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# EFFICIENCY OF SPANISH MUTUAL FUND COMPANIES

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# Efficiency of Spanish Mutual Fund Companies

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PhD Dissertation

Supervisors:
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# Motivation

The mutual fund industry has witnessed remarkable growth worldwide during the last decade. A significant effect on the savings patterns of the countries has been promoted by investment alternatives offered by mutual funds. Mutual fund management companies have suffered both great expansion and contraction periods in the same manner as other financial institutions. The need to analyse the efficiency of financial institutions has instigated an important line of research in the financial literature using alternative approaches. However, the emphasis of these studies has been typically on the banking and insurance industry rather than other specific companies related to the investment business. In addition, research on the mutual fund industry has been primarily focused on mutual funds rather than on their management companies. For that reason, this thesis aims to fill this gap in the empirical knowledge of the efficiency obtained by mutual fund management companies. In this sense, the thesis will contrast the efficiency level achieved by companies in the management and distribution of mutual funds to establish their core competence. The thesis analyses the potential interaction between this core competency and the overall efficiency results obtained by the fund company. This research will analyse the Spanish case, which is one of the most relevant fund industries in the Euro market. Therefore, to better understand the rationale behind the mutual fund industry, this study offers new insights into issues that have not been studied before in the European market.

This thesis develops an innovative model that considers different management stages of mutual fund companies, thereby overcoming the traditional dispute between the different approaches used in banking and insurance research. However, the variables considered in this model are unique and specific to mutual fund companies rather than a mere replication of the variables used in the banking and insurance literature.

Data envelopment analysis (DEA) is the methodology used to evaluate this model. This frontier method is one of the most widely used methods in studies of technical efficiency, but the specific technique used in this study is one of the most recent innovations in this field and overcomes the problem of the high market concentration in the Spanish mutual fund industry. Specifically, the thesis is one of the first empirical applications of slack-based measure (SBM) variations, which represents an important and recent contribution to DEA methodology. Additionally, the persistence analysis of the efficiency achieved by the different management stages considered in the fund company model is revealed to be an original contribution. Moreover, non-parametric statistics based on contingency tables have been developed based on an innovative cluster analysis of efficiency scores.

This dissertation consists of two parts. The first part initially includes the basic concepts, a brief explanation of the basic DEA models, and a review of the most important applications to financial institutions. We then formulate the multi-management stage model and the unique set of fund industry-specific variables used in this research. Subsequently, the efficiency of Spanish mutual fund companies is evaluated using the SBM approach. Finally, this part concludes and summarises the major findings of the efficiency analysis.

The second part of the thesis reviews the major concepts of the variations in the original SBM approach and the more accurate empirical results of these SBM variants in the Spanish mutual fund industry. Subsequently, this part illustrates the persistence phenomenon to further determine whether any relevant factors may drive the efficiency results previously obtained. Finally, the second part presents conclusions and a summary of the major findings.

Finally, the thesis presents an overview of the main results obtained by the research and proposes several ideas for further research.

# PART I: THE EFFICIENCY OF SPANISH MUTUAL FUND COMPANIES: A SLACKS-BASED MEASURE APPROACH

# 1 Introduction

From the early 1990s through the middle of 2007, the mutual fund industry saw remarkable growth worldwide, reaching a maximum of 26.13 trillion U.S. dollars in December 2007 (source: European Fund and Asset Management Association, EFAMA). This successful expansion involved both the proliferation of Mutual Fund Management Companies and the inception of a large number of mutual funds, both of which placed greater demands on the business structure of the industry. Then, when the markets experienced the subprime mortgage financial crisis, the mutual fund industry suffered a significant decline in the total assets under management, especially in 2008, primarily driven by a fall in financial investments by households due to both increased risk aversion sparked by the high market volatility and a drop in confidence in financial instruments as a result of the crisis.[1] This market picture stopped the creation of new management companies and, in some cases, led to the merger or closure of other firms, thereby rearranging the competitive map of the industry. This drop in assets under management and the number of investors is explained not only by the poor image of mutual funds but also by a lack of confidence in the global markets where these funds allocate their primary investment positions. Unfortunately, despite all financial advice about diversification, equity investors had no place to hide in this crisis (Bartram and Bodnar, 2009; Aït-Sahalia et al., 2012). In many cases, this situation forced financial institutions to rethink their production structures and to create new products not only on their own initiative but also driven by new legislative and regulatory requirements imposed by supervisory authorities who were trying to restore confidence in financial markets (Bernanke, 2009; McCauley et al., 2012; Kirkpatrick, 2009).

More recently, mutual fund assets worldwide have been slowly returning to the successful figures achieved before the crisis, i.e., 28.4 trillion U.S. dollars managed in September 2012, representing over one third of world GDP. This industry employs skilled

[1] Mutual fund net assets worldwide decreased by approximately 27% in 2008. Europe and America experienced quite similar trends, while Asia and the Pacific showed even more dramatic decreasing rates. Source: EFAMA, International Statistical Releases.

labour, has spillover effects on other sectors and tax returns, and provides important liquidity to the financial system and wealth for retail and institutional investors. The analysis of the efficiency of mutual fund industry is quite similar to the extensive literature addressed in other financial sectors such as banking and insurance. If banks and insurance companies are more productive, then these financial sectors should obtain better performance, thereby offering new and safer products to their customers at lower prices. According to this argument, Mutual Fund Management Companies should work to offer a wide range of top-performing funds with diverse investment characteristics for different types of investors while keeping fees and expenses as low as possible.[2] The expansion of these appropriate standards of management should result in higher levels of overall efficiency in the mutual fund industry. It is worth noting that mutual fund activities reduce the exposure of banks to financial-services industry risk and increase scale economies and bank profitability, thereby improving the operating performance of banks (Gallo et al., 1996; Asaftei, 2008). In addition, the analysis of productivity differences across these companies in recent years could make it possible to identify the success or failure of management initiatives and might also highlight the different strategies undertaken by the companies during the financial crisis.

While extensive research has been devoted to productivity in financial institutions, as far as we know, only Zhao and Yue (2010) and Medeiros (2010) have studied the efficiency of mutual fund companies and pension fund companies, respectively. On one hand, Zhao and Yue (2010) examine the core efficiency of Chinese fund firms by analysing both the investment/research and the marketing/service subsystems. On the other hand, Medeiros (2010) analyses the changes in total productivity of a sample of Portuguese pension fund companies from 1994 to 2007 by means of a DEA-Malmquist index. A potential explanation for this scarce literature may be the difficulty of identifying specific variables for the appropriate evaluation of these companies without merely replicating the previous studies focused on financial institutions, such as banks and insurance companies. To

[2] Referring to this last subject, there has been a gradual reduction in the annual management fees of funds since the mid-90s, leading to a major impact on fund-manager income during the last financial crisis due to the drastic fall in assets managed. For instance, in the Spanish market, the management fees dropped from 1.65% in 1994 to 0.83% in 2009. Source: INVERCO, Impact of Subprime crisis in the IIC, June 2010.

develop appropriate evaluation models for mutual fund companies, it should be desirable to have a range of possibilities for specific industry variables that would complement those models analysed in other financial sectors. Therefore, these fund industry-specific proposals should contain relevant management inputs/outputs for mutual fund companies instead of merely using the general approach previously considered in banking and insurance.

