

Credit Risk: Sector Comparisons Using Nonparametric Methods

*Rischio di Credito: Confronti Infrasettoriali con
Metodi Statistici Nonparametrici*

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Riassunto: con l'adozione dei criteri di Basilea 2 per le piccole e medie imprese, gli istituti finanziari non potranno più procedere con l'erogazione di finanziamenti senza fare (com'è prassi) distinzioni fra i settori di appartenenza. In questo contesto, ci si propone di confrontare statisticamente tra loro diversi settori di impresa con riferimento ad alcuni indicatori economico finanziari di bilancio. Tramite un opportuno test nonparametrico multivariato si vuole valutare se i settori siano o meno distinguibili rispetto agli indicatori di bilancio considerati. L'analisi dei risultati suggerisce in maniera chiara come il Sistema Bancario dovrebbe abbandonare la prassi di una politica del credito indifferenziata per settore a favore di una politica che tenga conto in maniera esplicita delle categorie aziendali.

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1. Introduction

In January 2001 the Basel Committee on Banking Supervision issued its consultative paper, namely "The New Basel Capital Accord", concerning the use of credit risk models in calculating the regulatory capital. In particular, institutions are allowed to develop their own proprietary credit models in order to provide internal ratings and evaluate the expected default frequencies related to their credit facilities. One of the possible effects of an unselective use of these models would be a less favourable treatment of small businesses and middle market borrowers, which are significant in Italian corporate positions. For this reason, credit risk management should be referred to homogeneous positions in relation to their specific economic and financial structure. In particular, a set of five balance sheet ratios were considered, they are discussed below (for more details, see e.g. Basile & Erzegovesi, 1989)

- the return on equity index ($ROE = \text{net income} / \text{net equity}$);
- the return on assets index ($ROA = \text{earnings before interest and taxes} * (1 - \text{tax rate}) / \text{total assets}$);

- the debt/equity index;
- the cash index = shorter assets / liabilities;
- the ratio of the net income before extraordinary items to revenues;

associated to a selected sample of 1398 positions from a medium size Italian financial institution and classified into nine different sectors following Bank of Italy watch committee⁽¹⁾, see Table 1.

Table 1: Sector classification

Sector	Bank of Italy Code	Frequency
“Società produttive”	430	618
“Quasi società artigiane”	48	309
- 20 or more employees	480	46
- more than 5 and less than 20	481	39
- 5 or less employees	482	224
“Quasi società non artigiane”	49	249
- 20 or more employees	490	32
- more than 5 and less than 20	491	11
- 5 or less employees	492	206
“Famiglie produttrici artigiane”	614	141
“Famiglie produttrici non artigiane”	615	81

Our aim is not to distinguish good and bad firms (a distinction usually obtained via discriminant analysis) but to evaluate, through a suitable multivariate nonparametric test, if considered sectors can or cannot be distinguished with respect to the indicators.

2. Methodological Aspects

The problem under issue, can be stated as a multivariate two-sample location problem with multiple comparisons. We address this problem within the nonparametric permutation framework because of the various advantages of permutation tests with respect to parametric tests (Marozzi 2002). A permutation test is a statistical procedure for hypothesis testing in which one calculates the value that the test statistic assumes on the observed data and on all permutations of the data (or on a large random sample of them) to decide whether to accept or reject the null hypothesis. More precisely, the p -value is computed as the proportion of permutations that have test statistic greater than the observed one. The main characteristic of permutation tests lies in their adaptability to many different situations. Another quality is the robustness: provided that the observations are exchangeable under the null hypothesis, a permutation test is always exact, it does not matter if the populations are normal or not, or if the sample size is large or small. For a more detailed discussion on permutation testing see, for example, Marozzi (2002).

⁽¹⁾ Visit for more details [www.Bancaditalia.it/Vigilanza_tutela/Istruzioni relative alla classificazione della clientele per settori e gruppi di attività economica](http://www.Bancaditalia.it/Vigilanza_tutela/Istruzioni_relative_alla_classificazione_della_clientele_per_settori_e_gruppi_di_attivita_economica)”.

For tackling the sector comparison problem we follow the Nonparametric Combination of Dependent Tests theory due to Pesarin (2001). The (global) null hypothesis is that two sectors cannot be distinguished for what concern the five economic indicators previously outlined. We formalize the hypothesis through the means of the five variables (i.e. economic indicators) $X_j, j=1, \dots, 5$

$$H_0 = \bigcap_{j=1}^5 H_{0j}, \text{ where } H_{0j}: \delta_{1j} = \delta_{2j}$$

and where δ_{1j} (δ_{2j}) is the mean of the j -th variable in the first (second) sector under comparison. The alternative hypothesis is

$$H_1 = \bigcup_{j=1}^5 H_{1j}, \text{ where } H_{1j}: \delta_{1j} \neq \delta_{2j}.$$

To test the five systems of partial hypotheses we use the statistic

$$T_j = \left| \frac{1}{n_1} \sum_{i=1}^{n_1} X_{i1j} - \frac{1}{n_2} \sum_{i=1}^{n_2} X_{i2j} \right|$$

where X_{i1j} (X_{i2j}) is the i -th observation on the j -th variable for the first (second) sector. Note that we intrinsically assume homoschedasticity but we do not assume anything else about populations. The p -value L_{T_j} of the test is permutationally estimated. T_j test is exact, unbiased and consistent (Pesarin, 2001).

To test the system of global hypotheses we use

$$T = -2 \sum_{j=1}^5 \ln(L_{T_j}).$$

According to standard testing rules, we reject H_0 at significance level α if the permutation p -value L_T is less than or equal to α . T test is exact, unbiased and consistent (Pesarin 2001).

We underline that rejecting H_0 means that the data at hand suggest that the two sector are different for what concern the five financial indicators. The major feature of the Nonparametric Combination is that the researcher is not required to specify the dependence structure of partial tests and variables because the underlying dependence structure is nonparametrically captured by the combining procedure. Thanks to this method we can draw a two level inference: the first level is the partial one and it is on each single variable, the second one is the global one (which is that of interest, here) and allows us to summarize the multivariate comparison through only one indicator. In presenting the results, the multiple comparison problem has been taken into account via the Bonferroni's correction (where the corrected p -value is the raw p -value multiplied by the number of comparisons).

3. Discussion

Table 2 contains the results of the analysis done in accordance with section 2 criteria: the Bonferroni corrected p -value relative to the multivariate comparison between row and column sectors are reported in the inner cells. p -values less than 0.05 indicate different sector positions with respect to the considered ratios. These results⁽²⁾ contradict the common banking practice of distributing funds without considering which sector firms belong to and strongly recommend for alternative credit treatment.

Table 2: *Corrected p -values*

		sector			
		480-1 490-1	482 492	614	615
sector	430	0.0120	<0.0001	<0.0001	<0.0001
	480-1 490-1		0.4950	0.4550	0.8082
	482 492			1	1
	614				1

Nevertheless, there are reasons for concern that, while the underlying results seem to indicate disparity between sectors, some of the ratios are referred to different time based values⁽³⁾ and so credit policies based on the proposed model should seek a prudential logic combined with qualitative information. Moreover, the proposed model is only based on “*ex post*” ratios, this was done in accordance with the standard banking practice, whereas it can be useful to take also into account “*ex ante*” information. In fact, banks distribute funds in order to support the development of a firm, but to decide how many funds should be distributed, they takes into account only ex-post budget information and not perspective indicators (Santamaria, 1988).

References

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⁽²⁾ It is worth noting that a more detailed firm classification gives analogous results.

⁽³⁾ It should be noted some of these indicators are computed by dividing a flow value by a stock value.