undertake risky strategies, such as green innovation. Moreover, in non-founder family firms, both family control and influence become more diluted

(Voordeckers et al., 2007), and family members may be more willing to develop green strategies to achieve both economic and reputational benefits. Reputational concerns may also increase as family firms evolve across generations. Specifically, non-founder family firms may have emotional and reputational incentives to encourage the firm to pursue green strategies in an attempt to enhance the family's image among both internal and external stakeholders (Fiorillo et al., 2025; Samara et al., 2018). Furthermore, non-founder family firms usually incorporate experienced professionals into their governance structures to address novel and challenging initiatives (Le Breton-Miller & Miller, 2013). These professionals may introduce new knowledge and innovative perspectives that encourage the adoption of green practices (Gutuleac et al., 2025). Therefore, through the incorporation of new managerial approaches and strategic orientations, second- and subsequent-generation family firms may foster the development of more sustainable business models and strengthen the firm's capacity to implement green innovation.

According to the above, family firms' generational stage can significantly influence the adoption and implementation of green innovation practices. In this sense, non-founder family firms often place greater emphasis on professionalization, stakeholder relationships, external legitimacy, reputation, and long-term continuity, which may increase their engagement in sustainability-oriented strategies (Díaz-Moriana et al., 2018; Fiorillo et al., 2025), such as green innovation. Thus, the logic of non-founder family firms is usually more proactive and environmentally oriented, generating conditions that are more conducive to the implementation of green innovation practices (Block et al., 2022). Therefore, we establish the following hypothesis:

H2. Family firms in non-founder generational stages exhibit higher levels of green innovation.

3. Methodology

3.1. Sample and Data

A sample of Spanish SMEs was used for this study because SMEs are the most representative organizational form in Spain. Specifically, SMEs account for more than 99% of all Spanish firms (Dirección General de Industria y de la PYME, 2024), contributing more than 62% of gross value added and approximately 66% of employment (Ministerio de Industria, Comercio y Turismo, 2024).

To ensure that the sample accurately reflects the structural composition of Spanish SMEs, we employed a stratified sampling approach for finite populations. The population was partitioned into distinct strata based on industry (manufacturing, construction, commerce, and services) and firm size (small and medium), ensuring adequate representation of the target population. A sampling margin of error of less than 5% was established, with a 95% confidence level, to determine the required sample size. The sampling frame was the SABI (Sistema de Análisis de Balances Ibéricos) database provided by Bureau van Dijk.

Data were collected through a telephone survey administered to SME CEOs, following a key-informant approach (Martínez-Romero et al., 2020; Martínez-Romero & Rojo-Ramírez, 2017). We designed the survey, based on previously validated measures, to collect information that was unavailable from secondary data sources. To mitigate common method bias, particularly ambiguity and social desirability, the survey incorporated different scale formats and response points, reverse-worded items, and a strategic alternation between perceptual and non-perceptual questions (Podsakoff et al., 2012). Before finalizing the survey, it underwent rigorous pre-testing to ensure construct validity. Necessary refinements were then incorporated to improve clarity and respondents' interpretation, following the approach of Stefanitsis et al. (2013).

A professional survey agency conducted the telephone interviews. The agency ensured compliance with quality, consistency, and data protection standards and helped achieve a high response rate.

Data collection was carried out in May and June 2023, yielding responses from 400 SMEs. This sample size is comparable to recent research in the area (Duong et al., 2025). From these SMEs, we retained only family firms (Voordeckers et al., 2024). Firms were classified as family firms if they self-identified as such. This self-identification criterion ensured a sample composed exclusively of family firms (Alayo et al., 2022, 2023). Firm-level financial reporting information was then drawn from the SABI database. After removing cases with missing economic and financial data, we obtained a final sample of 183 family SMEs. Table 1 provides a more detailed description of the final sample.

Table 1. Sample description

	%
Sample composition by size	
<i>Small-sized firms</i>	87.03%
<i>Medium-sized firms</i>	12.97%
Sample composition by industry	
<i>1. Manufacturing</i>	34.59%
<i>2. Construction</i>	21.08%
<i>3. Trade</i>	15.13%
<i>4. Services</i>	29.18%

Small- and medium-sized firms have been identified according to the European Commission's criterion (2003/361/EC, 6 May).

