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Synthetic indicator model of dynamism

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Summary – 1. Synthetic indicator model of dynamism (Scores mechanism) – 2. Building of the synthetic indicator of dynamism – 3. Definition of the model for the scoring – 4. Attribution of scores and construction of the Matrix to analyse an economic situation – 5. Methodology application on balance sheet data included in DB Complex (year 2004) – 6. Conclusions

Abstract

The positive vision of the quality level of the firms can be improved through the construction of a synthetic qualitative indicator resulting from the whole of the information about the excellence of the business management.

Therefore we have tried to set up a new indicator that gathers together several aspects of the quality level of the firm, including growth capacity, income, and liquidity assets.

The indicator built expresses a qualitative threshold judgement, based on the performance of the firm, as we can see from the analysis of available balance sheet data in the last three years.

1 – Synthetic indicator model of dynamism (Scores mechanism)

In order to achieve the target of the classification of Italian enterprises in relation to their economic condition, the research group of the Osservatorio Economico has devised a “*synthetic indicator model of dynamism*” that, owing to testing and comparison with the results of the other algorithms of classification, showed itself to be an effective system “to photograph” the quality level of the performance reached by the firms.

The indicator highlights, through quality level rankings, (on a scale from “nullo” to “eccellente”) groups of enterprises with similar performance.

The indicator isn't predictive of default situations, but shows risk status or pathologies of some categories of firms in a particularly effective way. At the same time it highlights and pools the most successful Italian enterprises and suggests how an enterprise in good economic situation should be.

In order to validate this model it was extremely important to apply testing techniques for cluster and multivariate tests, carried out on the balance sheet indicators, in relation to the qualitative variables deriving from the reference model and from the economic structures of the

DBCOMPLEX (database built from a sample of national enterprises). In particular, we have applied the Multiple Correspondences Analysis (A.C.M.), the Principal Components Analysis (A.C.P) and the Cluster Analysis whose objective was to identify and to rank groups of enterprises with the same performance through the exploration, description and synthesis of a matrix of economic data.

From the analysis of results obtained with statistical techniques and the synthetic indicator model of dynamism (also called “scores mechanism” because it assigns a score to every firm) it appears that each of the methodologies used furnishes different information in relation to the economic state of the enterprises and how they can be pooled. The A.C.M. identifies which, among the economic income factors that characterize the performance of the enterprises, are more important and allows us to effectively classify the so called “extremes” (excellent or null) enterprises compared with benchmark firms (calculated by median), and also it clearly distinguishes the firms in a good economic situation from those in serious difficulty.

The analysis for the principal components confirms the income aspects of operating profitability as relevant elements for the classification of the quality level of the firms and it also shows a classification typology for enterprises’ attitude to growth.

The analysis puts together in a “score” the results of the two previous methodologies, matching the information on income capacity, on attitudes to cash and on the final synthetic score.

This analysis opens new perspectives of a specific sartorial nature and introduces other techniques, statistics and others, that use large matrix of economic data in historical series.

2 – Building of the synthetic indicator of dynamism

The positive vision of the quality level of the firms can be improved through the construction of a synthetic qualitative indicator resulting from the whole of the information about the excellence of the business management.

Therefore we have tried to set up a new indicator that gathers together several aspects of the quality level of the firm, including growth capacity, income, and liquidity assets.

The indicator built expresses a qualitative threshold judgement, based on the performance of the firm, as we can see from the analysis of available balance sheet data in the last three years.

The concept of dynamism, that characterizes the new indicator, comes from the kind of indexes selected for its composition: growth and profitability indexes. The combination of the

evaluation of these indexes, allows us to show how the firm is “moving” therefore not stationary, with growing balance-sheet items and attitude to profitability.

