Linking financial statements to business models: empirical evidence of annual report's ability to predict sustainable performance

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Abstract

It is a widespread belief in literature that financial statements, especially those of privately held firms of small and medium sizes, find it difficult to precisely measure performance achieved as well as to anticipate possible future results related to the strategic management of the company.

This gap in the modern economy appears to increase, since intangible assets and networking competences (traditionally underestimated from accounting indicators even not considered at all in the context of entrepreneurial firms of small and medium dimensions) distinguishes the companies that succeed from those that gain normal or even negative performance.

This study demonstrates that financial statements - even if expressed at historical cost - reflects the business model and has significant predictive value about its sustainability over time when the analysis of financial statements takes care of two *premises*: 1. the analysis covers an adequate period of time; 2. the research is based on advanced methods of accounting data processing, able to highlight the relative position of a company business model undertaking from those implemented by other companies in the same time period.

To this end, moving from the observation of 15 variables elaborated from financial statements of 4.455 companies with a turnover of more than €1 million in 2003, we employed a non-linear cluster analysis technique based on SOM algorithm (Self Organizing Map) to: (i) detect different business models over the period 2003-2007; (ii) test the predictive ability of the same accounting variables by observing the performance development of the sample in an equal and subsequent time period (2008-2011) characterized by adverse economic conditions. The analysis is currently in process to connect BM and some specific accounting characteristics or financial disclosure of the firms that share a defined BM.

Keywords

Financial Statements; Self Organizing Map; Business Model; Entrepreneurial firms

1. Background

1.1 From business model to financial reports

The term Business Model (BM) refers to a concept that in the last two decades has grown its use in the language of international financial and academic community. The media have certainly contribute to enlarge its use: within major magazines and journals, only one article in 1990 used the term BM three times or more while by 2000, well over 500 articles fell into that category (Shafer et al. 2005). Similarly, Page ha recently stated that the term BM is a new addition to the lexicon of financial reporting (Page 2012). Giunta et al. posit that the level of

popularity reached by the BM and the wide academic debate on its meaning, can have originated a sort of «fashion effect» around the term.

As a result, in the last 15 years researchers and practitioners have examined what is the BM, what is its function and, as far as this paper is concern, why it is necessary in a financial report. The review of the existing literature over the past few years shows effectively a large number of definitions for BM (Timmers 1998, Linder and Cantrell 2000, Hamel 2000, Petrovic et al. 2001, Stewart and Zhao 2000, Weill and Vitale 2001, Hawkins 2001, Rappa 2001, Elliot 2001, Amit et Zott 2001, , Osterwalder et Pigneur 2002, Afuah 2004, Morris, Schindehutte, and Allen 2005, , Hamermesh et al. 2002, Magretta 2002, Stahler 2002, Shafer et Smith 2005, Morris et al. 2005, , Morris et al. 2006, Morris et al. 2013). The analysis of these studies confirms the lack of consensus around the term.

Anyway, literature shows that trying to embed BM in a comprehensive definition may by be difficult. From an accounting point of view it may also be unworthy (Giunta et al. 2009). Singleton-Green posits that despite the lack of consensus on the term, '*the substance of the matter is that financial reporting does and should reflect the fact that firms do different things and do them differently. Defining, or agreeing a definition of, the term 'business model' will not advance our understanding of the financial reporting issues*' (Singleton-Green 2012, p. 6). Hence, with reference to the field of financial reporting to find for BM a definition itself loses importance actually: the core points are that users could extract from the financial reports relevant and sharp information about how the firm generates income or earns money and how it hopes to generates income or make money in the next future.

The financial reporting ability to represent the firm BM refers to the set of financial and non financial (narrative) information included in the annual reports, from which the users may reconstruct the strategic choices that produce the current performance of an entity in any given moment of its life cycle. According to the literature, examining financial and non financial consequences of those strategic choices means to describe how an entity has put in place its processes to create and capture value within its specific competitive context (Morris et al 2013).

Attempts to capture business models and evaluate their effect on financial reporting rely on the ability of the regulators (and the accounting standards) to represent the economic performance of the entity. Recently, the business model is become a key concept in various accounting context, with regards to both assets and liabilities measurement and the narrative side of the financial report (IIRC 2012, Leisenring et al. 2012, Page 2012, Singleton-Green 2012).

The International Accounting Standards Board (IASB) utilizes an '*entity's business model for managing the financial asset*' as a criterion for determining in IFRS 9 whether such assets should be measured at the amortized cost or at fair value in its financial instruments accounting standard. The business model concept has also been introduced into the accounting of deferred taxes under International Financial Reporting Standards with amendments to IAS 12 in 2010, addressing deferred taxes related to investment property. Both the IASB and FASB have proposed a lessor's lease income and lease expense using the concept of business model in the context of reporting within their joint project on accounting for leases. The concept has also been proposed as an approach for determining measurement and classification when accounting for insurance contracts. Recently, IFRS 10 has established the analysis of investee business activity to assess the power of control of the investor over the investee.

Regulators have also put a lot of attention in providing BM information in the narrative commentary included within annual reports: for example, the IASB has issued an exposure draft in 2009 providing a framework for management commentary in which a lot of elements of a firm BM are included. In 2010 the UK Corporate Governance Code has posited that '*the directors should include in the annual report an explanation of the basis on which the*

company generates or preserves value over the longer term (the business model) and the strategy for delivering the objectives of the company'.

As a result of the increasing prominence the concept of business model has received in the context of financial reporting, the European Financial Reporting Advisory Group (EFRAG), which advises the European Union on the endorsement of financial reporting standards, commenced a project on the "*Role of the Business Model in Financial Reporting*" in 2011.

1.2 Is the gap between Financial Reporting and Business Model increasing?

Despite the strains of the standard setters, in modern economy the gap of the financial reporting to represent the BM appears to have increased (Singleton-Green 2010). The causes of this gap are linked to (a) the continuous innovations introduced in business models to face the increased market competitiveness, and (b) the recent directions of developments in accounting standards.

As far as the business models are concern, researchers stress that the BM representation should explain how a company generates income or earns money. Traditionally, this has included specifying revenue drivers and the components in the company's price structure (Stewart and Zhao 2000). But the enormous changes in business models over time, especially as a result of the globalization process and the 2008 Financial Crisis, impacted heavily on company performance (Teece 2007; Voelpel, Leipold, and Tekie 2005, Morris et al. 2013). New markets, new opportunities and discoveries, the increasing level of market competitiveness have speed up business model innovations. As a result, especially in manufacturing, a lot of companies are continually engaged in finding new ways to renew their strategies and to update their business models to maintain the market position (George and Bock 2011, Giesen et al. 2007, Giesen et al. 2010). Consequently, examples of successfully companies that conduct their activities according to a unique business model over time are becoming increasingly rare (Morris et al. 2013); similarly, examples of companies that conduct their activities according to a relatively simply and widespread business model are vanishing, while business model complexity and heterogeneity are quickly increasing (Lambert and Davidson, 2012). In other words, nowadays successful business models are rarely conceived fully formed but are way points in a process of change that requires continual 'fine tuning' of the core components of the business (Demil and Lecocq 2010, Harford 2011).

In this changing context many studies have focused attention on analyzing specific cases, explaining a company's competitive advantages by the nature of its unique business model (Magretta 2002; Morris, Schindehutte, and Allen 2005, Bagnoli and Redigolo 2011). Such research tends to analyze models at the level of a specific company, which complicates the generalization of the results obtained (Morris et al. 2013). Some research has also put forward generic classification schemes for business models and established the presence of a connection between the business model and company performance parameters (Malone et al. 2006; Zott and Amit 2007, Lambert and Davidson 2012). Yet, cross-sectional studies linking types of business models to financial performance at the level of a given industry are notably lacking, because of the enormous changes in business models over time.

As far as the accounting standards are concern, a great deal of criticism has been leveled at the reporting model and its capacity (*rectius*, incapacity) to provide appropriate and fitting information about the BM. These issues were also recently discussed in a panel session at the 2010 Annual Meeting of the American Accounting Association. To sum up, panelists "*agreed that the reporting model is broken and identified various problems with it. Key concerns*

included length, complexity, the dominance of a compliance mindset, reporting on intangibles, an excessive focus on financial reporting, and the need for an integrated approach to reporting. Concern was also expressed about the approach of financial reporting standard setters, including the role of fair value, and their assumption that it is possible to find 'God's method of accounting" (Singleton-Green 2010, p. 409). On the one hand, the literature posits that the reports have become too articulate and complex, providing a lot of information unanchored from a business framework able to explain how the company is strategically managed (Eccles and Krzus, 2010); thus, researchers and practitioners are now engaged in trying to bring together information about various firm activity dimensions (strategies, governance, performance, social and environmental impacts) in the narrative side of the financial reports or in an Integrated Report. On the other hand, a lot of criticisms has been leveled to some developments in accounting standards (i.e. fair value adoption, revenue recognition, financial information focus) coming from the valuation area of studies (Beyer et al. 2010). Such criticisms arise from the room of discretionary that those developments have introduced in the financial statements, increasing performance manipulations (Leisenring et al. 2012, Marton and Wagenhofer, 2010). As a result of the 2008 Financial Crisis, the movements towards those developments seems now to have marked a change of direction. For example, FASB and IASB recent proposals are going back towards historical cost and real revenue recognition, with the aim of reducing management manipulation (Singleton-Green 2010).

Beyond the issues linked to the continuous BM innovation and to the developments in accounting standards, a recent paper on the BM approach to financial reporting confirms that users can be able to extract from the financial report a lot if interesting information about how the firm generates income or earns money. In particular, the paper states that each of the different measurement approaches reflecting business models have some interesting characteristics (ICAEW 2010, p. 5). The key points posited be the Authors are the following:
- financial reporting should provide a reality check on a firm's business model and its execution;
- where the firm's business model is to transform inputs to create new assets or services as outputs, historical cost would generally be expected to be the most useful basis of measurement;
- where the firm's business model is not to transform inputs, but to buy and sell assets in the same market with the intention of making profits from variations in market prices, fair value would generally be expected to be the most useful basis of measurement;
- where more than one basis of measurement is used in the accounts, performance statements should be structured so that the gains and losses arising from each are clear.

In the light of the different ideas and research streams that emerges in the literature concerning the relationship between financial reporting and BM, this paper aims to show how the financial report of a large number of manufacturing companies using historical cost accounting may still reflect the dynamics of their respective business models and can be used to predict company performance.

2. Method

2.1 Research design

The decision to focus attention on a sample of manufacturing companies using historical cost accounting is associated with the fact that whilst financial assets may have the same value for any firm, the value of operating assets used by manufacturing companies depends on the business model adopted (Ohlson et al. 2010).

In this study, the analysis of the relations between financial reporting and BM is based on two premises:
1.   the analysis includes a lengthy period of time, in line with the processes for the

establishment and consolidation of a business model producing value over time.