The composition of the sample shows that 12.97% of the firms are medium-sized and 87.03% are small, according to the criteria of the European Commission (2003/361/EC). In terms of sector distribution, 34.59% of the firms belong to the manufacturing industry, 21.08% to construction, 15.13% to commerce and 29.18% to services.

To assess potential bias and the representativeness of our final sample, we compared the final estimation sample with the initial sample. The distributions by size and industry are similar in the original and final samples. Thus, there is no evidence of meaningful selection bias between the initial and final samples.

3.2. Definition of Variables

Dependent variable. Green innovation. Different qualitative and quantitative measures have been employed to capture green innovation (Horváthová, 2010; Vasileiou et al., 2022). Among these measures, we operationalized green innovation through four indicators measured on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). This type of measure has been widely adopted in environmental management and strategic management research (Ma et al., 2021; Wang et al., 2021). Respondents were asked to indicate the extent to which their firm had implemented the following actions: (a) substitution of polluting or hazardous materials;

(b) reduction of resource consumption (e.g., energy and water) during the production process; (c) reduction of waste generation during the production phase; and (d) improvement in product recyclability or reusability.

These items were aggregated by computing their mean value to capture the firm's overall engagement in green innovation practices (e.g., Chen et al., 2006). The use of an averaged index represents a widely accepted approach in empirical research when items are measured on the same scale and exhibit sufficient internal consistency (Doluc et al., 2018).

The results support the unidimensionality of the green innovation construct. All items are positively and significantly correlated, with coefficients ranging from 0.46 to 0.70, and the scale exhibits high internal consistency (Cronbach's $\alpha = 0.83$). In addition, the composite reliability ($CR = 0.82$) exceeds the recommended threshold of 0.70, while the average variance extracted ($AVE = 0.54$) is above the recommended value of 0.50, providing evidence of satisfactory reliability and convergent validity. Exploratory factor analysis further confirms a clear single-factor structure, with strong loadings on the primary factor and negligible loadings on additional factors, indicating that the variables capture a common underlying dimension of green innovation. Table 2 reveals similar mean values across items (ranging from 4.89 to 5.23) and moderate dispersion. Based on this evidence, the four items were aggregated using their mean to construct a composite index of green innovation ($mean = 5.02$; $SD = 1.27$).

Table 2. Operationalization of Green Innovation

Items	Mean	Std. Dev
(a) substitution of polluting or hazardous materials	4.99	1.66
(b) reduction of resource consumption during the production process	4.95	1.51
(c) reduction of waste generation during the production phase	4.89	1.56
(d) improvement in product recyclability or reusability	5.23	1.51
Green innovation	5.02	1.27

Notes: Green innovation is measured as the mean of the four items. The construct shows satisfactory internal consistency and convergent validity (Cronbach's $\alpha = 0.83$; $CR = 0.82$; $AVE = 0.54$). Exploratory factor analysis reveals a unidimensional structure, with factor loadings ranging from 0.64 to 0.82.

Independent variables. Family Management and Generational Stage. Consistent with prior research (Cambrea et al., 2021; Berrone et al., 2010; Cruz et al., 2010; Gómez-Mejía et al., 2022), we recognize the influence of family managers on decision-making as a well-established and valid proxy for SEW, particularly with respect to the dimension of family control and influence. We adopt this proxy and define family management as the active involvement of the controlling family in the management of family-owned firms (De Massis et al., 2014). Thus, family management is computed as the percentage of family members in the TMT of the family firm (Arzubiaga et al., 2019). For this purpose, we divided the number of family top managers by the total number of top managers to calculate the family management ratio (Bauweraerts et al., 2020; Santulli et al., 2022; Sánchez-Famoso et al., 2017, 2019).

With regard to generational stage, we operationalized it as the generation that controls the family business (Bammens et al., 2008). In this vein, the survey included a question asking respondents to indicate the generation that currently has decision-making power over the family business (Sonfield & Lussier, 2004). Consistent with prior research, we created dummy variables based on the survey responses: founder (first-generation) family firms and non-founder (subsequent-generation) family firms (Cruz & Nordqvist, 2011). Accordingly, the generational-stage variable takes the value 1 if the family firm is in the first generational stage and 0 if the family firm is in the second or a later generational stage (Martínez-Alonso et al., 2023).

