The strategic paths and performances of Italian mutual banks: a nonparametric analysis

Francesco Zen* and Cinzia Baldan

Department of Economic Sciences
University of Padova
Via del Santo, 33 – 35123 Padova, Italy
Fax: +39.049.827.4211
E-mail: francesco.zen@unipd.it
E-mail: cinzia.baldan@unipd.it
*Corresponding author

Abstract: This paper investigates an Italian group of Mutual Banks (MBs) over the period 2001–2005. We identify homogeneous groups by cluster analysis and then measure their performance ratios. We evaluate the groups' efficiency and productivity by means of nonparametric techniques (Data Envelopment Analysis (DEA) and Luenberger Indicator). Finally, we assess the strategic positioning in order to identify the competitive rank of each group. The aim of the study is to offer an innovative perspective of analysis that combines different methods. The integration of statistical and managerial analyses enables us to establish the competitive positioning of each group in the selected market and yields some suggestions for the assessment of banks. The results obtained reveal a prevailing trend towards 'traditional intermediation', which is not always matched by the highest efficiency and productivity scores. Most MBs pursue strategies linked with 'conservative policies', which are not always suited to ensuring competitiveness in the credit market.

Keywords: banking; cluster analysis; Data Envelopment Analysis; DEA; efficiency; Luenberger Indicator; Mutual Banks; MBs; productivity.

Reference to this paper should be made as follows: Zen, F. and Baldan, C. (2008) 'The strategic paths and performances of Italian mutual banks: a nonparametric analysis', *Int. J. Banking, Accounting and Finance*, Vol. 1, No. 2, pp.189–214.

Biographical notes: Francesco Zen is Associate Professor of Banking and Finance at the Faculty of Economics, University of Padova. He received his BS and PhD degrees from the University of Venezia (Ca' Foscari). His specialty areas include financial institutions and markets (especially banks), accounting and corporate finance. His current research interests include asset and liability management, banking competition and risks assessment.

Cinzia Baldan is Assistant Professor of Banking and Finance at the Faculty of Economics, University of Padova. She received her BS and PhD degrees from the University of Venezia (Ca' Foscari). Her specialty areas include financial intermediaries (especially banks), capital markets and corporate finance. Her current research interests include banking competition, statistical methodologies for performances' evaluation, and asset and liability management.

1 Introduction

In the European context, cooperative financial intermediation plays a key role in economic development: the internationalisation process is increasing, thanks to heightened competition. In Italy, cooperative credit is not as closely integrated as are the European cooperative systems; the internationalisation process is weak, and trade financing is feeble (Tarantola, 2007). The Italian cooperative banking system consists of 439 Mutual Banks (henceforth MBs), representing 55.5% of the Italian banks,[1] with 3616 branches (Bank of Italy, 2007). Grimaldi and Lopez (2005) have shown a territorial distribution of cooperative credit marked by a high geographical concentration. During the period 1999–2004, the localisation trend increased and extended the phenomenon of overlapping branches and, consequently, overlapping local markets. Where there is a strong overlapping among MBs, competition, although possible, seems not to come to its fullest extent.

Hence, one may ask whether the managerial models implemented by MBs, traditionally characterised by the reduction of information asymmetries and strong local rootedness, are still suited to maintaining the competitive advantages achieved (Dell'Atti and Pacelli, 2007; Bonaccorsi di Patti and Gobbi, 2004). This paper explores managerial issues that generally involve the 'bigger' banks (*e.g.*, commercial banks): strategic decisions, efficiency and productivity. We intend to identify what strategic paths MBs have pursued in order to cope with changing competitive dynamics, what operational decisions they have taken, and what results they have obtained (Di Salvo, 2002).

The first part of the study examines the evolution of a sample of Italian MBs over the period 2001–2005. Starting with the identification of homogeneous groups by means of cluster analysis (Section 2), we then measure performances relative to growth strategies by calculating the appropriate ratios (Sections 3 and 4). Then, we examine (Sections 5 and 6) efficiency (Molyneux and Williams, 2005; Resti and Lissoni, 1998) and productivity changes over the same period in the strategic clusters recognised, by means of nonparametric analysis (Barros *et al.*, 2006). Section 7 considers strategic territorial positioning. It identifies the role of each cluster within each regional market by comparing efficiency and productivity scores (Caratelli *et al.*, 2006).

We consider 121 Italian MBs belonging to four regions (Emilia Romagna, Friuli Venezia Giulia, Lombardia and Veneto) that represent the most relevant areas, in terms of financial and economic indicators (Bank of Italy, 2007), in the whole of 20 Italian regions.

The results reveal a lack of homogeneity among the MBs examined. In fact, the performances associated with each strategic growth path change in the comparison among the regions. Nevertheless, within the same region, the strategic groups are not markedly distinct in terms of performances and competitive positioning. These main findings seem to be very country specific; so, we think that a comparison with other MBs, by country, dimension, market share, and activities could be important to improve the effectiveness of the managerial interpretation of results.

Studies on financial intermediaries to date have neglected MBs. The main analyses have focused on evaluating efficiency (Molyneux and Williams, 2005; Resti and Lissoni, 1998) from a quantitative point of view, and on evaluating the positions of MBs in the developing local contexts in which they operate (Caratelli *et al.*, 2006; Dalla Pellegrina, 2005; Grimaldi and Lopez, 2005; Colarossi and Tarantola, 2004). This study proposes a new perspective of analysis, which could be useful for all the readers of MBs, since it

reports on a systematic overview on the mutual banking system by combining theoretical and empirical analyses; hence, it makes it possible to position each cluster in the credit market as a whole, furnishing interesting insights into strategic and operational decisions.

2 Literature review

2.1 Identifying strategic groups by means of cluster analysis

The early studies conducted to identify strategic groups in the banking sector, by means of cluster analysis, date to the end of the 1980s, their purpose being to extend the organisational implications of the 'structure-conduct-performance' paradigm originally applied by Bain (1956) to the credit industry. The concept of 'strategic group' was introduced by Hunt in 1972; later studies defined the principal elements of the theory (Caves and Porter, 1977; Porter, 1979; Hatten and Hatten, 1987). Amel and Rhoades (1988) considered US banks and their balance sheet composition in 16 selected markets during the years 1978, 1981 and 1984. They analysed the quantitative differences among groups and the stability of membership in groups over time. Their findings supported the strategic groups hypothesis: as Porter suggested, strategic groups, rather than efficiency differences (Demsetz, 1968), may explain observed intraindustry (or intramarket) differences in firm performance. In regard to Italian MBs, Grimaldi and Lopez (2005) applied cluster analysis to examine the territorial development of MBs within local markets over the period 1999–2004. They found six groups defined by six different competition levels: high overlapping, high competitive pressure, new markets with many competitors, restricted markets with high overlapping, 'quiet' markets and restricted markets. They also analysed performances associated with different groups, by measuring six categories of indicators: efficiency and productivity, profitability, diversification, growth, capitalisation and quality of assets. They observed that MBs operating in markets with 'high competitive pressure' seem to have implemented successful strategies to improve efficiency and productivity. Hence, MBs operating in competitive areas seem to react better to challenges deriving from the opening of local markets. On the contrary, MBs that operate in markets with 'high overlapping' (among them), in 'quiet markets' and in 'restricted markets' show worse performances. The authors conclude that the overlapping of MBs' branches does not produce the same competitive effects as the overlapping with different banks.[2]

2.2 Analysis of bank efficiency using data envelopment analysis

Several studies measure bank efficiency[3] by means of the Data Envelopment Analysis (DEA) approach.[4] The study by Casu and Girardone (2006) uses DEA as part of broader research, analysing how bank efficiency affects the competitive conditions of the EU banking systems. Banks have achieved higher efficiency through rationalisation processes and cost cutting. However, the most cost-efficient banks have sought to boost profitability and have expanded by acquiring less efficient banks. Thus, the relationship between competition and efficiency is not a straightforward one. In Italy, Resti and Lissoni (1998) apply the DEA approach to measure the efficiency of a sample of 30 branches of an Italian bank over 14 months (January 1996–March 1997). They found a positive correlation between branch size (identified by 'funds raised from customers')

and efficiency, which evidences the existence of scale economies. Resti and Lissoni show the existence of undersized branches, concerning which they stress the need for an increase in productive scale in order to improve efficiency.

