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THE EFFICIENCY OF SPANISH MUTUAL FUNDS COMPANIES: A SLACKS – BASED MEASURE APPROACH

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Abstract

This paper is the first analysis of the efficiency of Mutual Funds companies in Europe. Based on the recent approach of Holod and Lewis (2011), our paper overcomes some of the potential limitations of the DEA methodology by applying the variations to the slacks-based measure (Tone, 2010). Our fund-company model questions the significant role of the portfolio management activities of the company in the distribution results and therefore in the final profits obtained by the company shareholders. Finally, the application of SBM Variation III finds several globally inefficient but locally efficient companies according to standardized size of competitors.

Keywords: *Mutual funds companies, Efficiency, DEA, SBM, Sub-Stages approach*

JEL: G20, G23

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1. Introduction

Over the last decades, the landscape for the financial sector has been subject to a massive grade of structural changes. The internationalization and deregulation of markets, technological advances, and European monetary integration have changed the overall competition map of the financial industry. This process has entailed changes in the efficiency and productivity of the financial firms and in their diverse business units. As a consequence of the increasing importance of this industry[1], there has been an extensive literature of efficiency in financial institutions during the last decades, basically focused on the banking and insurance companies.

Data Envelopment Analysis (DEA) has been one of the most popular frontier efficiency methods in this literature (e.g., Berg et al. 1991; Berg et al. 1993; Schaffnit et al. 1997; Mlima and Hjalmarsson 2002; Cummins et al. 2004; Casu et al. 2004; Cummins and Xie 2008; Cummins et al. 2010; and recently Holod and Lewis 2011)[2].

In addition, the lack of DEA requirements to any functional form between the inputs and outputs of this method has made this frontier methodology quite interesting for the performance evaluation of financial portfolios since the original contribution of Murthi et al. (1997).[3] DEA is in fact an alternative approach to traditional performance measures which assume functional relationships between return and risk.[4] Lozano and Gutierrez (2007) provide a complete review of the increasing number of empirical studies which use DEA frontiers to assess the performance of mutual funds and hedge funds.

[1] In the case of banks, the total sector assets in the five largest European economies (France, Germany, Italy, Spain and the UK) experienced an increase rate of 340% in nominal terms between 1985 and 2004 (See Goddard et al., 2007).

[2] Some other studies are Drake and Howcroft (1994); Yeh (1996); Thompson et al. 1997; Athanassopoulos (1997); Sherman and Rupert (2006); Tortosa et al. (2008); Chen et al. (2009); and Eling and Luhnen (2010).

[3] DPEI index considers the mutual fund returns as the only output, and the standard deviation and transactional costs as inputs. Other papers that apply DEA to evaluate performance of institutional portfolios are Basso and Funari (2001, 2003), Daraio and Simar (2006), Gregoriou et al. (2005), Eling (2006), and Lozano and Gutierrez (2007, 2008).

[4] Choi and Murthi (2001) indicate that the Sharpe index is similar to a Constant-Returns-to-Scale (CRS) convex frontier model applied to a single input (risk) and a single output (return). That is the reason why many authors have used CRS models instead of Variable-Returns-to-Scale (VRS) models.

However, while an extensive research has been devoted to evaluate the efficiency in banks and insurance companies, as far as we know, only Zhao and Yue (2010) have studied the efficiency of mutual funds management companies.[5] These authors divide the core competence of a mutual fund company into a subsystem of portfolio investment and a subsystem of marketing and service. That is, the fund company manages financial assets to get returns derived from assuming certain levels of risk, but the fund company also pursues to enlarge the company assets constantly by gaining money inflows into the mutual funds managed by the company and thereby obtaining higher fees. However, these authors do not consider the potential interaction between both subsystems.

This scarce literature in mutual funds companies might be explained by the difficulty to identify specific models and variables for these DMUs without replicating merely the well-known literature focused on banks and insurance companies. Therefore, in order to work with appropriate evaluation models, it should be desirable to have a range of possibilities of specific-industry variables and conceptual models which should further complement the banking and insurance approach. As far as we know, our study fills this gap in the literature by analyzing one of the most relevant European fund industries, Spain. Our multi-management stage model based on Holod and Lewis (2011) and Berkowitz and Qiu (2003) includes a set of detailed variables which better captures and complement the interaction between the management stages proposed by Zhao and Yue (2010).

However, the important market concentration of the Spanish fund companies could be the most challenging feature to get an appropriate evaluation for this industry. DEA may fail to identify the appropriate 'best practice' competitors that should be the benchmark of the DMUs analyzed when there are striking differences in the management characteristics. That is, when the reference frontier is formed by DMUs with extremely different qualities than the DMU to be analyzed. This limitation could question the accuracy of DEA results in those industries with assorted competitors, such as the Spanish fund industry.

Our study overcomes the aforementioned limitation by using the recent and unexplored variations of the well-known slacks-based measure (SBM) proposed by Tone (2001). These new variations developed by Tone (2010) allow for the appropriate

[5] Recently, Medeiros (2010) also analyzes the changes in total productivity of a sample of Portuguese Pension Fund Companies by means of DEA-Malmquist Index.

comparison of DMUs with more homogeneous reference sets, thereby fitting fully to the assorted characteristics displayed by the Spanish mutual fund industry.

The paper is set forth as follows: Section 2 shows the major concepts and variables of our proposal of multi-management stages model; Section 3 shows the Variations of the SBM in the DEA methodology to compute the efficiency scores; Section 4 illustrates the main empirical results of the study; and Section 5 summarizes the findings of the paper and the further questions to be addressed by this research.

2. Multi-management stages model of mutual funds companies

2.1 The conceptual model

The interest in the analysis of the efficiency of the mutual fund industry is quite similar to that addressed by the extensive literature in other financial sectors such as banking and insurance. This industry employs skilled labor, has spillover effects on other sectors and tax returns, and provides important liquidity to the financial system and wealth for retail and institutional investors. In addition, it is worth noting that mutual fund activities reduce the exposure of banks to financial-services industry risk, increase scale economies and bank profitability, thereby improving the operating performance of banks (Gallo et al., 1996; Asaftei, 2008).

A major problem to begin the definition of our model is the apparent controversy between the two major conceptual approaches to the efficiency of banks and other financial institutions: the production approach and the asset approach. In the production approach, the banks are treated as companies that use capital and labor to produce different categories of deposit and loan accounts. In other words, banks provide services to customers by administering the customers' financial transactions, keeping customer deposits, issuing loans, cashing cheques and managing other financial assets (e.g. Berg et al. 1991; Berg et al. 1993; Parson et al. 1993; and Schaffnit et al. 1997). But in the asset approach, the banks are viewed as intermediaries of financial services rather than producers of loans and deposit account services. In this approach the bank accepts deposits from customers and transforms them into loans to clients. The inputs are labor, materials and deposits, and the outputs are

loans and other income generating activities, namely banking services (e.g. Battese et al. 2000; Berger et al. 1993; Mester 1996; and Thompson et al. 1997).[6]

Holod and Lewis (2011) recently argue that the main confusion in the previous studies has been the disagreement about the selection of appropriate inputs and outputs, and therefore the conceptual approach used to analyze the banking sector. According to these authors, banks use their employees and fixed assets to obtain deposits, to invest and to lend money with the purpose to generate profitability. In one first stage the deposits serve as the principal funding resource of a bank's lending and investing activity as second stage. So, the result of the deposits on bank efficiency depends on the efficiency at both stages. That is, in contrast to the extensive previous literature that treats deposits as a pure input or a pure output, the main contribution of Holod and Lewis (2011) is the double role of deposits in the bank production process where the deposits are an intermediate product, one output from the first and one input to the second stage.

Based on these interacting assumptions between the in-bank management stages proposed by Holod and Lewis (2011) to end with the well-known debate between production and asset approach, we develop a specific model to appropriately evaluate the efficiency of mutual funds companies. First, it is important to consider the main management areas within a fund company. According to Berkowitz and Qiu (2003) (see Figure 1), there are three different management stages in the production process of a fund company.

[6] Mlima and Hjalmarsson (2002) affirm that the non-parametric models are usually based on the production approach, thereby taking deposits to be the output based on positive consumption of labor and material. Casu et al. (2004) state that both approaches sometimes identify conflicting findings for the sources of productivity of European banks for individual years but not in terms of identifying the components of productivity growth.

