How do non-economic goals and priorities affect family firm's propensity to innovate in automation? The role of ownership, board of director, young successor and generation

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Abstract

Purpose – This study examines the propensity to innovate in automation of family firms (FFs) based on the socio-emotional wealth (SEW) perspective.

Design/methodology/approach – This study's analysis is based on three aspects. First, the authors consider three main non-economic goals and priorities of FFs: the family's relationship with employees (read as to care for their satisfaction and well-being); the inner pride of building and maintaining the family and firm image and reputation; and the inner feeling to be socially responsible. Second, the authors consider how these goals and priorities vary among FFs according to four dimensions: family ownership, the presence of family members on the board of directors, the involvement of young successors, and the presence of founding and later generations. Finally, the consequences of automation are considered: lower firm employment, lower employees' satisfaction and well-being, and higher firm productivity. The analysis is based on a sample of 4,150 Italian firms.

Findings – The analysis revealed that FFs are less prone to innovate in automation than non-FFs. Specifically, family ownership, the presence of family members on the board of directors, and the presence of founding generation are negatively associated with innovation in automation. Instead, the involvement of young successors and the presence of later generation are positively associated with innovation in automation.

Originality/value – To the authors' knowledge, this study is the first investigation that, based on SEW, examines how FFs act on the decision to innovate in automation, thereby providing empirical evidence.

Keywords Innovation, Automation, Family firms, Socio-emotional wealth

Paper type Research paper

1. Introduction

Family firms (FFs) operate preserving, in addition to their financial assets, the socioemotional wealth (SEW) coming from firm control (Gómez-Mejía *et al.*, 2007). In a long-term orientation, family members avoid risk-taking, even if this conservatism comes at the cost of profitability

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(Le Breton-Miller *et al.*, 2015). Family members also desire to be good stewards of the firm and its stakeholders to protect family's reputation and provide career opportunities for later generations (Miller and Le Breton-Miller, 2005). These tendencies affect, among other aspects, the propensity to innovate. FFs may be less innovative to protect their SEW (Block, 2012). However, even the SEW includes a variety of family preferences that relate quite positively to innovation (Miller and Le Breton-Miller, 2011). These peculiarities of FFs are also relevant concerning innovation in automation.

Automation technologies such as artificial intelligence and robotics are rapidly diffusing worldwide (Schwabe and Castellacci, 2020). They have now become essential for organizational survival since they are a source of competitive advantage (Acemoglu *et al.*, 2020). Nevertheless, automation is receiving increasing attention in the literature due to its negative consequences. While automation technologies may increase firm productivity (Acemoglu *et al.*, 2020; Bessen and Righi, 2019), they may significantly decrease firm employment (e.g. Bonfiglioli *et al.*, 2020; Jung and Lim, 2020) and negatively impact employees' satisfaction and well-being (Schwabe and Castellacci, 2020). However, even if automation engenders significant non-economic consequences, literature traditionally sees such effects as a by-product of automation strategies aimed to maximize financial returns. So far, no consideration has been given to the possibility that firms may be driven by non-economic rationales.

FFs may be fostered to innovate in automation as they can increase firm productivity and competitive advantage. At the same time, FFs may be reluctant in carrying out this activity because of their non-economic goals and priorities primarily motivated by preserving the SEW. When deciding if innovate in automation, FFs are particularly involved regarding three main aspects: (1) the family's feeling to care about their employees; (2) the inner pride of building and maintaining the reputation of the family and the firm; (3) and the inner feeling to be socially responsible. We expect that FFs may want to eschew the negative consequences of automation (i.e. lower firm employment and lower employees' satisfaction and well-being) as they may disappoint key stakeholders (particularly, employees), even if this decision implies the loss of financial gains (i.e. higher firm productivity). In contrast, non-FFs are mainly motivated by financial returns and consider only the economic opportunities that innovation in automation guarantees.

In this paper, adopting the SEW perspective, we aim to examine the relationship between family goals and priorities and the propensity to innovate in automation. To this end, we consider how families decide preserving their SEW, how those choices depend on different dimensions describing FFs, and the main effects of automation. We identify three main non-economic goals and priorities of FFs: the family's relationship with employees (read as to care for their satisfaction and well-being); the inner pride of building and maintaining the family and firm image and reputation; and the inner feeling to be socially responsible. Then, we consider how SEW non-economic goals and priorities vary among FFs accordingly to different dimensions, i.e. family ownership, the presence of family members on the board of directors, the involvement of young successors, and the presence of founding and later generations (Miller and Le Breton-Miller, 2014). Finally, we consider both financial gains and non-economic losses that automation implies: the negative consequences at the SEW level that can hinder innovation in automation (i.e. lower firm employment, lower employees' satisfaction and well-being) and the potential benefits at the economic level that can stimulate this innovation (i.e. increased productivity) (e.g. Koch *et al.*, 2019; Schwabe and Castellacci, 2020). The analysis consists of a Poisson regression based on a database of 4,150 Italian firms.

2. Theoretical background

2.1 FFs' goals and priorities under the lens of SEW perspective

The influence of family on firm decisions has been investigated from different theoretical perspectives. Among them, the SEW one is based on the conceptualization of the socioemotional endowment related to the family (Gómez-Mejía *et al.*, 2007) to capture the stock of non-economic goals and priorities that the family obtains from its controlling position (Berrone *et al.*, 2012). This stock emanates, for example, from the exercise of authority, the family pleasure arising from control, the strict identification with the firm, the retention of strong family identity and the continuation of the family dynasty (Gómez-Mejía *et al.*, 2007). According to the SEW perspective, FFs preserve family wealth (Gómez-Mejía *et al.*, 2007). As a result, the family makes choices that will avoid potential SEW losses so that non-economic goals and priorities may dominate economic ones (Berrone *et al.*, 2010; Kotlar and De Massis, 2013).

FFs are also described to hold profound roots in their community and are tied to local stakeholders more than non-FFs (Kallmuenzer *et al.*, 2018). FFs attribute a higher value to the relational and social capital [1], create closer relationships with stakeholders and give more importance to their social responsibility (Van Gils *et al.*, 2014). Consequently, decision-making in FFs is affected by their social ties and identification (Kallmuenzer *et al.*, 2018). Relevant stakeholders include internal actors (e.g. firm employees) and the external environment (Mustakallio *et al.*, 2002). According to the SEW perspective, this behavior enables family members to gain several social and affective endowments, such as the ability to enhance the image, reputation, and social status of the family and the ability to exploit the financial resources of the firm for the benefit of the entire family (Miller and Le Breton-Miller, 2014).