2.3 Nonparametric analysis of productivity

Nonparametric studies on enterprise productivity rely on two main methodologies deriving from the definition and extension of nonparametric technological frontiers: the Malmquist productivity index (1953) and the Luenberger Indicator (1992), as a generalisation of the directional technology distance function defined with the Malmquist index by Caves *et al*. (1982). Nonparametric statistics allow the evaluation of performance without fixing *a priori* a functional form of the technology, and without constraints on input returns (Boussemart *et al.*, 2003; Lovell, 2003; Färe and Grosskopf, 2000). Several studies on banking productivity have employed nonparametric techniques and, in particular, the Malmquist index approaches (Casu *et al.*, 2004; Lovell, 2003). Barros *et al.* (2006) employ the Luenberger Indicator to estimate productivity changes and their constituents for a sample of European cooperative banks between 1996 and 2003. They observe a productivity growth in the cooperative banking industry, which is driven by improvements in technology. Although positive, the rate of technological change varies across countries. This finding is consistent with previous research on the cooperative banking sector (Molyneux and Williams, 2005) and the European banking industry in general (Casu *et al.*, 2004). In particular, Molyneux and Williams (2005) provide evidence that over the period 1996–2003, profits increased for all cooperative banks, as a result of substantial improvements in profit productivity; the profitability of European cooperative banks has mainly been brought about by improvements in the best-practice banks; moreover, in the majority of countries cooperative banks appear to have reduced costs. The results obtained by Casu *et al.* (2004) seem to indicate productivity growth particularly for Spanish and Italian banks, while it has been more modest for French, German and British banks. The decomposition of the Malmquist Total Factor productivity index shows that productivity growth in the Italian and Spanish banking systems seems to have been brought about mainly by a positive technological change. In addition, whereas Spanish banks seem to have also been able to exploit some catching-up effect, their Italian counterparts display a decreasing trend in the efficiency change component over the 1990s.

3 Data and methodological issues

We considered a sample of 121 MBs, covering, as of 31 December 2005 (IRCEL, 2006), 47.08% of the total assets of Italian MBs. Our initial sample consisted of 133 units; we excluded eight of them (five for Lombardia, three for Emilia Romagna) owing to the absence of data in 2005. On conducting the 'Examine' analysis on the values of variables used as input/output, we excluded four more units because they were outliers.[5] We analysed the period 2001–2005 because only from 2001 did we have enough information concerning all the banks in the sample (we revised data collected from the database by comparing them with the information in the annual statements, because we found some incongruities in the database).

We used information collected from the 'ABI Banking Data' database. We carried out the cluster analysis, calculated the performance ratios, and evaluated the efficiency and productivity with variables collected from Financial Annual Statements drawn up following Legislative Decree 87/92. We consequently considered:

- Fixed Assets (FA)
- Labour Costs (LC)
- Other Administrative Expenses (oAE)
- Loans to customers (L)
- Fee-based Activities (FbA)
- Deposits (D)
- Interest Margin (IM)
- Intermediation Margin (IntM)
- Number of Branches (B).

We processed the data with nonparametric analysis techniques whose interpretative efficacy has been recognised by numerous authors (Fiorentino *et al*., 2006; Prior, 2003; Appennini *et al.*, 2002). We considered nonparametric techniques to be appropriate for the study of organisational structures that do not need the *a priori* definition of a production and a cost function (Resti and Lissoni, 1998). In particular, for MBs, it seems reasonable to assume technological homogeneity for each Decision-Making Unit (DMU), an unavoidable hypothesis when DEA, for example, is applied. In order to identify strategic groups, in Section 4 we used cluster analysis with the mutually exclusive method; in Section 5 we measured efficiency by means of DEA, following the approach developed by Banker *et al.* (1984; Banker, Charnes and Cooper, henceforth BCC), and then calculated productivity changes using the Luenberger Indicator.[6]

4 Identification of strategic groups

In order to divide the MBs of each region into strategic groups, we defined the input and output of the analysis by employing accounting data provided by the ABI Banking Data database. In particular, we used the balance sheets, income statements and explanatory notes corresponding to the period 2001–2005. We thus chose the most significant variables for banking-related performance indicators (Chambers and Cifter, 2007). Strategies definition enabled us to identify three hypothetical growth paths relative to bank activities. Each path adopted the same input variables but yielded different outputs (Table 1).

Since our intention was to define approaches associated with various strategic paths, we had to maintain some basic inputs and outputs, and introduce others. For example, the first input-output combination was associated with the paths strategically oriented to 'geographical extension': banks with this orientation produce loans, an interest margin and deposits, but above all they increase their branch numbers. In the same way, banks

oriented to 'diversification' concentrate on increasing fee-based activities. Finally, banks oriented to 'traditional intermediation' seek to increase the interest margin and to moderate operational expenses.

Table 1 Strategic growth paths

Geographical extension (Group 1)		*Diversification (Group 2)*		*Traditional intermediation (Group 3)*	
Input	*Output*	*Input*	*Output*	*Input*	*Output*
Fixed assets	Loans (to customers)	Fixed assets	Loans (to customers)	Fixed assets	Loans (to customers)
Labour costs	Interest margin	Labour costs	Interest margin	Labour costs	Interest margin
Other administrative expenses	Deposits	Other administrative expenses	Deposits	Other administrative expenses	Deposits
	Branches		Fee-based activities		

We calculated defined input/output values for five years, from 2001 to 2005, measuring changes between 2001 and 2005 by ratios (*i.e.*, fixed $assets_{2005}$/fixed $assets_{2001}$). The ratios obtained for each bank provided us with the input for the cluster analysis, which we ran for each region. We tested the stability over time of the strategic groups (Siegel, 1957) and ran a discriminant analysis to verify their validity (Tables 1 and 2 in the Appendix).

We started the research by running the cluster analysis on the entire sample (121 units), but we obtained inconsistent results; discriminant analysis, in fact, gave values for the probabilities of membership in each group lower than 90%. Moreover, the Mann-Whitney U test yielded nonsignificant values for independence among clusters. Values associated with input/output variables confirmed the statistical results: differences among regions mainly arose from the size of the changes between 2001 and 2005. For example, even if the input/output trend seemed to be similar for all regions, with the exception of 'fixed assets', which decreased in Lombardia and in Friuli Venezia Giulia, the size of the changes significantly differed from one region to another, thereby provoking the dispersion of homogeneity elements that characterise the output of a good cluster process. We consequently applied cluster analysis to the banks of each single region (22 units for Emilia Romagna; 16 units for Friuli Venezia Giulia; 45 units for Lombardia; 38 units for Veneto) and obtained a substantial increase in the significance of the statistical measures, both for the discriminant analysis and for the Mann-Whitney U test. This outcome supported our hypothesis concerning the existence of notable differences among the regions. In order to apply aggregate cluster analysis to all regions, we also normalised the input/output variables using logarithmic values, whose normal test produced significant results. Nevertheless, the cluster analysis was not acceptable, both because of the distance between clusters and because of the significance of Z-values in the Mann-Whitney U test.

The discriminant analysis (see Table 1 in the Appendix) showed that the groups obtained from the cluster analysis were correct from a minimum level of 97.16% to the maximum level of 100% (Group 1, Veneto; Groups 1, 2 and 3, Emilia Romagna). The Mann-Whitney U test (Table 2 in the Appendix) shows statistically significant changes from one group to another, for each region; the results confirmed the existence of

significant differences among the input/output values associated with each cluster. In particular, for all regions, the most representative grouping differences concerned Loans (L), Deposits (D); Branches (B) and, although less evidently for Veneto, Fee-based Activities (FbA).

We associated each cluster with the related strategic growth path by building specific performance indexes. We then measured changes in the indexes with ratios between 2005 and 2001. In this way, we were able to associate each group with a specific strategic growth path, and validate the association by measuring the performance ratios. The performance indexes associated with each growth strategy were constructed as follows:

- Geographical extension:
  1 $Branches_{2005}/Branches_{2001}$ (ΔBranches)
  2 Loans/Deposits (L/D)
- Diversification:
  1 Fee-based Activities/Intermediation Margin (FbA/IntM)
- Traditional intermediation:
  1 Interest Margin/Intermediation Margin (IM/IntM)
  2 $Operational\ Expenses_{2005}/Operational\ Expenses_{2001}$ (ΔOperational Expenses).

4.1 Main findings

Table 2 shows the changes in the performance indexes of each group, for each region, between 2001 and 2005. We measured these on the basis of the groups identified by the cluster analysis, processed with the inputs and outputs linked to growth strategies (Table 1) and used to recognise performance ratios. The analysis of performance indexes allowed us to associate the path 'Geographical extension' with Group 1; the strategy called 'Diversification' with Group 2 and, finally, the strategic path 'Traditional intermediation' with Group 3. Generally, the results bear out the association.

