# Cooperative banks, concentration and distance

Key words: Financial Institutions Performance; Relationship Banking; Financial Structure and Development.

## 1. Introduction and motivation

During the last decades banks have progressively moved towards centralized and hierarchical organizational structures. Therefore, the investigation of the determinants of bank efficiency and relationships with the functional distance between the bank head-quarter and operational units have become increasingly important. Previous studies suggest that cost and profit efficiency may be different among different banks groups because of a different organizational structure and that the cooperative banking sector is surprisingly more cost efficient than the other ones (Bernini and Brighi, 2012). This paper extends the literature on bank efficiency examining the impact of some key variables like distance, local concentration degree and functional diversification on the efficiency of the Italian cooperative banks over the period 2006-2010. Focusing only on the cooperative banking group some of previous results are partially reversed. To better investigate these aspects we consider as inefficiency determinants either bank branch distance distribution, income diversification and local banking degree of concentration. Since distance among cooperative banks is often inter-municipal we suggest a new measure of distance that better catch the effect of spatial distribution at micro-local level. The results confirm the importance of the distance in determining bank efficiency. As the distance increases the efficiency decreases. According to the information asymmetry theory, an organizational structure with close interaction between the HQ unit and the peripheral operational units better disentangle asymmetric information problems between lender and borrower increasing bank efficiency. Coherently with previous evidence an increase in bank size implies a positive effect on cost efficiency only in the case of very small banks and this is quite sensible in the case of cooperative banks. This result is strictly linked to the local monopolistic power that we study using a spatial model à la Hotelling. Our analysis suggests that the cooperative banks exploit a certain monopolistic power at the local level with positive effect in terms of greater efficiency. Finally the income diversification positively affects efficiency. As a robustness check we control also for micro and macro risk conditions. An increased credit risk implies a generalized decrease in efficiency. The micro risk effects on efficiency appear coherent with the results produced in the case of the macro risk consideration. The macro-risk implies a definitive negative effect on the efficiency. Once again an asymmetric information hypothesis holds. Local banks benefit from a close relationship between the HQ and the operational unit or the customer helping to better disentangle local credit risk.

## 2. The Italian cooperative banking system

In Italy there are nowadays approximately 400 mutual bannks with 3000's branches (10.5% of the total of all branches) and shares from 5% to 7% for all loans and deposits. The asset share are important also if compared to other countries (see Tab. 1).

Tab. 1 – Cooperative banks – Market shares of Assets

| | 1994 | 1997 | 2000 | 2003 |
|---|---|---|---|---|
| Austria | … | 29.4 | 29.5 | 35.6 |
| Finland | 18.5 | 17.5 | 16.2 | 15.9 |
| France 1/ | 28.4 | 27.9 | 28.1 | 24.1 |
| Germany | 14.3 | 12.4 | 9.8 | 10.3 |
| Greece | … | 0.2 | 0.3 | 0.6 |
| Italy | … | 17.0 | 16.8 | 14.9 |
| Netherlands | … | 21.2 | 29.0 | 26.7 |
| Portugal | … | 3.5 | 3.4 | 3.5 |
| Spain | 3.0 | 3.5 | 3.7 | 3.9 |

Source: Fonteyne, 2007.

Mutual banks have an important role in the financing of households, artisans and small businesses. The mutual banks are Italian credit institutions characterized by small, self-governance, an attitude very local, and the principle of mutuality (internal: the activity is mainly biased in favour of shareholders, making its benefits both economic and not; external activities aimed at supporting the development of the local community in terms of moral, cultural and economic system, the asset value to the cooperation between the banks of the class to implement the network model of the Cooperative Credit.

The strengths of the mutual banks are the deep understanding of local economies (which reduces the typical problems of asymmetric information existing in the credit market) and the network externalities associated with their mutual aid system. However, recently, deregulation and technological progress are increasing the contestability of local credit markets, requiring the mutual banks to improve their performance. Data suggest that mutual banks face relatively low profit margins, high costs, and restricted income sources (see Tab. 2).

