

## *1. Introduction*

The empirical literature of bankruptcy prediction gained further momentum and attention from financial institutions after academicians and practitioners realised that the problem of asymmetric information between banks and firms lies at the heart of an important market failure such as credit rationing and that the improvement in monitoring technologies represents a valuable alternative to any incomplete contractual arrangement aimed at reducing borrowers' moral hazard (Stiglitz-Weiss, 1981, 1986 and 1992; De Meza-Webb, 1987; Milde-Riley, 1989).

Among the three existing approaches to the problem (accounting analytical approach, option theoretical approach and statistical approach),<sup>1</sup> the statistical approach tries to assess corporate failure risk through four widely known methods that make use of balance-sheet-based ratios: linear or quadratic discriminant analysis, logistic regression analysis, probit regression analysis and neural network analysis.

Empirical studies which adopt the statistical approach aim to classify correctly a sample of firms into one of two pre-established categories (sound or unsound firms) on the basis of selected balance sheet data used in levels or in trends. After the pioneeristic research of Altman (1968) and Beaver (1966), relevant results in this field have been reached by Frydman, Altmann and Kao (1985) and Gentry, Shaw and Whitford (1991). Examples of empirical analyses on Italian data in this field are Altmann et al. (1994), Laviola and Trapanese (1997), Appetiti (1984); Varetto, (1990), Barontini (1992), Foglia et al. (1998).

The marginal contribution of our paper to this literature goes in three directions: i) a wider test of non balance sheet data available by questionnaire (such as market share, customers' concen-

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<sup>1</sup> The accounting analytical approach is mainly followed by rating agencies. For recent applications of the structural or reduced form option approach see Nickell, Perraudin and Varotto (2000) and Duffie and Lando (1998).

tration, strength of local competitors and others) as factors potentially affecting bankruptcy risk<sup>2</sup>; ii) the adoption of an unbalanced sample in which the two subgroups of sound and unsound firms are exogenously selected and not built by the same researcher investigating on bankruptcy risk; iii) the use of the distance from the "productive frontier" as a determinant of bankruptcy risk to test whether remoteness from the "best practice" has some predictive power on the probability of failure.

The paper is divided into six sections including introduction and conclusions. In the second section we describe our database and outline the methodology adopted to classify sound and unsound firms. In the third and fourth section we respectively present descriptive and econometric evidence on the determinants of bankruptcy from a logit analysis. In the fifth section we outline the stochastic frontier approach and comment the results obtained with this method.

## 2. *Sample features and the definition of variables used for the empirical analysis*

The database used in our empirical analysis is made of three different Mediocredito Centrale Surveys covering respectively the 1989-91, the 1992-94 and the 1995-1997 period.<sup>3</sup> The sample is

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<sup>2</sup> To this point Zavgren (1985) affirms that "any econometric model containing only financial statement information will not predict accurately the failure or non failure of a firm", while Keasey and Watson (1987) conclude that their results "indicate that marginally better predictions, concerning small company failure may be obtained from non-financial data as compared to those which can be achieved from using traditional financial ratios". Among the few authors using qualitative variables, Fisher (1981) identifies permanent and transitory information on sample firms from qualitative and socio-political data and Keasey and Watson (1987) evaluate the impact of qualified audit on the probability of failure.

<sup>3</sup> Significant attrition among the three different waves of the Survey prevented the creation of a large panel. While each three-year sample includes around 4500 firms, only 800 firms participated to the last two Surveys and only 300 firms to

stratified by industry activity, geographical area and size<sup>4</sup> for firms from 10 to 500 employees. It is by Census for firms above 500 employees. Collected data are of two types: quantitative (balance-sheet data) and qualitative (questionnaire).

Sample firms are classified into three mutually exclusive categories: “*Failed*”, “*Active*” and “*Stressed*”. *Failed* enterprises<sup>5</sup> are those who ceased existing, while *Stressed* firms are those who underwent different kinds of intervention procedures (*procedure concorsuali*<sup>6</sup>) contemplated by the Italian law (composition with creditors, controlled administration, extraordinary administration, voluntary liquidation, forced liquidation, and winding-up). Firms which continue to operate without problems are classified as *Active*.<sup>7</sup> The relative share of these three groups on total sample is presented in Table 1.

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the three of them. This number falls down considerably in the estimates when we rule out observations with missing values. We therefore analyse the three waves as separate samples.

<sup>4</sup> Size and composition of the sample have been defined according to Neyman’s formula in order to minimise sample variance.

<sup>5</sup> The “*Failed*” status is defined on the basis of the information provided by CERVED s.p.a (the databank of the Federation of the Italian Chambers of Commerce). It is worth remarking that data available on firm failure may be underestimated since not all such cases are dutifully reported to the competent authority in order to avoid paying the fines established by Italian laws.

<sup>6</sup> The present and past legal status of any natural and legal person in Italy is reported to the Federation of Chambers of Commerce by means of *modello AN/6* (*modello CF* and *S3* currently). The range of such procedures includes: *fallimento*, *liquidazione*, *liquidazione coatta amministrativa*, *liquidazione giudiziarie*, *liquidazione volontaria*, *scioglimento*, *scioglimento e liquidazione*, *scioglimento senza messa in liquidazione*, *scioglimento anticipato senza messa in liquidazione*, *scioglimento per atto dell’Autorità*, *bancarotta fraudolenta*, *bancarotta semplice*, *concordato fallimentare*, *concordato preventivo*, *amministrazione giudiziaria*, *amministrazione controllata*, *amministrazione straordinaria*, *sequestro giudiziario*, and *sequestro conservativo di quote*.

<sup>7</sup> There is no consensus on financial and economic criteria defining firm failure. Beaver (1966) defines failure as a business defaulting on interest payments on its debt, overdrawing its bank account, or declaring bankruptcy. Blum (1969) considers failure as entrance into a bankruptcy proceeding on an explicit agreement

In all of the three waves the samples are numerically unbalanced toward active firms,<sup>8</sup> but with the advantage of being generated randomly and not for the specific purpose of the credit risk analysis. This is a relevant difference with many previous studies, *e.g.*, Beaver (1966), Altman (1968) and Barontini (1992), which have selected a certain number of sound and unsound firms to generate two rather reduced, homogeneous (same firm size and industry) and equally-sized groups (50% *sound*, 50% *unsound* firms), according to the balanced-sampling method.<sup>9</sup>

On the basis of the financial ratios successfully identified by past studies, 20 indices have been built by using balance-sheet data (Table 2).<sup>10</sup> These indices reflect six different aspects of firm structure and performance: liquidity, turnover, gearing, operating structure and efficiency, size and capitalisation, and, finally, profitability. The indices have been calculated as three-year, two-year and one-year average ratios.<sup>11</sup>

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with creditors in order to reduce company debts. Everett and Watson (1998) mention five alternative definitions of failure: discontinuance of ownership, discontinuance of the business, bankruptcy, prevention of further losses, and failure to 'make a go of it' (pp. 374-376). On this point see also Appetiti (1984) and Laviola and Trapanese (1997).

<sup>8</sup> A problem with unbalanced sampling is that the intercept (but not the regressors' coefficients) needs to be decreased by  $(\log p_1 - \log p_2)$  where  $p_1$  and  $p_2$  are respectively the proportion of unsound and sound firms (Maddala, 1992).

<sup>9</sup> On the differences and problems related to the sampling methodology and on the influence of "equal-sized matched samples" on results biases and classification accuracy see Zagrev (1985).

<sup>10</sup> In most of the empirical literature the selection criteria for regressors are based upon the choices of previous empirical studies (Zavgren, 1984; Skogsvik, 1988) or on a combination of these choices with theoretical a priori (Keasey-McGuinness, 1988; Keasey-Watson, 1987; Edminster, 1972; Lo, 1986).

<sup>11</sup> By analysing the existing empirical literature it is clear that there is not a definite index group that presents a high discriminant ability and forecasting power common to all previous studies. For this reason we agree with Edminster's (1972) assertion that "...Although some ratios were found to be good predictors in more than one study, no one group of ratios is common to the [four] studies.

Other indices, based not only on balance-sheet data, have been calculated to control for additional firm characteristics. These are market share (firm sales / industry sales), the strength and proximity of competitors,<sup>12</sup> export status, subcontracting status, group membership, size, location in a macroarea (South and Isles, Centre, North-West, North-East) and the share of sales to the first three customers (only for the 1995-1997 database).<sup>13</sup>

As an alternative to the static ratios, a three-year trend has been calculated for each of the selected indicators following the Edmister's methodology<sup>14</sup>. We in fact define trend as "three consecutive years in which the ratio moves in the same direction" and we generate up-trend dummy variables (with a value of 1 if the trend is positive and 0 otherwise) and down-trend dummy variables (with a value of 1 if the trend is negative and 0 otherwise). The up-trend and down-trend dummy variables are used alternatively to static indices as regressors in a dynamic specification of the logit estimation (Table 2).<sup>15</sup>

### 3. *Descriptive features of sound and unsound firms*

Two different definitions of "unsound" firms have been considered to define the dependent variable in our empirical analysis. A *weak definition of unsoundness* that includes both "*stressed*" and

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This implies that the discriminant functions can be applied reliably only to situations very similar to those from which the function was generated."

<sup>12</sup> This qualitative information was collected through managers' responses to the Mediocredito questionnaire.

<sup>13</sup> Some of these indices are based on those created by Nickell (1996).

<sup>14</sup> Appetiti (1984) instead, runs a regression on the indices' values for the three periods prior to the crisis and uses the coefficients (Betas) in order to substitute for the static ratios in the discriminant function.

<sup>15</sup> Estimates presented in the paper include outliers. Estimates with 95% cut-off for regressors have been alternatively performed without showing results which are significantly different from those shown in the paper. These are available from the authors upon request.

"failed" firms as defined in Section 2 and a *strong definition* which separately considers the two above mentioned categories. Average values for static (ratios) and dynamic (trends) indices are presented in an Appendix available from the authors upon request.