Control variables. We also control for other firm-level characteristics, such as firm size (size), measured as the natural logarithm of the number of employees, and firm age (age), measured as the number of years since firm founding (Martínez-Alonso et al., 2020, 2022). Moreover, we control for firm profitability using ROA, i.e., return on assets (Martínez-Alonso et al., 2025). Activity-sector dummies (man, con, and serv) were included to control for whether firms operated in manufacturing, construction, trade, or services, with trade as the omitted reference category (Voordeckers et al., 2024). Finally, we control for both product innovation and process innovation using subjective measures of innovation, as these are considered particularly appropriate for SMEs (Hughes, 2001). Thus, respondents were asked to indicate the firm's situation relative to competitors with regard to significant changes or improvements in existing products/services and production processes, respectively (Madrid-Guijarro et al., 2021).

4. Results

4.1. Descriptive Statistics

Table 3 presents the descriptive statistics for the variables used in our model. As previously stated, the mean score for green innovation in family firms is 5.02 on a 7-point Likert scale, suggesting a generally high level of commitment to sustainable practices. In terms of governance, 79% of the firms' managers are family members. Regarding generational stage, approximately 48.47% of the sampled firms are first-generation family firms, while the remaining 51.53% are second- or subsequent-generation family firms. Table 3 also shows that firms are, on average, 26.33 years old, with a minimum age of 2 years and a maximum age of 89. The average size of the sampled firms is 30 employees, with a maximum of 365 employees. Mean ROA is 10.58%. Finally, with regard to innovation practices, the average score for product innovation is 5.37, while process innovation averages 4.98, both measured on a 7-point Likert scale. These results indicate a moderate-to-high level of innovation activity among family firms in the sample.

Table 4 presents the pairwise correlations. The correlation coefficients, variance inflation factor tests, and tolerance values indicate that multicollinearity is not a concern in the data (Hair et al., 1999).

Table 3. Descriptive statistical variables of family firms

Variables	Mean	S.D.	Minimum	Maximum
Green innovation	5.0163	1.2706	1	7
Family management	0.7892	0.3153	0	1
Generational stage	0.4847	0.5008	0	1
Firm age	3.2248	0.5152	1.6095	4.4188
Firm size	3.2173	0.7065	1.7917	5.8971
Manufacturing	0.3459	0.4881	0	1
Construction	0.2108	0.4106	0	1
Trade	0.1513	0.3609	0	1
Services	0.2918	0.4522	0	1
Product innovation	5.3711	1.2729	1	7
Process innovation	4.9781	1.6448	1	7
ROA	0.1058	0.1458	-0.1959	1.3

Table 4. Pairwise correlations

	1	2	3	4	5	6	7	8	9	10	11	12	
1	Green innovation	1											
2	Family management	0.0351	1										
3	Generational stage	-0.0363	-0.0431	1									
4	Firm age	-0.0180	0.0140	-0.2602***	1								
5	Firm size	0.1090*	-0.3654***	-0.0490	0.0380	1							
6	Manufacturing	0.0046	0.0367	-0.0683	0.1681***	0.0302	1						
7	Construction	-0.0238	0.0624	0.0696	-0.0670	-0.1224**	-0.3261***	1					
8	Trade	-0.0517	0.0440	-0.0108	0.1484***	0.0241	-0.2568***	-0.1956***	1				
9	Services	0.0519	-0.1311 **	0.0190	-0.2089***	0.0572	-0.4990***	-0.3801 ***	-0.2994***	1			
10	Product innovation	0.3962***	-0.0460	-0.0014	-0.1560***	0.0416	-0.0527	-0.1204**	-0.0180	0.1624***	1		
11	Process innovation	0.3084***	-0.0081	-0.0510	-0.1172***	0.0979*	0.1468**	-0.1487***	-0.0979*	0.0527	0.3728***	1	
12	ROA	0.0540	-0.1884**	0.1546**	-0.3007***	-0.0365	-0.1103*	0.0979*	-0.0994*	0.0904*	0.0579	0.0587	1

Pairwise correlations: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Abbreviation: ROA, return on assets.

4.2. Regression Analysis

Table 5 reports the results of the ordinary least squares (OLS) regression models used to test the proposed hypotheses. Green innovation is the dependent variable. Model 1 is the baseline model and includes only the control variables. Model 1 reveals a positive and significant effect of product innovation (*coef.* 0.2815; $p < .01$), process innovation (*coef.* 0.1358; $p < 0.05$), and ROA (*coef.* 0.4141; $p < .05$) on green innovation, while firm age, firm size, and activity sector do not have a significant effect on the dependent variable.