Tab. 2 – Selected Bank Performance Indicators (in %, 2002-04 average)

| | Banking system | *Banche Popolari* | *Banche di Credito Cooperativo* |
|---|---|---|---|
| Non-performing loans/total loans | 6.6 | 5.5 | 6.5 |
| Bad debts/total loans | 4.6 | 3.7 | 3.0 |
| Net interest income / total assets | 2.2 | 2.5 | 3.2 |
| Gross income / total assets | 3.5 | 3.8 | 4.1 |
| Share of non-interest income in total income | 38.2 | 35.8 | 21.8 |
| Operating expenses / Gross income | 59.4 | 59.4 | 67.8 |
| Loan losses / total assets | 0.48 | 0.44 | 0.25 |
| Return on equity | 7.9 | 7.6 | 6.7 |
| Solvency ratio | 11.4 | 10.1 | 17.8 |

Source: Fonteyne, 2007.

In fact, it must be said that there exists for mutual banks a so-called principle of prevalence, requiring that more than 50% of assets are either detained by members or in risk-free assets, according to the criteria established by the Financial Regulator. Furthermore, as far as profit distribution is concerned, the Testo Unico Bancario, 1993, requires that CB's must: i) devote at least 70% of annual net profits to legal reserve; ii) pay a share of annual net profits to mutual funds for the promotion and development of cooperation in an amount equal to 3%; iii) devote to purposes of charity or mutual aid, the remaining share of profits.

Because of these regulations, the possibility to compare mutual banks with other banks profit-efficiency wise must be seriously doubted. This is the reason why in this paper we focus only on this group of banks. Moreover since these banks have social aims different from the pure profit maximization goal it could be reasonable to compute cost efficiency instead than profit efficiency.

There is a further point, crucial for present purposes. Mutual banks can provide loans within a given area, generally inter-municipal. The territorial competence (jurisdiction) of the mutual banks determined by the Supervisory Instructions of the Bank of Italy and must be specified in their statute. It includes the municipalities in which the bank has its head office, branches and the surrounding areas, so that there must be territorial contiguity between these areas. Clearly this feature greatly hampers any move to territorial diversification on the part of mutual banks and makes them very sensitive to local shocks but also sometimes monopolistic in their areas of competence. In this respect we try to model a model of spatial competition à la Hotelling. Then we investigate if the new measure of distance computed at local level may hamper efficiency. For robustness check we control also for local macro indicators like local GDP growth rate and macro-risk conditions.

**3. The theoretical Hotelling set-up**

The theoretical set-up is based on a standard Hotelling framework (see for example Wong and Chan, 1993). Consider a bank operating in two locations, A and B, that are identical in all exogenous attributes except market sizes. For parsimony, in the description n of the model, we focus on the A location with the understanding that the analogous conditions hold for the foreign one.

The industry is monopolistic competitive and each bank supplies a variety of a horizontally differentiated good using capital and labour as inputs. There is an infinite number of ex-ante identical potential entrants. In both markets (municipality), each entrant faces the same sunk entry cost – rental rate of capital and the wage of labour. In the model we add additional costs to reach far customers. In such a world we can define the marginal cost to enter a new market.

In each market we hypothesize that banks face downward sloping demands.

Given the hypothesis of CES function we solve a standard profit maximization problem to obtain the relative equilibrium prices as constant markups over marginal costs.

A similar problem has been solved to derive quantities in a duopoly model. In this paper we try to extend the model to quantify different prices in function of different distances given that the bank operates in two separate markets. The aim is to derive an index of market concentration at the local level. For further information on the hypothesis and development of the model see Brighi (2003).

## 4. Data set

Data are provided by the balance sheets of individual Italian banks submitted to the Bank of Italy and collected by the Italian Banking Association over the period 2006–09. An unbalanced panel of 2282 cooperative independent banks is used in the analysis. The coverage of our sample relative to the population of the whole Italian banking system is nearly 90 per cent, and it is quite stable over the analysed period (Table 1).

The panel is composed by several bank groups, being different with respect to size and juridical category. Banks are classified with respect to size, distinguishing between small, medium  and large banks. Thresholds are given by Bank of Italy and are based on the average amount of total intermediation assets. Then, small banks are defined as those with average total intermediation assets lower than 1.3 billion euros; medium banks are those with average total intermediation assets ranging between 1.3 and 9 billion euros; large banks comprise all banks with average total intermediation assets higher than 9 billion euros. As regards juridical category, banks are distinguished between mutual, cooperative & saving and other commercial banks. The mutual banks are considered separately, being strictly linked to the local market and with a greater degree of capitalization. The cooperative group is based on the Italian Banking Association classification. The saving group is identified by using the ACRI (Italian Association of Saving Banks) classification. The business model of the last two bank groups is very similar, thus they are jointly considered. The third group of the other commercial banks is obtained as a residual. In Table 3 the sample data coverage by size and category over time is reported.

