SIZE & REGIONAL DISTRIBUTION OF FINANCIAL BEHAVIOR PATTERNS IN SPAIN

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FUNDACIÓN DE LAS CAJAS DE AHORROS
DOCUMENTO DE TRABAJO
Nº 512/2010

De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

ISSN: 1988-8767

Size & Regional Distribution of Financial Behavior Patterns in Spain.

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Abstract:

The relationship between the financial behaviour of firms and some business risk factors have been thoroughly researched during decades. Our paper tries to draw a dynamic two-dimensional map of companies using a broad number of accounting ratios during a period of seven years based on regional and size characteristics. The intention is to explain financial behaviour for a subsequent comparative classification of businesses. For small and medium sized firms, accounting ratios are not just the only data available, but the best suitable building blocks to our research. In order to reduce input dimensionality without losing information, we use two methodologies: the Principal Components Analysis, and correlation analysis. Finally, we also use the whole data set of variables with the intention to see if there are outstanding differences in the final results. Subsequently, the companies are sorted out by size and geographical / political areas or regions, using a neural net model called Self-Organizing Maps. We also use a cluster model as a benchmark. The model allows us to visualize dynamically some traits by means of mapping n variables in two dimensions: We can classify firms in groups, see which variables determine each group, monitor the evolution of firms in terms of group selection, and determine the fittest group in terms of financial ratios and the firms within it. Finally, we also see no outstanding differences between the Principal Component Analysis (PCA) model and the whole data set, whereas the model without high correlation variables shows a weaker stability. Although this analysis represents a step forward for the right valuation of the Spanish small and mid-size firm network, its applicability covers not only more dimensions, but any other country with clear-cut differentiated political regions. The data has been taken from the Spanish Register of Business Names, being the raw material the annual accounting books and records, covering the years 1998-2004, both included

Key words: neural networks, financial behaviour, accounting ratios, size & region classification
JEL Classification: G17, C45, R12

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1 Introduction

More than 90% of the Spanish firms are “pymes” (acronym for micro, small and mid-size companies in Spanish), being the most important group of productive units within the Spanish business network. Due to its economic importance, its analysis represents a key factor in the understanding of the Spanish economy. To define size, following many other studies and institutions, we use the variable number of workers: less than 10 for micro, less than 50 for small, and less than 250 for the medium sized segment. This paper supports the argument, forwarded by previous analysis (see Weiss & Hall, 1967; Hall, 1987; Capon et al, 1990; in Spain, Maroto, 2004; Hernando, & Martinez, 2003), that size is a key variable in generating behaviour and, therefore, outcomes.

There is an extensive literature that deals with this topic, starting with the hypothesis that large firms generate higher rates of return. Also, firm size has been used in the accounting literature as a proxy for an unobservable theoretical concept or as a control for omitted variable bias (Ball & Foster, 1992). As a result, firm size may be interpreted in very different ways, explaining everything and nothing at the same time (Bujaki, Richardson, 1997). There has been a controversy over lack of efficient information on the size of the firms analyzed, so that beyond some small scale, size has little effect on profits.

In general, there is an endogenous hierarchy of financial constraints over the size distribution of firms (Basu & Reagle, 1999). In other words, small firms incur in higher cost financing than larger firms. On the other hand, (Ammar et al, 2003) for some industries, large sized firms work against profitability. The difference in behaviour between mature small firms and start ups could also be an issue. Also, there are some other key variables that measure differences in productivity and outcome not studied here, like technology, managerial quality, ownership, country, and industrial sectors.

The country effect has also been studied thoroughly: Serrano et al (2005) show that financial profitability has more to do with the factor country (through the interest rate on debt) that with size. If this is so, then, we can reduce the concept of country to that of region, considering regions in the political sense, so that we can study the relationship of a group of financial ratios with the size of firms and regional boundaries (Hernando & Martinez, 2003). For this purpose, we draw a two-dimensional map of companies using a broad number of accounting ratios during a seven-year period based on regional and size characteristics.

The intention is to explain financial behaviour for a subsequent comparative classification of firms. Subsequently, the companies are sorted out by size and geographical areas or regions, using a neural net model called Self-Organizing Maps. The model allows us to visualize dynamically some traits by means of mapping n variables in two dimensions: We can classify firms in groups, see which variables determine each group, monitor the evolution of firms in terms of group selection, and determine the fittest group in terms of financial ratios and the firms within it. Also, we will use three different sets of data, and find out the importance of size, and the relatively weight of the regions in the financial behaviour and outcomes of firms. Although this analysis represents a step forward for the right valuation of a general perspective of the

Spanish small and mid-size firm network, its applicability covers not only more dimensions, but any other country with clear-cut differentiated regions.

For small and medium sized firms, accounting ratios are not just the only data available, but the best suitable building blocks to our research. Also, the high dimensionality of the input space could be a key problem for a classification process because it could generate weak training processes or a complexity catastrophe. To clarify this conundrum, and as part of the process to draw the dimensional map, we will make use of three different sets of accounting data: Two of them, as a result of a reduction of dimensionality (without losing any key information), and a third one using the whole pool of data. Finally, based on the results, we will proceed with the classification method.

Once input dimensionality has been settled, data can be classified by using a learning algorithm. Its mathematical description (Schütze et al, 1995) is as follows: as a function $f(x)$, then, $f(x) = q \times x$, q represents the feedback mechanism and x a variable vector representing the characteristics of the database. This kind of functional form is defined as linear classifier, and the more general they are, the more effort must be made to fit the specific characteristics of training data to the whole dataset (Sjoberg, & Ngia, 1998). Depending on the main features of each database, some classifiers are better suit than others. Specifically, the artificial neural networks methods (ANNM), not only are very adaptable to a broad range of databases, but they are indeed very efficient. They have the ability to handsomely adjust themselves to a very wide range of distributions. They represent a very robust set of models (Simon, 1982), being this the main reason that we have decided to select it as our classification method.