Over the years, three dominant conceptual frameworks have emerged in relation to a company's business model. The first is an economic perspective, reflected in the work of Stewart and Zhao (2000), who approach the business model as a statement of how a company makes money and maintains its profit stream over a long period of time. A second approach focuses on an operations perspective, where attention is directed to the internal processes and infrastructure design (architecture) that enable companies to create value in the long run (Morris et al. 2006). A third perspective focuses on overall strategy, including how the company defines its market position, selects its customers, differentiates its products and services, goes to market, and its growth options (Katkalo 2008). All the empirical researches that have been done according to those frameworks share the collection of data over an adequate period of time, during which the business model is built up, and produces its results. In the accounting literature the focus has been on the financial reporting parameters able to shed light on these perspectives, in particular to the first one (i.e. the economic perspective). To this end, the financial statement can give a concise account of how a company makes money and maintains its competitive advantage and profit stream over time. Hence, a company's business model can be deduced from its key parameters, including operational, financial and economic measures collected for an sufficient period of time. Together, these parameters show how value is created and for whom, how decisions regarding revenue are made, how profits are earned, and demonstrate the strategic decisions taken for growth (Morris at al 2013).

2. the analysis is based on advanced methods of accounting data processing able to signal the relative positions of the companies, in line with the framework leading the competition between BM, which the market rewards or punishes giving rise to the business model providing the best performance. The comparison between the financial reports is a good way to mark the differences amongst BMs and hence to shed light to their different ways to generate income or earn money.

    In particular, this paper adopts an innovative approach involving non-linear clustering based on *Self Organizing Maps* (SOM). This method of cluster analysis assumes a theoretical vision that it is not focused on a "simplification" process based on a few parameters. It uses instead a computational basis able to interpret the complexity and heterogeneity underlying the business models representation. This algorithm can even be usefully integrated with more conventional instruments of investigation for the purposes of studying more incisively and thoroughly a complex, highly articulated phenomenon such as BM.

2.2 Non-linear clustering technique based on self-organizing maps

In the international literature, a lot of techniques have been adopted to go beyond individual cases and to give an empirical response to the configuration of the BM, identifying similarities between firms, describing comparable behavior and designing archetypes that could be generalized as far as possible (Lambert and Davidson 2012). Cluster analysis is certainly one of the most widely used techniques in this field of investigation, and has been used in strategic management and financial accounting studies since the seventies (Hatten and Hatten, 1987). Clustering techniques can analyze many parameters defining the characteristics of the BM, grouping together a statistical population of homogeneous.

The spread of these techniques is unrelated to the general acceptance by researchers of the analytic capability of cluster analysis (Barney and Hoskinsson, 1990; Meyer, 1991; Thomas and Venkatraman, 1988). The main resistance to cluster analysis comes from two types of criticism (Ketchen and Shook, 1996). In the first instance, what is criticized is the high degree of discretion for the researcher in assessing and interpreting results, which reduces the extent

to which the company's BM derived from the analysis can be generalized. This subjectivity is not only seen in some steps of the clustering process, but also in the absence of a statistical test able to establish (or disprove) the existence of a significant relationship between the results of the analysis and the starting hypotheses (Ketchen and Shook, 1996). It is essential the researcher's role, who gives significance to the results of the investigation. The second criticism leveled is about the widespread lack of solid theoretical underpinning by researchers, often more attentive to statistical profiles than to producing and disseminating knowledge about - and an understanding of - the relations between the different dimensions of BM involved (Barney and Hoskinsson, 1990; Thomas and Venkatraman, 1988). In these circumstances, the clusters identified might not reflect any actual situation, due to the possibility of cluster analysis to identify groups that do not exist.

To reduce these criticisms, some studies have developed a sort of agenda, indicating the criteria to follow for a reliable use of cluster analysis (Ketchen and Shook, 1996).

These studies highlight the importance of the following aspects in order to obtain reliable results by using cluster analysis: (a) the selection and processing of parameters[1]; (b) the choice of a suitable clustering algorithm for the type of analysis being carried out[2]; (c) the validation of the results[3].

Within the framework of research methods based on cluster analysis, some algorithms have recently been developed. They are able to process a large quantity of data, referring simultaneously to many different dimensions of the research, considerably reducing recourse to simplifications (Kohonen 1995, Li and Shanmuganathan 2007). These algorithms enable methods of quantitative analysis to be used which do not oversimplify the complexity of the concept under investigation (i.e, the business model) via an *a priori* choice of some parameters, but enables company behavior to be investigated in numerous dimensions.

Here, specific reference is made to a method based on *Self Organizing Maps* (hereafter SOM), in the category of artificial neural and competitive learning[4] networks.

Compared to linear *clustering* technique conventionally used, SOM offers the following benefits (Curry et al, 2003; Peeters and Dassargues 2006):

a)   it does not require "supervision" in determining output (for example, a preset number of clusters) and hence data processing does not require additional information beyond the input data, reducing the time dedicated by the researcher and its room of subjectivity[5];

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[1] The parameters can be chosen on the basis of an inductive approach (i.e. selected by the researcher according to what he/she thinks are the relevant dimensions), a deductive approach (based on the theoretical framework underpinning the research) or cognitive approach (with the parameters chosen by experts in the sector). In addition, the chosen parameters may or may not be standardized or processed to solve the problem of multi-co-linearity.

[2] There are two large families of algorithms for the application of a cluster analysis: hierarchical (in which a hierarchy of divisions is created with a growing – or decreasing - number of groups, as shown by a tree diagram) and non-hierarchical (in which belonging to a group is defined by the distance from a representative point in the cluster, after establishing a priori the number of groups). The methods used for the second group (such as *K-means*) allow (*i*) the impact of extreme values to be limited because observations can change from one group to another and (*ii*) enhance the homogeneity within the groups.

[3] Validation means verifying the soundness of the results. Despite the rigorous criteria adopted for the clustering process, without validation the cluster may appear unreliable or hard to believe. The literature shows that confidence in the results increases with validation based on techniques integrating the cluster analysis: for example, examining a similar but different sample from the one analyzed, using tests of significance or complementing the quantitative analysis with suitable qualitative methods.

[4] This means that during the processing phase the input data is treated randomly (or cyclically) until a balance is reached, where certain "winning" vectors of observation are determined, expressing the characteristics of the types (or prototypes) identified. Having determined the "winning" observational vectors, the relevant weighting is adjusted for all other close vectors (called the *vicinity*). This adjustment of weighting extended to the vicinity is a distinctive feature compare to other clustering algorithms and is essential for the purposes of maintaining the topological characteristics of the input data.

b)   it is able to project a multi-dimensional dataset (comprising all the observations carried out on the sample) onto a 2-dimensional map, maintaining the topological order between variables and displaying the complex non-linear relations between them.

As can be seen from figure 1, SOM provides two subsequent levels of abstraction:
–   the first level is obtained by applying the algorithm to the information vectors collected for every firm in the sample. This enables the type of BM relevant to the investigation to be identified among the data sets. At this level of abstraction, SOM leads to the display of a 2-dimensional map with all the information used for the analysis of all the firm's BM in the sample: this map comprises a number of cells corresponding to the number of BM identified; the distances between each cell and the others are an expression of the degree of homogeneity (or dissimilarity) between the types of BM in each cell;
–   the second level of abstraction includes in the *clustering* the types of BM identified. This *clustering* can be carried out by the researcher either by observing the degree of homogeneity (or dissimilarity) of the maps or by using conventional methods (such as K-means)[6].

Figure 1. SOM levels of abstraction[7]
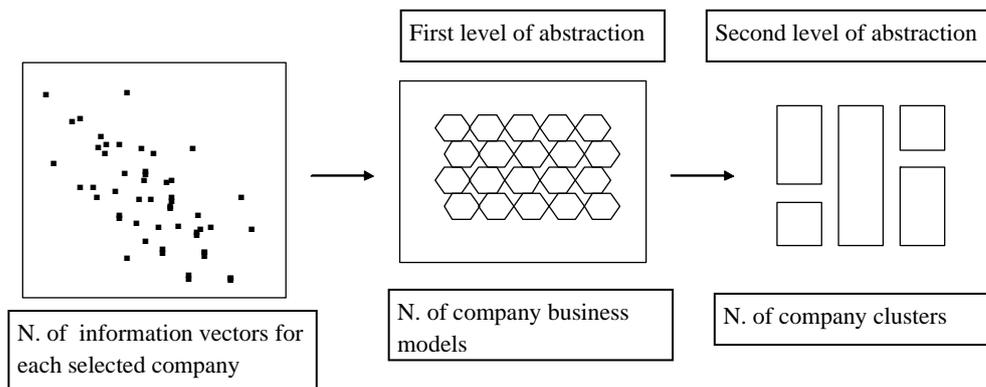
To sum up, the SOM algorithm carries out two functions:
(1)   it composes the complexity of the input data, by identifying clusters of multi-dimensional similarity. For this purpose, the SOM is able to treat datasets constructed from data with quantitative origin (for example financial data in the financial report) and with qualitative origin (for example data from responses to questionnaires, coded in discrete parameters interpretable as scales of value);

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[5] With reference to the learning dynamics of neural networks, those defined as "non-supervised" do not involve the a priori determination by the researcher of the cluster output (for example the number of expected clusters). The "non- supervised" networks function starting from the vector of input information; the results need only to comply with the formal restrictions of the algorithm, which essentially consist in grouping the inputs by the multidimensional similarity found in them (Buscema 1999). The quality of SOM results is expressed by two error measurements: quantification error (providing evidence of the map resolution) and topological error (which enhances the ability of SOM to maintain the topology of input data). The use of SOM has also some limitations: for example, the learning algorithm does not always "converge" towards an output with good quality results (a large number of data are required for a good learning curve and low quantification and topological error); furthermore, continuity in the representation of outputs means that the values are not always precise, but have a "*range* of oscillation" within which they may vary.

[6] As expressed by Vesanto and Alhoniemi, 2000: "*The goal of the SOM is not to find an optimal clustering for the data but to get good insight into the cluster structure of the data for data mining purposes. Therefore, multidimensional and complex data set is first clustered using the SOM, and then, the SOM could be clustered.*"

[7] Adjusted from Vesanto and Alhoniemi, 2000.

(2) the ability to organize, group and display data in a map, based on less than obvious similarities found among the input data.

These characteristics enable the SOM to overcome some criticisms posited in the literature (and stated above) in relation to conventional clustering techniques: the ability to choose a large number of parameters together with the functioning of the algorithm without the need for "supervising" the configuration of the results, reducing the space for the discretion of the researcher. Added to this is the ability of the algorithm to make the most of the information derived from much larger number of parameters, even if their linear correlation index with the dependent variable is low (Breda 1999). For these reasons SOM, just sporadically used in previously financial accounting studies (Rutherford et al., 2001; Kloptchenko et al. 2004), has excellent potential due to its analytic capability in dealing with the multi-dimensional figures recognized in financial statement.

2.3 Data collection and analysis

We collected data from the financial statements available in the AIDA database[8]. The sample of companies was selected according to the following criteria:

1. legal form: limited liability companies[9];
2. revenues: more than 1 million euro revenues at the beginning of the observed period (2003)[10];
3. industries: all manufacturing industries located in a Region of North Italy (Veneto)[11].