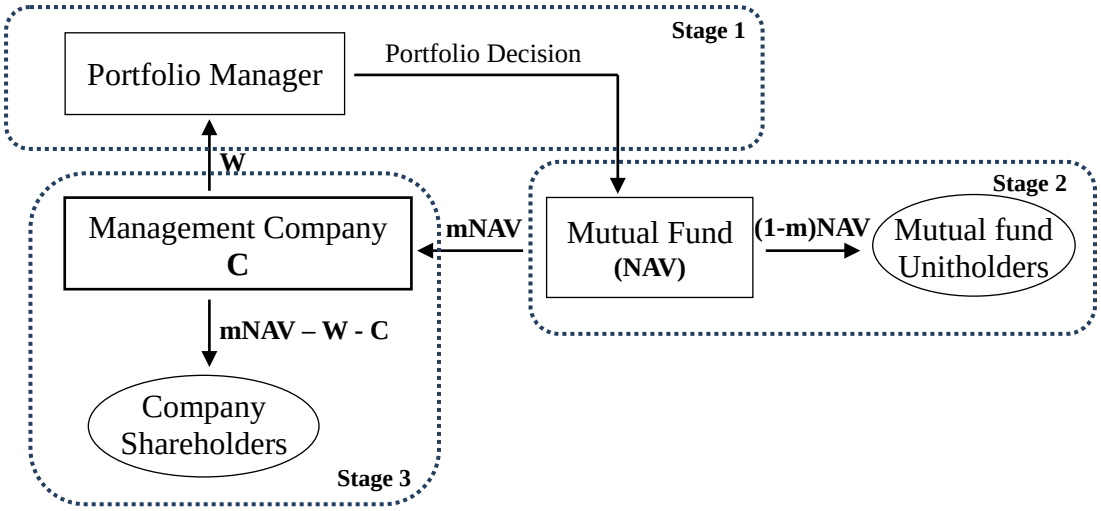

Figure 1 Mutual fund company complex based on Berkowitz and Qiu (2003)

Where: *m* is the fees ratio of the company, *NAV* is the net assets value of the mutual fund, *W* is wages of the company, and *C* is the total operating expenses of the company.

The most intuitive area would be that in charge of portfolio management (Stage 1), which is in fact described as the main activity by the Spanish Official Business Registry. But other important area of the company would be that referring to the sales of these portfolios in the market to gain money and investor inflows into the company (Stage 2). Finally, a fund company should also generate returns for the company shareholders which should be considered also as part of the production process (Stage 3).

Therefore, based on Berkowitz and Qiu (2003), we identify Stage 1 as *Portfolio management stage;* Stage 2 as *Marketing and Service stage*; and Stage 3 as *Overall efficiency*. Zhao and Yue (2010) only include Stage 1 and Stage 2 in their analysis for the Chinese fund companies, but they did it independently without considering the possible interrelationship between both management stages.

To overcome the contradictions between both the production approach and the intermediation approach previously detected in the banking and insurance literature, we consider the recent proposal of the un-oriented network DEA model applied to the banking by Holod and Lewis (2011).

Figure 2 illustrates our unoriented conceptual model based on the interacting management stages of Holod and Lewis (2011). This figure displays the variables of the model and their different roles as inputs and outputs for the three management stages considered in this conceptual model to evaluate the efficiency of mutual funds companies.

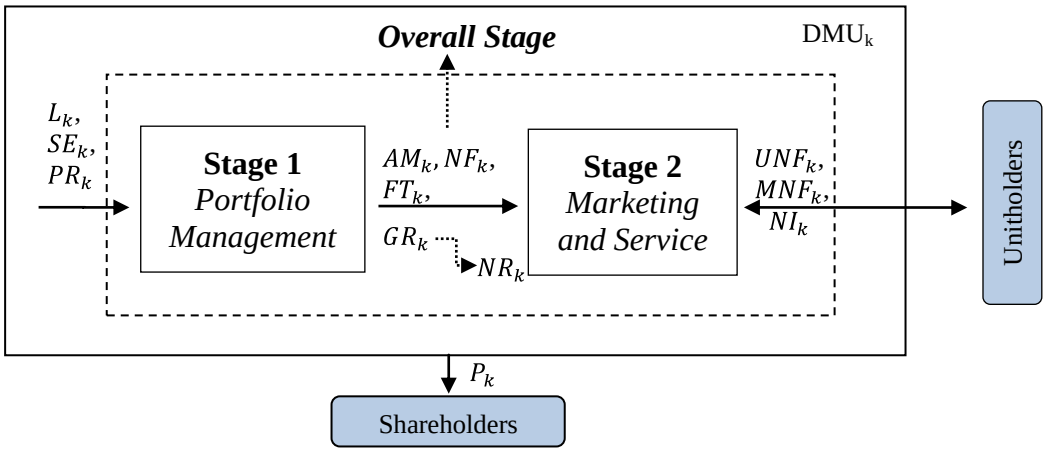

Figure 2 Multi-management stages model for a mutual fund company

Our no-oriented model considers two main steps in the core management process of each fund company analyzed (DMU_k). The first stage in this management process in-company would correspond to the *Portfolio Management stage*. In this stage, human L_k and capital resources SE_k of the company assume a specific level of risk[7] PR_k to get higher gross returns GR_k than the competence in as many mutual funds NF_k, money AM_k and fund types FT_k as possible. The intuition behind this first stage is that a company with efficient portfolio management skills is one that is able to obtain better return records before fees and other expenses than the competence with controlled levels of risk for a large and well-diversified offer of mutual funds without assuming extra personnel expenses and financial resources.

According to the sub-stages framework of Holod and Lewis (2011), the outputs of this first stage could be considered as intermediate outputs of the fund company, thereby being part of the inputs for the *Marketing and Service stage*. In this second step of the management process, an efficient distribution stage would be able to gain both unitholders

[7] The risk has been extensively considered as an input in those works applying DEA methods to evaluate mutual fund performance since the original paper of Murthi et al. (1997).

UNF_k and money net inflows MNF_k into every fund managed by the company, thereby generating higher new incomes NI_k because of the asset-based fees charged by the company. On the other hand, the resources to aim the goal of this *Marketing and Service stage* will be represented by the offer of the company to the market which is represented by the intermediate outputs generated by the *Portfolio Management stage*.[8]

Both stages of our unoriented model are similar in nature to the proposal of Zhue and Yue (2010), but our original contribution is the definition of a clear interaction between these two subsystems of the core competence of a fund company, thereby overcoming the aforementioned problem of the conceptual orientation model as in most banking studies.

Finally, the *Overall efficiency stage* will evaluate the final return of the fund company on the shareholder's equity as a consequence of the whole activity of each company. That is, this overall stage includes both portfolio management stage and marketing stage as a whole, thereby considering the profits P_k as the final output of the activity of the core competence of the fund company (Stage 1 and Stage 2). These profits will be related to the shareholder's equity SE_k as an input and will reflect the income and cost structure of all resources of the company which are necessary to manage all the money of the company AM_k through different mutual funds NF_k and investment types FT_k.

2.2 The variables

Once we have described the conceptual framework to evaluate the efficiency of the fund management companies, it is necessary to define how we measure the variables which are going to appropriately represent the inputs and outputs which capture the ideas displayed by Figure 2.

Table 1 lists the inputs and outputs included in this multi-management stage approach to run the different models for the year 2009. All the data necessary to set these variables comes from the Iberian Balance-sheets Analysis System (SABI), Spanish Official Business Registry, and Spanish Securities Exchange Commission (CNMV).

[8] The returns offered by the company to the market should be considered after management fees and other expenses. Therefore, gross returns GR_k included as an intermediate output of Stage 1 should be replaced by net returns NR_k in the set of inputs of Stage 2.

Table 1 Set of Inputs and Outputs

Stage	Inputs	Outputs
Portfolio Management	Labor: L_k is the number of employees of the company *k* at 31st December 2009.	Assets Managed: AM_k: is the total assets managed by the company *k* at 31st December 2009.
	Shareholders' Equity: SE_k is the equity capital including reserves[9] of the company *k* at 31st December 2009.	Number of Funds: NF_k is the number of funds of the company *k* at 31st December 2009
	Portfolio Risk: PR_k is the fund size-weighted average of the normalized value[10] of the standard deviation of the daily gross returns of all funds managed by company *k* at 31st December 2009.	Fund Types: FT_k is the number of fund categories according to the official classifications[11] covered by the company *k* at 31st December 2009
		Gross Returns: GR_k is computed by the fund size-weighted average of the normalized value[12] of the daily average gross returns of all the funds managed by company *k* at 31st December 2009.

[9] This variable does not consider the profits obtained during 2009.