SEW is inextricably tied to the social context in which FFs operate (Cennamo *et al.*, 2012). Investments in the community offer continuity and an abundance of goodwill toward the family (Miller and Le Breton-Miller, 2014). As per SEW gains, owing to reciprocal ties, FFs pursue the welfare of those who surround them, even if it does not produce no obvious transactional economic gains (Berrone *et al.*, 2010). Instead, as per SEW losses, linkages to the local community restrain FFs from actions that could be regarded as socially irresponsible and reduce SEW (Berrone *et al.*, 2010). Therefore, in SEW logic, FFs prefer preserving their local reputation, even if this means impairing financial well-being (Kurland and McCaffrey, 2020).

In addition to the above consideration, to deeply understand the difference among FFs we consider how SEW priorities vary depending on family presence over time and across firm life cycle (Miller and Le Breton-Miller, 2014). Accordingly, we applied the SEW perspective considering family ownership, the presence of family members on the board of directors, the involvement of a young successor, and the presence of founding and later generations. All these aspects may alter the family's SEW goals and priorities (Sciascia *et al.*, 2014; Zellweger *et al.*, 2012), and consequently, FFs' propensity to innovate in automation.

2.2 Interpreting innovation in automation through the SEW perspective

The complexity and uncertainty associated with innovation may create both economic and non-economic gains and losses that are taken into account by decision-makers (Gómez-Mejía *et al.*, 2014). Family-specific non-economic goals and priorities that affect innovation should therefore be considered.

Literature on innovation in FFs provides some conflicting results. While according to some authors, a family makes decisions that are positively related to firm ambidexterity (Lubatkin *et al.*, 2006), other studies conclude that family involvement is detrimental to innovation given the lack of professional experience of family members engaged in the decision-making process (Sanchez-Famoso *et al.*, 2017). Further, the perceived risk of losing sight of the financial results and the non-economic goals and priorities limit innovation in FFs (Calabrò *et al.*, 2019). We believe that the family's specificity as a decision-maker also affects the decision to innovate in automation.

This decision is tough given that automation technologies are associated with negative and positive consequences that may generate non-economic concerns. On the one hand, they have an unclear impact on firm employment and may decrease it (e.g. Bonfiglioli *et al.*, 2020; Jung and Lim, 2020). They can also negatively impact employees' satisfaction and well-being (Schwabe and Castellacci, 2020). On the other hand, automation technologies may increase firm productivity (e.g. Acemoglu *et al.*, 2020; Bessen and Righi, 2019). All these consequences are the root of not economic goals and priorities as they may have an impact in terms of SEW. Consequently, they affect the decision to innovate in automation by FFs. In the following, the consequences of automation are examined in detail.

Lower firm employment. Automation technologies impact firm employment causing a substitution effect as they are designed to carry out tasks previously performed by workers or reduce the amount of labor necessary to produce the same level of output (i.e. increase labor productivity) (Acemoglu and Restrepo, 2019) [2].

While, according to some studies, the impact on firm employment is positive (e.g. Bessen *et al.*, 2020; Domini *et al.*, 2021), other studies stress the possibility of a decrease (e.g. Bonfiglioli *et al.*, 2020; Ni and Obashi, 2021). Specifically, the adoption of industrial robots may significantly reduce firm employment (Ballestar *et al.*, 2021) as they inhibit employment growth (Jung and Lim, 2020) and cause an increase in efficiency and a decline in demand for labor (Bonfiglioli *et al.*, 2020). Moreover, even the diffusion of robots at the industry level may negatively affect employment in labor-intensive firms (Ni and Obashi, 2021).

We believe that the possible negative impact on firm employment may generate SEW losses in FFs, including the fear of ruining the relationship with employees and losing firm reputation due to the lower societal well-being following layoffs. The SEW may thus influence the decision to innovate in automation.

Lower employees' satisfaction and well-being. Automation technologies could impact non-pecuniary aspects that shape employees' well-being (Kaplan and Schulhofer-Wohl, 2018; Schwabe and Castellacci, 2020). These include many job outcomes (e.g. expectations, job prospects, satisfaction and commitment) and well-being outcomes (e.g. mental health and stress) (Brougham and Haar, 2018). When a firm is considering the adoption of automation technologies, employees begin to fear that these technologies may displace them and thus become unemployed and face financial difficulties in the future (Schwabe and Castellacci, 2020). Such uncertainty about future working conditions immediately reduces job satisfaction (Schwabe and Castellacci, 2020).

Automation technologies may also have an indirect effect on well-being. Automation may decrease job satisfaction, an important component of subjective well-being given the long time spent at work (Böckerman *et al.*, 2011). In addition, long-term job insecurity that automation entails can negatively affect employee's mental health and increase the probability of psychological stress, nervousness and burnout as employees can control their future work situation to a lesser extent (Abeliansky and Beulmann, 2019; Chen *et al.*, 2004).

We believe that the negative consequences of automation on employees' satisfaction and well-being may decrease the SEW in the firm. The SEW may thus influence the decision to innovate in automation.

Higher firm productivity. Studies analyzing the effect of automation technologies on firm productivity find a positive impact as they increase labor productivity and total factor productivity, especially in larger firms (Ballestar *et al.*, 2021; Dinlersoz and Wolf, 2018). These plants have a greater capital share than the labor share, resulting in higher productivity for production labor; they also register a greater growth in the production labor productivity (Dinlersoz and Wolf, 2018). Labor productivity can even double and total factor productivity triple after introducing robots (Stapleton and Webb, 2020).

We believe that the possibility of achieving a higher firm productivity has a positive impact on the economic goals within both FFs and non-FFs.

2.3 Hypothesis development

Drawing on the SEW perspective and based on the negative consequences of automation (i.e. lower firm employment and lower employees' satisfaction and well-being), three main non-economic goals and priorities are identified and described to develop our hypotheses: the family's relationship with employees (read as to care for their satisfaction and well-being); the inner pride of building and maintaining the family and firm image and reputation; and the inner feeling to be socially responsible.

Family's relationship with employees. According to SEW perspective, FFs have the priority to take care of their employees. FFs recognize their employees as part of an extended family and make special efforts in treating them well (Christensen-Salem *et al.*, 2021). For these reasons, FFs are strongly committed to employment stability and do not resort to decisions that imply massive layoffs or violations of psychological contracts regardless of economic considerations (Stavrou *et al.*, 2007). They also avoid decisions that are considered heartless or insensitive and harm their employees (Christensen-Salem *et al.*, 2021). Instead, they tend to offer "care-oriented" and protective contracts (Cruz *et al.*, 2014). Thus, FFs generally tend to be better employers in terms of job security than non-FFs and display intense concern for employees' satisfaction and well-being (Kaplan and Schulhofer-Wohl, 2018; Schwabe and Castellacci, 2020).

According to the SEW perspective, we expect that FFs will avoid the layoffs due to automation and ensure employees' satisfaction and well-being.