After reviewing the main references of this topic in the introduction, we structure the paper as follows: The second section describes the Methodology followed by Organized Neural Networks in the third section. The fourth section details the selection process of key accounting ratios; the fifth section shows the results of the final model, and the sixth section presents the conclusions

2. Methodology

Within the ANNM, the self-organized maps (SOM) will be used to generate a set of clusters with common features. Cluster analysis consists of a set of methods and algorithms with the intention to cluster similar objects in different groups, according to specific criteria. Although there are a few analysis tools, nevertheless, it is customary to use first the hierarchical method to find out the right number of clusters, followed by the K-means method, which does not allow the data to be included in more than just one cluster. Because of that, other methods could generate confusion in the classifying process of Spanish companies by size / region. This is the reason the K-means method was selected as a complementary one to SOM.
K-means, MacQueen (1967), one of the simplest non-supervising learning algorithms, divides the data in k clusters, generating a tag number which indicates the group each vector belongs to. K- means, as opposed to the hierarchical cluster, does not generate a tree-structure, and uses current object data instead of their neighbours´.

The procedure lies basically in classifying a dataset through a specific number of clusters previously prefixed. The separation principle consists of two rules: the objects within a cluster are very close to each other, while, at the same time, the same clusters are separated the most from each other. Five different distances can be selected, depending on the type of data that have been divided. Each cluster is defined by its member object and its centroid. The centroid of each cluster is the point in which the sum of distances between objects is minimized, and K-means calculates the centroids for each distance, minimizing the sum with respect to the specified measure.

K-means uses an iterative algorithm that minimizes the sum of distances from each object to its centroid. This algorithm moves the objects between the clusters until the sum is minimized. The result is a set of clusters as compact as separated. An iteration process in the form of a recalculation of positions is generated in a way that the minimization process can be carried out. The goal is to minimize an objective function as a potential error such that

Equation 1

$$J = \sum_{j=1}^{k}\sum_{i=1}^{n}\left\| x_i^{(j)} - c_j \right\|^2,$$

where $\left\| x_i^{(j)} - c_j \right\|^2$ represents a measure of the distance between a specific point of the database $x_i^{(j)}$ and the centre of the cluster c_j. It represents the distance of the *n* points of the database with respect to their clustering centres.

The K-means algorithm does not always minimize the global objective function, and, therefore, it does not always find the optimal configuration. Also, it is very sensitive to the centres of the initial clusters which they have been randomly chosen. However, the centres can be picked and tried out as many times as needed to reduce this effect. Also, the final result depends on the k value, and this, though, can cause problems, because, usually, the number of clusters is unknown ex-ante. Besides, in terms of the dataset size, there is not a theory that could guarantee an optimal solution to the number of clusters. Finally, the metric used to measure $\|\mathbf{x} - \mathbf{m}_i\|$ must be considered. A common solution is to normalize each variable by its standard deviation.

3 Organized Neural Networks

The artificial neural networks are mathematical non linear algorithms based on the way the brain works. Although its roots dates from the 60s (Minsky & Papert, 1969; Rosenblatt, 1958; Wildrow & Hoff, 1960)), they really appeared as an alternative to the predominant boolean logic computation during the 90s (Hopfield, 1984; Kohonen, 1982; Vesanto & Alhoniemi, 2000). The network learns to adapt based on the experiences collected from previous training patterns. They are based on simple computations carried out by a single unit, the neuron. Specifically, the artificial neural networks find similar patterns within a dataset, and cluster the input vectors according to this similarity (Martin & Sanz, 1997). They can carry out a large number of activities, being the most important: similarity of patterns (Hertz et al, 1991), principal component analysis (PCA), clustering, and feature maps.

Kohonen (1982, 1989, 1990, 1997) introduces the neighbourhood function, generating the SOM (*Self-Organizing Feature Maps)*. In this kind of maps, a neuron becomes a winner when the Euclidian distance between its synaptic weights and the input data vector is minimized. The innovation, therefore, lies in the fact that the winning neuron incorporates a neighbourhood function that defines its environment when the weights of both, the winning and the neighbouring neurons, are updated.

The effect of introducing the neighbourhood function is that the neurons closer to the winner are in tune with the input patterns responsible for the winning results. The neuron weights are not updated in the area outside the neighbourhood. This neighbourhood depends of the distance between the winning neuron and its neighbours within a bidimensional zone that can be either circular or hexagonal. In this way, the neighbouring neurons become in tune with similar patterns, reflecting on the map a topological order found in the input space. The order of information contained in the input patterns is captured in the mapping of the output layer of a SOM-type network.

SOM carries out a classification assignment: the output neuron activated as a response to an input represents the type to which such input belongs to. Also, and due to the similarity between classes, the same output neuron is activated as a response to a similar input or an adjacent to it. Because of that, the topological adjacent neurons become sensitive to similar inputs. For this reason, the self organized map networks are especially useful to establish unknown relations between datasets. A dataset without a predetermined order can be classified through a SOM network. Different input patterns arise during the learning process. Each pattern will be identified with a winning neuron and its neighbourhood, resulting in that the larger the number of input patterns, the smaller the neighbourhood size.

Besides the winning one, a neighbourhood of radius 2 includes two neurons, whereas, on the other hand, a neighbourhood of radius 1 will only affect the adjacent neurons to the winning one. We can distinguish two phases in the learning process: the identification of the winning neurons and their neighbourhoods, and fine tuning, where the winning neurons are specialized.

The mechanics of the self-organized maps begins with a random value to the W_{ijk} weights that link the input and output layers. Next, a data input pattern is shown X(t), and each output layer neuron estimates its similarity between the synaptic weights and the input vector through the Euclidean distance.