We have created a double scale of values, which was set up to highlight excellence, but which is also able to clearly show some of the aspects of managerial difficulties. The concept of “threshold” is essential to the analysis of the work. It is defined, first of all, beginning from the study of the statistics distribution of the indicators selected to obtain the synthetic judgement. These indicators are grouped in classes and for each of them we have created a score system to qualify each enterprise’s performance.

Afterwards, we build the synthetic index as a linear combination of the assigned scores.

From the analysis of its statistics distribution the new thresholds are created, therefore we have clusters in which the enterprises are grouped by quality levels of business performance.

The model is included in the category of “scoring” and aims at the measure of the ability of the enterprises to stay in the market in an effective way.

From the results of the surveying analysis on the balance sheets data we get the choice of the indicators to use for the building of the synthetic judgement.

The selected variables are:

- *Indicators of growth*: the percentage fluctuation of sales and value added between two years that allow us to evaluate the dynamism of the enterprises in our sample
- *Indicators of profitability and ability to produce cash flow*: ROI (Return on Investment), MOL (Gross Operating Margin) on Financial Charges, Value added on Total Assets, Cash Flow Operating on Total Assets. These indicators describe the relationship between the achieved results (in terms of profits or cash) and funds at its disposal for production which constitute the natural connection between the structure of the enterprises and their results. They estimate the ability of the enterprises to pay back all the production factors, as they have been organized by managers.

In details:

- *ROI* (Return on Investment) is defined as the typical rate of return of the enterprise investments and it is built as the ratio between the operating result and the semi sum of the Total assets of two consecutive years.
- *MOL (Gross Operating Margin) on financial charges* is the ratio calculated between the characteristic net profit before interest and taxes and financial charges.
- *Value added on Total Assets*: this ratio expresses the way to pay back the factor production compared to the total of the enterprise’s investments.

- *Cash flow Operating on Total Assets* evaluates the liquid assets before the payment of the interest in relation to all invested capital. This indicator looks like a good ratio to highlight the ability of an enterprise to “make cash” among the normal activities of management, and suggests, therefore, how much the firms or sectors considered are able to follow a growth course caused by the activities strictly connected to profit or if they are relying on sources of liquidity of a structural nature (disinvestments, access to the short term credit...).

To choose the indicators, it was important to build the correlation survey (before the model application) among the selected indexes. This is necessary to avoid extended positive effects or crisis conditions caused by the presence in the model of two or more closely correlated variables.

Table 1.1. – Matrix Correlation

| | Var % fatturato | Var % valore aggiunto | ROI % | Val_agg su Attivo % | Mol su On_Fin | Cash flow operating su Attivo % |
|---------------------------------|-----------------|-----------------------|-------|---------------------|---------------|---------------------------------|
| Var % fatturato | 1,00 | | | | | |
| Var % VA2 | 0,20 | 1,00 | | | | |
| ROI % | 0,11 | 0,33 | 1,00 | | | |
| Val_agg su Attivo % | 0,05 | 0,13 | 0,40 | 1,00 | | |
| MOL su On_Fin | 0,04 | 0,04 | 0,31 | 0,18 | 1,00 | |
| Cash flow operating su Attivo % | 0,08 | 0,06 | 0,39 | 0,27 | 0,18 | 1,00 |

The result of the correlation and the test values (Tab 1.1) obtained has been basically satisfying because the selected indicators don't result excessively correlated among them. (Tab 2.1).

Table 2.1. – Matrix Value Test

| | Var % fatturato | Var % valore aggiunto | ROI % | Val_agg su Attivo % | Mol su On_Fin | Cash flow operating su Attivo % |
|---------------------------------|-----------------|-----------------------|-------|---------------------|---------------|---------------------------------|
| Var % fatturato | 99,99 | | | | | |
| Var % VA2 | 35,87 | 99,99 | | | | |
| ROI % | 20,51 | 61,09 | 99,99 | | | |
| Val_agg su Attivo % | 8,34 | 23,61 | 77,13 | 99,99 | | |
| MOL su On_Fin | 6,50 | 8,02 | 57,22 | 32,54 | 99,99 | |
| Cash flow operating su Attivo % | 13,84 | 10,21 | 74,01 | 50,16 | 33,25 | 99,99 |

