# Risk, Regulation and Performance in Banking: Theory and Estimates for Italian Banks

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# Set-up

*Objective*

- Investigate the impact of variables related to local growth and riskiness upon the development of financial sector, making particular attention to the local institutions (CB's).

*Motivation*

- Italian CB's have an important role in the financing of households, artisans and small businesses, and are characterised by small size, self-governance, a very local attitude, and the "principle of mutuality".

*Contribution*

- Examine the production processes within banking, especially for CB's that operating a purely local level, and their role in stimulating economic growth.

# Chapter 1 - Introduction

- Provide a survey of the main models used in literature to estimate productive efficiency, with some emphasis on the analysis of banking;
- Analyze the parametric and nonparametric frontier models, their estimation problems and main differences;
- Highlight the importance in the banking sector of the multi-input multi-output nature of their production, the relevance of risk aversion, credit risk, and of environmental factors;

# Main Approaches to Estimate the Efficiency

Parametric Frontier Analysis

- Deterministic Frontier Model;
- Stochastic Frontier Model;

Non Parametric Frontier Analysis

- FDH model;
- DEA model;

# Stochastic Frontier Analysis

Aigner, Lovell & Schmidt (1977), Meeusen & van den Broeck (1977) and Battese & Corra (1977) proposed simultaneously the stochastic frontier model, also called "composite error model":

$$y = f(\beta; x)exp(v - u) \qquad \text{with } u \geq 0$$

- $y$ - output of firm;
- $x$ - vector of independent variables;
- $\beta$ - vector of unknown parameters;
- $u$ - inefficiency term associated with technical efficiency;
- $v$ - statistical noise;

# DEA-VRS Model

Banker, Charnes & Cooper (1984) propose DEA model, where the inputs are minimized to achieve the maximum output:

- $\theta^* = min\theta \qquad (1)$ s.t.
- $\sum_{j=1}^{i} \lambda_j x_{jn} \leq \theta x_{n0} \qquad n = 1, ..., m \qquad (1.1)$
- $\sum_{j=1}^{i} \lambda_j y_{jr} \geq y_{r0} \qquad r = 1, ..., s \qquad (1.2)$
- $\sum_{j=1}^{i} \lambda_j = 1 \qquad j = 1, ..., i \qquad (1.3)$
- $\lambda_j \geq 0 \qquad j = 1, ..., i \qquad (1.4)$

where

- $x_{n0}$ *nth* input for $bank_0$;
- $y_{r0}$ *rth* output for $bank_0$;

Two cases

- $\theta^* < 1$ - $bank_0$ is inefficient (doesn't lie on the frontier);
- $\theta^* = 1$ - $bank_0$ is efficient (lies on the frontier);

# Main Assumptions for DEA-VRS Model

- Free disposability (from input and output sides).
- Convexity:

$$\forall \quad (x_i, y_i) \quad \text{and} \quad (x_j, y_j) \in Z_{BCC}(Z^o)$$
$$\forall \quad 0 \leq \lambda \leq 1, \binom{x}{y} = \lambda\binom{x_i}{y_i} + (1-\lambda)\binom{x_j}{y_j} \in Z_{BCC}(Z^o).$$

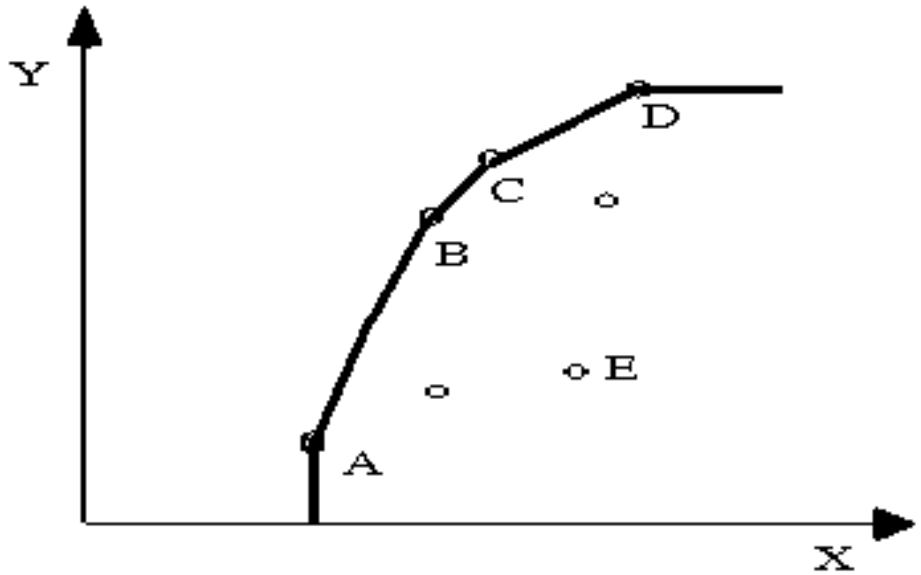


Figure: The Frontier in the DEA-VRS model.

