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Family firm's management composition: the role played by family members' age in TMT and supervisor levels

M. Carmen Díaz-Fernández[1] · M. Rosario González-Rodríguez[1] · Marek Pawlak[2] · Biagio Simonetti[3]

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Abstract Family firms (FFs) are the backbone of entrepreneurial fabric in many countries. Management of such businesses is complex because of their features: the overlap between family and company, and roles played by several members of the owning family. In the paper we carry out a study regarding FFs management's age composition, focusing on the analysis of owning family' member's age within such companies in reference to a sample of Polish family joint-stock companies. Our main purpose is to understand how management is faced by the owning family according to the age composition of board members. Given the important role that the owning family has played for the survival of family businesses, the paper focuses on the study of management tasks based on the analysis of two management levels: Top Management Teams (TMTs) (senior management) and first level managers or supervisor level (the executive). This study has been assumed to be cognitive-exploratory. In general, we consider that the results achieved reveal key aspects of FFs' internal performance, responding to questions related to management. The results show the identification of a group of very young people aged 18–28 who are members of Supervisory boards. The average age of family members in Supervisory boards does not differ from the average age of family members in TMTs. The distribution of age of family members in TMTs and Supervisory boards is multimodal and can be split into Gaussian components. Different age components were found in Supervisory boards and in TMTs. The result achieved offers a more realistic and reliable view on the status of FFs, which can be very useful not only to its leaders but also to all the stakeholders related to it.

Keywords Family firms (FFs) · Family members · Owning family · Management · Management composition · Top Management Teams (TMTs) · Supervisors

✉ M. Rosario González-Rodríguez
rosaglez@us.es

[1] University of Seville, Seville, Spain

[2] The John Paul II University of Lublin, Lublin, Poland

[3] University of Sannio, Benevento, Italy

1 Introduction

In recent years, a greater recognition of the importance and value of family businesses has been observed in the literature (Casillas-Bueno et al. 2005; 2007, Naldi et al. 2007; Eddleston et al. 2008; Debicki et al. 2017; Marler et al. 2017). The significant impact that these organizations have had and still have on the economy of many countries has been addressed by many researchers and professionals (Gallo et al. 1999; Craig and Moores 2006; Gomez-Mejia et al. 2007; Amat Salas 2013) being a topical issue of growing interest and constant concern. In the international context, FFs account for between 80 and 90% of the total corporate fabric of a country, generating a high percentage of GDP in addition to a high employment creation (about 70% of the workforce employed) (www.infomipyme.com) (Casillas-Bueno et al. 2014). On the basis of previous results, the idea of a family business associated with inefficient, underdeveloped entities or with reduced training levels in relation to non-family companies begins to fall behind (Carney 2005). In fact more and more practitioners are defending that family businesses have certain characteristics (commitment, values, culture, trust, reputation…) and a modus operandi which become valuable intangible resources that can provide these family businesses specific competitive advantages guaranteeing their sustainable success (Leach 1993).

However, FFs face complex problems, since their constitution, not only limits their development (Belausteguigoitia Rius 2006) but can also prevent their continuity. The origin, the diversity and the consequences of this problem are as broad and changing as its own reality. Amat Salas (2000), Ward et al. (1994) and Lansberg (1983) place the origin of this problem in the following elements: family, property, business, management and succession, with special mention to the wrong management by the owning family. This management is characterized by the overlap and confusion between family and business, and thereby, the non-adequate exercises of the different roles played by their members. Thus, few companies reach the second and following generations. Accordingly, FFs should carry out a management characterized by the separation of both realities: family-company, as well as taking advantage of these realities. These strengths are traditionally materialized in elements inherent to the people who work in FFs, especially in the members of the owning family, such as fundamental values, membership or the unity of its members, knowledge, culture and idiosyncrasy and business modus operandi (Casillas-Bueno et al. 2014).

The main objective of this paper is to expand the knowledge of owning family management taking into account a variable widely considered in demographic and strategic literature such as age composition (Hambrick and Mason 1984), focusing on two relevant management levels as TMT and supervisors.

The results will enable us to provide a better comprehension and understanding of the role played by family members. Secondly, the results also allow us to show an initial vision of the role played by the two key family members, the founders and the young generations alongside the period of the study concerning the FFs management. These outcomes are relevant not only to guarantee the generational turnover, but also to accomplish FFs' goals and their survival. In order to achieve this purpose, the paper, after a first identification of the family members, extended the study of FFs' age composition focusing in particular on two different age groups: young people (the next generations of family firm owners) and the elderly (the founders). According to their characteristics, these types of studies have been defined as an exploratory cognitive analysis (Hernández et al. 1990). Following Díaz-Fernández (2004), an initial understanding of the phenomena through this type of analysis is necessary to be able to explain it using more complex statistical techniques latterly.

In addition, this research extends the analysis of management, firstly, by considering a type of firms scarcely considered in managerial research, the FFs. Previous research tends to analyze the management of a firm through their TMT composition focused on cases of large US companies. Secondly, compared to earlier works, analyzing the management of FFs by considering both TMT composition and supervisor's composition, therefore not exclusively the TMT; thirdly, going beyond traditional management studies to explore the participation and degree of the committee of the owning family members; and finally, considering an industrial context different from the usual one analyzed, as Poland.

The lack of continuity of many FFs in recent years has been counterproductive both for themselves and for the economy of many countries, given the significant impact that these entities have on these economies. The traditional consideration that an effective management by the owner family is the only way to solve this unwanted situation is the main argument that justifies this research.

The findings were based on a sample of 1626 Polish FFs and applying both the moving average and a bimodal distribution for the identification of the modal age components on TMTs and Supervisory boards. Furthermore, a multimodal distribution of age of family members in TMTs and Supervisory boards has been split into Gaussian components using a graphical method.