Group 3 comprises the largest number of MBs in three regions: Emilia Romagna, Lombardia and Veneto. In particular, for Emilia Romagna, where there are 17 out of 22 banks in Group 3, the ratio 'interest margin/intermediation margin' exhibits a 2005/2001 ratio smaller than that of the other groups, but the differences can be considered residual. The increase in 'operational expenses', by contrast, is lower than in the other groups (1.295, compared with 1.723 and 1.544 for Groups 1 and 2 respectively). Group 3 for Lombardia comprises 22 elements. The interest margin/intermediation margin ratio between 2001 and 2005 is lower than that of the other groups (0.994 vs. 1.007 and 1.102), but the gaps are marginal. Moreover, the ratio's trend during the five years considered shows higher values than those for other groups (from 1.003 in 2001 to 0.994 at the end of 2005, as opposed to changes between 0.989 and 0.920 for Group 1 and between 0.977 and 0.987 for Group 2). The increase in operating expenses is lower than that of Group 1 (26.672 vs. 39.113), but higher than that of Group 2 (16.06%). These values are explained by the increase in the number of branches, by 20.71% for Group 3 versus 15.37% for Group 2. At last, in Veneto, the slight increase in operational expenses (35.48%, compared to 68.5% and 59.81% for Groups 1 and 2) supports the association of Group 3 with the strategic path focused on traditional intermediation.

Table 2 Changes in performance ratios by region and cluster (2005/2001 mean values)[1]

Region	*ΔBranches*[2]	*L/D*[3]	*FbA/Int.M.*[4]	*IM/Int.M.*[5]	*ΔOp.Expenses*[6]
Emilia Romagna					
Group 1 (2)	1.4643	1.4679	1.0823	0.9988	1.7225
Group 2 (3)	1.2861	1.1231	1.2335	0.9978	1.5435
Group 3 (17)	1.2065	1.2869	1.0869	0.9968	1.2948
Total (22)	1.2408	1.2810	1.1065	0.9971	1.3676
Friuli Venezia Giulia					
Group 1 (9)	1.3211	1.2167	1.3064	1.0102	1.2516
Group 2 (3)	1.3167	1.3775	1.6867	1.0124	1.2801
Group 3 (4)	1.2285	1.2656	1.3061	1.0480	1.3348
Total (16)	1.2971	1.2591	1.3776	1.0201	1.2777
Lombardia					
Group 1 (8)	1.2976	1.0879	1.1507	1.0069	1.3911
Group 2 (15)	1.1537	1.0963	1.2041	1.0117	1.1606
Group 3 (22)	1.2071	1.1962	1.1933	0.9937	1.2667
Total (45)	1.2054	1.1437	1.1893	1.0021	1.2535
Veneto					
Group 1 (1)	1.6250	1.5814	1.2508	1.0468	1.6850
Group 2 (14)	1.4561	1.2537	1.2535	1.0122	1.5981
Group 3 (23)	1.2610	1.3566	1.2050	1.0047	1.3548
Total (38)	1.3425	1.3246	1.2240	1.0085	1.4531

Notes: [1] Standard deviation and median for these results are available with the authors. Number of observations in brackets.

[2] $Branches_{2005}/Branches_{2001}$.

[3] Loans/Deposits.

[4] Fee-based Activities/Intermediation Margin.

[5] Interest Margin/Intermediation Margin.

[6] $Operational\ Expenses_{2005}/Operational\ Expenses_{2001}$.

For the MBs of Friuli Venezia Giulia, the greatest cluster is Group 1, which consists of nine banks. In fact, the average '$Branches_{2005}/Branches_{2001}$' ratio is higher than for both Groups 2 and 3 (1.321, compared to 1.317 and 1.229 respectively). The increase in the loans/deposits ratio is lower than that of Group 2 (21.669 vs. 37.750) because the initial values of Group 2 are much lower than those of Group 1. In comparison between Group 1 and Group 3, the lower value of Group 1 can be attributed to the similarity between the geographical extension and traditional intermediation strategies: both give rise to an increase in loans to customers. In this specific case, the increase is particularly marked for Group 3. We accordingly note that the loans/deposits ratio cannot be adopted as a discriminant factor with which to identify a specific strategy clearly; by contrast, the remaining variables enable us to clearly identify the strategic growth paths.

5 Evaluating bank efficiency and productivity

5.1 Methodology for evaluating efficiency

DEA is a mathematical linear programming technique developed by Charnes, Cooper and Rhodes (the CCR model) (Charnes *et al*., 1978), which identifies the efficient frontier from the linear combination of those units/observations that (in a production space) use comparatively fewer inputs to produce comparatively more outputs (Casu and Girardone, 2006). We assume that the technology can be described as follows:

$$\begin{aligned} &T \subseteq R_+^N \times R_+^M \\ &T_t = \{(x_t, y_t) : x_t \text{ can produce } y_t\} \\ &\text{with} \\ &x_t \in R_+^N \\ &y_t \in R_+^M \end{aligned} \tag{1}$$

where:

$x_t \in R_+^N$ = vector of inputs
$y_t \in R_+^M$ = vector of outputs in a time period *t*.

In this paper, the technology satisfies the following conventional assumptions:

- $(0,0) \in T_t \Rightarrow y_t = 0$, *i.e*., no fixed costs and no free lunch
- the set $A(x_t) = \{(u_t, y_t) \in T_t; u_t \le x_t\}$ of dominating observations is bounded $\forall x_t \in R_+^N$, *i.e.*, infinite outputs cannot be generated with a finite input vector
- T_t is closed
- $\forall (x_t, y_t) \in T_t, (x_t, -y_t) \le (u_t, -v_t) \Rightarrow (u_t, v_t) \in T_t$, *i.e.*, fewer outputs can always be produced with more inputs, and the inverse (strong disposal of inputs and outputs)
- T_t is convex: $\forall (x_t, y_t) \in T_t, \lambda \in [0,1]; \lambda x_t + (1-\lambda) y_t \in T_t$; distances between inputs and outputs are elements of T_t.

The efficiency of a firm can be measured as the radial distance of its actual performance from a frontier. In a production function context, this frontier is defined as the maximum feasible level of outputs given the input levels, or alternatively as the minimum feasible level of inputs given the output levels; a firm's inefficiency will be respectively measured as the radial inputs contraction or radial outputs expansion necessary to reach the frontier. In particular, if *J* firms use a vector of inputs to produce a vector of outputs, the input-oriented CCR measure of efficiency of a particular firm is calculated as:

$$\min_{\theta,\lambda} \theta_i \tag{2}$$

subject to

$$\begin{aligned}
&\sum_{j=1}^{J} y_{mj}^{t} \lambda_j^t \geq y_{mi}^{t} \\
&\sum_{j=1}^{J} x_{nj}^{t} \lambda_j^t \leq \theta_i x_{ki}^{t} \\
&\lambda_j^t \geq 0 \\
&\sum \lambda_j = 1
\end{aligned} \tag{2.1}$$

where:

y_{mj}^{t} = m-th element of the vector of outputs of the j-th firm in the time period t

x_{nj}^{t} = n-th element of the sector of inputs of the j-th firm in the time period t

λ_j^t = weights assigned to the inputs and outputs of J firms in the time period t

$\theta_i \leq 1$ = scalar efficiency score for the i-th unit.

If $\theta_1 = 1$, the i-th firm is efficient because it lies on the frontier, whereas if $\theta_i < 1$ the firm is inefficient and needs a $1-\theta_i$ reduction in the input levels to reach the frontier (Casu and Girardone, 2006). The CCR model assumes constant returns to scale, which is the optimal scale in the long run. The additional convexity constraint $\sum \lambda_j = 1$ is included to allow variable returns to scale, following the BCC approach (Banker *et al.*, 1984). Therefore, in this paper DEA measures of efficiency are based on estimates of the extent to which the unit under analysis could have used less input for its output levels.

5.2 Evaluating bank productivity

The Luenberger Indicator, as a generalisation of the Malmquist index, is a difference-based index of directional distance functions (Debreu, 1951; Chambers *et al.*, 1998); this shortage function has the properties of accounting for both input contractions and output improvements, and of establishing duality between the shortage function and the profit function. The indicator is thus able to accommodate either an input or output perspective corresponding to cost minimisation or profit maximisation.