There are many parameters reported in the literature, consequently, a discrimination was needed to identify a limited set of parameters (Chen et al., 81).
The choice of the parameters compounded for this study has been driven by: *i)* previous studies; *ii)* a learning process last 4 years during those we run multiple pilot analysis.
Previous studies that analyzed the predictive ability of ratio are: Beaver (1966, 1968), Altman (1968a, 1968b), Edmister (1970, 1972) and Deakin (1972).
During the past analysis we progressively refined the parameters following two main directions: first of all, identifying the parameters that are more accurate in depicting the company performance; secondly, combining the parameters that provide, jointly considered, the more complete picture of the multiple dimensions that represent companies performance.
In particular, the combinations of the different parameters is crucial to improve the accuracy of the analysis. The set of the parameters has to be well balanced to avoid duplication of information provided by different variables that would lead to multi-collinearity among them.
Following previous practice shared in the literature (Libby, 1975), in order to reduce the number of ratios and remove redundancy we identify five salient dimensions of companies performance: operative, financial, structural, economic and efficiency.
The operative dimension shows the company ability to generate and increase the turnover.
The financial dimension depicts the company leverage, the trend of the leverage and the ability of the company to generate cash flow that allows to cope with debt.
The structural dimension shows the company propensity to invest and to do that with its own resources.
The economic dimension provides insights on the ability to generate and maintain return on sales and value added.

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[8] Aida is a commercial data provider that compiles data for Financial Statements derived from the Italian Chamber of Commerce.
[9] This restriction was imposed in order to ensure that the businesses examined were companies rather than individuals.
[10] Appendix A shows the dimension of firms that compose the sample.
[11] Appendix B displays the industries and the percentage of companies for each industry.

The efficiency dimension reflects the ability of the company to manage operative costs (like personnel costs and purchase costs).

Following this process we have identified 15 parameters grouped in five dimensions. The 15 parameters grouped in five dimensions are following listed (see table 1):

- operative (revenues; cagr revenues)
- financial (cash-flow; leverage; cagr leverage)
- structural (investment; self-financing investment)
- economic (ROS; ROS trend; value added; cagr value added)
- efficiency (cagr personnel costs; cagr operating costs; cagr purchase costs)

Table 1. Parameters for an integrated and longitudinal understanding of business model sustainability

Operative dimension	
Revenues	Revenues in the first year of the observed period
Cagr revenues	Compound annual growth rate of revenues
Financial dimension	
Leverage	Leverage of the first year of the observed period
Cagr leverage	Compound annual growth rate of the leverage
Financial charges	Ratio of financial charges on revenues in the first year of the observed period
Cash flow	Cash flow in the first year of the observed period
Structural dimension	
Investments	Ratio of the average investments in assets done in the period on the average revenues
Self-financing	Ratio of the self-financing (earnings plus depreciations) of the period on the investments of the period
Economic dimension	
ROS	Return on sales (average of the period)
ROS 2 last years	Return on sales (average of the two last years)
Value added	Ratio of the added value on revenues in the first year of the observed period
Cagr value added	Compound annual growth rate of the ratio of added value on revenues
Efficiency	
Cagr operative efficiency	Compound annual growth rate of the ratio of the production cost (less change in raw materials and other operating expenses) on revenues
Cagr purchase costs	Compound annual growth rate of the ratio of purchase costs on revenues
Cagr personel costs	Compound annual growth rate of the ratio of personnel costs on revenues

Two restrictions were imposed on the sample. As a result we have removed:

- companies without values for the chosen parameters in the entire observation period (2003-2011). Only companies with available data for the chosen parameters were retained.
- companies that show outlier values. We considered a value an outlier where the difference from the mean was more than 3 times its standard deviation. Outliers were calculated for all the parameters except stock values.

The final sample is constituted by 4,445 companies.

2.4 Clustering technique and procedures

In order to investigate the predictive capacity of financial statement, data from financial statements was analyzed after adjusting the parameters specified above, over a lengthy period of time (2003-2011), divided into two periods (2003-2007) and (2007-2011).

The decision to use 2007 both as the last year of the first period and the first year of the second period is based on the fact that the financial statement for 2008 were the result of the worldwide credit crunch and recession that began that year.

The 15 parameters created from the financial statement data of the 4,445 manufacturers in the survey were processed in the two periods using the SOM ("Self Organizing Map") algorithm. Applying SOM data processing (see section 2.2) to two periods we aim to:

a) identify the business models that characterize the surveyed companies, by interpretation of the values for the parameters in each cluster;
b) track the developments of the business model of the companies in the survey, interpreting migrations from one cluster to another in the two periods observed.

The analysis of these two aspects shows the predictive capacity of financial statement data, where analyzed with multivariate methods, since it enables:

a) the grouping of companies by commonality, in relative terms, of the data in the financial statement. The interpretation of the group processed by the algorithm enables the extrapolation and identification of the business model characterizing the company. Hence the analysis deduces the business model from the financial statement data;
b) the verification of the evolution of the business model over several periods.

In this study the process of "training" the neural network based on the SOM algorithm produced among other computational outputs 15 topological grills (Kohonen maps) for each of the two periods analyzed.

Each map represents and displays on a 2-dimensional scale the 15 parameters used to carry out the analysis of the 4,445 companies surveyed in the two periods.

The 15 maps of each period can be brought together in a single grill (called a U-Matrix, see figures 2 and 3) summarizing the information used for the analysis of all 4,445 companies. In other words, a single "map" shows the data for all fifteen parameters jointly considered and the values for all 4,445 companies surveyed in the two different periods of time.

Both the maps, the one showing the individual parameters and the one summarizing the trends of all 4,445 companies surveyed in the two periods (see figure 2 and figure 3), show in the darker areas the companies with homogeneous characteristics, and the lighter areas the companies with different characteristics.

It can be seen at a glance that the 4,445 companies tend to polarize in the cells at the edges of the map, indicating the differences between groups of companies with different business models according to the 15 chosen parameters.

In fact, via this procedure, the clusters are formed on the basis of the degree of intensity exhibited by a parameter (for example the intensity of the process of growth for the operational set-up, or the degree of indebtedness, or the company size, or operational efficiency and so on) and not the presence/absence of the parameter itself.

Since the SOM algorithm defines the position of the observations 2-dimensionally on the basis of the distances between the parameters, this technique of analysis enables all companies to be represented on the maps simultaneously, placing in adjacent cells the companies that have homogenous behavior and in the distant cells the companies that have the opposite kind of behavior.

Hence, this technique of computation and representation highlights "groups" of companies as if in a coherent universe, in which the gradual variation of some characteristics determines belonging to a particular type, shown in the cells of the U-Matrix (see figures 2 and 3).

The colors indicate the intensity of each variable on the topological map created by the SOM, in this case comprising three hundred cells indicating groups of companies with similar values for the 15 parameters analyzed.

To sum up, when reading the map, bear in mind that:
  i)   where cells are closed they are similar, where they are distant they are dissimilar;
  ii) changes in the characteristics of the cells are shown by the shading.

Figure 2. Sample performance in the first period (2003-2007)
based on the integrated analysis of the fifteen
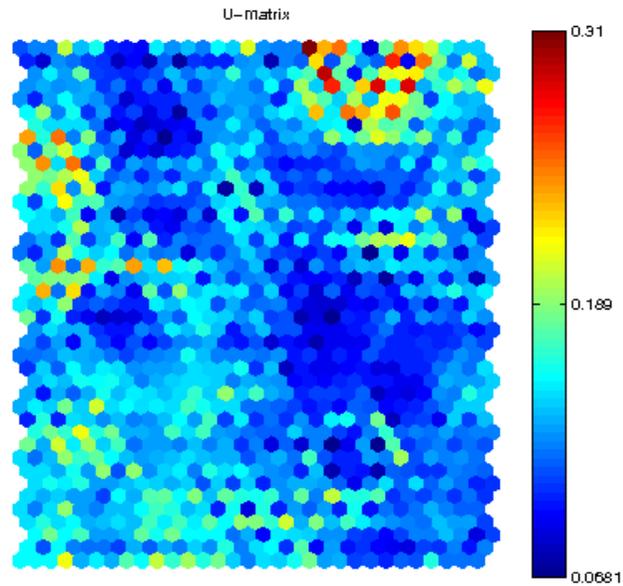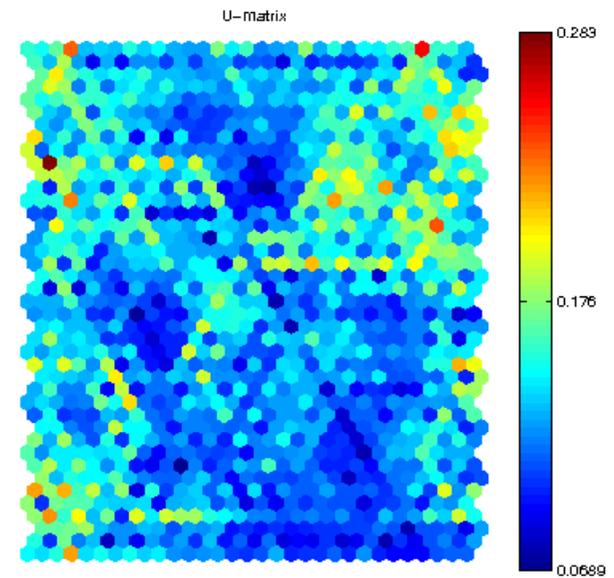accounting indicators selected

Figure 3. Sample performance in the second period (2007-2011)
based on the integrated analysis of the fifteen
accounting indicators selected

For the purposes of this investigation, the SOM algorithm was used together with clustering procedures based on the linear K-means algorithm, which enabled the three hundred cells comprising the Kohonen layer (see note 1) to be incorporated into a smaller number of clusters comprising companies with similar behavior for the chosen financial statement parameters for performance over the two time periods analyzed.[12]

Specifically, this procedure for analyzing data was based on the input of the 300 cells identified by the application of the neural network via the SOM algorithm, leading to the identification of 6 particularly significant groups. Each of these 6 clusters minimizes the distance of observations from one centroid, which represents the 'prototype' of the cluster on the basis of the values for the 15 financial statement parameters analyzed over the two 5-year periods. These procedures lead to the results described in the following section.

3. Results

Among the 4,445 firms analyzed, some performing definitely well in the first period gained poor financial and economic results in the second one while others, that achieved good performance in the first period, maintained or even improved profits.

In this section we describe, over the two different period considered and relying on the fifteen variables built on balance sheet data, how the firms that compose the sample performed with reference to the operative, structural, economic, financial and efficiency-related dimension analyzed. It is through the combination of these integrated and selected parameters processed by the SOM algorithm that is possible both to identify the existence of different business model and to go through a comparison of their sustainability in the long run.

3.1 First period 2003 – 2007

In the first period six different groups of firms emerged belonging on the five years performance observed, which are displayed in figure 4. With the help of table 2 we show the parameter values and specifically the centroids that the 4,445 companies, divided in 6 clusters, obtained for each variable considered in the first period.

