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Cost Efficiency and Returns to Scope in Italian Investment Firms

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Abstract - This paper estimates cost efficiency and returns to scope of Italian investment firms during the period 1998−2002, following the stochastic frontier function approach. Results indicate a large inefficiency for Italian investment firms (with a high standard deviation across sample) and the absence of significant returns to scope.

Keywords: Stochastic Frontier, Efficiency, Returns to scope, Investment Firms.
JEL classification: D24; G24; L25.

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Introduction

Investment firms[1] In Italy in the last fifteen years have amplified their importance in the financial industry and have had an increasing role in financial markets, particularly in stock and bond markets. In this scenario it is important to measure the economic performances and the efficiency of investment firms, since economic efficiency is a general notion that can involve different aspects and characteristics of firms' activity. It is common to evaluate the economic performances of investment firms using balance sheet ratios such as: operating costs over gross revenue, return on equity (ROE), return on assets (ROA), expense to premium ratios, etc. However, over the last several years, a great number of studies has been conducted in which the economic efficiency of investment firms has been evaluated by estimating their efficient economic frontier functions.[2] Among economic frontier methodologies it is possible to distinguish between deterministic (non-parametric) frontier functions and stochastic (parametric) frontier functions.

The deterministic approach to the measurement of efficiency, i.e., the Data Envelopment Analysis (DEA henceforth), due to Farrell (1957), defines a frontier envelopment surface for all sample observations following a mathematical programming model. All the firms that do not lie on the frontier are inefficient; it is possible to calculate the individual score of inefficiency by measuring the distance from the frontier, as well as each firm's pier(s). By using DEA it is possible to define a benchmark of excellence (the efficient firm(s)) with respect to which evaluate all the other firms in the sample. The DEA does not imply any restriction about the functional form of fron-

[1]With the term "investment firms" we denote Italian banks and non-banks whose main activity is trading and asset management, associated in the Italian ASSOSIM. For a definition of the industry see the European Directive n.93/22/CEE or the ASSOSIM web site.

[2]The literature is too vast to be reviewed here. For a survey, see Amel *et al.* 2002.

tier functions. However, it is very sensitive to model-specification errors and it tends to become inaccurate with small samples since it assumes that there is no random error in the data. Moreover, it misrepresents those variations in outputs or inputs that are due to external and uncontrollable factors since (by assumption) it ascribes all deviation from the efficient frontier to inefficiency.

The stochastic frontier function approach (SFF, henceforth) requires the specification of the functional form and some assumptions about the error terms, but it leaves room to error in measurement and random factors that explain changes in inputs and/or outputs. SFF does not input all the distance from the efficient frontier to inefficiency, since it distinguishes core inefficiency from random error. It has contributed to extend the range of efficiency analysis by considering economies of scale and scope (given the set of technologies).[3]

Even if there is a general agreement about the existence of a large inefficiency in the financial industry the dimension of inefficiency reported in various studies differs widely (see Berger and Mester, 1997). Differences in the efficiencies of financial institutions seem to depend on: discrepancy in the concept of efficiency used, dissimilarity in methods of measurement, existence of correlates of efficiency, such as exogenous environmental variables.[4] Notwithstanding the divergences in estimated efficiencies and the dependence from exogenous variables, frontier efficiency methodologies have made the standard methods based on ratios to evaluate the economic performances of investment firms at least complemental.

In this paper investment firms' efficiency is considered; neither international nor intersectorial comparison is examined. Following the SFF approach, the paper estimates the core efficiency of investment firms without defining a benchmark of excellence, in order to highlighting if firms' over-

[3]See Kalirajan and Shand (1999) and Murillo-Zamorano (2004)

[4]See Becalli (2003).

all performances are adequate with respect to the realization of their own potentials. Cost efficiency is estimated, which refers to the problem of cost minimization, i.e., the optimal allocation of inputs given their prices. In order for a firm to be cost-efficient it must equal the marginal value product of an input to its marginal cost. By estimating the distance between the observed production's cost and the theoretically correct one that lays along the efficient isoquant, the stochastic measure of cost efficiency expresses both purely technical efficiency and allocative efficiency. Moreover, returns to scope[5] are considered too, in order to identify the profitability of joint production. This is particularly interesting since mergers and acquisitions in financial industry are commonly justified by the need of exploiting scope economies.[6]

The paper is organized as follows: in section 2 the stochastic cost function is defined and discussed. Section 3 reports data and comments. In section 4 cost efficiencies are estimated and the results are analyzed. In section 5 the returns to scope are modelled and evaluated. Concluding remarks follow in section 6.