Model 2 incorporates family management as the independent variable. The control variables exhibit the same pattern as in Model 1, except for firm size, which becomes significant (*coef.* 0.4014; $p < .01$). The results reveal a positive and significant effect of family management on green innovation (*coef.* 0.5785; $p < .05$). Specifically, these findings indicate that as the proportion of family managers increases, firms are more likely to adopt green innovation practices. This suggests that family managers, driven not only by financial objectives but also by a desire to preserve the family's legacy, reputation, and transgenerational continuity, foster a stronger commitment to sustainable strategies such as green innovation. Thus, the findings support Hypothesis 1.

Regarding Model 3, which incorporates generational stage as an independent variable, the results show a negative but non-significant relationship between founder family firms and green innovation (*coef.* -0.042 ; $p > .10$). This result provides no evidence that generational stage is systematically associated with green innovation. Therefore, the specific knowledge endowments and emotional dynamics inherent to each generation (Alayo et al., 2022; Lansberg et al., 1997) do not appear to have a significant direct effect on green innovation strategies in our sample. Consequently, these findings do not support Hypothesis 2.

Table 5. Regression analysis results

	Model 1	Model 2	Model 3
Firm age	0.1212	0.1648	0.1388
Firm size	0.1413	0.4014***	0.3033**
Manufacturing	0.1448	0.0255	-0.0173
Construction	0.1541	0.2321	0.2165
Services	0.0713	0.0683	0.0180
Product innovation	0.2815***	0.2589***	0.2481***
Process innovation	0.1358**	0.1343**	0.1385**
ROA	0.4141**	1.7530***	1.4752**
Family Management		0.5785**	
Family generational stage			-0.0420
R ²	0.1536	0.1948	0.1741
R ² adjusted	0.1315	0.1529	0.1312

Notes. Green innovation is the dependent variable and is measured as the mean of four green innovation items. Robust standard errors are used. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.3. Robustness Checks

To further assess the robustness of the results, the baseline specification was compared with two alternative model specifications (Table 6). As a first robustness check, an ordered probit model was estimated to account for the ordinal nature of the dependent variable, which is derived from a Likert scale. This approach is widely recommended when the dependent variable reflects ordered response categories rather than a strictly continuous outcome.

As a second robustness check, the model was re-estimated using an alternative construction of the green innovation index based on the sum of the items instead of their mean. This specification provides an additional test of whether the results depend on the particular operationalization of the construct. This approach is also methodologically appropriate, as multi-item Likert scales are commonly treated as summated or composite measures once internal consistency and unidimensionality have been established.

Third, for each of the specifications described above (ordered probit and OLS using the sum-based green innovation index), we included an additional model that incorporated family management and generational stage simultaneously.

The results remain substantively stable across all specifications. Regarding the models including family management, the results are highly consistent across all specifications. In particular, firm size, product innovation, process innovation, and ROA exhibit a positive and statistically significant association with green innovation across all models, regardless of whether the dependent variable is measured as a mean or as a

sum. Importantly, family management retains a positive and significant effect in all specifications, reinforcing the robustness of our main findings.

In contrast, the coefficient for generational stage remains non-significant throughout, suggesting that this source of family firm heterogeneity does not play a decisive role in explaining green innovation outcomes. Control variables behave similarly to those in the previous models. Overall, the consistency in both the sign and statistical significance of the coefficients across alternative specifications and both sets of models provides strong support for the robustness and reliability of the proposed relationships.

Finally, the models including family management and generational stage simultaneously, i.e., those labeled 'joint models', show that the results remain consistent with the previous findings. Family management continues to exert a positive and significant effect on green innovation, whereas generational stage has a negative but non-significant effect.

