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A Fuzzy-set Hierarchical Classification of Family Firms

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Abstract

Family firms can be thought of as heterogeneous configurations where ownership, governance, management and succession are often intertwined. Previous works have typically used a partial definition of family firm based on one or more of these three aspects. In this empirical work we seek to clarify the definitions and typologies of family firms by using fuzzy sets qualitative comparative analysis (fs/QCA). Based on this methodology, we propose a hierarchical classification of family firms based on necessity and sufficiency conditions, including some possible overlapping among alternative types. We use an international sample of 6,611 companies from different industries and national/legal systems.

JEL Codes: M10, M13, M19
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> A [taxonomy] is a statement that a large number of variables have only a small number of combinations of values which actually occur, with all other combinations being rare or nonexistent. This results in a radical improvement in scientific theory (Stinchcombe, 1968: pp. 47).
>
> Stinchcombe, A. L. (1968). Constructing social theories. Chicago: University of Chicago Press.

Introduction

Since the publication of Lansberg, Perrow and Rogolsky (1988) editorial note in the first issue of *Family Business Review* asking "what is a family business?" scholars have tried to provide operational and theoretical definitions that capture the essence of what a family firms is and how it differs from non-family business in the economy (Chua, Chrisman and Sharma, 1999). These definitions can be roughly classified into *components-based* and *essence-based* definitions (Chua, Chrisman and Sharma, 1999; Sharma and Nordqvist, 2007).

Definitions based on the components of family involvement –ownership, governance, management and succession– (Westhead and Cowling, 1998; Klein, Astrachan, Smyrnios, 2005; Sharma and Nordqvist, 2007) are easier to operationalize than essence-based definitions which are based on firm' owners and managers reflections about on whether they consider themselves a family firm or not and, in general, the behavioral consequences of family involvement in business (Chua et al., 1999; Klein et al., 2005; Sharma and Nordqvist, 2007). Both, the *components* and the *essence-based* elements must be present in a given firm in order to assert that such a company belongs to the set of family firms. "The existence of the components makes the essence possible" (Chua et al., 1999: 24); therefore, the existence of the *components* is a necessary condition but not sufficient to fully characterize a family business.

This paper tries to shed some new light on the internal structure of *components-based* definitions and characterization of family firms. For that purpose, we introduce a novel methodology in this literature that has recently started to be used in management research: fuzzy set analysis (Fiss, 2007; Ragin, 2008). Set-theoretic and fuzzy sets approaches, based on set and subset relationships, allow a deeper understanding of necessary and sufficient causal conditions explaining a given outcome (Fiss, 2009). We argue that the relations existing between the different components of family involvement in definitions of family firms found in the literature may be better understood in terms of set-theoretic relations rather than correlations --for a correlation-based empirical paper, see for example Klein, Astrachan and Smyrnios (2005). As we show in the paper, this understanding may lead to the development of a hierarchical classification of family business attending to criteria based on set membership and the relations between sets and subsets (Ragin, 2008).

The paper is structured as follows. In the next section we briefly review the previous literature on components of family involvement. Next we make the case for the relevance of set-theoretic and fuzzy sets methodologies in the family firm's literature. Then, we use a database of about 6,611 international firms to establish a hierarchical taxonomy of family firms based on the components of family involvement. Finally, we discuss the main contributions, limitations and conclusions of the paper.

Set-theoretic analysis of components of family involvement

As stated in the introduction the components-based definition must enumerate the necessary conditions for a family firm to exist. In other words: what are the components that must be necessarily present in a firm so that combined with other "essence conditions" will constitute a family firm?. These other "essence conditions" posited in the literature are,

among others, a vision of how the firm and the family relate to each other and the potential sustainability of that vision across generations (Chua et al., 1999).

However, a literature review of component-based definitions and related empirical works shows some degree of contradiction about what a family firm is and thus, about the necessary conditions for a family firm to be such (Chua et al., 1999; Sharma, 2004, 2009). Since the well-established overlapping three circles model --family membership, ownership and managerial roles-- introduced by Lansberg (1988), family business scholars have used circles, Venn diagrams and similar mapping tools to develop typologies of family firms (Davis and Tagiuri, 1989; Tagiuri and Davis, 1996; Gersick, Davis, Hampton and Lansberg, 1997; Neubauer and Lank, 1998; Sharma, 2004, 2009). Sharma (2009), for instance, has proposed a typology that identifies 72 distinct non-overlapping categories of family firms according to the extent of family involvement in terms of ownership and management. Although 72 different categories may seem too many, we think that this is the right approach towards a complete classification of family firms in a first step. We argue, however, that the application of set-theoretic methods may reduce the total number of categories based on sufficiency and necessity conditions.