[10] We agree with Zhue and Yue (2010) that returns weighted by scales are able to represent in some extent the mutual funds management companies' investment skills. However, the different size and return patterns between the different fund types could bias the weighted returns and levels of risk associated with the fund companies due to the assorted fund types managed by these companies. For instance, a company with much more assets in equity funds than in bond funds would obtain upwards biased size-weighted returns in years with bullish stock markets than a company much more focused on bond funds, and the opposite would be found in bearish stock markets. Zhue and Yue (2010) solve this potential problem by using a membership function to characterize fund types. In our case, we compute the normalized standard deviation of the daily gross returns for each mutual fund existing at 31st December 2009 with respect all the funds of the market included in the same category and during the same time period. This normalization provides a value between 0 and 1 which reports more insightful information of the risk skills of the fund with respect to the fund competitors with the same investment objective.

[11] These official classifications are reported by the Spanish Securities Exchange Commission (CNMV)

[12] The reason to reject a fund size-weighted average of the returns obtained by the different funds offered by a company is similar to that addressed in the measure of risk. We obtain the daily average gross return for each mutual fund existing at 31st December 2009 with respect all the funds of the market included in the same fund official category and during the same time period. Then we compute the normalized value between 0 and 1 of these average gross returns to obtain the size-weighted value for every fund company.

Table 2 Set of Inputs and Outputs (Continue)

Marketing and Service	Assets Managed: AM_k Number of Funds: NF_k Fund Types: FT_k Net Returns: NR_k is the fund size-weighted average of the normalized value[13] of the daily average net returns of all the funds managed by company *k* at 31st December 2009.	Unitholders Net Flows: UNF_k represents the normalized value of the unitholder inflows minus unitholder outflows for the company *k* from 1st January 2009 to 31st December 2009. Money Net Flows: MNF_krepresents the normalized value of the implied net money flows[14] for the company *k* from 1st January 2009 to 31st December 2009 New Incomes: NI_k computes the new management fees received by the fund company during 2009 as a consequence of the net money flows into the company *k* from 1st January 2009 to 31st December 2009.[15]
Overall Efficiency	Assets Managed: AM_k Number of Funds: NF_k Fund Types: FT_k Shareholders' Equity: SE_k	Profits: P_k is the normalized value of the profits obtained by the fund company *k* in 2009.

[13] Daily management and custodial fees charged by the company to the fund unitholders have been subtracted from the daily gross returns obtained by each fund.
[14] Implied net flows have been defined as monthly changes in total assets of each fund net of fund returns.
[15] This variable is proxied by the product of the asset-based management fees of each fund and the implied money flows obtained by MNF_k

3. DEA methodology: Variations of the slacks-based measure (SBM) of efficiency

There are many approaches to implement DEA methodology. The basic radial models, such as CCR (Charnes et al., 1978) and BCC (Banker et al., 1984) adopt proportional changes of inputs or outputs and usually do not deal directly with the slacks for the calculation of the efficiency scores. The additive DEA model (Charnes et al., 1985) has no scalar measure or ratio efficiency per se, but it can discriminate between efficient and inefficient DMUs by the existence of excesses in inputs and/or shortfalls in outputs (slacks). Tone (2001) states that this additive model has no means of gauging the depth of inefficiency in a form similar to radial efficiency scores and introduces a non-radial model which deals with the slacks of each input and output individually and independently in order to integrate them into an efficiency measure (SBM). But Tone (2010) states that the problem of this slacks-based measure is that it aims to minimize this score, and the referent point could be far from the DMU analyzed.

In most DEA models, the production possibility set is a polyhedral convex set whose vertices correspond to the efficient DMUs found by the corresponding DEA method. Based on Simmonard (1966), Tone (2010) argues that a polyhedral convex set can be defined by its vertices or by its supporting hyperplanes. Contrary to the most of the literature, Tone (2010) proposes variants of the SBM of efficiency (Tone, 2001) which are based on the hyperplanes instead of the vertices. The first variation (Variation I) aims to obtain the minimum slacks-based measure point on the facet (supporting hyperplane) that the SBM finds for the objective DMU. That is, to find the nearest referent point on the efficient frontier. Then, this author extends this approach to consider all facets of the production possibility set (Variation II). Finally, there are two additional variants because the exhaustive enumeration of all facets required in Variation II may need huge computing: Variation III clusters all facets and Variation IV makes a random search of these facets.

Note that we consider a set of *n* DMUs, where each DMU_j *(j = 1, 2, 3, ..., n)* uses the same *m* inputs x_{ij} *(i = 1, 2, 3, ..., m)*, possibly in different positive amounts, and produces the same *s* outputs y_{rj} *(r = 1, 2, 3, ..., s)*, also possibly in different positive amounts. Being λ a non-negative set of variables $(\lambda_1, \dots, \lambda_n)$ which represents the intensity vector; and s^+ and s^- the non-negative sets of input excesses and output shortfalls, correspondingly.

Under the hypothesis of constant returns to scale, the production possibility set P is defined in expression (1) as

$$P = \quad x, y \setminus x \geq \sum_j X_j \lambda_j , \qquad y \leq \sum_j Y_j \lambda_j , \ \lambda_j \geq 0 \qquad (\mathbf{1})$$

According to the original SBM approach (expression 2) proposed by Tone (2001), an objective DMU will be considered as efficient in terms of Pareto-Koopmans when it has no input excesses and no output shortfalls for any optimal solution, that is, when $p_o^{min} = 1$

$$p_o^{min} = min \frac{1 - \frac{1}{m} \sum_{i=1}^{m} s_i^- / x_{io}}{1 + \frac{1}{s} \sum_{r=1}^{s} s_r^+ / y_{ro}}$$

s.t.

$$\sum_{j=1} x_j \lambda_j + s^- = x_o$$

$$\sum_{j=1} y_j \lambda_j - s^+ = y_o$$

$$\lambda_j, s_i^-, s_r^+ \geq 0 \qquad (\mathbf{2})$$

The reference-set R_0 to the objective DMU x_o, y_o being analyzed in (2) is defined as the set of DMUs corresponding to positive λ_j^*

$$R_o = \ j \ \lambda_j^* > 0, \ j = 1, \dots n \qquad (\mathbf{3})$$

According to Theorem 1 of Tone (2010), the objective DMU can be projected in terms of the reference-set R_0, being this projection efficient:

$$x_0 = x_0 - s^{-*} = \sum_{j \in R_0} x_j \lambda_j^* \qquad (\mathbf{4})$$

$$y_0 = y_0 + s^{+*} = \sum_{j \in R_0} y_j \lambda_j^* \qquad (\mathbf{5})$$

Tone (2010) states that the objective function expressed by the original SBM might project the objective DMU (x_o, y_o) onto a very remote point on the frontier because the basic SBM aims to find the worst efficiency score associated with the relatively maximum slacks under the constraints of the SBM model. These remote projections could be sometimes hard to interpret in terms of appropriate efficiency comparisons.

In order to overcome this limitation, Tone (2010) explores the facets[16] of the production possibility set *P* to define the existence of a supporting hyperplane (Facet) to *P* which includes efficient linear combinations of the DMUs analyzed.

For each inefficient DMU detected in the original SBM model (2), the reference set R_o is obtained according to expression (3), which only includes efficient DMUs (see Theorem 2 of Tone, 2010). After that, **SBM Variation I** looks for the nearest point on the reference set by minimizing the slacks-based measure from the frontier. Therefore, this variant modifies the basic SBM model maximizing the objective function rather than minimizing it. That is, it evaluates the minimum slacks-based measure and hence the maximum score on the efficient supporting hyperplane as follows:

$$p_o^{max} = max \frac{1 - \frac{1}{m} \sum_{i=1}^{m} \frac{s_i^-}{x_{io}}}{1 + \frac{1}{s} \sum_{r=1}^{s} \frac{s_r^+}{y_{ro}}}$$

s. t.

$$x_o = \sum_{j \in Ro} x_j \lambda_j + s^-$$

$$y_o = \sum_{j \in Ro} y_j \lambda_j - s^+$$

$$\lambda_j, s_i^-, s_r^+ \geq 0 \qquad (6)$$

Therefore, Variation I requires only one easy-to-implement additional solution for each inefficient DMU detected in the original SBM model. Since this variant works with the same facet than the original SBM model, the new scores will be at least similar to those obtained in the basic SBM model:

$$p_o^{max} \geq p_o^{min} \qquad (7)$$

[16] See section 2.3 of Tone (2010) for further details about the investigation of the facets of production possibility set.