Table 3 – Sample structure

| | 2006 | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|---|
| **Independent banks** | | | | | | |
| *by size:* | | | | | | |
| Large | 0 | 0 | 0 | 0 | 0 | 0 |
| Medium | 40 | 36 | 36 | 35 | 27 | 174 |
| Small | 423 | 435 | 431 | 419 | 400 | 2,108 |
| *by juridical groups* | | | | | | |
| Mutual banks | 406 | 415 | 412 | 401 | 360 | 1,634 |
| Other commercial banks | 31 | 28 | 28 | 26 | 26 | 139 |
| Cooperative & Saving | 26 | 28 | 27 | 27 | 41 | 149 |
| Total unbalanced sample | 463 | 471 | 467 | 454 | 427 | 2,282 |
| Total sample over total national system | 91% | 93% | 94% | 93% | 89% | 92% |

In the analysis data on macro environmental variables, over the period 2006-10, affecting banks efficiency are also used. Information on GDP at the provincial level are provided by Istituto Tagliacarne; ISTAT offers data on the number of provincial default and registered firms. The number of branches (referred to each bank at the municipal level) are taken from the Bank of Italy, as well as a measure of credit risk (defined as the ratio of the flow of new-performing loans on the stock of performing loans at the end of the previous period).

We estimate cost and profit efficiency models using a stochastic frontier approach. We further investigate factors affecting bank efficiency in order to assess the importance of any (in)efficiency determinants. The inefficiency is specified as a function of some key variables – functional distance, local degree of concentration and diversification; internal balance-sheet based risk factors and environmental factors within a bank and over time.

**5. The empirical model**

Evaluating the efficiency of a bank involves a comparison between actual and optimal values. In particular, it is concerned with the comparison between observed outputs and maximum potential outputs obtained from given inputs; or observed inputs and minimum potential inputs to produce a given amount of outputs. It is also possible to define efficiency in terms of behavioural goals, where efficiency is measured by comparing observed and optimal costs and profits, leading to cost and profit efficiencies respectively.

In this paper, for measuring the cost efficiency of Italian banks, we use the SFA approach (Battese and Coelli, 1995). This model incorporates the estimation of cost function and the determinants of efficiency at the same time, by parameterizing the mean of the efficiency term as a function of exogenous variables.

As for the cost function we consider:

(1) $$\ln(TC_{it}) = X_{it}\beta + (V_{it} + U_{it}),$$

where $\ln(TC_{it})$ is the logarithm of total production cost for bank *i* at time *t*, X indicates the natural logarithm of input prices and output quantities, $\beta$ is a vector of unknown parameters to be estimated; the $V_{it}$ s are random variables that are assumed to be independent and identically distributed, $N(0;\sigma_V{}^2)$. The non-negative random variables, ($U_{it}$), which account for cost inefficiency, are assumed to be independently distributed, such that $U_{it}$ is the truncation (at zero) of the $N(\mu_{it};\sigma^2)$-distribution, where $\mu_{it}$ is a function of observable explanatory variables and unknown parameters, as defined below. We choose the truncated normal form because of the hypothesis that the market is competitive, that is, the greater proportion of the enterprises operate 'close' to efficiency. It is assumed that the $V_{it}$ s and $U_{it}$ s are independent random variables.

The parameters of the frontier production function are simultaneously estimated with those of the inefficiency model ($\beta$, $\delta$, $\sigma^2$, $\sigma^2{}_v$), in which the cost inefficiency effects are specified as a function of other variables:

(2) $$\mu_{it} = \delta_0 + \sum_{m=1}^{M} \delta_m \ln z_{mit}.$$

In the eq. 2 the *δs* are parameters to be estimated. A positive parameter value of $\delta_m$ implies that the mean inefficiency increases as the value of the *m*-input variable increases.