3 – Definition of the model for the scoring

The model for the attribution of an annual synthetic final score, has provided for the building of a weighted mean (average) of assets by each indicator of the firms balance sheet

$$Y = \frac{\alpha_1 X_1 + \alpha_2 X_2 + \dots + \alpha_n X_n}{n} = \sum_{i=1}^k \frac{\alpha_i \cdot X_i}{n}$$

Where α represents the given weight to each indicator, while X_i is the value of each indicator considered in the formula, and n is the number of indicators.

4 – Attribution of scores and construction of the Matrix to analyse an economic situation

The selected indicators are assembled in classes depending on the quartile of belonging and for each class a system of scores is produced (from -10 to +10) destined to qualify each aspect of business management. Moreover we had to define the threshold value = 0 because for all the balance indicators it is in itself a significant value.

Therefore some groups of enterprises are built according to the level of quality (threshold level) obtained from the business management of each single enterprise during every financial period.

We obtain a matrix of diagnoses that expresses the “state of health” of enterprises in the above mentioned management, putting on the lines the balance indicators and in the columns the classes identified by quantity levels of business performance. Therefore we have created a summary table which describes for each column the typical behaviour of the enterprise that have had a poor, medium or excellent “state of health”.

5 – Methodology application on balance sheet data included in DB Complex (year 2004)

The mechanism just described has been applied to the data of the active firms present in 2004 on the DB Complex. The Sample, stratified for region (area) and for economic activity, is made up 38,125 enterprises that operate in all the economic sectors (except the tobacco division and financial services) and that have deposited a statement without errors.

Table 3.1. – Distribution of Growth sales % in scoring classes

| Quartiles | Sales Growth % | Score |
|-----------------------|--------------------|-------|
| 0 - 25° | <= -9.45 | -10 |
| 25 - threshold value | > -9.45 and <=0 | -5 |
| threshold value - 50° | > 0 and <=2.42 | 2 |
| 50° - 75° | >=2.42 and <=14.89 | 6 |
| 75° - 100° | >14.89 | 10 |

For the balance sheets year 2004 the procedure provides for the allotment of a higher score to those enterprises which have a of sales higher than 14.89% and so they fall in the last quartile of the distribution and a lower score to those ones with a negative growth percentage lower than - 9.45 % and so they are placed in the first quartile of distribution (Tab. 3.1).

Table 4.1. – Distribution of Value Added Growth % in scoring classes

| Quartiles | Value Added Growth % | Score |
|-----------------------|----------------------|-------|
| 0 - 25° | <= -10.94 | -10 |
| 25 - threshold value | > -10.94 and <=0 | -5 |
| threshold value - 50° | > 0 and <=3.08 | 2 |
| 50° - 75° | >=3.08 and <=17.71 | 6 |
| 75° - 100° | >17.71 | 10 |

When we need to estimate the growth of the value added, the analysis gives the maximum score to the enterprises with a percentage growth higher than 17.71% because they are placed in the last quartile of the distribution (Tab. 4.1).

Table 5.1. – Distribution of ROI % in scoring classes

| Quartiles | ROI % | Score |
|-----------------------|---------------------|-------|
| <= threshold | <= 0 | -10 |
| threshold value - 25° | > 0 and <= 2.38 | -5 |
| 25° - 50° | > 2.38 and <=4.85 | 2 |
| 50° - 75° | >= 4.85 and <= 8.19 | 6 |
| 75° - 100° | > 8.10 | 10 |

The ROI % (Return on Investment) evaluation leads to definition of the following five classes and the identification of the best level of quality when ROI is higher than 8.19 % (Tab 5.1). For the Value Added on Total Assets ratio the maximum score is given to those firms that have a level of the indicator higher than 40.76%, while a minimum score is given to those firms with a negative value (Tab 6.1). In the case of the MOL (Gross operating margin) on Financial Charges ratio, the analysis assigns the maximum score to the enterprises with a level higher than 11.81% (Tab 7.1).