# Parametric vs Non-Parametric Method

Advantages of Non-Parametric Method

- No require the building of a theoretical production frontier.
- No decomposition of composite error, made up by $u$ and $v$.

Disadvantages of Non-Parametric Method

- Sensitive to the presence of outliers.
- No testing the significance of the impact of exogenous factors.
- Define, a priori, the direction of exogenous factors.

Advantages of Parametric Method

- No sensitive to the presence of outliers.
- Test the intensity of the impact of exogenous factors.

Disadvantages of Parametric Method

- Require the building of a theoretical production frontier.
- Assumption about the distribution of $u$.
- Decompose the composite error, made up by $u$ and $v$.

# Value Added, Asset and Modified Production Approaches

| Approaches | Outputs | Inputs |
|---|---|---|
| Value Added Approach (Goldschmidt, 1981) | Customer Deposits<br>Customer Loans<br>Securities (bank loans, Treasury bills and similar securities, bonds and other debt minus bonds and debt securities held by banks and other financial institutions)<br>Other Services (Fees and other operating incomes) | Physical Capital<br>Labour |
| Asset Approach (Sealey and Lindley, 1997) | Customer Loans<br>Securities (bank loans, Treasury bills and similar securities, bonds and other debt minus bonds and debt securities held by banks<br>Other Services (Fees and other operating incomes) | Physical Capital<br>Labour<br>Funds (customer deposits, bank debts, bonds, certificates of deposit and other securities. |
| Modified Production Approach (Berger and Humphrey, 1991) | Customer Loans<br>Customer Deposits<br>Securities (bank loans, Treasury bills and similar securities, bonds and other debt minus bonds and debt securities held by banks and other financial institutions)<br>Other Services (Fees and other operating incomes) | Physical Capital<br>Labour<br>Funds(customer deposits bank debts, bonds, certificates of deposits and other securities) |

# Chapter 2 - Introduction

- Test the nexus between financial development and economic growth relying upon territorially disaggregated data (NUTS3 and SLL) from Italy;
- Use cost and profit efficiency measures, computed through a parametric approach (SFA), as qualitative measures of financial development, and credit volume divided by gross domestic product as its quantitative measure;
- A key element of novelty is the interaction between banking and national accounting at a territorially very disaggregated level;

# Performance within Banking

- Efficiency analysis determines, by calculating the optimal distance from the frontier, the scores that give rise to the efficiency ranking of reference.
- Many studies dealing with estimating cost (e.g. Kwan & Eisenbeis, 1996; Berger & DeYoung, 1997; Kumbhakar & Sarkar, 2003; Williams et al., 2004; Altunbas et al., 2007) and profit efficiency (Berger & Bonaccorsi di Patti, 2006) using parametric method.
- Other works assess both types of efficiency (Giordano & Lopes, 2006; Pasiouras et al., 2009; Battaglia et al., 2010; Fiordelisi et al., 2011)

# Financial Development and Growth

- Financial development predicts, optimally, growth (King & Levine 1993a, 1993b; Jayaratne & Strahan, 1996; Demirguc-Kunt & Maksimovic, 1998; Levine et al., 2002; Rajan and Zingales, 1998), also having an impact on the phases of growth (Bekaert et al., 2001; Levine & Zervos, 1998).
- Economic growth goes to financial development (Gurley & Shaw, 1967; Goldsmith, 1969; Jung, 1986);
- The causal direction leads by two-way (Demetriades & Hussein, 1996; Blackburn & Huang, 1998; Khan, 2001; Shan et al., 2001);
- Most studies use different environmental indicators associated with the level of financial sector development (Dietsch & Lozano - Vivas, 2000; Fries & Taci, 2005; Bonin et al., 2005; Hasan et al., 2009).