We illustrate this last argument. Leaving succession aside for a moment and only considering ownership, governance and management and all the possible combinations of family involvement (yes/no), there are eight (2^3) possible configurations as depicted in table 1.

-------- Insert Table 1 about here --------

Which of the eight combinations qualify as a family firm? Researchers agree that combination (A) qualifies as a necessary condition for a family firm while combination (H) does not. There is disagreement, however, on most of the other combinations. Most authors

seem to prefer combinations (B) and (C) over (F) and (G), while configurations (D) and (E) are still problematic. To make things worse, there is a second empirical challenge about how to operationalize each component: when does a family have control over the firm' stock? Over the board of directors? Over management? What are the relevant percentages of involvement (e.g., 5%, 25%, 50% or 100% of firm's equity?). The operational definition of family firms used in empirical research is a critical issue and, in fact, empirical findings can change or even be reversed when different definitions are adopted (e.g., Villalonga and Amit, 2006).

Some of the above mentioned definitional challenges may be partially mitigated if a set-theoretic connection is found between the different components of family involvement. Using set-theoretic connections we can answer the following: what are the core elements in a components-based definition of family firm? Is there some overlapping between the sets? Are there sufficient and necessary conditions so that membership in one set may imply membership in another set? For example, it is possible that the set of firms where the CEO is a family member is a subset of the set of firms whose board of directors is controlled by a family and so forth. In this way, finding regular subset relationships between the components, a hierarchy of the components of family involvement may be established, similar to concentric circles in Venn Diagrams.

Although previous research suggests that all kinds of combinations can be found in reality ranging from (A) to (H), a rigorous testing of the plausibility of those combinations and their empirical relevance, teasing apart the causally relevant components from those that are causally irrelevant, can be done using fuzzy sets. In addition, this methodology will allow us to distinguish the *core* elements in a definition of family firm from the *peripheral* ones based on causal necessity and sufficiency, rather than just a correlation between the components (Ragin, 2008; Fiss, 2009).

Study design and methods

Sample description

We use a dataset of 6,611 international companies from 46 countries that we have created from OSIRIS database (Bureau Van Dijk). All observations used in the study belong to 2005. The companies in the sample belong to all industries and are coded following the 1-digit NACE classification.

OSIRIS dataset, in addition to accounting and financial information, contains data on firm' ownership (shareholders' names and family names, direct and indirect percentage of shares held by owners or type of shareholder --individual, bank, industrial company, mutual & pension fund…), board of directors composition (board members, chairman full names and their position in the board), management information (full name and management position of those managers with presence in the board as for example the CEO) and age of the company.

Variables description and sets calibration

As stated above, the variables used in this paper have been built *ex profeso* for this study starting from the original data obtained from OSIRIS dataset. The set-theoretic analysis with fs/QCA requires a previous transformation of variables into sets that are calibrated regarding full membership, the cross-over point of maximum ambiguity and full non-membership regarding membership in the set of interest (Ragin, 2000, 2008; Fiss 2007). These values are qualitative anchors that calibrate a measure in regards to substantively meaningful thresholds. This calibration is essential to any set-theoretic analysis as it determines which cases belong to each of the sets analyzed and, therefore, the results obtained are sensible to such calibration (Ragin, 2008).

According to the purpose of our paper we have tried to identify the different typologies of family firms. We started the analysis with the most inclusive components-based definition of family firm. As stated in the introduction, most definitions of family firm are merely based on ownership characteristics, such as the existence of blood or marriage ties among shareholders or percentage of shares held by members of a family. Thus, as a first step, we infer the level of family involvement in a firm from the *surname relationships* among the shareholders in line with earlier family business works (Anderson and Reeb, 2003; Villalonga and Amit, 2006). This identification has been done following two criteria:

I. *Family names criterion.* This criterion is based on the *surname relationship*. We consider a business to be a potential family firm when there are at least two common family names (surname relationship)[1] among the shareholders. Also, we consider as potential family firms those companies where among the shareholders there is another company whose corporate name is totally or partially related to the family names of some of the shareholders in the first company.

II. *Personal largest shareholder criterion.* We consider a business to be a potential family firm when among the owners there is a single person who is the largest shareholder even though he does not have common family names with other shareholders[2].