Maximum-likelihood estimates of the model parameters are obtained using the program, FRONTIER 4.1, written by Coelli (1996). The variance parameters are defined by $\sigma_S^2 = \sigma_V^2 + \sigma^2$ and $\gamma = \sigma^2 / \sigma_S^2$ originally recommended by Battese and Corra (1977). The log-likelihood function of this model is presented in the appendix of Battese and Coelli (1993). When the variance associated with the technical inefficiency effects converges toward zero (i.e. $\sigma^2 \rightarrow 0$) then the ratio parameter, γ, approaches zero. When the variance of the random error ($\sigma_V^2$) decreases in size, relative to the variance associated with the technical inefficiency effects, the value of *γ* approaches one.

The cost efficiency of a unit at a given period of time is defined as the ratio of the minimum cost to the observed cost needed to produce a given set of outputs. The technical efficiency of the *i*-unit in the year *t* is given by:

(3) $$CE_{it} = \exp(-U_{it}).$$

The cost efficiency of one unit lies between zero and one and is inversely related to the inefficiency effect.

Hypotheses about the nature of the inefficiency can be tested using the generalised likelihood ratio statistic (LR test), *λ*, given by:

(4) $$\lambda = -2\left[\ln(L(H_0)) - \ln(L(H_1))\right],$$

where $L(H_0)$ and $L(H_1)$ denote the value of the likelihood function under the null and alternative hypotheses, respectively. If the given null hypothesis is true, then $\lambda$ has approximately a Chi-square (or a mixed Chi-square) distribution. If the null hypothesis involves $\gamma = 0$, then the asymptotic distribution involves a mixed Chi-square distribution (Coelli, 1995).

**6. The cost function specification**

In the literature, the definition of bank inputs and outputs varies across studies. This study follows the so called value-added approach, originally proposed by Berger and Humphrey (1992). This approach asserts that all liabilities and assets of banks have some output characteristics, rather than categorizing them as either inputs or outputs only. The econometric models are specified for panel data, with both stochastic frontier cost function and inefficiency model. A flexible functional form as the translog production function is used:

$$\begin{aligned}
\ln(c_{it}) = \alpha + \sum_{k=1}^{3} \beta_k \ln q_{kit} + \sum_{p=1}^{3} \beta_p \ln(p_{pit}) + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln q_{jit} \ln q_{kit} + \\
\frac{1}{2}\sum_{m=1}^{3}\sum_{p=1}^{3} \beta_{mp} \ln(p_{mit}) \ln(p_{pit}) + \sum_{k=1}^{3}\sum_{p}^{3} \beta_{kp} \ln q_{kit} \ln p_{pit} + \beta_E \ln E_{it} + \\
\beta_t t + \beta_{t2} t^2 + (V_{it} + U_{it}).
\end{aligned} \tag{5}$$

where $\ln c_{it}$ is the natural logarithm of the operative cost of bank *i* in year *t*. Accordingly to the value-added approach and following (see among others Akhigbe and McNulty (2003), we consider three outputs, $\ln q_{kit}$ (*k=1, 2, 3*), that are: total net loans, retail deposits and fee-based financial services (i.e. non-interest income assets), respectively. $\ln p_{pit}$ (*p=1,2,3*) is the logarithm of three price, that are the price for wage rate for labour, the price of borrowed price of funds and the price of physical capital, respectively. We also consider a fixed input *E*, that is the equity capital defined at the bank level, controlling for differences in equity capital risk across banks. Banks with lower equity ratios are assumed to be more risky, in line with Mester (1996). The cost frontier may also shift over time according to the values of the parameters $\beta_t$ and $\beta_{t2}$. The conditions for ensuring that the cost function is linearly homogeneous in input price are:

$$\sum_{p=1}^{3}\beta_p = 1; \quad \sum_{m=1}^{3}\beta_{mp} = 0; \quad \sum_{k=1}^{3}\beta_{kp} = 0; \qquad (6)$$