Equation 2

$$d = \sqrt{\sum_{k=1}^{N} \left(W_{ijk} - X_k \right)^2}$$

The neuron of the output layer with the shortest distance to the input pattern is the winning neuron *g**. The next step is the updating of weights of the winning neuron and its neighbours through the following equation:

Equation 3

$$W_{ijk}(t+1) = W_{ijk}(t) + \alpha(t) \cdot h(|i - g^*|, t) \cdot (X_k(t) - W_{ijk}(t))$$

Where $\alpha(t)$ represents a learning term with values between 0 and 1. When the number of iterations reaches 500, then, $\alpha(t)$ approximates 0. To calculate $\alpha(t)$, we use:

Equation 4

$$\alpha(t) = \alpha_0 \cdot \left(\frac{\alpha_f}{\alpha_0} \right)^{\frac{1}{t_\alpha}}$$

Being α_0 the initial pace, α_f, the final pace, which usually takes the 0.01 value, t represents the current iteration, and t_α is the maximum number of iterations we want to carry out. The function $h(|i - g^*|, t)$, represents the neighbourhood function and, as we have already seen, its size becomes smaller in each iteration. The neighbourhood depends on the distance and the neighbouring radius. The distance is measured as:

Equation 5

$$|i - g| = \sqrt{(i - g_1)^2 + (j - g_2)^2}$$

This function is telling us that the neighbourhood function decreases in relation to the distance to the winning neuron: The farther, the smaller the function. It depends on the neighbourhood radius R(t), which represents the size of the current neighbour.

Equation 6

$$h(|1 - g^*|, t) = f[R(t)]$$

The Mexican hat or the Heaviside Step functions are commonly used to calculate the neighbourhood functions

Equation 7

$$y = 2 \cdot e^{-1 \cdot x^2} - 0{,}5 \cdot e^{-0{,}05 \cdot x^2}$$

The neighbourhood ratio R(t) decreases through time. A common equation used to decrease the neighbourhood ratio in terms of time is the following:

Equation 8

$$R(t) = R_0 + \left(R_f - R_0\right) \cdot \frac{t}{t_R}$$

R_f represents the final radius that takes the value equal to 1, and t_R is the number of iterations before reaching R_f. During the fine adjustment, α equals 0.01, and the neighbourhood ratio equals 1. The number of iterations is proportional to the number of neurons, and it is independent of the amount of inputs.

A range between 50 and 100 iterations usually is considered enough. The larger the number of similar patterns shown, the more neurons specialized in that pattern. The number of neurons that specialized to recognize an input pattern depends on the probability of the formation of that pattern. In this way, the resulting map approximates the form of the probability density function of the sensorial space. The amount of gathered neurons in a region shows the greater probability of generating that type of patterns. Once the winning neuron is declared Best-Matching Unit, BMU, the vectors of the SOM weights are updated, and their topological neighbours move toward the input vector, making the distance smaller. This adaptation causes a reduction of distance between the winning neuron with its topological neighbours and the input vector.

The work of Bell et al (1990) is a pioneering application of neural networks to business failures. Based on more than one thousand banks, they find that the neural model is slightly better that the logit model in terms of classification in the irresolution area. Odom & Sharda (1992), and Rahimian et al (1992) compare different neural models to the discriminant analysis using data from American firms. The result, in both studies, is that neural models carry out a better job. Miguel et al (1993) compare a neural network model to four statistical models to Spanish banks, finding the higher quality results of the neural model. According to Laffarga and Mora (2002), models like logit and discriminant analysis have limitations concerning variables, reliability of financial information, and statistical and methodological limitations.

4 Process of selection of key accounting ratios

There are some good reasons to separate explanatory variables with a probabilistic ability to predict success from the ones to predict failure and bankruptcy. Mainly, the causes of success do not always coincide with the causes of failure. Notwithstanding, some research papers offer a dual success / failure interpretation. Our paper aims to study the financial behaviour of firms beyond any dual interpretation. After all, both concepts are linked. The concept of financial health is broad and general, covering both, successes and failures. While failure could be defined as bankruptcy (Altman, 1968) or delinquency (Beaver, 1966), success, on the other hand, is tied, at least partially, to the observer. Also, the frontier between failure and non failure enterprises depends to some degree of the economic cycle (Neophytou & Molinero, 2004) or the sector in which they are in (Birley & Westhead, 1994).

If we consider a firm like a group of resources, so that any competitive advantage is the outcome of such resources, then, we should base our analysis only in internal ratios (Roquebert et al, 1996). However, many authors (see Palepu, 1985; Altman, 2000) call into question the use of accounting data in firm analysis due to the fact that they carry the so called "accounting noise". But, then, all the accounting profession would be useless. Besides, there are not market data for small enterprises, therefore, for practical reasons, and following the accounting principle of veracity, accounting data are trustworthy enough as to be the raw material for a research of this kind.

The set of models that uses as raw material just accounting data is based on the rule of proportionality which is generated by the ratio system. However, there is a debate about this concept because if this rule were really true, there will not be any size effect. However, the size is a key factor in the financial structure of any firm (Mar & Serrano, 1994), and its importance has not changed over time. Many ratios can be observed, but this does not mean that they can explain the value generating process. R. Altman, (2000), in a revision paper about the Z-score models (Altman, 1968) and Zeta (Altman at al, 1977) indicates that most of the researchers have eliminated the use of the ratio analysis.

A broad revision about the prediction and valuation of results using accounting ratios is summarized in Reverte (2002). However, there is not a generalized agreement about the best ratios. The reason is that, again, there is not a theory to guide us in the selection process (Dieguez et al, 2006).We should mention some outstanding studies: Beaver (1966), Altman (1968), Altman, *et al.* (1977), and Ohlson (1980). There are many other research papers that use explanatory variables, but most of them are not based on a technique to reduce them. Those studies are just based on a bunch of given variables (Edmister, 1972; Joliffe, 1973; Fotopoulos & Louri, 2000; Bunn & Redwood, 2003; Mehra (1996); Mar y Serrano, 1994). Serrano-Cinca *et al* (2002) selected the same 15 ratios used by the European Commission. Miguel et al, (1993), applied a neural network model to 15 accounting ratios.

A very broad review of the literature carried out by Capon et al (1990) between 1921 and 1987 shows the relationship between internal and external business factors, and the financial outcomes at the industrial and company-specific level. The results show that in more than 1,100 tests, there is a clear-cut cause-effect relationship between industrial concentration, market share, and growth on one hand, and financial results. There are, though, less obvious results regarding size and investment capital.