[1] We have looked at the names and surnames of all the shareholders of each firm in the database and looked for possible surname repetitions and surname connections between husband and wife, descendants, relatives, etc. In some countries like Spain and some Latin-American countries some family ties might have been overlooked because in these countries the spouses typically keep their own family names after marriage.

[2] In those cases where among the owners there are two single persons who are the two largest shareholders holding similar percentages of shares *and* they do not have common family names with each other, then, we have considered these companies to be potential family firms that belong to the family of the shareholder who sits in the board.

Out of the total 6,611 companies in our sample we identified 2,105 firms that meet criteria I and II, 1,016 (48%) applying criterion I and 1,089 (52%) applying criterion II. Criteria I and II only identify possible "family firms". It is from the combination of criteria I and II *and* the five components of family involvement that a typology of family firms emerges.

Following the components-based literature of family involvement, we identified five variables in this study: two variables in the sphere of *governance* (family board and family chairman) and one variable for each of the other three components, *ownership* (family ownership), *management* (family CEO) and *succession* (succession). Next, we define and calibrate each of these five variables, following criteria I and II to identify a family of reference for each firm.

Family ownership. It measures the family ownership, which has been built by adding the ownership in hands of every family member (identifying a family of reference according to criteria I and II). Then, we have constructed this variable as a fuzzy set considering the following anchors: 1% threshold for full non-membership; 5% is the value for our crossover point; 25% threshold for full membership in the set of firms with high family involvement in ownership. Similar cut-off points have been used in previous studies (Miller and Le-Breton Miller, 2005). In order to be conservative, we have used the 25% threshold for full membership inclusion in the set of family firms following the definition suggested by European Group of Owner Managed and Family Enterprises (GEEF) and the Family Business Network Board (Milan, April, 7 2008). Our crossover point of 5% has been used in previous studies of family firms (see for example, Anderson and Reeb, 2003). This threshold is often considered to screen relevant shareholders within the ownership of listed companies in many Anglo-saxon countries as this is the maximum percentage of shares that a single bank is

allowed to own in these companies. In addition, in some countries (e.g., Spain) this 5% is also a relevant threshold because it gives the owners who have at least this percentage important tax benefits.

Family Board. It captures the family presence in the board of directors. It is computed as the ratio of family directors to total board directors (excluding those cases where the chairman was a family member). In order to calibrate this variable into a fuzzy set, we have followed these three anchors: 1% threshold for full non-membership; 5% is the value for our crossover point; 10% threshold for full membership in the set of firms with high family involvement in the board of directors.

The European Group of Owner Managed and Family Enterprises (GEEF) in his definition of family firm suggests that there is at least one family member in the board. In order to come with a conservative measure of family involvement in the board, and in line with previous works (Anderson and Reeb, 2003; Villalonga and Amit, 2006), we have used the lowest percentage --1% threshold for fullnonmembership-- in order to leave out those firms where none or almost no presence of family members in the board. For the crossover point, we have used the same 5% used for our first variable "shareholders". Our threshold for full-membership is 10%, slightly lower than the threshold for family ownership because the GEEF definition and previous research refer, in general, to "at least one family member in the board" as the relevant criterion. Thus, we decided to set this threshold at a relatively low level in order to be consistent with these definitions.

Family Chairman. This variable measures whether a family member is the chairman of the board of directors or not. It is a dummy variable that takes the value of 1 if a family member is the chairman of the board and 0 otherwise. Calibration of this variable is

straightforward as it is already a crispy set where 1 indicates full membership and 0 indicates full non-membership in the set of firms whose chairman is a family member. This measure has been previously used by Nieto, Casasola, Fernández and Usero (2008).

Family CEO. This variable measures whether a family member is the CEO of the company or not. It is a dummy variable that takes the value of 1 when a family member is the CEO and 0 otherwise. As with the variable "family chairman", calibration of this variable is also straightforward as it is already a crispy set where 1 indicates full membership and 0 indicates full non-membership in the set of firms whose CEO is a family member. Family CEO has been used as a proxy for family management in previous works (e.g., Anderson and Reeb, 2003; Villalonga and Amit, 2006).

Succession. This variable measures whether the potential family firm, as defined by criteria I and II, is in the first generation or in a later generation. Following previous works (Fernandez and Nieto, 2005) we proxy first generation when the company's age is lower than 30 years, second generation when it is in between 30 and 60 years, third generation when it is in between 60 and 90, and so on. It is a dummy variable that takes the value of 0 when a firm is in the first generation and 1 when it is in a second or later generation (i.e., there has been at least one succession). Calibration of this variable into a crispy set has been done directly from this dummy variable.