Descriptive results highlight the following interesting evidence: i) when we consider the *weak definition of unsoundness*, liquidity ratios are generally higher for active than for failed firms, while the pattern of liquidity variation is alternatively favorable to active (second period) and failed companies (first and third period); ii) turnover indices (and, specifically, sales to assets ratios) are higher for active firms. Assets to net worth ratios are higher for failed firms presumably because of their reduced capital resources (as it will be confirmed by other ratios in which the same item is implied), but variations of this index are generally more positive for active companies; iii) the gearing indices, in turn, display greater solvency for active firms, even though debts over the three-year periods examined have increased a bit more for these firms with respect to failed ones presumably reflecting higher creditworthiness; iv) the operating structure ratios indicate that active companies have a lower incidence of interest charges on sales and value added, and higher depreciation charges over gross fixed assets than failed ones. The analysis of trend indicators generally confirms this evidence; v) both size and capitalization indices and their three-year trends clearly reflect the superior growth of active versus failed firms; vi) the various profitability indices and trends emphasise the overall higher profitability of active enterprises; vii) finally, additional indices such as market share, competitors' location, share of sales to three biggest customers, return and operating risk significantly discriminate sound companies from stressed and failed ones, the latter having higher

operating risk, higher customers' concentration and higher local competitive pressure.<sup>16</sup>

#### 4. *The logistic analysis: specification and results*

As a first step in the determinants of bankruptcy risk, we use a maximum likelihood logistic approach. The dependent dichotomic variable stands for the probability of "firm failure", delimited by the [0,1] interval, and is represented by the dual "active/failed" enterprise state, according to the definitions explained in section 2. The model takes on the usual specification:

$$[1] \quad P(g_1 | X) = \exp(-Z) / (1 + \exp(-Z))$$

$$P(g_2 | X) = 1 / (1 + \exp(-Z))$$

where  $P(g_i/X)$  -  $i=1, 2, \dots, n$  - is the probability of pertaining to group  $i$  given a set of observed variables  $X$ , and  $Z$  is a linear combination of the set of  $X$ -variables:

$$[2] \quad Z = \mathbf{b}_0 + \mathbf{b}_1 X_1 + \mathbf{b}_2 X_2 + \dots + \mathbf{b}_n X_n.$$

The set of  $X$  -variables consists of 24 financial indices adopted to evaluate the strength of the firms' structure and performance (see Tab. 2).

The first model estimated use the ratios in levels (static approach) for the three waves (89-91, 92-94, 95-97). The second model, instead, incorporates the three-year trends of the ratios

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<sup>16</sup> It is interesting to note that mean ratios and trend values for stressed firms are not always contained in the range of the active and the failed firm value, as it might be expected. This may be due to the fact that once intervention procedures have been initiated, firms have a long way to go through the various steps of *procedure concorsuali* (see footnote 7) before being finally liquidated or set to operate again after financial restructuring, in a procedure which usually takes more than one year. During this period, the firm is often still operative and its various financial items are remarkably affected by the measures adopted in order to rehabilitate or to liquidate the enterprise.

(dynamic approach). In each case, the sector of economic activity has been controlled for in order to isolate idiosyncratic effects of a given industry. Two versions of each model have been run depending on the inclusion or not of qualitative information.<sup>17</sup>

Tables 3a and 3b report a synthesis of model results estimated with financial indices and trends, along with qualitative variables and industry controls.<sup>18</sup>

A first comparison of the most significant variables (Table 3a) shows that, in the case of the three-year model, only four ratios (earnings before taxes to total debt, net working capital to medium and long term debt, total debts to total assets, and operating profits to total assets) are significant in the expected direction in at least two periods. This suggests that indices of liquidity, gearing, and profitability have a predominant role in the assessment of the probability of failure in our samples. Five more indices of gearing (current liabilities to net worth), operating structure (interest charges to value added), size and capitalization (reserve to total assets) and profitability (current profit/loss to net worth, current profit/loss to sales) are significant in only one period and their signs fit the expectations. This confirms the heterogeneity of results across studies done in different period and in different countries already noted by Edmister (1972) and Barontini (1992), among others.<sup>19</sup>

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<sup>17</sup> Both, the static and the dynamic approach make use of the *weak* definition of unsoundness (see Section 3). The *strong* definition has not been used due to the small number of enterprises that fall into the two separate categories of "stressed" and "failed" firms (Tab. 1).

<sup>18</sup> Detailed results of logit estimates are displayed in the Appendix 1.

<sup>19</sup> Barontini (1992) tests on a balanced sample of 70 manufacturing firms the classificatory efficiency of more than 10 models, their transferability across time, and their sensitivity to changes in the cut-off point. He concludes that the performance of the models does not guarantee transferability given the highly cut-off sensitive high percentage of type I and type II errors.



By comparing the effects of regressors across different time periods we in fact find no common factors affecting the dependent variable in the two-year model, and only one common factor (interest charges/value added) in the one-year model. Several indices, however, have common effects with the expected sign in at least two periods.<sup>20</sup>

If we consider differences in macroeconomic scenarios across the three waves and evaluate them in the light of theory and empirical findings of the credit view (Gertler et al., 1990; Kashyap et al., 1993), we may consider part of sample specificity as depending on changes in the monetary policy stance. In fact, the public debt and currency crisis occurred in Italy in 1992 generated a shift to restrictive fiscal and monetary policies which may have significantly increased the relative relevance of financial over real bankruptcy risk factors.<sup>21</sup> This would be consistent with the significance, only in the first wave, of liquidity and gearing indicators which include firm debt.

In the same way, the robustness across the three waves of the significance of the interest charges/value added indicator in the last year before failure or stress suggests that the combination of variables included in this indicator resumes the effects of both types of failing conditions (those generated by financial and those generated by real factors).

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<sup>20</sup> A result which needs to be interpreted is the positive and significant sign of the net working capital/medium and long term debt ratio, which might reasonably mean that inventories build up more rapidly than usual *i.e.*, for diving sales- in unsound firms during the considered period(s).

<sup>21</sup> See for instance the large relevance of gearing indicators in Lo (1986) who examines a sample of US firms until 1982 during the shift to a severe antinflationary monetary policy which generated a significant real rise in interest rates and is considered as one of the factors which determined the Latin American foreign debt crisis.

Among qualitative variables, it seems that group membership and small size are negatively related with failure. Since descriptive evidence shows that active firms are on average larger than failed and stressed firms (94 employees versus 34 in the first wave and 148 employees versus 90 in the third wave) this result is not so surprising as it shows that marginally smaller firms are not more likely to fail when the impact of relevant variables significantly correlated with size (such as age, customers' concentration and subcontracting status) is taken into account. In fact and unsurprisingly, customers' concentration (the sales share of the three largest customers on total sales) positively and significantly affects bankruptcy risk.

Results from the trend specification confirm that many of the variables affecting the probability of bankruptcy are sample specific. Table 3b shows no common factors across the three waves, though the interest charges/sales and the sales/gross fixed assets ratios have the expected and common effects in two out of the three samples. Once again, group membership holds an inverse relationship with the probability of failure.

Finally tabb. 4a-4c shows that qualitative variables become jointly significant in the logit estimate as far as their information get richer and new variables are added (second and third waves).

### *5.1 The stochastic frontier approach and the probability of bankruptcy: the specification of the model*

The adoption of a stochastic frontier approach to predict bankruptcy risk is, to our knowledge, an original attempt in this literature. We test here the hypothesis that the state of financial unsoundness of firms, in general, and the failure condition, in our particular case, are directly related to the concept of productive

efficiency<sup>22</sup>. At least three concepts of efficiency may be recalled when referring to the analysis of productivity of single firms or industries: i) technical efficiency which implies maximizing output from a given combination of factors; ii) allocative efficiency which refers to minimizing input combination costs, at given relative prices, for any output level (that is equivalent to equating the marginal product of every variable input to its corresponding opportunity cost or maximizing the profit); iii) revenue efficiency which relates to the maximization of value added, gross earnings or any other financial parameters.<sup>23</sup>

We focus on technical efficiency, by using a parametric approach. Following the Battese and Coelli (1995) approach, we define the following generic production function:

$$[3] \quad Y_{it} = X_{it} \mathbf{b} + (V_{it} - U_{it}) \quad , i = 1, \dots, N, \quad t = 1, \dots, T,$$

where  $Y_{it}$  is the production of the  $i$ -th firm;  $X_{it}$  is a  $k \times 1$  vector of input quantities of the  $i$ -th firm;  $\mathbf{b}$  is a vector of unknown parameters; the  $V_{it}$  are random variables which are assumed to be iid.  $N(0, \mathbf{s}_v^2)$ , and independent of the  $U_{it}$  which are non-negative random variables which account for technical inefficiency in production and are assumed to be independently distributed as truncations at zero of the  $N(m_{it}, \mathbf{s}_u^2)$  distribution, where:

$m_{it} = z_{it} \mathbf{d}$   $z_{it}$  is a  $p \times 1$  vector of variables that may influence the efficiency of a firm, and  $\mathbf{d}$  is a  $1 \times p$  vector of parameters to be estimated.

As for the parameters,  $\mathbf{s}_v^2$  and  $\mathbf{s}_u^2$  are replaced with by

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<sup>22</sup> An illustrative explanation on the origin and operative variations of the concept of efficiency applied to economic analysis is provided by Scazzieri (1981).

<sup>23</sup> The last type of efficiency depends on the first two classes and, as noted by Fanti (1997), if output, labor, and capital are empirically proxied in the production function by value added, cost of labor, and capital stock respectively, the resulting readout measuring "revenue inefficiency" caused by technical and allocative inefficiency does not tell one from the other.

$$\mathbf{s}^2 = \mathbf{s}_v^2 + \mathbf{s}_u^2 \text{ and } \mathbf{g} = \mathbf{s}_u^2 / (\mathbf{s}_v^2 + \mathbf{s}_u^2).$$

The measure of technical efficiency is defined as:

$$[4] \quad EFF_i = E(Y_i^* | U_i, X_i) / E(Y_i^* | U_i = 0, X_i),$$

Where  $Y_i^*$  is the production of the  $i$ -th firm, which is equal to  $Y_i$  if the dependent variable is in original units and is equal to  $\exp(Y_i)$  if the dependent variable is in logs.

$EFF_i$  takes a value between zero and one. The efficiency measures relative to the production function may be defined as  $\exp(-U_i)$  if the dependent variable is logged, or as  $(X_i \mathbf{b} - U_i) / (X_i \mathbf{b})$  if it is not.

These expressions for  $EFF_i$  rely upon the value of the unobservable  $U_i$  being predicted.<sup>24</sup>

Within this general framework, we choose a Cobb-Douglas production function specified as follows:

[5]

$$\ln(Y / L)_{it} = \mathbf{b}_0 + \mathbf{b}_1 \ln(K / L)_{it} + \sum_{j=1}^{m-1} \mathbf{I}_j \ln(K / L)_{it} * Industry_j + (V_{it} - U_{it})$$

in which real output is proxied by the log of real sales value per worker of the  $i^{\text{th}}$  firm at time  $t$  ( $I=1, \dots, N$ ;  $t=1, \dots, T$ ), production inputs are represented by the log of the capital stock per worker, the latter being evaluated at the replacement cost of capital. The prices of both inputs and output have been deflated using the industry inflation indexes computed by ISTAT.