Family and firm image and reputation. SEW perspective suggests that the family has the priority to preserve the family and firm image and reputation in the community and treat stakeholders in a solicitous manner (Miller and Le Breton-Miller, 2005) [3]. The family's need to preserve the family and firm image and reputation leads to the awareness that outsiders know the decision role held by the family in the firm (Kellermanns *et al.*, 2012). Firm image and reputation may change over time, depending on how stakeholders evaluate firm's attentiveness to the competing demands it faces (Neubaum *et al.*, 2012). According to SEW perspective, image and reputation are related to the family goal to create a robust firm to pass to future generations (Cruz *et al.*, 2014). Further, the preservation of the firm image and reputation provides family members with a positive effect on their identities (Mahto *et al.*, 2010).

The consequences of automation in terms of lower firm employment and lower employees' satisfaction and well-being will induce in the decision-makers of FFs a feeling of losing both family and firm image and reputation.

Inner feeling to be socially responsible. According to SEW perspective, the family has the priority to be recognized as an actor that plays a positive role in society (Cruz *et al.*, 2014; Miller and Le Breton-Miller, 2005; Shepherd, 2016; Vardaman and Gondo, 2014). The family influence in decision-making can thus result in decisions and actions that are more socially responsible (Berrone *et al.*, 2010; Dyer and Whetten, 2006). This prosocial motivation refers to the desire to help, protect or increase the welfare of other people and to solve social problems exceeding the scope of the firm (Grant, 2007). The prosocial motivation of FFs is the result of the role of FFs as active actors and deeply embedded in the local community as well as more in distant groups (Shepherd, 2016). Then, due to the interest of FFs in social ties within and beyond the firm's boundaries (Berrone *et al.*, 2012), the external environment strongly affects the strategic decisions of FFs (Kallmuenzer *et al.*, 2018).

We consider that the negative impact of automation on firm employment and employees' satisfaction and well-being is a matter of social responsibility.

In addition to the above, it should be borne in mind that the relevance of SEW non-economic goals and priorities vary among FFs accordingly to different dimensions: family ownership, the presence of family members on the board of directors, the involvement of young successors, and the presence of founding and later generations (Azila-Gbettor *et al.*, 2021; Miller and Le Breton-Miller, 2014; Sonfield and Lussier, 2004).

Family ownership. Ownership substantially affects how (and the goals toward which) a firm is governed (Sur *et al.*, 2013). FFs are shaped by their ownership, and the equity share controlled by the family strongly affects decision choices (Berrone *et al.*, 2012;

Gómez-Mejía *et al.*, 2007). Family owners are characterized by the desire to create strong ties with the community and the employees (Zellweger *et al.*, 2012). As family owners frame problems and take decisions to preserve the family's relationship with employees, the inner pride of building and maintaining the family and firm image and reputation, and the inner feeling to be socially responsible, we expect firms in which the family holds the majority of firm ownership will avoid innovation in automation. We thus hypothesize that:

H1. Family ownership is negatively associated with innovation in automation.

The presence of family members on the board of directors. The board of directors is in charge of firm's strategic decision-making (Hambrick and Mason, 1984). On it, shareholders' different interests and views are settled (Nicholson and Newton, 2010). Shaped by the ownership choices, FFs are most likely to appoint family directors, who are family-centric stakeholders and make decisions based on non-economic goals and priorities (Schulze *et al.*, 2001). Instead, external directors are not linked to family ties and the preservation of the SEW (Goel *et al.*, 2013). FFs are thus reluctant to incorporate outsiders' perspectives and opinions in their decision-making and tend to have a significantly lower proportion of independent directors than non-FFs (Villalonga and Amit, 2006).

For these reasons, we expect that FFs with family directors make decisions based on non-economic goals and priorities to protect the family's SEW, thus avoiding innovation in automation. We therefore hypothesize that:

H2. The presence of family members on the board of directors is negatively associated with innovation in automation.

The involvement of young successors. The role of family as a shareholder is often followed by the presence of a young successor on the board of directors (Parker, 2016). The involvement of at least one family young successor is a proxy of the intention of the family to continue the firm and guarantee its dynasty (Parker, 2016). The involvement of a young successor is a sign of renewal and openness (Sardeshmukh and Corbett, 2011). A young successor is in fact often associated with a discontinuity with previous strategies (Kammerlander and Ganter, 2015) and may encourage the adoption of new business ideas (Hauck and Prügl, 2015). According to SEW perspective, a young successor is a predictor of the variety of goals and priorities among FFs and over firm life cycle (Lazzarotti *et al.*, 2020). While older family members have more concerns about non-economic goals and priorities, young members are more focused on economic goals (Miller and Le Breton-Miller, 2014). In the transition phase, when the power is shifted from one generation to the following, the new generation's strategic participation increases while the older generation's involvement and decisional power decrease (Hauck and Prügl, 2015). Since non-economic goals and priorities shift to economic ones (Miller and Le Breton-Miller, 2014), we expect that the presence of a young successor will favor innovation in automation. We therefore hypothesize that:

H3. The involvement of young successors is positively associated with innovation in automation.

The presence of founding and later generations. Generational differences may affect the strategic decision-making of FFs given the characteristics of founding and later generations (Sciascia *et al.*, 2014). Founding generations are strongly attached to the FF compared to later generations as they are identified to the firm due to their significant involvement with personal investments and their informal shared experiences with family members and other stakeholders (Berrone *et al.*, 2012; Sciascia *et al.*, 2014). On the contrary, later generations have different SEW priorities, and the financial consideration may take precedence (Sciascia *et al.*, 2014). FFs' behavior regarding innovation may thus vary considerably among FFs led by founders and those led by later generations (Zhong *et al.*, 2021). The succession process dilutes the family members' ownership shares and their affective attachment to and identification with the firm (Gómez-Mejía *et al.*, 2007). The deterioration of the ties to the FF may emphasize the need to grow the firm (Sciascia *et al.*, 2014) and the preservation of financial wealth more than non-economic goals and priorities (Anderson and Reeb, 2003). Consequently, we expect that FFs at the early stage, particularly the founder generation, are more likely to refrain from innovating in automation while FFs at later stages are more likely to innovate in automation. We therefore hypothesize that:

H4a. The presence of founding generation is negatively associated with innovation in automation.

H4b. The presence of later generation is positively associated with innovation in automation.

Based on the above analysis, we propose the theoretical framework shown in Figure 1.

3. Method

3.1 Sample and data

The sample for the analysis comprises 4,150 Italian firms. Italy represents an interesting context in terms of both the presence of FFs and the adoption of automation technologies. Italy has been in second place in Europe for the stock of robots since the nineties (Dottori, 2021) despite currently lagging in the adoption of other automation and digital technologies (Cirillo *et al.*, 2020).

In selecting the sample, we considered the universe of Italian firms that registered at least a patent in automation and are currently active. The choice of the control sample was made at random. χ^2 tests on the distribution of firms confirmed that the selected firms are representative of the population of Italian firms.