1 Stochastic cost frontier functions

We estimate efficiency following the stochastic frontier function approach. A SFF assumes the following form:

[5]Returns to scope refer to the superadditivity of the production function while economies of scope denotes the subadditivity of cost function.There exists, under some mild assumptions, a biunivocal correspondence between the two concepts because of cost-production duality (Baumol *et al.*, 1982, Theorem p.62). However, this is true only under the hypothesis of optimization, i.e., revenue maximization or cost minimization, which implies full efficiency. Since our aim is to test inefficiency we cannot assume it; this implies that the duality of cost subadditivity - production superadditivty ceases to hold.

[6]Again, for a survey, see Amel *et.al.* (2002).

$$y_i = \beta x_i + v_i - u_i \tag{1}$$

where y_i is the log of firm's i dependent variable, x_i is the vector of explicative variables, β is the (row) vector of estimands, v_i is a random error which accounts for measurement errors and random factors and u_i is the inefficiency parameter. The latter is supposed to be distributed according to a $\mu-$truncated normal distribution, i.e., it is obtained by the truncation at zero of a normal distribution with mean μ and variance σ^2. It is estimated following a maximum likelihood iterated procedure[7] that provides an estimation of the average efficiency. Moreover, values of μ are compounded; the ratio of standard deviation for u and v is calculated as $\gamma = \frac{\sigma}{\sigma^2+\sigma_v^2}$, which provides an estimate of random (i.e. non-technical) inefficiency effects; the efficiency estimates of each firms are obtained as:

$$E(u_i|e_i) = \frac{1 - \Phi(\sigma_A + \frac{\gamma e_i}{\sigma_A})}{1 - \Phi(\frac{\gamma e_i}{\sigma_A})} \exp(\gamma e_i + \frac{\sigma_A}{2}) \tag{2}$$

where $\sigma_A = \sqrt{\gamma(1-\gamma)(\sigma^2+\sigma_v^2)}$; $e_i = (y_i - \beta x_i)$ and $\Phi(\cdot)$ is the distribution function of the standard normal random variable.

A stochastic cost function is analyzed, assuming a translog specification. More precisely, we adopt the following specification for the stochastic cost function:

$$\begin{aligned}\ln C_i = b_0 + b_1 \ln P_{L_i} + b_2 \ln P_{K_i} + b_3 \ln Q_i + \tfrac{1}{2}[b_4 \ln P_{L_i}^2 + b_5 \ln P_{K_i}^2 + b_6 \ln Q_i^2] \\ + b_7 \ln P_{L_i} \ln P_{K_i} + b_8 \ln P_{L_i} \ln Q_i + b_9 \ln P_{K_i} \ln Q_i + v_i - u_i\end{aligned} \tag{3}$$

where P_{L_i} is the price of labour of firm i, P_{K_i} is its price of capital, Q_i is the output of firm i and C_i is firm's i total cost.

[7] which can be run using any specific software package such as the computer program Frontier 4.1 (Coelli 1996).

The introduction of the translog function is due to Jorgenson *et al.* (1973) that use a second-order Taylor expansion in natural logarithms as an approximation of an unknown function. The translog form has been chosen because of its flexibility of the assumptions.[8]

2 The Data

The data used here are derived from financial statements of the Italian investment firms associated in Associazione degli Intermediari Immobiliari[9] (ASSOSIM). The sample consists of 242 observation (balance sheet of investment firms) for the period $1998 - 2002$.[10] Labour and capital costs are directly obtained by manipulation of financial statements of each investment firm. Capital, in particular, is compounded grouping all operating expenses less labour and interest expenses and it includes passive commissions. These are brokerages paid in order to acquire from other intermediaries some of financial services that investment firms sell to their customers (mainly foreign assets' negotiation). Therefore, it can be interpreted as one of the capital inputs that are used to produce the specific output "financial intermediation" dealt by investment firms. Price of labour and capital is defined as the total labour cost over the total number of employees (average salary) and the total cost of capital over the total fixed assets (average cost of capital), respectively.

The choice of the appropriate measures for the above-mentioned variables is not problematic; it is more difficult to define clearly what investment

[8] Vantages and disvantages of using a translog forms are discussed in Cummins and Weiss (1998).

[9] We have excluded from the sample those universal banks associated with the ASSOSIM for which it is impossible to obtain disaggregated data about their financial activities.

[10] The panel is unbalanced due to the processes of entry, exit and merges during the period of observation.

firms' outputs are and find the appropriate proxy to measure them. We can broadly identify three main typologies of their activities, given that they can exploit profits following three main roads; indeed, they can: *i*) deal to customers their financial intermediation services (intermediation activity, which includes trading and order routing, primary market activities and asset management); *ii*) manage their own portfolio of participations and assets; *iii*) exploit differences between active and passive interests in savings and deposits accounts ("interest margin").