To meet these homogeneity conditions, eq. (5) is transformed into a normalized function. Specifically, costs and input prices are normalized by the price of wage rate for labour ($p_1$). Then, the normalized cost function to be estimated is:

$$\ln(c_{it} / p_{1it}) = \alpha + \sum_{k=1}^{3} \beta_k \ln q_{kit} + \sum_{p=1}^{2} \beta_p \ln(p_{pit} / p_{1it}) + \frac{1}{2} \sum_{j=1}^{3} \sum_{k=1}^{3} \beta_{jk} \ln q_{jit} \ln q_{kit} +$$

$$\frac{1}{2} \sum_{m=1}^{2} \sum_{p=1}^{2} \beta_{mp} \ln(p_{mit} / p_{1it}) \ln(p_{pit} / p_{1it}) + \sum_{k=1}^{3} \sum_{p}^{2} \beta_{kp} \ln q_{kit} \ln(p_{pit} / p_{1it}) + \tag{7}$$

$$\beta_E \ln E_{it} + \beta_t t + \beta_{t2} t^2 + (V_{it} + U_{it}).$$

Table 4 reports some statistics of the input and output variables used in estimating the cost functions.

Table 4. Descriptive statistics of input and output variables

| Variable | Mutual | | |
|---|---|---|---|
| | ***Mean*** | ***Median*** | ***Std. Dev.*** |
| **Cost (Profit) (in thousand €)** | | | |
| Total cost (cit) | 5,663 | 4,003 | 160 |
| **Output Quantities (in thousand €)** | | | |
| Loans (q1) | 199,194 | 116,454 | 5,994 |
| Demand deposits (q2) | 130,434 | 84,739 | 3,925 |
| Other earning assets (q3) | 60,541 | 42,221 | 2,108 |
| Equity (E) | 31,696 | 20,643 | 866 |
| **Input prices** | | | |
| Price of labor (p1) | 48.348 | 47.323 | 0.303 |
| Price of funds (p2) | 0.021 | 0.011 | 0.000 |
| Price of fixed capital (p3) | 1.103 | 0.792 | 0.033 |

**3.4 What causes cost inefficiency?**

We further investigate factors affecting bank efficiency in order to assess the importance of any (in)efficiency determinants. In particular, the main aim of the analysis is to examine whether bank organizational structure – proxy by functional distance, size and income diversification – differently affect bank efficiency. In the inefficiency model we also consider risk variables and macro environmental factors, in order to control for bank heterogeneity.

Supposing that internal and environmental economies factors impact on bank efficiency, we propose a novel specification of the inefficiency model in which the means $\mu_{it}$, associated with the cost inefficiency of bank i at time t, are assumed to be specified as a function of three different sets of variables. The variables of interest are obviously related to business model strategy, depending on the bank branching diffusion degree (*HQ-DISTANCE*), its income diversification policy ($DIV_{REV}$) and its size (*SIZE*). Furthermore, to account for asset quality and the bank micro credit risk conditions, a second group of variables has been included: i) the loan-loss provisions over total net loans (*LLP*); ii) the traditional non-performing loans over total net loans ratio (*NPL*). Macro environmental effects are finally controlled by: i) the standard provincial *GDP* annual growth rate; ii) the provincial firm default rate; and iii) a macro non-performing loans rate.

Then the inefficiency model is specified as follows:

$$(8)\quad \mu_{it} = \delta_0 + \delta_{div} \ln DIV_{REV\,it} + \delta_{fd} \ln HQ - DISTANCE_{it} + \delta_{size} \ln SIZE_{it} + \delta_{llp} \ln LLP_{it} + \delta_{npl} \ln NPL_{it} + \delta_{gdp} \ln GDP\_RT_{it} + \delta_{dr} \ln DEF\_RT_{it} + \delta_{npli} \ln NPL\_INDEX_{it}$$

Following Alessandrini et al. (2009) a measure of functional distance (*HQ-DISTANCE*) between bank branches and its headquarter (HQ) at the municipal level is specified as follows:

$$(9)\; HQ - DISTANCE_i = \frac{\sum_{z_b=1}^{B_i} [Branches_{iz_b} \times \ln(1 + D_{iz_b})]}{\sum_{z_b=1}^{B_i} Branches_{z_b}},$$

where $z_b = 1, ..., \mathrm{B_i}$ are the municipalities where the *i*-bank has branches, with *i:1,..,I.* $D_{iz_b} = \sqrt{(X_{z_b} - X_{HQ_i})^2 + (Y_{z_b} - Y_{HQ_i})^2}$ is the Euclidean distance between the municipality $z_b$ where the branch is located and the municipality where the HQ of the *i*-bank is located ($HQ_i$). The *HQ-DISTANCE* is calculated in respect to municipalities where at least one branch is present, that is for almost 5,900 Italian municipalities.