The paper is structured as follows. First, a brief introduction is presented. Second, the main topics and theoretical arguments are commented giving theoretical consistency and support to the theoretical framework of the paper. Third, the methodology is explained. Fourth, the more relevant results reached are exposed. Finally, there is a series of conclusive remarks.

2 Theoretical body: the role played by both TMTs and Supervisors levels

As noted by Family Firm Institute (FFI): "Family firms are the most common form of business entity in the majority of sectors of the world's economies" (FFI 2017). Furthermore, "Family-owned enterprises dominate global business, generating 70–90% of the world's gross domestic product" (Maloni et al. 2017, p. 123). Nevertheless, there is no one definition for FFs universally accepted that is able to comprise the family firm's whole complexity. In fact, the definition of FFs has been one of the most discussed issues in the managerial field over years persisting the lack of agreement until today (Kraiczy 2013).

However, despite this conceptual controversy, it is relevant to remark that, after a revision on the multiple academic definitions (see for example Kraiczy 2013 for a review), there is a strong agreement concerning the requirements that it is necessary for a firm to be considered a FF. These requirements can be summarized as follows: (1) a family member must be the owner; (2) the firm must be managed and controlled by the family over time; (3) the survival family firm is determined both by the continuity of the family in the firm ownership and the effective management of their members across generations of the family (Chrisman et al. 2004; Arregle et al. 2007). Accordingly, and in a general way, FFs, as any other organization, can be defined as "a systematic group of people aiming at a specific purpose" (Robbins and Coulter 1996, p. 4) and as every firm, the management tasks are so relevant to achieve their goals and the sufficient level of firm performance to guarantee its survival in the current complex, dynamic and global environment. These findings are so relevant for Economy and Society with implications for the stakeholders (Gedajlovic and Carney 2010; Wright et al. 2014).

In the management literature, in particular firm management, the following premises are widely assumed (Drucker 1974, 2012; Mintzberg 1989, 2008). First, the organizations are composed of two categories of individuals: managers and operational personnel where the former manage the activities of the latter (Robbins and Coulter 1996). Voordeckers et al. (2007) focusing on FFs have strived to determine this management composition in these type of family entities. Second, the correct firm performance and hence, the firm goals' achievement are needed to guarantee the firm survival, being the role played by the whole firm human resources very important, and the managers labor specially relevant (Child 1974; Haveman 1993; Díaz-Fernández 2004; Brunninge et al. 2007); In FFs research these previous assumptions are exposed by authors such as Combs (2008), who highlights the relevance of the different human resources in FFs by distinguish among the role played by different subjects such as servant, parasite and directors.

Third, the work run by these managers is quite arduous and complex, being executed in FFs through different hierarchical levels and different activities (Stoner et al. 1996). Thus, in a company the following managerial levels are distinguished:

(1) First-line managers (first level or supervisors): "Managers who are only responsible for the work of the operations employees and who do not supervise other managers, represent the first level, the lowest in the hierarchy of an organization" (Stoner et al. 1996, p. 17);
(2) Average management or intermediate managers: "Managers in the middle ranks of the organizational hierarchy, are responsible for other managers and depend on managers at the highest level" (Stoner et al. 1996, p. 17). "They are located between the level of supervision and the top *management of the organization*" (Robbins and Coulter 1996, p. 7); and
(3) TMTs: "Managers responsible for the general management of the organization, establish organizational policies and guide the interaction of the organization and its environment" (Stoner et al. 1996, p. 18). "They are responsible for making the decisions and for establishing the policies that affect all aspects of the company" (Robbins and Coulter 1996, p. 7). Researchers such as Carney (2005) and Bartholomeusz and Tanewski (2006) have focused their works on FFs aiming to determine the links between the managerial level previously detailed as determinants of the corporate governance of these FFs and the competitive advantage achieved in these FFs.

Forth, a correct functioning of the organization requires the assumption that "the management of the company is not a matter of a single individual, but a matter of all" (Kinicki and Kreitner 2008, p. 6), with adequate coordination and understanding between all these managerial levels, along with an efficient performance in the tasks undertaken by these and the rest of the workers that make up the company. Tasks and results in which, once again, the management, and concretely, the TMT plays an essential role. A management task whose knowledge in an environment like the current one acquires a special relevance being one of the most important and critical strategic resources to improve and reach the desired performance levels (Carrasco-Hernández and Jiménez-Jiménez 2016).

Bearing in mind the previous general managerial arguments and focusing on FFs, the paper encourages emphasizing the relevance of the adequate managerial action in these firms. This argument is widely shared by academics and practitioners (Daspit et al. 2017; Carr and Ring 2017). Besides, "existing management research has validated that family businesses often behave differently than non-family (Maloni et al. 2017, p. 123), and

as consequence, that family businesses are different from others (Chrisman et al. 2004). "Yet, the ownership, management, and family composition in FFs create a complexity that requires special knowledge and skills in order to understand them and to advise them effectively" (FFI 2017).

At this point there is no doubt that the continuity of the FFs can be guaranteed by good management in the hands of the various members of the owing family. This family management must be able to solve the common problems for both FFs and any type of firms (Mehrotra et al. 2011). From this perspective, the younger generations under the constant supervision and guidance by the FFs' founders start their professional career by occupying and performing management tasks from the lowest levels (as supervisors) to the upper levels in the FFs' hierarchical scale as those in TMTs (Aronoff and Ward 1995; Bork et al. 1997; Bird et al. 2002).

According to previous arguments, it is possible to formulate the following research question:

RQ in family businesses, the burden of management work, the most important strategic tasks, are undertaken by older, more experienced members, the founders (senior members) as well as supervision tasks (the executive) are undertaken by younger individuals under the supervision of TMT members.