This study fills this gap in the financial literature and aims to shed additional light by analysing the efficiency of mutual fund companies in Spain, which is one of the most relevant fund industries in the Euro market. The important market concentration of Spanish mutual fund companies is the most challenging feature when obtaining an appropriate evaluation for this industry. That is, the coexistence of a few, very large and well-diversified Mutual Fund Management Companies together with a huge number of small managers specialised in fund strategy per sector and/or geographical area makes it difficult to obtain appropriate evaluations of the industry as a whole because of the striking differences between competitors. Therefore, a question arises as to the selection of an accurate methodology and management variables to appropriately analyse so heterogeneous a set of Spanish mutual fund companies.

To conduct this analysis, we apply Data Envelopment Analysis (DEA), which has been one of the most popular methods over the last decades for evaluating efficiency in the financial industry (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; Holod and Lewis, 2011)[3], and we examine the performance of institutional portfolios as an alternative approach to the traditional performance measures; portfolio performance works with the functional relationships between return and risk associated with behavioural assumptions (e.g., Murthi et al., 1997; Basso and Funari, 2001; Gregoriou et al., 2005; Eling, 2006; Lozano and Gutiérrez, 2008a, 2008b).

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

This first part of study employs an original model and a unique set of fund industry-specific variables that complement the traditional models in banking and insurance, thereby allowing for an accurate and comprehensive evaluation of the overall efficiency of Mutual Fund Management Companies.

We used this innovative approach to address a number of questions regarding the efficiency of Mutual Fund Management Companies in the Spanish market and to further discuss the implications of the results obtained in this analysis. What are the key management stages driving the efficiency of a Mutual Fund company? Is efficiency robust across the different management stages within a mutual fund company? How does scale affect the efficiency results?

This first part is organised as follows: Section 2 provides a review of the early DEA literature, a brief explanation of the basic models, a short review of major contributions to efficiency in financial institutions, and a discussion of the two most popular approaches. Section 3 describes the proposed theoretical model and the variables used in our analysis. Section 4 illustrates the data, the empirical analysis and results, the influence of the variable-returns-to-scale, and robustness analyses. Finally, Section 5 concludes and summarises the primary findings.

# 2 Background

## 2.1 Basic Concepts

In this section, we provide a brief overview of the conceptual framework that underpins efficiency and productivity measurement. Essentially, the productivity of an organisation is defined as the ratio of the outputs that it produces to the inputs that it uses.

$$productivity = output/input \tag{I.1}$$

If the production unit uses a single input to produce a single output, the efficiency is easy to calculate, but it is more likely that the unit uses multiple inputs to produce multiple outputs. Both inputs and outputs must be combined in an economically reasonable way to maintain the productivity ratio of two scalars. Differences in production technology, differences in the efficiency of the production process, and differences in the settings in which production occurs are all potential issues in an industry analysis.

The comparison between the observed values of outputs and inputs (the production unit efficiency) can take the form of the ratio of the maximum potential output obtainable from the inputs or the ratio of the minimum potential input required to produce the outputs. The optimal result is defined in terms of production possibilities, and the efficiency is technical. Economic efficiency is obtained through the comparison of the optimal revenue, cost, profit or any other data that consider an appropriate quantity and price, and it is defined as the behavioural goal of the production unit.

Tangen (2005) has provided a useful description of the terms “productivity”, “efficiency” and “effectiveness”, which are often interchangeable but are quite distinct from each other. According to this study, productivity is closely related to the use of resources, meaning that a company's productivity is reduced if its resources are not properly used. Secondly, productivity is also strongly connected to the creation of value. Thus, high productivity is accomplished when activities and resources in the manufacturing transformation process add value to the produced outputs. Because productivity is the productive capability of the resources consumed in organisations, it can be measured for each production resource separately, i.e., single factor productivity, as well as for all resources jointly.[4]

With respect to the concepts of efficiency and effectiveness, Tangen (2005) states that both concepts may be confused with productivity.[5] Efficiency, in an organisational context, is related to the utilisation of inputs during the transformation process; effectiveness is concerned with the correctness and enhancement of the output, i.e., higher quantity and/or quality of output. It is important to note that productivity, efficiency, and effectiveness are relative concepts because it cannot be said to be increased or decreased unless a comparison is made with either variations from a "standard" at a certain point in time (which can be based on, for instance, a competitor or another production unit) or from changes over time.

The productivity ratio is an indicator of the efficiency with which a firm converts its resources (inputs) into finished goods or services (outputs). An increase in productivity can firstly be driven by producing more output with the same level of input (maximum potential output). Productivity can also be increased by producing the same output with fewer inputs (minimum potential input), or it can be a combination between both approaches. One of the primary problems when measuring productivity is the identification of the most appropriate inputs and outputs and determining how they will be measured.[6] In Figure I-1 shows a scheme for the relationship between these terms.

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[4] This measure is known as the total productivity factor (TPF).

[5] Saari (2006) states that efficiency is a general concept related to economic activity, and that productivity and profitability are typically specific concepts of efficiency.

[6] Any of the traditional factors of production — land, labour, or capital — can be used as the denominator for the ratio, although productivity calculations are rarely made for land or capital in practice because their capacity is difficult to measure. Labour is in most cases easily quantified — for instance in R&D, where workers are engaged in developing a particular product.

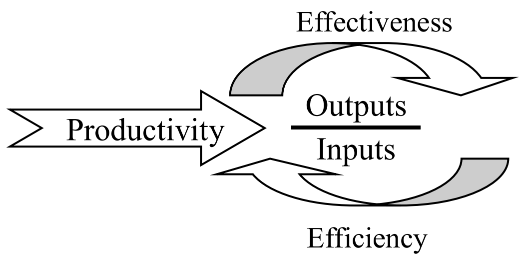


**Figure I-1** Relationships between productivity, efficiency and effectiveness

Certainly, productivity is based on both efficiency and effectiveness; therefore, it is possible to talk in terms of productive efficiency when the orientation model is based on possible changes in the inputs and in terms of productive effectiveness when the orientation model is based on the possible changes in the outputs. Basically, one should select the orientation according to the managers' ability to control the inputs or/and outputs. As discussed in the next subsection, there are models that do not consider any orientation, which may be a useful approach when it is not clear what the managers can better control and influence. In any case, most of the studies over the last 30 years have referred to efficiency rather than productivity or performance (see Emrouznejad et al., 2008).[7]

A simple commonly accepted definition is that efficiency refers to how firms are performing relative to the existing technology in an industry, whereas productivity refers to the evolution of technology over time (Cummins and Weiss, 2001). For this reason, in this first part we refer to efficiency, but considering the issues clarified above

Moreover, it is essential to be familiar with the concept and utility of the production function (production frontier). The production function is basically the total product *P*, related to the labour *L*, capital *C*, and terrain *T*, along with the other inputs that are combined to produce it.

$$P = f(L, C, T \ldots) \quad \textbf{(I.2)}$$

[7] Performance is another term extensively used in the literature. Performance is the umbrella term for excellence in financial studies and includes profitability and productivity as well as other non-cost factors such as quality, speed, delivery and flexibility.

The technological relationship is expressed in the function. The function expounds the maximum output obtainable at the existing state of technological knowledge from given quantities of factor inputs. In other words, a production function is a set of recipes or techniques for combining inputs to produce outputs, and the goal must be to maximise outputs or minimise inputs. Production functions are related to the level of the individual firms and the macro economy at large. At the micro level, economists use production functions to generate cost functions and input demand schedules for the firm. The renowned profit-maximising conditions of optimal factors derive from these micro-economic functions. At the level of the macro economy, analysts use aggregate production functions to explain the determination of factor income shares and to specify the relative contributions of technological progress to the expansion of factor supplies to economic development.