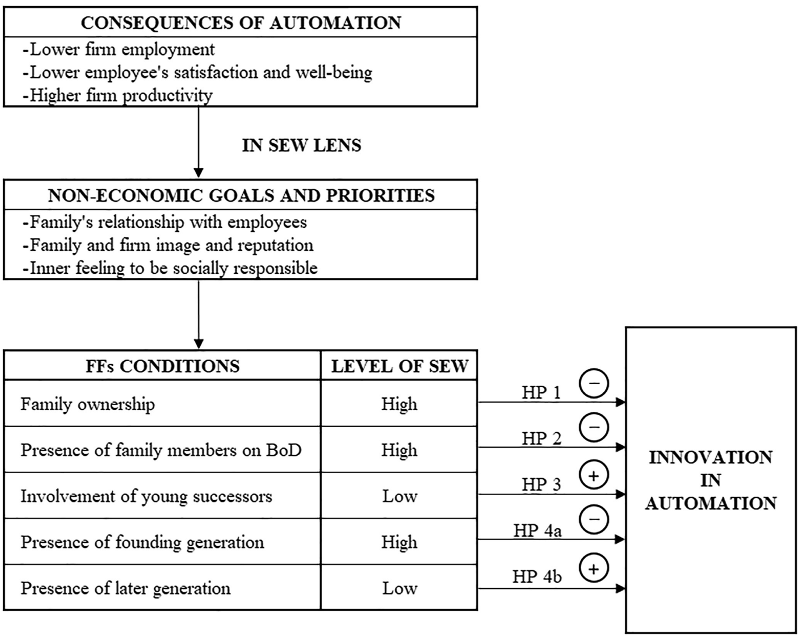

Figure 1.
Theoretical framework

The dataset, as of 2019, results from a merging process of three datasets: EPO Worldwide Patent Statistical Database (EPO-PATSTAT), Aida (Bureau Van Dijk) and Reprint. Information on patents is extracted from the EPO-PATSTAT [4]. From this database, patents related to the three automation technologies considered – artificial intelligence, big data and robotics – and filed by firms based in Italy were selected. Patents in automation were extracted based on patent codes retrieved from these papers: Fujii and Managi (2018), IPO (2014a, b, 2019), Keisner *et al.* (2015), Martinelli *et al.* (2019) and Webb *et al.* (2018) (Table 1).

Information about firms is derived from the AIDA (Bureau van Dijk) database, which contains firm identification data (e.g. location, year of foundation, sector), financial data and information regarding the ownership structure (i.e. family name of each board member and shareholder together with their ownership share).

The two databases – EPO-PATSTAT and Aida (Bureau van Dijk) – were merged following a procedure similar to that proposed by Lotti and Marin (2013). To solve the inconsistency in the data regarding patents [5] and obtain the list of firms to be considered, these authors suggest the following steps: harmonize the list of applicants in EPO-PATSTAT and the list of firms in Aida; harmonize addresses in both lists; identify the exact matches by checking both firm name and address; identify duplicate matches.

Finally, information regarding the multinational status of the firm was obtained from Reprint, which provides data on outward FDIs made by Italian firms since 1986.

3.2 Variables and measures

Table 2 reports the sources and definitions of the variables used in the empirical analysis.

Dependent variable. The dependent variables are the four variables regarding innovation in automation (i.e. *Automation*, *Automation in artificial intelligence*, *Automation in big data*, *Automation in robotics*). Studies on innovation have measured it in different ways, including the number of patents registered by the firm (Nagaoka *et al.*, 2010). In line with previous studies, innovation in automation is measured with the number of patents registered by the applicant firm in the period 2010–2019.

Independent variable. FF is considered through the dimensions of family ownership, the presence of family members on the board of directors, the involvement of young successors,

Technology	Patent codes	Source
Artificial intelligence	A61B, G06K, G06N, G06N20, G06N3, G06N5, G06N7/00, G06N99/00, G06T, G16C20/70	Fujii and Managi (2018) IPO (2019) Martinelli *et al.* (2019) Webb *et al.* (2018)
Big data	G06F, G06F12/00, G06F15/16, G06F15/173, G06F17/00, G06F19/00, G06F7/00, G06Q10/00, G06Q30/02, H04L, H04L29/08	IPO (2014b) Martinelli *et al.* (2019) Webb *et al.* (2018)
Robotics	B25J11/0005, B25J11/0015, B25J9/0003, B25J9/16, B25J9/20, B60R21/00, B60W, B60W10/04, B60W10/06, B60W10/10, B60W10/18, B60W20/30, B60W30/00, G01C, G01S, G05D, G05D1/0088, G05D1/02, G05D1/03, G05D2201/0207, G05D2201/0212, G08G, G08G1/16, Y10S901/00	IPO (2014a) Keisner *et al.* (2015) Martinelli *et al.* (2019) Webb *et al.* (2018)

Source(s): Our elaboration from Fujii and Managi (2018), IPO (2014a, b, 2019), Keisner *et al.* (2015), Martinelli *et al.* (2019) and Webb *et al.* (2018)

Table 1.
Patent codes regarding automation

Variable	Definition	Source
Dependent variables		
Automation	Number of patents in automation registered by the firm in the period 2010–2019	EPO-PATSTAT
Automation in artificial intelligence	Number of patents in artificial intelligence registered by the firm in the period 2010–2019	EPO-PATSTAT
Automation in big data	Number of patents in big data registered by the firm in the period 2010–2019	EPO-PATSTAT
Automation in robotics	Number of patents in robotics registered by the firm in the period 2010–2019	EPO-PATSTAT
Independent variable		
Family ownership	Dummy variable taking the value 1 if a non-listed firm is majority-owned by the family or a listed firm is 20% owned by the family, and 0 otherwise	AIDA
Family members on BoD	Percentage of family members on the board of directors	AIDA
Young successors	Dummy variable taking the value 1 if at least one young family member is on the board of directors, and 0 otherwise	AIDA
Founding generation	Dummy variable taking the value 1 if the firm is in its first generation, and 0 otherwise	AIDA
Later generation	Dummy variable taking the value 1 if the firm is at least in the third generation, and 0 otherwise	AIDA
Control variables		
Firm dimension	Logarithm of domestic sales	AIDA
Firm age	Logarithm of number of years since firm foundation	AIDA
Automation pre-2010	Number of patents in automation registered by the firm before 2010	EPO-PATSTAT
Automation in artificial intelligence pre-2010	Number of patents in artificial intelligence registered by the firm before 2010	EPO-PATSTAT
Automation in big data pre-2010	Number of patents in big data registered by the firm before 2010	EPO-PATSTAT
Automation in robotics pre-2010	Number of patents in robotics registered by the firm before 2010	EPO-PATSTAT
Multinational status	Dummy variable taking the value 1 if the firm is part of a multinational group or has foreign subsidiaries, and 0 otherwise	REPRINT
Return on equity	Net income on equity	AIDA
Risk	Standard deviation of return on assets on the last five years	AIDA
Fixed assets	Fixed assets (euro, millions)	AIDA
Available slack resources	Cash flow on assets	AIDA
Recoverable slack resources	Capital investments on sales	AIDA
Potential slack resources	Long-term debts on assets	AIDA
North	Dummy variable equal to 1 if the firm is located in North Italy	AIDA
Centre	Dummy variable equal to 1 if the firm is located in Central Italy	
Industry	Categorical variable describing the industry in which the firm operates, with these levels: “Pavitt science based”, “Pavitt specialized suppliers”, “Pavitt scale and information intensive”, “Pavitt suppliers dominated”, “Pavitt other”	AIDA