The researchers, sometimes, select variables used by external bodies, like the OECD, BACH, or the European Commission. Nevertheless, to use a short number of variables is necessary that they be endorsed by theory or, at least, a statistical process, and a clear-cut objective (Frederikslust & RAI Van, 1978). However, the variables used in a classifying analysis could depend on the technology chosen and, also, neural networks depend heavily upon the characteristics of the input variables (Hertz et al, 1991; Pakath & Zaveri, 1995). For this reason, and to check Joliffe´s old assertion (1973) that there is not any method superior to the rest, we are going to use three sets of accounting data, based on different reduction techniques. After applying the Neural Networks method to the three sets, we will compare them with the intention to find similarities among them, and select one, which it will described in this paper.

The initial model was made up of 48 variables, and through the Principal Components technique, it has been reduced to 27 variables. The following set of data is made up of the whole set of variables without using any reduction procedure. It shows some changes, although small. We can appreciate a slight reduction in stability. That is quite expected because the Principal Components analysis homogenizes the differences due to the fact that we are now using 48 variables instead of 27. Notwithstanding, the most stable regions are not affected. Finally, the third set of data is the result of a reduction based on correlations. We have eliminated any variable with correlations in absolute terms over 0,7, and reducing the pool to just 18 variables.

The number of firms covered in this paper is 244,720 micro firms, 53,061 small, and 1,708 medium-sized firms, with a total of 299,489 firms. These companies run their business in 17 Spanish regions, and in 186 sectors classified by the CNAE (National Classification of Economic Activities). The data has been taken from the Spanish Register of Business Names, being the raw material the annual accounting books and records, covering the years 1998-2004, both included. This period of time could be characterized as one in which Spanish firms run their businesses in an environment of high stable growth, low interest rates, moderate inflation rates, and general prosperity

With the intention to find similarities among the three sets of data, and after applying the Neural Networks methodology to them, we have calculated the Euclidean Distance between the outcomes obtained for each set. These results come in terms of size and regions, generating qualitative dynamical descriptions: unstable, totally stable, trend to stability, very stable, very unstable, depending on the changes through the seven year period. These descriptions have been transformed into a numerical form for each dimension, and used as the raw material to find out the Euclidean Distance.

Table 1

	P.Components / no reduction	P- Componentes / reduction by correlation	No reduction / reduction by correlation
Euclidean Distance	**31.70**	**35.83**	**37.90**

We can see in Table 1, that the models are very similar to each other. Because of that, we have decided to eliminate the Principals Components set due to the difficulty of interpreting the lineal relations observed in the results within the classifying model used in this study. The model without reduction has a weak applicability because of the large amount of high correlations between variables, making it redundant and generating noise. As a result, we use the reductions by correlations model. After taking out the most correlated variables, the model has been reduced to 18 variables (see table 2).

Table 2

1	Total assets (euros)	TOTACT	10	Value Added / Sales (%)	VAdCNEG
2	Current Assets / Fixed Asset (%)	ACIRdAFIJ	11	Financial Expenses / Sales (%)	GFINdCNEG
3	Inventories / Total Assets (%)	EXISdATOT	12	(Receivable – Var. Provisions) / Sales (days)	DEUdCNEG
4	Short Term Financial Assets and Cash / Total Assets (%)	AFCPYDdATOT	13	Fin. Exp./ EBIT (%)	GFINdRGEN
5	Accumulated Depreciation. / Fixed Asset (%)	DOTAMORdINMAT	14	EBIT / Total Receivables (%)	RGENdETOT
6	Accumulated Depreciation. / Total Assets (%)	DOTAMORdRGT	15	ROS (%)	BAITdCNEG
7	Equity / Total Liabilities (%)	FPdPASTOT	16	Fiscal Effect	EFECFIS
8	Short Term Acc. Payable / (Receivable – Var. Provisions of Bad Debt) (%)	ACPdD	17	Average number of no temporal employees (nº)	TRABFIJ
9	(Equity + Long Term Receivable) / Fixed Assets (%)	RPELPdIMAT	18	Average labor cost (euros)	GTOTRAB

Where: EBIT means earnings Before Interest and Taxes

ROS means Return on Sales

Fiscal Effect represents the impact of the corporate tax on earnings.

5 Results of the final model

Figure 1 show a distant map (U-Matrix) where the firms are clustered. The colours represent the cell separation. The blue-colour spectrum indicates a shorter distance whereas the red-colour one indicates a longer distance. A firm in a blue cell means that it is much closed to the firms located in adjacent cells, and this means that both companies have a high level of similarity

It can be seen that there is a set of reddish colour cells across the map from the central bottom area to right corner, splitting the map in two

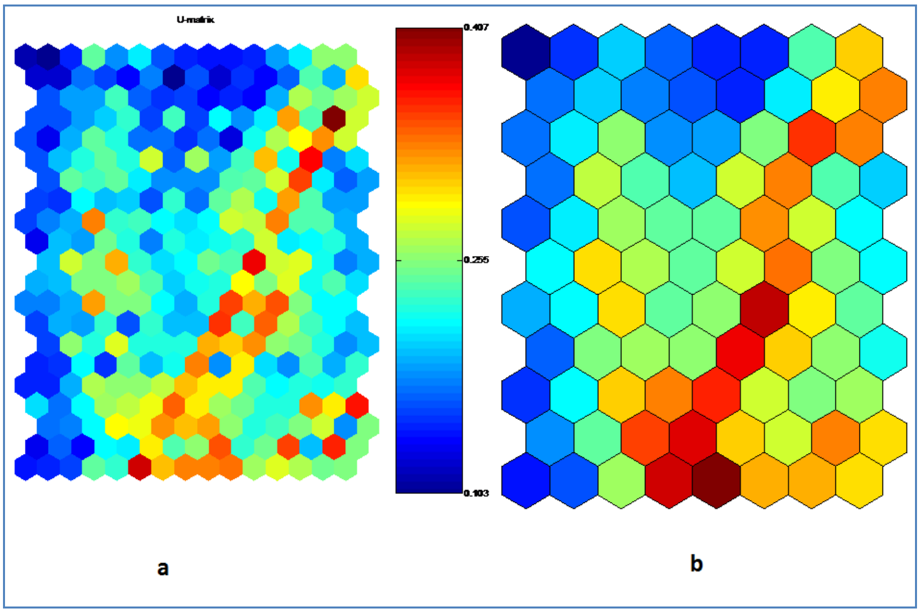


fig. 1

With the intention to understand it better, we simplify the previous figure to a map with few cells. We can observe in the new map (fig. 1b) two somehow differentiated large areas corresponding to the blue-colour spectrum. The frontier between these two areas is represented by the yellow and red cells narrow area. In this map, again, the colour represents distances.