Starting from the technology function used for DEA, the directional distance function generalises the traditional Shephard (1970) distance function. It projects the input and/or output vector from itself to the technology frontier in a preassigned direction. The distance function in the direction of $g = (h, k)$ is defined as follows:

$$D_t(x_t, y_t; g) = \begin{Bmatrix} \sup\{\delta : (x_t - \delta h; y_t + \delta k) \in T_t\} & \text{if } (x_t - \delta h; y_t + \delta k) \in T_t, \delta \in R \\ -\infty & \text{otherwise} \end{Bmatrix}. \tag{3}$$

To estimate the function, we use the nonparametric approach of Banker and Maindiratta (1988) and of Barros *et al.* (2006). Therefore, the technology can be rewritten as:

$$T_t = \left\{ (x_t, y_t), x_t \geq \sum_j \lambda_j x_t^j, y_t \leq \sum_j \lambda_j y_t^j, \sum_j \lambda_j = 1, \lambda_j \geq 0; j = 1, ..., J \right\}. \tag{4}$$

The linear programming that calculates the values of the directional distance function is given by:

$$D_t(x_t, y_t) = \max \delta_t \tag{5}$$

subject to

$$\begin{aligned} & x_t - \delta_t x_t \geq \sum_j \lambda_j x_t^j \\ & y_t + \delta_t y_t \leq \sum_j \lambda_j y_t^j \\ & \sum_j \lambda_j = 1, j = 1, ..., J. \end{aligned} \tag{5.1}$$

In order to assign a cardinal measure to the productivity change, we employ the directional distance function in one of two possible ways, corresponding respectively to using either the initial technology at time t or the final technology at $t+1$. The Luenberger Indicator can thus be used to assess productivity change. It is obtained as the arithmetic mean of the productivity change measured by the technology at time $t+1$ (T_{t+1}) and the productivity change measured by the technology T_t. It is defined as follows:[7]

$$L(z_t, z_{t+1}) = \frac{1}{2}[D_{t+1}(z_t; g) - D_{t+1}(z_{t+1}; g) + D_t(z_t; g) - D_t(z_{t+1}; g)]. \tag{6}$$

The growth (decline) of productivity is indicated by the positive (negative) value of the indicator. The indicator is additively decomposed as follows:

$$\begin{aligned} L(z_t, z_{t+1}) = {} & [D_t(z_t; g) - D_{t+1}(z_{t+1}; g)] + \frac{1}{2}[D_{t+1}(z_{t+1}; g) - D_t(z_{t+1}; g) \\ & + D_{t+1}(z_t; g) - D_t(z_t; g)]. \end{aligned} \tag{6.1}$$

The first term of Equation (6.1) measures the efficiency change between time periods t and $t+1$. The arithmetic mean of the difference between the two figures expresses the technological change component, which represents the shift of technology between the two time periods (different mix of inputs and outputs as θ; see Figure 1 in the Appendix).

Finally, in the aggregate context, following Farrell (1957) and Briec *et al.* (2003), we employ an aggregate directional distance function constructed as:

$$D_t\left(\sum_{k=1}^{K} x_t^k, \sum_{k=1}^{K} y_t^k\right). \tag{7}$$

The aggregate efficiency indicator is a structural efficiency indicator, and the aggregate Luenberger Indicator (AL) is constructed as follows:

$$AL\left(\sum_{k=1}^{K} z_t^k, \sum_{k=1}^{K} z_{t+1}^k\right) = \frac{1}{2}\left[D_{t+1}\left(\sum_{k=1}^{K} z_t^k\right) - D_{t+1}\left(\sum_{k=1}^{K} z_{t+1}^k\right) + D_t\left(\sum_{k=1}^{K} z_t^k\right) - D_t\left(\sum_{k=1}^{K} z_{t+1}^k\right)\right]. \tag{8}$$

6 Results on efficiency and productivity by cluster

Efficiency scores were measured assuming that the banks in the sample produce five categories of outputs:

1 loans to customers

2 interest margin

3 deposits

4 branches

5 fee-based activities, using three types of inputs:

- fixed assets
- labour costs
- other administrative expenses.

Table 3 shows the annual efficiency scores of MBs in our sample for each region during the period 2001–2005. Individual scores are grouped with reference to the strategic groups identified by the cluster analysis. DEA was also applied to the entire sample in order to make comparisons among regions.[8] In the regional analysis, the efficiency score was obtained by comparing the values of the *i*-th bank and the values of *J* banks of the region; in the 'aggregate analysis' the comparison was made for the 121 banks in the sample.

The productivity results are shown in Table 4, where the indicator (L) is decomposed into its constituents: technical efficiency change (EFFCH – the diffusion or catch-up component) and technological change (TECH, the innovation or frontier-shift component). EFFCH represents the diffusion of best-practice technology in the management of banking activities and it is attributable to investment planning, technical experience and management organisation. TECH results from the innovations and the adoption of new technologies by best-practice banks in each region between 2001 and 2005.

Table 3 DEA efficiency scores by year, region and group (mean values and ratios 2005/2001 (%))

Region	*2001*	*2002*	*2003*	*2004*	*2005*	*Average*	*Δ2005/2001*
Emilia Romagna (22)[1]							
Group 1	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Group 2	96.29	98.61	93.53	89.65	94.59	94.53	98.50
Group 3	94.72	95.77	97.00	95.14	97.25	95.97	103.05
Friuli Venezia Giulia (16)							
Group 1	98.92	100.00	100.00	99.26	98.26	99.29	99.44
Group 2	97.80	99.35	98.52	96.41	95.76	97.57	97.82
Group 3	99.55	99.39	100.00	98.23	98.40	99.11	98.85
Lombardia (45)							
Group 1	98.29	98.79	98.71	98.80	98.34	98.58	100.06
Group 2	93.14	92.99	94.27	92.95	90.68	92.80	97.46
Group 3	90.20	92.91	94.53	93.97	95.24	93.37	105.89
Veneto (38)							
Group 1	89.63	90.73	94.65	84.18	89.12	89.66	99.43
Group 2	92.85	92.21	92.05	93.03	95.43	93.11	103.06
Group 3	88.45	88.59	89.27	89.17	91.39	89.37	103.86
Aggregate analysis (121)							
Emilia Romagna	87.93	88.73	90.44	89.64	89.43	89.23	102.14
Group 1	98.94	99.34	100.00	100.00	98.30	99.31	99.34
Group 2	91.89	92.12	90.88	87.71	86.80	89.88	94.67
Group 3	85.94	86.89	89.23	88.76	88.85	87.93	103.79
Friuli Venezia Giulia	86.76	87.16	88.71	88.07	89.08	87.96	103.26
Group 1	86.16	86.19	88.61	88.58	90.08	87.92	91.66
Group 2	77.60	84.17	85.67	87.64	88.84	84.79	114.38
Group 3	94.98	91.57	91.21	87.25	87.00	90.40	104.72
Lombardia	82.27	85.09	87.90	86.04	86.07	85.48	104.67
Group 1	89.52	93.26	94.21	92.11	92.39	92.30	103.50
Group 2	80.02	82.36	85.71	83.44	83.49	83.00	104.51
Group 3	81.18	83.98	87.11	85.61	85.53	84.74	105.20
Veneto	87.66	89.22	87.53	87.65	88.65	88.14	101.42
Group 1	89.50	89.75	83.76	80.03	82.56	85.12	92.25
Group 2	90.55	91.61	89.68	90.41	91.34	90.72	101.09
Group 3	85.81	87.74	86.39	86.31	87.28	86.71	102.02
Total	85.64	87.25	88.24	87.30	87.73	87.33	103.00

Note: [1] Number of observations in brackets.

Table 4 Productivity changes in mutual banks (2001–2005): regional and aggregate analysis

Region	*L*[1]	*EFFCH*[2]	*TECH*[3]
Emilia Romagna			
Group 1	0.0253	0.0000	0.0253
Group 2	0.0173	–0.0086	0.0259
Group 3	–0.0146	0.0140	–0.0286
Friuli Venezia Giulia			
Group 1	–0.0111	–0.0033	–0.0078
Group 2	–0.0211	–0.0177	–0.0034
Group 3	0.0051	–0.0010	0.0061
Lombardia			
Group 1	0.0152	0.0003	0.0149
Group 2	–0.0342	–0.0136	–0.0207
Group 3	–0.0163	0.0271	–0.0434
Veneto			
Group 1	0.1032	–0.0028	0.1060
Group 2	0.0465	0.0143	0.0322
Group 3	–0.0146	0.0174	–0.0321
Aggregate analysis (L = AL)[4]			
Emilia Romagna	–0.0092	0.0091	–0.0184
Group 1	0.0400	–0.0033	0.0433
Group 2	0.0071	–0.0286	0.0357
Group 3	–0.0179	0.0172	–0.0352
Friuli Venezia Giulia	–0.0423	0.0135	–0.0557
Group 1	–0.0461	0.0217	–0.0678
Group 2	–0.0310	0.0647	–0.0956
Group 3	–0.0422	–0.0436	0.0014
Lombardia	–0.0422	0.0214	–0.0636
Group 1	0.0056	0.0166	–0.0109
Group 2	–0.0625	0.0213	–0.0838
Group 3	–0.0457	0.0233	–0.0689
Veneto	0.0132	0.0061	0.0071
Group 1	0.0692	–0.0401	0.1093
Group 2	0.0542	0.0046	0.0496
Group 3	–0.0142	0.0091	–0.0233
Total	–0.0188	0.0133	–0.0321

Notes: [1] Luenberger Indicator.
[2] Technical efficiency change.
[3] Technological change.
[4] Aggregate Luenberger Indicator.

6.1 Emilia Romagna

This is the region with the highest value of efficiency in the aggregate analysis (89.23%). Group 1 was the most efficient, with an average efficiency score of 99.31%, compared with 89.88% for Group 2 and 87.93% for Group 3. This last group, however, recorded the highest increase in efficiency between 2001 and 2005 (3.79%). The aggregate result was confirmed by the intraregion analysis, where the ratio 2005/2001 for Group 3 is 103.05%, corresponding to 100% and 98.5% of Groups 1 and 2 respectively.