Table 2.
Definitions and sources of the variables used in the empirical analysis

and the presence of founding and later generations. *Family ownership* indicates whether a family owns the firm and is a dummy variable taking the value 1 if a non-listed firm is majority-owned by the family or a listed firm is 20% owned by the family, and 0 otherwise (Cascino *et al.*, 2010). *Family members on BoD* is measured by the percentage of family representatives on the board of directors (Carney, 2005). The involvement of a young successor is measured by the variable *Young successors*, which is a dummy variable taking the value 1 if at least one young family member is on the board of directors, and 0 otherwise (Anderson and Reeb, 2003). Finally, the variable *Founding generation* is a dummy variable taking the value 1 if the firm is in its first generation, while *Later generation* is a dummy variable taking the value 1 if the firm is at least in the third generation.

Control variables. Control variables regard firm-specific characteristics. Firm dimension and age are included as they influence the propensity to innovate (Acs and Audretsch, 1987). *Firm dimension* is measured as the logarithm of domestic sales, while *Firm age* is given by the logarithm of firm age (Hölzl, 2014). Firm experience in innovating in automation is considered through four variables describing the number of patents in automation registered by the firm before 2010 (variables *Automation pre-2010*, *Automation in Artificial intelligence pre-2010*, *Automation in Big data pre-2010*, and *Automation in Robotics pre-2010*). We control for the multinational status of the firm (variable *Multinational status*), considered through a dummy variable, as multinational firms have greater knowledge and can better capitalize on investments in innovation (Kafouros *et al.*, 2008; Kotabe *et al.*, 2002). Since the propensity for innovation is associated with firm's profitability, this dimension is considered through the variable *Return on equity* (Acs and Audretsch, 1987). A measure of risk is also included in the analysis; *Risk* is given by the standard deviation of return on assets in the previous five years (Miller and Chen, 2004). *Fixed assets* is also included. As in Daniel *et al.* (2004), three types of slack resources are included: *Available slack resources* is given by the ratio between cash flow and assets; *Recoverable slack resources* is measured as capital investments on sales and *Potential slack resources* is given by as long-term debt on assets. The geographical area in which the firm operates (variables *North* and *Centre*) is considered as the context can affect both the strategy and the performance of firms (Wright *et al.*, 2007). Finally, the type of industry (variable *Industry*) is included based on the Pavitt Taxonomy to capture the structural differences among industries (Pavitt, 1984).

3.3 The econometric models

The estimated model evaluates the impact of FFs' characteristics on their propensity to innovate in automation (Model 1), controlling for the effect of firm characteristics. The model tests the four hypotheses by analyzing the impact of family ownership, the presence of family members on the board of directors, the involvement of young successors, and the presence of founding and later generations. Due to the count nature of the dependent variable, a Poisson regression is used. Formally, the equation is defined as follows:

$$\text{Automation} = \text{f}\,(\text{Family ownership, Family members on BoD, Young successors, Founding generation, Later generation, Control Variables}) \quad \text{(Model 1)}$$

As robustness checks, we examined the impact on automation by distinguishing the three types of automation technologies, i.e. artificial intelligence (Model 2), big data (Model 3) and robotics (Model 4). Formally, the equations are defined as follows:

$$\text{Automation in intelligence} = \text{f}\,(\text{Family ownership, Family members on BoD, Young successors, Founding generation, Later generation, Control Variables}) \quad \text{(Model 2)}$$

$$\text{Automation in Big data} = \text{f (Family ownership, Family members on BoD, Young successors, Founding generation, Later generation, Control Variables)} \quad \text{(Model 3)}$$

$$\text{Automation in Robtics} = \text{f Family ownership, Family members on BoD, Young successors, Founding generation, Later generation, Control Variables} \quad \text{(Model 4)}$$

4. Results

4.1 Descriptive statistics

Table 3 reports the means and standard deviations for the explanatory variables for the whole sample (Panel A) and the two subsamples of FFs and non-FFs (Panel B). The distinction between FFs and non-FFs is based on family ownership: a firm is defined as FF when it is majority-owned by the family if non-listed or is 20% owned by the family if listed.

On average, during the period 2010–2019 firms in the full sample registered 0.41 patents in automation (0.16 in artificial intelligence, 0.11 in big data, and 0.14 in robotics). Before 2010, firms in the whole sample registered 0.09 patents in automation (0.04 in artificial intelligence and in robotics, and 0.02 in big data). FFs registered fewer patents in automation than non-FFs, both in the period 2010–2019 and before 2010.

In the whole sample, 61.16% of firms are FFs. In the subsample of FFs, on average, 91.33% of family members are on the board of directors, and 88.65% of firms have at least one young family member on it. 48.35% of FFs are in their first generation, while almost 5% are at least in their third generation.

FFs are smaller and slightly older than non-FFs. 37.42% of firms in the whole sample have a multinational status; this percentage is slightly higher in the case of FFs (37.94%). Further differences between FFs and non-FFs emerge when analyzing the other control variables regarding the economic and financial situation, firm location and industry.

Non-parametric Wilcoxon rank tests were performed to analyze the differences between the means of the variables of FFs and non-FFs. FFs are significantly different from non-FFs regarding all variables with the exception of return on equity, available slack resources, centre, Pavitt scale and information intensive, and Pavitt other.

The correlation matrix shows acceptable correlation indexes between all regressors (Greene, 2003). The variance inflation factor (VIF), which is equal to 4.54, shows that multicollinearity is not a concern.

4.2 Empirical findings

Table 4 shows the regression results for the models developed. Of the 4,150 observations used in the regression analysis, 2,538 (61%) refer to FFs, while 1,612 (39%) to non-FFs.

In model 1, *Family ownership* has a negative and significant impact ($b = -0.6005, p < 0.01$) on innovation in automation, thus confirming hypothesis 1. *Family members on BoD* has a negative and significant impact ($b = -1.5906, p < 0.01$) on innovation in automation, thus supporting hypothesis 2. *Young successors* has a positive and significant impact ($b = 1.1730, p < 0.01$) on innovation in automation: Hypothesis 3 is confirmed. *Founding generation* has a negative and significant impact ($b = -1.2160, p < 0.01$) on firm innovation in automation: Hypothesis 4a is supported. Finally, *Later generation* has a positive and significant impact ($b = 0.7186, p < 0.01$) on innovation in automation, thus confirming hypothesis 4b. In summary, all our hypotheses were supported by the analysis.