The Cobb-Douglas production function includes output and capital stock per worker. The input variables have been multiplied by

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<sup>24</sup> This approach simultaneously estimates the production function and the (in)efficiency effects. Such estimates are more efficient than those previously obtained through two-stage procedures which assumed the independence of the (in)efficiency effects.

the corresponding industry dummies<sup>25</sup> in order to account for industry specificities which may influence the intercept and the slope of the production function. In fact, each industry is expected to have a different production function. This implies the existence of variations in output-per-worker/capital-per-worker elasticities across industries.

The nonzero mean residual of the production function is regressed on the following variables that are assumed to affect efficiency:

[6]

$$U_{it} = \mathbf{d}_0 + \sum_{i=1}^{m-1} \mathbf{a}_i \text{Industry}_i + \sum_{j=1}^{p-1} \mathbf{h}_j \text{Area}_j + \sum_{k=1}^{q-1} \mathbf{q}_k \text{Size}_k + \mathbf{d}_1 \text{Marketshare} + \mathbf{d}_2 \text{Subsidies} \\ + \mathbf{d}_3 \text{Innovation} + \mathbf{d}_4 \text{Export} + \mathbf{d}_5 \text{Age} + \mathbf{d}_6 A / F \text{dummy} + w_{it}$$

while for the 1995-1997 model, three additional regressors (available only for this data set) are included:

$$\dots + \gamma_7 \text{Largestcl} + \gamma_8 \text{Competarea} + \gamma_9 \text{Caput} + \dots$$

The variables affecting efficiency are: size (number of employees), market share (*Market share*), sales to the three biggest customers (*Largestcl*), capacity utilisation rate (*Caput*), age and a series of dummy variables: *Area* (geographic location in the North-East, North-West, Centre, South and isles), sector of economic activity (*Industry*), export status (*Export*), access to state subsidies (*Subsidies*), process and/or product innovating status (*Innovation*), Active/Failed status (*A/F dummy*), and presence of direct competitors in the same geographic area (*Competarea*).

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<sup>25</sup> Nineteen industries have been defined with reference to the four-digit *ISTAT* classification: 1 Food, beverages, and tobacco; 2 Textile and clothing; 3 Leather and shoes; 4 Wood, wood products, and furniture; 5 Paper, paper products, printing, and publishing; 6 Chemicals; 7 Rubber and plastic products; 8 Glass and ceramic products; 9 Construction industry; 10 Metal extraction; 11 Metal products; 12 Mechanical materials; 13 Mechanical equipment; 14 Electronic equipment; 15 Electric equipment; 16 Precision instrument and apparels; 17 Transport vehicles; 18 Transport - Other; 19 Energy production.

The model is estimated for each of the three waves as a cross-section in which all the quantitative variables are expressed as three-year averages.

### *5.2 The stochastic frontier approach and the probability of bankruptcy: econometric results*

A positive and statistically significant gamma coefficient indicates that the variance of the nonzero mean residual explains a significant part of the overall variability (Tables 5a to 5c). The model specified therefore fits well the data and supports the presence of relevant technical inefficiencies.

As expected, the signs and coefficients reported show that firms which we know are going to fail in the near future are significantly more distant from the "best practice" in two of the three periods, while in the first wave the coefficient has the expected sign but is not significant. This result supports the hypothesis of the strong relevance of financial factors on bankruptcy for firms surveyed in the first period in which they are affected by the shift in monetary policy and by the consequent increase in real interest rates. Since the distance from the frontier mainly measures firm inefficiency on the real side (and not financial difficulties) its significance in the second and third wave parallels the higher relevance of nonfinancial efficiency in the logit estimate for the same two periods.

Among other factors affecting the distance from the efficient frontier, we find that firms located in the South are significantly less efficient.<sup>26</sup> Another result which is not sample specific and holds for all of the three considered periods is the relatively

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<sup>26</sup> To interpret this finding we may consider the influence of productive efficiency of factors such as infrastructural weakness, a stronger criminal control and lower social capital (Putnam, 1993).

higher efficiency of exporting firms vis-à-vis those which sell only in the domestic market. This result is consistent with most of the empirical literature (Aw and Hwang, 1995; Clerides, Lach and Tybout, 1998, Becchetti-Santoro, 2001) and is generally explained by two non mutually excluding rationales: i) export is a learning process that improves firm productivity; ii) export markets select the most efficient firms (Delgado and Farinas, 1999).

The impact of size and age on productive efficiency seems less robust and more sample specific. This means that it is probably affected by changes in fiscal, monetary and exchange rate policies which crucially altered the economic framework in the three sample periods.<sup>27</sup>

### *5.3 The distance from the efficient frontier and the logit model*

The finding that ex post failed firms are ex ante significantly more distant from the efficient frontier confirms the link between productive efficiency and the probability of bankruptcy but does not imply in itself that remoteness from the best practice has a significant marginal impact on the probability of failure net of the effect of other qualitative and quantitative factors typically taken into account when evaluating credit and firm risk. In other terms, the above mentioned result does not tell whether the stochastic frontier approach adds valuable information to banks which already are in possess of balance sheets and of relevant qualitative information considered in this paper. To answer this question we test whether dummies for firms which go beyond a given distance from the efficient frontier have additional predictive power in the logit estimates described in section 4.

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<sup>27</sup> Expansionary fiscal policy and fixed exchange rates with real exchange rate appreciation in 1989-91. Public debt and currency crisis with devaluation and shift to flexible exchange rates and restrictive fiscal and monetary policies after 1992. Fixed exchange rates again in the last sample period.

In fixing the threshold we must consider that a too short distance from the frontier increases the probability of type II error therefore reducing the significance of the dummy coefficient. On the other hand, a too long distance from the frontier reduces the number of firms captured by the dummy variable and increases the weight of eventual "false signals" (firms which are far from the frontier but do not fail) on the significance of the dummy variable. Therefore, the optimal distance which solves this trade-off must be in the middle. Our empirical results (tab. 6) confirm the inverse U-shaped relationship between the marginal capacity of explaining bankruptcy and the distance from the efficient frontier showing that the dummy is significant when the threshold is between 30 per cent and 60 per cent of relative inefficiency with respect to the best practice.

## 6. *Conclusions*

A typical problem of the empirical literature on bankruptcy risk is that results cannot be generalised since the significance of the relevant variables tends to be sample specific. In addition, limits to the available information and the traditional approach followed by banks generally lead researchers to restrict the scope of the analysis to balance sheet variables. Furthermore, the potentially unlimited number of firms that can be included in the control sample leads them to build ad hoc balanced samples with the risk that endogeneity of the control sample may generate distortions in the results obtained.

Do findings of this paper improve our knowledge of the determinants of bankruptcy and provide useful insights to solve some of the above mentioned problems? We think that they do in at least five respects.

First, results from this paper suggest that only one of the indicators traditionally considered in the empirical analysis - earnings



before taxes to total debt - is not sample specific being significant in each of the three considered waves.

Second, our results suggest that non balance sheet information may disclose relevant risk factors (such as customers' concentration) and may significantly improve the explanatory power of logit estimates.

Third, the stochastic frontier analysis suggests that productive inefficiency measured as the distance from the "best practice" is a quite robust indicator of the probability of failure.

Fourth, the distance from the "best practice" has additional predictive power in the previously estimated logit models in the last two waves. This shows that the efficient frontier approach provides original and relevant, even though limited, information for banks evaluating borrowers' bankruptcy risk with quantitative and qualitative information.

Finally, the relatively higher relevance (in explaining failure or stress) of debt indicators in the first wave and of real indicators in the second and third wave suggests that part of sample specificity may be explained by the business cycle and by unexpected changes in monetary policies. This interpretation is consistent with the significance of the distance from the efficient frontier (which is a nonfinancial indicator of productive efficiency) only in the last two waves.

The paper therefore suggests that to eliminate sample specificity generated by uncertainty in the expected macroeconomic scenario it is necessary to find ratios which resume financial and real causes of bankruptcy risk.

Table 1 – Sound and unsound firms in the Mediocredito Centrale sample

	<b>1989-1991</b>	
	<b>N. OF OBS.</b>	<b>% TO TOTAL SAM- PLE</b>
Total number of firms	4194	100.0
Active	4112	98.0
Stressed*	11	0.3
	35	0.8
Failed + Stressed*	46	1.1
	<b>1992-1994</b>	
	<b>N. OF OBS.</b>	<b>% TO TOTAL SAM- PLE</b>
Total number of firms	4714	100.0
Active	4676	99.2
Stressed*	8	0.2
Failed	10	0.2
Failed + Stressed*	18	0.4
	<b>1995-1997</b>	
	<b>N. OF OBS.</b>	<b>% TO TOTAL SAM- PLE</b>
Total number of firms	4106	100.0
Active	4081	99.4
Stressed*	7	0.2
Failed	18	0.4
Failed + Stressed*	25	0.6

\*Firms which are under "*procedure concorsuali*" (composition with creditors, controlled administration, extraordinary administration, voluntary liquidation, forced liquidation, and winding-up). These procedures include: *fallimento*, *liquidazione*, *liquidazione coatta amministrativa*, *liquidazione giudiziarla*, *liquidazione volontaria*, *scioglimento*, *scioglimento e liquidazione*, *scioglimento senza messa in liquidazione*, *scioglimento anticipato senza messa in liquidazione*, *scioglimento per atto dell'Autorità*, *bancarotta fraudolenta*, *bancarotta semplice*, *concordato fallimentare*, *concordato preventivo*, *amministrazione giudiziarla*, *amministrazione controllata*, *amministrazione straordinaria*, *sequestro giudiziario*, and *sequestro conservativo di quote*.

Table 1 – Definition of financial indices and trends –

No.	RATIO DEFINITION	TYPE
1	Net working capital <sup>28</sup> / Current liabilities	Liquidity
2	Net working capital / Medium & long term debt	Liquidity
3	Net working capital / Total assets	Liquidity
4	Sales / Total assets	Turnover
5	Total assets / Net worth	Turnover
6	Total debt / Total assets	Gearing
7	Current liabilities / Net worth	Gearing
8	Interest charges / Sales	Operating structure
9	Interest charges / Value added	Operating structure
10	Depreciation charges / Gross fixed assets	Operating structure
11	Reserves / Total assets	Size and capitalization
12	Profit (Loss) for the period / Net worth	Profitability
13	Sales / Gross fixed assets	Profitability
14	Operating profit / Total assets	Profitability
15	Earnings before interest and taxes / Total assets	Profitability
16	Profit (Loss) for the period / Sales	Profitability
17	Profit (Loss) for the period / Share capital	Profitability
18	Profit (Loss) for the period / Total assets	Profitability
19	Earnings before taxes / Total debt	Profitability
20	Earnings before interest and taxes / Sales	Profitability
21	(Gross operating profit + Net financial provision – Depreciation	Profitability
22	Provision for risk and charges / Total assets	Risk
23	Firm sales / Industry sales	Non balance sheet inf.
24	Macroarea location	Non balance sheet inf.
25	Size	Non balance sheet inf.
26	Export status	Non balance sheet inf.
27	Subcontracting status	Non balance sheet inf.
28	Strength and proximity of competitors	Non balance sheet inf.
29	Sales to three biggest customers/total sales (for 95-	Non balance sheet inf.