Table 6. Robustness checks

Variables	Ordered probit			OLS (sum-based DV)		
	Family management	Generational stage	Joint model	Family management	Generational stage	Joint model
Firm age	0.2272	0.1969	0.2271	0.6593	0.5556	0.6412
Firm size	0.3567***	0.2572**	0.3560***	1.6058***	1.2134**	1.6058***
Manufacturing	0.0873	0.0448	0.0868	0.1021	-0.0696	0.1000
Construction	0.2038	0.1874	0.2041	0.9286	0.8662	0.9299
Services	0.1378	0.0872	0.1374	0.2735	0.0723	0.2720
Product innovation	0.2383***	0.2247***	0.2377***	1.0356***	0.9925***	1.0334***
Process innovation	0.0960*	0.0993**	0.0958*	0.5372*	0.5540*	0.5367**
ROA	1.6514***	1.3602**	1.6519***	7.0122**	5.9009*	7.0149**
Family management	0.5666**	—	0.5647**	2.3140**	—	2.3064*
Family generational stage	—	-0.0407	-0.0149	—	-0.1683	-0.0605
Observations	183			183		
R ² / Pseudo R ²	0.0377	0.0332	0.0377	0.1948	0.1786	0.1948

Notes. Ordered probit models employ the same dependent variable while accounting for its ordinal nature. Columns labeled "OLS (sum-based)" re-estimate the models using an alternative operationalization of green innovation based on the sum of the four underlying items. "Joint model" columns re-estimate each specification including Family management and Family generational stage simultaneously. The consistency of the results across specifications supports the robustness of the findings. Coefficients are reported for comparability across specifications. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. Discussion and Conclusion

The purpose of this study was to explore variation in family SMEs' green innovation strategies by analyzing how differences in two sources of family firm heterogeneity, namely family management and generational stage, affect such sustainable investments. Based on the SEW approach and taking family firm heterogeneity into consideration, we find that disparities in family management explain why some family firms are more prone to invest in green innovation, while others are more reluctant to engage in such investments. Specifically, as the percentage of family managers increases, family SMEs become more oriented toward sustainable practices. Family managers' long-term investment horizons, their desire to protect and perpetuate the family image and reputation (Berrone et al., 2010), and their willingness to increase their visibility as sustainability-oriented firms (Martínez-Alonso et al., 2025) make them uniquely predisposed to investing in green innovation.

On the other hand, our findings do not reveal a significant direct effect of family firms' generational stage on green innovation. Therefore, although family firms may have distinct priorities in terms of SEW as they evolve across generational stages (Martínez-Romero & Rojo-Ramírez, 2016; Miller & Le Breton-Miller, 2014), our findings suggest that the generation controlling the business does not have a direct effect on green innovation. Although prior literature suggests that later-generation family firms are more prone to adopt sustainable strategies (Fiorillo et al., 2025), they also face countervailing forces that may neutralize this tendency. For example, founder firms may be risk-averse in order to protect their SEW (Gómez-Mejía et al., 2007), but they often have sufficient control to implement green strategies quickly if they perceive

regulatory or market threats (Bendell, 2022) or respond to sustainability-related peer effects (Liu & Wu, 2016). Conversely, second- or third-generation family SMEs may favor green initiatives, but fragmented family ownership, the involvement of different family branches, and paralyzing internal conflicts may prevent green innovations (Arena & Michelon, 2018). Similarly, non-founder family SMEs may remain attached to firm traditions (Chirico & Salvato, 2016; Miroshnychenko et al., 2025), making them resistant to radical green innovation.

The findings remain consistent across different estimation techniques, an alternative proxy for the dependent variable, and models that include both independent variables simultaneously, providing support for and consistency with the main analysis.