Table 3.
Descriptive statistics

Variable	Panel A Full sample (4,150 firms) Mean/%	Std. Dev	Min	Max	FF (2,538 firms, 61%) Mean/% (1)	Std. Dev	Panel B Non-FF (1,612 firms, 39%) Mean/% (2)	Std. Dev	Wilcoxon rank test (1) vs (2)
Automation	0.41	3.80	0	191.00	0.20	1.77	0.73	5.6590	***
Automation in artificial intelligence	0.16	1.48	0	49.00	0.11	1.16	0.24	1.8658	***
Automation in big data	0.11	1.82	0	112.00	0.03	0.35	0.23	2.8786	***
Automation in robotics	0.14	1.46	0	56.00	0.06	0.49	0.27	2.2475	***
Family ownership	61.16%	0.49	0	1					
Family members on BoD	55.86%	0.50	0	1	91.33%	0.28			
Young successors	54.22%	0.50	0	1	88.65%	0.32			
Founding generation	52.41%	0.50	0	1	48.35%	0.50			
Later generation	5.18%	0.22	0	1	4.77%	0.21			
Firm dimension	6.83	1.21	0	10.45	6.79	1.13	6.90	1.33	***
Firm age	1.43	0.25	0.47	2.19	1.45	0.24	1.40	0.28	***
Automation pre-2010	0.09	0.28	0	1	0.06	0.25	0.12	0.3276	***
Automation in artificial intelligence pre-2010	0.04	0.18	0	1	0.03	0.17	0.05	0.2093	**
Automation in big data pre-2010	0.02	0.15	0	1	0.01	0.09	0.05	0.2107	***
Automation in robotics pre-2010	0.04	0.19	0	1	0.03	0.17	0.05	0.2223	***
Multinational status	37.42%	0.48	0	1	37.94%	0.49	36.60%	0.48	***
Return on equity	6.54%	22.99	−144.23%	109.26%	6.86%	21.15	6.02%	25.62	
Risk	4.52	11.47	0.03	327.88	4.11	11.59	5.15	11.25	***
Fixed assets	102.57	1311.00	0	56892.57	41.39	388.46	198.90	2042.94	***
Available slack resources	0.06	0.09	−1.11	0.83	0.06	0.08	0.06	0.11	
Recoverable slack resources	74.15	1699.50	−48.44	66970.91	24.97	390.40	151.57	2681.18	***
Potential slack resources	0.12	0.15	0	1.19	0.12	0.14	0.12	0.16	***
North	71.61%	0.45	0	1	69.86%	0.46	74.38%	0.44	***
Centre	18.84%	0.39	0	1	19.31%	0.39	18.11%	0.39	
Pavitt science based	12.43%	0.33	0	1	9.38%	0.29	17.25%	0.38	***
Pavitt specialised suppliers	27.40%	0.45	0	1	25.73%	0.44	30.02%	0.46	***
Pavitt scale and information intensive	11.88%	0.32	0	1	12.29%	0.33	11.23%	0.32	
Pavitt suppliers dominated	39.30%	0.49	0	1	43.50%	0.50	32.69%	0.47	***
Pavitt other	8.99%	0.29	0	1	9.10%	0.29	8.81%	0.28	

Note(s): Wilcoxon Rank test: Significance levels: $^{*}p < 0.1$ $^{**}p < 0.05$ $^{***}p < 0.01$
The variable "Family ownership" shows missing values with reference to the subsample of FFs and non-FFs as it denotes whether the firm is FF or non-FFs. The variables "Family members on the BoD", "Young successors", "Founding generation", and "Later generation" show missing values with reference to the subsample of non-FFs as they are not applicable for this type of firms. Non-parametric Wilcoxon rank tests were therefore not performed for these variables

Table 4. Regression results

	Model 1 automation	Model 2 automation in artificial intelligence	Model 3 automation in big data	Model 4 automation in robotics
Intercept	−2.3976 *** (0.3884)	−0.1063 (0.5922)	−2.5918 *** (0.7251)	−8.5132 *** (0.8637)
Family ownership	−0.6005 *** (0.2075)	−0.0553 (0.2934)	−1.8864 *** (0.7294)	−0.3041 (0.3248)
Family members on BoD	−1.5906 *** (0.0940)	−1.5215 *** (0.1296)	−1.5754 *** (0.2300)	−1.8089 *** (0.1734)
Young successors	1.1730 *** (0.2039)	0.8486 *** (0.2900)	2.0408 *** (0.7189)	0.9778 *** (0.3175)
Founding generation	−1.2160 *** (0.0838)	−1.4172 *** (0.1347)	−1.2789 *** (0.1638)	−0.8072 *** (0.1496)
Later generation	0.7186 *** (0.1110)	0.7947 *** (0.1937)	1.3083 *** (0.2064)	0.2183 (0.1906)
Firm dimension	0.6866 *** (0.0310)	0.5067 *** (0.0500)	0.5910 *** (0.0567)	0.9343 *** (0.0589)
Firm age	−2.9015 *** (0.1438)	−3.7713 *** (0.2241)	−3.0351 *** (0.2758)	−1.7045 *** (0.2805)
Automation pre-2010	1.6801 *** (0.0561)			
Automation in artificial intelligence pre-2010		2.8374 *** (0.0924)		
Automation in big data pre-2010			2.0766 *** (0.1094)	
Automation in robotics pre-2010				1.8817 *** (0.0974)
Multinational status	0.3012 *** (0.0585)	0.1184 (0.0967)	0.5260 *** (0.1155)	0.1511 (0.1106)
Return on equity	−0.0070 *** (0.0011)	−0.0004 (0.0018)	−0.0030 (0.0023)	−0.0156 *** (0.0016)
Risk	0.0086 *** (0.0016)	0.0086 *** (0.0026)	0.0094 *** (0.0028)	0.0080 ** (0.0036)
Fixed assets	0.0000 *** (0.0000)	0.0000 *** (0.0000)	0.0000 *** (0.0000)	0.0000 *** (0.0000)
Available slack resources	3.2332 *** (0.3282)	1.1019 ** (0.5154)	2.0044 *** (0.6367)	5.5422 *** (0.5142)
Recoverable slack resources	0.0000 *** (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0001 *** (0.0000)
Potential slack resources	−0.5186 *** (0.1886)	−0.3341 (0.2774)	−0.2054 (0.3490)	−1.1894 *** (0.3661)
North	0.1297 (0.1644)	0.1899 (0.2340)	−0.1507 (0.3293)	0.1123 (0.3260)
Centre	−0.1130 (0.1741)	−0.3936 (0.2541)	−0.1474 (0.3432)	0.0165 (0.3407)
Pavitt science based	1.3162 *** (0.1577)	0.5980 *** (0.1996)	1.7598 *** (0.3295)	2.4928 *** (0.5116)
Pavitt specialised suppliers	0.4987 *** (0.1597)	−0.4312 ** (0.2100)	0.7593 ** (0.3330)	2.2313 *** (0.5119)
Pavitt scale and information intensive	0.1867 (0.1698)	−1.0305 *** (0.2571)	0.1958 (0.3625)	1.6795 *** (0.5169)
Pavitt suppliers dominated	−0.1664 (0.1675)	−0.2930 (0.2053)	−1.1567 *** (0.4156)	0.5856 (0.5351)
Observations	4150	4150	4150	4150
R^2 Nagelkerke	0.780	0.640	0.592	0.675