With reference to the productivity changes, Emilia Romagna exhibits a modest downturn compared with the other regions (–0.0092). In the regional analysis, only Group 3 showed a decrease between 2001 and 2005 (–0.015) due to a –0.029 decline in TECH. In the aggregate context, the decrease of Group 3 was more evident (–0.018) and the TECH decrease of –0.035 only partly compensated for the increase in EFFCH by 0.017. Group 1 recorded the highest productivity increase, both in the regional analysis (0.025) and in the aggregate one (0.040).

6.2 Friuli Venezia Giulia

The regional analysis exhibits high DEA efficiency scores for all the clusters, with average 2001–2005 values varying between 99.29% (Group 1), 97.57% (Group 2) and 99.11% (Group 3). In the aggregate analysis, only Group 1 recorded decreases in efficiency: the 2005/2001 ratio, in fact, is 91.66%, whilst the same ratio for Groups 2 and 3 is 114.38% and 104.72% respectively. Group 2, by contrast, obtained the lowest efficiency scores in both the regional and the aggregate analysis, but it recorded the highest increase between 2001 and 2005.

Concerning productivity, in the aggregate analysis all strategic groups recorded reductions between 2001 and 2005. In the cases of Groups 1 and 2, the downturn is explained by negative changes of TECH amounting to –0.068 and –0.096 respectively. Despite improved efficiency in input/output diffusion (EFFCH), the MBS of Friuli Venezia Giulia do not seem to have adopted technological innovation in order to reach the frontier of efficient production technology (Figure 1 in the Appendix – shift from T_t to T_{t+1}). The regional analysis confirmed the productivity reduction for Groups 1 and 2. Group 3, on the other hand, showed a negative productivity change in the aggregate analysis (–0.042), while in the regional analysis it recorded a moderate increase of 0.005.

6.3 Lombardia

In the regional analysis, the average DEA efficiency score of Group 1 was higher than that of the other two groups (98.58%, compared with 92.8% and 93.37% for Groups 2 and 3 respectively). In the aggregate analysis, Group 1 was again the most efficient, and increased the gap with respect to the other groups. Given the average DEA efficiency score of 85.48% for the entire region, Group 1 obtained an average DEA efficiency score of 92.3%, compared with aggregate values for Groups 2 and 3 of 83% and 84.74% respectively.

Efficiency scores for Group 1 are supported by results in productivity changes. In the regional analysis, only this group exhibited a positive change in productivity (0.015) due to an increase in TECH (0.015). In the aggregate analysis (AL), the increase

was halved (0.006) because of the reduction in TECH (–0.011). Group 2 recorded the largest decrease in productivity, both in the regional and aggregate analyses (–0.0342 and –0.0625 respectively).

6.4 Veneto

Group 2 is the most efficient, with average efficiency scores constantly higher than those of the other groups. Moreover, it is represented by best-practice banks (35.71%) whose average DEA efficiency scores during the period 2001–2005 were 100%; they consequently lie on the frontier. Group 3 exhibits a growing trend in efficiency, but the average DEA efficiency scores are lower than the average for the region. In particular, increases in efficiency between 2001 and 2004 were modest (from 88.45% to 89.17%); only in 2005 did the increase in efficiency raise the score to 91.39%. In the aggregate analysis, the regional average DEA efficiency score was 88.14%, and Group 3 recorded the highest increase in efficiency (2.02%).

In relation to productivity, Veneto was the only region showing a positive change between 2001 and 2005 in the aggregate analysis ($AL = 0.013$). With reference to groups, only Group 3 exhibited a decline in productivity (–0.014), due to a declining TECH (–0.023). Also in the regional analysis, only Group 3 recorded a productivity reduction (–0.015), which was driven by the decrease in TECH (–0.032), as in the aggregate context. Group 1 recorded the highest positive changes in productivity growth, both in the regional and the aggregate analysis (0.103 and 0.069 respectively), thanks to the increase in TECH (0.106 and 0.109 respectively).

7 Competitive positioning

Finally, we assessed the competitive positioning[9] by comparing efficiency and productivity changes between 2001 and 2005, for each group and region, and also in the aggregate context (Figure 1).

In Emilia Romagna (Figure 1a), Group 1 records the highest productivity growth, but Group 3 exhibits the most marked increase in the efficiency score (3.054%), although this is penalised by a decrease in productivity (–0.015). In Friuli Venezia Giulia (Figure 1b), the banks belonging to Group 1 are the most efficient in the regional analysis, both for the mean values and for the 2005/2001 ratio. In Lombardia (Figure 1c), the largest group (Group 3 – 22 elements) represents 48.89% of the region; it records a positive variation in efficiency during the period 2001–2005, which is larger than that of the other groups in both the regional and the aggregate analyses (Figure 2); nevertheless, it exhibits a negative change of productivity (–0.016). Finally, also in Veneto (Figure 1d), the majority of banks (23 out of 38) are associated with Group 3. They display the highest positive changes in efficiency between 2001 and 2005 (3.86%), but a reduction in productivity (–0.015), compared to increases achieved by Groups 1 and 2. Fourteen banks belong to Group 2; in the regional analysis, they exhibit the best combination of changes in efficiency and productivity (3.06% and 4.65% respectively).

Figure 1 Competitive positioning by efficiency and productivity: regional analysis (changes in efficiency and productivity 2005/2001)

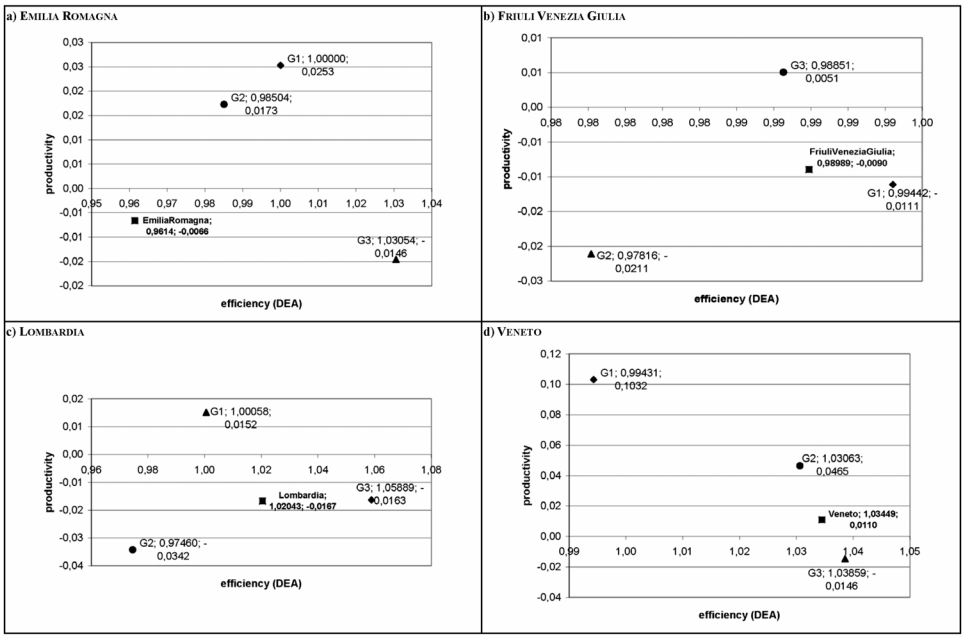
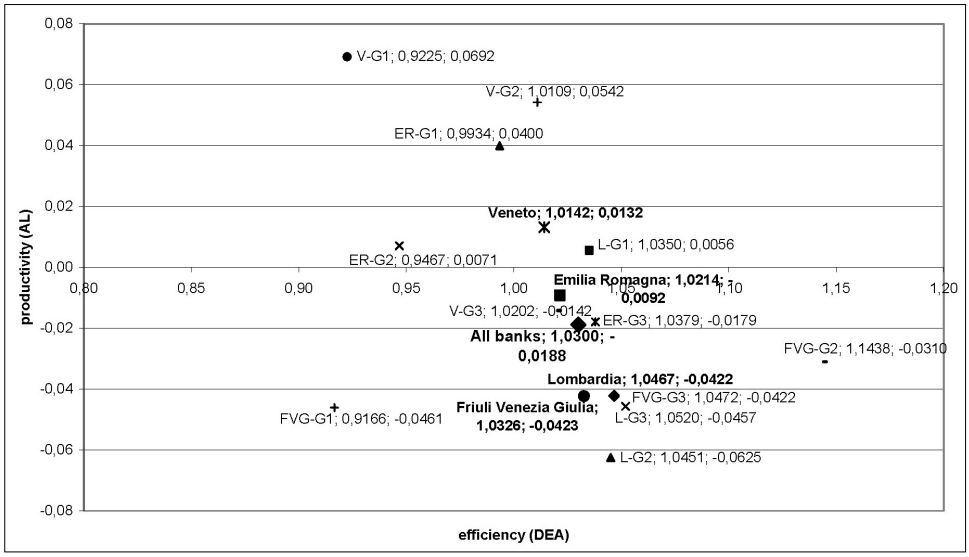


Figure 2 Competitive positioning by efficiency and productivity: aggregate analysis (changes in efficiency and productivity 2005/2001)



The aggregate competitive positioning (Figure 2) shows that the increase in efficiency was accompanied by a decline in productivity (–0.019). The majority of banks follow the strategic growth path focused on 'traditional intermediation', but the highest scores for

efficiency and productivity do not always pertain to the largest group. Hence, the MBs analysed seem to follow 'conservative policies' targeted at saving capital requirements. This may represent a prudent approach, centred on maintaining the adequacy of capital, sanctioned by new rules; nevertheless, it can also be interpreted as a sort of 'credit crunch' towards riskier SMEs, which distinguish the MBs' customers. If this is so, the strategic growth paths identified during the period 2001–2005 may not be suited to achieving and maintaining an adequate competitive position in the credit markets, national and international, despite the deep territorial rootedness, which represents their main competitive advantage (Fonteyne, 2007).