However, there may be other facets of the production possibility set *P* apart from that defined by the reference set *Ro*. All these facets should be considered to appropriately evaluate the efficiency of the objective DMU (x_o, y_o). Tone (2010) proposes a method to enumerate all facets of *P*. First, this author defines that a subset of efficient DMUs in *P* is called *friends* if a linear combination of this subset is also efficient. Then, *maximal friends* are those *friends* when any addition of an efficient DMU (not in the *friends*) to the *friends* is not more *friends*. Finally, a *friends* is dominated by other friends (*dominated friends*) if the set of efficient DMUs is a subset of others.[17]

SBM Variation II searches minimizing the SBM score from all facets through three steps. First, this variant finds the set of efficient DMUs by solving the basic SBM model. Then, this variant enumerates all facets and only selects those *maximal friends*. Third, for each inefficient DMU, Variation I is applied but only for the facets (*h*) selected in the previous step (i.e. *maximal friends*).

$$p_o^h = max \; \frac{1 - \frac{1}{m} \sum_{i=1}^{m} \frac{s_i^-}{x_{io}}}{1 + \frac{1}{s} \sum_{r=1}^{s} \frac{s_r^+}{y_{ro}}}$$

s. t.

$$x_o = \sum_{j \in R(h)} x_j \lambda_j + s^-$$

$$y_o = \sum_{j \in R(h)} y_j \lambda_j - s^+$$

$$\lambda_j, s_i^-, s_r^+ \geq 0 \qquad \textbf{(8)}$$

Where *R(h)* is the set of efficient DMUs that span each Facet (h) obtained in the second step of this variant. The efficiency score p_o^{all} of each objective DMU is obtained as the maximum p_o^h obtained for all the *maximal friend facets* (h).

[17] Tone (2010) defines an algorithm for finding the *maximal friends*. Detailed explanations of this algorithm and the definitions of *friends*, *dominated friends* and *maximal friends* can be found in his paper.

Therefore, Tone (2010) finds the following inequalities among the three SBM scores[18]

$$p_o^{all} \geq p_o^{max} \geq p_o^{min} \quad \textbf{(9)}$$

The enumeration of facets required by Variation II may need large computation resources for real and large scale problems. To solve this potential problem, **SBM Variation III** modifies Variation II by using a clustering DMUs process. This variant requires again three steps. First, it is necessary to classify all DMUs in clusters. Second, this variant obtains the efficient DMUs according to basic SBM model. This step is similar to the first step of Variation II. Finally, this variant obtains the efficiency scores p_o^h (model 8) for each inefficient DMU but based on the *maximal friend facets* composed by efficient DMUs included in the same cluster that each inefficient DMU analyzed.[19] If this model finds no feasible solution for the new within-cluster facets, the DMU analyzed is considered to be efficient in its cluster, that is, globally inefficient but locally efficient in relation to the DMUs with common clustering characteristics.

According to Tone (2010) the merits of this modification are as follows:

- The enumeration of facets and the selection of maximal friends can be largely reduced by introducing a considerable number of clusters.
- In the case of the inefficient DMUs, the efficiency score is acquired in reference to the efficient DMUs in the same cluster. Thus, the results are more adequate and comprehensible because the DMUs are compared with competitors that show common clustering characteristics.

Finally, **SBM** V**ariation IV** approximates a random search method for enumerating facets of *P*. Based on the creation of random directions around efficient DMUs obtained from the basic SBM model. This variant finds facets by repeating this random search until a sufficiently large number of facets is found. Finally, the efficiency scores p_o^h of Variation II are obtained for each inefficient DMU for those *maximal friend facets* randomly obtained.

[18] See examples 1 and 2 in Tone's (2010) study for further details of SBM Variation I and II.
[19] If none of DMUs in the Cluster analyzed is efficient, Tone (2010) proposes to pick up the efficient DMUs in the adjacent clusters to form the *maximal friend facets*.

The steps proposed by Tone (2010) are as follows: (1) finding center of gravity of efficient DMUs G (see the illustrative example in the figure 6), (2) creating random directions around each efficient DMUs, (3) finding a facet solving the following linear program, (4) repeating the random search around the $k \quad j = 1, \ldots, k$ efficient DMUs until a sufficient number of facets is found, and (5) evaluating the score of inefficient DMUs similar to Variation II.[20]

Therefore, the main contribution of Tone (2010) is the consideration of all facets to be potentially considered as appropriate references for the objective DMU being analyzed. Variation II and the corresponding more easy-to-implement Variations III and IV should be the relevant issues to be considered in this original step forward in the DEA tools.

4. Empirical analysis

We work with all Spanish Fund Management Companies which were registered in the Spanish Securities Exchange Commission (CNMV) at 31st December 2009. This data set finally contains 95 out of the 98 mutual funds companies initially considered.[21]

Table 2 shows some descriptive statistics of our data set. These statistics show the large dispersion of the data, indicating the assorted characteristics of the companies competing in the Spanish fund industry.

Table 3 Descriptive statistics of the data (31st December 2009)

	Number of Employees (L_k)	SEquity* (SE_k)	Assets Managed* (AM_k)	Number of Funds (NF_k)	New Incomes* (NI_k)	Profits* (P_k)	Number of Unitholders
Mean	23	12.908	1.794.888	27	105	1.806	57.631
Stand. Dev.	27	25.000	4.848.550	42	3.742	5.204	154.350
Minimum	2	104	4.457	1	-15.094	-3.163	95
Maximun	145	184.102	32.580.875	206	24.911	36.126	1.107.698

* *Thousand euros*

[20] See section 6.2 of Tone (2010) for further explanation about this random search procedure.

[21] The three excluded companies managed more than 15% of its assets in hedge funds, which could distort the focus of the study. In any case, the bias of this exclusion is quite residual in terms of economic relevance of the sample.

4.1 Comparative evaluation between SBM original model and SBM Variation I

First, for each Stage considered in the conceptual model developed in Section 2, we run the original SBM-efficiency model under constant-returns-to-scale (equation 2). After that, we run SBM Variation I thereby maximizing the objective function for the reference set obtained for each SBM-inefficient company (equation 6). The results obtained by our multi-management approach for the Stage 1 *Portfolio Management*, Stage 2 *Marketing and Service*, and Stage 3 *Overall Efficiency* are shown in Table 3, 4 and 5, respectively (See Appendix A).

According to Tone (2010) the scores are higher or equal in Variation I than in SBM ($p_o^{max} \geq p_o^{min}$), therefore showing an improvement of the average efficiency score in the new approach for every stage. However, Table 6 shows that the Spearman rank correlation for both SBM and Variation I are nearly 1, which questions the relevance of this modification in practical terms for our study.

Table 6 Descriptive statistics of the data (31st December 2009)

	Average SBM	Average Var. I	Spearman Rank Corr. SBM vs. Variation I	Spearman Rank Corr. (SBM scores) Stage 1	Stage 2	Stage 3
Stage 1	0.451	0.536	0.92	1	-0.341664	-0.102149
Stage 2	0.269	0.271	0.99		1	0.708035
Stage 3	0.193	0.196	0.99			1

Table 6 also highlights that both scores are significantly higher in Stage 1 than in the Stage 2 and 3. A more detailed look at this result in Appendix A indicates that 20 companies are efficient in the Stage 1. These efficient companies managed in 2009 about 34% of the assets of all mutual funds, about 37% of the unitholders' accounts, about 30% of the funds, and maintained about 18% of the direct jobs in the market. On the other hand, the number of efficient companies was reduced to 7 in the marketing and service stage. These commercially efficient fund companies downgraded its value regarding to assets managed in 2009 since they only managed 10% of all mutual fund assets of the market, 8% of the unitholders' accounts, 8% of mutual funds (8%), and 9% of the direct jobs in the market.

In addition to this result, we find that only 2 out of the 20 efficient companies found in the first stage remain efficient in the second stage (DMUs 46 and 100). Therefore, only these companies are able to sell in an efficient way their efficiently-managed mutual funds. However, these companies manage a residual percentage of assets in the Spanish fund industry at December 2009.

If we extend this analysis to the overall-stage, we find that the number of efficient companies is reduced to 5. The assets managed by these companies do not exceed 2% of total mutual fund assets, and their unitholders and funds do not exceed 1%, and their direct jobs represent only 3% of the total sector in the sample.

Table 6 also reports some major findings in our analysis. The rank correlation coefficient between SBM ranks of Stage 1 and Stage 2 (-0.3416), provides evidence that the commercial skills of the company are quite independent to portfolio management abilities of the mutual fund managers. Furthermore, we find the same evidence after comparing the ranks between Stage 1 and Stage 3 (-0.1021). However, we find a higher and more significant rank correlation (0.7081) between the commercial management (Stage 2) and the overall efficiency (Stage 3). That is, the abilities of a company to sell the funds seem to be a much more relevant factor to explain the profitability of a fund company instead of the pure portfolio management skills. Only one company (100) out of the twenty efficient portfolio managers found in Stage 1 remains overall efficient for the shareholders as a consequence of an efficient distribution of its mutual funds too. This company is really small and it only manages the 0.002614% of the assets of the industry at December 2009.