Note(s): *$p < 0.1$ **$p < 0.05$ ***$p < 0.01$

Regarding control variables, *Firm dimension* has a positive and significant impact on innovation in automation, while *Firm age* has the opposite impact. Having registered patents in automation in the past increases in a significant way the propensity to innovate in automation (*Automation pre-2010*). The multinational status of the firm has a similar effect (*Multinational status*). *Return on equity* has a slightly negative and significant impact on innovation in automation, while *Risk* has a slightly positive effect. *Fixed assets* has no impact. Slack resources have a different (but always significant) impact on innovation in automation: *Available slack resources* has a positive impact, *Recoverable slack resources* has no impact, while *Potential slack resources* a negative effect. Variables describing firm's location (*North* and *Centre*) do not have a significant impact. Finally, industry variables have a positive and significant impact or a non-significant impact depending on the type of industry.

The results obtained from the regressions run as a robustness check, i.e. those examining the impact on automation by distinguishing the type of automation technologies (artificial intelligence, big data, and robotics), are generally in line with previous ones, but some changes in the magnitude of the impact can be observed (Models 2, 3 and 4). *Family ownership* has a negative and significant impact on innovation in big data and a non-significant impact on innovation in artificial intelligence and robotics. The impact of *Family members on BoD* is similar to that in model 1 regardless of the type of automation technology. The impact of *Young successors* remains positive, but becomes smaller for innovation in artificial intelligence and robotics while it turns larger for innovation in big data. Regarding *Founding generation*, its negative impact becomes larger for innovation in artificial intelligence, remains stable for innovation in big data and turns smaller for innovation in robotics. Finally, the impact of *Later generation* remains stable for innovation in artificial intelligence while it becomes larger for innovation in big data and non-significant for innovation in robotics.

Some changes in the significance and direction of the impact also affect some control variables in relation to certain types of automation technology.

5. Discussion

Our empirical finding supports the notion that family ownership, the presence of family members on the board of directors, the involvement of young successors, and the presence of funding and later generations affect FFs' decision to innovate in automation.

Family ownership is negatively associated with innovation in automation, despite losing significance when analyzing the impact on specific automation technologies (specifically, artificial intelligence and robotics). Our results support prior research, emphasizing that family ownership influences firm goals and priorities, thus affecting firm propensity to innovate (Calabrò *et al.*, 2019; Li and Daspit, 2016). Moreover, the unstable results obtained when considering specific automation technologies confirm prior research stating that family ownership should be analyzed together with other dimensions describing FFs (Block *et al.*, 2013). This consideration is important as FFs' effect in terms of innovation may be mainly driven by the presence of family members on the board of directors rather than by family ownership: while family ownership may simply reflect the need for representativeness, the actual distribution of decisional power in terms of innovation lies in the board (Block *et al.*, 2013).

The presence of family members on the board of directors has a negative effect on innovation in automation, irrespective of the type of automation technology. The importance of non-economic goals and priorities leads to a high commitment of the family, resulting in a great involvement in the decision-making process concerning strategic choices such as innovation. In the case of automation, non-economic goals and priorities of the family result in a lower propensity to innovate in automation. This result confirms the strong role of the presence of family members on the board of directors in decisions on innovation (Block *et al.*, 2013). Instead, non-family directors, who are not linked to family ties and the preservation of the SEW, may consider different alternatives based exclusively on economic goals and support innovation in automation.

The involvement of young successors is positively associated with innovation in automation irrespective of the type of automation technology. This result is consistent with previous research stating that when young successors are involved in a firm, the firm has greater innovative output and better management of innovation (Calabrò *et al.*, 2019). The participation of at least one younger family member on the board can be a source of open-minded initiatives (Miller and Le Breton-Miller, 2014). Moreover, as young successors may refer less to non-economic goals and priorities, they may be more rational and interested in the positive consequences of innovation in automation. Therefore, a young family member may promote innovation in automation by encouraging risk-taking and overcoming non-economic goals and priorities of FFs.

Finally, the presence of founding generation is negatively associated with innovation in automation, while the presence of later generation has the opposite impact irrespective of the type of automation technology. Scholars showed how founders may desire to build a robust firm to be passed on to later generations and thus focus on non-economic goals and priorities (Cruz *et al.*, 2014). In contrast, later generations may simply aim to benefit from the wealth and community status built by their FF and thus focus on the financial wealth (Lubatkin *et al.*, 2005; Sciascia *et al.*, 2014). Our results confirm prior research as it emerged that FFs at the founding generation refrain from innovating in automation to protect the non-economic goal and priorities of FFs. Instead, FFs at later stages are more likely to innovate in automation.

6. Conclusions

To our knowledge, this study is the first investigation that, based on SEW perspective, examines FFs' propensity to innovate in automation. We found that family ownership, the presence of family members on the board of directors, and the presence of the founding generation are negatively associated with innovation in automation. Instead, the involvement of young successors and the presence of later generations have the opposite effect. Our results thus support the notion that family presence affects FFs' decisions (Berrone *et al.*, 2012; Dibrell and Memili, 2019). Our results also confirm that FFs make different decisions from non-FFs and that such choices cannot be enlightened only through the traditional economic logic. For some decisions, such as those regarding innovation in automation, non-economic goals and priorities are also relevant.