While all three types of activity generate firms's revenues, the former is the most interesting variable to focus on in order to measure the activity of financial markets' intermediation performed by investment firms since it is an activity performed "on demand", i.e., it depends on the ability of each financial firms to cope with the market.[11] We therefore use data about intermediation to represent the typical investment firms' outputs.[12]

There is another advantage of focusing on these data. The intermediation activity placed upon order is made of three main typologies, namely, brokerage of securities and currencies, primary market activity and asset management.[13] Figures of active and passive commissions can be disaggregated into *i*) active and passive brokerage of securities and currencies; *ii*) active commissions accruing from primary market activity; *iii*) active and passive commissions stemming from asset management.[14] Therefore, by focusing on intermediation we can compute estimates of efficiency related to

[11] Moreover, revenues accruing from the other two activities are marginal.

[12] Other studies (Beccalli 2003) have compared (cost) efficiency using different proxies for revenues, and found that there are no significant variation between estimates obtained using different measures of output.

[13] There is a fourth residual category that groups commissions accruing from several other minor services dealt to customers such as marketing and advisory, stock holders's rights management, dividends distributions and similar. We call it "various".

[14] Notice, however, that it is not possible to acquire disaggregated data about costs and prices of each activity.

each typology of activity and use them to test for the existence of returns to scope within all the components of the intermediation activity.

Table 1 reports aggregate yearly data of variables used for our estimates as well as other aggregates useful for comparisons, and yearly percentage changes. Overall revenues from financial intermediation (Q henceforth) increase from year 1998 to year 2000, when they reach $38,209,033$ euros; then they decrease in the following years down to $27,330,047$ euros in year 2002. On the contrary total costs (TC) increase continuously from $14,707,965$ euros to $35,044,029$ euros. The ratio of the former over the latter, i.e., Q/TC decreases from 1.469 in year 1998 to 0.689 in year 2002, showing a worsening of investment firms performances.[15] It is worth noticing that the decrease in Q/TC derives from the two different dynamics of total costs excluding passive commissions ($TC1$), and passive commissions (PC). $TC1$ increase from $11,409,913$ euros (1998) to $28,001,670$ euros (2002), and the ratio $Q/TC1$ decreases from 1.894 in year 1998 to 0.976 in year 2002. More evident is the increase in costs deriving from passive commissions, that boost from $3,298,052$ euros at the beginning of the sample period to $11,675,519$ euros at the end of the period; the ratio Q/PC decreases from 6.552 in year 1998 to 2.341 in year 2002. Labour cost increases from $5,478,648$ euros to $11,607,871$ euros, with an increasing trend but with two different dynamics: a very steep one up to year 2000, and an almost flat increase thereafter (+6% in year 2001 and +7% in year 2002). The price of labor increases up to year 2000, when it reaches a maximum of $114,721$ decreasing thereafter down to $99,712$ euros in the last year of observation.

It is dramatically evident that the worsening of investment firms' performances is due to the abnormal growth of PC. The evolution over time of PC shows an increasing trend with respect to the relative reduction of other

[15] Notice moreover that from year 2001 onward overall revenues from financial intermediation do not cover total firms' costs.

costs, such as labour, whose dynamic is completely ineffective and it only mitigates the critical effects on profitability.

[Insert table 1 here]

Table 2 shows average data of active and passive commissions disaggregated into brokerage (of securities and currencies), primary market activity and asset management. Active commissions show that the mean is twice as much as the median, putting in evidence that a large part of firms have a small dimension. The disaggregate analysis of active commissions shows that investment firms' core business is represented by brokerage and primary market activity, while asset management is residual. Passive commissions put in evidence that investment firms have a different attitude with respect to the possibilities of acquiring financial products dealt by other institutions. The mean is seven times the median and the standard deviation is three times the mean; it is therefore possible to infer that passive commissions are more weighed for large and very large firms. The main component among passive commissions are payments for brokerage of securities and currencies. In this case the analysis might suggest that investment firms (even the larger ones) face strong barriers to entry into foreign markets (which are increasing over time) which not only put their balance under pressure but looms on their ability to stay in the international financial markets.

[Insert table 2 here]

3 Average Efficiencies

Results of the estimates of cost efficiencies indicate the existence of quite large mean inefficiencies. Table 3 reports average cost efficiencies of investment firms for years $1998 - 2002$.

[insert table 3 here]

The values of γ show that almost all the inefficiency is to be attributed to

internal factor rather than to random events. The figures of μ demonstrate that the choice of a $\mu-$truncated normal distribution is to be preferred to the normal truncated one. The overall goodness of choice of our specification is confirmed by the figures of the Likelihood Ratio tests, that are all highly significative.