# A Canonical Form of Stochastic Frontier

Battese & Coelli (1995) model:

$$y_{it} = f(x_{it}\beta)exp(v_{it} \pm u_{it})$$

- $y_{it}$ (natural log of) total cost or profit of bank i at time t;
- $x_{it}$ - vector of explanatory variables (output quantities, input and output prices);
- $\beta$ - vector of unknown parameters;
- $v_{it}$ - random variables assumed to be i.i.d. $N(0, \sigma_v^2)$;
- $u_{it}$ - non-negative random variables measuring inefficiency obtained from the truncation to zero of the distribution $N(m_{it}, \sigma_u^2)$ where $m_{it} = z_{it} * \delta$;
- $z_{it}$ - vector of determinants of (profit or cost) efficiency of bank i at time t;
- $\delta$ a vector of unknown coefficients;

# Translog Functional Form

Translog specification:

$$lnY = \alpha_0 + \sum_{i=1}^{3} \alpha_i lny_i + \sum_{i=1}^{3} \beta_i lnw_i + \tau_1 T + \frac{1}{2}[\sum_{i=1}^{3}\sum_{j=1}^{3} \delta_i lny_i lny_j + \sum_{i=1}^{3}\sum_{j=1}^{3} \gamma_{ij} lnw_i lnw_j + \theta_{11} T^2] + \sum_{i=1}^{3}\sum_{j=1}^{3} \rho_{ij} lny_i lnw_j + \sum_{j=1}^{3} \varphi_i T lny_i + \sum_{i=1}^{3}\sum_{i=1}^{3} \vartheta_i T lnw_i + \epsilon$$

- $lnY$ - natural logarithm of total cost and profit, alternatively;
- $y_i$ $(i = 1, 2, 3)$ - output quantities;
- $w_j$ $(j = 1, 2, 3)$ - input prices;
- $T$ - time trend;
- $\epsilon = u_c + v_c$ - composite error;
- $\alpha, \beta, \tau, \delta, \gamma, \theta, \rho, \varphi, \vartheta$ - parameters to be estimated;

# Linear Homogeneity Assumption and Symmetry Conditions

Linear homogeneity in factor prices (for cost and profit frontier):

- $\sum_{j=1}^{3} \beta_i = 1$
- $\sum_{i=1}^{3} \gamma_{ij} = 0$
- $\sum_{j=1}^{3} \rho_{ij} = 0$

Symmetry conditions:

- $\delta_{ij} = \delta_{ji}$
- $\gamma_{ij} = \gamma_{ji}$

The linear restriction conditions allow ensuring "constant returns to scale".

# SFA and Growth Model

First Step: environmental factors, taken at NUTS3 and SLL level, are included in a single stage stochastic frontier:

- deposit density, capitalisation, credit risk, intermediation ratio, branch density, deposits per branch;

Second Step: examine the nexux between financial development and economic growth:

$$Y_{i,t} = a_1 * Y_{i,t-1} + a_2 * Y_{i,t-2} + b_1 * lnFV_{i,t} + b_2 * lnFQ_{i,t} + b_3 lnFV_{i,t} * lnFQ_{i,t} + b_4 * N_{i,t} + \eta_i + \tau_t + e_{i,t}$$

- $Y$ - rate of growth in GDP per worker;
- $FV$ (finance volume) - aggregate credit relative to GDP;
- $FQ$ (finance quantity) - cost or profit efficiency;
- $N$ - rate of growth in employment;
- $\eta$ - unobserved area-specific effects;
- $\tau$ - year dummies controlling for time-specific effects;
- $e$ - disturbance terms;

# Composition of the Sample

1. In order to compare the efficiency scores between minor (CB's) and small banks (PB's + COB's - popular and commercial banks) many observations are needed.
2. The information about the bank balance sheet are taken from ABI (Associazione Bancaria Italiana) over 1998-2008 (about banks for each year).
3. The results of the following tables are averages of the respective categories, took over the entire period available and differentiate for macro areas.

# Production Set

- OUTPUTS: customer loans, other services and securities.
- INPUTS: branches, workers, fundraising.
- COSTS: labour, physical and financial capital.
- TOTAL COST: personnel expenses, other administrative expenses, value adjustments to tangible and intangible assets and other operating expenses and interest expenses and similar charges and commission expenses.
- TOTAL PROFIT: difference between total revenue (interest and similar income on loans to costumers, interest and similar income on debt securities and services) and total cost.