As described above the transformation of normal variables into sets requires the specification of full membership, full non-membership and the crossover point of maximum ambiguity. Only for dummy variables (0,1) this transformation can be done directly from the original variable into a crispy set where 1 indicates full membership and 0 indicates full non-

membership. For the construction of the fuzzy sets we have used the anchors specified above and we have followed the "direct method" described by Ragin (2008: 89). The direct method transformation proceeds in two steps. In the first, variables scores are translated into the metric of log odds. Scores associated with ≥ .99 membership, according to the three qualitative anchors defined previously for each variable, are translated to log odds values of 5, scores with ≥ 0.95 are translated to log odds values of 3, scores with the crossover point of 0.5 are translated to log odds values of 0, scores with ≥ 0.05 are translated to log odds values of -3, and so forth for all the intermediate scores. Then, these log odds are used to calculate a standardized deviation of each score from the crossover point. In a second step, these log odds deviations are converted to rescaled scores ranging from 0 to 1, namely:

Degree of membership = exp (log odds) / [1+exp (log odds)]

The final rescaled measures range from 0 to 1 and the converted scores are firmly tied to the three qualitative anchors specified of full membership, crossover point and full non-membership (for the full details of fuzzy sets calibration see Ragin, 2008).

After creating the crispy and fuzzy sets needed in our study, we proceed next to apply fuzzy sets analyses in order to test for the presence of set-theoretic relationships between ownership, governance, management and succession.

Fuzzy sets analyses

Previous fuzzy set empirical works have used the inclusion algorithm described by Ragin (2000) to examine the relationship between membership in causal conditions and the outcome of interest (Kogut, MacDuffie and Ragin, 2004; Kogut and Ragin, 2006). We based our empirical work in the more recent approach followed by Fiss (2009) where he takes advantage of a new truth table algorithm that permits a better exploitation of the rich information contained in fuzzy sets using standard methods of Boolean algebra. We do so

using the truth table algorithm implemented in the fs/QCA software package version 2.0

The truth algorithm of fs/QCA is based on a counterfactual analysis of causal conditions, which allows the researcher to distinguish between core and peripheral conditions explaining an outcome. As the number of causal conditions increase so does the number of combinations. In our research we have worked with 5 causal conditions –ownership, board, chairman, CEO and succession-- that together lead to 32 (2^5) possible combinations--. When the number of total combinations is high it often happens that for some particular combinations the number of observations is very small or zero. This problem is known as the problem of limited diversity. To deal with it, the truth table algorithm distinguishes between easy and difficult counterfactuals.

A counterfactual is a thought experiment by which the researchers can gain insight on the causal significance of individual components of events by imagining "unreal" cases. Max Weber (1949) is commonly cited as the first social scientist to advocate the use of counterfactual analysis in social research. With the aid of these counterfactuals, important simplifications can be done. But, how plausible are these counterfactuals? If the researcher can establish on the basis of existing knowledge (e.g., previous empirical findings) that the presence (or absence) of an additional condition contributes to the outcome, then this counterfactual is said to be "easy". If there is not previous knowledge on the matter or this previous knowledge suggests a different connection between the condition and the outcome than the connection assumed by the counterfactual, then this counterfactual is said to be "difficult" (Ragin, 2008).

The use of "easy" and "difficult" counterfactuals leads, in turn, to three different types of solutions: complex, parsimonious and intermediate. The complex solution includes only the information contained in the sample and includes neither "easy" nor "difficult" counterfactuals. The intermediate solution includes simplifying assumptions based only on

"easy" counterfactuals. Finally, the parsimonious solution includes all simplifying assumption regardless of whether they are based on "easy" or "difficult" counterfactuals.

In this paper we use the notions of core and peripheral conditions introduced by Fiss (2009). According to Fiss (2009), the core and peripheral conditions derive from the intermediate and parsimonious solutions. Core conditions are those that are part of parsimonious solutions while peripheral conditions only appear in the intermediate solution.