Another important variable is made by the income diversification index that is specified as follows:

$$(10)\qquad DIV_{REV} = 1 - HHI_{REV}.$$

where: $HHI_{REV} = \left(\frac{NET}{NET + NII}\right)^2 + \left(\frac{NII}{NET + NII}\right)^2.$

Moreover all the macro-environmental variable are specified based on the following formula:

$$\text{(11)} \qquad \text{X\_INDEX}_i = \frac{\sum_j \frac{\text{branches}_{ij}}{\text{branches}_i} * (\text{X})_j}{\sum_j \text{p}_{ij}}$$

where X is alternatively the GDP growth rate, the firm default rate and the macro non-performance loans rate.

Descriptive statistics on this variable and on all the other regressors are reported in Table 5.

Table 5. Descriptive statistics of the inefficiency variables for mutual banks

| | Mutual | | |
|---|---|---|---|
| **Variable** | ***Mean*** | ***Median*** | ***Std. Dev.*** |
| ***Banking business model*** | | | |
| Functional distance (HQ-DISTANCE) | 1.421 | 1.623 | 0.015 |
| Income diversification (DIVREV) | 0.189 | 0.192 | 0.002 |
| Total assets (in thousand €) (SIZE) | 271,983 | 169,964 | 6,426 |
| ***Micro risk conditions*** | | | |
| Loan loss provisions/Total net loans (LLP) | 0.006 | 0.004 | 0.015 |
| Non performing loans/Total net loans (NPL) | 0.020 | 0.014 | 0.001 |
| ***Macro environmental conditions*** | | | |
| GDP growth rate (GDP) | 89.355 | 89.179 | 0.071 |
| Firm default rate (DEF_RT) | 2.670 | 2.610 | 0.042 |
| Macro NPL (NPL_ INDEX) | 28.481 | 4.000 | 1.030 |

## 7. Some preliminary results

In order to control for the inefficiency of the Italian banking system a stochastic frontier function and a inefficiency model are estimated, as proposed in eq. (8), for the cooperative sample and for the full sample of banks. Table 6 summarizes our main preliminary results. With respect to the banking business model, we find a negative and statistically significant relationship between *HQ-DISTANCE* and efficiency.

As $DIV_{REV}$ rises, the bank becomes more diversified and less concentrated, however our results suggest that the benefit of diversification doesn't outweigh the cost of *NII* volatility.

To better investigate the effects of banking business organization structure on the inefficiency, we also control for the *SIZE* effect. Our results evidence that efficiency gains due to the size are verified in the case of mutual banks but not for the full sample of banks.

As regards micro risk conditions, model estimates reveal a negative effects of *LLP* on mutual bank efficiency. The contrary holds for the full sample. In the case of the *NPL* variable the signs are coherent for the mutual and the full sample with the expected positive sign.

Finally, the main effects of environmental macro conditions on efficiency are controlled for. The per-capita value added growth rate (GDP) produces a positive effect on banking efficiency but it is not statistical significant. As expected, the macro risk variables negatively affect bank efficiency.

Table 6. Estimate results for the inefficiency model

| Variable | Mutual | Full |
|---|---|---|
| ***Banking business model*** | | |
| HQ-DISTANCE | 0.202 * | 0.086 * |
| $DIV_{REV}$ | 0.078 * | 0.188 * |
| SIZE | -0.314 * | 0.035 * |
| ***Micro risk conditions*** | | |
| LLP | 0.013 * | -0.098 * |
| NPL | 0.035 * | 0.088 * |
| ***Environmental macro conditions*** | | |
| GDP | -0.541 | -0.224 |
| DEF_RT | 0.056 * | 0.423 * |
| NPL_INDEX | 0.013 * | 0.018 * |
| CE_group | 0.83 | 0.77 |
| CE_pool | 0.82 | 0.73 |
| LL | 402.50 | -780.70 |
| Gamma | 0.58 | 0.50 |

p-value: * 0.05; ** 0.10.

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