# CE and PE stochastic frontier scores, NUTS3 and SLL level - 1998-2005

| | NUTS3 | | | | SLL | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| | **North** | | | | **North** | | | |
| **All** | | | | | | | | |
| CE | 0,95 | 0,06 | 0,34 | 0,99 | 0,94 | 0,06 | 0,32 | 0,99 |
| PE | 0,51 | 0,14 | 0,10 | 0,96 | 0,5 | 0,14 | 0,10 | 0,96 |
| **Others** | | | | | | | | |
| CE | 0,96 | 0,04 | 0,62 | 0,98 | 0,88 | 0,04 | 0,6 | 0,98 |
| PE | 0,45 | 0,21 | 0,09 | 0,95 | 0,45 | 0,21 | 0,09 | 0,95 |
| **CB's** | | | | | | | | |
| CE | 0,97 | 0,07 | 0,43 | 0,99 | 0,95 | 0,07 | 0,41 | 0,99 |
| PE | 0,52 | 0,18 | 0,11 | 0,97 | 0,48 | 0,18 | 0,11 | 0,97 |
| | **Centre** | | | | **Centre** | | | |
| **All** | | | | | | | | |
| CE | 0,95 | 0,07 | 0,29 | 0,98 | 0,94 | 0,07 | 0,59 | 0,98 |
| PE | 0,52 | 0,19 | 0,11 | 0,94 | 0,5 | 0,19 | 0,11 | 0,94 |
| **Others** | | | | | | | | |
| CE | 0,93 | 0,04 | 0,62 | 0,98 | 0,92 | 0,05 | 0,4 | 0,98 |
| PE | 0,49 | 0,18 | 0,12 | 0,92 | 0,47 | 0,18 | 0,12 | 0,92 |
| **CB's** | | | | | | | | |
| CE | 0,96 | 0,08 | 0,4 | 0,98 | 0,95 | 0,08 | 0,37 | 0,98 |
| PE | 0,51 | 0,19 | 0,12 | 0,96 | 0,49 | 0,19 | 0,12 | 0,96 |
| | **South** | | | | **South** | | | |
| **All** | | | | | | | | |
| CE | 0,94 | 0,06 | 0,3 | 0,98 | 0,92 | 0,07 | 0,28 | 0,98 |
| PE | 0,54 | 0,19 | 0,1 | 0,94 | 0,51 | 0,19 | 0,1 | 0,94 |
| **Others** | | | | | | | | |
| CE | 0,94 | 0,07 | 0,46 | 0,98 | 0,93 | 0,09 | 0,41 | 0,98 |
| PE | 0,51 | 0,18 | 0,1 | 0,93 | 0,5 | 0,18 | 0,1 | 0,93 |
| **CB's** | | | | | | | | |
| CE | 0,95 | 0,08 | 0,41 | 0,99 | 0,94 | 0,05 | 0,38 | 0,99 |
| PE | 0,57 | 0,19 | 0,1 | 0,95 | 0,56 | 0,19 | 0,1 | 0,95 |