Finally, the truth table algorithm allows the researcher to calculate the consistency and coverage of the solutions obtained. The consistency assesses the degree to which cases sharing a given condition or a combination of conditions agree in displaying the outcome in question. That is, consistency indicates how closely a perfect subset relation is approximated. The consistency goes from 0 to 1, where 1 would indicate a perfect subset relation. The coverage assesses the degree to which a cause or a causal combination "accounts for" instances of an outcome. The coverage can be thought of as a measure similar to an R-square in regression models, allowing the researcher to evaluate the empirical relevance of the solutions found. The calculation of fuzzy set-theoretic consistency and coverage is done as follows:

$$\text{Consistency } (X_i \leq Y_i) = \sum [\min (X_i, Y_i)] / \sum (X_i)$$

$$\text{Coverage } (X_i \leq Y_i) = \sum [\min (X_i, Y_i)] / \sum (Y_i)$$

Results

Tables 2a and 2b provide descriptive statistics, sets calibration and correlations for our sample for all measures. Table 2b shows positive correlations between family ownership, family board, family chairman, family CEO and succession. However, it is necessary to move

from correlations to set-theoretic relationships if our goal is to establish a hierarchical classification of family firm (i.e., to test if some sets are partially or fully contained by other sets).

--------- Insert Table 2a and 2b about here ---------

Table 3 describes all possible combinations using the five components of family involvement. Although there are 32 theoretical combinations, empirically we have found only 24 combinations with at least one observation in our sample. The number of combinations found with at least 1% of cases (66 firms) in our sample reduces to only 11. The fact that some combinations do not have any real firm reduces the complexity in the elaboration of a typology of family firms. For example, we did not find any company in our sample with no family ownership, no family board, but with a family chairman and a family CEO. Therefore, to the extent that our sample is representative, this last combination and others shown in table 3 with few or no observations can be regarded as rare or non-existing types of family business.

--------- Insert Table 3 about here ---------

Table 4 shows the results of our fuzzy set analysis. We follow the notation recently introduced by Ragin and Fiss (2008) and Fiss (2009). In their notation, full circles indicate the presence of a condition, while cross-out circles indicate the absence of a condition. In addition, a large circle indicates a core condition (parsimonious solution), while a small circle indicates a peripheral condition (intermediate solution). We set the lowest acceptable consistency for solutions at 0.80, above the minimum recommended threshold of 0.75 (Ragin, 2008). The minimum acceptable solution frequency was set at four.

Table 4 shows the only solutions where we have found consistent sufficient causal conditions leading to an outcome. We have found consistent solutions only for membership in "family ownership" and membership in "family board". For the other three sets, "family chairman", "family CEO" and "succession" we did not find any sufficient condition or combination of causal conditions with a consistency above the 0.80 threshold (consistencies for these sets were all well below 0.60).

--------- Insert Table 4 about here ---------

Family Ownership

We have found three alternative solutions leading to membership in the set of firms with family ownership. Any of these three solutions are sufficient by themselves, reinforcing the idea of equifinality: different paths lead to the same outcome. Solution 1S in table 4 indicates that being a member of the set of firms with a family board is a sufficient condition (consistency = 0.88) for being a member of the set of firms with a family shareholder. Solution 2S indicates that being a member of the set of firms with a family chairman *and* being in the first generation (i.e., "no succession") also constitutes a sufficient condition (consistency =0.89) for being a member of the set of firms with a family ownership. Note, however, that the second condition (no succession) is a peripheral condition and this condition is not present in the parsimonious solution. The intuition behind is that what is really nuclear or core in this case is having a family chairman regardless of whether the firm is in the first or second generation --causal coreness is based on the strength of the evidence relative to the outcome.

Finally, solution 3S confirms this intuition as firms with membership in the set of firms where there has been at least one family succession (i.e., second or later generations)

and no membership in the set of firms with a family CEO also belong to the set of firms with family ownership (consistency= 0.84). This latter condition (no CEO) is peripheral while the former condition (succession) is core.

Together, solutions 1S, 2S, 3S suggest three alternative configurations combining elements of governance, management and succession that by themselves constitute sufficient conditions for being a member of the set of firms with a family ownership.

In terms of coverage, the three models (1S, 2S, 3S) combined account for about 90% of membership in the outcome (family ownership). This high coverage proves the empirical relevance of the five components studied and it is due to the high overlapping between them. This coverage, being lower than perfect coverage, also indicates that there are other causal conditions leading to family ownership different from the conditions studied in this paper.

Family Board

We have also found in our sample sufficient conditions leading to membership in the set of firms with a family board. We found 3 different independent and consistent solutions. Solution 1B indicates that having a family chairman (core condition) *and* a family ownership (peripheral condition) is a sufficient condition (consistency=0.96) leading to membership in the set of firms with a family board. Note, however, that the second condition (family ownership) is a peripheral condition and therefore this condition is not present in the parsimonious solution. What is core in this solution is the condition of having a family chairman. Solution 2B points out an alternative, consistent configuration. Firms with a family chairman (core condition) and no family succession (peripheral condition) also belong to the set of firms with a family board (consistency=0.94). Finally, solution 3B indicates that having

a family CEO (core condition) is a sufficient condition (consistency=0.97) by itself leading to membership in the set of firms with a family board.