The previous results show a very interesting efficiency pattern in the Spanish fund industry. In general terms, the best-managed funds are not the most-efficiently sold by the commercial management stage of the company, thereby reducing considerably the overall profits of the company shareholders.

4.2 The search for locally efficient companies

Variation III allows for a refined evaluation of efficient companies because the target company is going to be referred to the best practice frontier formed by fund companies with homogeneous characteristics than the target company. Variation III is in fact a refinement of SBM Variation II (equation 8) proposed by Tone (2010) which enumerates all the facets of the efficient frontier (*maximal friends*). Variation III will only enumerate those facets formed by companies with similar characteristics based on a specific clustering process.

Our clustering proposal is based on the assets managed by the companies because the Spanish fund industry is extremely concentrated, thereby drawing a competition map where a large number of small fund companies manage a residual market asset share and a reduced number of huge fund companies dominate the industry. Under this clustering process, we assume the hypothesis that fund companies with clustering-homogeneous size should have similar opportunities to reach efficiency for every management stage proposed in our conceptual model (Figure 2).

The clustering procedure is based on the standardized values of the assets managed by the companies. Cluster 1 will include 10 companies with a standardized value higher than 0.25. Cluster 2 will include 27 companies around the average size of the industry, i.e. with a standardized value between -0.25 and 0.25. Cluster 3 will include 37 companies with a standardized asset value between -0.25 and -0.35. Finally, in order to difference the extremely small companies existing in Spain at December 2009, Cluster 4 will include the remaining 21 companies with a standardized asset value lower than -0.35. Table 7 shows some descriptive statistics of these clusters, thereby highlighting the assorted size figures of these four different groups. Under our clustering hypothesis the extreme differences between the assets managed by each cluster will correspond to different resources to reach the efficiency in the 3 management stages considered in our model.

Table 7 Descriptive Statistics of Clusters

	Companies	Assets managed per company*	Funds	Unitholders per company
Cluster 1	10	12,170,499	1,277	390,117
Cluster 2	27	1,445,682	753	47,633
Cluster 3	37	243,250	410	7,041
Cluster 4	21	36,938	90	1,292

* *Thousand euros*

After clustering the different companies, we identify the efficient companies within each cluster. Then, we enumerate all the facets to be potentially compared with each objective company analyzed within each cluster. After that, we should select those efficient combinations (friends) which are not dominated by any other efficient combination (maximal friends)[22]. That is, we will select the maximal friends for every cluster to run Variation III, instead of searching all the maximal friends for the combination of SBM-efficient companies (i.e. Variation II).

The results for SBM Variation III in the different management stages are also displayed in Appendix A. Table 3 reports that there were 12 globally inefficient companies but locally efficient in the portfolio management stage (Stage 1). That is, the analysis of efficiency restricted to homogeneous competitors reveals that 32 out of 95 fund companies included in the sample are efficient in their portfolio management stage, which may be considered as a relevant figure. In addition, Table 5 indicates that besides of 5 companies overall-efficient in 2009, there were other 6 companies that were locally overall-efficient according to size-homogeneous reference companies.

But, the most relevant bias detected in the traditional SBM measures is present in the second stage (marketing and service), where we find 42 locally efficient companies. This socking result is explained by the fact that most of the efficient companies included in the reference sets of the traditional SBM measures do not belong to the same cluster that the company analyzed. An extension of this interpretation could be that the marketing and service is the most sensitive management stage to the size of the fund company. That is, the resources to sell and distribute properly the funds managed by a company seem to be significantly related to the size of the company. Therefore, in the case that the reference companies included in the efficient frontier do not belong to the same cluster that the target

[22] The search for the maximal friend facets has been quite different for each stage. For the case of the commercial management unit (stage 2) and the overall unit (stage 3) the maximal friends were easily found due to the reduced number of SBM efficient companies included in the reference sets for each stage. Thus, the algorithm proposed by Tone (2010) to find the maximal friend facets within each cluster to run expression (8) was easily developed. For the case of Stage 1, the existence of a higher number of efficient companies involves higher computational resources, but the consideration of 4 clusters aims to reduce largely the enumeration of facets and the selection of maximal friends. Detailed information is available upon request.

company, the traditional SBM scores could be extremely biased to find efficient companies in this second stage.

5. Conclusions

This study is the first analysis of the efficiency of Mutual fund management companies in a relevant Euro fund industry, i.e. Spain. Based on the sub-DMUs approach of Holod and Lewis (2011), our paper develops a model which includes the three interacting management subsystems within a fund company originally proposed by Berkowitz and Qiu (2003): Portfolio management, Marketing and Service, and Overall. The interaction between these different units overcome the traditional existing debate between the production or intermediation approach in the banking and insurance companies.

The first empirical application of the recent variants to the non-oriented slacks-based measures of efficiency (Tone, 2010) aims to overcome some of the limitations potentially present in this frontier methodology as a consequence of inappropriate benchmarking of the fund companies analyzed. However, the consideration of the nearest point on the reference set (Variation I) do not alter significantly the rankings of the Spanish fund companies provided by the original SBM scores (Tone, 2001). On the other hand, we find a large number of globally inefficient but locally efficient companies in the marketing and service stage under the size-cluster process, which may reveal that the evaluation of the efficiency of this stage should consider carefully the size of the fund companies to avoid misinterpreting results. This issue is especially relevant in a concentrated market such as the Spanish fund industry.

In addition, the efficiency rankings provide evidence of a low impact of the portfolio management abilities in the efficiency of the marketing and sale process of the mutual funds managed by the company. Furthermore, the lower efficiency records in this commercial stage seem to affect to the overall profits reported to the company shareholders. That is, the results support the evidence that the best-managed funds are not the most-efficiently sold by the commercial management stage of the company, thereby reducing considerably the overall profits of the company shareholders.

Further research to complement this first draft of our study includes: 1) the extension and comparison of our results with other time horizons; 2) a more detailed consideration of the variables included in our multi-management stages model; and 3) a set of robustness tests of different clustering procedures to gain accuracy in the results obtained by Variation III.

References

Asaftei, G. (2008). The contribution of product mix versus efficiency and technical change in US banking. *Journal of Banking and Finance, 32*(11), 2336-2345.

Athanassopoulos, A. D. (1997). Service quality and operating efficiency synergies for management control in the provision of financial services: Evidence from greek bank branches. *European Journal of Operational Research, 98*(2), 300-313.

Banker, R. D., Charnes, A., & & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science, 30*(9), 1078-1092.

Basso, A., & Funari, S. (2001). A data envelopment analysis approach to measure the mutual fund performance. *European Journal of Operational Research, 135*(3), 477-492.

Basso, A., & Funari, S. (2003). Measuring the performance of ethical mutual funds: A DEA approach. *Journal of the Operational Research Society, 54*(5), 521-531.

Battese, G. E., Heshmati, A., & Hjalmarsson, L. (2000). Efficiency of labour use in the swedish banking industry: A stochastic frontier approach. *Empirical Economics, 25*(4), 623-640.

Berg, S. A., Førsund, F. R., & Jansen, E. S. (1991). Technical efficiency of norwegian banks: The non-parametric approach to efficiency measurement. *Journal of Productivity Analysis, 2*(2), 127-142.

Berg, S. A., Førsund, F. R., Hjalmarsson, L., & Suominen, M. (1993). Banking efficiency in the nordic countries. *Journal of Banking and Finance, 17*(2-3), 371-388.

Berger, A. N., Hancock, D., & Humphrey, D. B. (1993). Bank efficiency derived from the profit function. *Journal of Banking and Finance, 17*(2-3), 317-347.

Berkowitz, M. K., & Qiu, J. (2003). Ownership, risk and performance of mutual fund management companies. *Journal of Economics and Business, 55*(2), 109-134.

Casu, B., Girardone, C., & Molyneux, P. (2004). Productivity change in european banking: A comparison of parametric and non-parametric approaches. *Journal of Banking and Finance, 28*(10), 2521-2540.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2*(6), 429-444.

Charnes, A., Cooper, W. W., Golany, B., Seiford, L., & Stutz, J. (1985). Foundations of data envelopment analysis for pareto-koopmans efficient empirical production functions. *Journal of Econometrics, 30*(1-2), 91-107.

Chen, Y., Gregoriou, G. N., & Rouah, F. D. (2009). Efficiency persistence of bank and thrift CEOs using data envelopment analysis. *Computers and Operations Research, 36*(5), 1554-1561.

Choi, Y. K., & Murthi, B. (2001). Relative performance evaluation of mutual funds: A Non-Parametric approach. *Journal of Business Finance and Accounting, 28*(7-8), 853-876.

Cummins, J. D., & Xie, X. (2008). Mergers and acquisitions in the US property-liability insurance industry: Productivity and efficiency effects. *Journal of Banking and Finance, 32*(1), 30-55.