# CE and PE stochastic frontier scores, NUTS3 and SLL level - 1998-2008

| | NUTS3 | | | | SLL | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| | North | | | | North | | | |
| All | | | | | | | | |
| CE | 0,94 | 0,07 | 0,33 | 0,99 | 0,93 | 0,08 | 0,25 | 0,99 |
| PE | 0,53 | 0,16 | 0,10 | 0,99 | 0,52 | 0,16 | 0,10 | 0,99 |
| Others | | | | | | | | |
| CE | 0,96 | 0,02 | 0,72 | 0,99 | 0,95 | 0,02 | 0,79 | 0,98 |
| PE | 0,57 | 0,13 | 0,09 | 0,91 | 0,58 | 0,13 | 0,12 | 0,92 |
| CB's | | | | | | | | |
| CE | 0,91 | 0,10 | 0,33 | 0,99 | 0,90 | 0,11 | 0,25 | 0,99 |
| PE | 0,44 | 0,18 | 0,11 | 0,99 | 0,43 | 0,19 | 0,09 | 0,99 |
| | Centre | | | | Centre | | | |
| All | | | | | | | | |
| CE | 0,93 | 0,08 | 0,21 | 0,98 | 0,93 | 0,06 | 0,54 | 0,98 |
| PE | 0,47 | 0,19 | 0,12 | 0,99 | 0,48 | 0,18 | 0,18 | 0,98 |
| Others | | | | | | | | |
| CE | 0,95 | 0,04 | 0,61 | 0,98 | 0,94 | 0,05 | 0,54 | 0,98 |
| PE | 0,48 | 0,17 | 0,11 | 0,91 | 0,49 | 0,17 | 0,18 | 0,91 |
| CB's | | | | | | | | |
| CE | 0,89 | 0,11 | 0,21 | 0,98 | 0,90 | 0,06 | 0,55 | 0,98 |
| PE | 0,44 | 0,22 | 0,14 | 0,99 | 0,46 | 0,18 | 0,18 | 0,98 |
| | South | | | | South | | | |
| All | | | | | | | | |
| CE | 0,92 | 0,06 | 0,30 | 0,99 | 0,90 | 0,08 | 0,28 | 0,99 |
| PE | 0,46 | 0,22 | 0,14 | 0,99 | 0,43 | 0,23 | 0,12 | 0,99 |
| Others | | | | | | | | |
| CE | 0,92 | 0,05 | 0,43 | 0,99 | 0,91 | 0,07 | 0,39 | 0,99 |
| PE | 0,48 | 0,21 | 0,12 | 0,94 | 0,47 | 0,22 | 0,14 | 0,95 |
| CB's | | | | | | | | |
| CE | 0,90 | 0,08 | 0,30 | 0,99 | 0,89 | 0,09 | 0,28 | 0,98 |
| PE | 0,38 | 0,24 | 0,13 | 0,99 | 0,36 | 0,24 | 0,12 | 0,99 |

# GMM, 1998-2005, NUTS3 and SLL

| NUTS3 Models | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|---|---|---|---|---|---|---|---|
| $Y_{i,t-1}$ | 1,00*** | 1,10*** | 0,96*** | 1,00*** | 0,96*** | 0,68*** | 0,76*** |
| $Y_{i,t-2}$ | -0,18** | -0,18** | -0,05 | -0,13** | -0,13** | 0,12*** | 0,13*** |
| $lnFV$ | 0.03** | | | 0.03*** | 0,04*** | 0,02*** | 0,01*** |
| $lnCE$ | | 0,03** | | 0,11** | | 0,13*** | |
| $lnPE$ | | | 0.06** | | 0.05*** | | 0,04*** |
| $lnFV * lnCE$ | | | | | | -0,10** | |
| $lnFV * lnPE$ | | | | | | | -0,06*** |
| $N_{i,t}$ | -0,16 | -0,1 | -0,13 | -0,13** | -0,05* | 0,12 | 0,13 |
| n | 1889 | 1889 | 1889 | 1889 | 1889 | 1889 | 1889 |
| Sargan | 0,03 | 0,62 | 0,6 | 0,02 | 0,22 | 0,02 | 0,06 |
| AR(3) | 0,01 | 0,18 | 0,34 | 0 | 0,33 | 0,09 | 0,13 |
| SLL Models | B1 | B2 | B3 | B4 | B5 | B6 | B7 |
| $Y_{i,t-1}$ | 0,48*** | 0,89*** | 0,91*** | 0,68*** | 0,84*** | 0,82*** | 0,81*** |
| $Y_{i,t-2}$ | 0,47*** | 0,03 | 0,02 | 0,23*** | 0,11 | 0,11* | 0,14** |
| $lnFV$ | 0.05** | | | 0.09*** | 0,02** | 0,03** | 0,10** |
| $lnCE$ | | 0,02** | | 0,02** | | 0,13*** | |
| $lnPE$ | | | 0.03** | | 0.06** | | 0,08*** |
| $lnFV * lnCE$ | | | | | | 0,02* | |
| $lnFV * lnPE$ | | | | | | | 0,07*** |
| $N_{i,t}$ | -0,06 | -0,11 | -0,09 | -0,11* | -0,05* | 0,08 | 0,11 |
| n | 2945 | 2945 | 2945 | 2945 | 2945 | 2945 | 2945 |
| Sargan | 0,05 | 0,92 | 0,92 | 0,20 | 0,13 | 0,01 | 0,07 |
| AR(3) | 0,01 | 0,47 | 0,47 | 0,20 | 0,13 | 0,08 | 0,07 |