Finally, the coverage for solutions 1B, 2B and 3B combined is about 77%. While lower than the coverage for family ownership, this coverage still suggests a strong empirical relevance of the conditions studied. The lower than perfect coverage again suggests that there are other paths to the outcome in question (family board) that do not rely on conditions 1B, 2B or 3B (i.e., equifinality).

Necessary conditions

Necessary conditions are somehow the reverse of sufficient conditions. In logical terms, if A is a sufficient condition for B, then B is always a necessary condition for A. In this case, and regarding the core conditions, having a family ownership is a necessary condition for family board, family chairman and succession, while having a family board is a necessary condition for having a family chairman and a family CEO.

The set and subset relationships described in table 4 have been "approximated" in a Venn diagram (Figure 1). It is important to note that the precise set-theoretic relationships and their consistencies and coverage are described in table 4 while the Venn diagram is just a visual representation to aid in the interpretation of the results obtained. It is not possible to represent accurately 32 different combinations with core and peripheral conditions in a simple two-dimensional diagram. Figure 1 shows how some of the sets are concentric. For example, family CEO and family chairman sets are subsets of a larger set, family board, while family board is a subset of family ownership. Other sets, like succession, are subsets of family ownership but they are not consistent subsets of family board, suggesting a different type of family firm.

--------- Insert Figure 1 about here ---------

Discussion and Conclusions

Family firms represent at least 35% of the firms listed in Fortune 500 and S&P500 (Anderson and Reeb, 2003). There are at least four million family firms in the US ranging from traditional stores to large publicly traded firms such as Ford or Inditex (Shanker and Astrachan, 1996). Sharma (2009) argues that with these differences there are bound to be significant differences among these family firms. This author regrets that:

> "No serious attempt has been made so far to categorize family firms either by developing theoretical typologies or empirical taxonomies of these firms. Without a classification system to sort our different types of firms, it is difficult to have confidence in our research findings that may be based on samples that are hodge-podge of different types of firms. Moreover, there is no way to determine the extent of applicability of research findings". (Sharma, 2009: 13).

The intended contribution of this paper was to provide an exploratory hierarchical typology of family firms using set-theoretic methods and applying them to an international sample of 6,611 family and non-family firms. As stated in the introduction, a definition of family firm can be made according to the *components* of family involvement or to its *essence* (Chua, Chrisman and Sharma, 1999; Sharma and Nordqvist, 2007). In this paper we have focused on the components-based definition and we have argued that it can be better understood in a hierarchical way, using set-theoretic connections, rather than as a continuum of family involvement or familiness that typically rely on correlational methods such us factor analysis or regression models.

Our results have two important implications. First, using fuzzy-sets methods we have identified the most frequent configurations of family firms found in the real world according to the family involvement in terms of ownership, governance, management and succession,

the typical components studied in previous works (Chua, Chrisman and Sharma, 1999). Although any configuration, out of the 32, is theoretically possible (see for example Sharma, 2009), our results show that, in practice, some configurations are more likely than others. Thus, our findings reduce the number of possible types of family firms because some configurations simply do not exist or they are very unlikely in the real world –in our study we found 24 configurations with at least one observation and only 11 configurations with at least 1% of the observations in our sample.

Second, our results show that some types of family firms are self-contained in others based on sufficiency and necessary conditions. For example, if a firm has a family CEO, it also has a family board and a family ownership (see table 4). Or putting it differently, the set of firms having a family CEO is a subset of the set of firms having a family board which at the same time is a subset of the set of firms having a family ownership.

Our contribution in this paper has been to make explicit these existing connections. We believe that this reduction in the total number of family firms types and the hierarchical classification provided can be very useful for researchers conducting empirical research as it may allow them to focus on just a few types of family firms. As Sharma (2009:17) emphasizes: "ideally, it is desirable to find a small number of categories that encompass a large proportion of the population".

Our study also has some limitations. Fuzzy set methods are sensible to sets calibration. Different cross-over points may lead to different conclusions. Given the lack of previous applications of fuzzy sets to the family business literature it would be desirable to share the best practices in set calibration, the most appropriate membership breakpoints and so on. This would facilitate comparison between different empirical works. By improving this calibration researchers may learn more about the object of study because membership and nonmembership in a given set has to be guided, precisely, by some qualitative definition of

the set and the conditions for membership in it, instead of using just a traditional uncalibrated measure[3].