Cummins, J. D., Rubio-Misas, M., & Zi, H. (2004). The effect of organizational structure on efficiency: Evidence from the spanish insurance industry. *Journal of Banking and Finance, 28*(12), 3113-3150.

Cummins, J. D., Weiss, M. A., Xie, X., & Zi, H. (2010). Economies of scope in financial services: A DEA efficiency analysis of the US insurance industry. *Journal of Banking and Finance, 34*(7), 1525-1539.

Daraio, C., & Simar, L. (2006). A robust nonparametric approach to evaluate and explain the performance of mutual funds. *European Journal of Operational Research, 175*(1), 516-542.

Drake, L., & Howcroft, B. (1994). Relative efficiency in the branch network of a UK bank: An empirical study. *Omega, 22*(1), 83-90.

Eling, M. (2006). Performance measurement of hedge funds using data envelopment analysis. *Financial Markets and Portfolio Management, 20*(4), 442-471.

Eling, M., & Luhnen, M. (2010). Efficiency in the international insurance industry: A cross-country comparison. *Journal of Banking and Finance, 34*(7), 1497-1509.

Gallo, J. G., Apilado, V. P., & Kolari, J. W. (1996). Commercial bank mutual fund activities: Implications for bank risk and profitability. *Journal of Banking and Finance, 20*(10), 1775-1791.

Goddard, J., Molyneux, P., Wilson, J. O., & Tavakoli, M. (2007). European banking: An overview. *Journal of Banking and Finance, 31*(7), 1911-1935.

Gregoriou, G. N., Sedzro, K., & Zhu, J. (2005). Hedge fund performance appraisal using data envelopment analysis. *European Journal of Operational Research, 164*(2), 555-571.

Holod, D., & Lewis, H. F. (2011). Resolving the deposit dilemma: A new DEA bank efficiency model. *Journal of Banking and Finance, 35*(11), 2801-2810.

Lozano, S., & Gutierrez, E. (2007). TSD-consistent performance assessment of mutual funds. *Journal of the Operational Research Society, 59*(10), 1352-1362.

Lozano, S., & Gutiérrez, E. (2008). Data envelopment analysis of mutual funds based on second-order stochastic dominance. *European Journal of Operational Research, 189*(1), 230-244.

Medeiros, M. T. (2010). Efficiency evaluation of the portuguese pension funds management companies. *Journal of International Financial Markets, Institutions and Money, 20*(3), 259-266.

Mester, L. J. (1996). A study of bank efficiency taking into account risk-preferences. *Journal of Banking and Finance, 20*(6), 1025-1045.

Mlima, A. P., & Hjalmarsson, L. (2002). Measurement of inputs and outputs in the banking industry. *Tanzanet Journal, 3*(1), 12-22.

Murthi, B., Choi, Y. K., & Desai, P. (1997). Efficiency of mutual funds and portfolio performance measurement: A non-parametric approach. *European Journal of Operational Research, 98*(2), 408-418.

Schaffnit, C., Rosen, D., & Paradi, J. C. (1997). Best practice analysis of bank branches: An application of DEA in a large canadian bank. *European Journal of Operational Research, 98*(2), 269-289.

Sherman, H. D., & Rupert, T. J. (2006). Do bank mergers have hidden or foregone value? realized and unrealized operating synergies in one bank merger. *European Journal of Operational Research, 168*(1), 253-268.

Thompson, R. G., Brinkmann, E. J., Dharmapala, P., Gonzalez-Lima, M., & Thrall, R. M. (1997). DEA/AR profit ratios and sensitivity of 100 large US banks. *European Journal of Operational Research, 98*(2), 213-229.

Tone, K. (2001). A slacks-based measure of efficiency in data envelopment analysis. *European Journal of Operational Research, 130*(3), 498-509.

Tone, K. (2010). Variations on the theme of slacks-based measure of efficiency in DEA. *European Journal of Operational Research, 200*(3), 901-907.

Tortosa-Ausina, E., Grifell-Tatje, E., Armero, C., & Conesa, D. (2008). Sensitivity analysis of efficiency and malmquist productivity indices: An application to spanish savings banks. *European Journal of Operational Research, 184*(3), 1062-1084.

Yeh, Q. J. (1996). The application of data envelopment analysis in conjunction with financial ratios for bank performance evaluation. *Journal of the Operational Research Society, 47*(8), 980-988.

Zhao, X., & Yue, W. (2010). A multi-subsystem fuzzy DEA model with its application in mutual funds management companies' competence evaluation. *Procedia Computer Science, 1*(1), 2469-2478.

Appendix A

Table 4 SBM original, SBM Variation I, and SBM Variation III for Stage 1 (Portfolio management)

DMU	SBM	Ref.	Var. I	Ref.	Var. III	Ref.	Cluster	Remark
2	0.405214	7 14 76	0.418864	7 76	0.801508	51 193	3	
4	1	4	1	4	1	4	1	
6	0.131564	14 50 76	0.414326	50 76	0.605949	45 193 210	3	
7	1	7	1	7	1	7	2	
9	0.238762	76	0.238762	76	0.320711	7 76	2	
12	0.630831	14 46	0.660968	14 46	0.659493	14	1	
14	1	14	1	14	1	14	1	
15	0.245764	14 46	0.450529	14	0.677253	14 128	1	
20	0.218546	14 46 51	0.305106	14 51	0.378347	127 140	2	
21	0.237102	14 46	0.242519	14 46	1	21	2	locally eff.
24	0.257505	14 46 76	0.343705	46 76	0.587467	45 193	3	
29	0.386496	45 76 131	0.420246	45 76 131	1	29	3	locally eff.
31	0.515172	7 14 50 51	0.668702	7 51	0.649535	51 62 193	3	
34	0.147533	14 76	0.153213	76	0.487809	45 210	3	
35	0.560535	46 76 210	0.756567	76 210	1	35	3	locally eff.
36	0.065589	46 76	0.157722	46 76	0.503366	46 100 174	4	
37	0.246667	14 46 76	0.363939	46 76	0.602355	51 62	3	
38	0.042263	14 50 76	0.123489	14 50	0.399699	51 62 193	3	
40	0.125952	45 46 76 100	0.560421	45 46 76 100	0.611959	46 100 174	4	
43	0.643482	7 14 76 128	0.648086	7 14 128	0.718550	7 76 140	2	
45	1	45	1	45	1	45	3	
46	1	46	1	46	1	46	4	
47	0.384560	14 46 50 76	0.442537	76	0.637322	127 140	2	
49	0.182921	46 76	0.383214	46 76	0.458162	51 62	3	
50	1	50	1	50	1	50	4	
51	1	51	1	51	1	51	3	
53	0.034280	45 76	0.053050	45	0.606336	46 100 152 217	4	
55	1	55	1	55	1	55	1	
57	0.363342	46 76 210	0.556842	46 76 210	0.629280	45 193 210	3	
58	0.395759	14 46 51	0.418610	14 51	0.403788	14 128	1	
61	0.199778	14 50 76	0.328839	50 76	0.431500	7	2	
62	1	62	1	62	1	62	3	
63	0.452489	14 46 51	0.507074	14 51	1	63	1	locally eff.
69	0.035914	45 46 76	0.270154	45 46	0.666740	46 50 100 152	4	
71	0.704889	7 14 50 76	0.873954	7 14 50 76	1	71	2	locally eff.
76	1	76	1	76	1	76	2	
78	0.306180	46 76	0.482834	46 76	0.717929	51 62	3	
83	0.370169	14 46 50 76	0.419184	14 76	0.623786	140	2	
84	0.464164	14 46 51	0.487202	14 51	1	84	1	locally eff.
85	0.521177	14 46 51	0.548461	14 51	0.598392	14 55	1	
86	0.483283	14 46 51	0.519715	14 51	0.700260	127 140	2	
93	0.147371	14 50 76	0.321942	14 50	0.377075	45 193 210	3	
95	0.608247	7 14 46 50 51 140	0.815635	7 14 140	1	95	2	locally eff.
98	0.156524	7 14 76	0.242442	7	0.402669	193	3	
100	1	100	1	100	1	100	4	
103	0.183879	76	0.183879	76	0.227661	7 76	2	
105	0.015024	14 46	0.148982	14 46	0.329823	45 174 217	4	
110	0.344480	7 14 50 76	0.580057	7	0.659679	51 193	3	
113	0.172873	14 51	0.313402	14 51	0.397997	7	2	
115	0.083064	46 50 76 100	0.255409	50 76 100	0.624864	152 174 217	4	
121	0.240661	14 46 50	0.250978	14 50	0.375106	7 76	2	
125	0.001755	14 46	0.138374	46	0.348756	100 152 174	4	
126	0.243446	46 76	0.334153	46 76	0.620581	45 210	3	
127	1	127	1	127	1	127	2	