To answer this question and based on the analyzed database, it is possible to make an assumption about the distribution of the family members' age.

H1 The distribution of age composition of family members on TMT and Supervisory Boards is a bimodal distribution.

3 Method

As already mentioned, the paper mainly aims to analyse the management profile of family firms due to the relevant role that these type of entities play in the economy. This paper, in line with the majority of the family firm research, is focused on firms where ownership is linked with a family who manages and controls the firm. The effectiveness of the management makes the family firm possible to survive over time alongside the different family ownership's generations (Birley 2002; Casillas-Bueno et al. 2014).

First, the research strives to analyse the age composition of Family Firm's management focusing on TMT's and supervisor's level or Supervisory boards. The result led us to provide a better comprehension and understanding of the role and relevance played by the family members both in the management of this type of firms and the results achieved. Second, the findings also lead us to show an initial vision of the role played by two key family members, founders and young generations in the period of the study. This knowledge is pertinent in order to know not only how the firm progress but also about the generational change, and thereby the achievement of FFs goals and survival. In order to achieve this purpose, the paper, after a first identification of the family members, has extended the study of the FFs' age composition by focusing particularly on two different age groups: young people (next generations of family firm owners) and the elderly (founders)-in the prime of life and being retired. This study is assumed to be cognitive-exploratory (Hernández et al.

1990) being adequate by following to Díaz-Fernández (2004), since an initial first understanding of the phenomena is necessary to explain the phenomenon.

The sample size is composed of Polish family joint stock companies due to the largest number of these one in active during the period considered. This data was obtained from sufficient credible and well-known database, 'kkpsk' ("leading staff of Polish corporations"). The database was created in 2005 as a tool for corporate governance studies (Pawlak 2006, 2007). Since 2009, the database has been partially accessible via the Internet http://www.bdkkpsk.info/baza/index.php and enables, among others, to find joint stock companies registered in Poland performing a specific business activity http://www.bdkkpsk.info/przedmiot_dzia_a.php.

The database is updated to a large extent automatically (Pawlak 2008) on the basis of official data currently published by the National Court Register on the Internet at https://ems.ms.gov.pl/msig/monitoring and currently includes data on 12,798 joint stock companies and 117,688 people. The database contains data from 2001 and it is a complete set of joint stock companies operating in Poland since that year and about persons sitting on the TMTs and Supervisory boards of these companies.

More than 88% of people in the database have a PESEL number. It identifies the gender and includes the date of birth (day, month, and year—in the form of six digits). This allows for a detailed study of the age of persons including the age of family members. People who do not have a PESEL number are usually foreigners, but many foreigners also have this number so it cannot be used to identify whether someone is a foreigner or not.

The number of family companies in Poland is steadily growing and in 2014 it was reported to be 1626. Due to the largest number of active joint stock companies this year has been adopted for further detailed analysis.

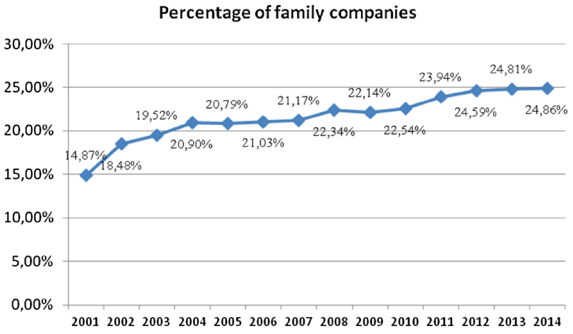
The final sample size was conditioned by certain assumptions: It is assumed that a family company is one in which the management level analyzed (TMT's and supervisor's level) sit at least two people with the same family name. Only active companies were considered, that is, those that announced that they had published their financial statements. As a result of this research, non-performing companies were excluded from the survey. On the other hand, this approach omitted in the research the companies that have been registered, but they have not yet announced that they have published the financial statements. Usually, the announcement of the financial statements is made within a delay of several months, but this delay can also be many years.

Moving average and the bimodal distribution have been applied for the identification of the modal age components on TMTs and Supervisory boards. In addition, the multimodal distribution of age of family members in TMTs and Supervisory boards has been split into Gaussian components using graphical method (Folk and Ward 1957, 1967; Bajgier and Aggrawal 1991).

4 Results

4.1 Management FFs' composition: Studies of family members' age in TMT's and Supervisor level

The phenomenon of family businesses in Poland began to grow after 1989. During the years 2001–2014, which are of particular interest here, it is possible to observe their constant