<sup>28</sup> Net working capital is calculated as the sum of immediate liquidity, deferred liquidity, and total inventories (raw materials and items available for sale or in the process of being made ready for sale) net of current liabilities.

Table 3a – Variables significantly affecting the probability of bankruptcy in the logit analysis\*

Model	1989 - 1991	1992 - 1994	1995 - 1997
<b>Three-year Indices</b>	Net working capital / Medium & long term debt (+) Industry 3 (+) Total debt / Total assets (+) Industry 8 (+) Current liabilities / Net worth (+) Industry 10 (+) Interest charges / Value added (+) Industry 11 (+) Reserves / Total assets (-) Earnings before taxes / Total debt (+)	Total debt / Total assets (+) Industry 10 (+) Operating profit / Total assets (-) group members. (-) Current Profit (Losses) / Sales (-) market share (+) Earnings before taxes / Total debt (-)	Net working capital / Medium & long term debt (+) Industry 7 (+) Current Profits (Losses) / Net worth (-) Industry 13 (+) Operating profit / Total assets (-) Industry 14 (+) Earnings before taxes / Total debt (-) small size (-) Customers' concentration (+) Strenght of Local competitors (+)
	Total debt / Total assets (+) Industry 3 (+) Industry 8 (+) Industry 10 (+) Industry 11 (+)	Total debt / Total assets (+) Industry 10 (+) Operating profit / Total assets (-) Current Profits (Losses) / Sales (-)	Net working capital / Medium & long term debt (+) Industry 13 (+) Reserves / Total assets (-) Industry 14 (+) Current Profits (Losses) / Net worth (-) Operating profit / Total assets (-) Earnings before taxes / Total debt (-)
<b>Two-year Indices</b>	Net working capital / Medium & long term debt (+) Industry 3 (+) Total debt / Total assets (+) Industry 8 (+) Interest charges / Value added (+) Industry 10 (+) Reserves / Total assets (-) Industry 11 (+)	Reserves / Total assets (-) Industry 10 (+) Operating profit / Total assets (-) group members. (-) market share (+)	Net working capital / Medium & long term debt (+) Industry 9 (+) Interest charges / Value added (+) Industry 13 (+) Earnings before taxes / Total debt (-) Industry 14 (+) Group members. (-) small size (-) Strenght of local competitors (+)
	Net working capital / Medium & long term debt (+) Industry 3 (+) Total debt / Total assets (+) Industry 8 (+) Industry 10 (+) Industry 11 (+)	Net working capital / Total assets (+) Industry 10 (+) Reserves / Total assets (-) Operating profit / Total assets (-)	Net working capital / Medium & long term debt (+) Industry 9 (+) Net working capital / Total assets (-) Industry 13 (+) Reserves / Total assets (-) Industry 14 (+) Current Profits (Losses) / Net worth (-)
<b>One-year Indices</b>	Current liabilities / Net worth (+) Industry 3 (+) Total debt / Total assets (+) Industry 8 (+) Interest charges / Value added (+) Industry 10 (+) Reserves / Total assets (-) Industry 11 (+)	Interest charges / Value added (+) Industry 10 (+) Operating profit / Total assets (-) market share (+) Reserves / Total assets (-)	Net working capital / Current liabilities (+) group members. (-) Interest charges / Value added (+) small size (-) Current Profits (Losses) / Net worth (-) customers' concentration (+)
	Reserves / Total assets (-) Industry 3 (+) Total debt / Total assets (+) Industry 8 (+) Industry 10 (+) Industry 11 (+)	Total debt / Total assets (+) Industry 10 (+) Reserves / Total assets (-) Operating profit / Total assets (-) Current Profits (Losses) / Sales (-)	Net working capital / Current liabilities (+) Industry 9 (+) Net working capital / Total assets (-) Industry 13 (+) Industry 14 (+)

\* 95 percent significance level.

Table 3b – Main trends obtained for the periods under study (risk direction)\*

Model	1989 - 1991	1992 - 1994	1995 - 1997
Three-year Trends	Interest charges / Sales (Up +) Industry 10 (+) Net working capital / Total assets (Down -) Industry 11 (+) Total assets / Net worth (Down +) Depreciation charges / Gross fixed assets (Down -) Reserves / Total assets (Down +)	Interest charges / Sales (Up +) Industry 10 (+) Sales / Gross fixed assets (Up -) Industry 14 (+) Industry 16 (+) Group members. (-)	Interest charges / Value added (Up +) Group members. (-) Sales / Gross fixed assets (Up +) Size (+) Up 14 (+) Sales / Gross fixed assets (Down +) Operating profit / Total assets (Down -) Current Profits / Losses / Total assets (Down -)
	Interest charges / Sales (8 +) Industry 6 (+) Total assets / Net worth (Down +) Industry 10 (+) Depreciation charges / Gross fixed assets (Down -) Industry 11 (+) Reserves / Total assets (Down +)	Interest charges / Sales (8 +) Industry 10 (+) Industry 14 (+) Industry 16 (+)	Interest charges / Value added (Up +) Sales / Gross fixed assets (Up +) Operating profit / Total assets (Down -)

\* 95 percent significance level.- A trend is represented by a three-year period in which the indicator moves in the same direction. For increasing (decreasing) trends the dummy variable is called up (down) and it is given the value of 1 or zero otherwise.

Table 4a - Test for the joint significance of qualitative variables 1989-1991

Variables	Indices	$\chi^2(7, 3413)$	$\text{Prob} > \chi^2$
Group membership	Three years	6.64	0.4671
Market share	Two years	7.78	0.3522
Age	One year (91)	9.15	0.2420
Subcontracting status	Trend	13.47	0.0614
Small size			
Big size			
Export status			

Table 4b - Test for the joint significance of qualitative variables 1992-1994

Variables	Indices	$\chi^2(7, 3090)$	$\text{Prob} > \chi^2$
Group membership Market share Age Subcontracting status Small size Large size Export status	Three years	11.45	0.1200
	Two years	13.91	0.0528
	One year (94)	16.44	0.0214
	Trend	6.17	0.5201

Table 4c - Test for the joint significance of qualitative variables 1995-1997

Variables	Indices	$\chi^2(10, 3144)$	$\text{Prob} > \chi^2$
Group membership Age Subcontracting status Small size Large size Export status Market share Sales to three largest customers (%) Large competitors in the same region Use of production capacity (%)	Three years	47.63	0.0000
	Two years	55.03	0.0000
	One year (97)	93.79	0.0000
	Trend	23.71	0.0021

Table 5a - Stochastic frontier results - 1989-91 sample

	Coef.	t-ratio	Coef.	t-ratio		Coef.	t-ratio	Coef.	t-ratio
Constant	4.343	97.665	4.351	92.583	Constant	0.109	0.337	-0.050	-0.216
Ln (K/L)	0.571	16.166	0.569	16.211	Industry1	0.133	0.162	0.122	0.149
Ln (K/L) * Ind1	-0.117	-2.880	-0.120	-2.948	Industry2	0.893	3.628	0.892	3.972
Ln (K/L) * Ind2	-0.177	-4.566	-0.175	-4.545	Industry3	1.039	3.663	1.037	3.917
Ln (K/L) * Ind3	-0.092	-1.797	-0.094	-1.851	Industry4	0.0001	0.0003	0.029	0.094
Ln (K/L) * Ind4	-0.256	-6.142	-0.254	-6.031	Industry5	0.059	0.218	0.046	0.184
Ln (K/L) * Ind5	-0.267	-6.918	-0.267	-7.012	Industry6	-0.305	-0.868	-0.428	-1.292
Ln (K/L) * Ind6	-0.211	-5.474	-0.214	-5.557	Industry7	0.134	0.416	0.135	0.459
Ln (K/L) * Ind7	-0.257	-6.304	-0.257	-6.534	Industry8	-0.460	-1.025	-0.550	-1.230
Ln (K/L) * Ind8	-0.354	-8.614	-0.355	-8.747	Industry9	-0.807	-2.188	-0.896	-3.023
Ln (K/L) * Ind9	-0.313	-7.743	-0.314	-8.326	Industry10	0.300	0.913	0.338	1.097
Ln (K/L) * Ind10	-0.163	-4.005	-0.158	-3.805	Industry11	-0.034	-0.136	-0.063	-0.269
Ln (K/L) * Ind11	-0.296	-8.115	-0.297	-8.292	Industry12/13	-1.076	-3.420	-1.096	-2.593
Ln(K/L) * Ind12/13	-0.284	-7.607	-0.284	-7.725	Industry14	0.133	0.162	0.122	0.149
Ln (K/L) * Ind14	-0.200	-5.073	-0.198	-5.101	Industry15	-0.003	-0.009	-0.027	-0.096
Ln (K/L) * Ind15	-0.248	-6.217	-0.250	-6.363	Industry16	0.497	1.283	0.481	1.324
Ln (K/L) * Ind16	-0.257	-4.801	-0.256	-4.722	Industry17	0.133	0.162	0.122	0.149
Ln (K/L) * Ind17	-0.253	-6.445	-0.249	-6.319	Industry18	0.899	1.989	0.928	2.119
Ln (K/L) * Ind18	-0.306	-4.342	-0.300	-4.121	Small size	0.373	4.485	0.382	4.492
1 Food, beverages, and tobacco;					Size	-0.040	-0.445	-0.031	-0.333
2 Textile and clothing;					Age	-0.006	-2.383	-0.005	-2.621
3 Leather and shoes;					North-west	-8.323	-16.463	-8.242	-14.861
4 Wood, wood products, and furniture;					North-east	-0.081	-0.997	-0.088	-1.071
5 Paper, paper products, printing, and publishing;					South	-0.191	-2.314	-0.183	-2.164
6 Chemicals;					Market share	0.515	5.777	0.517	5.685
7 Rubber and plastic products;					Subsidies	0.217	3.854	0.213	3.699
8 Glass and ceramic products;					Innovation	-0.003	-0.026	0.003	0.025
9 Construction industry;					Export	-0.686	-10.138	-0.709	-10.794
10 Metal extraction;					Active	-0.161	-0.807		
11 Metal products;					Failed (wide definition)			0.223	0.899
12 Mechanical materials;					Sigma-squared	0.599	20.802	0.607	19.285
13 Mechanical equipment;					Gamma	0.514	18.207	0.518	16.635
14 Electronic equipment;					Log likelihood function		-3288.905		-3273.320
15 Electric equipment;					Number of observations		3514		3493
16 Precision instrument and appparels									
17 Transport vehicles;									
18 Transport - Other;									
S19 Energy production.									