Figure I-2 shows a simple production process in which a single input is used to produce a single output. The line 0*F'* denotes a production frontier that defines the relationship between the input and the output. Firms in this industry that operate on the frontier are technically efficient, and those that are below the frontier are inefficient. Point *B* represents an inefficient point, while points *A* and *C* represent efficient points. In other words, the distance from one firm to the frontier identifies the degree of inefficiency, and, therefore, any improvement in the efficient use of inputs will result in a movement toward the frontier (e.g., the optimisation of capital and technological resources or improvements in organisational practices). A firm operating at point *B* could technically increase the output quantity to the level of point *C* without more input.

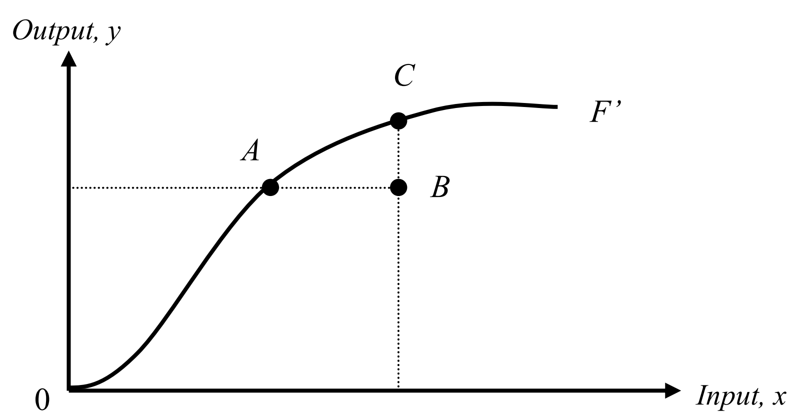


**Figure I-2** Production frontier and technical efficiency

## 2.2 Basic DEA Models

Farrell (1957) made some important contributions to the issue of efficiency and productivity, specifically speaking of "productive efficiency".[8] This author states that there has been a total neglect of the theoretical side of efficiency measurement because for a long time, it was considered adequate to measure the average productivity specifically of labour and to use it as a measure of efficiency. This measure is patently unsatisfactory for Farrell because it ignores all other inputs aside from labour. Farrell (1957) proposes a satisfactory measure of productive efficiency for U.S. agricultural production. This measure takes into account all inputs and yet avoids index number problems. One of the most important features of this method is the distinction between technical efficiency and allocative efficiency. The former measures the firm's success in producing maximum output from a given set of inputs, while the latter, called price efficiency by Farrell (1957), measures the success in choosing an optimal set of inputs. These two measures are then combined to afford a measure of total economic efficiency, called overall efficiency by Farrell (1957).

Measures in decision making efficiency were initially applied to evaluate public programs, where each program had a collection of decision making units (DMUs) with common inputs and outputs and focused on decision making rather than profits.[9] For instance, in an educational program, the efficiency of various schools (DMUs) was measured by reference to outputs involving standard education categories such as cognitive or affective skills. The inputs could similarly range between fairly easy-to-measure quantities such as the number of teachers or the time spent in program activities by community leaders or parents. The measure of efficiency was obtained as the maximum of the ratio of weighted outputs to weighted inputs, subject to the condition

[8] There were other interesting statistical contributions before Farrell (1957). We could mention Cobb and Douglas (1928), who offered what is commonly known as the Cobb-Douglas production function. These authors describe the relationship between the time series for manufacturing output, labour input, and capital input. Their equation displayed constant returns to scale, assumed unchanged technology, and omitted land and material inputs. Malmquist (1953) proposed total factor productivity (TFP), which is a measure of the changes in total output relative to inputs as well as the distance function approach. TFP is also a productivity measure that combines labour and capital as inputs.

[9] Fried et al. (2008) presents a summary of the primary empirical applications in public areas such as health care, transportation, among others.

that similar ratios for each DMU should be less than or equal to unity (Charnes et al., 1978).

Based on Farrell (1957), Charnes et al. (1978) developed the well-known "Data Development Analysis" (DEA). This method identifies the production frontier as mentioned in the paragraph above; that is, it is necessary to find the maximum set of outputs that can be obtained from a given set of inputs. This frontier is a function that envelops or is restricted to the data sample. Essentially, DEA aimed at assessing the relative performance of a number of comparable DMUs, which may be within a company or across different companies within an industry.

There are many areas of application for DEA, from public programs to private financial studies. There are also many different techniques for implementing DEA and a wide range of different factors (inputs and outputs) depending on what is being evaluated or measured. In financial institutions, these efficiency methods are useful in a variety of contexts, from agency problems to control methodologies for regulators and policy makers. The application of DEA to mutual funds has usually been focused on the excess mean returns versus standard deviation and other risk measures. In most DEA models, it is common to find that the scalar efficiency measure is between zero (poor performance) and one (good performance) after applying a linear programming model, i.e., the efficiency score is the distance between the assessed DMU and a composite benchmark or target DMU that dominates it and lies on the efficient frontier (Cooper et al., 2000).

Schmidt (1985) classified the DEA as a non-parametric approach. Efficiency studies can be divided into those that measure technical efficiency using non-parametric techniques such as DEA and FDH (free disposal hull) and those that measure economic efficiency using parametric approaches such as SFA (stochastic frontier analysis), TFA (thick frontier approach) and DFA (distribution free approach).[10] The parametric

[10] The Free Disposal Hull (FDH) approach is a more flexible model that is considered to be a special case of DEA, where the points on lines connecting the DEA vertices are not included in the frontier. The econometric stochastic frontier analysis (SFA) is a method that assumes a two-part or composed error term. Efficiency is

methods adopt a specific functional form of the cost, profit or production functions. In contrast, the non-parametric methods do not place any restrictions on the functional form of the relationship between inputs and outputs. In the case of financial institutions, it is not a simple task to specify this functional relationship in the production process, which explains why non-parametric methods are predominantly applied for calculating the efficiency of financial institutions.[11]

There are several types of DEA, but the two models most extensively applied are the CCR model proposed by Charnes et al. (1978), which has an input orientation and assumes constant returns to scale (CRS), and the BCC model proposed by Banker et al. (1984), which considers variable returns to scale (VRS). Since these well-known studies, other papers have considered alternative sets of assumptions in recent years: the Pareto-Koopmans model by Charnes et al. (1985), the Russell measure by Färe and Lovell (1978), the slacks-based measure (SBM) introduced by Tone (2001), and the recent variants of the SBM approach (Tone, 2010). These two latter papers are the methodological basis of this thesis.

Let us briefly review the basic ideas behind the most popular DEA models. We begin with the input-oriented CCR model because this approach was the first to be widely applied in the DEA literature.

Based on the explanations of Cook and Seiford (2009), we consider a set of *n* DMUs, with each DMU $j$, *(j = 1, 2, 3, ..., n)* using the same $m$ inputs $x_{ij}$ *(i = 1, 2, 3, ..., m)*, possibly in different amounts, and producing the same *s* outputs $y_{rj}$ *(r = 1, 2, 3, ..., s)*, also possibly in different amounts. If the prices or multipliers $\bar{u}_r$ and $\bar{v}_i$ related to outputs $r$ and inputs $i$, correspondingly, are known, then using the conventional

assumed to follow an asymmetric distribution, usually half normal, while the random error is assumed to follow a standard symmetric distribution. The thick frontier approach (TFA) compares the average efficiencies of groups of firms instead of estimating the frontier edge. The distribution free approach (DFA) employs the average residuals of the cost function estimated using panel data to construct a measure of frontier-efficiency cost. DFA does not impose a specific form on the distribution of efficiency but assumes that there is a core efficiency or average efficiency for each firm that is constant over time. Lovell (1993) provides an excellent introduction to the different methods used over the last 40 years.