Tab. 6.1. – Distribution of Value Added on Total Assets % in scoring classes

| Quartiles | Value Added on Total Assets % | Score |
|-----------------------|-------------------------------|-------|
| <= threshold | <= 0 | -10 |
| threshold value - 25° | > 0 and <=14.04 | -5 |
| 25° - 50° | > 14.04 and <=24.85 | 2 |
| 50° - 75° | >= 24.85 and <= 40.76 | 6 |
| 75° - 100° | > 40.76 | 10 |

Finally, the ratio “Cash Flow on Total Assets %” evaluation leads to the definition of the following five classes and to the identification of the level of excellence when the index is higher than 16.73% (Tab 8.1). The matrix of diagnosis obtained is indicated in Tab 9.1.

Table 7.1. - Distribution of Gross operating margin (MOL) on Financial charges in scoring classes

| Quartiles | Gross operating margin on Financial Charges | Score |
|-----------------------|--|-------|
| <= threshold | <= 0 | -10 |
| threshold value - 25° | > 0 and <=1.85 | -5 |
| 25° - 50° | > 1.85 and <= 4.10 | 2 |
| 50° - 75° | >= 4.10 and <= 11.81 | 6 |
| 75° - 100° | > 11.81 | 10 |

Table 8.1. – Distribution of Cash flow operating on Total Assets % in scoring classes

| Quartiles | Cash Flow operating on Total Assets % | Score |
|-----------------------|--|-------|
| 0 - 25° | <= -1.04 | -10 |
| 25 - threshold value | > -1.04 and <=0 | -5 |
| threshold value - 50° | > 0 and <=7.76 | 2 |
| 50° - 75° | >=7.76 and <=16.73 | 6 |
| 75° - 100° | >16.73 | 10 |

From the reading of the median values it is possible to observe that the group of enterprises included in the 2004 data base which are in precarious financial situation (enterprises with a level “null”) is characterized by a lower growth of sales and net capital (in fact the growth % of sales is equal to – 17.83%, that is the enterprises have lost more than a sixth of their sales in the previous year). Roe (Return on Equity) is negative (and it is equal to – 8.74%), this means that for each 100 Euro putted into the running of the company by those bringing the risk capital, the management have a loss of 8.74 Euro). ROI (Return on Investment), which is an expression of operating performance, highlights the crisis existing in these enterprises (with a value equal to - 0.14%). The cash profitability highlights a negative balance between cash receipts and payments deriving from the flow of collected proceeds minus the paid costs. Level of debt indicated by Leverage, shows a high level vulnerability and makes clear the problem of undercapitalization, in fact the liabilities are almost seven times the risk capital (6.67).

In contrast with this first group, we have the cluster of the “ excellent “ enterprises which are characterized by an excellent dynamism in all the aspects investigated. They show a big profit

growth of 12.51 % and a remarkable net capital improvement (14.24%). Also ROE (return on equity) remains at a high level (15.58 %).

Table 9.1. – Matrix of Diagnosis of enterprises by classes of excellence of the Synthetic Indicator of Dynamism - Median Values