The cost efficiency results indicate the existence of a wide inefficiency for investment firms. The efficiency decreases in the period: from 0.638 (the maximum) in year 1998 to 0.568 (the minimum) in year 2002. The evolution over time of the efficiency scores have an up and down movement. Notice, that the figure of year 1998 seems to confirm the findings about Italian firms for the period $1995 - 1998$ reported in Beccalli (2003).[16]

In table 4 we partition the set of all firms according to their size into five classes in order to study how average cost efficiency of each set changes among groups and overtime.

[insert table 4 here]

Four classes[17] of firms have a similar trend in their own efficiency scores: all of them show a double digit decreasing in efficiency. The smallest and the largest investment firms have the large decreasing of $0,140$ in the average efficiency. The mean efficiency of the smallest investment firms (less than $1M$ of euro of active commissions) decreases from 0.607 in year 1998 to 0.467 in year 2002, with a minimum (0.228) in year 2000. For very large firms

[16]Beccalli's (2003) work differes in the definition of firms output (she uses total earning assets) and for the choice of the model to be tested. In particular Beccalli tests both a half-truncated specification and a Z_i-truncated model in which Z_i is a vector of firm-specific variables that varies over-time. Our figure of average cost inefficiency for the year 1998 coincides with the figure reported in that work for the half-truncatet model and is slightly bigger than the mean efficiency obtained with the truncated one.

[17]We understand that any dimensional classification can be arbitrary; however, we have chosen that classification for which firms' distribution across classes and years is as stable as possible. For each class the *sup* belongs to the class while the inf is excluded.

(more than $90M$ of euros) the mean efficiency declines from 0.407 in year 1999 to 0.267 in year 2002, the miminum of the period. For large investment firms ($30 - 90M$ of euros) efficiency declines from 0.689 (1998) to 0.583 (2002) and standard deviation increases from 0.234 (1998) to 0.321 (2002) putting in evidence an increasing difformity in the performance of firms in this class. The medium-large (from $10M$ to $30M$ of euros) firms efficiency also decreases in the period, from 0.640 (1998) to 0.579 (2002), but the firms have a more stable performance as the variation of standard deviation shows. The medium-size ones (from $1M$ to $10M$ of euros) have a stable efficiency, indeed it increases from 0.602 (1998) to 0.605 (2002), and this behavior is common for all the firms in the class as the values of standard deviation denote.

The reported estimation seems to suggest that the medium and the medium-large investment firms are more able to use labour and skill to make profits or reduce losses as compared to small and very large firms.

Notice that the degree of correlation between firms' efficiency and their ranking (reported in the last column of table 3) shows that the relative efficiency score does not changes much over time, since it ranges from 0.723 to 0.829. Therefore, the change in efficiency across groups observed in table 4 seems to be due to the entry and exit of marginal firms from one group to the other rather than a change in average efficiencies.

4 Returns to Scope

In this section we consider the three main components of investment firms' intermediation activity, namely, brokerage of securities and currencies, primary market activity and asset management, aiming at analyzing whether there are gains in efficiency that investment firms can exploit by offering a whole mix of activities.

Given the results of the previous section we cannot assume that firms are efficient, i.e. operating at the optimal level (that level that maximize product or minimize cost). Therefore, we need to distinguish between returns to scope and economies of scope.[18] We focus on returns to scope, i.e., the superadditivity of the production function and estimate it indirectly by comparing firms' efficiency, measured with respect to a single output, with the efficiency measured using bundles of output. This allows us to encompass in the (possible) returns to scope two sources of gains in efficiency: *i*) improvement in resources' allocation (i.e. input reduction) and *ii*) increase in output that depends on the joint offer of the product mix, such as gains in outputs' market value due to customers' appreciation of the purchase of a whole mix of products or due to the increase in output quality when some mix of products are offered.[19]

Three models are set to analyze scope returns between each pair of activities, namely, between brokerage and asset management (model 1), between primary market activity and asset management (model 2) and between brokerage and primary market activity (model 3).[20]

In each model, we follow a two-steps procedure. In step 1, we use a time-varying, random effect, unbalanced panel data maximum likelihood specification of stochastic frontier (Battese and Coelli, 1992) to run two regressions and obtain firms' estimates of technical efficiency for each regression. The first one is performed taking into account data of active and passive commissions accruing from just one single activity per each model, that is, brokerage for model 1 and 3 and primary market activity for model 2; the second regres-

[18] See the above footnote 5.

[19] Notice that, on top of the argument exposed in the text, we were forced to follow the procedure highlighted there instead of estimating a multiple-output cost function because of a lack of data about input-specific costs and prices.