# GMM, 1998-2008, NUTS3 and SLL

| NUTS3 Models | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|
| $Y_{i,t-1}$ | 0,91*** | 0,92*** | 0,67*** | 1,00*** | 0,76*** | 1,09*** | 0,81*** |
| $Y_{i,t-2}$ | 0,06 | -0,07 | 0,15** | -0,08** | 0,13** | -0,12*** | 0,12*** |
| $lnFV$ | 0.03* | | | 0,01* | 0,02* | 0,02* | 0,01 |
| $lnCE$ | | 0,09** | | 0,02 | | 0,07* | |
| $lnPE$ | | | 0.07** | | 0.05** | | 0,04** |
| $lnFV * lnCE$ | | | | | | 0,02 | |
| $lnFV * lnPE$ | | | | | | | -0,03*** |
| $N_{i,t}$ | 0,05 | -0,04 | -0,01 | 0,03 | -0,03* | 0,10** | 0,03* |
| n | 2012 | 2012 | 2012 | 2012 | 2012 | 2012 | 2012 |
| Sargan | 0,02 | 0,35 | 0,86 | 0,02 | 0,11 | 0,03 | 0,08 |
| AR(3) | 0,03 | 0,32 | 0 | 0,28 | 0,32 | 0,01 | 0 |

| SLL Models | D1 | D2 | D3 | D4 | D5 | D6 | D7 |
|---|---|---|---|---|---|---|---|
| $Y_{i,t-1}$ | 0,52*** | 0,83*** | 0,88*** | 0,74*** | 0,67*** | 0,66*** | 0,83*** |
| $Y_{i,t-2}$ | 0,43*** | 0,10 | 0,06 | 0,19** | 0,28** | 0,28*** | 0,13*** |
| $lnFV$ | 0.05** | | | 0.01* | 0,02** | -0,02* | 0,02* |
| $lnCE$ | | 0,02* | | 0,03 | | -0,03* | |
| $lnPE$ | | | -0,01 | | -0.01* | | -0,02** |
| $lnFV * lnCE$ | | | | | | 0,01* | |
| $lnFV * lnPE$ | | | | | | | 0,01* |
| $N_{i,t}$ | -0,16 | -0,11 | -0,13 | -0,04 | -0,05* | 0,01 | -0,01 |
| n | 3396 | 3396 | 3396 | 3396 | 3396 | 3396 | 3396 |
| Sargan | 0,08 | 0,73 | 0,73 | 0,01 | 0,30 | 0,03 | 0,08 |
| AR(3) | 0,73 | 0,84 | 0,26 | 0,90 | 0,03 | 0,90 | 0,01 |

# Empirical Evidence

- CB's achieve lower cost and profit efficiency if the sample includes the financial crisis. So, in the wake of the crisis, they have been strongly penalized by the "principle of mutuality".
- Financial development has indeed some (positive) significant impact on GDP per capita.
- The quantitative (finance volume) proxy turns up almost invariably with a positive and significant coefficient.
- The performance of the model deteriorates if we take into account the full 1998-2008 period.
- A puzzling feature of our estimates, not easily explained is also that the interaction between qualitative and quantitative proxies of financial development has very often a negative sign.

# Chapter 3 - Introduction

- Analyze the determination of cost efficiency in a sample of Italian small banks located in different geographical areas and including two great institutional categories: cooperative banks (CB's) and other banks.
- Investigate the relationship between environment, risk and regulation.
- Study the impact of local variable upon bank efficiency.

# Cooperative Banks in the Italian Banking Landscape: The Main Features

In Italy there are approximately 430 CB's with 3600's branches (about 11% of the total of all branches, 6.6% total loans, 8.3% of total deposits). These banks are characterized by small self-governace, an attitude very local and principle of mutuality (activity mainly based in favor of shareholders). The Testo Unico Bancario (1983) requires that CB's must:

1. devote at least 70% of annual net profits to legal reserve.
2. devote an amount equal to 3% of annual net profits to mutual funds for the promotion and development of cooperation.
3. devote to purposes of charity or mutual aid, the remaining share of profits.

According to the "area of territorial competence", CB's can provide loans within a given area (determined by "Supervisory Instructions" of the Bank of Italy). This feature greatly hampers any move to territorial diversification.

# Banking, Risk and Regulation

"Risk" and "Regulation" play an important role within the banking system (*Rossi et al., 2009*).