To better understand the differences in behavior of the six groups, we summarize in table 3 and specifies the index values obtained for the "centroids" of the 15 parameters used in the analysis. In particular, in this table:

max = gives the maximum index-value found in the six clusters for the given parameter;
min = gives the minimum index-value found in the six clusters for the given parameter;
+++ = gives the index-value of the parameter which is much higher than the average for the six cl.
+ = gives the index-value of the parameter which is higher than the average for the six clusters;
0 = gives the index-value of the parameter as an average of the six clusters (in this case, the parameter is the average index-value not needed to characterize the cluster and differentiate it from the others with regard to the dimension under consideration);
- = gives the index-value of the parameter which is lower than the average for the six clusters;
- - - = gives the index-value of the parameter which is significantly lower than the average for the six clusters;

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[12] The procedure non-hierarchical clustering of K-means algorithms has the advantage of enabling the analysis of huge quantities of data at a relatively low cost. The conventional method of data-clustering suffers from the non-linearity of the descriptive parameters and introduces a potential error due to the need to establish a priori the number of clusters to be defined. Hence further trials were carried out to assess the number of clusters enabling the observations to be distributed homogenously.

Figure 4. The definition of the cluster through the integrated reading of the selected parameters (first period 2003 – 2007)
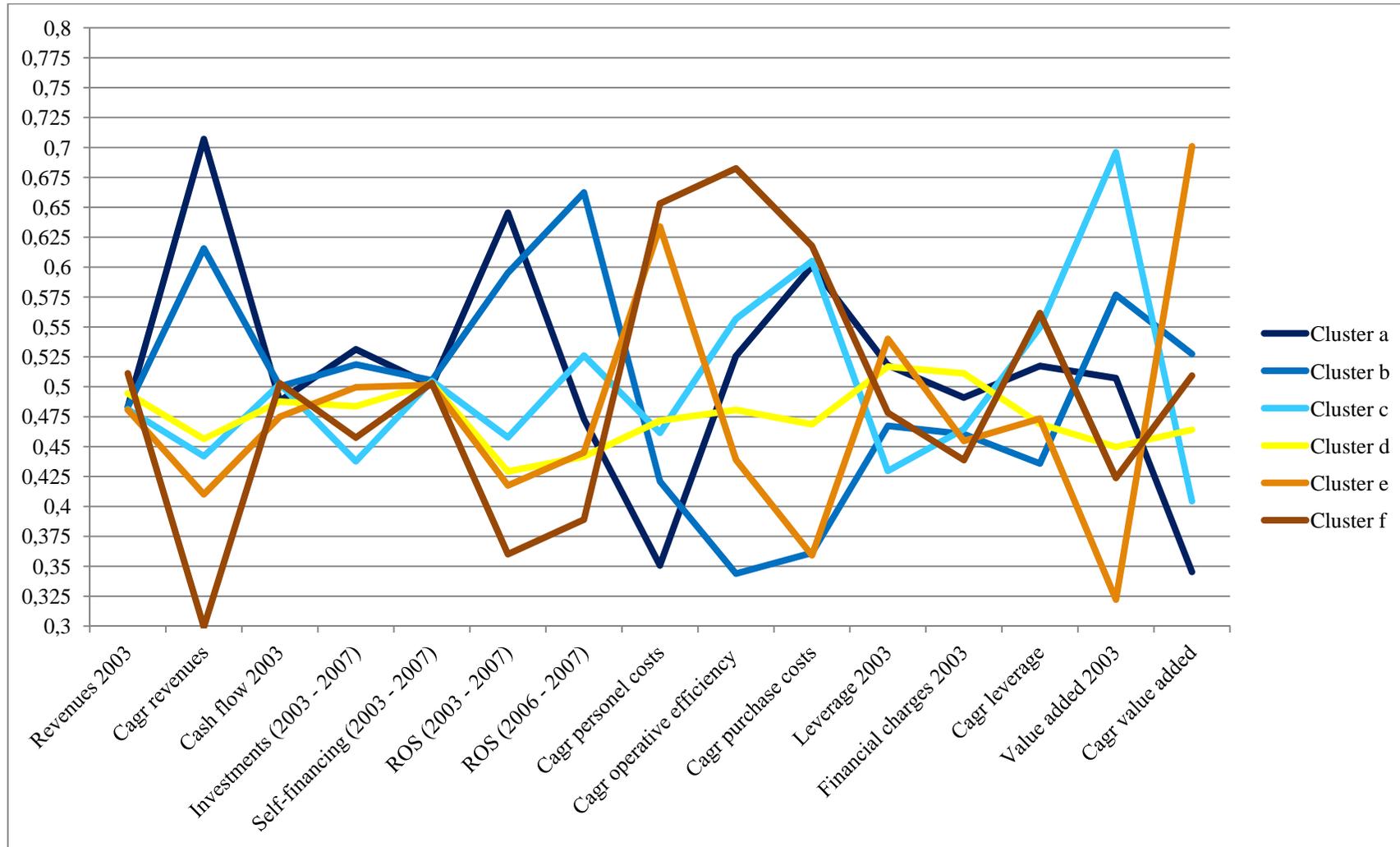
Table 2. The description of centroids parameters for each variable obtained by the 4,445 companies included in the six clusters obtained in the first period (2003 – 2007)

n.	Variables:	a	b	c	d	e	f	Average
0	Cluster composition	790 (18%)	654 (15%)	680 (15%)	979 (22%)	831 (19%)	521 (12%)	**4.455 (100%)**
1	Revenues 2003	9,736	10,701	8,147	9,177	7,366	21,188	**11,053**
2	Cagr revenues (2003 - 2007)	18.2%	12.5%	3.7%	4.8%	2.9%	-3.2%	**6.5%**
3	Cash flow 2003	453	1.130	824	365	179	1.427	**730**
4	Investments (2003 - 2007)	2.1%	1.5%	-0.4%	0.9%	1.2%	0.2%	**0.9%**
5	Self-financing investments (2003 - 2007)	-68.289	-14.568	33.455	32.105	-40.783	-110.236	**-28.053**
6	ROS (2003 - 2007)	34.0%	27.0%	12.0%	10.0%	9.0%	5.0%	**16.2%**
7	ROS (2006 - 2007)	4.6%	10.0%	6.0%	4.0%	4.0%	3.0%	**5.3%**
8	Cagr personnel costs	-6.6%	-3.7%	-1.4%	-0.9%	7.6%	8.3%	**0.6%**
9	Cagr operative efficiency	0.5%	-3.2%	0.9%	-0.2%	-1.0%	4.6%	**0.3%**
10	Cagr purchase costs	2.9%	-2.8%	2.8%	0.0%	-2.3%	4.3%	**0.8%**
11	Leverage 2003	67.0%	51.3%	40.1%	64.9%	71.8%	54.3%	**58.2%**
12	Financial charges 2003	2.0%	1.7%	2.0%	2.1%	1.7%	1.5%	**1.8%**
13	Cagr leverage	1.9%	-2.4%	5.0%	-1.8%	0.0%	5.6%	**1.4%**
14	Value added 2003	28.2%	33.6%	41.5%	24.8%	16.1%	23.5%	**28.0%**
15	Cagr value added	-6.6%	0.3%	-3.8%	-1.9%	8.8%	2.0%	**-0.2%**

Table 3. The behavior of the surveyed companies in the single "group" during the first period compared to the behavior observed in the other five clusters

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Rev. 03	Cagr Rev. 03-07	Cash-flow 03	Inv. 03-07	Inv. self-fin. 03-07	ROS 03-07	ROS 06-07	**Cagr per. costs 03-07**	**Cagr op. costs 03-07**	**Cagr pur. costs 03-07**	**Lev. 2003**	Fin. char. 2003	**Cagr Lev. 03-07**	VA 2003	Cagr VA 03-07
a	0	max	0	max	---	max	0	**min**	**0**	+++	+	0	+	0	min
b	+	+++	+++	+++	0	+++	max	**---**	**min**	min	-	0	**min**	+++	0
c	-	0	+	min	+	0	0	**0**	**0**	+++	**min**	0	+++	max	---
d	0	0	-	0	max	0	0	**0**	**0**	0	+	0	**---**	-	-
e	min	-	min	0	-	0	0	**0**	**0**	---	**max**	0	**-**	min	max
f	max	min	max	-	min	min	min	**max**	**max**	max	**0**	0	**max**	-	+

NB: on the basis of the underlying economic significance, the five parameters in bold invert minimum and maximum values in the scale compared to the other 10 parameters

A comparative analysis of the behavior of each parameter transversally to the six clusters is useful in order to define the essential characteristics of the cluster.

In fact, with the exception of financial charges which have a reduced variance between a minimum of 1.5% and maximum of 2.1%, all the other 14 accounting parameters chosen to carry out the investigation show very different index-values between the clusters: this means they are discriminatory in the process of composing the *codebooks* and for the identification of different business models.

First of all, the six clusters have quite homogenous numbers, although *cluster d* and *cluster f* have a significantly higher (979) and lower (521) than average (742) number of companies.

The stock parameter (2003 revenues) clearly identifies smaller companies (*group e*) compared to larger companies (*group f*).

Revenue cagr over the first five years analyzed shows a generalized increase in the operating dimension for all clusters (except *group f*), but specifically identifies two groups (*cluster a; cluster b*) which increased revenues much more than the other four clusters.

The other stock parameter (2003 cash-flow) shows how the largest companies – in the same sector – obtain the best cash flows (as would be expected) by virtue of their greater negotiating power in relation to average payment times for clients and to suppliers (*group f*). More surprisingly, there is another group of medium-sized companies, only slightly larger than the average for the overall sample (of 4,445 companies), with high levels of cash flow (*group b*).

The financial statement parameter (investments for 2003-2007) which indicates new investments in financial, tangible and intangible fixed assets (within the limitations of the financial statement to express this specific, heterogeneous item) is uniformly decreasing (from *group a* to *group f*) and clearly shows the linkage over a period of more than one financial period between the decision to invest in fixed assets and growth in operations over time.

On the other hand, the breadth and apparently random nature of the index-values for new fixed assets (self-financing investments in 2003-2007) shows the attitude of family ownership towards making investments in fixed assets, wholly (*group d*), prevailingly (*group b, group c*) as a minority with other investors (*group e*) or not at all (*group f*).

The average ROS for the period (2003-2007) and the most recent trend for this parameter in the first 5 years of the analysis (ROS 2006-2007) shows two distinct groups of companies which have based their competitive advantage on the continuous improvement of product and process, which the market rewards with a premium price paid by client segments (*group a, group b*), compared to the other four groups which obtain (when the economy is expanding) an average margin on sales (*groups c, d, e*) or a low margin (*group f*), which is nonetheless positive.

Similarly, the ebitda/revenues (VA) parameter measured at the beginning of the observation period shows two opposing clusters of companies (*group c, group b*) which manage to retain more added value through their activities than groups where less (*groups a, d, f*) or almost no (*group e*) added value is retained by the company.

The three financial statement parameters which express the efficiency of company management (cagr personnel costs, cagr operative efficiency, cagr purchase costs) demonstrate the positive (*group b*), negative (*group c, group e*) or not clear (*group a, group d*) association between attempts to improve production and economic-financial performance.

Finally, in the financial sector (leverage 2003, cagr leverage 2003-2007), the financial statement clearly shows strategic economic-financial models at the corporate level, distinguishing the six different groups. In some cases, companies were forced by poor economic results to take out huge loans (leverage 2003) and were then forced to reduce the initial debt (cagr leverage 2003-2007) due to persisting low or inadequate margins undermining the confidence of banks and other lenders who are not shareholders in relation to the company's ability to reply the loans (*group e*). In other cases (*group a*), the opposite occurred: senior management used and intensified financial leverage in the first five-year period given the excellent earnings of the company. In still other cases, companies that - compared to the overall sample of 4,455 companies analyzed - had a low (*group f*) or less

severe (*group c*) level of indebtedness, adopted leverage as a means of attempting to re-launch the business.