Although our sample covers 6,611 firms from 46 different countries, it contains only large listed companies. Thus, generalization of our results to larger populations of family and non-family firms must be made with this limitation in mind. In addition, the cross-sectional nature of our database does not allow us to take into account dynamic effects and, thus, the analysis of more years would enrich our results. One intriguing possibility pointed out by Fiss (2009: 39) is that although some solutions may be equifinal for the current state of a firm -- regarding a given outcome--, but not for future states of the firm (i.e., organizational trajectories do matter). Such analysis, although out of the scope of this paper, is a promising avenue for future research.

Beyond the current paper we hope that more empirical research in the family business field can be done using the fuzzy sets principles and methods. The recent adoption of these methods in other management research areas (Fiss, 2007; Pajunen, 2008; Grekhamer et al., 2008; Fiss, 2009) suggests that fuzzy sets may prove to be relevant for family business research as well.

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[3] According to Ragin (2008), uncalibrated measures are inferior to calibrated measures because the former simply show the positions of cases relative to each other. For example, with an uncalibrated measure of temperature it is possible to know that one object has a higher temperature than another or if that temperature is higher than the average but still not know whether it is hot or cold. By contrast, a calibrated measure indicates purposeful "phase shifts" (e.g., the breakpoint where the water changes qualitatively and starts boiling, shifting from water to steam of water).

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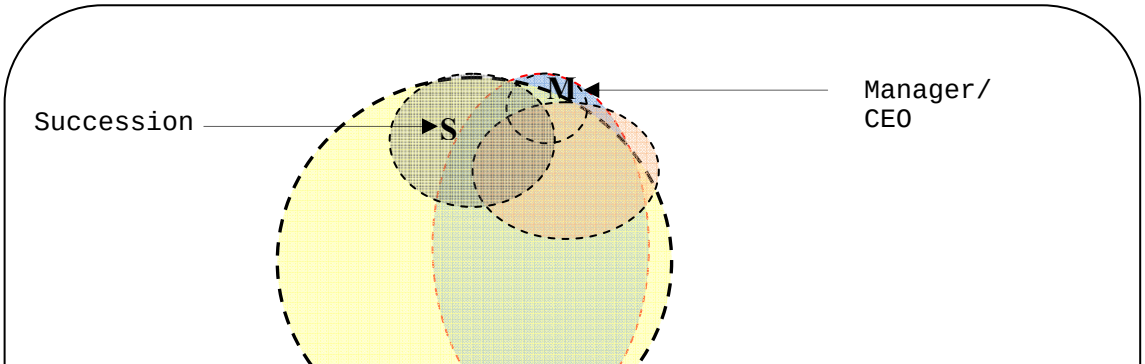
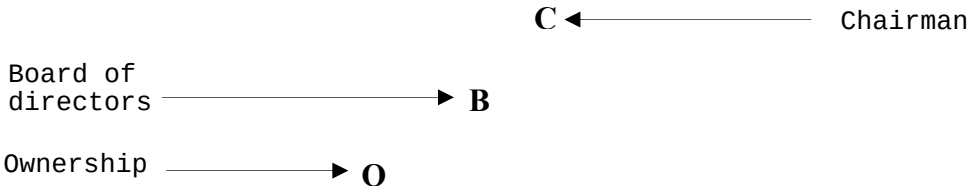
Figue 1[1]
Fuzzy set's Venn diagram representation





Universe of all possible family firms
(Components-based + essence-based)

[1]For the sake of simplicity we represent in this figure all the sets as "crispy sets" (Y/N). However, it is important to note that only chairman, CEO and succession are truly crispy sets while ownership and board are fuzzy sets where each firm has a different degree of membership in that set from 0 (fully out) to 1 (fully in).

O: *Family ownership*. Set of firms where family members own more than 5% of firm equity.
B: *Family Board*. Set of firms where family members represent more than 5% of the Board of directors.
C: *Family Chairman*. Set of firms whose chairman is a family member.
M: *Family CEO*. Set of firms whose CEO is a family member.
S: *Succession*. Set of firms where a least one family succession took place (i.e., second or later generation).