[20] We have not considered a fourth model in which the three activities are altogether because of data numerosity problems. See the following footnote.

sion is performed considering active and passive commissions derived from the union of those two activities whose relationship is tested in each model, namely, brokerage plus asset management in model 1, primary market activity plus asset management in model 2 and brokerage plus primary market activity in model 3.

In step two we compare, in each model, the (difference from the mean of each firms') efficiency estimates obtained in the second regression over the (mean difference of) estimates derived in the first regression running using OLS.

The following list summarizes the procedure followed here for the three models.[21]

Summary 1 (Model 1: brokerage vs. asset management) ***Step 1.*** *Two production functions are defined to obtain efficiency estimates:*

$$\ln Q_{a_{it}} = b_{0t}+b_1 \ln L_{it}+b_2 \ln K_{a_{it}}+\frac{1}{2}(b_3 \ln L_{it}^2)+\frac{1}{2}(b_4 \ln K_{a_{it}}^2)+b_5 \ln L_{it} \ln K_{a_{it}}+v_{it}-u_{it} \tag{4}$$

$$\ln Q_{b_{it}} = b_{0t}+b_1 \ln L_{it}+b_2 \ln K_{a_{it}}+\frac{1}{2}(b_3 \ln L_{it}^2)+\frac{1}{2}(b_4 \ln K_{a_{it}}^2)+b_5 \ln L_{it} \ln K_{a_{it}}+v_{it}-u_{it} \tag{5}$$

where $Q_{a_{it}}$ are active commissions from brokerage of securities and currencies; $K_{a_{it}}$ is physical capital plus passive commissions from brokerage of se-

[21] The data used for models 1, 2, and 3, are not the same even when the same type of activity is considered, since the subsets of firms that perform each couple of activity are not equal. For instance, in model 1 we consider the subset of firms that during the observation period performed activity of brokerage and asset management, while data about brokerage in model 3 is referred to the subset of firms that performed activities of brokerage and primary market activity; clearly, not all firms that in the period of observation made brokerage of securities and currencies were active in the primary market (and the same is true for the other couples of activities). Notice, moreover, that results of our step 2 would not be different if in equation 4 brokerage was replaced by asset management, and the same is true -mutatis mutandis- for model 2 and 3.

curities and currencies; $Q_{b_{it}}$ are active commissions from brokerage of securities and currencies plus active commissions from asset management; $K_{b_{it}}$ is physical capital plus passive commissions from brokerage of securities and currencies plus passive commissions from asset management. ***Step 2.*** *The difference from the mean of each estimates obtained from equation 5 is regressed over the difference from the mean of each estimate obtained from equation 4:*

$$\tilde{e}_{a_i} = \mu_1 \tilde{e}_{b_i} + \varepsilon_i \tag{6}$$

where $\tilde{e}_{a_i} = (e_{a_i} - \bar{e}_{a_i})$ is the difference from the mean of firm's i efficiency estimated in equation 4 by means of equation 2 (and similarly for $\tilde{e}_{b_i}$); μ_1 is the estimand and ε_i is a $N \sim (0, \sigma^2)$ error.

Summary 2 (Model 2: primary market activity vs. asset management) ***Step 1.*** *Two production functions are defined to obtain efficiency estimates:*

$$\ln Q_{c_{it}} = b_{0t} + b_1 \ln L_{it} + b_2 \ln K_{c_{it}} + \frac{1}{2}(b_3 \ln L_{it}^2) + \frac{1}{2}(b_4 \ln K_{c_{it}}^2) + b_5 \ln L_{it} \ln K_{c_{it}} + v_{it} - u_{it} \tag{7}$$

$$\ln Q_{d_{it}} = b_{0t} + b_1 \ln L_{it} + b_2 \ln K_{d_{it}} + \frac{1}{2}(b_3 \ln L_{it}^2) + \frac{1}{2}(b_4 \ln K_{d_{it}}^2) + b_5 \ln L_{it} \ln K_{d_{it}} + v_{it} - u_{it} \tag{8}$$

where $Q_{c_{it}}$ are active commissions from primary market activity; $K_{c_{it}}$ is physical capital[22]; $Q_{d_{it}}$ are active commissions from primary market activity plus active commissions from asset management; $K_{d_{it}}$ is physical capital plus passive commissions from asset management. ***Step 2.*** *The difference from the mean of each estimates obtained from equation 8 is regressed over the difference from the mean of each estimate obtained from equation 7:*

$$\tilde{e}_{c_i} = \mu_2 \tilde{e}_{d_i} + u_i \tag{9}$$

where $\tilde{e}_{c_i} = (e_{c_i} - \bar{e}_{c_i})$ is the difference from the mean of firm's i efficiency estimated in equation 7 by means of equation 2 (and similarly for $\tilde{e}_{d_i}$); μ_2 is the estimand and u_i is a $N \sim (0, \sigma^2)$ error.