A horizontal rather than vertical analysis gives the results set out in tables 2 and 3. Here, it is possible to read the behavior of companies in each cluster compared to the different behavior of companies in other groups and to interpret the business model in the light of the trend in financial statement data over the five-year period.

Below (in decreasing order in relation to the economic-financial results analyzed in the balance sheet), the peculiarities of each "group" are illustrated in the light of the interpretations carried out with reference to the fifteen parameters considered *overall*.

Cluster a is populated by companies which, over the first five years, showed a significant increase in operating size (cagr 18%) and, on average, very high revenues (ROS 34%).

Cluster b is populated by companies which, over the first five years, managed to obtain the best trend in the index for the return on sales (ROS), with the highest average values in the last two years. Specifically, this result was obtained in virtue of a marked improvement in productivity, enabling companies to reduce costs as a percentage of sales prices. To achieve this result, they carried out considerable investments in order to base their competitive advantage on the continuous improvement of product and process, where the market is willing to pay a premium price. In addition, following the success of this strategy, companies in this cluster – despite huge investments and initial leveraging below the average for the sample – had the largest reduction in debt of all the six groups.

Cluster c includes 680 companies with similar trends to the 979 companies in *Cluster d* for half of the parameters considered.

Therefore, the two groups have rather unclear differences in their business models and, not surprisingly, the two clusters are adjacent in the U-matrix.

Cluster c shows higher (and hence cluster d lower) earnings from average sales over the period, due to the level of debt (which, in the entire sample, is lowest in cluster c) and the added value on initial turnover (in 2003 in cluster c this was double the value of cluster d).

Cluster e groups together smaller companies (on average €7 m.). Compared to the overall sample, the cluster shows a lack of growth (2.9%) in the operating dimension over the five years considered; they had lower cash flow at the beginning of the period; in the five-year period they invested in fixed capital at the average level for the sample as a whole, but did not match loans with self-financing; at the beginning of the period, they had the highest leveraging of the whole sample, and this remained the case throughout the five years; revenues from sales were moderate, falling steeply in the last two years, above all due to the sharp increase in personnel costs (cagr 7.6%); these were partly offset by a slight improvement in operating costs (cagr -1%) and purchasing costs (cagr -2.3%); jointly with low revenues from sales, they determine the lowest level of added value at the beginning of the period (16.1%, compared to 28% for the sample as a whole).

Cluster f comprises larger companies than in the other five groups. Despite the highest cash flow of the entire sample at the beginning of the period, in the five years analyzed, on average these companies invested less in fixed capital than other companies; despite this low level of annual investments, they had the worst coverage index for fixed assets; in addition, they had the smallest rate of variation of earnings from sales in the five-year period, and were the only cluster of the six to lose revenues (cagr revenues: -3,2%); they had the worst revenues from sales both as an average for the period (5%) and as trend (a fall of 3%); they also had the highest increase of personnel costs, operating costs and purchasing costs on turnover; finally, compared to the initial level of debt (in line with the average for the sample), they were the companies which increased leverage most in the five years analyzed.

3.2 Second period 2007 – 2011

For the following five-year period (2007-2011), characterized by recession and the subsequent stagnation of consumption the world over, but particularly in the European Union and United States, the same 4,554 companies can once be grouped into six clusters (see figure 5, tables 4 and table 5) that reveal several significant differences both among them and compared to the six ones identified in the first period (2003-2007).

A comparative analysis of the behavior of each parameter transversally to the six clusters is useful in order to define the essential characteristics of the cluster.

Two groups in particular (*cluster A, cluster B*) did not suffer a fall in turnover, but actually increased it (annually on average by 3.5% and 7.7%), with the other groups either with unchanged (cluster F) or with diminished operations (*groups C, D, E*).

In the five-year period 2007-2011, only two clusters (*cluster A, cluster F*) had a higher coverage of fixed assets than the average for the sample. Curiously, the two groups are "opposites" in terms of performance and not surprisingly were placed by the SOM at opposite corners of the Kohonen map. In all likelihood, the "first" group (*cluster A*) can *choose* to finance growth mainly from its own resources due to high earnings, whilst the "last" group (*cluster F*) does not have access to credit due to its poor performance and is therefore *obliged* to finance itself.

In the period 2007-2011, clusters *A* and *B* were virtuous (cutting the cost of personnel annually by 1% and 3% respectively), whereas clusters *E* and *F* were populated by companies facing enormous difficulties (with personnel costs rising annually by 2% and 12% respectively).

Similarly to the period 2003-2007, horizontal rather than vertical analysis can be used, giving the results set out in tables 4 and 5 showing the behavior of companies in each cluster compared to the other groups and hence enabling deductions to be made about the business models of the six groups in the light of trends in financial statement parameters over the period of 2007-2011.

Without repeating the analysis of the six clusters, three considerations should be borne in mind when consulting tables 4 and 5;

1) in this second period of time the decreasing capital letter show the rankings of the 4.445 companies surveyed in terms of economic-financial performance;
2) the average values and range of values for the fifteen parameters in the second time period differ from the first period, reflecting the change in the international macro-economy after 2007, with worsening performance of the companies due to the recession;
3) compared to the results for the previous 5-year period (2003-2007), in the second period there was a polarization of performance between opposite clusters (for example cluster A compared to cluster F).

To sum up, the analysis carried out on the basis of the chosen parameters, where considered jointly and over a lengthy time period (2003-2011) gives two main results:

I.   the ability to discern a difference between various business models adopted by the sample of 4,455 manufacturing companies;
II. within the framework of sub-periods identified within the whole period investigated, the ability ex post facto to reflect the dynamics at work inside the manufacturing companies in the light of micro and macro-economic considerations over the time period.

In addition to these two results, an analysis was carried out to see if the financial statement model expressed with evaluations based on historic cost has predictive capability, i.e. can be used to make forecasts rather than to understand what has already happened. In other words, do the 1,444 companies that adopted "virtuous" business models in the first period 2003-2007 (*cluster a, cluster b*) maintain similar performance also in the second period 2007-2011, characterized by a recession of global economy? Do cluster a and b describe sustainable business model or just group of firms operating under favorable external conditions? How many of the 1,444 companies populate clusters A and B in the second period?

The following section addresses these questions.

Figure 5. The definition of the cluster through the integrated reading of the selected parameters (second period 2007 – 2011)
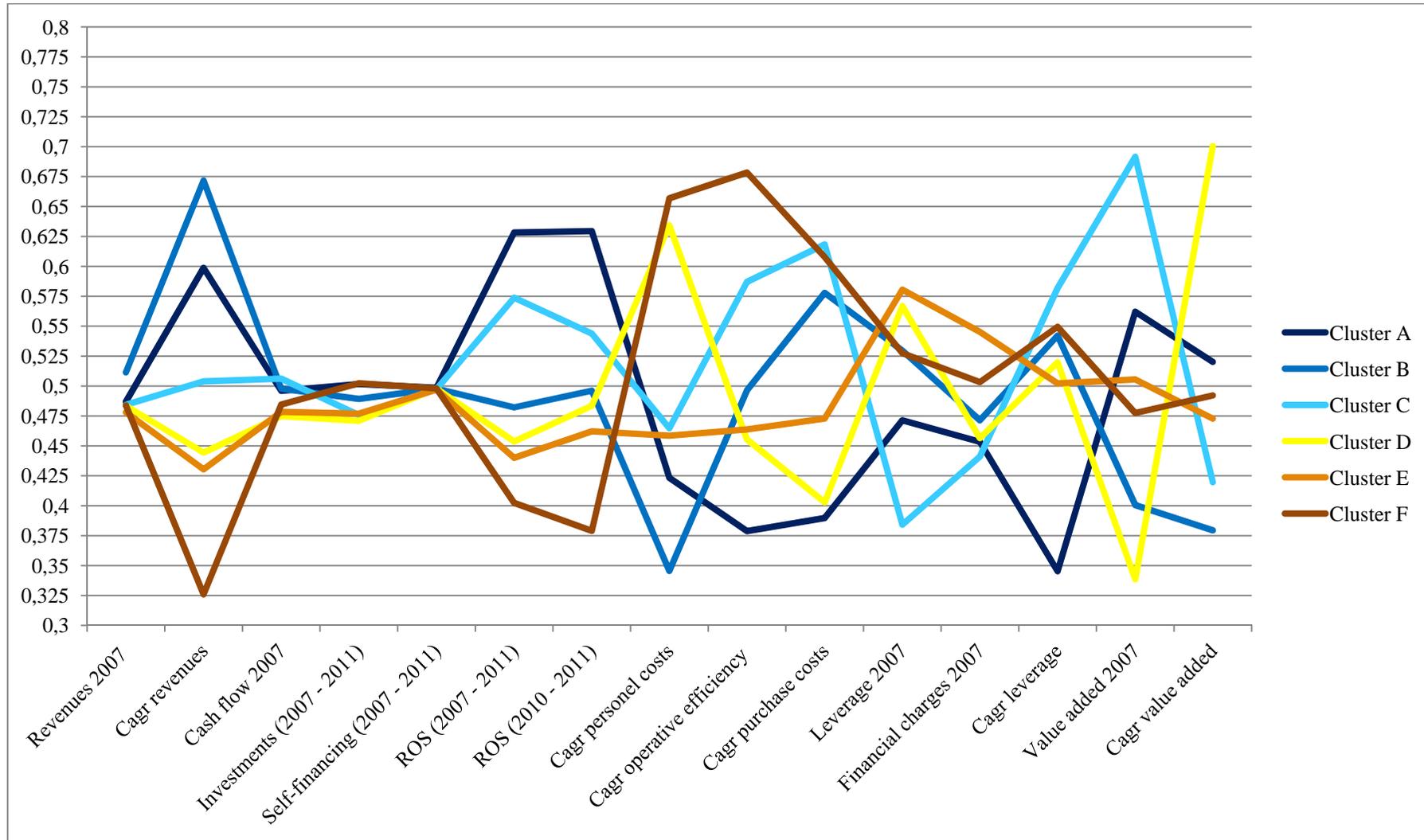
Table 4. The description of the centroids parameters for each variable obtained by the 4,445 companies included in the six clusters obtained in the second period (2007 – 2011)

n.	Variables:	A	B	C	D	E	F	Average
0	Cluster composition	826 (19%)	771 (17%)	561 (13%)	840 (19%)	778 (17%)	679 (15%)	**4,455 (100%)**
1	Revenues 2007	12,691	27,201	14,943	11,357	8,914	10,990	14,349
2	Cagr revenues (2007 - 2011)	3.5%	7.7%	-0.9%	-4.2%	-4.8%	0.0%	0.2%
3	Cash flow 2007	1.049	1.272	1.922	309	335	503	898
4	Investments (2007 - 2011)	2.8%	2.0%	1.6%	1.5%	2.2%	2.7%	2.1%
5	Self-financing investments (2007 - 2011)	55.863	20.987	-10.372	17.873	-53.020	214.300	40.939
6	ROS (2007 - 2011)	7.0%	3.0%	7.0%	2.0%	2.0%	1.0%	3.7%
7	ROS (2010 - 2011)	8.0%	3.0%	6.0%	2.0%	2.0%	2.0%	3.8%
8	Cagr personnel costs (2007 - 2011)	0.7%	-3.0%	2.8%	10.0%	2.0%	11.7%	4.0%
9	Cagr operative costs (2007 - 2011)	-2.3%	0.3%	2.0%	-0.5%	-0.4%	4.5%	0.6%
10	Cagr purchase costs (2007 - 2011)	-3.4%	1.1%	2.1%	-2.8%	-1.4%	2.4%	-0.3%
11	Leverage 2007	47.6%	63.4%	24.6%	67.0%	72.6%	62.7%	56.3%
12	Financial charges 2007	1.7%	2.0%	1.4%	1.7%	2.9%	2.1%	2.0%
13	Cagr leverage (2007 - 2011)	-14.5%	0.8%	3.5%	-0.9%	-2.8%	0.5%	-2.2%
14	Value added 2007	31.4%	21.1%	40.8%	17.0%	28.5%	24.9%	27.3%
15	Cagr value added (2007 - 2011)	1.0%	-4.8%	-2.4%	9.4%	-0.4%	0.0%	0.5%