Table 5b - Stochastic frontier results - 1992-94 sample

	Coef.	t-ratio	Coef.	t-ratio		Coef.	t-ratio	Coef.	t-ratio
Constant	4.837	101.703	4.829	98.972	Constant	2.635	6.244	2.255	5.475
Ln (K/L)	0.713	9.771	0.716	9.582	Sector1	-1.778	-4.195	-1.884	-4.091
Ln (K/L) * Ind1	-0.358	-4.713	-0.361	-4.543	Industry2	-0.990	-2.599	-1.061	-2.631
Ln (K/L) * Ind2	-0.425	-5.794	-0.431	-5.632	Industry3	-1.419	-3.265	-1.516	-3.270
Ln (K/L) * Ind3	-0.414	-5.166	-0.418	-4.960	Industry4	-1.775	-4.111	-1.879	-4.148
Ln (K/L) * Ind4	-0.530	-6.961	-0.531	-6.899	Industry5	-1.781	-4.460	-1.884	-4.440
Ln (K/L) * Ind5	-0.521	-6.947	-0.522	-6.829	Industry6	-2.536	-4.934	-2.587	-4.875
Ln (K/L) * Ind6	-0.467	-6.059	-0.464	-5.964	Industry7	-2.260	-4.728	-2.311	-4.648
Ln (K/L) * Ind7	-0.550	-7.185	-0.549	-7.140	Industry8	-1.961	-3.653	-2.019	-3.598
Ln (K/L) * Ind8	-0.573	-7.594	-0.575	-7.513	Industry9	-2.204	-5.119	-2.237	-4.853
Ln (K/L) * Ind9	-0.527	-6.963	-0.524	-6.855	Industry10	-1.520	-3.444	-1.690	-3.571
Ln (K/L) * Ind10	-0.390	-5.009	-0.399	-5.007	Industry11	-1.906	-4.940	-2.030	-4.714
Ln (K/L) * Ind11	-0.566	-7.720	-0.570	-7.530	Industry12/13	-2.679	-5.064	-2.491	-5.005
Ln(K/L) * Ind12/13	-0.660	-8.568	-0.652	-8.513	Industry14	-1.681	-3.859	-1.715	-3.821
Ln (K/L) * Ind14	-0.511	-6.574	-0.506	-6.451	Industry15	-1.795	-4.287	-1.906	-4.332
Ln (K/L) * Ind15	-0.495	-6.518	-0.497	-6.457	Industry16	-2.542	-3.407	-2.594	-2.995
Ln (K/L) * Ind16	-0.595	-7.532	-0.591	-6.886	Industry17	-2.015	-3.850	-2.148	-3.983
Ln (K/L) * Ind17	-0.519	-6.699	-0.524	-6.635	Industry18	-2.491	-3.224	-2.611	-3.288
Ln (K/L) * Ind18	-0.587	-7.032	-0.593	-6.996	Small size	-0.055	-0.738	-0.092	-1.212
1 Food, beverages, and tobacco;					Size	0.117	1.529	0.107	1.400
2 Textile and clothing;					Age	-0.001	-0.376	-0.001	-0.900
3 Leather and shoes;					North-west	-0.013	-0.168	-0.028	-0.373
4 Wood, wood products, and furniture;					North-east	-0.228	-2.730	-0.259	-3.237
5 Paper, paper products, printing, and publishing;					South	0.472	5.291	0.484	5.535
6 Chemicals;					Market share	-14.573	-2.442	-14.470	-2.265
7 Rubber and plastic products;					Subsidies	-0.032	-0.546	-0.034	-0.615
8 Glass and ceramic products;					Innovation	-0.014	-0.237	-0.029	-0.505
9 Construction industry;					Export	-0.734	-11.599	-0.774	-12.648
10 Metal extraction;					Active	-0.508	-2.968		
11 Metal products;					Failed (wide definition)			0.677	2.715
12 Mechanical materials;					Sigma-squared	0.432	18.865	0.441	20.472
13 Mechanical equipment;					Gamma	0.371	7.934	0.386	9.121
14 Electronic equipment;					Log likelihood function		2674.306		2658.674
15 Electric equipment;					Number of observations		3182		3163
16 Precision instrument and appparels;									
17 Transport vehicles;									
18 Transport - Other;									
19 Energy production.									



Table 5c - Stochastic frontier results - 1995-97 sample

	Coef.	t-ratio	Coef.	t-ratio		Coef.	t-ratio	Coef.	t-ratio
Constant	5.217	105.816	5.265	113.467	Constant	3.111	8.526	2.214	7.067
Ln (K/L)	0.563	9.334	0.516	8.675	Industry1	-1.679	-5.651	-1.465	-5.226
Ln (K/L) * Ind1	-0.300	-4.823	-0.255	-4.223	Industry2	-0.916	-3.303	-0.642	-2.384
Ln (K/L) * Ind2	-0.317	-5.069	-0.254	-4.092	Industry3	-0.884	-2.866	-0.663	-2.215
Ln (K/L) * Ind3	-0.243	-3.489	-0.196	-2.811	Industry4	-1.935	-5.876	-1.695	-5.451
Ln (K/L) * Ind4	-0.450	-7.136	-0.407	-6.651	Industry5	-1.761	-5.647	-1.501	-4.958
Ln (K/L) * Ind5	-0.412	-6.620	-0.367	-5.995	Industry6	-1.832	-5.367	-1.671	-5.054
Ln (K/L) * Ind6	-0.331	-5.271	-0.291	-4.723	Industry7	-1.945	-6.163	-1.641	-5.409
Ln (K/L) * Ind7	-0.425	-6.875	-0.380	-6.265	Industry8	-1.938	-5.396	-1.653	-4.532
Ln (K/L) * Ind8	-0.476	-7.448	-0.433	-6.880	Industry9	-1.546	-4.629	-1.330	-4.217
Ln (K/L) * Ind9	-0.416	-6.391	-0.376	-5.951	Industry10	-0.445	-1.537	-0.234	-0.810
Ln (K/L) * Ind10	-0.111	-1.747	-0.069	-1.076	Industry11	-1.712	-5.600	-1.387	-4.876
Ln (K/L) * Ind11	-0.436	-6.886	-0.387	-6.335	Industry12	-1.646	-4.591	-1.359	-3.966
Ln (K/L) * Ind12	-0.425	-6.454	-0.378	-5.878	Industry13	-2.178	-7.007	-1.935	-6.600
Ln (K/L) * Ind13	-0.443	-7.102	-0.401	-6.631	Industry14	-2.584	-7.272	-1.606	-5.468
Ln (K/L) * Ind14	-0.469	-7.270	-0.405	-6.606	Industry15	-1.879	-4.032	-1.444	-3.010
Ln (K/L) * Ind15	-0.362	-5.249	-0.317	-4.517	Industry16	-2.000	-4.997	-1.549	-3.549
Ln (K/L) * Ind16	-0.483	-6.640	-0.438	-6.241	Industry17	-2.513	-6.841	-2.056	-5.606
Ln (K/L) * Ind17	-0.452	-6.976	-0.410	-6.461	Industry18	-0.707	-1.532	-0.438	-1.360
Ln (K/L) * Ind18	-0.308	-2.730	-0.267	-3.542	Small size	-0.359	-9.120	-0.346	-8.842
1 Food, beverages, and tobacco; 2 Textile and clothing; 3 Leather and shoes; 4 Wood, wood products, and furniture; 5 Paper, paper products, printing, and publishing; 6 Chemicals; 7 Rubber and plastic products; 8 Glass and ceramic products; 9 Construction industry; 10 Metal extraction; 11 Metal products; 12 Mechanical materials; 13 Mechanical equipment; 14 Electronic equipment; 15 Electric equipment; 16 Precision instrument and apparels; 17 Transport vehicles; 18 Transport - Other; 19 Energy production.	Size	-0.013	-0.236	0.045	0.752				
	Age	0.002	1.769	0.002	2.065				
	North-west	0.098	1.881	0.081	1.490				
	North-east	0.078	1.370	0.061	1.028				
	South	0.504	8.358	0.468	7.627				
	Market share	-20.256	-4.926	-36.293	-10.586				
	Subsidies	-0.007	-0.202	0.003	0.076				
	Innovation	-0.038	-0.999	-0.028	-0.709				
	Export	-0.338	-8.273	-0.331	-8.023				
	Sales to the 3 largest customers	0.004	5.621	0.003	4.668				
	Competitors in the same area	0.054	1.630	0.048	1.471				
	Capacity utilization	-0.009	-7.099	-0.008	-6.079				
	Active	-0.644	-4.008						
	Failed (wide definition)			0.670	3.644				
	Sigma-squared	0.338	27.795	0.343	29.159				
	Gamma	0.235	6.220	0.264	7.469				
	Log likelihood function		2546.678		2541.386				
	Number of observations		3195		3195				

Table 6 – Distance from efficient frontier and the logit model  
(*t*-value reported in parentheses)

	Test signific	Coeff	VIF	1 <sup>st</sup> corr. var	2 <sup>nd</sup> corr. var	3 <sup>rd</sup> corr. Var
<b>1995-97</b>						
<i>Three-year model</i>						
Dummy (inef >= 0.30)	2.597	4.531	1.33	(Industry2) 0.385	(Industry13) -0.200	(Industry7) -0.138
Dummy (inef >= 0.35)	1.797	3.444	1.27	(Industry2) 0.344	(Industry13) -0.184	(Industry7) -0.128
Dummy (inef >= 0.40)	1.914	2.609	1.24	(Industry2) 0.306	(Industry13) -0.171	(Small) -0.141
Dummy (inef >= 0.50)	1.965	3.884	1.16	(Industry2) 0.206	(Industry13) -0.148	(Industry1) -0.133
Dummy (inef >= 0.60)	2.986	6.286	1.10	(Industry13) -0.1250	(Industry1) -0.1235	(cliefat) -0.095
<b>1992-94</b>						
<i>Three-year model</i>						
Dummy (inef >= 0.30)	1.232	1.868	2.01	(Industry2) 0.447	(Export) -0.349	(Age) 0.180
Dummy (inef >= 0.35)	2.784	3.425	1.73	(Industry2) 0.451	(Export) -0.269	(Age) 0.224
Dummy (inef >= 0.40)	3.505	4.261	1.52	(Industry2) 0.382	(Age) 0.257	(Export) -0.236
Dummy (inef >= 0.50)	1.836	3.756	1.39	(Age) 0.297	(Industry2) 0.269	(Export) -0.205
Dummy (inef >= 0.60)	1.506	4.127	1.35	(Age) 0.373	(Industry2) 0.188	(Group) 0.174

The table presents *t*-stat and coefficients of the "distance from the efficient frontier" dummy variable included in the Logit estimate models whose synthetic results are presented in Tab. 3a. The dummy equals one if the firm has a relative inefficiency which is higher than the threshold indicated in the table (measuring one minus the ratio between its efficiency relative to that of the most efficient firm) and zero otherwise. It also indicates the Variance Inflation Factor measuring the correlation between this variable and all other regressors in the estimate - the formula is  $1/(1-R(x))$  where  $R(x)$  is the *R* squared when the independent variable *x* is regressed on all other independent variables - and the three regressors with which the variable is more correlated in each estimate. VIF ratios higher than 20 are generally considered as an indicator of multicollinearity.