[11] These issues will be further discussed in the next sections.

benefit/cost concept, the efficiency of $\text{DMU}_j$ could be expressed as the ratio of weighted outputs to weighted inputs, i.e.,

$$\sum_r \bar{u}_r y_{rj} \,/ \sum_i \bar{v}_i x_{ij} \qquad \textbf{(I.3)}$$

If the multipliers are unknown, Charnes et al. (1978) proposed deriving appropriate multipliers for a given DMU by solving a particular non-linear programing problem. Thus, the fractional programming problem, with an input-oriented model would be

$$\max \theta = \sum_r u_r y_{ro} \Big/ \sum_i v_i x_{io}$$

s.t.

$$\sum_r u_r y_{rj} - \sum_i v_i x_{ij} \leq 0, \quad for\ all\ j$$

$$u_r, v_i \geq \varepsilon, \ all\ r, i. \qquad \textbf{(I.4)}$$

where $y_{ro}$ is the output vector, $x_{io}$ is the input vector of the DMU evaluated, and $\varepsilon$ is a non-archimedian value designed to enforce strict positivity on the output and input multipliers ($u_r$ and $v_i$).[12] The objective of this problem is to minimise inputs while producing at least the given output levels, i.e., to obtain values (weights) for $u_r$ and $v_i$ that maximise the ratio.[13] The constraints mean that this ratio should not exceed 1 for every DMU. By virtue of these constraints, the optimal objective value $\theta^*$ is at most 1.

Problem (I.4) can be converted to an equivalent linear programming model applying the theory of fractional programing (See Charnes and Cooper, 1962; Charnes et al.,

[12] In the original paper of Charnes et al. (1978), the authors simply restricted the variables to be non-negative ($\varepsilon$=0); the imposition of a strictly positive lower limit ($\varepsilon > 0$) was added by Charnes et al. (1981).
[13] We could invert this ratio and solve the corresponding output-oriented model, which attempts to maximise outputs while using no more than the observed amount of any input.

1978), making the following changes in the variables: $u_r = tu_r$ and $u_i = tu_i$, where $t = (\sum_i v_i x_{i0})^{-1}$, Thus, we have the *multiplier* model:

$$max\ \theta = \sum_r u_r y_{ro}$$

s.t.

$$\sum_r v_r x_{io} = 1$$

$$\sum_r u_r y_{rj} - \sum_i v_i x_{ij} \leq 0, \quad all\ j$$

$$u_r, v_i \geq \varepsilon,\ all\ r, i. \qquad \textbf{(I.5)}$$

and finally, this multiplier model can be expressed with a real variable $\theta$ and a non-negative set of variables $\lambda\,(\lambda_1, \dots, \lambda_n)$, making it equivalent to the linear programming problem; we now have the *envelopment* or primal problem:

$$\min \theta_o - \varepsilon\left(\sum_r s_r^+ + \sum_i s_i^-\right)$$

s.t.

$$\theta_o x_{io} = \sum_j \lambda_j x_{ij} + s_i^-, \qquad i = 1, \dots, m$$

$$y_{ro} = \sum_j \lambda_j y_{rj} - s_r^+, \qquad r = 1, \dots, s$$

$$\lambda_j, s_i^-, s_r^+ \geq 0, \qquad all\ i, j, r$$

$$\theta_o\ unconstrained \qquad \textbf{(I.6)}$$

Note that the optimal solutions show the occurrence of both excess inputs and shortfalls in outputs, which are called *slacks* $(s_i^-, s_r^+)$. If $\theta < 1$, the objective DMU is inefficient. If an optimal solution satisfies $\theta = 1$ and $s^+ = 0$ and $s^- = 0$, it is called CCR-efficient. These conditions taken together are also described as Pareto-Koopmans efficient and denote that a DMU is efficient if and only if it is not possible to improve any input or output without worsening some other input or output.

Then, the constraint space of equation (I.6) defines the following *production possibility set* P:

$$P = \left\{ (x, y) \backslash \quad x \geq \sum_j X_j \lambda_j , \qquad y \leq \sum_j Y_j \lambda_j ,\ \lambda_j \geq 0 \right\} \qquad \mathbf{(I.7)}$$

Any semi positive linear combination of activities in *P* belongs to *P*, and it assumes constant returns-to-scale. The CCR model appears to be appropriate when the entire set of firms is operating at an optimal scale. However, imperfect competition, government regulations, constraints on finance, etc., may cause a DMU to not operate at optimal scale. The BCC DEA model by Banker et al. (1984) suggests adjusting the CCR DEA model to account for variable returns to scale (VRS). According to Coelli et al. (2005), the use of constant returns to scale (CRS, named the CCR model here) when not all DMUs are operating at the optimal scale results in measures of *technical efficiency* that are mistaken for *scale efficiencies*. Thus, the use of the VRS specification allows for appropriate calculations of *technical efficiency*.

Banker et al. (1984) simply added a convexity constraint on $\lambda_j$. That is, the BCC model has its production frontiers *P* now spanned by the convex hull of all existing DMUs, namely $\sum_j \lambda_j = 1$ for the CRS linear programming problem (equation I.6), to provide the following model:

$$\min \theta_o - \varepsilon\left(\sum_i s_i^- + \sum_r s_r^+\right)$$

s.t.

$$\theta_o x_{io} = \sum_j \lambda_j x_{ij} + s_i^-, \qquad i = 1, \dots, m$$

$$y_{ro} = \sum_j \lambda_j y_{rj} - s_r^+, \qquad r = 1, \dots, s$$

$$\sum_j \lambda_j = 1$$

$$\lambda_j, s_i^-, s_r^+ \geq 0, \qquad all\ i, j, r$$

$$\theta_o \ unconstrained \qquad \textbf{(I.8)}$$

This model essentially ensures that the projected point of the inefficient DMU on the BCC DEA frontier is a convex combination of the observed DMUs. In this situation, the λ-weights do not sum to a value less than or greater than one.[14]

In Figure I-3, the difference between both production sets can be observed. Efficiency estimates are generally higher with BCC, and rankings can differ in the two specifications. Note that equation (I.8) differs from equation (I.6) in that it has the additional convexity constraint on $\lambda_j$, $\sum_j \lambda_j = 1$. The frontier BCC determines the different returns to scale: the portion of the frontier from point *A* up to (but not including) *B* establishes increasing returns to scale; point *B* has a constant returns to scale[15]; and all the points on the frontier BCC to the right of *B*, in this case only point *D*,

[14] The BCC model aims to somehow determine a benchmark between the points from an inefficient DMU alongside DMUs of a similar size.

[15] Point *B* is the point of maximum possible productivity, the point representing the technically optimal scale. Operation at any other point on the production frontier results in lower productivity. The DMUs *A* and *D* are

represent decreasing returns to scale. As with the CCR model, a DMU is BCC-efficient in the VRS model if the solution of equation (I.8) obtains a value of $\theta_o = 1$ and all the slacks $s_i^-$ and $s_i^+$ have a zero value. Hence, any CCR-efficient DMU can also be BCC-efficient. However, it is possible to project the inefficient point *C* to the frontiers (points *C'* and *C"*), and we can see that it is a horizontal projection; an output-oriented model would involve a vertical projection from DMU *C* up to the frontier.