Table 5. The behavior of the surveyed companies in the single "group" during the second period compared to the behavior observed in the other five clusters

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Rev. 07	Cagr Rev. 07-11	Cash-flow 07	Inv. 07-11	Inv. self-fin. 07-11	ROS 07-11	ROS 10-11	**Cagr per. costs 07-11**	**Cagr op. costs 07-11**	**Cagr pur. costs 07-11**	**Lev. 2007**	Fin. char. 2007	**Cagr Lev. 07-11**	VA 2007	Cagr VA 07-11
A	-	+++	0	max	+	max	max	**---**	**min**	**min**	**-**	0	**min**	+++	0
B	max	max	+	0	-	0	0	**min**	**0**	+	**0**	0	+	0	min
C	0	-	max	-	---	+++	+++	**0**	+	+++	**min**	min	**max**	max	-
D	-	---	min	min	-	---	---	+++	**-**	**---**	+	0	**0**	min	max
E	min	min	---	0	min	---	---	**-**	**-**	**-**	**max**	max	**0**	-	-
F	-	0	-	+	max	min	min	**max**	**max**	**max**	**0**	0	**+**	-	0

NB: on the basis of the underlying economic significance, the five parameters in bold invert minimum and maximum values in the scale compared to the other 10 parameters

4. Discussion

The cluster analysis provides some insights about the predictive capacity of financial statements, as it allows to identify the diversities between business models, pointing out those that are, in the long time, more sustainable.

To show how the cluster analysis allows to verify the predictive capacity of Financial Statement data, this section interprets the results of the cluster analysis in a dynamic perspective, focusing on companies located in the most successful clusters of the first period: *cluster a* and *cluster b*. Observing where the companies in these two clusters were located in the second period, we investigated how they have reacted to the ongoing economic crisis.

Table 6 shows the location in the second period of the companies in the clusters (*a and b*) which outperformed the others in the first period.

Table 6. How firms that were ranked first (cluster a) and second (cluster b) place in the first period migrate in the second period

Cluster		Second period (2007 - 2011)						Total	
		A	*B*	*C*	*D*	*E*	*F*	*N.*	*%*
First period	*a*	136	145	35	252	126	96	*790*	*17%*
(2003 - 2007)	*b*	172	47	222	31	59	123	*654*	*22%*

This table, focusing on the migrations of companies from clusters *a* and *b* (2003-2007) over the subsequent period (2007-2011) suggests that:

1. *cluster a* companies with the best performances in the first period and seemingly therefore with the most successful business model, experienced difficulties in the second period, migrating to less successful clusters. Most of the companies moved to worse positions, in cluster D (32%), cluster B (18%) and finally clusters E (16%), F (12%) and C (4%).
2. *cluster b* companies with valid if not the best performance in the first period, improved in the second period or, in the worst cases, maintained their positions: most cluster *b* companies (34%) migrated to cluster C, and many (26%) moved to cluster A.

The following paragraphs analyze the profiles of the two business models (clusters *a* and *b*), identifying the characteristics that – by careful analysis - seem to have determined their position in the second period. Further the paragraphs describes, in a dynamic perspective, the clusters where companies of cluster *a* and *b* are located in the second period.

Cluster a

Companies in cluster *a* in the first period are characterized by good economic performance, including the highest growth in turnover and best average margins. Despite this, they pay little attention to operating efficiency and keeping down costs; they had some financial difficulties due to increased indebtedness. What is most worrying, however, is their difficulty in generating and, above all, increasing added value.

Figure 6 shows values in cluster a derived from the parameters.

Figure 6. Business model captured by Cluster a (first period 2003 – 2007)
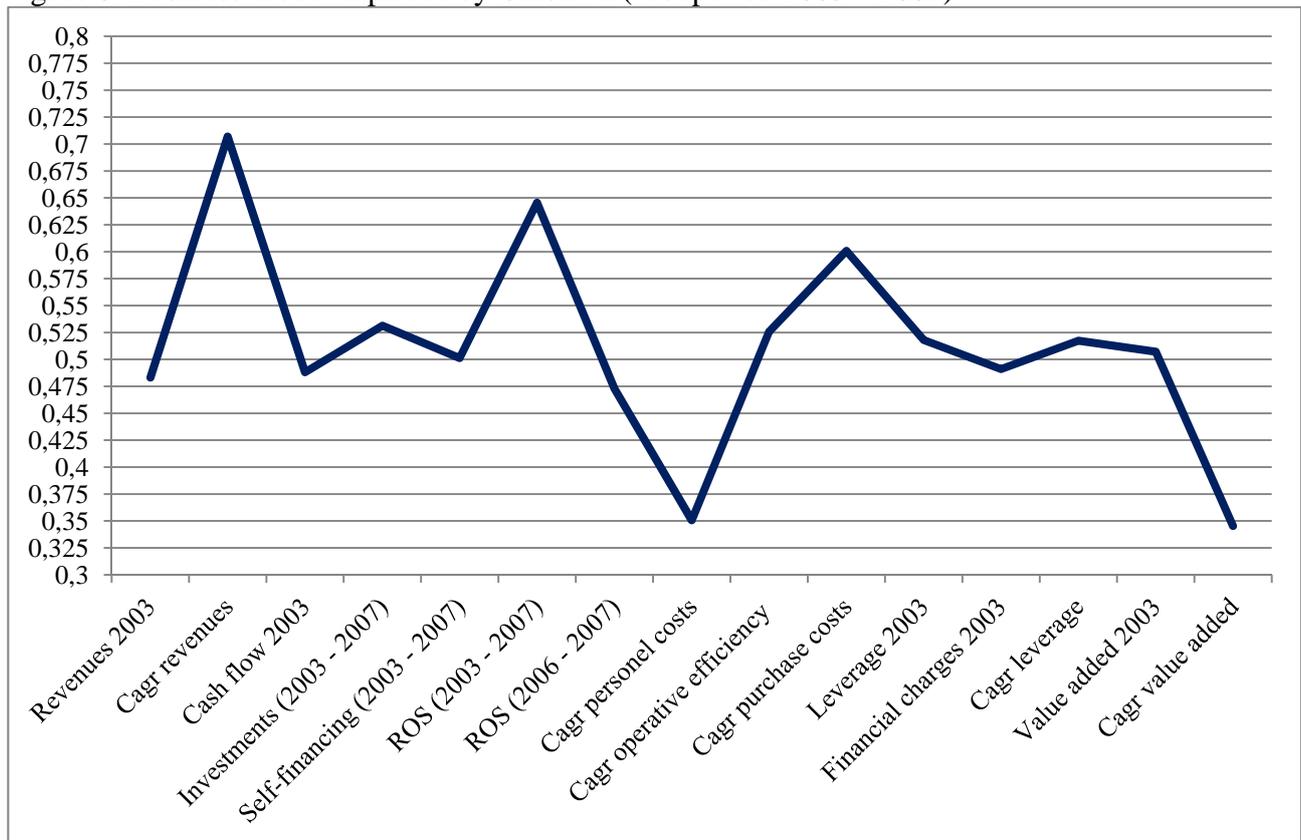
As shown in table 6, 252 companies, or 32% of cluster *a*, find themselves in cluster D in the second period. Cluster D is characterized by disappointing performance; 145 companies, or 18%, found themselves in cluster B, indicating deterioration in their position, despite remaining in a cluster with more less satisfactory performance.

The remainder migrated to clusters: E (16%), F (12%) and C (4%).

Therefore, in hostile market conditions most of the companies that in the first period recorded an excellent performance, had severely worsened their position in the second period. This indicates the latent danger to a company which appears to be healthy, but on careful analysis of the financial statement data over a medium or long period can be seen to be fragile.

Specifically, migration to cluster D shows a sharp fall in performance, since the companies in this cluster in the second period are characterized by low turnover and poor average margins. They also have financial difficulties due to low cash flow and a poor level of investment.

Figure 7 shows values in cluster D derived from the parameters.

Figure 7. Business model captured by Cluster D (second period 2007 – 2011)
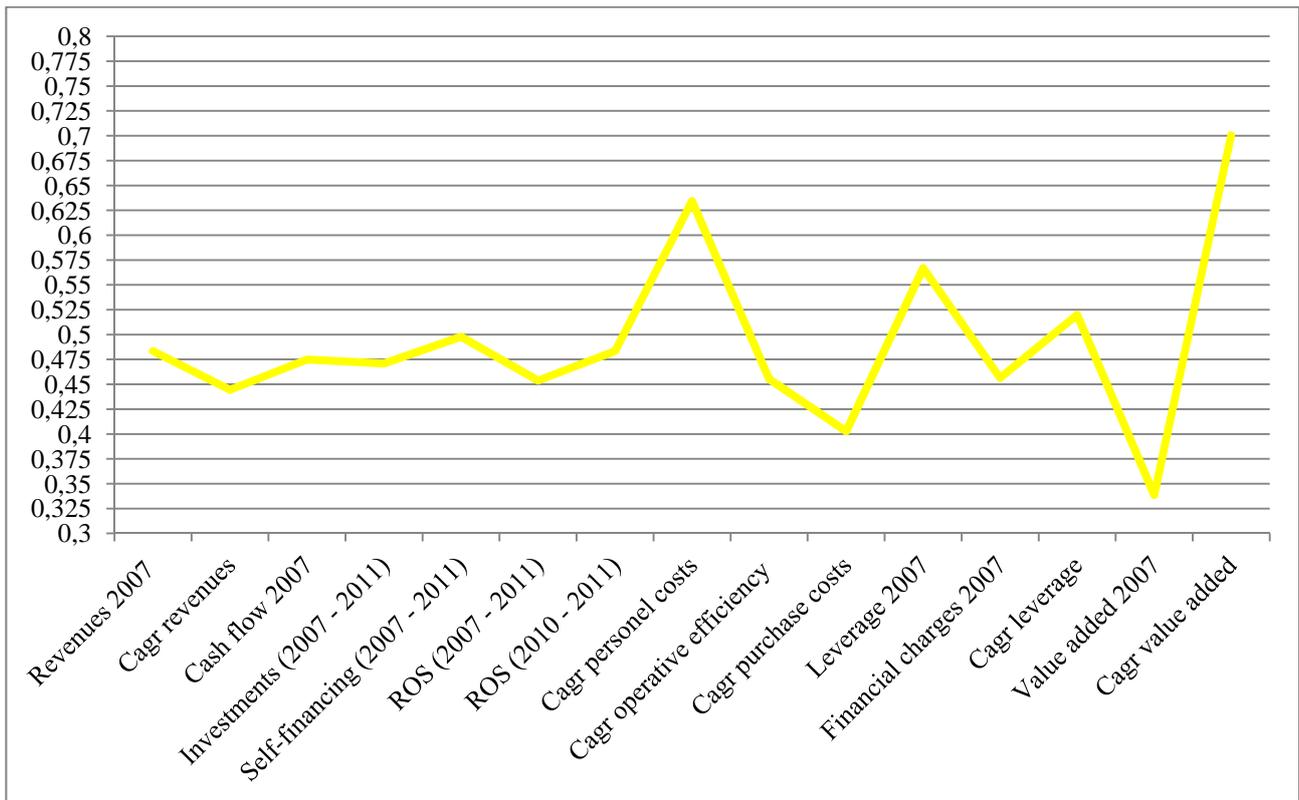
Migration to cluster B does not denote an absolutely negatively result but it does indicate a relatively poor result, with erosion of competitive advantage and hence a dynamic of deterioration. Cluster B has the highest turnover and highest growth. Despite this, it was unable to retain top position in average margins because it succeeds in keeping down only personnel costs whilst other costs have risen. It invests little and has become increasingly indebted. In the light of this data, it is reasonable to assume the companies are seeking to subcontract part of their production, without managing the process altogether successfully. In fact, they find it hard to produce added value, which is tending to fall.
Figure 8 shows values in cluster B derived from the parameters.