8 Conclusions

We presented an analysis of 121 Italian MBs, operating in four regions over the time period 2001–2005. We identified strategic groups by using cluster analysis and then measured the efficiency and productivity changes for each cluster. We considered three strategic growth paths drawn from the literature: geographical extension, diversification and traditional intermediation. Each strategic path is identified by specific input/output variables that we have taken from annual accounting information (Balance Sheet, Statement of Income, Explanatory Notes). We defined and measured the performance ratios for each group, according to the association of each cluster with the relative strategic path. We then examined the changes in efficiency and productivity between 2001 and 2005 by using the DEA input-oriented and Luenberger Indicator approaches respectively. Finally, we assessed the competitive positioning by comparing efficiency and productivity changes between 2001 and 2005, for each group and region, and also in the aggregate context.

Our study revealed a lack of homogeneity in the sample analysed. The statistical results highlight that the strategic groups of different regions achieved different performances; on the other hand, the banks in each region are very similar to each other, even if they belong to different strategic groups. Hence, within the same region, the strategic groups are not markedly distinct in terms of performances and competitive positioning. Moreover, the performances associated with each strategic growth path change in the comparison among regions (*i.e.*, the performances of Group 3 in Friuli Venezia Giulia are different from those of the same group in Lombardia; the performances of Group 1 in Emilia Romagna are different from those of the same group in Veneto, and so on). We maintain that there are some structural factors which impact on strategic growth among the regions analysed.

We think that our main findings have some implications for other countries/banking sectors, besides the Italian one. In a more general way, it would be useful to make a comparison with other MBs by country, dimension, market share and activities, in order to improve the effectiveness of the managerial interpretation of results (*i.e.*, *Banques Populaires*, *Crédit Agricole*, *Crédit Mutuel* and *Caisses d'Épargne* in France; *Genossenschaftenbanken* in Germany; *Rabobank* in the Netherlands). Further researches have to amplify the sample and the period considered, according to an extension of the competitive analysis towards a worldwide and long-run dimension.

Acknowledgements

This paper has benefited from comments by an anonymous referee and from suggestions by Paolo Biffis (University Ca' Foscari – Venezia) and Matteo Grigoletto (University of Padova). We take responsibility for any errors that remain.

References

Amel, D.F. and Rhoades, S.A. (1988) 'Strategic groups in banking', *The Review of Economics and Statistics*, Vol. 70, No. 4, pp.685–689.

Appennini, A., Lopez, J.S. and Rossi, S.P.S. (2002) 'Are Italian mutual banks efficient? Evidence from two different cost frontier techniques', *SUERF Studies*, Vienna, No. 15, pp.7–42.

Bain, J.S. (1956) *Barriers to New Competition. Their Character and Consequences in Manufacturing Industries*, Cambridge: Harvard University Press.

Bank of Italy (2007) 'Economic developments in the Italian regions in 2006', *Economic and Financial Issues (Occasional Papers)*, July, No. 10, www.bancaditalia.it.

Banker, R.D., Charnes, A. and Cooper, W.W. (1984) 'Some models for estimating technical and scale inefficiency in data envelopment analysis', *Management Science*, Vol. 30, No. 9, pp.1078–1092.

Banker, R.D. and Maindiratta, A. (1988) 'Nonparametric analysis of technical and allocative efficiency in production', *Econometrica*, No. 56, pp.1315–1332.

Barros, C.P., Peypoch, N. and Williams, J. (2006) 'A note on productivity change in European co-operative banks: the Luenberger indicator approach', Working Paper No. 36, Department of Economics, Institute for Economics and Business Administration (ISEG), Technical University of Lisbon, http://pascal.iseg.utl.pt/~depeco/wp/wp362006.pdf.

Berger, A.N. and Humphrey, D.B. (1997) 'Efficiency of financial institutions: international survey and directions for future research', *European Journal of Operational Research*, Vol. 98, No. 2, pp.175–212.

Bonaccorsi di Patti, E. and Gobbi, G. (2004) 'Piccole imprese e cambiamenti strutturali nei mercati locali del credito', in F. Panetta (Ed.) *Il sistema bancario italiano negli anni Novanta*, Il Mulino, Bologna, pp.189–225.

Boussemart, J.P., Briec, W., Kerstens, K. and Poutineau, J.C. (2003) 'Luenberger and Malmquist productivity indices: theoretical comparison and empirical illustration', *Bulletin of Economic Research*, Vol. 55, No. 4, pp.391–406.

Briec, W., Dervaux, B. and Leleu, H. (2003) 'Aggregation of directional distance functions and industrial efficiency', *Journal of Economics*, Vol. 79, No. 3, pp.237–261.

Camanho, A.S. and Dyson, R.G. (2005) 'Cost efficiency measurement with price uncertainty: a DEA application to bank branch assessments', *European Journal of Operational Research*, No. 161, pp.432–446.

Caratelli, M., Filotto, U., Milani, C. and Terriero, G. (2006) 'Valore o valori: la prospettiva della banca del territorio', in G. Bracchi and D. Masciandaro (Eds.) *Banche e geografia. Nuove mappe produttive e metamorfosi del credito*, Edibank, Rome, pp.265–301.

Casu, B. and Girardone, C. (2006) 'Bank competition, concentration and efficiency in the single European market', *The Manchester School*, Vol. 74, No. 4, pp.441–468.

Casu, B., Girardone, C. and Molyneux, P. (2004) 'Productivity change in European banking: a comparison of parametric and non-parametric approaches', *Journal of Banking and Finance*, No. 28, pp.2521–2540.

Caves, D.W., Christensen, L.R. and Diewert, W.E. (1982) 'Multilateral comparisons of outputs, inputs and productivity using superlative index number', *Economic Journal*, Vol. 92, pp.73–86.

Caves, R.E. and Porter, M.E. (1977) 'From entry barriers to mobility barriers: conjectural decisions and contrived deterrence to new competition', *Quarterly Journal of Economics*, Vol. 91, No. 2, pp.421–441.

Chambers, N. and Cifter, A. (2007) 'The effect of scale on productivity of Turkish banks in the post-crises period: an application of data envelopment analysis', *Proceedings of the Traditional International Finance Symposium*, MPRA Paper No. 2487, April, http://mpra.ub.uni-muenchen.de.

Chambers, R.G., Chung, Y. and Färe, R. (1998) 'Profit, directional distance functions, and Nerlovian efficiency', *Journal of Optimization Theory and Applications*, No. 98, pp.351–364.

Charnes, A., Cooper, W.W. and Rhodes, E. (1978) 'Measuring efficiency of decision making units', *European Journal of Operational Research*, Vol. 2, pp.429–444.

Colarossi, T. and Tarantola, A.M. (2004) 'Economia e Finanza nella provincia di Brescia', Banche e Banchieri, No. 1, pp.6–18.

Cook, W.D. and Hababou, M. (2001) 'Sales performance measurement in bank branches', *Omega. The International Journal of Management Science*, No. 29, pp.299–307.

Dalla Pellegrina, L. (2005) 'Intermediazione bancaria e crescita economica nelle province italiane', in G. Bracchi and D. Masciandaro (Eds.) *Le banche italiane e la finanza per lo sviluppo*, Territori, imprese, famiglie, Edibank, Roma, pp.53–73.

Debreu, G. (1951) 'The coefficient of resource utilisation', *Econometrica*, Vol. 19, pp.273–292.

Dell'Atti, S. and Pacelli, V. (2007) 'L'assetto organizzativo e gestionale delle banche minori', in S. Dell'Atti (Ed.) *Basilea 2 e piccole banche. Organizzazione, gestione e scelte strategiche*, Edibank, Rome, pp.95–116.

Demsetz, H. (1968) 'Do competition and monopolistic competition differ?', *The Journal of Political Economy*, January–February, Vol. 76, No. 1, pp.146–148.