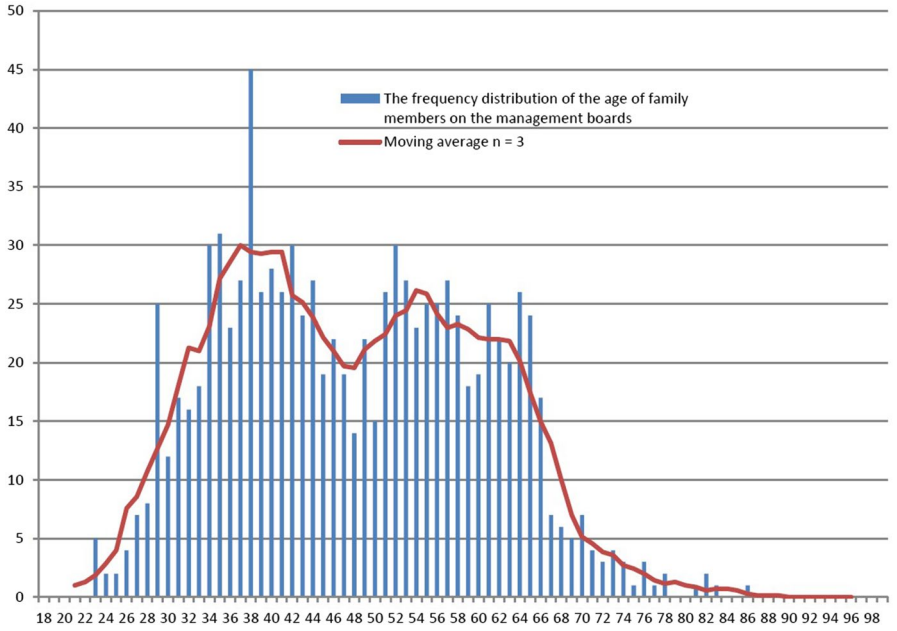


Fig. 1 FFs evolution in period 2001–2014

Fig. 2 The frequency distribution of the age of family members on the management boards of family companies in the year 2014

growth. Figure 1 shows the number of FFs as a percentage of all companies. It can thus be assumed that around 25% of joint-stock companies registered in Poland are FFs.

Over many years, studies regarding the age composition of Polish joint-stock companies identified two relevant groups, the group with age between 18 and 19 years old and people aged 90 years old or more. Figures 2 and 3 show the frequency distribution of owning family members' age in the management boards and Supervisory boards in the year 2014. The figures are calculated by using the moving average

$$F_t = \frac{A_{t-n} + A_{t-n+1} + \cdots + A_t + \cdots + A_{t+n-1} + A_{t+n}}{n \cdot 2 + 1}$$

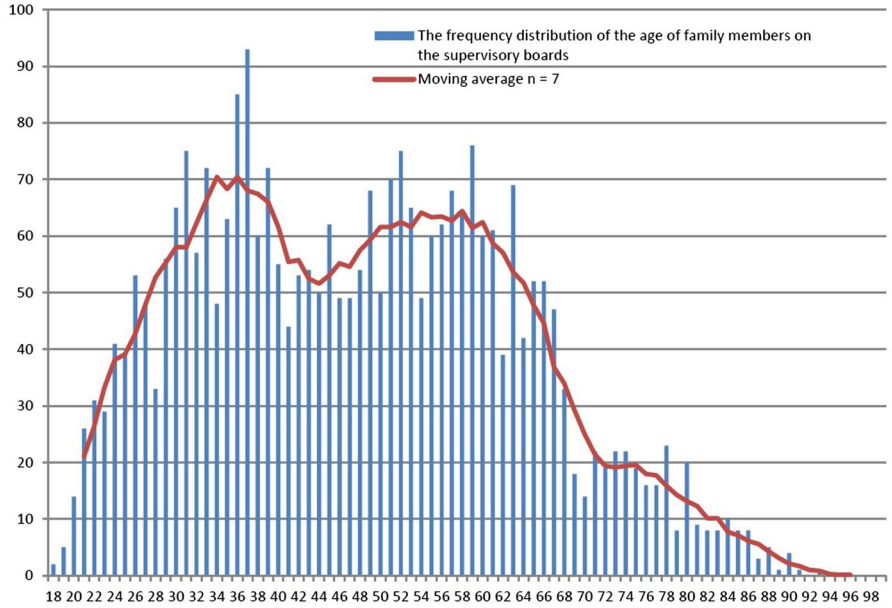


Fig. 3 The frequency distribution of the age of family members on the supervisory boards of family companies in the year 2014

The use of the moving average for the graphical identification of modal values is similar to the approach used by Folk and Ward (1957).

A visual analysis of the two frequency distributions allows us to note two phenomena: Firstly, in the case of Supervisory boards, a relatively large group of young people around 18–24 years old, and of older people aged between 72 and 88 can be identified. In the case of the TMT, such groups do not exist.

The variance of the age of the Supervisory boards is much higher than the variance of the age of the TMTs (Table 1), thus the results based on Figs. 2 and 3 are confirmed. In the case of the Supervisory board gap, it is much larger. The minimum age is also smaller, and the maximal age value higher in the Supervisory board in comparison to TMTs. An important observation is that the average age of the family members in the Supervisory boards is

Table 1 Descriptive age statistics of TMTs and supervisory boards

	N	Range	Min	Max	Mean	Standard deviation	Skewness		Kurtosis
							Statistic	Standard deviation	
Descriptive statistic									
Top Management Team	890	63	23	86	48.02	12.116	.211	.082	−.732
Supervisory boards	3053	75	18	93	47.91	15.616	.277	.044	−.682

slightly lower than the average age of the family members on the management boards (but this difference is not statistically significant).

For a distribution, a skewness value higher than twice its standard error indicates a deviation from the symmetry of the distribution. In our case, this relationship exists, so the two distributions can be regarded as unbalanced. This is not surprising since the minimum age of the boards members is as low as 18, while an upper age limit does not exist. The skewness is much higher in the case of Supervisory boards.

A positive kurtosis indicates that, compared to a normal distribution, the observations are more concentrated around the centre of the distribution and have thinner ends to the extreme values of the distribution. In our case, we are dealing with a negative kurtosis, so the distributions for both TMTs and Supervisory distributions are platykurtic. The kurtosis for TMTs is smaller than that for Supervisory boards being thus more platykurtic. Another phenomenon that can be observed in Figs. 2 and 3 is that those distributions are bimodal.