Figure 8. Business model captured by Cluster B (second period 2007 – 2011)
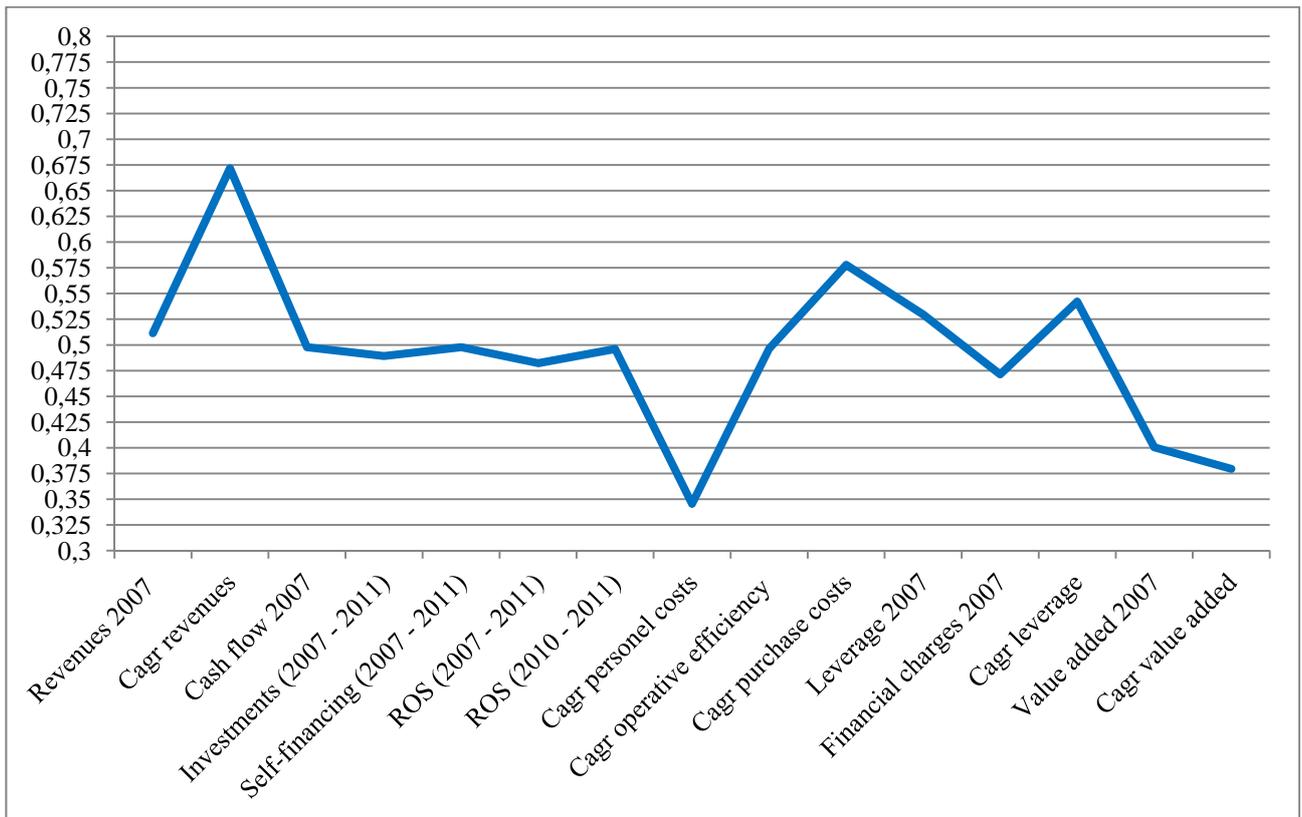
Cluster b
Companies in cluster b in the first period considerably improved their productivity; despite the huge investments made and the initial leveraging below the average for the sample – they reduced their debt the most.
Figure 9 shows values for cluster b derived from the parameters (first period).

Figure 9. Business model captured by Cluster b (first period 2003 - 2007)
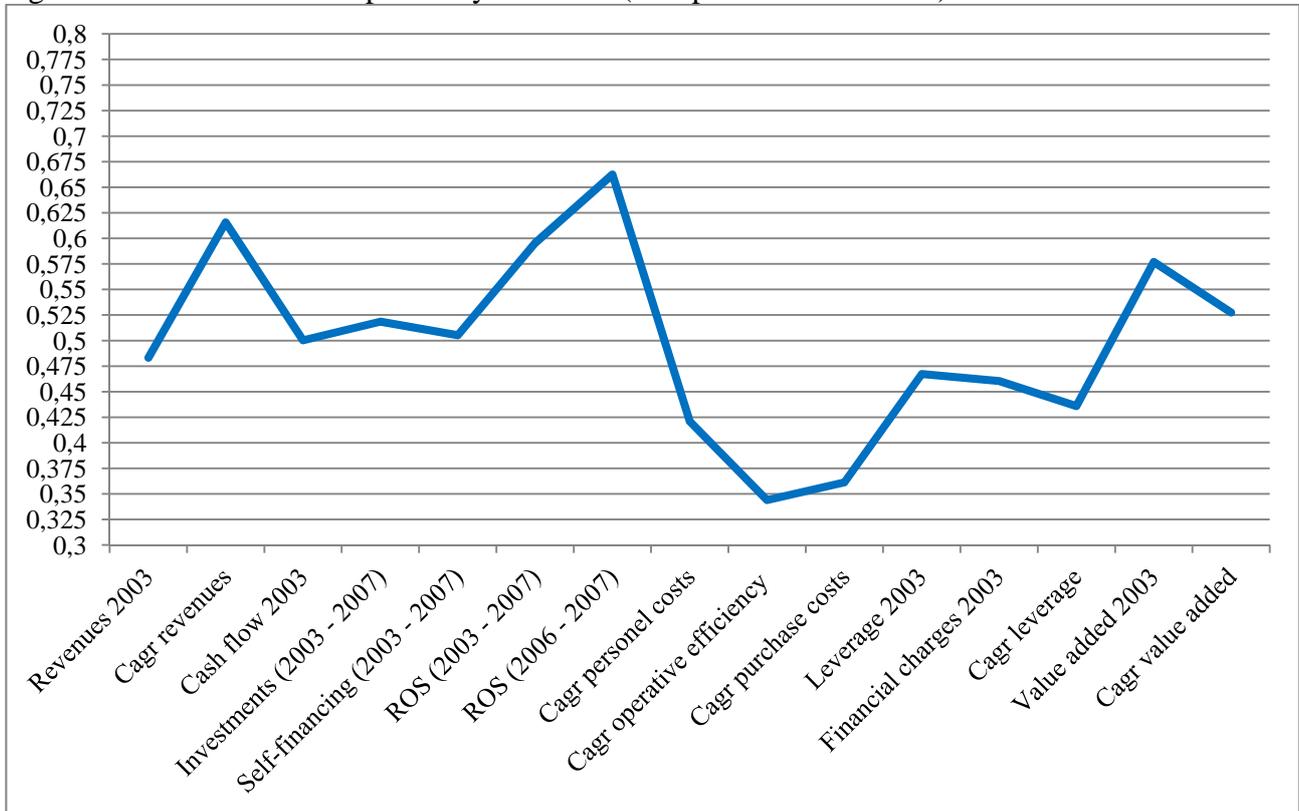
As shown in table 6, 222 companies, or 34%, migrated to cluster C in the second period. Cluster C is characterized by discrete performance. The companies in this cluster in the second period are characterized by medium a turnover and little potential to increase it. Despite this, they have maintained good margins and have the best ratio of added value to turnover, although they are unable to increase it over time. They have no problems of liquidity and do not need loans from third parties. They find it difficult to invest.
Figure 10 shows values in cluster C derived from the parameters (second period).