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Appendix 1  
Table A1 – Model Estimation with Indices and Indices and Qualitative  
Variables 1989-1991  
(*t*-value reported in parentheses)

VARIABLES	ONLY INDICES			INDICES AND QUALITATIVE VARIABLES		
	Three-year model	Two-year model	One-year model	Three-year model	Two-year model	One-year model
Net working capital / Current liabilities	-0.0020665 (-0.632)	-0.001682 (-0.693)	-0.1504451 (-0.217)	-0.0019564 (-0.400)	-0.0014531 (-0.457)	-0.0224325 (-0.050)
Net working capital / Medium & long term debt	0.0201082 (1.538)	0.033316 (2.141)	.0199993 (1.379)	0.0566024 (3.108)	0.0596447 (2.984)	0.0274276 (0.912)
Net working capital / Total assets	-1.599772 (-1.300)	-2.086139 (-1.615)	-1.460709 (-0.788)	-1.549169 (-0.974)	-1.896721 (-1.171)	-1.303885 (-0.665)
Sales / Total assets	-0.1813484 (-0.336)	-0.2842725 (-0.509)	-0.2169341 (-0.429)	-0.1680632 (-0.267)	-0.3159788 (-0.468)	-0.3246051 (-0.489)
Total debt / Total assets	2.969673 (2.224)	2.807751 (2.122)	2.583662 (2.018)	3.729097 (2.509)	3.514044 (2.348)	3.455174 (2.177)
Current liabilities / Net worth	0.0041686 (1.881)	0.003183 (1.289)	0.0043209 (1.778)	0.0044494 (2.083)	0.0033183 (1.200)	0.0053482 (2.194)
Interest charges / Value added	0.8174812 (1.767)	0.5382903 (1.196)	0.2090215 (1.008)	1.202567 (2.982)	0.8245071 (2.878)	0.5110892 (3.081)
Amortization charges / Gross fixed assets	-8.557706 (-1.704)	-5.43404 (-1.247)	-4.146166 (-1.047)	-7.763986 (-1.589)	-4.400369 (-1.062)	-1.688663 (-0.526)
Reserve / Total assets	-5.649994 (-1.930)	-5.244576 (-1.865)	-6.489554 (-2.432)	-6.405521 (-2.045)	-6.214887 (-2.008)	-6.978131 (-2.183)
Profit (Loss) for the period / Net worth	-0.0104192 (-0.709)	-0.0058416 (-0.587)	0.0045574 (0.677)	-0.0503741 (-1.507)	-0.0601869 (-1.378)	-0.0764194 (-1.922)
Sales / Gross fixed assets	-0.0008744 (-0.465)	0.0047253 (0.618)	0.007092 (0.900)	-0.0005316 (-0.327)	0.0063946 (0.889)	0.0078885 (0.889)
Earnings before interest and taxes / Total assets	0.2603248 (0.063)	1.000966 (0.261)	-2.560369 (-0.992)	1.556024 (0.426)	2.799929 (0.927)	-0.6261497 (-0.259)
Profit (Loss) for the period / Sales	0.0491648 (0.233)	0.0724243 (0.758)	-2.014478 (-1.241)	0.2381519 (0.981)	0.1322838 (1.179)	1.096345 (0.578)
Profit (Loss) for the period / Share capital	-0.0058955 (-1.460)	-0.0037947 (-1.369)	-0.0013933 (-1.790)	-0.0061795 (-1.914)	-0.0039737 (-1.809)	-0.0021187 (-1.875)
Earnings before taxes / Total debt	1.71153 (1.520)	0.8372074 (0.803)	3.055102 (1.417)	2.333179 (2.296)	1.439619 (1.951)	2.02983 (0.863)
Sector 2	1.227736 (1.455)	1.173345 (1.444)	1.09813 (1.451)	2.228267 (1.316)	2.000962 (1.310)	1.521819 (1.328)
Sector 3	2.565353 (2.769)	2.48276 (2.765)	2.3783 (2.906)	3.713449 (2.120)	3.468285 (2.115)	2.99313 (2.438)
Sector 4	1.740385 (1.732)	1.677089 (1.709)	1.610761 (1.710)	2.391213 (1.237)	2.142132 (1.186)	1.690205 (1.144)
Sector 6	1.546749 (1.541)	1.487441 (1.529)	1.651319 (1.870)	2.086146 (1.052)	1.748777 (0.941)	1.213831 (0.734)
Sector 7	1.578068 (1.503)	1.481292 (1.438)	1.30828 (1.440)	2.946785 (1.620)	2.615111 (1.579)	1.931273 (1.439)
Sector 8	2.217502 (2.105)	2.15117 (2.080)	2.140198 (2.137)	3.890008 (2.109)	3.667915 (2.135)	3.372804 (2.472)
Sector 10	3.150392 (3.698)	3.087502 (3.780)	3.034185 (3.999)	4.481519 (2.613)	4.239397 (2.749)	3.785653 (3.293)
Sector 11	2.21077 (2.854)	2.125501 (2.872)	1.929301 (2.674)	3.426916 (2.044)	3.133773 (2.072)	2.627803 (2.281)
Sector 12-13	1.183584 (1.275)	1.104329 (1.234)	1.008864 (1.171)	2.343773 (1.331)	2.094661 (1.295)	1.664923 (1.306)
Sector 15	1.561351 (1.685)	1.424914 (1.572)	1.343591 (1.552)	2.414529 (1.372)	1.983255 (1.149)	1.590986 (1.222)
Age				0.0020786 (0.666)	0.0023619 (0.813)	0.002985 (1.156)
Operating risk				18.63219	19.42558	17.65689

				(1.682)	(1.697)	(1.619)
Market share				-248.5486 (-1.562)	-246.0635 (-1.530)	-222.9582 (-1.536)
Subcontracting status				0.503749 (1.250)	0.5231419 (1.286)	0.5589205 (1.388)
Export status				0.1059291 (0.260)	0.1376734 (0.321)	0.0653827 (0.158)
Big size				0.691307 (1.156)	0.7076265 (1.174)	0.7258793 (1.175)
Group membership				-0.1430257 (-0.350)	-0.107096 (-0.272)	-0.1363172 (-0.351)
Small size				-0.1038614 (-0.186)	-0.1417041 (-0.255)	-0.099821 (-0.177)
Constant	-6.943347 (-5.176)	-6.883591 (-5.577)	-6.59679 (-5.738)	-9.302703 (-4.130)	-9.040615 (-4.251)	-8.491958 (-5.060)

**Table A2 – Model Estimation with Indices and Indices and Qualitative Variables 1992-1994**  
(*t*-value reported in parentheses)

VARIABLES	ONLY INDICES			INDICES AND QUALITATIVE VARIABLES		
	Three-year model	Two-year model	One-year model	Three-year model	Two-year model	One-year model
Net working capital / Current liabilities	-.8835442 (-1.409)	-1.213696 (-1.670)	-.9388108 (-0.990)	-.776505 (-1.128)	-.3264289 (-0.471)	-.3048808 (-0.403)
Net working capital / Medium & long term debt	.0024234 (0.060)	-.0305986 (-1.288)	.0429075 (0.282)	.0195898 (0.582)	-.0117305 (-0.321)	.0200078 (0.535)
Net working capital / Total assets	5.164526 (1.875)	5.496724 (2.391)	3.981598 (1.840)	4.496305 (1.674)	2.766466 (0.899)	1.909971 (0.664)
Sales / Total assets	-.4754801 (-0.626)	-.5472569 (-0.639)	-.7394663 (-1.282)	-.8049487 (-0.906)	-.6698277 (-0.672)	-1.20695 (-1.152)
Total debt / Total assets	5.842957 (2.295)	3.93965 (1.622)	3.683458 (2.106)	6.85619 (2.375)	3.892057 (1.253)	2.646515 (1.438)
Current liabilities / Net worth	.011299 (1.233)	.0076813 (0.955)	-.0019614 (-0.272)	.0086018 (0.889)	.006536 (0.714)	.0037526 (0.145)
Interest charges / Value added	-.0863741 (-1.114)	.0587941 (0.599)	.0984455 (0.651)	-.0326265 (-0.490)	.2359837 (1.046)	.3617846 (2.586)
Amortization charges / Gross fixed assets	-5.937223 (-0.748)	-7.162743 (-1.003)	-.7454529 (-0.123)	-14.07884 (-1.814)	-15.16214 (-1.917)	-14.04184 (-0.948)
Reserve / Total assets	-3.999855 (-1.594)	-6.799221 (-2.716)	-5.217211 (-1.990)	-3.772109 (-1.245)	-7.55575 (-2.480)	-9.065416 (-2.619)
Profit (Loss) for the period / Net worth	.0360242 (0.698)	.0217971 (0.630)	-.1174093 (-1.522)	.0624667 (1.119)	.1163937 (1.186)	-.02386 (-0.074)
Sales / Gross fixed assets	-.293539 (-1.402)	-.2184266 (-1.239)	-.344122 (-1.059)	-.2791655 (-1.018)	-.1940201 (-0.703)	-.2611476 (-0.781)
Operating profit / Total assets	-6.803184 (-3.713)	-5.905465 (-4.258)	-3.97862 (-4.321)	-6.226338 (-2.500)	-7.378355 (-4.064)	-4.319148 (-2.205)
Profit (Loss) for the period / Sales	-.6152676 (-2.485)	-.7719837 (-1.934)	-.5374723 (-2.331)	-.6850975 (-2.114)	-1.270678 (-0.834)	-.8615086 (-0.663)
Earnings before taxes / Total debt	-.8117207 (-1.799)	-.3949375 (-1.240)	-.3139986 (-1.521)	-1.346327 (-2.227)	-.4525609 (-0.605)	-.2539086 (-0.404)
Sector 2	-.1777366 (-0.192)	.0058657 (0.006)	-.4211661 (-0.290)	-.2390972 (-0.287)	-.1625241 (-0.174)	-.3797181 (-0.295)
Sector 5	1.029842 (1.251)	1.264788 (1.507)	1.227295 (1.460)	1.087636 (1.197)	1.263105 (1.300)	1.286816 (1.331)
Sector 10	2.095103 (3.161)	2.358615 (3.338)	2.046642 (2.885)	2.278535 (3.278)	2.552377 (3.060)	1.919354 (2.749)