Table 1

Possible combinations according to the components of family involvement

	Ownership	Governance	Management	Succession	Family firm
(A)	Yes	Yes	Yes	-	Yes
(B)	Yes	Yes	No	-	?
(C)	Yes	No	Yes	-	?
(D)	Yes	No	No	-	?
(E)	No	Yes	Yes	-	?
(F)	No	Yes	No	-	?
(G)	No	No	Yes	-	?
(H)	No	No	No	-	No

Yes: Family is involved in the ownership/governance/management of the firm

No: Family is not involved in the ownership/governance/management of the firm

Table 2a

Descriptive statistics and set calibration (fuzzy and crispy sets)

	Descriptive Statistics			Membership criteria		
	N. Obs.	***Mean***[2]	***St. Desv.***	***Full membership***	***Crossover point***	***Full non-membership***
Ownership						
Family Ownership	6,611	8.86% (27.6%)	17.4 (20.57)	25%	5%	1%
Governance						
Family Board	6,611	6.30% (19.8%)	13.17 (16.6)	10%	5%	1%
Family Chairman[1]	6,611	16.02% (52.2%)		*Crispy sets (1,0)*		
Management						
Family CEO[1]	6,611	16.44% (53.6%)		*Crispy sets (1,0)*		
Succession						
Succession[1]	6,611	11.25% (35.3%)		*Crispy sets (1,0)*		

[1]*In these cases, the variable is a dummy and the mean refers to the cases where Chairman, CEO or Succession take the value of 1.*

[2]*The means refer to our total sample of 6,611 firms. The values in parenthesis refer to the mean only for the potential family firms identified in our sample, according to criteria I and II (2,105 firms).*

Table 2b

Correlation Matrix

	F. Ownership	F. Board	F. Chairman	F. CEO	Succession
F. Ownership	1.0000				
F. Board	0.6488*	1.0000			
F. Chairman	0.5798*	0.5832*	1.0000		
F. CEO	0.5908*	0.6469*	0.5929*	1.0000	
Succession	0.3861*	0.4143*	0.3364*	0.3263*	1.0000

* Significance level: *p-value* 0.05

Table 3
Typology of Family firms[1]

Components of family involvement[2]					**In the sample**	
OWNERSHIP	***GOVERNANCE***		***MANAGEMENT***	***SUCCESSION***		
Family Ownership	**Family Board**	**Family Chairman**	**Family CEO**	**Succession**	**Firms #**	**%**
N	N	N	N	N	4570	69.13%
				Y	26	0.39%
			Y	N	-	-
				Y	-	-
		Y	N	N	-	-
				Y	-	-
			Y	N	-	-
				Y	-	-
	Y	N	N	N	5	0.08%
				Y	1	0.02%
			Y	N	1	0.02%
				Y	2	0.03%
		Y	N	N	2	0.03%
				Y	-	-
			Y	N	7	0.11%
				Y	2	0.03%
Y	N	N	N	N	97	1.47%
				Y	70	1.06%
			Y	N	-	-
				Y	1	0.02%
		Y	N	N	14	0.21%
				Y	9	0.14%
			Y	N	4	0.06%
				Y	2	0.03%
	Y	N	N	N	258	3.90%
				Y	147	2.22%
			Y	N	259	3.92%
				Y	116	1.75%
		Y	N	N	214	3.24%
				Y	113	1.71%
			Y	N	440	6.66%
				Y	251	3.80%

[1]For the sake of simplicity we represent in this table all the sets as "crispy sets" (Y/N). However, it is important to note that only chairman, CEO and succession are truly crispy sets while ownership and board are fuzzy sets where each firm has a different degree of membership in that set ranging from 0 (fully out) to 1 (fully in).

[2]**Y="Yes"** *when the variable is above the cross-over point according to the fuzzy and crispy sets definitions specified in table 2a.*
N = "No" *when the variable is below the cross-over point according to the fuzzy and crispy sets definitions specified in table 2a.*

Table 4
Fuzzy sets Results

	Solutions[1]					
	Shareholders[2]			**Board**[2]		
	1S	2S	3S	1B	2B	3B
Ownership						
Family ownership				●		
Governance						
Family Board	●					
Family Chairman		●		●	●	
Management						
Family CEO			⊗			●
Succession						
Succession		⊗	●		⊗	
Consistency	0.88	0.89	0.84	0.96	0.94	0.97
Raw Coverage	0.85	0.33	0.16	0.51	0.36	0.60
Unique coverage	0.41	0.01	0.04	0.05	0.01	0.22
Overall Solution Consistency		**0.87**			**0.95**	
Overall Solution Coverage		**0.90**			**0.77**	

[1]No consistent sufficient conditions were found for family chairman, family CEO and succession. Consistencies were in all these three cases lower than 0.60.

[2]● Presence of conditions (● Core conditions ● Peripheral conditions)

⊗ Absence of conditions (⊗ Core conditions ⊗ Peripheral conditions)

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