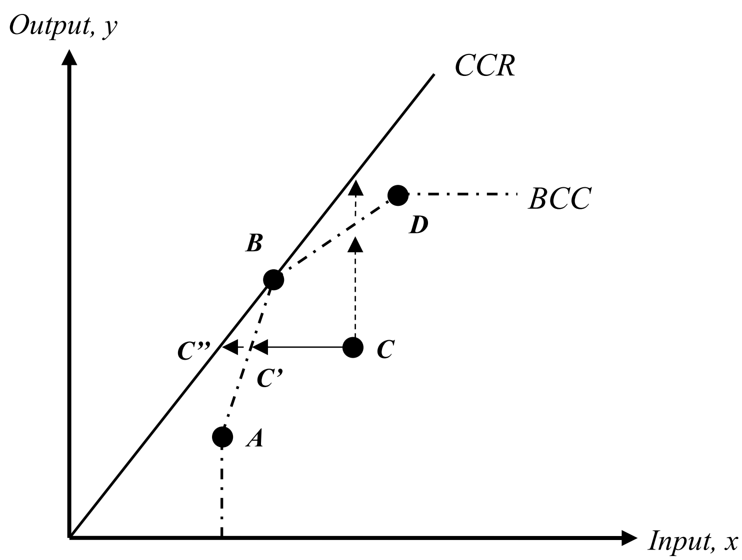


**Figure I-3** Differences of returns to scale

Charnes et al. (1985) proposed combining both models and formulated the Pareto-Koopmans (PK) model. In this approach, the inputs are proportionally reduced while the outputs remain fixed, and the outputs are proportionally increased while the inputs remain unchanged. This additive model has the same convex production as the BCC model, and a DMU is PK efficient if and only if it is VRS-efficient and all of its slacks are equal to zero. Specifically, the model is

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efficient but could have higher or lower productivity, i.e., at these points, the firm may still be able to improve its productivity by exploiting scale economies.

$$P_o = max \sum_r s_r^+ + \sum_i s_i^-$$

s.t.

$$x_{io} = \sum_j \lambda_j x_{ij} + s_i^-, \qquad i = 1, \dots, m$$

$$y_{ro} = \sum_j \lambda_j y_{rj} - s_r^+, \qquad r = 1, \dots, s$$

$$\sum_j \lambda_j = 1$$

$$\lambda_j, s_i^-, s_r^+ \geq 0, \ all\ i, j, r \qquad \textbf{(I.9)}$$

This model has no scalar measure or efficiency ratio per se, unlike the CCR and BCC models. The additive PK model can discriminate between efficient and inefficient DMUs by the existence of slacks, but it does not measure the depth of inefficiency, which is similar to $\theta_o$ in the CCR and BCC models.

To address the above shortcoming, Tone (2001) defines the slacks-based measure (SBM), which is invariant to the units of measurement and is monotonic increasing in each input and output slack.[16] This scalar measure directly addresses the input excesses and the output shortfalls of the decision making unit (DMU) evaluated.

[16] The Russell measure proposed by Färe and Lovell (1978) and later revised by Pastor et al. (1999) is considered to be equivalent to SBM according to Cook and Seiford (2009).

Tone (2001) states that the following properties should be considered when designing the efficiency measures:

- (P1) I*nvariant units*: The measure should be invariant with respect to the units of data.
- (P2) *Monotone*: The measure should be monotone decreasing in each slack in input and output.
- (P3) *Translation invariant*: The measure should be invariant under a parallel translation of the coordinate system applied.
- (P4) *Reference set dependent*: The measure should be determined only by consulting the reference set of the DMU concerned.[17]

Tone (2001) maintains that the SBM model satisfies the properties (P1), (P2) and (P3). He also states that because the beginning DEA employs piece-wise linear efficient frontiers whose area is spanned by efficient DMUs and because an inefficient unit is “inefficient” with respect to the DMUs in its reference set, the measure of efficiency should be determined by the reference set dependent values as in the CCR and BCC models. In addition, the measure should not be influenced by extreme values, e.g., the minimum and the maximum of the data set.

Based on the CCR and BCC models, which consider that n DMUs have inputs $X = (x_{ij}) \in R^{m\times n}$ and outputs $Y = (y_{rj}) \in R^{s\times n}$ [18], the SBM model initially assumes that the data set is positive, i.e., $X > 0$ and $Y > 0$, although this assumption can be relaxed. Thus, production possibility *P* is defined as in the former expression (I.7):

$$P = \left\{ (x,y) \backslash \quad x \geq \sum_j X_j\lambda_j , \qquad y \leq \sum_j Y_j\lambda_j,\ \lambda_j \geq 0 \right\} \qquad \mathbf{(I.7)}$$

being $\lambda_j$ a non-negative vector in $R^n$, constrains $\lambda$, such as $\sum_j \lambda_j = 1$.

[17] The reference set $R_o$ for an inefficient $DMU_o$ is defined as $R_o = \{j \setminus \lambda^*_j > 0\}$; *(j = 1, 2, 3, …, n)*

[18] *X* is a matrix with *n* columns (DMUs being analysed) and *m* rows (inputs). *Y* is a matrix with *n* columns (DMUs being analysed) and *s* rows (outputs).

A certain DMU $(x_o, y_0)$ is described as

$$x_0 = X\lambda + s^-, \qquad \textbf{(I.10)}$$

$$y_0 = Y\lambda - s^+, \qquad \textbf{(I.11)}$$

with $\lambda \geq 0, s^- \geq 0 \; and \; s^+ \geq 0$. The vectors $s^- \in R^m$ and $s^+ \in R^s$ indicate the *input excesses* and *output shortfalls* of expressions (I.10) and (I.11), respectively,[19] as we have seen the so-called *slacks*. From the conditions $X > 0 \; and \; \lambda \geq 0$, it holds that

$$x_o \geq s^-. \qquad \textbf{(I.12)}$$

Using $s^- \; and \; s^+$, Tone (2001) defines an index *p* as follows:

$$p = \frac{1 - \left(1/m\right) \sum_{i=1}^{m} s_i^- / x_{io}}{1 + \left(1/s\right) \sum_{r=1}^{s} s_r^+ / y_{ro}} \qquad \textbf{(I.13)}$$

According to Cooper et al. (2000), expression (I.13) could be interpreted as the ratio of mean input and output mix inefficiencies, that is, the relative proportional reduction rate of inputs and the relative proportional expansion of outputs. Here, it can be verified that *p* satisfies the properties (P1) = units invariant because the numerator and denominator are measured in the same units for every item and (P2) = monotone because an increase in either $s^-$or $s^+$(the rest remains constant) will decrease *p* in a strictly monotone manner. Additionally, from expression (I.12), it holds that

$$0 < p \leq 1 \qquad \textbf{(I.14)}$$

[19] $s^-$ and $s^+$ are points in the *n* dimensional vector space $R^n$.