5.1. Contributions

Our study makes important contributions to the literature. First, it addresses the call from previous research to better understand the drivers of green innovation in family firms (Bendell, 2022; Gómez-Mejía et al., 2025; Liu et al., 2023). Crucially, our research narrows this focus to family SMEs, whose green practices have been largely overlooked in prior research despite their prevalence worldwide (Herrero et al., 2024; Martín-Castejón & Aroca-López, 2016; Martínez-Romero et al., 2025). Second, by focusing exclusively on family SMEs, we deepen our understanding of family firm heterogeneity (Chua et al., 2012; Daspit et al., 2021, 2023). While previous literature has mainly focused on examining differences in sustainable strategies between family and non-family firms (Arena & Michelon, 2018; Dangelico et al., 2019; Miroshnychenko & De Massis, 2022), this study examines family firm heterogeneity in relation to green innovation (Gómez-Mejía et al., 2025; Herrero et al., 2024; Martínez-Alonso et al., 2025). Consequently, our study highlights that family firms should be regarded as a heterogeneous group in order to develop a more detailed understanding of their strategic choices (Alessandri et al., 2018; Martínez-Romero et al., 2023). Specifically, our findings reveal that a particular source of family firm heterogeneity, namely family management, may explain existing divergences in family firms' green innovation strategies. That is, our findings highlight family managers' propensity to prioritize long-lasting green strategies over short-term financial gains (Dangelico et al., 2019; Duong et al., 2025). Therefore, we focus on differences among family SMEs and reinforce the need to study them as a heterogeneous group (Duong et al., 2025). Finally, this study contributes to the literature by demystifying the effect of generational stage on green innovation, revealing that the lack of a significant direct relationship may be driven by opposing counterforces that neutralize one another. This insight offers a nuanced view of the generational-stage effect and may explain the mixed findings obtained in prior research (Fiorillo et al., 2025; Oke et al., 2025; Wu et al., 2024). As previously stated, founder family SMEs are normally more risk-averse but have absolute decision-making power to act quickly in response to regulatory threats or sustainability-related peer effects (Bendell, 2022; Liu & Wu, 2016). By contrast, non-founder family SMEs may strongly support green initiatives but can be paralyzed by fragmented family ownership, conflicts between different family branches, and resistance to change rooted in firm tradition (Arena & Michelon, 2018; Miroshnychenko et al., 2025). By capturing these counterbalancing mechanisms, our study clarifies why the generation in control does not automatically translate into distinct green innovation outcomes.

5.2. Practical Implications

Our research responds directly to rising ecological concerns by highlighting how family SMEs can drive sustainable practices, particularly green innovation. Because family SMEs represent over 60% of all global businesses (Martínez-Romero et al., 2025; Van Gils et al., 2019), understanding their environmental impact is crucial. Therefore, our findings provide insights into how green innovation can be fostered within the world's most prevalent group of businesses (Duong et al., 2025). Specifically, this study offers practical guidance to family firm members and policymakers seeking to encourage green innovation practices. In this vein, family SMEs may benefit from retaining qualified family members in their management teams when these members promote green innovation. The desire to reinforce the image of a responsible and environmentally committed firm and to enhance the family's reputation, trustworthiness, and industry standing (Aiello et al., 2021; Garcés-Ayerbe et al., 2022; Kim et al., 2017) can drive sustainable innovation. However, to maximize the effectiveness of green innovation, the appointment of relatives to management roles must be based strictly on relevant technical qualifications and expertise, thereby minimizing nepotism (Martínez-Alonso et al., 2023, 2025). Family members across first and subsequent generations should also attend environmental training programs (Rivera-Torres et al., 2015; Huang & Huang, 2024; Zhang & Ma, 2021) to understand the benefits of sustainable strategies for both the firm and society. It is particularly important to make family members across generational stages aware of sustainability issues. In this regard, to bridge generational and hierarchical divides, family SMEs should cultivate an environment that fosters innovative thinking and open communication. Shadow boards may serve as a mechanism for bridging these gaps (Gutuleac et al., 2025). Finally, policymakers can support green innovation through measures such as tax reductions and incentives, financial support, and technical resources.

5.3. Limitations and Future Research Avenues

Finally, the study has several limitations that provide opportunities for future research. First, although we construct a composite measure of green innovation based on multiple items, its operationalization is constrained by the availability of survey data and may capture only part of the multidimensional nature of green innovation. Second, family firm heterogeneity should be further analyzed by considering additional family firm variables, such as CEO duality, CEO tenure, relationships among family owners, or the values pursued by different family members (Daspit et al., 2021, 2023). Third, this study is based on a cross-sectional design. Although cross-sectional designs are common in this type of research, we cannot demonstrate causality. In this regard, potential endogeneity concerns, such as reverse causality and omitted variable bias, cannot be entirely ruled out. Therefore, our findings should be interpreted as associative rather than strictly causal. Future research could address these limitations using longitudinal data or more advanced empirical strategies.

5.4. Conclusion

Ultimately, this study advances our understanding of sustainable practices within family SMEs by providing nuanced empirical evidence that family management directly and significantly drives green innovation, while generational stage does not exert a significant direct effect on this type of innovation. By focusing specifically on family SMEs, our findings underscore the critical importance of recognizing family firm heterogeneity. Rather than viewing family businesses as a uniform group, this research demonstrates that the degree of family involvement in management is a primary catalyst for green innovation.

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