Figure 10. Business model captured by Cluster C (second period 2007 – 2011)
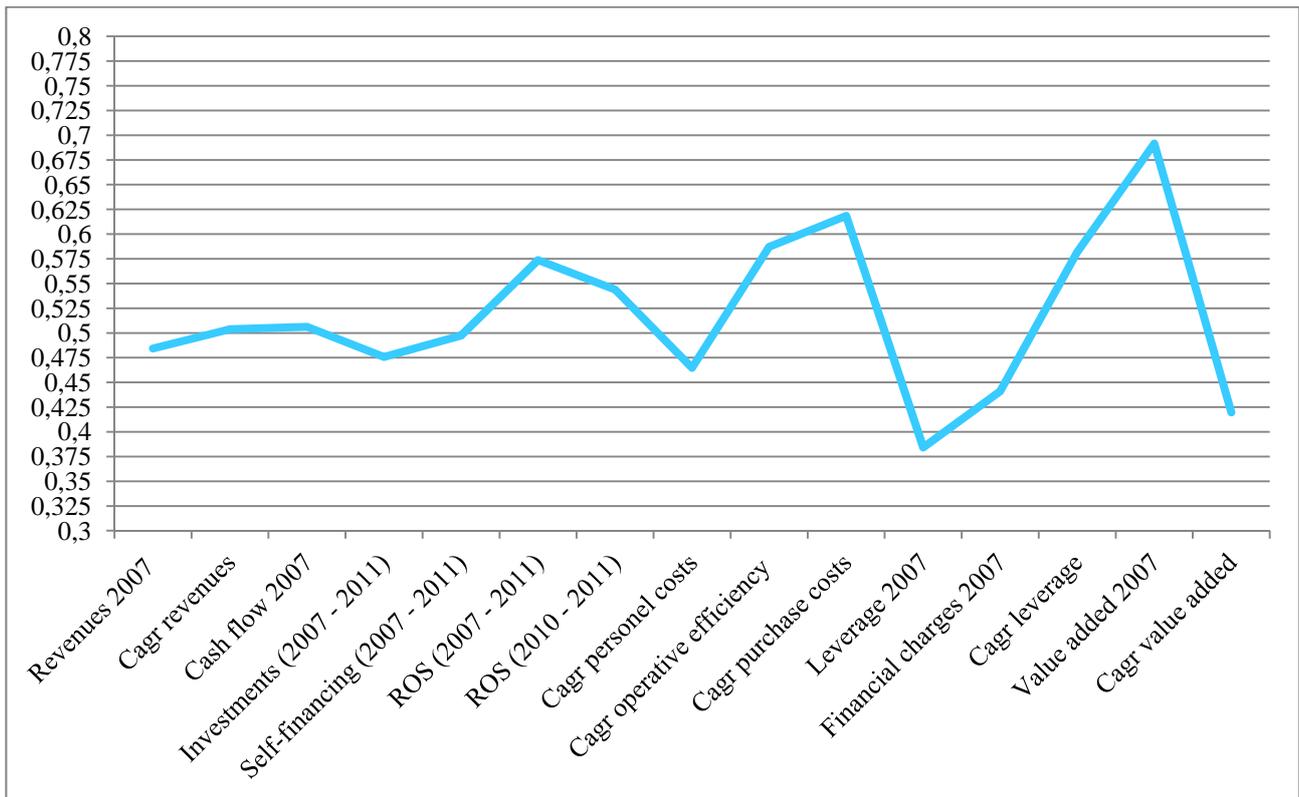
In the light of the considerations stated briefly above, it is not surprising that as many as 172 companies, or 26% of the companies in cluster B, find themselves in cluster A in the second period, improving their performance. In this regard, it should be pointed out that the characteristics of cluster A in the second period are not the same as for cluster A in the first period, but are the relatively best group for the period. The companies in cluster A start from a position of low turnover but manage to increase it more than the other companies. They have the best margins throughout the period, due largely to their ability to combat rises in costs. They have an excellent added value to turnover ratio, although find it hard to increase this ratio. They invest more than other companies without increasing their borrowing.
Figure 11 shows the values in cluster A derived from the parameters (in the second period).

Figure 11. Business model captured by Cluster A (second period 2007 – 2011)
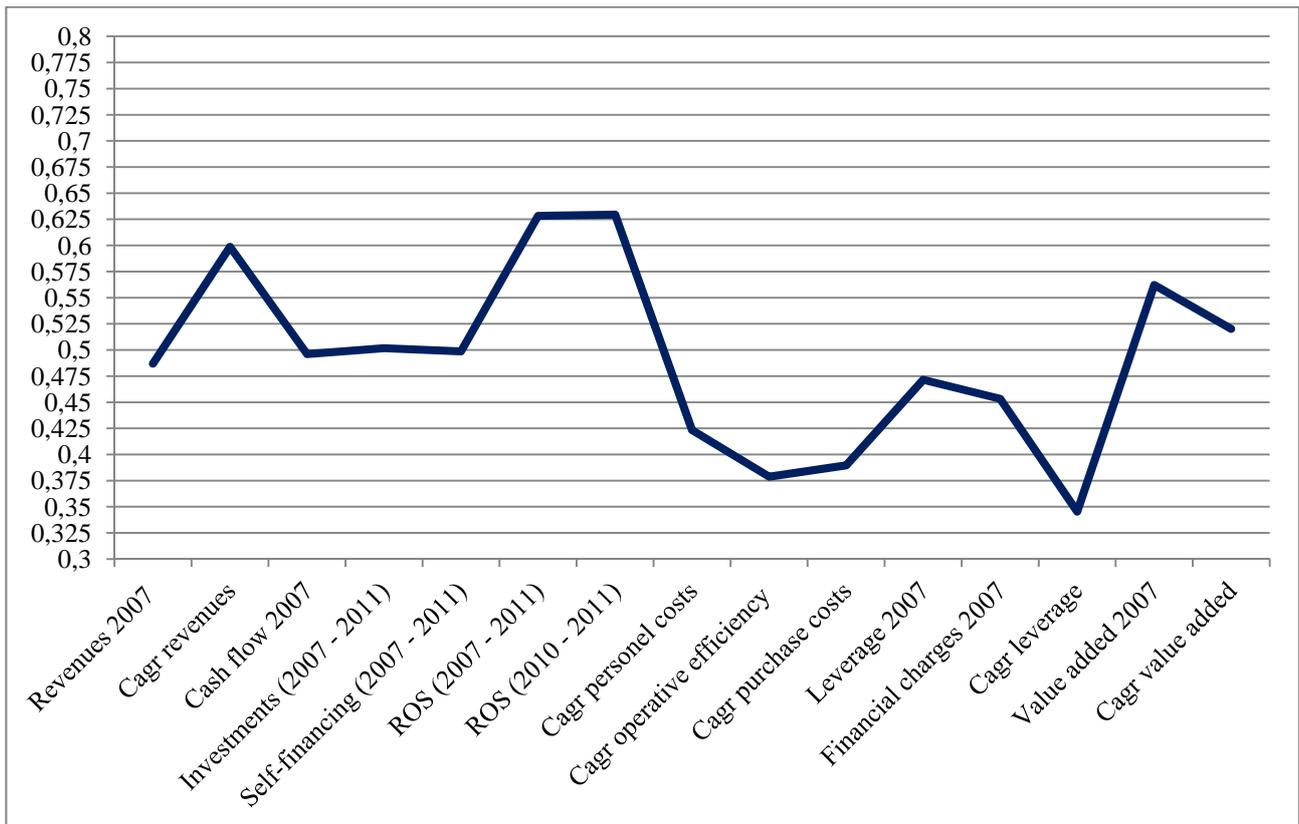
5. Conclusion

A great deal of criticism has been leveled at the reporting model and its capacity to provide appropriate and fitting information about the business model. Literature has stated that the link between financial reporting and business model is almost broken. Key criticisms regard the dominance of a compliance mindset the deficiencies of reporting on intangibles, the excessive focus on the financial dimension of the firm, and excessive reliability on the predictive ability of fair value. As far as small and medium entrepreneurial firms are concerned, networking competences and the increasing tendency of the business models to get complicated increasingly discriminate between "good" and "bad" companies, while financial accounting traditionally underestimates or even not considers those issues.

Our research tries to bridge this gap between financial report and BM. The investigation demonstrates that financial statements - even if expressed at historical cost - reflects the BM and has significant predictive value about its sustainability over time when the analysis:

i.   is based on financial parameters extracted not only from one year financial report, but from an adequate period of time, in line with the processes for the establishment and consolidation of a BM producing value over time;

ii.   is based on advanced methods of accounting data processing indicating the related positions of the companies surveyed, in line with the logic leading the competition between BMs, which the market rewards or punishes giving rise to the BM ability to achieve the best financial performance. We use an innovative approach involving non-linear clustering (SOM) that assumes complexity as a relevant characteristic and presupposes a theoretical vision not focused on processes of "simplification" founded on a few parameters, since it uses computational instruments able to interpret the complexity and heterogeneity underlying the BM.

Starting from these premises, the empirical analysis conducted in this study bring to select some specific financial parameters (15 parameters divided in five salient dimensions), suggested by the literature and empirically tested and progressively refined through our analysis (see table 1), that are, jointly considered, more accurate and sharp in depicting the company BM.

The article represents also a useful guide for managers interested in adopting an innovative and accurate approach to financial analysis, than can be easily used to examine, on the base of the parameters we have selected, the relative position of their firms or of their competitors, suppliers or customers.

Our results suffer of three main limitations: we are now working to overcome the first and the second one; the third is the consequence of the focus on financial statement and is, therefore, insurmountable.

The first limit regards methodological constrains which occur when self-organizing maps are processed by k-means algorithm in order to define clusters. In fact, while SOM algorithm face complexity displaying hundreds of "cells" that group similar firms showing through colors the difference among the cells, K-means tend to reduce this "distance" among cell, creating a "continuum" in BM which reduce a clear measurement of the "distance" among them. Starting from SOM maps of the two periods, we are testing rivals algorithms in order to better derive the complex non-linear relations between the fifteen accounting variables employed.

The second limitation regards the analysis of the accounting determinants of the BM we have identified. More specifically, we are now working to analyse the link between the BMs we have identified and some specific accounting characteristics (ie: goodwill or intangible or tangible assets dimension), accounting policies (ie: equity method or asset revaluation adoption) or financial disclosure (ie: overall disclosure quality, disclosure on the organic or acquisitive growth) of the firms that share a BM. This analysis will complete the investigation on BM connecting it with their accounting determinants in privately held firms of small and medium sizes.

The third limitation is the result of the focus on financial statement information, that bring to identify BM only on the basis of the financial data included in the annual report of the firm we have analyzed. An interesting further analysis could be integrating financial data with other source of information (market analysis, business plan, etc.) that together with the financial data could deep the accuracy of the BM analysis and the predictive power ability of the financial statement.

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Appendix A

Dimension of firms that compose the sample

Ml. Euro	Number of companies	%
1 - 5	2.773	62,24
5 - 10	778	17,46
10 - 20	464	10,42
20 - 30	159	3,57
30 - 40	84	1,89
40 - 50	48	1,08
50 - 100	99	2,22
>100	50	1,12
Total	4.455	100

Appendix B

Industries and the percentage of companies for each industry

Industries	%
Manufacture of metal products (excluding machinery and equipment)	14,52
Manufacture of other machinery and equipment	9,99
Building construction	6,44
Manufacture of furniture	6,11
Specialist construction	5,99
Manufacture of rubber items and plastics	5,52
Manufacture of leather and similar items	5,45
Foodstuffs	4,49
Clothing	4,13
Foodstuffs	3,93
Clothing	3,66
Manufacture of chemicals	3,23
Other manufacturing industries	3,19
Timber, wood and cork	2,24
Manufacture of chemicals	2,20
Manufacture of paper and paper products	1,95
Printing and the reproduction of recording supports	1,93
Textiles	1,80
Manufacture of computers and electronic/optical products	1,64
Metalwork	1,50
Production of software, IT consulting and related activities	1,46
Beverages	1,26
Repair, maintenance and installation of machinery and equipment	1,23
Waste collection, treatment and disposal	1,12

Civil engineering	1,12
Manufacture of vehicles, trailers and semi-trailers	1,03
Other mining activities	0,58
Manufacture of other means of transport	0,58
Manufacture of pharmaceuticals	0,25
Publishing	0,22
Manufacture of pharmaceuticals	0,18
Fishing and aquaculture	0,18
Repair of computers and personal/household items	0,16
Sewerage management	0,13
Supply of electricity, gas, steam and air conditioning	0,11
Manufacture of coke and the products of refining crude oil	0,09
Water collection, treatment and supply	0,09
Manufacture of coke and the products of refining crude oil	0,07
Waste management service and redevelopment	0,07
Tobacco	0,07
Telecommunications	0,07
Total	100