| | Italia | Nulla | Molto insufficiente | Insufficiente | Sufficiente | Buono | Eccellente |
|---|--------|--------|------------------------|---------------|-------------|--------|------------|
| Numerosità | 38.125 | 7.538 | 4.053 | 3.106 | 7.459 | 4.414 | 11.555 |
| Parametri fondamentali | | | | | | | |
| Valore Aggiunto | 624 | 217 | 493 | 563 | 665 | 804 | 1.059 |
| Fatturato | 2.779 | 1.549 | 2.441 | 2.696 | 2.937 | 3.227 | 3.547 |
| Attivo totale | 2.546 | 2.173 | 2.751 | 2.708 | 2.648 | 2.655 | 2.549 |
| Patrimonio Netto | 373 | 168 | 296 | 327 | 384 | 418 | 559 |
| Indicatori sviluppo | | | | | | | |
| Variazione % del fatturato | 2,36 | -17,83 | -5,85 | -1,63 | 1,88 | 6,53 | 12,51 |
| Variazione % del valore aggiunto | 3,16 | -25,56 | -6,18 | -1,85 | 3,07 | 7,51 | 15,31 |
| Variazione % Attivo | 3,49 | -4,73 | 0,84 | 1,79 | 3,59 | 5,41 | 8,69 |
| Variazione % Netto | 4,39 | -8,62 | 1,21 | 2,68 | 4,64 | 6,42 | 14,24 |
| Variazione % Costi d'acquisto | 1,86 | -15,99 | -3,99 | -1,13 | 1,96 | 6,52 | 11,47 |
| Variazione % Costo del lavoro | 4,71 | -4,82 | 1,04 | 2,67 | 4,62 | 6,55 | 9,08 |
| Variazione % Oneri Finanziari | -5,26 | -11,64 | -6,02 | -2,76 | -2,04 | -1,56 | -5,41 |
| Variazione % Mol | 1,17 | -51,98 | -14,29 | -5,93 | -0,39 | 6,79 | 21,79 |
| Indicatori di redditività e di cash flow | | | | | | | |
| Roe % | 4,38 | -8,74 | 0,73 | 2,09 | 4,26 | 6,67 | 15,58 |
| Roi % | 4,80 | -0,14 | 3,03 | 3,93 | 4,84 | 5,83 | 9,54 |
| Valore Aggiunto su Attivo % | 24,97 | 9,44 | 17,26 | 19,59 | 24,66 | 28,91 | 41,55 |
| Valore Aggiunto su valore della produzione | 21,46 | 12,22 | 18,28 | 18,84 | 21,20 | 22,91 | 28,99 |
| Valore Aggiunto su Costo del lavoro | 1,46 | 1,12 | 1,45 | 1,49 | 1,49 | 1,51 | 1,58 |
| Mol su Oneri Finanziari | 4,02 | 0,47 | 2,39 | 2,94 | 4,01 | 5,30 | 12,43 |
| Cash flow Operating su Attivo % | 7,88 | -2,47 | 2,18 | 4,65 | 7,21 | 9,47 | 17,34 |
| Ros | 4,06 | -0,04 | 2,94 | 3,46 | 4,01 | 4,42 | 6,24 |
| Turnover | 1,23 | 0,75 | 1,02 | 1,12 | 1,25 | 1,34 | 1,53 |
| Ebit su Totale Attivo | 4,66 | -0,17 | 3,01 | 3,82 | 4,69 | 5,60 | 9,10 |
| Indici di struttura dell'attivo e del passivo | | | | | | | |
| Immobilizzazioni Immateriali su Immobilizzazioni | 3,41 | 2,37 | 2,72 | 3,35 | 3,62 | 3,58 | 4,28 |
| Immobilizzazioni Materiali su Immobilizzazioni | 79,75 | 74,03 | 78,62 | 80,00 | 80,95 | 81,31 | 81,19 |
| Passività a Bt su Passività totali % | 84,85 | 87,88 | 86,64 | 85,93 | 85,03 | 84,34 | 82,53 |
| Indice di Dipendenza Finanziaria % | 84,92 | 91,23 | 89,11 | 87,76 | 85,52 | 84,25 | 78,00 |
| Leverage | 5,11 | 6,67 | 7,55 | 6,80 | 5,72 | 5,27 | 3,49 |
| Indici di liquidità e di gestione del circolante | | | | | | | |
| Disponibilità su Esigibilità % | 114,54 | 106,54 | 109,76 | 110,08 | 113,08 | 114,35 | 125,96 |

This growth is explained with a higher trend of the ROI (9.54%), which illustrates a better gross performance of the invested capital.