[22]There are no passive commissions from primary market activity.

Summary 3 (Model 3: brokerage vs. primary market activity) ***Step 1.*** *Two production functions are defined to obtain efficiency estimates:*

$$\ln Q_{e_{it}} = b_{0t}+b_1 \ln L_{it}+b_2 \ln K_{e_{it}}+\frac{1}{2}(b_3 \ln L_{it}^2)+\frac{1}{2}(b_4 \ln K_{e_{it}}^2)+b_5 \ln L_{it} \ln K_{e_{it}}+v_{it}-u_{it} \tag{10}$$

$$\ln Q_{f_{it}} = b_{0t}+b_1 \ln L_{it}+b_2 \ln K_{f_{it}}+\frac{1}{2}(b_3 \ln L_{it}^2)+\frac{1}{2}(b_4 \ln K_{f_{it}}^2)+b_5 \ln L_{it} \ln K_{f_{it}}+v_{it}-u_{it} \tag{11}$$

where $Q_{e_{it}}$ are active commissions from brokerage of securities and currencies; $K_{e_{it}}$ is physical capital plus passive commissions from brokerage of securities and currencies; $Q_{f_{it}}$ are active commissions from brokerage of securities and currencies plus active commissions from primary market activity; $K_{f_{it}}$ is physical capital plus passive commissions from brokerage of securities and currencies. ***Step 2.*** *The difference from the mean of each estimates obtained from equation 11 is regressed over the difference from the mean of each estimate obtained from equation 10:*

$$\tilde{e}_{e_i} = \mu_3 \tilde{e}_{f_i} + u_i \tag{12}$$

where $\tilde{e}_{e_i} = (e_{e_i} - \bar{e}_{e_i})$ is the difference from the mean of firm's i efficiency estimated in equation 10 by means of equation 2 (and similarly for $\tilde{e}_{f_i}$); μ_2 is the estimand and u_i is a $N \sim (0, \sigma^2)$ error.

Returns to scope can be analyzed studying the sign and the significativity level of $\mu_i, i \in (1, 2, 3)$. More precisely, the null hypothesis $H_o : \mu_i = 1$ corresponds to the case of no returns to scope, given that there would be an additive production function. For instance, in model one we would have that $\tilde{e}_{a_i} = \tilde{e}_{b_i} + u_i$, which means that there is no significative gain in efficiency from grouping activities of brokerage with asset management (and similarly for model 2 and 3). The sign of μ_i shows whether there are gains in efficiency (i.e. positive returns to scope) or negative returns to scope (production

subadditivity). The results are reported in Table 5.[23]

[Insert tables 5 here]

It shows that there exist (moderate) returns to scope only between primary market activity and asset management ($\mu_i = 1.163$). On the contrary there exist negative returns to scope between brokerage and asset management ($\mu_i = 0.778$) and between brokerage and primary market activity ($\mu_i = 0.681$). These outcomes put in evidence that only in one case the investment firms find (slightly) profitable to manage jointly more than one activity, namely, the the primary market one and the asset management one. Generally, it would be preferable to externalize these activities and focus on the core business.

5 Concluding remarks

In this paper the efficiency of Italian investment firms is estimated by using the stochastic frontier function method during the period $1998 - 2002$. It is shown that the average efficiency is around 62% for years 1998-2002. Passive commissions play a relevant role in explaining the inefficiency of Italian investment firms since they show an increasing trend, larger than the other costs. On the contrary the trend of active commissions had been increasing until year 2000 and it decreased in the following years. In year 2002, active commissions are only two third of their amount in year 2000.

We find that inefficiency appears to be larger for the small and very large firms and decreasing from the large to the medium ones. It seems that all the medium investment firms have a virtuous skill to face the markets. As a consequence, it is possible to deduce that efficiency does not depends mainly from size but from different character of firms, such as some exoge-

[23] The data we used for each panel are: 37 firms, 112 observations for model 1; 32 firms, 96 observations for model 2; 46 firms, 152 observations for model 3.

nous environmental variables.[24] We estimate returns to scope and find that they arise only between asset management and primary market activity; yet they are modest. Returns to scope do not emerge between other investment firms' activities; these, on the contrary, show negative impacts on the joint efficiency when brokerage is considered (i.e., negative returns to scope between brokerage and primary market activity and between brokerage and asset management).