4.2 Study of bimodal distributions

In order to test the hypothesis that it is possible to use the Larkin (1979) test. This test is based on the following assumption: it is assumed that both modes fall somewhere near the maximum of normal or quasinormal subdistributions. None of the modes in the distribution should be located near an extreme. As illustrated in Figs. 2 and 3, the distributions meet these goals. As described by Larkin, the distribution should be divided into two parts repeatedly, once at each bin between the end points. The mean and variances of the two parts are computed each time. The lowest such mean variance is used to represent the variance of distribution considered as bimodal. In the next step, the F ratio between the unimodal and bimodal variances is returned as an index of bimodality. As Larkin (1979) writes, the F value is small if the population is unimodal, and large when the population is bimodal. The test results are shown in Table 2.

Based on the examples of the F values specified in Larkin's article, we can assume that the two distributions are bimodal.

4.2.1 The study of parameters of bimodal distributions

In the case of the study of bimodal distributions that are skewed, and differing in kurtosis from the normal distribution, other methods should be used than in the case of unimodal distributions. Below, the approach proposed by Folk and Ward (1957), who studied the

Table 2 Results of the Larkin test

	Mean	Variance	*F ratio*
The first part of TMT members population	37.69	31.085	4.722
The second part of TMT members population	58.36	48.690	
The whole population of TMT members	48.02	146.795	
The first part of supervisory board members population	34.74	51.680	4.718
The second part of supervisory board members population	61.06	89.470	
The whole population of supervisory board members	47.91	243.849	

distributions of the characteristics of the size of grains of sand in the river, is used. They proposed using the following formula for calculating the mean value:

$$M_z = \frac{Ø16 + Ø50 + Ø84}{3}$$

Ø16, Ø50 and Ø84 are the 16th, 50th and 84th percentile of the distribution.According to previous formula, in the case of management boards $M_{ZZ} = 47.66$ and in the case of Supervisory boards $M_{ZRN} = 47.33$

Here, the average age of the Supervisory board members is also smaller than the average age of the management board members.

In order to calculate the variance and standard deviation, Folk and Ward (1957) propose the following formula, describing it as "Inclusive Graphic Standard Deviation":

$$\sigma_I = \frac{Ø84 - Ø16}{4} + \frac{Ø95 - Ø5}{6.6}$$

For the populations studied here, the values of standard deviation are as follows:

$$\sigma_{IZ} = 12.308; \quad \sigma_{IRN} = 15.868$$

4.2.2 Calculation of skewness

In order to calculate the skewness of bimodal distribution, Folk and Ward (1957) suggests the following formula, named it as "Inclusive Graphic Skewness":

$$Sk_I = \frac{Ø16 + Ø84 - 2Ø50}{2(Ø84 - Ø16)} + \frac{Ø5 + Ø95 - 2Ø50}{2(Ø95 - Ø5)}.$$

For the populations considered here, the calculation looks as it does below:

$$Sk_{IZ} = 0.069; \quad Sk_{IRN} = 0.062.$$

The values calculated are very small, which indicates a lack of distribution skewness. As Folk and Ward (1957) write, a Sk_I from $-.10$ to $+.10$ indicates that the distribution is almost symmetrical. Skewness is higher in the case of the management boards.

4.2.3 Kurtosis

For bimodal distributions, Folk and Ward (1957) propose the following formula for calculating Graphic Kurtosis:

$$K_G = \frac{Ø95 - Ø5}{2.44(Ø75 - Ø25)}.$$

For normally distributed curves $K_G = 1.00$. For $K_G = 2$, distribution is leptokurtic. If $K_G = .7$, the distribution is platykurtic. In our case:

$$K_{GZ} = 0.84; \quad K_{GRN} = 0.86.$$

The smaller value of Graphic Kurtosis for the Supervisory boards indicates that there is greater age diversity in this group—the distribution is more platykurtic. This confirms the results shown in Table 1.

4.3 Identification of modal values

Bajgier and Aggrawal (1991) propose a method for identifying Mixed Normal Distributions, but it can only be used for balanced distributions—in our study, the distributions are not balanced. Clark (1976) describes three groups of methods for the statistical analysis of multimodal distributions: analytical, graphical and numerical. The advantage of graphical methods is their conciseness and ease of understanding. For those reasons they are used here.

A graphical method was proposed by Bhattacharya (1967) and applied by him to the studies of fish populations. As the author writes, the frequency distribution of the length of the fish obtained from a population is usually skewed, and multimodal. In many cases, the modal values correspond to different age groups and are very helpful in identifying them. The author also warns against identifying modal values based on the histogram by "smoothing" them.

The approach proposed by Bhattacharya (1967) is used here to study the age of family members in the population of Supervisory boards and TMT members. To do this, we need to identify the range of values, to determine the incidence of interval(s), and to count the value log10y and Δlog10y.

Figures 4 and 5 show the plots of Δlog10y in relation to the value of the mid-point for the management boards and the Supervisory boards. The figures also show so-called "straight regions" to identify the components of the distributions. It can be seen that the frequency distribution of the age of the management board members consists of two sub-normal distributions (two-modal points), and the frequency distribution of the age of the Supervisory board consists of three sub-normal distributions (with three modal points).

As identified by Bhattacharya (1967), "While matching the straight line it is better to fit closely to the points where the frequency is large even if the apparent discrepancy becomes somewhat large where the frequency is small".

The mean values of each of the constituent components may be determined based on the formula:

$$\widehat{\mu}_r = \widehat{\lambda}_r + \frac{h}{2}$$

where $\widehat{\mu}_r$—the mean value for component r; $\widehat{\lambda}_r$—x-intercept for the rth line; h—class interval.

The variance and standard deviation of each of the components we calculate according to the formula:$\widehat{\sigma}_r^2 = \left(d \cdot \log e \cdot h \cdot \cot \widehat{\theta}_r / b\right) - \left(h^2/12\right)$.where $\widehat{\sigma}_r^2$—variance, b—relative scale for x; d—relative scale for Δlog$y$; $\widehat{\theta}_r$—angle of line r with the axis x.