Therefore, the final fractional program in $\lambda$, $s^{-}$, $s^{+}$ of Tone (2001) to estimate the efficiency under constant returns to scale (CRS) of $(x_o, y_0)$ is as follows:

$$[SBM]$$

$$\text{minimise} \qquad p = \frac{1-(1/m)\sum_{i=1}^{m} s_i^{-}/x_{io}}{1+(1/s)\sum_{r=1}^{s} s_r^{+}/y_{ro}}$$

s. t.

$$x_o = X\lambda + s^{-},$$
$$y_o = Y\lambda - s^{+},$$
$$\lambda, s^{-}, s^{+} \geq 0 \qquad \textbf{(I.15)}$$

Then, Tone (2001) multiplies a scalar variable $t(> 0)$ by both the denominator and the numerator of expression (I.15). This transformation is performed because the goal is to minimise the numerator, and it does not cause changes in *p*.

$$[SBMt]$$

$$\text{minimise} \qquad \tau = t - \frac{1}{m}\sum_{i=1}^{m} ts_i^{-}/x_{io}$$

s. t.

$$1 = t + \frac{1}{s}\sum_{r=1}^{s} ts_r^{+}/y_{ro},$$
$$x_o = X\lambda + s^{-},$$
$$y_o = Y\lambda - s^{+},$$
$$\lambda \geq 0,\ \ s^{-} \geq 0,\ \ s^{+} \geq 0,\ \ t > 0 \qquad \textbf{(I.16)}$$

The model given above is a nonlinear programming model because it contains the nonlinear term $ts_r^{+}(r = 1, \dots, s)$. However, Tone (2001) transforms it into a linear program using the Charnes-Cooper transformation, as follows. The transformation is defined as $S^{-} = ts^{-},\ S^{+} = ts^{+}$ and $\Lambda = t\lambda$.

Thus, $[SBMt]$ becomes the following linear program in $t,\ S^-,\ S^+$ and $\Lambda$:

$$[LP]$$

$$minimise \qquad \tau = t - \frac{1}{m}\sum_{i=1}^{m} S_i^- / x_{i0}$$

s. t.

$$1 = t + \frac{1}{s}\sum_{r=1}^{s} S_r^+ / y_{r0},$$
$$tx_o = X\Lambda + S^-,$$
$$ty_o = Y\Lambda - S^+,$$
$$\Lambda \geq 0,\ S^- \geq 0,\ S^+ \geq 0,\ t > 0 \qquad \textbf{(I.17)}$$

Allow the optimal solution of $[LP]$ to be

$$(\tau^*, t^*, \Lambda^*, S^{-*}, S^{+*}).$$

This optimal solution is defined by

$$p^* = \tau^*,\ \lambda^* = \Lambda^*/t^*,\ s^{-*} = S^{-*}/t^*,\ s^{+*} = S^{+*}/t^* \qquad \textbf{(I.18)}$$

Based on this optimal solution, Tone (2001) determines that a DMU $(x_o, y_o)$ is *SBM-efficient* if $p^* = 1$. This condition is equivalent to $s^{-*} = 0$ (no input excesses) and $s^{+*} = 0$ (no output shortfalls) for any optimal solution.

For an SBM inefficient DMU$(x_o, y_o)$, it holds that $x_o = X\lambda^* + s^{-*}$, and $y_o = Y\lambda^* - s^{+*}$

This inefficient DMU $(x_o, y_o)$ can be improved and become efficient by deleting the input excess and augmenting the output shortfall as follows:

$$x_o \leftarrow x_o - s^{-*}, \qquad \textbf{(I.19)}$$
$$y_o \leftarrow y_o + s^{+*}. \qquad \textbf{(I.20)}$$

Based on $\lambda^*$, Tone (2001) defines the reference set to $(x_o, y_o)$ as the set of indices corresponding to positive $\lambda_j^* s$.[20] The *reference set* $R_0$ is therefore

$$R_o = \{j | \lambda_j^* > 0,\ j = 1, \dots n\} \quad \textbf{(I.21)}$$

Now, $(x_{io}, y_{ro})$ can be expressed in terms of the reference set $R_0$ as follows:

$$x_o = \sum_{j \in R_0} x_j \lambda_j^* + s^{-*} \quad \textbf{(I.22)}$$

$$y_o = \sum_{j \in R_0} y_j \lambda_j^* - s^{+*} \quad \textbf{(I.23)}$$

Tone (2001) adds some bounds on the slacks.[21] This operation is called the SBM-*projection*. The projection of the DMU is obtained as follows:

$$\bar{x}_0 = x_0 - s^{-*} = \sum_{j \in R_0} x_j \lambda_j^* \quad \textbf{(I.24)}$$

$$\bar{y}_0 = y_0 + s^{+*} = \sum_{j \in R_0} y_j \lambda_j^* \quad \textbf{(I.25)}$$

SBM $p^*$ depends only on $s^{-*}$ and $s^{+*}$, i.e., the reference set dependent values. That is, $p^*$ is not affected by values attributed to other DMUs that are not included in the reference set $R_0$.

In summary, this section has presented the basic ideas behind the most extensively used DEA models. Every DEA model allows us to analyse multiple outputs and multiple inputs without assuming functional forms between these factors, which is an important difference with respect to conventional regression-based methods. This section has also

[20] In the case of multiple optimal solutions, there may be different reference sets.

[21] These bounds are subject to $s^- \leq s_0^{-B}$ *and* $s^+ \leq s_0^{+B}$, where the vector $s_0^{-B}(s_0^{+B})$ is the upper bound of input reduction (output enlargement) of the DMU and should be specified for each DMU.

highlighted that there are three basic orientation types: input-oriented, which focuses on reducing the input amounts while keeping the current output levels; output-oriented, which maximises output levels under the current inputs; and a third, based on both the additive and the SBM models and addressing excess inputs and output shortfalls simultaneously, i.e., the unoriented model. In any case, the efficiency determination for a set of DMUs will have the same goal as these methods. Table I-1 shows a recap of some of the important topics behind the basic DEA models treated briefly in this section.

It is important to note that further DEA models were developed in the subsequent years through multilevel DEA models, multiplier restrictions, and considerations regarding the status of variables and data variation (see Cook and Seiford, 2009).[22] The refinement of these methodologies during the search for more appropriate evaluations is a challenging issue in the literature.

**Table I-1** Comparison between basic DEA models (Cooper et al., 2000)

| Model | CCR | BCC | ADD | SBM |
|---|---|---|---|---|
| **Data *X*** | Semi-p | Semi-p | Free | Semi-p |
| **Data *Y*** | Free | Free | Free | Free |
| **Trans invariance *X*** | No | No | Yes | No |
| **Trans invariance *Y*** | No | Yes | Yes | No |
| **Units invariance** | Yes | Yes | No | Yes |
| $\boldsymbol{\theta}^*$ | [0,1] | [0,1] | No | [0,1] |
| **Tech. or Mix** | Tech. | Tech. | Mix | Mix |
| **Returns to scale** | CRS | VRS | C(V)RS | C(V)RS |

Semi-p = semi positive, means nonnegative with at least one positive element in the data for each DMU. Free permits negative, zero or positive data. Tech. or Mix indicates whether the model measures use technical efficiency or mix efficiency.[23] CRS and VRS represent constant and variable returns to scale, respectively. The variable returns to scale of ADD and SBM depend on the added constraint λ = 1.

[22] With respect to data variation, the subject of sensitivity analysis is of great interest as it can influence the efficiency status of DMUs. Among these issues, both ranking problems and the size problems of DMUs are important. One approach to the ranking problem is provided by the super efficiency model of Andersen and Petersen (1993). This model involves executing the CRS or VRS models, but under the assumption that the DMU being evaluated is excluded from the reference set. It can also be thought of as a measure of stability, evaluating changes over time for specific input data.