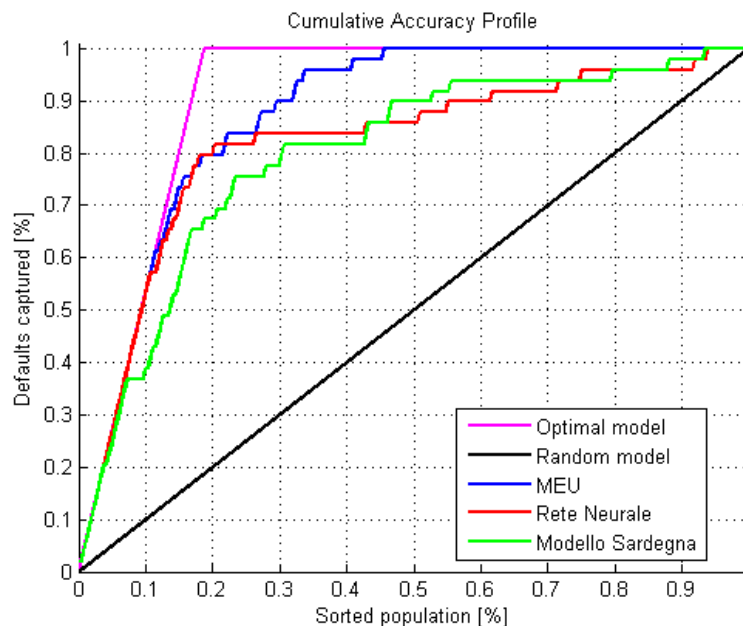
The group of enterprises included in the classes from “sufficient” to “good”, is characterized by performances higher than or equal to average value. It includes enterprises that, even though they didn't show high growth levels of sales and net capital (for the “good” level the variation of sales does not exceed 6.53 % in relation to the previous year, while variation of net property capital is equal to 6.42%), highlights a positive net capital return, which is higher than the general performance offered by other forms investment characterized by a lower degree of risk.

In relation to the operating management, the ROI (Return on Investment) remains around median levels (5.83% for the “good” enterprises). The cash profitability (7.21% for “sufficient” enterprises and 9.47 for the “good“ ones) demonstrates a sufficient ability to produce liquidity from the operating management.

6 – Conclusions

The first results can be summarized in the precision chart of the model expressed with the so-called ROC (*Receiver Operating Characteristic or Relative Operating Characteristic*) curve (Fig. 1).

Figure 1 – The ROC curve



The ROC curves are put in the binary classification as a supervision model; in fact they allow using the evaluation of a score (apart from the fact that it is a radar signal, or a value of probability, etc....) to build a decision rule, which assigns to every character the presence or absence of a fixed characteristics. Nevertheless they require the knowledge of the actual state of the studied unit, as it must be also possible to verify the real ability to recognition the rule.

The discriminating ability of a test (its attitude to separate precisely the population in the survey in “patients” and “non-patients”) is proportional to the extraction of the included area of the ROC curve (Area Under Curve or AUC) and is equal to the probability that the result of a test on a character (enterprise in this case) randomly chosen from the group of “patients” is higher than those chosen by the group of “non- patients”.

In a perfect test, that doesn't return any false positive or false negative (discriminating ability = 100%), the AUC goes through the coordinates (0,1) and its value corresponds to the all area of the square defined by the coordinates (0,0), (0,1), (1,0), and (1,1), that accepts value 1 if the probability is equal 100% of a correct classification (in the diagram it is represented by the Optimal model).

On the contrary, the ROC for a test absolutely devoid of informative value is represented by the diagonal or "chance line" that goes through the origin, with $AUC = 0.5$ (in the chart it is represented by the Random model).