Summing up, it appears that Italian investment firms are facing a critical time in which they have to increase their efficiency by increasing revenues and reducing costs (mainly cost of passive commissions). The existence of returns to scope only between two specific activities and negative returns to scope between brokerage with the other activities seems to suggest that investment firms can better gain efficiency by inducing a higher level of specialization among them, creating niche markets and focusing on their specific skills.

6 References

Amel, D., Colleen, B., Panetta, F. and Salleo, C. (2002), Consolidation and Efficiency in the Financial Sector: a Review of the International Evidence, Bank of Italy, Tema di Discussione n. 464, December.

Battese, G.E. and Coelli, T. (1992) Frontier Production Function, Technical Efficiency and Panel Data: with Applications to Paddy Farmers in India, Journal of Productivity Analysis, 3, 153-169.

Baumol, W. J., Panzar J. C. and Willig, R.D., (1982), Contestable Markes and the Theory of Industry Structure, Harcourt Brace Jovanovic, New York.

Berger, A.N. and Mester, L.J. (1997) Inside the Black Box: What Explains Differences in the Efficiencies of Finanacial Institutions?, Journal of Banking and Finance, 21, 895-947

[24] See Becalli (2003) for more discussions about this point.

Beccalli, E. (2003), Cross-country Comparisons of Eefficiency: Evidence from the UK and Italian Invstment Firms, Journal of Banking and Finance, forthcoming.

Coelli, T., Rao, D.S. Prasada and Battese, G.E. (1998), An Introduction to Efficeincy and Productivity Analysis, Kluwer Academic Publisher, Dordrecht.

Coelli, T. (1996), A guide to FRONTIER Version 4.1: A Computer Program for Frontier Production Function Estimation, CEPA Working Paper 96/07, University of New England, Armindale.

Cummins, J.D. and Weiss, M.A. (1998), Analyzing Firm Performance in the Insurance Industry Using Frontier Efficiency Methods, The Wharthon Financial Institutions Center Working Paper Series, 98/22.

Farrell, M.J. (1957), The Measurement of Productive Efficiency, Journal of the Royal Statistical Society, Series A, CXX, 3, 253-290.

Jorgenson, D.W., Christensen L.R. and Lau, L.J. (1973) Transcendental Logarithmic Production Frontiers, Review of Economics and Statistics, 55, 28-45.

Kalirajan, K.P. and Shand, R.T. (1999), Frontier Production Functions and Technical Efficiency Measures, Journal of Economic Surveys, 13, 149-172.

Murillo-Zamorano, L.R. (2004), Economic Efficiency and Frontier Techniques, Journal of Economic Surveys, 18, 33-77.

websites:

ASSOSIM: *http://www.assosim.it*

Descriptive statistics of inputs, outputs and prices. Aggregate yearly figures

	98	99	*% 98-99*	00	*% 99-00*	01	*% 00-01*	02	*% 01-02*
Q	**21.608.204**	**26.482.082**	***23%***	**38.209.033**	***44%***	**33.352.881**	***-13%***	**27.330.047**	***-18%***
PC	3.298.052	3.814.725	*16%*	7.129.394	*87%*	10.495.509	*47%*	11.675.519	*11%*
ratio Q/P	6,552	6,942		5,359		3,178		2,341	
TC	**14.707.965**	**19.161.653**	***30%***	**30.951.688**	***62%***	**35.044.029**	***13%***	**39.677.188**	***13%***
TC1	11.409.913	15.346.928	*35%*	23.822.294	*55%*	24.548.520	*3%*	28.001.670	*14%*
ratio Q/TC	1,469	1,382		1,234		0,952		0,689	
ratio Q/TC1	1,894	1,726		1,604		1,359		0,976	
Labour	5.478.648	7.013.457	*28%*	10.284.712	*47%*	10.865.671	*6%*	11.606.871	*7%*
Price of L	**90.705**	**106.290**	***17%***	**114.721**	***8%***	**103.768**	***-10%***	**99.712**	***-4%***
Capital (K) (*)	9.229.317	12.148.195	32%	20.666.976	70%	24.178.358	17%	28.070.317	*16%*
Price of K (inc. passive comm)	**0,88**	**0,45**	***-49%***	**0,48**	***8%***	**0,54**	***12%***	**0,52**	***-4%***
Physical Capital (**)	5.931.265	8.333.470	41%	13.537.582	62%	13.682.849	1%	16.394.799	*20%*

figures are in euro, percentage changes are in italics
Bold: variables used for eff. estimates. Normal: other variables used for comparations
Q = total active commissons derived from intermediation
TC=total costs (including passive commissions)
TC1= total costs excluding passive commissions
PC = total passive commission paid by financial firms
(*) = total cost of capital, including PC (operating expenses less labour and interest expenses plus passive commmissions/ total fixed assets)
(**) = total cost of capital excluding PC (operating expenses less labour and interest expenses/ total fixed assets)