128	1	128	1	128	1	128	1	
130	0.853867	7 14 51 128 140	0.865845	7 14 128 140	0.853867	7 76 140	2	
131	1	131	1	131	1	131	4	
132	0.256825	76	0.256825	76	1	132	3	locally eff.
133	0.209764	45 46 76	0.454209	45 46 76	0.652300	46 100 174	4	
137	0.253198	46 76	0.285374	46 76	0.537194	62 210	3	
139	0.453512	46 76 210	0.480514	46 76 210	0.462942	45 193 210	3	
140	1	140	1	140	1	140	2	
142	0.288476	14 46 51	0.418642	14 51	0.484744	7 140	2	
152	1	152	1	152	1	152	4	
154	0.652423	14 46 76	0.667771	14 46 76	0.788859	7 76 140	2	
156	0.293293	50 76	0.543747	50 76	0.682333	45 193 210	3	
159	0.215848	14 46 76	0.326558	46 76	0.636802	51 62 193	3	
160	0.313096	14 46 76	0.318411	46 76	0.739835	51 62 193	3	
161	0.547538	14 50 76	0.564087	76	0.647399	7 76 140	2	
162	0.479661	14 46 76	0.515201	46 76	0.615901	7 76	2	
163	0.418338	7 14 50 76	0.476826	7 14	0.470549	51 193	3	
168	0.207925	46 76	0.265913	46 76	0.663030	51 62 193	3	
173	0.408956	14 50 51	0.526581	14 51	0.584316	127 140	2	
174	1	174	1	174	1	174	4	
176	0.585691	14 50 51 76	0.761193	14 51 76	0.744038	7 76	2	
177	0.126015	14 50 76	0.317804	50 76	0.542941	46 100 152 174	4	
182	0.387004	14 50 76	0.424541	50 76	0.556141	7	2	
185	0.327103	14 51	0.449130	14 51	0.483931	7 140	2	
190	0.498746	7 14 50 76	0.698639	7	0.704765	7 140	2	
191	0.550857	46 76 174	0.658533	46 76 174	1	191	3	locally eff.
192	0.158360	14 50 76	0.388775	50 76	0.500167	193 210	3	
193	1	193	1	193	1	193	3	
194	0.429584	46 76 210	0.549800	76 210	0.678276	51 62 193	3	
195	0.306785	46 76 210	0.483172	76 210	0.597335	51 62 193	3	
196	0.022429	14 46 76	0.299048	46 76	0.393182	46 50 100 174	4	
197	0.300226	45 76 174	0.509768	174	0.530789	100 174	4	
198	0.227024	14 46 50 76	0.307947	14 50 76	0.728169	51 193	3	
200	0.111429	14 46	0.116560	14 46	1	200	3	locally eff.
203	0.070500	45 46 76	0.125250	45 46 76	0.647850	46 131 217	4	
204	0.245524	14 46 76	0.346674	46 76	0.617173	45 193 210	3	
206	0.146704	45 46 76	0.296613	45 46 76	0.656012	46 100 174	4	
207	0.080970	14 46 76	0.157287	46 76	1	207	4	locally eff.
210	1	210	1	210	1	210	3	
217	1	217	1	217	1	217	4	
221	0.235530	50 76 174	0.305155	50 76	1	221	3	locally eff.

DMU is the fund company analyzed (Official registers in CNMV). SBM corresponds to efficiency score with SBM model (Equation 2). Variation I corresponds to efficiency score with SBM Variation I (Equation 6). Variation III corresponds to efficiency score with SBM Variation III (Equation 8 for those maximal friends belonging to the same cluster that the company analyzed). Ref. in each case corresponds to the reference set for each company analyzed. Cluster displays the corresponding cluster of each company according to the standardized value of the assets managed by the company. Remark highlights those globally inefficient companies but locally efficient within its cluster.

Table 4 SBM original, SBM Variation I, and SBM Variation III for Stage 2 (Marketing and Service)

DMU	SBM	Ref.	Var. I	Ref.	Var. III	Ref.	Cluster	Remark
2	0.141370	196	0.141370	196	0.510772	221	3	
4	0.098353	196	0.098353	196	0.556202	15	1	
6	0.214641	196	0.214641	196	1	6	3	locally eff.
7	0.154805	196	0.154805	196	1	7	2	locally eff.
9	0.241724	196	0.241724	196	0.519481	221	2	
12	0.000089	196	0.000089	196	0.000272	15	1	
14	0.000035	196	0.000035	196	0.000136	15	1	
15	1	15	1	15	1	15	1	
20	0.186487	196	0.186487	196	1	20	2	locally eff.
21	0.191002	196	0.191002	196	0.325852	221	2	
24	0.141321	196	0.141321	196	0.444230	221	3	
29	0.145453	196	0.145453	196	0.439837	221	3	
31	0.298843	196	0.298843	196	1	31	3	locally eff.
34	0.158012	196	0.158012	196	0.581987	221	3	
35	0.156623	196	0.156623	196	1	35	3	locally eff.
36	0.443154	196	0.443154	196	0.790220	46 53 196	4	
37	0.179624	196	0.179624	196	1	37	3	locally eff.
38	0.146002	196	0.146002	196	1	38	3	locally eff.
40	0.344107	196	0.344107	196	0.664449	196 207	4	
43	0.185158	196	0.185158	196	1	43	2	locally eff.
45	0.194257	196	0.194257	196	1	45	3	locally eff.
46	1	46	1	46	1	46	4	
47	0.170264	196	0.170264	196	1	47	2	locally eff.
49	0.219680	196	0.219680	196	1	49	3	locally eff.
50	0.408323	196	0.408323	196	0.666890	46 53	4	
51	0.233293	196	0.233293	196	1	51	3	locally eff.
53	1	53	1	53	1	53	4	
55	0.115163	196	0.115163	196	1	55	1	locally eff.
57	0.214876	196	0.214876	196	1	57	3	locally eff.
58	0.132936	196	0.132936	196	1	58	1	locally eff.
61	0.134146	196	0.134146	196	1	61	2	locally eff.
62	0.215756	196	0.215756	196	1	62	3	locally eff.
63	0.090701	196	0.090701	196	1	63	1	locally eff.
69	0.780748	46 53 196	0.918346	46 53 196	0.918346	46 53 196	4	
71	0.151988	196	0.151988	196	1	71	2	locally eff.
76	0.167952	196	0.167952	196	0.340890	221	2	
78	0.192126	196	0.192126	196	1	78	3	locally eff.
83	0.122911	196	0.122911	196	1	83	2	locally eff.
84	0.197488	196	0.197488	196	1	84	1	locally eff.
85	0.088412	196	0.088412	196	0.454792	15	1	
86	0.178990	196	0.178990	196	0.314957	221	2	
93	0.294175	196	0.294175	196	0.732404	221	3	
95	0.148572	196	0.148572	196	0.288747	221	2	
98	0.224249	196	0.224249	196	0.507128	221	3	
100	1	100	1	100	1	100	4	
103	0.158214	196	0.158214	196	0.371342	221	2	
105	0.211970	196	0.211970	196	0.653566	207	4	
110	0.143262	196	0.143262	196	0.399381	221	3	
113	0.135212	196	0.135212	196	1	113	2	locally eff.
115	0.325201	196	0.325201	196	0.514220	196 207	4	
121	0.144656	196	0.144656	196	1	121	2	locally eff.
125	0.929112	46 53 196	0.973399	46 53 196	0.973399	46 53 196	4	
126	0.160611	196	0.160611	196	0.565598	221	3	