We use a cluster technique and calculate the Davies and Boulding (1979) index for each group with the intention to define groups of homogeneous firms, (see fig. 2b). Five groups are formed: 1, 2, 3, 4 y 5.

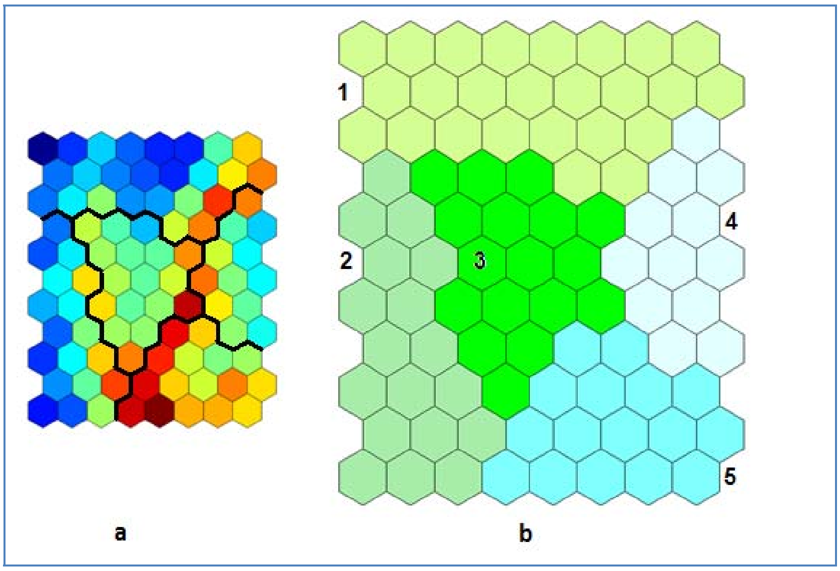


fig. 2

The characteristics of each group in the figure 2 are shown in table 3. The first column represents the 18 variables after reduction; each cell shows the maximum and minimum of the variables. Table 3 shows the ranges of variables that define each group formed by applying Davies-Boulding..

Table 3

		Grou, 1	Grou, 2	Grou, 3	Grou, 4	Grou, 5
TOTACT	Max	3,456,722,399.16	4,264,120,886.80	6,427,144,207.93	2,627,725,766.41	5,573,796,348.75
	min	880,873,622.61	1,363,872,183.68	2,219,527,442.69	1,719,128,051.14	1,920,970,258.76
ACIRdAFIJ	Max	172.59	175.78	159.31	170.24	149.99
	min	147.98	148.16	132.75	151.39	97.86
EXISdATOT	Max	26.70	19.86	23.84	27.40	23.08
	min	19.84	16.80	18.01	24.29	16.24
AFC,YDdATOT	Max	12.17	13.36	13.98	11.64	13.24
	min	9.61	10.95	12.08	9.51	10.66
DOTAMORdINMAT	Max	13.91	17.44	12.78	10.85	11.33
	min	9.29	12.93	10.11	8.72	7.73
DOTAMORdRGT	Max	54.59	51.66	47.01	42.35	39.93
	min	41.94	42.53	40.04	35.18	34.14
F,d,ASTOT	Max	35.14	41.02	40.01	40.37	45.86
	min	30.00	34.25	35.60	33.75	40.71
AC,dD	Max	212.97	173.59	197.78	193.10	177.65
	min	173.26	143.97	162.41	171.48	151.22
R,EL,dIMAT	Max	181.82	194.83	199.77	217.97	214.74
	min	149.02	164.62	161.98	186.67	179.03
VAdCNEG	Max	29.03	33.60	29.26	27.44	31.29
	min	22.32	28.99	24.26	23.60	25.23
GFINdCNEG	Max	1.77	1.48	1.61	1.87	2.17
	min	1.44	1.25	1.38	1.54	1.45
DEUdCNEG	Max	88.88	81.48	85.17	98.62	97.87
	min	69.61	75.06	71.78	83.60	85.01
GFINdRGEN	Max	36.11	24.82	25.35	29.29	21.34
	min	24.87	18.05	18.80	19.57	17.40
RGENdETOT	Max	11.68	16.62	13.71	13.25	16.78
	min	7.85	12.78	11.72	9.55	12.94
BAITdCNEG	Max	6.81	6.57	7.17	9.59	10.53
	min	4.61	5.26	5.97	6.89	7.20
EFECFIS	Max	67.35	74.45	72.90	69.92	80.11
	min	60.38	65.57	66.98	66.43	69.80
TRABFIJ	Max	17.28	12.22	14.50	23.64	24.51
	min	2.70	8.16	3.41	15.70	10.69
GTOTRAB	Max	17,884.96	22,738.50	21,961.00	21,211.25	22,188.37
	min	15,131.89	17,651.36	17,835.04	16,967.60	18,654.49

Fig. 3 shows the 18 variables used in the model. We can observe that there isn't any similar behavioural pattern between them, although we can infer some relationships between the variables, ie, companies with a high level of ACPdD (red colour cells) have a low level of FPdPASTOT (blue colour cells).