On the basis of Fig. 5, we can identify the following interception points of lines r and the x-axis, and also the interception angles for the TMTs:

$$\widehat{\lambda}_{1Z} = 37.5; \quad \widehat{\lambda}_{2Z} = 52.5; \quad \widehat{\theta}_{1ZA} = 68.5°; \quad \widehat{\theta}_{2ZA} = 52.3°$$

This allows us to calculate the mean values for the three components of distributions for the management boards:

$$\widehat{\mu}_{1Z} = 37.5 + \frac{4}{2} = 39.5; \quad \widehat{\mu}_{2Z} = 52.5 + \frac{4}{2} = 54.5;$$

The readings from the diagram are as follows: $b = 1.98$; $d = 121.19$. This allows the calculation of variance. Thus, for the first distribution for TMT, the variance and the standard deviation is as follows:

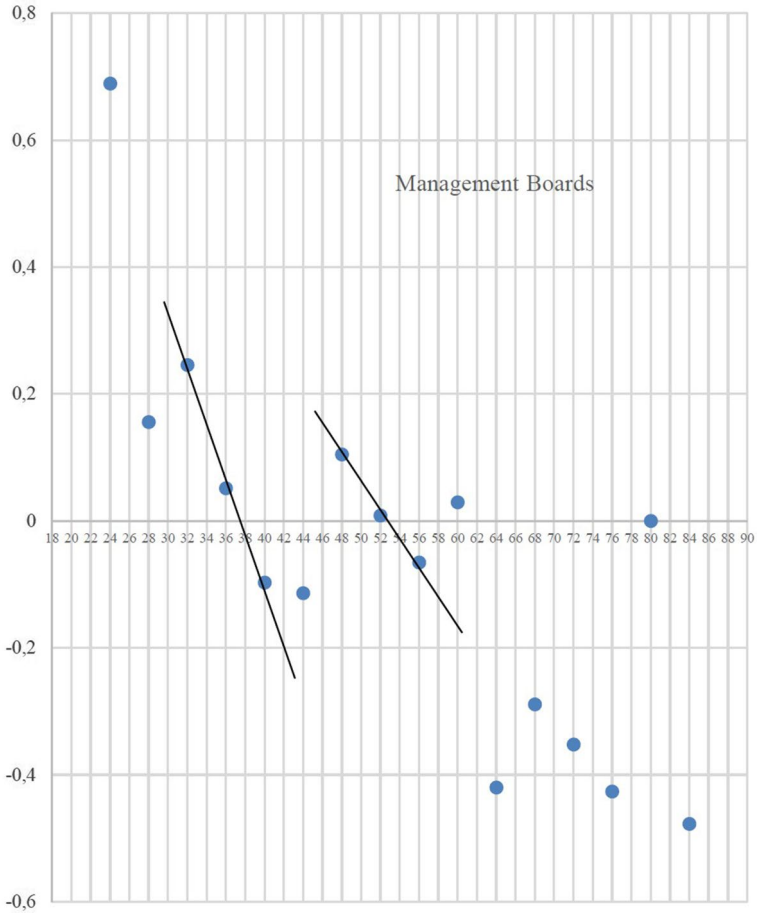


Fig. 4 Graph of logarithmic differences of the class-frequencies against the mod-points of the classes for Top Management Team

$$\widehat{\sigma}^2_{1Z} = 40.32; \quad \widehat{\sigma}_{1Z} = 6.35.$$

For the second component distribution by analogy, we obtain:

$$\widehat{\sigma}^2_{1Z} = 80.80; \quad \widehat{\sigma}_{1Z} = 8.99.$$

Based on Fig. 5, the following intersection points can be identified and at the same time the mean values of the three decomposition components for Supervisory boards:

$$\widehat{\mu}_{1RN} = 33 + \frac{4}{2} = 35 \quad \widehat{\mu}_{2RN} = 56 + \frac{4}{2} = 58 \quad \widehat{\mu}_{3RN} = 72 + \frac{4}{2} = 74$$

The readings from the diagram of the angles of inclination are respectively:

$$\widehat{\theta}_{1RN} = 60.6°; \quad \widehat{\theta}_{2RN} = 51.4°; \quad \widehat{\theta}_{3RN} = 56.3°.$$

Standard deviation calculations give the following results:

$$\widehat{\sigma}^2_{1RN} = 53.76; \quad \widehat{\sigma}_{1RN} = 7.33 \quad \widehat{\sigma}^2_{2RN} = 76.91; \quad \widehat{\sigma}_{2RN} = 8.77 \quad \widehat{\sigma}^2_{3RN} = 64.00; \quad \widehat{\sigma}_{1RN} = 8.00$$