- Regulation and property forms have always played a powerful role in shaping the analysis of the determinants of bank efficiency.
- Generally, regulation is associated with the treatment of risk and of risk management within the production process of banks.
- In particular, a higher level of equity (or capitalisation) reduces insolvency risk (or credit risk), urging risk-averse managers to rely upon a equity.
- If bank managers are not risk neutral, their degree of risk aversion is likely to affect, in a stochastic environment, their choices about the production set.

# Development in the Analysis 1

The combination of inputs and outputs allows to reach the efficient frontier.

- The outputs are exogenuos?
- What we put in the vector of inputs and outputs for banks to reach the efficient frontier? Asset approach: the deposits are an input used to produce loans.
- How we find the efficient frontier? DEA-VRS (input oriented).
- Did we include in the set of all input and output relevant? Are we implementing a fair comparison? In the literature is well known that, in order to measure accurately bank efficiency, proper account must be taken for the role of output quality and risk aversion.

# Development in the Analysis 2

We should take into account some variables that can capture the "institutional characteristics" of small banks and the geographical location of deposits and loans (their specific values), such that:

1. Risk aversion (ratio between equity and total assets).
2. Quality asset (one minus the ratio between bad and total loans).
3. Local economic development, such as GDP per capita (from ISTAT SLL - Sistemi Locali del Lavoro).
4. Mean distance between a head office and a given branch (taken from the Bank of Italy's database of branches).

Except to Hasan et al. (2009), these factors have been used in works within - country comparisons for European countries.

# Models

| **Model** | *Model* ♯1 | *Model* ♯2 | *Model* ♯3 |
|---|---|---|---|
| *Inputs* | Physical Capital<br>Labour<br>Funds | "♯1" +<br>GDP per capita<br>(non - discre<br>tionary input) | "♯1" +<br>GDP per capita<br>(non - discre<br>tionary input)<br>Mean Distance<br>(discretionary input) |
| *Outputs* | Customer Loans<br>Securities<br>Other Services<br>Capitalisation<br>Asset Quality | "♯1" | "♯1" |

Table: The Empirical Models for DEA-VRS approach (2006-2008).

# Mean Efficiency Scores (2006-2008)

| CB's, One sample<br>Model with Asset Quality Indicator | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Model ♯1 | | | Model ♯2 | | | Model ♯3 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,7336 | 0,8497 | 0,6229 | 0,7477 | 0,8521 | 0,6367 | 0,7637 | 0,8358 | 0,6382 |
| North-East | 0,7790 | 0,8870 | 0,6906 | 0,7957 | 0,8909 | 0,7086 | 0,8178 | 0,8683 | 0,7101 |
| Centre | 0,6710 | 0,8731 | 0,5853 | 0,7016 | 0,8683 | 0,6088 | 0,7141 | 0,8545 | 0,6101 |
| South | 0,6452 | 0,8160 | 0,5266 | 0,7310 | 0,8198 | 0,5992 | 0,7390 | 0,8106 | 0,5991 |
| Other Banks, One sample<br>Model with Asset Quality Indicator | | | | | | | | | |
| | Model ♯1 | | | Model ♯2 | | | Model ♯3 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,8176 | 0,8224 | 0,6729 | 0,8242 | 0,8251 | 0,6805 | 0,8509 | 0,8006 | 0,6818 |
| North-East | 0,8864 | 0,8407 | 0,7458 | 0,8929 | 0,8466 | 0,7565 | 0,9037 | 0,8367 | 0,7566 |
| Centre | 0,7794 | 0,7680 | 0,5992 | 0,8054 | 0,7695 | 0,6204 | 0,8193 | 0,7564 | 0,6206 |
| South | 0,7687 | 0,7558 | 0,5809 | 0,8140 | 0,7586 | 0,6176 | 0,8196 | 0,7538 | 0,6180 |
| CB's, Two sample<br>Model with Asset Quality Indicator | | | | | | | | | |
| | Model ♯1 | | | Model ♯2 | | | Model ♯3 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,8384 | 0,9452 | 0,7925 | 0,8418 | 0,9469 | 0,7971 | 0,8479 | 0,9398 | 0,7969 |
| North-East | 0,8612 | 0,9504 | 0,8185 | 0,8684 | 0,9545 | 0,8290 | 0,8820 | 0,9404 | 0,8294 |
| Centre | 0,8168 | 0,9483 | 0,7746 | 0,8255 | 0,9506 | 0,7847 | 0,8307 | 0,9446 | 0,7847 |
| South | 0,8346 | 0,9118 | 0,7612 | 0,8743 | 0,9218 | 0,8060 | 0,8765 | 0,9181 | 0,8047 |
| Other Banks, Two sample<br>Model with Asset Quality Indicator | | | | | | | | | |
| | Model ♯1 | | | Model ♯2 | | | Model ♯3 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,8494 | 0,7979 | 0,6777 | 0,8643 | 0,8031 | 0,6945 | 0,8881 | 0,7899 | 0,6933 |
| North-East | 0,9050 | 0,8266 | 0,7485 | 0,9147 | 0,8406 | 0,7697 | 0,9194 | 0,8317 | 0,7651 |
| Centre | 0,8197 | 0,7333 | 0,6013 | 0,8494 | 0,7547 | 0,6415 | 0,8534 | 0,7428 | 0,6340 |
| South | 0,7941 | 0,7398 | 0,5873 | 0,8470 | 0,7710 | 0,6531 | 0,8498 | 0,7619 | 0,6474 |