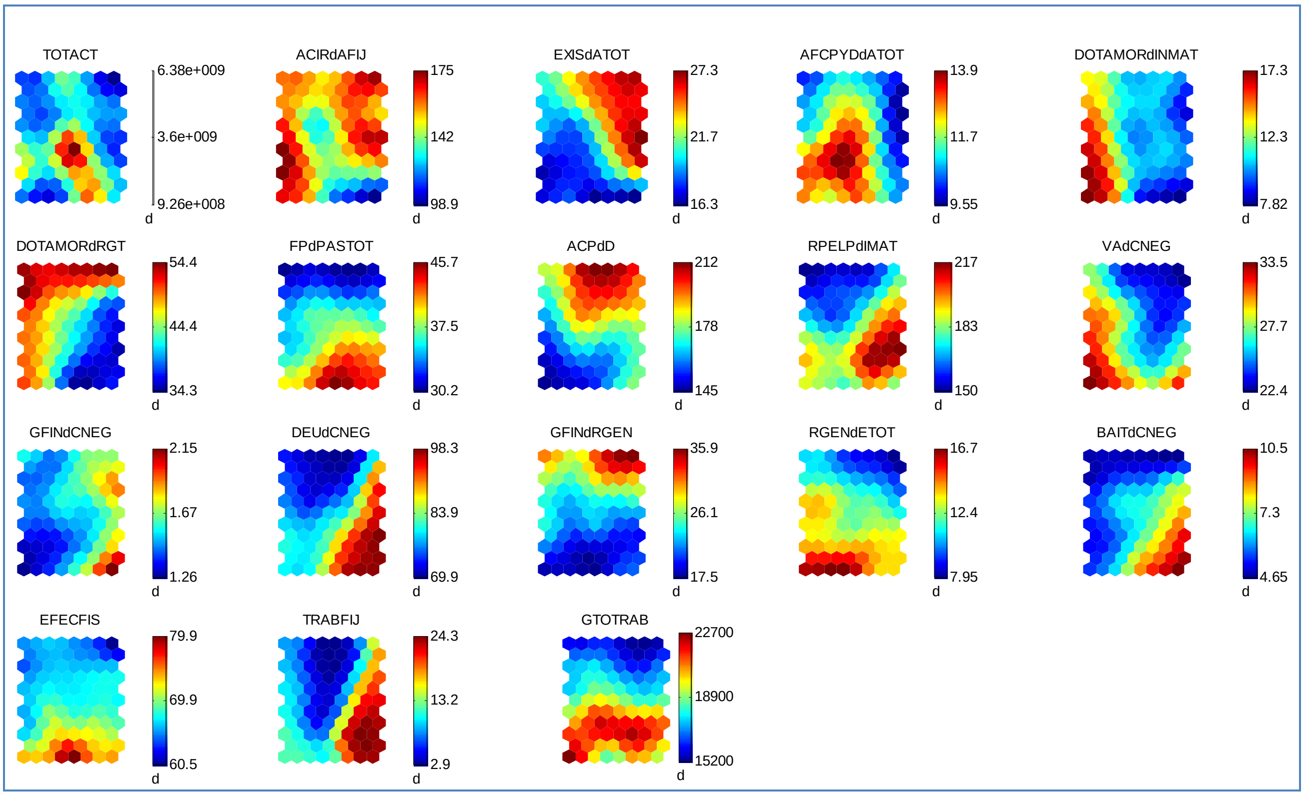


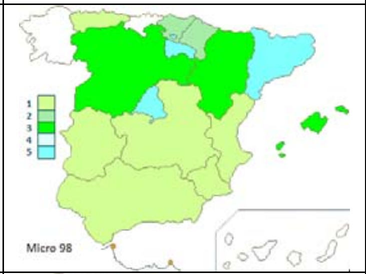
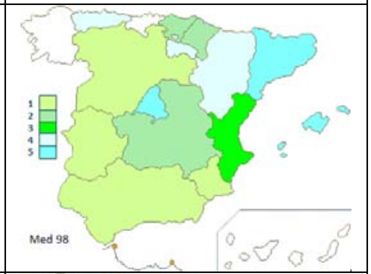
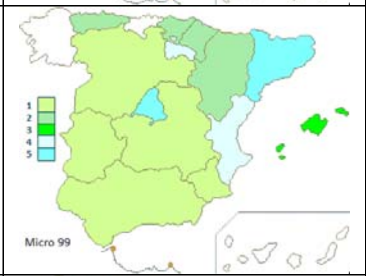
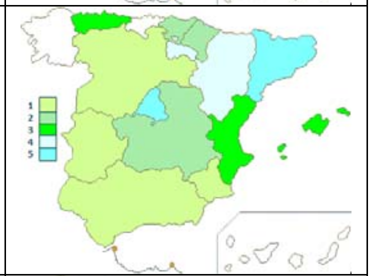
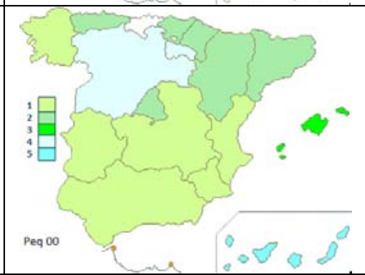
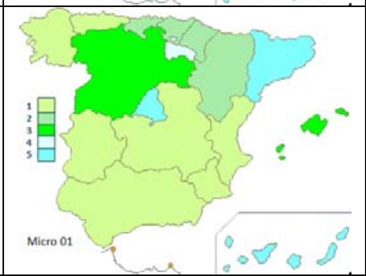
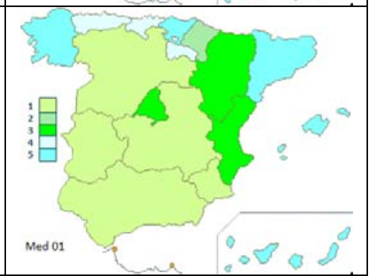
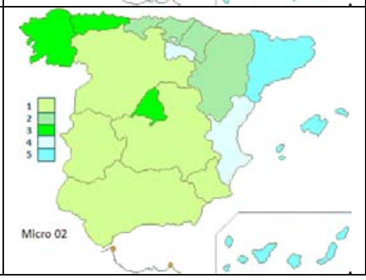
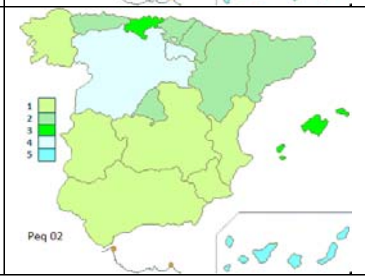
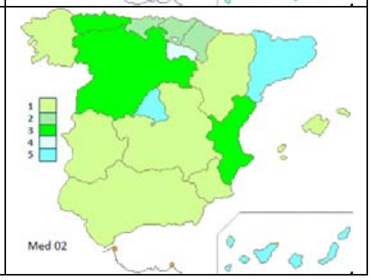
fig. 3

To facilitate the visual observation, and to reach conclusions, we have drawn a colour map (Table 4). Each group has been assigned a colour, and each region has been defined with a particular colour, classifying in this way their companies. Each column represents size, rows represent years, and each map shows the colour key to identify groups. The observed changes in particular regions should be due to specificities related to region and size. Specifically, in our study of Spanish firms, we can see some traits. With the intention to be able to see through a colourful string of maps, we achieve a cross-sectional and dynamical analysis of them. First, we carry out a dynamical description of the 17 Spanish regions according to size, following the axis North-South, West-East, as if we were reading a text. In a second table, we show the general similarities among sizes for each region during the period studied.