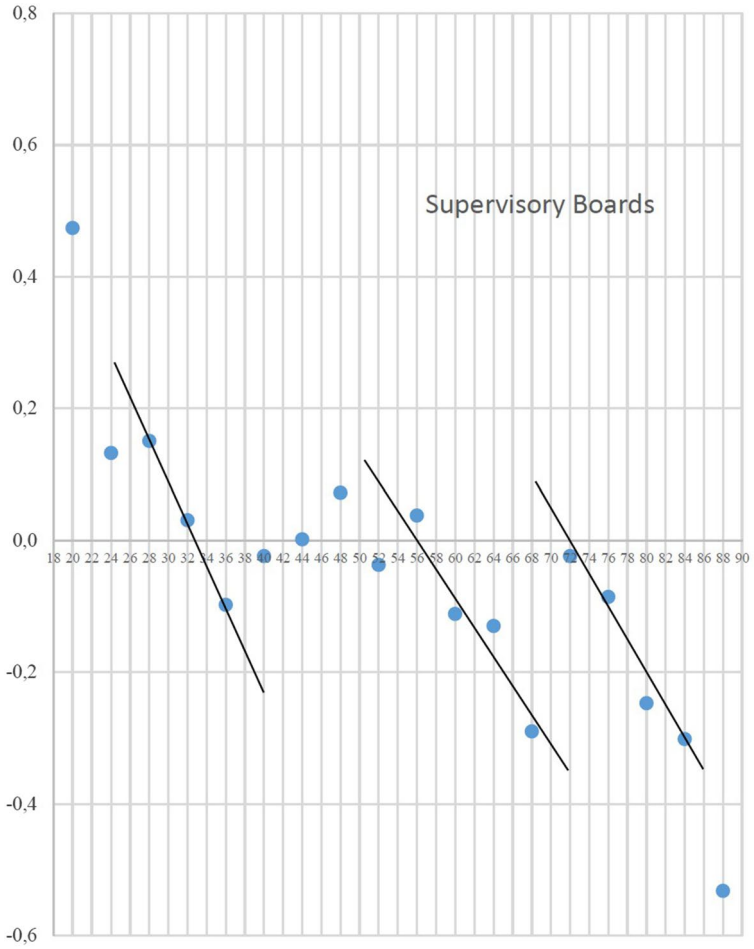


Fig. 5 Graph of logarithmic differences of the class-frequencies against the mod-points of the classes for supervisory boards

5 Identification of partial distributions (resolution into Gaussian components)

Bhattacharya's approach also allows for the identification of partial distributions (assuming they are normal distributions) and determining the size of the components of the population—two different age groups for TMTs and three for Supervisory boards. In the approach used, the following formulae for calculating the number of elements in each group is used (Bhattacharya 1967):

$$P_i(x) = P\left(\frac{x + \frac{1}{2}h - \mu_i}{\sigma_i}\right) - P\left(\frac{x - \frac{1}{2}h - \mu_i}{\sigma_i}\right), \quad Y = \sum_{i=1}^{k} N_i P_i$$

For simplicity, an estimate of the total frequency of each component was worked out by considering only two classes near the centre of the straight region (closest to the modal values).

For TMTs and Supervisory boards of population discussed here, the number of elements in each group (N_i) can be calculated as follows for the management boards, where x is calculated according to the equation above and $P_i(x)$ is read from the probability distribution function of the Gaussian distribution. Thus:

$$\widehat{P}_{1Z}(36) = 0.21302; \quad \widehat{P}_{1Z}(40) = 0.24656; \quad N_{1Z} = \frac{y(36) + y(40)}{\widehat{P}_{1Z}(36) + \widehat{P}_{1Z}(40)} = \approx 514.$$

$$\widehat{P}_{2Z}(52) = 0.16754; \quad \widehat{P}_{2Z}(56) = 0.17565; \quad N_{2Z} = \frac{y(52) + y(56)}{\widehat{P}_{2}(52) + \widehat{P}_{1Z}(56)} = \approx 577$$

$$N_Z = N_{1Z} + N_{2Z} = 514 + 577 = 1091$$

The actual number of TMT members is 973, so the total error of the estimate is 118, that is, over 12%.

For Supervisory boards, the calculation results are as follows:

$$\widehat{P}_{1RN}(32) = 0.20399; \quad \widehat{P}_{1RN}(36) = 0.21477 \quad N_{1RN} = \frac{y(32) + y(36)}{\widehat{P}_{1RN}(32) + \widehat{P}_{1RN}(36)} = \approx 1332$$

If we wish to subtract people under the age of 18, the value would be 1323

$$\widehat{P}_{1RN}(17) = 0.00695; \quad 1332 \cdot 0.00695 \approx 9. \quad \text{It is about 9 people.}$$

$$\widehat{P}_{2RN}(56) = 0.17724; \quad \widehat{P}_{2RN}(60) = 0.17724 \quad N_{2RN} = \frac{y(56) + y(60)}{\widehat{P}_{2RN}(56) + \widehat{P}_{2RN}(60)} = \approx 1410$$

$$\widehat{P}_{3RN}(72) = 0.19146; \quad \widehat{P}_{3RN}(76) = 0.19146; \quad N_{3RN} = \frac{y(72) + y(76)}{\widehat{P}_{2RN}(72) + \widehat{P}_{2RN}(76)} = \approx 391$$

Thus, the total number of Supervisory board members based on the estimation is:

$$N_{RN} = N_{1RN} + N_{2RN} + N_{3RN} = 1323 + 1410 + 391 = 3133.$$

This is a value greater than the actual number of members. The estimation error is: $3133 - 2983 = 150$, which is about 5%. The error here is smaller than in the case of management boards.

One of the reasons for the errors reported here is the fact that the values of y in the interval $x \pm 1/2\ h$ are taken into account in the calculation, assuming that there are only elements of one of the partial distributions. In fact, there are also a few elements from other distributions and perhaps for this reason the estimated number of group members is higher than the actual number. This overestimation for management board is shown on Fig. 6.

As identified, the error appeared especially when estimating the size of the first (younger) group. In the interval $\widehat{\mu}_{1Z} = 39.5 + 2$ there are also elements belonging to the second partial distribution.

Estimation for boards of directors is shown on Fig. 7. In this case we do not have so many overlapping regions therefore estimation is in this case much better. An overestimation seems to be in the case of the third oldest group $\widehat{\mu}_{2RN} = 74 + 2$.