# Mean Efficiency Scores (1994-2008)

| CB's, One sample<br>Model with Asset Quality Indicator | | | | | | |
|---|---|---|---|---|---|---|
| | Model ♯1 | | | Model ♯2 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,71 | 0,8261 | 0,5993 | 0,7241 | 0,8285 | 0,6131 |
| North-East | 0,7554 | 0,8634 | 0,667 | 0,7721 | 0,8673 | 0,685 |
| Centre | 0,6474 | 0,8495 | 0,5617 | 0,678 | 0,8447 | 0,5852 |
| South | 0,6216 | 0,7924 | 0,503 | 0,7074 | 0,7962 | 0,5756 |
| Other Banks, One sample<br>Model with Asset Quality Indicator | | | | | | |
| | Model ♯1 | | | Model ♯2 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,794 | 0,7988 | 0,6493 | 0,7979 | 0,7988 | 0,6542 |
| North-East | 0,8628 | 0,8171 | 0,7222 | 0,8666 | 0,8203 | 0,7302 |
| Centre | 0,7558 | 0,7444 | 0,5756 | 0,7791 | 0,7432 | 0,5941 |
| South | 0,7451 | 0,7322 | 0,5573 | 0,7877 | 0,7323 | 0,5913 |
| CB's, Two sample<br>Model with Asset Quality Indicator | | | | | | |
| | Model ♯1 | | | Model ♯2 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,8248 | 0,9316 | 0,7789 | 0,8258 | 0,9309 | 0,7811 |
| North-East | 0,8476 | 0,9368 | 0,8049 | 0,8524 | 0,9385 | 0,813 |
| Centre | 0,8032 | 0,9347 | 0,761 | 0,8095 | 0,9346 | 0,7687 |
| South | 0,821 | 0,8982 | 0,7476 | 0,8583 | 0,9058 | 0,79 |
| Other Banks, Two sample<br>Model with Asset Quality Indicator | | | | | | |
| | Model ♯1 | | | Model ♯2 | | |
| | Tech. | Alloc. | Cost | Tech. | Alloc. | Cost |
| North-West | 0,8358 | 0,7843 | 0,6641 | 0,848 | 0,7868 | 0,6782 |
| North-East | 0,8914 | 0,813 | 0,7349 | 0,8984 | 0,8243 | 0,7534 |
| Centre | 0,8061 | 0,7197 | 0,5877 | 0,8331 | 0,7384 | 0,6252 |
| South | 0,7805 | 0,7262 | 0,5737 | 0,8307 | 0,7547 | 0,6368 |

# Concluding Remarks

- Comparing the models, local shocks affect technical efficiency differentials especially in the "One Sample".
- There is a strong linkage between the local financial sector and economic growth.
- The environmental factors cancel differentials efficiency among Northern and Southern banks. So there exists a strong endogeneity of bank performance on indicators.
- CB's are penalized in the territorial diversification due to the "territorial competence policy", causing a cost to (missing) diversification.
- However, CB's gain between 2% and 7% in term of technical efficiency (One Sample) in the "Model ♯3" than Other banks.

THANKS FOR YOUR ATTENTION