Table 1

Descriptive statistics of inputs and outputs (disaggregated into brokerage, primary market activity and assets management) averages of total observations, years 1998-2002

	Mean	Median	St. Dev.	Min	Max
Q	29.166.580,78	14.246.085,00	43.683.697,26	51.295,00	320.530.199,00
PC	7.265.754,41	1.138.887,97	22.597.118,01	0,00	239.699.352,00
Qa	13.889.004,83	4.346.530,51	21.604.839,59	0,00	163.702.636,00
Qc	6.461.540,26	280.368,64	22.677.391,01	0,00	201.138.000,00
Qpm	1.160.254,36	146.682,89	2.191.692,43	0,00	18.685.000,00
Pca	2.714.609,45	197.029,00	7.516.974,75	0,00	62.758.195,00
Ppm	165.061,93	0,00	458.069,76	0,00	3.267.106,34

figures are in euro
Q = total active commissons derived from intermediation
PC = total passive commission paid by financial banks
Qa = active commissions from brokerage of securities and currencies
Qc = active commissions from primary market placement
Qpm = active commissions from asset management
Pca = passive commissions from brokerage of securities and currencies
Ppm = passive commissions from asset management

Table 2

Cost Efficiency (statistics)

year	*cost eff.*						correlation
	mean	median	s.dev.	γ	LR	μ	*eff-ranking (*)*
1998	**0,638**	0,641	0,220	0,999	9,89	0,24	-
1999	**0,653**	0,663	0,195	0,970	6,12	-2,57	0,723
2000	**0,574**	0,598	0,253	0,995	4,97	-3,83	0,822
2001	**0,670**	0,735	0,186	0,960	4,16	-2,33	0,718
2002	**0,568**	0,562	0,268	0,999	10,94	-0,29	0,829

Observations: 48 in 1998; 54 in 1999; 41 in 2000; 49 in 2001; 50 in 2002
(*) efficiency ranking; correlation between year t and year t+1.
μ–truncated distribution

Table 3

Average Efficiency (volumes of revenues*)

year	*cost efficiency*																			
	size(*)			# obs	*size(*)*			# obs	*size(*)*			# obs	*size(*)*			# obs	*size(*)*			# obs
	≤1000				**1,000-10,000**				**10,000-30,000**				**30,000-90,000**				**>90,000**			
	mean	median	dev.st.		mean	median	dev.st.		mean	median	dev.st.		mean	median	dev.st.		mean	median	dev.st.	
1998	0,607	0,756	0,322	3	0,602	0,557	0,231	15	0,640	0,665	0,196	18	0,689	0,722	0,234	12	-	-	-	0
1999	0,228	0,279	0,104	3	0,687	0,720	0,183	18	0,673	0,658	0,126	16	0,756	0,793	0,112	13	0,407	0,347	0,178	4
2000	0,231	0,231	0,275	2	0,573	0,571	0,268	12	0,483	0,429	0,193	10	0,708	0,727	0,182	12	0,576	0,787	0,339	5
2001	0,707	0,707	0,068	2	0,654	0,745	0,224	18	0,714	0,747	0,147	14	0,666	0,692	0,120	9	0,610	0,615	0,260	6
2002	0,467	0,331	0,348	4	0,605	0,595	0,235	18	0,579	0,610	0,262	16	0,583	0,610	0,321	10	0,267	0,267	0,097	2

* classes: thousands of euro of active commissions from brokerage, primary market activity and asset management + various

Table 4

Returns to Scope

	μi	s.e.	test: μi =1
mod.1	0,778	0,070	***
mod.2	1,163	0,066	**
mod.3	0,681	0,090	***

test:
** = rejected at 95 % conf. int.
*** = rejected at 99 % conf. int.

model1: Eai=μ1Ebi+ui
Eai=Eff obs i, model 1, comm. from brokerage of securities and currencies
Ebi=Eff obs i, model 1, comm. from brokerage of securities and currencies + asset mangement
Panel: 112 observations, 37 firms.

model2: Eci=μ2Edi+ui
Eci=Eff obs i, model 2, comm. from primary market activity
Edi=Eff obs i, model 2, i.e., comm. from primary market activity + asset management.
Panel: 96 observations, 32 firms.

model3: Eei=μ3Efi+ui
Eei=Eff obs i, model 3, i.e., comm from brokerage of securities and currencies
Efi=Eff obs i, model 3, comm. from brokerage of securities and currencies + primary market activity.
Panel: 152 observations, 46 firms.

notice: all parameters are to be intended as differencies from the mean

Table 5