From a theoretical point of view, our research contributes to the call of family business scholars on the analysis of the different dimension that characterize FFs (Daspit *et al.*, 2021; Dibrell and Memili, 2019). FFs cannot be simplistically viewed as uniform entities (Li and Daspit, 2016). As such, we proposed a framework that reflects the links between FFs' dimensions (i.e. family ownership, the presence of family members on board of directors, the involvement of young successors, and the presence of founding and later generations) and innovation in automation extending prior work on the governance as a source of heterogeneity (Daspit *et al.*, 2018). Previous studies agree that family involvement influences goal orientation (Gómez-Mejía *et al.*, 2007; Le Breton-Miller and Miller, 2015) and is a critical element when deciding on innovation (Carnes and Ireland, 2013). We advance the literature on the uniqueness of family governance as a source of heterogeneity (Carney, 2005; Daspit *et al.*, 2018) also in innovation decisions. This is an advancement in the family business literature both at the theoretical and empirical level. Empirical investigations on FFs have traditionally distinguished between FFs and non-FFs without further differentiating the former category. This might have been the primary reason for the discrepancies in the empirical results that characterize FFs' innovation. Specifically, we contribute to the challenge launched by Miller and Le Breton-Miller (2014) about the necessity to distinguish among the varieties of SEW priorities. In their inspiring work, the authors suggest that family business scholars need to invest in the SEW's drivers in order to characterize them more precisely, surround their diversity and tie-up them more directly to the firm's outcomes. In essence, we extend the specific aspect of how the generational differences may affect the strategic decision-making of FFs given the characteristics of founding and later generations and their impact on SEW priorities.

Our second contribution is an improvement in our understanding of FF strategic choice regarding innovation in automation by relying on SEW perspective. The existing literature on automation has primarily focused on the consequences of automation technologies, specifically the impact on firm employment, employees' satisfaction and well-being, and firm productivity. Our study shows, for the first time, that the decision to innovate in automation is not solely influenced by the traditionally analyzed (mainly economic) aspects. Still, non-economic goals and priorities are also relevant, at least in the case of FFs, which are primarily concerned regarding the family's relationship with employees, the inner pride of building and maintaining the family and firm image and reputation, and the inner feeling to be socially responsible. Thereby, our study responds to the call for more research on innovation in FFs (Calabrò *et al.*, 2019).

Third, we showed that it is fundamental to consider the type of innovation (i.e. specific technology) because it may generate different non-economic goals and priorities in the family and thus different strategic decisions. Following Li and Daspit (2016), our study contributes to the family business literature by describing different attitudes of FFs towards innovation strategies in automation. In addition, we offer understanding into the earlier inconsistent results relating to firm innovation behavior in family business studies.

Our findings are also relevant for practitioners and policymakers due to the increasing importance of automation and the consequences it entails.

For firms, automation technologies can be a source of competitive advantage (Acemoglu *et al.*, 2020). Family managers and consultants should be aware that non-economic goals and priorities may discourage FFs to innovate in automation though they may potentially benefit more from automation than non-FFs. The negative effect of family involvement on firm propensity to innovate in automation may be reduced by disseminating a deeper knowledge among FFs on the positive effect of automation. Moreover, our findings suggest that including non-family directors on the board of directors can be an antidote against the loss of the opportunities arising from automation (i.e. higher firm productivity). The inclusion of a young successor can be another positive factor as he/she can bring a variety of cognitive perspectives and knowledge and potentially encourage innovation in automation. However, in accordance to Miller and Le Breton-Miller (2014), later generations may merely point to advantage from the financial wealth of their FF. Thus, they are more likely to innovate in automation.

Evidence from this study could be used to design policies that promote innovation in automation by helping FFs carefully evaluate the positive and negative consequences of automation and overcome any resistance due to the influence of SEW. FFs need to be convinced that automation can be an opportunity to be seized and that the potential negative effects of automation (i.e. lower firm employment and lower employee's satisfaction and well-being) as well as repercussions in terms of non-economic goals and priorities can be mitigated or addressed.

This study is not devoid of limitations. First, since our sample focuses on Italy, our results may not be valid in other contexts. Italy has been in second place in Europe for the stock of robots since the nineties (Dottori, 2021). However, Italian firms lag in the adoption of other automation and digital technologies (Cirillo *et al.*, 2020) due to several factors such as the production structure, the high diffusion of small and medium-sized firms, and the family structure of firms (e.g. Bruno and Polli, 2017; Bugamelli *et al.*, 2012). Moreover, the diffusion of new technologies is uneven and usually focuses on a single technology (Cirillo *et al.*, 2020). Considering the characteristics of the Italian context, additional comparative studies are needed to understand how innovation in automation is affected by FFs and non-FFs in countries with different characteristics. Second, this analysis relies on patent data, implying that not patented innovations are excluded from the analysis, and therefore their impact cannot be understood. Moreover, patents tend to be less used by FFs (Block *et al.*, 2013).

Future research could expand the present analysis in several directions.

First, the influence of SEW on strategic decisions regarding innovation in FFs should be further analyzed. The defense of the SEW perspective could be evaluated from an economic point of view as a defense or resistance to the maintenance of jobs and human ties that can also be competitive differentials. The presence of the founding, the young and/or the later generations have an impact on strategic decisions.

Second, the differentiated impact of FFs' dimensions on innovation in automation suggests the opportunity to extend this line of analysis to additional features such as organizational experience and culture. This would give a more complete understanding of how heterogeneity in family FFs impacts innovation in automation (Li and Daspit, 2016).

Third, the impact of automation technologies depending on the sector should be further evaluated. For some sectors, the non-adoption of automation technologies may entail a strategic loss, of greater significance than the lower firm employment and lower employee's satisfaction and well-being that automation technologies imply. In these sectors, firms may be forced to adopt automation technologies and the impact on firm employment and employee's satisfaction and well-being must be only accepted.

Fourth, this study is built on a cross-sectional research design. Future studies may adopt panel data thus examining the dynamic interplay of non-economic goals and priorities and innovation in automation.

Finally, according to our finding and to the call from family business scholars (Calabrò *et al.*, 2019), we suggest developing specific studies considering the impact of the different types of innovation (e.g. automation, sustainability) on firm strategic decisions. Innovation cannot be treated as a homogeneous strategic decision.

In essence, the main suggestion of our study is to stress the need for additional theoretical and empirical research in managing technological innovation and FFs.

Notes

1. Social capital encompasses "social interactions, network ties, trusting relations, and value systems" (Sanchez-Famoso *et al.*, 2017, p. 138).
2. At the same time, automation technologies produce some compensation mechanisms, i.e. the indirect effects at economy-wide or sectoral levels that mitigate the initial reduction of employment (Acemoglu and Restrepo, 2019). The final impact could be a net decrease in employment (Acemoglu and Restrepo, 2019).
3. Following Dyer and Whetten (2006) definition, image is the impression that is intentionally projected to external audiences and is often tied to the firm's goals and strategies; reputation is how outsiders perceive the firm, based on information and assumptions that stakeholders (internal and external) have about it.
4. This database, released by the European Patent Office (EPO) on behalf of the OECD Taskforce on Patent Statistics, contains data on more than 100 million patent documents.
5. This inconsistency is due to these main reasons (Lotti and Marin, 2013): the names of applicants and inventors are collected under different name conventions; previous applications are not considered when adding a new applicant or inventor; a unique identifier is absent; other information such as addresses are not standardized.

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