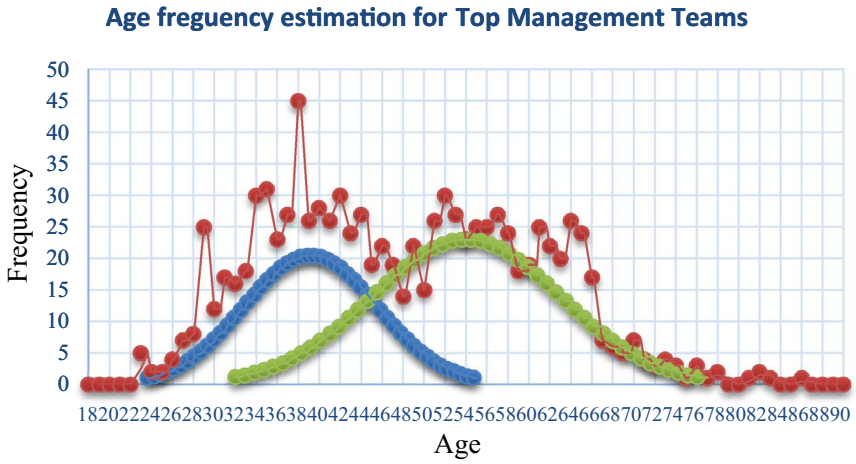


Fig. 6 Estimation of partial Gaussian distributions for Top Management Team

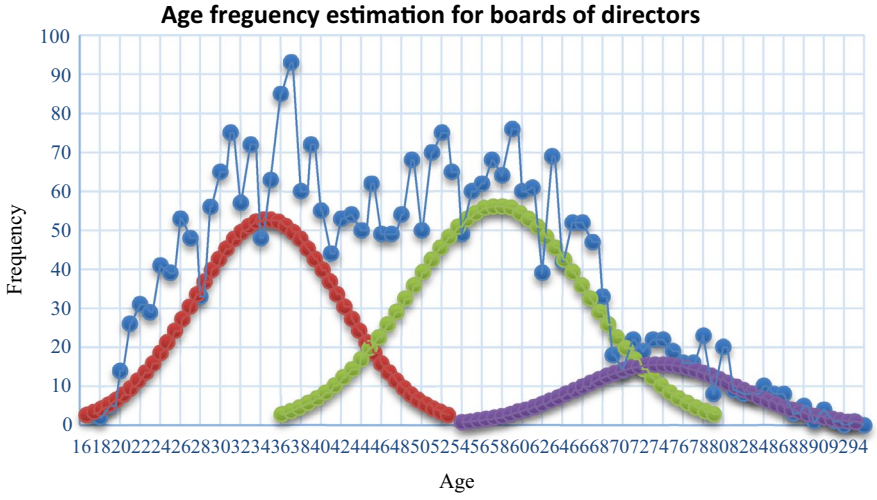


Fig. 7 Estimation of partial Gaussian distributions for boards of directors

As many studies and trials have shown, the effect of the method used here depends largely on the size of the class. In this case, a value of 4 was assumed, but further experiments for sizes 5, 6 and 7 would have to be made and the results compared.

6 Discussion and conclusion

In the academic literature most authors argue that the FFs continuity can be guaranteed by the owning family's right management (Danco 1992; Schultze et al. 2003; Cabrera-Suarez 2005; De Massis et al. 2013). This management has to be able to solve the

problems common to any company and proper to their status as Family Firm by taking advantage of the strengths of FFs. Good management must also be characterized by a high degree of commitment, participation of the family owner, the member's professionalization and the delegation of functions, tasks and responsibilities. FFs, like any company, are created to be profitable, being this only achieved through efficient and effective management, knowing, delegating and trusting other members of the company that will progressively join the new generations (More 2013).

The unit of analysis of the study described here was the population of family members who are members of TMT's and Supervisory boards in joint-stock companies owning family in Poland. The most important goals are the identification of a group of very young people aged 18–28 who are members of Supervisory boards. It can be hypothesised that for such young family members, the Supervisory board is a place for gathering experience and learning about how to manage a joint-stock company. These people are still too young and to inexperienced to perform functions independently on the management boards.

The average age of family members in the Supervisory boards is smaller than the average age of family members in the management boards, although this difference is not significant. This finding is contradictory to the theoretical assumptions and the current results of research as reported in the literature, since members of the Supervisory board are generally older and more experienced than management board members. Only with the right knowledge and experience can the Supervisory board members effectively supervise the work of the management boards. This phenomenon again indicates that the Supervisory boards in family companies are different from the Supervisory boards in other companies.

The method used to graphically identify the Gaussian components in the population of members of the Supervisory boards and the management boards gave satisfactory results. Two normal components for management boards and three normal components for Supervisory boards were separated. Errors in the estimation were as high as 12 and 5%. This method requires further testing and refinement. As numerous experiments (not described here) have shown, it is important to correctly identify the class range. In the studies described, a value of 4 was taken, but one would have to look for better values, which could be different values for the management boards and Supervisory boards, and even different values for the identification of individual subdivisions within the two groups studied. The method itself is not difficult, and could be used in other areas of research to identify Gaussian components in multimodal distributions.

As a conclusion of the study, on one hand we highlight from the results achieved, the fact that most of FFs analyzed are in a stage of maturity, possibly at the beginning of the succession process characterized by a progressive incorporation of new generations of family businesses to managerial positions. The younger family members start at the supervisor level to reach progressively the TMTs' levels.

On the other hand, we again emphasize the harmful consequences of the disappearance of the FFs after a poor management for the owning family, their stakeholders (customers, suppliers, shareholders, workers…) and the region and the economic where it operates. These circumstances not only revive the interest and growing concern for the study of these business entities but also reinforce the growing motivation that both professionals and practitioners show to achieve the keys to an effective and efficient management of the same guarantors not only of their survival, but also of its growth in the current environment (Saldaña et al. 2013; Belausteguigoitia Rius 2006; Casillas-Bueno et al. 2014).

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