127	0.140410	196	0.140410	196	1	127	2	locally eff.
128	0.025922	196	0.025922	196	0.130370	15	1	
130	0.159905	196	0.159905	196	1	130	2	locally eff.
131	0.188279	196	0.188279	196	0.548895	207	4	
132	0.164597	196	0.164597	196	1	132	3	locally eff.
133	0.307294	196	0.307294	196	0.642993	46 53	4	
137	0.208714	196	0.208714	196	1	137	3	locally eff.
139	0.245742	196	0.245742	196	0.699074	221	3	
140	0.139947	196	0.139947	196	0.312577	221	2	
142	0.122923	196	0.122923	196	1	142	2	locally eff.
152	0.433774	196	0.433774	196	0.590081	46 53	4	
154	0.154445	196	0.154445	196	0.339147	221	2	
156	0.189264	196	0.189264	196	1	156	3	locally eff.
159	0.188603	196	0.188603	196	1	159	3	locally eff.
160	0.211354	196	0.211354	196	0.571076	221	3	
161	0.141682	196	0.141682	196	0.344965	221	2	
162	0.121234	196	0.121234	196	0.368790	221	2	
163	0.131955	196	0.131955	196	1	163	3	locally eff.
168	0.201624	196	0.201624	196	0.618992	221	3	
173	0.165978	196	0.165978	196	1	173	2	locally eff.
174	0.286179	196	0.286179	196	0.676333	196 207	4	
176	0.164605	196	0.164605	196	1	176	2	locally eff.
177	0.236251	196	0.236251	196	0.620440	207	4	
182	0.141829	196	0.141829	196	0.368752	221	2	
185	0.139406	196	0.139406	196	0.347916	221	2	
190	0.133832	196	0.133832	196	0.359874	221	2	
191	0.216361	196	0.216361	196	1	191	3	locally eff.
192	0.197080	196	0.197080	196	1	192	3	locally eff.
193	0.166775	196	0.166775	196	0.516477	221	3	
194	0.163644	196	0.163644	196	1	194	3	locally eff.
195	0.167115	196	0.167115	196	1	195	3	locally eff.
196	1	196	1	196	1	196	4	
197	0.240109	196	0.240109	196	0.601558	196 207	4	
198	0.200080	196	0.200080	196	1	198	3	locally eff.
200	0.294351	196	0.294351	196	1	200	3	locally eff.
203	0.375156	196	0.375156	196	0.571643	46 53	4	
204	0.227473	196	0.227473	196	1	204	3	locally eff.
206	0.231998	196	0.231998	196	0.591086	196 207	4	
207	1	207	1	207	1	207	4	
210	0.195806	196	0.195806	196	1	210	3	locally eff.
217	0.906750	46 53 196	0.920022	46 53	0.920022	46 53	4	
221	1	221	1	221	1	221	3	

DMU is the fund company analyzed (Official registers in CNMV). SBM corresponds to efficiency score with SBM model (Equation 2). Variation I corresponds to efficiency score with SBM Variation I (Equation 6). Variation III corresponds to efficiency score with SBM Variation III (Equation 8 for those maximal friends belonging to the same cluster that the company analyzed). Ref. in each case corresponds to the reference set for each company analyzed. Cluster displays the corresponding cluster of each company according to the standardized value of the assets managed by the company. Remark highlights those globally inefficient companies but locally efficient within its cluster.

Table 5 SBM original, SBM Variation I, and SBM Variation III for Stage 2 (Overall efficiency)

DMU	SBM	Ref.	Var. I	Ref.	Var. III	Ref.	Cluster	Remark
2	0.066837	100	0.066837	100	0.286273	45	3	
4	0.077474	100	0.077474	100	0.103085	103	1	
6	0.098677	100	0.098677	100	0.422110	45	3	
7	0.086502	100	0.086502	100	0.272733	103	2	
9	0.239528	100	0.239528	100	0.532239	103	2	
12	0.000025	100	0.000025	100	0.000025	103	1	
14	0.241035	100	0.241035	100	0.263843	103	1	
15	0.059329	100	0.059329	100	0.067526	103	1	
20	0.230181	100	0.230181	100	0.365246	103	2	
21	0.116113	100	0.116113	100	0.168457	103	2	
24	0.068905	100	0.068905	100	0.263225	45	3	
29	0.079430	100	0.079430	100	0.226800	45	3	
31	0.077136	100	0.077136	100	0.253209	45	3	
34	0.089811	100	0.089811	100	0.424338	45	3	
35	0.107707	100	0.107707	100	0.324958	45	3	
36	0.313285	100	0.313285	100	0.570641	100 217	4	
37	0.119096	100	0.119096	100	0.479890	45	3	
38	0.067783	100	0.067783	100	1	38	3	locally eff.
40	0.299081	100	0.299081	100	0.499236	100 217	4	
43	0.073261	100	0.073261	100	0.278262	103	2	
45	1	45	1	45	1	45	3	
46	0.603394	100	0.603394	100	0.904081	100 125	4	
47	0.088804	100	0.088804	100	0.219279	103	2	
49	0.142723	100	0.142723	100	0.588961	45	3	
50	0.262746	100	0.262746	100	0.649280	100 217	4	
51	0.138881	100	0.138881	100	0.475422	45	3	
53	0.354897	100	0.354897	100	0.878636	100 217	4	
55	0.128053	100	0.128053	100	0.223584	103	1	
57	0.181963	100	0.181963	100	0.590603	45	3	
58	0.161270	100	0.161270	100	0.214414	103	1	
61	0.001174	100	0.001174	100	0.004544	103	2	
62	0.174925	100	0.174925	100	0.579052	45	3	
63	0.018455	100	0.018455	100	0.031390	103	1	
69	0.328525	100	0.328525	100	0.677476	100 217	4	
71	0.121690	100	0.121690	100	0.300568	103	2	
76	0.125076	100	0.125076	100	0.342137	103	2	
78	0.143693	100	0.143693	100	0.527720	45	3	
83	0.045829	100	0.045829	100	0.120775	103	2	
84	0.171397	100	0.171397	100	0.268884	103	1	
85	0.072182	100	0.072182	100	0.108382	103	1	
86	0.063922	100	0.063922	100	0.163161	103	2	
93	0.196974	100	0.196974	100	0.596342	45	3	
95	0.069810	100	0.069810	100	0.153407	103	2	
98	0.090032	100	0.090032	100	0.418793	45	3	
100	1	100	1	100	1	100	4	
103	1	103	1	103	1	103	2	
105	0.046047	100	0.046047	100	0.157572	217	4	
110	0.078889	100	0.078889	100	0.303844	45	3	
113	0.047736	100	0.047736	100	0.142105	103	2	
115	0.171928	100	0.171928	100	0.472175	217	4	
121	0.063313	100	0.063313	100	0.114562	103	2	
125	1	125	1	125	1	125	4	
126	0.121119	100	0.121119	100	0.525329	45	3	

127	0.065831	100	0.065831	100	0.168937	103	2	
128	0.027220	100	0.027220	100	0.046586	103	1	
130	0.054144	100	0.054144	100	0.139879	103	2	
131	0.831847	45 100 217	0.842776	45 100 217	1	131	4	locally eff.
132	0.063986	100	0.063986	100	0.229560	45	3	
133	0.255236	100	0.255236	100	0.587293	100 217	4	
137	0.210642	100	0.210642	100	0.566303	45	3	
139	0.349979	100	0.349979	100	1	139	3	locally eff.
140	0.045341	100	0.045341	100	0.140417	103	2	
142	0.061056	100	0.061056	100	0.135359	103	2	
152	0.373132	100	0.373132	100	0.699889	217	4	
154	0.063512	100	0.063512	100	0.155470	103	2	
156	0.124812	100	0.124812	100	0.525367	45	3	
159	0.112413	100	0.112413	100	0.402037	45	3	
160	0.132876	100	0.132876	100	0.509790	45	3	
161	0.062682	100	0.062682	100	0.176436	103	2	
162	0.076965	100	0.076965	100	0.266026	103	2	
163	0.053263	100	0.053263	100	0.196975	45	3	
168	0.160935	100	0.160935	100	0.606051	45	3	
173	0.046808	100	0.046808	100	0.149407	103	2	
174	0.220814	100	0.220814	100	0.408661	217	4	
176	0.076936	100	0.076936	100	0.227855	103	2	
177	0.127041	100	0.127041	100	0.346821	217	4	
182	0.069083	100	0.069083	100	0.204259	103	2	
185	0.048218	100	0.048218	100	0.110761	103	2	
190	0.061860	100	0.061860	100	0.234784	103	2	
191	0.224948	100	0.224948	100	0.625969	45	3	
192	0.104557	100	0.104557	100	1	192	3	locally eff.
193	0.080550	100	0.080550	100	0.273236	45	3	
194	0.109093	100	0.109093	100	0.318698	45	3	
195	0.085122	100	0.085122	100	0.296042	45	3	
196	0.531583	100	0.531583	100	0.706647	100 125	4	
197	0.153320	100	0.153320	100	0.317230	100 125	4	
198	0.107003	100	0.107003	100	1	198	3	locally eff.
200	0.165544	100	0.165544	100	0.577109	45	3	
203	0.200738	100	0.200738	100	0.504625	217	4	
204	0.135948	100	0.135948	100	0.581051	45	3	
206	0.168660	100	0.168660	100	0.405153	217	4	
207	0.133474	100	0.133474	100	0.371749	217	4	
210	0.204248	100	0.204248	100	1	210	3	locally eff.
217	1	217	1	217	1	217	4	
221	0.458516	100 103	0.748042	100 103	0.484029	45	3	

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