Sector 14	1.413556 (1.497)	1.474436 (1.402)	1.817355 (1.640)	1.677141 (1.606)	1.456357 (1.083)	2.084403 (1.658)
Sector 16	2.135018 (1.609)	2.187096 (1.570)	2.349235 (1.451)	2.531672 (1.906)	2.617432 (1.631)	3.061399 (2.064)
Group membership				-1.383194 (-2.051)	-1.60293 (-2.149)	-1.376951 (-1.909)
Market share				10.24336 (2.542)	10.67051 (2.702)	10.79314 (2.206)
Age				-.0034357 (-0.340)	-.0057926 (-0.572)	-.0023757 (-0.263)
Subcontracting status				-.3288359 (-0.535)	-.5526673 (-0.767)	-1.028419 (-1.274)
Small size				.5091297 (0.573)	.2767944 (0.286)	.1801332 (0.182)
Big size				.4901936 (0.658)	.5659846 (0.734)	.3778264 (0.466)
Export status				.1167893 (0.144)	.1382717 (0.136)	.8745793 (0.763)
Operating risk				-2.663847 (-0.546)	-2.512858 (-0.511)	-3.229664 (-0.657)
Constant	-7.705008 (-3.318)	-6.380585 (-2.835)	-6.297706 (-3.595)	-7.458464 (-2.509)	-5.378156 (-1.821)	-4.385743 (-1.960)

**Table A3 – Model Estimation with Indices and Indices and Qualitative Variables 1995-1997**  
(*t*-value reported in parentheses)

VARIABLES	ONLY INDICES			INDICES AND QUALITATIVE VARIABLES		
	Three-year model	Two-year model	One-year model	Three-year model	Two-year model	One-year model
Net working capital / Current liabilities	0.027 (1.444)	.1803375 (0.208)	.6342718 (2.314)	.0318516 (1.827)	.3110329 (0.317)	.8940309 (2.602)
Net working capital / Medium & long term debt	0.089 (3.103)	.0840937 (2.282)	.0234562 (1.403)	.1191922 (3.265)	.1104947 (2.519)	.0456337 (1.419)
Net working capital / Total assets	-3.268524 (-1.944)	-4.433955 (-2.209)	-2.987404 (-2.281)	-3.535653 (-1.490)	-4.389007 (-1.412)	-3.241417 (-1.361)
Sales / Total assets	.3261874 (0.782)	-.8491412 (-0.662)	-.5378796 (-0.443)	.727577 (1.669)	.026224 (0.020)	.3916281 (0.359)
Total debt / Total assets	.7981058 (0.881)	-.1412814 (-0.145)	-.6125068 (-0.705)	1.346138 (1.159)	.1097348 (0.077)	-.9232924 (-0.766)
Current liabilities / Net worth	.0015181 (0.360)	.0034197 (0.715)	.0025064 (1.159)	.0044931 (0.825)	.0041677 (0.524)	.0010764 (0.337)
Interest charges / Value added	.0732418 (0.824)	.0928169 (1.863)	.0182269 (0.584)	.1285332 (0.961)	.2106962 (2.953)	.0709028 (2.005)
Amortization charges / Gross fixed assets	-2.991113 (-0.657)	-.2429228 (-0.062)	1.287718 (0.660)	-2.468044 (-0.464)	1.528668 (0.942)	1.808698 (1.230)
Reserve / Total assets	-3.326665 (-1.955)	-5.276322 (-2.804)	-6.311601 (-1.703)	-2.244435 (-0.948)	-3.775998 (-1.413)	-5.235824 (-1.094)
Profit (Loss) for the period / Net worth	-.0362982 (-2.716)	-.041941 (-2.183)	-.0086703 (-1.668)	-.0524903 (-2.911)	-.0726418 (-1.039)	-.0194288 (-3.603)
Sales / Gross fixed assets	-.0276416 (-0.960)	-.0157328 (-0.418)	-.0046157 (-0.225)	-.0672692 (-1.388)	-.0293411 (-0.585)	-.0193277 (-0.333)
Operating profit / Total assets	-9.223443 (-3.171)	-5.242539 (-1.826)	-3.584892 (-1.195)	-10.00979 (-3.221)	-4.960895 (-1.363)	-2.101468 (-0.568)
Profit (Loss) for the period / Sales	.2034129 (0.305)	-1.383403 (-0.595)	-2.321403 (-1.010)	.0182716 (0.023)	-2.518393 (-0.841)	-4.243348 (-1.411)
Earnings before taxes / Total debt	-.2124887 (-2.982)	-.3531865 (-1.616)	-.2653302 (-0.772)	-.3630849 (-4.024)	-.7724711 (-2.016)	-.5146613 (-1.213)
Sector 1	-.7046644 (-0.458)	1.072089 (0.848)	1.42528 (1.206)	-.054645 (-0.045)	1.727696 (1.039)	2.09951 (1.309)
Sector 2	.5927771 (0.775)	1.677689 (1.773)	.9405656 (0.846)	1.227178 (1.436)	2.297607 (1.622)	1.439879 (0.944)
Sector 7	1.012639 (1.183)	1.41896 (1.027)	1.369685 (1.030)	1.655198 (2.035)	2.396158 (1.649)	2.409772 (1.681)
Sector 9	1.328063 (1.583)	2.287719 (2.276)	2.397908 (2.313)	2.135037 (1.842)	3.23806 (1.984)	2.89817 (1.648)
Sector 13	1.696411 (2.697)	2.792402 (3.279)	2.135898 (2.463)	2.081507 (2.599)	3.468969 (2.495)	2.498954 (1.947)
Sector 14	2.435618 (3.670)	2.944422 (3.104)	2.174625 (2.153)	3.405017 (4.145)	4.249712 (3.080)	2.961743 (1.784)
Group membership				-.8068432 (-1.240)	-2.164794 (-2.857)	-2.365104 (-2.195)
Age				-.0259292 (-1.831)	-.0358848 (-1.910)	-.0315687 (-1.691)
Subcontracting				-1.706504 (-0.296)	-.5221807 (-0.616)	-.8415751 (-0.786)
Small size				-1.654324 (-2.591)	-2.260424 (-2.670)	-1.914369 (-2.042)
Big size				.031485 (0.011)	1.329463 (0.526)	1.373031 (0.622)
Export status				.0294384 (0.049)	-.0098227 (-0.013)	.2156372 (0.279)
Sales to the three largest clients				.0250593	.0283612	.0346926

				(2.316)	(1.909)	(2.109)
Large competitors in the same region				1.431937 (2.364)	1.633105 (1.955)	1.307132 (1.705)
Use of production capacity				.0425797 (1.489)	.0244627 (0.906)	.0488796 (1.400)
Market share				-1936.703 (-1.239)	-2348.335 (-1.062)	-1001.466 (-0.782)
Operating risk				5.665711 (0.749)	-32.48073 (-0.820)	-30.81296 (-0.783)
Constant	-5.360563 (-5.772)	-4.959057 (-3.263)	-5.2029 (-3.490)	-9.998015 (-3.468)	-8.128452 (-2.729)	-10.7716 (-2.728)

Appendix (not to be published)

Table 3a – Comparison of index mean values 1989-1991 (wide failure definition)

INDICES		RATIO LEVEL		RATIO VARIATION	
		ACTIVE	FAILED	ACTIVE	FAILED
No.	Variable	Mean	Mean	Mean	Mean
1	Cc_pscme	1.585	0.197	0.297	3.946
2	Cc_dmlme	1.299	0.661	0.217	17.510
3	Cc_atme	0.126	0.020	0.146	2.905
4	Fat_atme	0.993	0.926	0.195	0.050
5	At_patme	8.667	22.957	0.083	0.013
6	Db_attme	0.576	0.692	-0.0003	0.011
7	Ps_patme	4.603	17.643	0.144	0.065
8	Of_fatme	0.055	0.080	0.626	0.193
9	Of_vame	0.137	0.290	0.374	0.110
10	Am_iflme	0.089	0.074	0.176	0.246
11	Ri_attme	0.101	0.046	0.585	-2.114
12	Pr_patme	0.058	-0.112	-10.07	-13.75
13	Fa_iflme	5.934	5.782	0.122	0.099
14	Mon_atme*	0.066	0.051	-0.199	-0.744
15	Pr_fatme	0.013	-0.028	-1.940	-4.184
16	Pr_csme	1.716	-11.796	-0.600	1.103
17	Pr_atme	0.018	0.00003	-1.847	-6.843
18	Ui_dtme	0.084	0.045	-0.700	-1.642
19	Mon_fame	0.071	0.031	-0.299	-1.007
20	Returnme	0.030	-0.023	-0.798	-1.826
21	Opriskme	0.006	0.008	0.568	0.840
22	Market share	0.002	0.001	0.602	0.209

Table 3b – Comparison of index mean values 1989-1991 (strict failure definition)

INDICES		RATIO LEVEL			RATIO VARIATION		
		ACTIVE	STRESSE D	FAILED	ACTIVE	STRESSE D	FAILED
No.	Variable	Mean	Mean	Mean	Mean	Mean	Mean
1	Cc_pscme	1.585	0.257	0.007	0.297	5.347	-0.259
2	Cc_dmlme	1.299	0.670	0.634	0.217	23.378	-0.092
3	Cc_atme	0.126	0.025	0.004	0.146	3.949	-0.228
4	Fat_atme	0.993	0.859	1.139	0.195	0.055	0.034
5	At_patme	8.667	7.912	70.827	0.083	-0.039	0.169
6	Db_attme	0.576	0.673	0.752	-0.0004	0.012	0.007
7	Ps_patme	4.603	4.432	59.676	0.144	0.021	0.198
8	Of_fatme	0.055	0.082	0.071	0.626	0.202	0.169
9	Of_vame	0.137	0.299	0.260	0.374	0.089	0.172
10	Am_iflme	0.089	0.071	0.085	0.176	0.208	0.361
11	Ri_attme	0.101	0.052	0.027	0.585	-3.389	2.190
12	Pr_patme	0.058	-0.104	-0.137	-10.069	-18.282	-0.169
13	Fa_iflme	5.934	3.184	14.049	0.122	0.055	0.231
14	Mon_atme*	0.066	0.052	0.045	-0.199	-0.923	-0.204
15	Pr_fatme	0.013	-0.034	-0.007	-1.940	-5.499	-0.240
16	Pr_csme	1.716	-15.458	-0.147	-0.600	1.522	-0.153
17	Pr_atme	0.018	0.002	-0.008	-1.847	-9.016	-0.324
18	Ui_dtme	0.084	0.062	-0.011	-0.700	-2.113	-0.231
19	Mon_fame	0.071	0.030	0.033	-0.299	-1.278	-0.193
20	Returnme	0.030	-0.030	-0.002	-0.798	-2.370	-0.195
21	Opriskme	0.006	0.006	0.014	0.568	0.978	0.358
22	Market share	0.002	0.001	0.001	0.602	0.148	0.393

\*Operating profit not available from 1989 balance-sheet data. EBIT has been used to calculate the index. Ratio *ut\_atme* is then equivalent to *mon\_atme*.