Di Salvo, R. (2002) 'Italian mutual banks: performance, efficiency and mergers and acquisitions', *SUERF Studies*, Vienna, No. 15, pp.5–6.

Färe, R. and Grosskopf, S. (2000) 'Theory and application of directional distance functions', *Journal of Productivity Analysis*, No. 13, pp.93–103.

Farrell, M.J. (1957) 'The measurement of productive efficiency', *Journal of the Royal Statistical Society*, No. 120, pp.253–281.

Fiorentino, E., Karmann, A. and Koetter, M. (2006) 'The cost efficiency of German banks: a comparison of SFA and DEA', Deustche Bundesbank Discussion Paper, Series 2: Banking and Financial Studies, No. 10.

Fonteyne, W. (2007) 'Cooperative banks in Europe – policy issues', IMF Working Paper, WP/07/159.

Goddard, J.A., Molyneux, P. and Wilson, J.O.S. (2001) *European Banking: Efficiency, Technology and Growth*, UK: Wiley.

Grimaldi, S. and Lopez, J.S. (2005) 'Le relazioni tra Credito Cooperativo e territorio. Un modello complesso', *Cooperazione di Credito*, No. 188, pp.115–145.

Hatten, K.J. and Hatten, M.L. (1987) 'Strategic groups, asymmetrical mobility barriers and contestability', *Strategic Management Journal*, Vol. 8, No. 4, pp.329–342.

Hunt, M.S. (1972) 'Competition in the major house appliance industry 1960–1970', unpublished Doctoral dissertation, Harvard University.

IRCEL (2006) 'Bollettino Statistico 2005', *Cooperazione di Credito*, January/March, No. 191.

Lovell, C.A.K. (2003) 'The decomposition of Malmquist productivity indexes', *Journal of Productivity Analysis*, Vol. 20, pp.437–458.

Luenberger, D.G. (1992) 'Benefit function and duality', *Journal of Mathematical Economics*, No. 21, pp.461–481.

Malmquist, S. (1953) 'Index numbers and indifference surface', *Trabajos de Estatistica*, No. 4, pp.209–242.

Molyneux, P. and Williams, J. (2005) 'The productivity of European co-operatives banks', *Managerial Finance*, Vol. 31, No. 11, pp.26–35.

Portela, M.C.A.S. and Thanassoulis, E. (2007) 'Comparative efficiency analysis of Portuguese bank branches', *European Journal of Operational Research*, No. 177, pp.1275–1288.

Porter, M.E. (1979) 'The structure within industries and companies' performance', *Review of Economics and Statistics*, Vol. 61, No. 2, pp.224–227.

Prior, D. (2003) 'Long – and short-run – non-parametric cost frontier efficiency: an application to Spanish savings banks', *Journal of Banking and Finance*, No. 23, pp.655–671.

Prior, D. and Surroca, J. (2006) 'Strategic groups based on marginal rates: an application to the Spanish banking industry', *European Journal of Operational Research*, Vol. 170, pp.293–314.

Resti, A. and Lissoni, C. (1998) 'La Data Envelopment Analysis e l'efficienza delle filiali delle banche. Un caso concreto', *Banche e Banchieri*, No. 6, pp.569–576.

Shephard, R.W. (1970) *Theory of Cost and Production Functions*, Princeton, NJ: Princeton University Press.

Siegel, S. (1957) 'Nonparametric statistics', *The American Statistician*, Vol. 11, No. 3, pp.13–19.

Sørensen, C.K. and Gutiérrez, J.M.P. (2006) 'Euro area banking sector integration using hierarchical cluster analysis techniques', ECB WP Series No. 627, www.ecb.int.

Tarantola, A.M. (2007) 'Internazionalizzazione e localismo', *Proceedings of the workshop Le Banche di Credito Cooperativo nel processo di internazionalizzazione delle PMI italiane. Ruoli e prospettive*', 15 June, www.bancaditalia.it.

Young, M.R. (1999) 'Market structure analysis: a foundation for developing and assessing bank strategy', *International Journal of Bank Marketing*, Vol. 17, No. 1, pp.20–26.

Zineldin, M. (1996) 'Bank strategic positioning and some determinants of bank selection', *International Journal of Bank Marketing*, Vol. 14, No. 6, pp.12–22.

Zúñiga-Vicente, J.A., de la Fúente-Sabaté, J.M. and Suarez-Gonzalez, I. (2004) 'Dynamics of the strategic group membership-performance linkage in rapidly changing environments', *Journal of Business Research*, No. 57, pp.1378–1390.

Notes

1 MBs belong to the larger set of 'cooperative banks'. The Italian legislation governing 'cooperative banks' is laid down in 'The 1993 Banking Law' (Legislative Decree of 1 September 1993, no. 385), which includes Articles 28–37, specifically concerning cooperative banks, classified into 'popular' and 'mutual' banks. MBs are all small local banks (Art. 34, co. 2: "To be a member of a mutual bank it is necessary to reside, have a place of business or engage in a continuing activity in the area of the bank's operations."). Their explicitly mutualistic *mission* translates into specific legal treatment, consisting basically of the tax exemption of profits allocated to a reserve that is *indivisible* among the members. (Art. 37: "1. Mutual banks must allocate at least 70% of net profits for the year to the legal reserve. 2. A portion of net profits for the year must be paid, in the amount and manner established by law, into mutualistic funds for the promotion and development of co-operation. 3. Profits not allocated (…), used to increase the value of the shares, allocated to other reserves or distributed to members must be allocated to charity or mutual aid.")

2 See also Zúñiga-Vicente *et al.* (2004); Prior and Surroca (2006) and Sørensen and Gutiérrez (2006) for a wider application of cluster analysis to analysing the European banking industry.

3 Two important reviews of literature on efficiency in the banking sector are Berger and Humphrey (1997) and Goddard *et al.* (2001).

4 For an extensive application of DEA methodology in the banking sector, see, among others, Chambers and Cifter (2007); Portela and Thanassoulis (2007); Camanho and Dyson (2005); Prior (2003); Appennini *et al.* (2002); Cook and Hababou (2001).

5 Any values distant from the median by more than 1.5 times the interquartile distance are considered outliers. The Interquartile Range (IQR) is the difference between the 75th and 25th percentiles and corresponds to the length of the 'box' (the boxplot, sometimes called a box-and-whiskers plot, shows the median, quartiles, and outliers and extreme values for a scale variable). Outliers are values between 1.5 IQRs and 3 IQRs from the end of a box. By default, the boxplot displays outliers.

6 We employed Statistical Package for the Social Sciences (SPSS) software to perform the cluster analysis, and Generic Algebraic Modelling System (GAMS) software to elaborate the linear programming algorithms associated with DEA and the Luenberger Indicator.

7 The notation is simplified by setting $z_t = (x_t, y_t)$.

8 The expansion of the analysis to the whole sample also allows us to partially solve the interpretation problem of the regional analysis results, deriving from the relatively low number of observations. In fact, aggregate results strengthen the regional ones.

9 Competitive positioning enables one to assess a company's perceived strengths and weaknesses against those of competitors, in order to develop more effective strategic plans. In our study, we have tried to distinguish every bank from its competitors along real dimensions, by using perceptual mapping. It is a data summary technique of spatial representations, which show the relative positions of a set of banks on a set of evaluative dimensions. The objective is to condense a large amount of data into a meaningful 'picture' that portrays the interrelationships among a set of banks. See Young (1999) and Zineldin (1996).

Appendix

Table 1 Discriminant analysis: probabilities of membership in each group (P(n))[1]

Region	*Group 1*		*Group 2*		*Group 3*	
	Elements (n)	*P(n)*	*Elements (n)*	*P(n)*	*Elements (n)*	*P(n)*
Emilia Romagna (22)	2	100.00	3	100.00	17	100.00
Friuli Venezia Giulia (16)	4	99.82	3	99.71	9	99.75
Lombardia (45)	22	98.25	15	97.56	8	97.16
Veneto (38)	1	100.00	14	95.31	23	95.02

Note: [1] Number of observations (n) in brackets.