We define a period of seven years with the absence of changes as a very stable period, with just one change, then, it would be considered just stable, if two, unstable, and, finally, three changes would be considered very instable. The trend either to stability or to instability labels means when there are four years in a row of stability or three of instability, and vice versa. The next table shows the dynamical changes within the size range for each year and region. In other words, we measure the similarity or dissimilarity grade of results, according to size, for each of the 17 Spanish regions.

The regional income data comes from Eurostat (published in 2004), and we break down the different segments of income in terms of the European average. In this way, a 15% regional income over the European average is considered high; up to this 15%, upper-middle; a 15% inferior, lower-middle; and a level lower than 85%, low income region.

Table 4

	Micro	Small	Medium
1998			
1999			
2000			
2001			
2002			

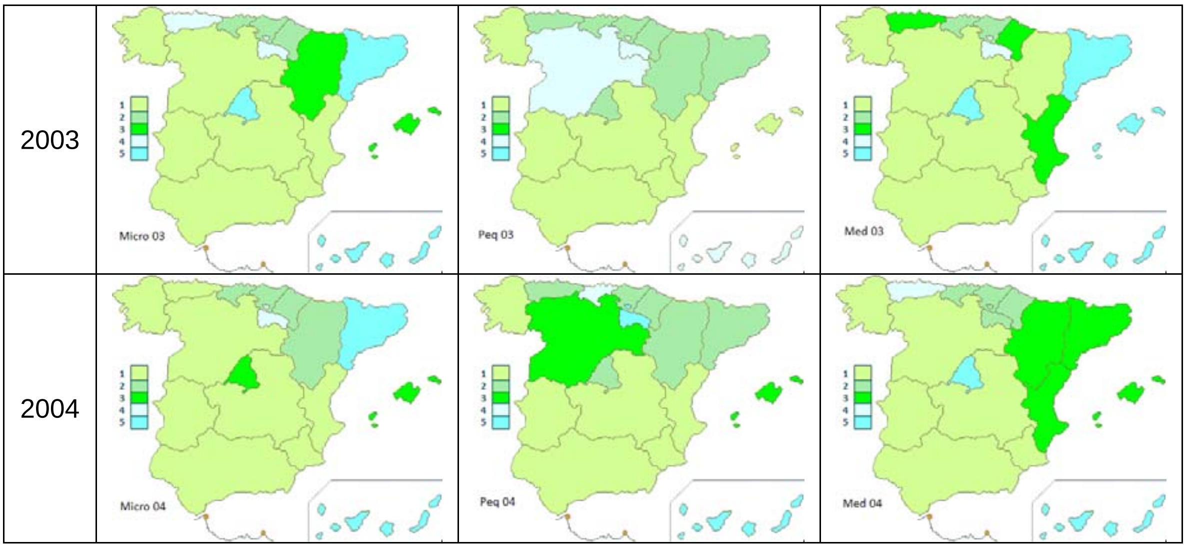


fig. 4

Dynamical description of Spanish regions by size

Table 5

Regional Income	Regions	Micro	Small size	Medium size
Low	Galicia	Stable	Stable	unstable
Low-medium	Asturias	Very instable	Very stable	Very unstable
Low-medium	Cantabria	Very stable	very unstable	unstable
High	Basque country	very stable	unstable	Stable
High	Navarre	Very stable	very stable	Stable
High-medium	Aragon	Instable	very stable	Very unstable
High	Catalonia	Very stable	very stable	stable
Low-medium	Castile- León	Instable	Very unstable	Stable
High-medium	La Rioja	Stable	unstable	Stable
High	Madrid	Instable	Stable	Stable
Low-medium	Valencia	Instable	Very stable	stable
High-medium	Balearic Isl.	Instable	unstable	very unstable
Low	Extremadura	very stable	Very stable	Very stable
Low	Castile- La Mancha	Very stable	very stable	Stable
Low	Andalusia	very stable	very stable	Very stable
Low	Murcia	Very stable	very stable	very stable
Low-medium	Canary Isl.	very stable	Stable	Very stable

Size description by regions

Table 6

Regional Income	Regions	1998	1999	2000	2001	2002	2003	2004
Low	Galicia	-	-	D	D	D	S	S
Low-medium	Asturias	D	D	D	D	D	D	D
Low-medium	Cantabria	-	-	-	D	D	D	D
High	Basque country	D	S	S	D	S	S	S
High	Navarre	S	S	S	S	D	D	S
High-medium	Aragon	D	D	S	D	D	D	D
High	Catalonia	D	D	D	D	D	D	D
Low-medium	Castile- León	D	D	D	D	D	D	D
High-medium	La Rioja	D	S	S	D	S	S	D
High	Madrid	S	S	D	D	D	D	D
Low-medium	Valencia	D	D	S	D	D	D	D
High-medium	Balearic Isl.	D	S	D	D	D	D	S
Low	Extremadura	S	S	S	S	S	S	S
Low	Castile- La Mancha	D	D	D	S	S	S	S
Low	Andalusia	S	S	S	S	S	S	S
Low	Murcia	S	S	S	S	S	S	S
Low-medium	Canary Isl.	-	-	S	S	S	D	S

D: dissimilarity: Dynamical changes between the three types of size for each year analyzed (level of similarity in terms of size from one period to another.
S: similarity: the opposite.