Table 4a – Comparison of index mean values 1992-1994 (wide failure definition)

INDICES		RATIO LEVEL		RATIO VARIATION	
		ACTIVE	FAILED	ACTIVE	FAILED
No.	Variable	Mean	Mean	Mean	Mean
1	Cc_pscme	0.503	0.178	-0.199	-3.702
2	Cc_dmlme	1.112	-0.451	0.255	-2.510
3	Cc_atme	0.128	0.175	-0.348	-3.201
4	Fat_atme	1.182	0.855	0.076	-0.068
5	At_patme	6.869	14.048	0.122	-0.458
6	Db_attme	0.560	0.758	0.363	0.071
7	Ps_patme	4.659	7.684	0.243	0.109
8	Of_fatme	0.062	0.244	0.057	0.340
9	Of_vame	0.176	0.282	0.333	0.163
10	Am_iflme	0.137	0.082	0.441	0.508
11	Ri_atme	0.142	0.035	-0.004	-0.505
12	Pr_patme	0.019	-0.247	-1.901	-38.468
13	Fa_iflme	7.895	2.340	0.422	0.243
14	Ut_atme	0.067	-0.025	0.496	-0.802
15	Mon_atme	0.064	-0.030	0.436	-1.040
16	Pr_fatme	-0.002	-0.449	-2.936	-20.275
17	Pr_csme	0.377	-2.853	-2.093	-20.739
18	Pr_atme	0.006	-0.087	-3.188	-24.050
19	Ui_dtme	0.145	-0.108	-0.015	-9.102
20	Mon_fame	0.227	-0.092	0.522	-0.884
21	Returnme	0.014	-0.445	-0.547	-11.726
22	Opriskme	0.011	0.014	2.888	2.341
23	Market share	0.002	0.002	0.131	-0.088

Table 4b – Comparison of index mean values 1992-1994 (strict failure definition)

INDICES		RATIO LEVEL			RATIO VARIATION		
		ACTIVE	STRESSE D	FAILED	ACTIVE	STRESSE D	FAILED
No.	Variable	Mean	Mean	Mean	Mean	Mean	Mean
1	Cc_pscme	0.503	0.025	0.370	-0.199	-5.771	-1.041
2	Cc_dmlme	1.112	-1.398	0.733	0.255	-3.978	-0.624
3	Cc_atme	0.128	-0.079	0.166	-0.348	-4.925	-1.045
4	Fat_atme	1.182	0.735	1.004	0.076	-0.106	-0.020
5	At_patme	6.869	16.506	10.975	0.122	-1.143	0.422
6	Db_attme	0.560	0.788	0.721	0.363	0.041	0.108
7	Ps_patme	4.659	7.888	7.429	0.243	-1.084	1.644
8	Of_fatme	0.062	0.387	0.067	0.057	0.507	0.125
9	Of_vame	0.176	0.539	-0.039	0.333	0.253	0.013
10	Am_iflme	0.137	0.089	0.074	0.441	0.290	0.787
11	Ri_atme	0.142	0.014	0.062	-0.004	-0.721	-0.228
12	Pr_patme	0.019	0.014	-0.540	-1.901	7.341	-97.365
13	Fa_iflme	7.895	1.460	3.330	0.422	0.758	0.458
14	Ut_atme	0.067	-0.017	-0.034	0.496	0.278	-2.190
15	Mon_atme	0.064	-0.025	-0.037	0.436	0.074	-2.471
16	Pr_fatme	-0.002	-0.730	-0.098	-2.936	-7.474	-36.732
17	Pr_csme	0.377	-5.024	-0.139	-2.093	-9.680	-34.958
18	Pr_atme	0.006	-0.085	-0.088	-3.188	-9.387	-42.901
19	Ui_dtme	0.145	-0.103	-0.114	-0.015	-2.457	-17.646
20	Mon_fame	0.227	-0.137	-0.035	0.522	0.220	-2.304
21	Returnme	0.014	-0.727	-0.093	-0.547	-1.979	-24.259
22	Opriskme	0.011	0.020	0.007	2.888	2.565	1.894
23	Market share	0.002	0.002	0.001	0.131	-0.132	-0.022

Table 5a – Comparison of index mean values 1995-1997 (wide failure definition)  
Source: Elaboration on MedioCredito Centrale data

INDICES		RATIO LEVEL		RATIO VARIATION	
No.	Variable	ACTIVE Mean	FAILED Mean	ACTIVE Mean	FAILED Mean
1	Cc_pscme	0.399	0.136	0.057	-3.876
2	Cc_dmlme	1.233	-0.291	-0.154	0.052
3	Cc_atme	0.116	-0.011	-0.074	1.024
4	Fat_atme	1.305	1.274	0.154	0.230
5	At_patme	6.715	*10.769	-0.034	*0.217
6	Db_attme	0.509	0.602	0.324	-0.073
7	Ps_patme	4.819	*7.957	0.302	*0.262
8	Of_fatme	0.043	0.065	0.158	0.147
9	Of_vame	0.146	0.244	0.280	0.368
10	Am_iflme	0.132	0.096	0.046	-0.008
11	Ri_attme	0.139	0.075	0.631	1.143
12	Pr_patme	0.100	*-0.253	-1.686	*4.769
13	Fa_iflme	9.028	5.080	0.002	-0.079
14	Ut_atme	0.078	-0.032	-0.534	19.491
15	Mon_atme	0.071	-0.039	0.297	14.102
16	Pr_fatme	-0.0002	-0.063	-0.335	-8.062
17	Pr_csme	1.103	-0.620	0.425	-9.834
18	Pr_atme	0.022	-0.052	-0.061	-8.205
19	Ui_dtme	0.359	-0.111	0.313	-2.506
20	Mon_fame	0.041	-0.020	0.060	19.303
21	Returnme	0.020	-0.060	-0.005	-2.015
22	Opriskme	0.010	0.012	1.299	4.647
23	Market share	0.0008	0.0004	0.684	-0.090
24	Cliefat3	35.043	31.746		

\*The indices marked with the asterisk present much higher values in the *stressed firms* category (See Table 7 just below) due to the fact that two observations report a very low net worth value. Being the sub-sample very small (7 out of 4106 observations), the estimated mean value is biased by the two outliers; the values reported in the table do not include them. However, the mean value including these observations is listed below:

5	At_patme	6.715	*71.257	-0.034	*9.281
7	Ps_patme	4.819	*50.189	0.302	*13.445
12	Pr_patme	0.100	*-18.072	-1.686	*40.256

Table 5b – Comparison of index mean values 1995-1997 (strict failure definition)  
Source: Elaboration on MedioCredito Centrale data

INDICES		RATIO LEVEL			RATIO VARIATION		
		ACTIVE	STRESSE D	FAILED	ACTIVE	STRESSE D	FAILED
No.	Variable	Mean	Mean	Mean	Mean	Mean	Mean
1	Cc_pscme	0.399	0.219	-0.774	0.057	-4.342	-2.478
2	Cc_dmlme	1.233	0.024	-1.101	-0.154	0.748	-2.034
3	Cc_atme	0.116	0.016	-0.080	-0.074	2.202	-2.510
4	Fat_atme	1.305	1.398	0.955	0.154	0.321	-0.042
5	At_patme	6.715	*8.557	15.509	-0.034	*0.329	-0.064
6	Db_attme	0.509	0.604	0.595	0.324	-0.049	-0.144
7	Ps_patme	4.819	*6.124	11.885	0.302	*0.346	0.053
8	Of_fatme	0.043	0.063	0.069	0.158	0.119	0.231
9	Of_vame	0.146	0.264	0.193	0.280	0.523	-0.047
10	Am_iflme	0.132	0.100	0.086	0.046	0.00001	-0.029
11	Ri_attme	0.139	0.096	0.022	0.631	0.594	3.120
12	Pr_patme	0.100	*-0.331	-0.075	-1.686	*-0.973	20.081
13	Fa_iflme	9.028	4.453	6.693	0.002	-0.085	-0.062
14	Ut_atme	0.078	-0.044	0.00004	-0.534	26.741	-2.259
15	Mon_atme	0.071	-0.052	-0.005	0.297	19.583	-2.341
16	Pr_fatme	-0.0002	-0.067	-0.053	-0.335	-0.979	-29.311
17	Pr_csme	1.103	-0.001	-2.211	0.425	-0.990	-36.367
18	Pr_atme	0.022	-0.054	-0.047	-0.061	-0.492	-31.344
19	Ui_dtme	0.359	-0.068	-0.221	0.313	0.973	-12.945
20	Mon_fame	0.041	-0.026	-0.002	0.060	26.486	-2.245
21	Returnme	0.020	-0.063	-0.052	-0.005	0.310	-8.989
22	Opriskme	0.010	0.005	0.030	1.299	1.734	12.415
23	Market share	0.0008	0.0005	0.0003	0.684	-0.096	-0.077
24	Cliefat3	35.043	41.824	69.333			

\*The indices marked with the asterisk present much higher values in the *stressed firms* category due to the fact that two observations report a very low net worth value. Being the sub-sample very small (7 out of 4106 observations), the estimated mean value is biased by the two outliers; the values reported in the table do not include them. However, the mean value including these observations is listed below:

5	At_patme	6.715	*92.938	15.509	-0.034	*12.397	-0.064
7	Ps_patme	4.819	*65.085	11.885	0.302	*17.909	0.053
12	Re_patme	0.100	*-25.070	-0.075	-1.686	*46.981	20.081