Table 2 Z-values of the ratios regarding changes in input/output variables

Group	*FA*[1]	*LC*[2]	*oAE*[3]	*L*[4]	*IM*[5]	*D*[6]	*B*[7]	*FbA*[8]
				Emilia Romagna				
Group				1				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	–1.732*	0.000	–1.732*	–1.732*	–1.732	0.000	–0.577*	–0.577*
3	–1.063*	–2.258***	–2.258***	–2.258***	–2.258***	–1.993**	–2.273***	–2.125***
				2				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	∅	∅	∅	∅	∅	∅	∅	∅
3	–2.699	–2.276***	–1.852*	–0.900*	–1.535*	–1.217*	–0.373*	–2.593***
				Friuli Venezia Giulia				
Group				1				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	–1.941*	–0.462*	–0.647*	–1.387*	–0.462*	–0.277*	–0.278*	–2.311***
3	–2.777***	–1.004*	–1.389*	–1.004*	–0.926*	0.000*	–1.393*	–0.463*
				2				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	∅	∅	∅	∅	∅	∅	∅	∅
3	–2.121**	0.000*	–1.061*	–0.707*	–0.354*	–0.707*	–0.535*	–2.121**
				Lombardia				
Group				1				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	–0.452*	–3.808	–3.615	–3.034	–3.486	–3.227	–1.785*	–3.227
3	–4.127	–1.994**	–2.110***	–1.829*	–2.532***	–3.330	–1.156*	–1.829*
				2				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	∅	∅	∅	∅	∅	∅	∅	∅
3	–5.104	–2.691***	–3.341	–1.825*	–2.722***	–0.309*	–0.873*	–2.877

Table 2 Z-values of the ratios regarding changes in input/output variables (continued)

Group	*FA*[1]	*LC*[2]	*oAE*[3]	*L*[4]	*IM*[5]	*D*[6]	*B*[7]	*FbA*[8]
				Veneto				
Group				1				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	–1.620*	–0.694*	–0.463*	–1.620*	–1.620*	–0.694*	–1.157*	–1.620*
3	–1.661*	–1.661*	–1.517*	–1.661*	–1.661*	–1.228*	–1.522*	–1.661*
				2				
1	∅	∅	∅	∅	∅	∅	∅	∅
2	∅	∅	∅	∅	∅	∅	∅	∅
3	–2.850***	–4.165	–4.338	–3.163***	–3.727	–3.821	–3.528	–3.633

Notes: Mann-Whitney U test (*, ** and ***: significant at 0.1, 0.05 and 0.01 respectively).

[1] Fixed Assets.

[2] Labour Costs.

[3] Other Administrative Expenses.

[4] Loans (to customers).

[5] Interest margin.

[6] Deposits.

[7] Number of Branches.

[8] Fee-based Activities.

Table 3 Strategic groups by region and cluster[1]

Cluster 1	*Cluster 2*	*Cluster 3*
	Emilia Romagna (22)	
1 BCC DI CRETA CRED COOP PIAC.	1 BANCA REGGIANA BCC	1 BCC BOLOGNESE
2 BANCA DI CAVOLA	2 BCC DI MACERONE	2 BANCA DI CESENA
	3 BANCA DI BOLOGNA BCC	3 EMIL BANCA
		4 BANCA ROMAGNA
		5 BCC DI VERGATO
		6 BCC DELL'ALTO RENO
		7 BCC DELLA ROMAGNA
		8 BCC DI CASTENASO
		9 BCC DI CENTO CREVALCORE
		10 BANCA DI FORLI' BCC
		11 BCC DI GATTEO
		12 BCC DI MONTERENZIO
		13 BCC DI SALA DI CESENATICO
		14 BCC DI SARSINA
		15 ROMAGNA EST BCC
		16 BANCA DI RIMINI BCC
		17 BCC VALMARECCHIA

Table 3 Strategic groups by region and cluster[1] (continued)

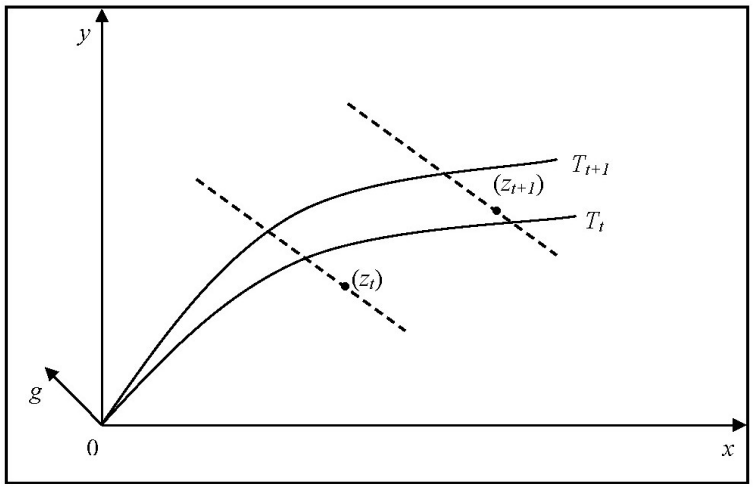
Cluster 1	*Cluster 2*	*Cluster 3*
	Friuli Venezia Giulia (16)	
1 CREDITO COOP.VO FRIULI	1 BCC DI FIUMICELLO	1 BCC BASSA FRIULANA
2 BCC PORDENONESE	2 BANCA DI UDINE BCC	2 BCC CRA DI LUCINICO FARRA
3 BCC DI BASILIANO	3 BCC DI TURRIACO	3 BCC DEL FRIULI CENTRALE
4 BCC DI DOBERDO' E SAVOGNA		4 BCC DI SAN GIORGIO E MEDUNO
5 BCC DI MANZANO		
6 BCC DI STARANZANO		
7 BCC DI VILLESSE		
8 BCC DELLA CARNIA		
9 BCC DEL CARSO		
	Lombardia (45)	
1 CRA DI BORGO SAN GIACOMO	1 BANCA CREMASCA BCC	1 BCC DI LISSONE
2 BCC CAMUNA (ESINE)	2 CR DEL CREMASCO BCC	2 BANCA DELLA VALSASSINA
3 BCC COLLI MORENICI	3 BCC DI BORGHETTO LODIGIANO	3 MANTOVABANCA 1896 CC
4 BCC DI BRESCIA	4 BCC DELL'ALTA BRIANZA	4 BANCA CENTROPADANA
5 BCC DI OFFANENGO	5 BCC DI BARLASSINA	5 CASSA PADANA BCC
6 BCC DI POMPIANO	6 CRA DI CANTÙ BCC	6 BCC DI BEDIZZOLE
7 BCC DI RIVOLTA D'ADDA	7 BCC DI CARATE BRIANZA	7 CRA DI BINASCO BCC
8 BCC DI SESTO SAN GIOVANNI	8 BCC DEL CREMONESE	8 BCC ALTA VALTROMPIA
	9 BCC DI CARUGATE	9 BCC DI BUSTO GAROLFO
	10 BCC OROBICA DI BARIANO	10 BCC DEL BASSO SEBINO
	11 BCC DI CALCIO E DI COVO	11 BCC DI CARAVAGGIO
	12 BCC DI CREMENO	12 BCC DELL'AGRO BRESCIANO
	13 BCC DI MOZZANICA	13 BCC DI GHISALBA
	14 BCC DI DOVERA E POSTINO	14 BCC DI INZAGO
	15 BCC VALLE SERIANA	15 BCC DI LESMO
		16 CRA DI RIVAROLO MANTOVANO
		17 BCC LAUDESE
		18 BCC DI SORRISOLE
		19 CRU BCC DI TREVIGLIO
		20 BCC DI TRIUGGIO
		21 BCC DI VEROLAVECCHIA
		22 BANCA DELLA BERGAMASCA CC

Table 3 Strategic groups by region and cluster[1] (continued)

Cluster 1	*Cluster 2*	*Cluster 3*
	Veneto (38)	
1 BCC MARTELLAGO	1 BCC INTERPROV.LE VENETO	1 BCC DELLA MARCA
	2 BANCA DI MONASTIER	2 BANCA ATESTINA DI BCC
	3 BENACO BCC COSTERMANO	3 BANCA DI ROMANO
	4 BANCA MARANO BCC	4 BCC CATTEDRALE DI ADRIA
	5 BANCA VERONESE	5 BCC DEL VENEZIANO
	6 CRA DI BRENDOLA BCC	6 BCC DEL BASSO VERONESE
	7 BCC DI VERONA CADIDAVID	7 BCC DI CARTURA
	8 BCC DI CAMPIGLIA DEI BERICI	8 BCC DI CEREA
	9 BCC DELL'ALTA PADOVANA	9 CRA DI CORTINA D'AMPEZZO
	10 BCC DI MARCON	10 BANCA DEL CENTROVENETO CC
	11 BCC VICENTINO POJANA	11 BANCA COLLI EUGANEI
	12 CRA DI VESTENANOVA	12 BCC DI LUSIA E CAVAZZANA
	13 BANCA SAN BIAGIO	13 BANCA ALTO VICENTINO BCC
	14 BCC PADANA ORIENTALE	14 BCC EUGANEA
		15 BCC DI PEDEMONTE
		16 BCC DI PIOVE DI SACCO
		17 CENTROMARCA BANCA
		18 BCC DI QUINTO VICENTINO
		19 CRA DI ROANA BCC
		20 BCC DI SANT'ELENA
		21 BCC DELLE PREALPI
		22 CRA DI TREVISO BCC
		23 BCC SANTA MARIA ASSUNTA

Note: [1] Number of observations in brackets.

Figure 1 The Luenberger Indicator



Source: Barros *et al.* (2006, p.6)