6 Conclusions

There is a wide diversity of sizes, geographical characteristics, and sectors under the term pyme (acronym for small and medium sized firms). Many of these differences could not been observed until very recently in any of the available data bases due to the lack of a suitable sorting mechanism. Neural Networks offer us a very flexible tool to cope with the many problems that a huge data base, and many variables entails. This paper has tried to add some new insights in the study of some of the characteristics and different behaviours of the whole small and medium sized Spanish companies. Our model shows the differences between their financial structures and their behaviour. It stands out the fact that, in general terms, the wide range of outcomes in firm behaviour is the result of a specialization of services and products by regions [1](this assertion should be analysed deeply in a further study). Our main conclusions are:

We can see in the first table that some regions stay very stable through time and across sizes, other regions are quite unstable, and a third group moves to stability. Also, we can see in the second table that some regions hold the same general characteristics, independently of the size, while others change.

Navarre, Extremadura, Andalusia, La Mancha, the Canary Islands, Catalonia, and Murcia are regions that, independently of their wealth and firm size, are thoroughly stable. Notwithstanding, poor regions are more stable than rich ones. We can see that Galicia, being also a poor region, it is not stable, and coincidentally, it is located far from the poor regions, which, on the other hand, are all stuck together. Perhaps, the fact that four poor regions are next to each other and, at the same time, they hold some stability, is due to some peculiarities. On the other hand, by comparing the table of the dynamical description by size with the table of the size description by regions, we can no infer any special relationship between stability and similarity or resemblance. What about the middle classes? None is totally stable (except the Canary Islands which is low-medium).

We can see that, as a whole, the stability level is uniformly distributed throughout all the companies, independent of size.). Almost all regions hold similar levels (11, 12, and 13 for micro, small, and medium size respectively).This characteristic is far from what we found in the other two analysis (with the whole set and the reduced set by Principals Components.

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[1] See Maroto (2010): Las PYME españolas con forma societaria, Colegio de Registradores de la Propiedad, Madrid.

It is worth to mention that this model does not include any trend either towards stability or instability, whereas the other two models, the one with all the variables hold some.

The regions of higher and lower income show a higher stability and similarity among themselves than between the regions of middle income, being the low-rent regions that form a conglomerate or compact group, the most stable of all.

On average, we find that there is as much similarity as divergence among companies, without standing out any one. As the selected model is the one with the shortest number of variables, it could be expected to see a greater similarity, but this is not the case, except in the case of Andalusia, Extremadura, and Murcia, three poor regions next to each other. As a result, in this sense, little can be inferred.

The results obtained from both sets, the one reduced by the Principal Components Analysis, and the other one with all variables, are quite similar in the sense that they keep a certain level of stability. On the other hand, the correlation model shows a lesser stability level, exception made of the lower rent regions.

As a closing, we want to mention that our classification model within regional and size dimensions has offered us a reference dynamical map for future analysis. The next step should add the sector /industry dimension to the analysis, although that means increasing the complexity of the model to a three dimensional map.

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Appendix 1

The initial model was made up of 48 variables.

FAMILY	Variable	FAMILY	Variable
Total assets (euros)	ATM	Cash / S-T Account Payable (%)	LIQ1
Sales (euros)	CNM	[(Receivable – Var. Provisions)+S_T Financial Investment.+ Cash.] / S-T Account Payable (%)	LIQ2
Net Income (euros)	RNM	Current Assets / S-T Account Payable (%)	
Current Assets / Fixed Asset (%)		Financial Expenses/ (Net Income + Financial Exp.)(%)	
Current Assets / Total Assets (%)	CIR1	Fin. Exp./ (EBT.+ Financial Expenses.)(%)	SOL1
Inventories / Total Assets (%)	CIR2	Fin. Exp./ EBIT (%)	SOL2
S-T Financial Assets and Cash / Total Assets (%)		EBIT / Total Receivables (%)	
Fixed Asset / Total Assets (%)		Total Assets / Total Receivables (%)	
Accumulated Depreciation. / Fixed Asset (%)	CEF1	Net Income. / Equity (%)	ROE
Accumulated Depreciation. / Total Assets (%)	CEF2	ROA (%)	
Equity / Total Liabilities (%)		ROS (%)	ROA1
S-T. Acc. Receivables / Total Receivables (%)	EXI	Sales / Total Assets (%)	ROA2
Total Receivables / Equity (%)		Leverage	
S-T. Acc.Receivables / Equity + L-T Receivables (%)		EBT /EBIT (%)	APF1
S-T Acc. Payable / (Receivable – Var. Provisions of Bad Debt) (%)	CFC1	Total Assets / Equity (%)	APF2
(Equity + L-T Receivable) / Fixed Assets (%)	CFC2	Net Income / EBT (%)	
(Equity + L-T Receivable) / Total Assets (%)		Fiscal Effect	EFI
Value Added / Sales (%)	ACT1	Net income /EBT	
Value Added / Fixed Assets (%)	ACT2	Average number of no temporal employees (nº)	
Working Capital / Sale (%)		Average number of temporal employee (nº)	TRB1
Overhead Expenses / Sales (%)	CTE1	Average labor cost (euros)	TRB2
Salaries / Sales (%)	CTE2	Value Added per employee (euros)	
Financial Expenses / Sales (%)		Labor Expenses / Value Added (%)	
(Receivable – Var. Provisions) / Sales (days)	RT		
S-T Account Payable / Overhead Expenses (days)			

The number of firms covered in this paper is 244,720 micro firms, 53.061 small, and 1,708 medium-sized firms. These companies run their business in 17 Spanish regions in 186 sectors classified by the CNAE (National Classification of Economic Activities). After applying Principal Components Analysis to our model (see appendix), the variables have been reduced to:

1. ATM
2. CNM
3. RNM
4. CEE1
5. CEE2
6. CEF1
7. CEF2
8. CFE
9. CFC1
10. CFC2
11. ACT1
12. ACT2
13. CTE1
14. CTE2
15. RT
16. LIQ1
17. LIQ2
18. SOL1
19. SOL2
20. ROE
21. ROE1
22. ROE2
23. APF1
24. APF2
25. EFI
26. TRB1
27. TRB2
28. CCAA (regions)

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