[23] According to Tone (2001), the SBM model (I.15) can be transformed into $p = \left(\frac{1}{m}\sum_{i=1}^{m}\frac{x_{io}-s_i^-}{x_{io}}\right)\left(\frac{1}{s}\sum_{r=1}^{s}\frac{y_{ro}+s_r^+}{y_{ro}}\right)^{-1}$, where the ratio $\frac{x_{io}-s_i^-}{x_{io}}$ evaluates the relative reduction rate of input $i$ and, therefore, the first term corresponds to the mean proportional reduction rate of inputs or input mix inefficiencies. This interpretation is similar for the second term with regard to the outputs of the model. Therefore, SBM $p$ can be interpreted as the ratio of mean input and output mix inefficiencies.

## 2.3 Applications to Financial Institutions

### 2.3.1 Context of Study

According to Cummins and Weiss (2001), frontier efficiency methods are useful in a variety of contexts for financial institutions. One primary use is for testing economic assumptions. These methods may explore the success of firms using different scenarios such as cost minimisation or profit maximisation under different economic assumptions. Other issues related to organisational form, distribution systems, corporate governance, and vertical integration have also been analysed by these frontier-methodologies.

A second significant application of frontier methodologies is to provide regulators and policymakers with answers to problems and advances in different industries or for the overall economy. For instance, frontier methodologies might be used to determine whether mergers and acquisitions in both banking and insurance industries have positive or negative consequences on the overall efficiency of the sector (in terms of price and quality of services).

A third application of frontier efficiency would be the comparison of economic efficiency between different countries. Several studies have addressed macroeconomic and social differences, which should allow multilateral agencies and governments to make better decisions.

A fourth application, and not the least important, is to warn management units about the strategies tracked by competitors. That is, frontier analysis can be used not only to understand the evolution of a company's productivity over time but also to compare the performance of a set of companies and to analyse the performance of different management units within a company. Frontier analysis can contribute by providing more meaningful evidence than conventional ratios and survey analyses.

### 2.3.2 Brief Literature Review

Over the last decades, the landscape of the financial sector has seen massive structural changes. The internationalisation and deregulation of markets (Edison et al., 2002; Fernández de Guevara et al., 2007; Salas and Saurina, 2003; Chen, 2007; King, 2012), technological advances, and European integration have changed the financial industry.[24] Financial institutions have been forced to diversify their business to remain in the market. For instance, banks have diversified into non-interest earning activities such as insurance and mutual fund sales, private banking and asset management (Goddard et al., 2007). This diversification could potentially entail changes in the efficiency and productivity of banks and in the diverse business units. That is why in recent decades, there have been many studies of efficiency in financial institutions that basically focus on banks, branches, savings and loan companies, and the insurance industry, leaving to assessing specific business units such as investment companies in themselves. This section provides a brief review of the seminal and most current frontier studies in financial institutions, particularly in banking and insurance firms.[25]

In the banking area, Benston (1965) and Greenbaum (1967) are the first studies that address both cost analyses and banking structure to evaluate their returns to scale. However, not until the decades of the 1980s and 1990s were a great number of empirical studies on cost structure and efficiency in banking conducted. Initially, the most common inputs used in the DEA and FDH methodology were labour, machines, materials, buildings and borrowings, and on the side of the outputs we find incomes, short and long-term loans, number of branches, the opening of new accounts, and other banking services (Aly et al., 1990; Elyasiani and Mehdian, 1990, 1992; Berg et

[24] 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 (Goddard et al., 2007).

[25] For our purpose, we only consider those studies that use non-parametric methodologies, such as DEA and FDH, and parametric models such as SFA, DFA and TFA.

al., 1991; Berg et al. 1993).[26] At the same time, we find several studies that apply parametric methodologies (Berger and Humphrey, 1991; Berger et al., 1993).[27]

The treatment of deposits was one of the major discrepancies between both methodologies. The non-parametric approaches are usually based on the production or service provision approach and take deposits to be an output based on positive consumption of labour and materials. The parametric approaches are based on the asset approach and regard deposits as an input for the production of loans and other financial assets. This issue was further discussed by Berger et al. (1993) and then by Pastor et al. (1997). In this latter study, the efficiency levels of different European and US banking systems were compared and the deposits were taken as an output, i.e., this paper adopted a production approach.

Berger and Humphrey (1997) provide a review of early works on some banks and other financial institutions. This paper finds that efficiency rankings differ depending on which frontier approach is implemented and by how financial institution outputs are measured – "as a transaction-based flow, a stock of numbers of accounts, or a stock of value in these accounts".[28]

In the last decade we do not find major changes in the inputs and outputs used in banking studies. In essence, the changes have been linked to the use of other balance sheet values but within the same model approach and with the variables mentioned above. For instance, inputs such as risk measures, equity capital, reserves, cost of

[26] Some other studies are Fukuyama (1993), Grabowski et al. (1993), and Tulkens (1993).
[27] Some other studies are Bauer et al. (1993) and Pi and Timme (1993).
[28] Berger and Humphrey (1997) find that more than half of the studies use the non-parametrical approach, especially DEA, although they also conclude that "The efficiency estimates from non-parametric (DEA and FDH) studies are similar to those from parametric frontier models (SFA, DFA, and TFA), but the non-parametric methods generally yield slightly lower mean efficiency estimates and seem to have greater dispersion than the results of the parametric models". This debate is still open because other authors consider that there are not significant differences in the results obtained by both approaches. Berger and Humphrey (1997) also identify the potential cost savings from maximising productive efficiency through the comparison of the results of the non-parametric and parametric approach in their large sample of studies. As is known, there are two aspects to productive (operational) efficiency: technical (x-efficiency) involves avoiding input waste by achieving the maximum possible output from a given set of inputs, and allocative efficiency involves selecting the most cost-effective mixture of inputs given an actual set of input prices.

capital, credit losses, and other price ratios, and outputs such as cash, fees and commissions, securities, contingent liabilities, net provisions, purchased funds, and others price ratios can be used (Lang and Welzel, 1996; Chaffai, 1997; Kumbhakar et al., 2002; Mlima and Hjalmarsson, 2002; Casu et al. 2004; Boning et al., 2005; Sherman and Rupert, 2006; Tortosa et al., 2008; Berger et al., 2009; among other studies).

Several studies were conducted collaterally in the insurance industry. The evidence is more recent but there have been few variations in the nature of inputs and outputs in relation to banking. Weiss (1991) uses worldwide surveys to compare productivity in the property-liability insurance industries in the U.S. market and four European countries, applying index numbers for total factor productivity. Later, Delhausse et al. (1995) and Diacon (2001), among others, analysed cross-country efficiency in the European Union using DEA methodology. Studies have also been conducted on Asian insurance companies applying DEA models since Boonyasai et al. (1999). The inputs and outputs included in these studies are summarised in a general overview[29] by Eling and Luhnen (2010), who develop an additional proposal of study.[30]

Moreover, in the last decade, many studies in the insurance industry have focused on analysing scope economies from the hypotheses derived by Berger et al. (2000). These authors take labour, materials, business services, and financial equity capital as inputs and use different output proxies related to risk-pooling and risk-bearing. They find that the conglomeration hypothesis dominates for some types of financial service providers and that the strategic focus hypothesis dominates for other types.[31] Later, we find Cummins et al.'s (2004) study applying DEA and Greene and Segal's (2004)

[29] It is notable that more than 2/3 of the studies reviewed by Eling and Luhnen (2010) applied DEA models.

[30] Eling and Luhnen (2010) apply DEA and SFA by taking proxy variables from inputs such as labour and business services, debt capital, and equity capital and outputs such as non-life claims + additions to reserves, life benefits + additions to reserves, and investments.

[31] The conglomeration hypothesis argues that owning and operating a broad range of services can add value from exploiting cost scope economies by sharing inputs in joint production. In contrast, proponents of the strategic focus hypothesis argue that firms can maximise value by focusing on core services and core competencies.

study using SFA.[32] The inputs are similar in both papers: labour, business services, financial debt capital, equity capital, and other balance sheet variables. However, in Cummins et al. (2004), the outputs are the risk-pooling, risk-bearing, ‘‘real’’ financial services relating to insured losses and intermediations while in Greene and Segal (2004), the outputs are life policies, annuities, accident and health (A&H) and investment income. Later, Fenn et al. (2008) apply the SFA method to the European insurance industry, considering total capital and reserves, technical provisions, debt capital, and labour as inputs. On the outputs side, this research considers the product itself, thereby using proxy variables such as the insurer’s estimation of incurred claims (claims paid together with the reserves set against future payments).

The aforementioned literature included in this section indicates that labour in its several forms of calculation[33] is present in most research, and other inputs such as materials and physical capital, funding and equity capital are also common. However, different approaches are taken toward the outputs. In general, we find fee-based income, investment income, consumer and commercial loans, and branches as outputs. As mentioned in some paragraphs above, one of the major differences is the consideration of deposits because they can be found as an input or an output, depending on the efficiency approach considered (asset approach or production approach).

In the most innovative applications of frontier methods to the financial industry, it is worth noting that DEA models have been applied to the performance analysis of mutual funds and pension funds since the DPEI index originally developed by Murthi et al. (1997).[34] Interest in DEA methodology in this area has increased because DEA models do not require any functional form between inputs and outputs, while this is

[32] Cummins et al. (2004) analyse the effect of organisational structure on efficiency in the Spanish insurance industry. In a later study, Cummins et al. (2010) use similar variables, but they are applied to the US insurance industry. Greene and Segal (2004) also analyse efficiency in the US life insurance industry.

[33] Some of the measures of labour found in the literature are administrative or agent labour, personnel expenses, the number of employees, man-hour expenses, and ratios such as personnel expenses divided by total assets, among other measures of labour.

[34] The DPEI index considers mutual fund returns as the only output and the standard deviation and transactional costs as inputs.

required by well-known classical performance indexes such as the Sharpe and Jensen ratios (See Basso and Funari, 2001). This type of application is different from that in the extensive existing literature of DEA empirical studies because the DMUs evaluated are financial portfolios rather than companies or business units. Choi and Murthi (2001) indicate that the Sharpe index is similar to a CRS convex frontier model applied to a single input (risk) and a single output (return). For this reason, many authors have used CRS models to evaluate portfolio management, but there are also many others that have implemented VRS models. This controversy remains in new studies (see Glawischnig and Sommersguter-Reichmann, 2010), although Kerstens et al. (2011) recently justify the use of CRS frontiers in the analysis of these collective portfolios.

Lozano and Gutiérrez (2008b) provide a complete review of the empirical studies that use DEA frontiers to assess the performance of mutual funds and hedge funds. The most common inputs in these studies are the standard deviation of fund returns and the expense ratio, while the fund return is the most common output. The latest studies fine-tune these basic variables using subscription and redemption costs and fund size as new inputs (Basso and Funari, 2001; Daraio and Simar, 2006) and an ethical score as an output (Basso and Funari, 2003). Recently, Andreu et al. (2013) include some of these variables in a SBM model to evaluate the efficiency of the strategic asset allocation of a sample of pension funds.

Despite the increasing interest in DEA methodology in mutual fund studies, there is very scarce evidence of evaluations of efficiency in Mutual Fund Management Companies. As far as we know, only Zhao and Yue (2010) explore the efficiency of mutual fund companies in the Chinese market by proposing a multi-subsystem fuzzy DEA. These authors divide the core competence[35] of a mutual fund company into an investment subsystem and a marketing and service subsystem. That is, the mutual fund company manages financial assets to obtain returns derived from assuming

[35] According to Prahalad and Hamel (1990), the core competence of a company represents the knowledge and experience accumulated in the firm.

certain levels of risk, but the mutual fund company also constantly pursues an increased company market size by obtaining larger money inflows into the mutual funds managed by the firm. This paper provides a concept model with variables that aim to appropriately represent both subsystems.

This study fills this gap in the studies in the literature by implementing a two-stage concept model based on Holod and Lewis (2011) for the first time to a major European mutual fund industry. Our model includes a set of more detailed variables that better represent the two subsystems proposed originally by Zhao and Yue (2010) to properly evaluate the efficiency interactions between the different management subsystems present in the core competence of a Mutual Fund Management Company.

### 2.3.3 Brief Discussion on the Production and Asset Approaches

The literature review addressed in the previous section highlights the apparent controversy between the two major conceptual approaches to measuring the efficiency of financial institutions, especially in banking: the production approach and the asset approach. It is necessary to know the main characteristics of these different conceptual models to better understand the conceptual system used in our analysis. In this section, we briefly discuss the main points of these different approaches to the production process in financial institutions. Let us briefly review these two major theoretical models found in the literature.

*The production approach or service provision approach:* a business valuation method based on the production value of a going concern. Here, banks are treated as companies that use capital and labour 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 (Berg et al. 1991; Berg et al. 1993; Parson et al. 1993; and Schaffnit et al. 1997). Efficiency and productivity can be analysed by comparing the quantity of services offered with the quantity of resources used by the bank. It is widely known that Berg et al. (1991) identified five activities performed by a bank: (1) supplying demand, facilitating deposit services, (2) short and long-term loan services, (3) brokerage and other services, (4) property management and (5) the provision of safe deposit boxes. These authors also noted that a bank incurs positive operating costs in terms of (1) labour, (2) machines, (3) materials and (4) buildings.

*The asset approach or intermediation approach:* a business valuation method based on the net asset value of a going concern. Here, the banks are viewed as intermediaries of financial services rather than as producers of loan and deposit account services. In this approach, the bank accepts deposits from customers and transforms them into loans to clients. The inputs are labour, materials and deposits and the outputs are loans and other income generating activities, namely banking services (Mester, 1997). The banks perform the two major roles of mobilising and distributing resources efficiently to ease investment activities in the economy. Colwell and Davis (1992) noted that the major disadvantage of this approach is the absence of trust operations, which causes increases in the unit costs of large banks.

The asset approach has two major sub-groups: (1) the profit approach and (2) the risk management approach. In the profit approach, the bank manager's purpose is to maximise the bank's profit function. The bank manager must evaluate all types of costs and the income generated in the production process. This approach simultaneously measures inefficiency on the input and output side, which reduces problems associated with mis-specification and mis-measurement (Berger et al. 1993; Thompson et al. 1997). In the second sub-group based on risk-management, it is necessary to evaluate the risks linked to various forms of assets in a bank. In risk-management, banks take some risks to produce acceptable returns. A bank's performance will affect its valuation in the market, its ability to acquire other banks or to be acquired at a good price, and therefore its ability to be funded in deposits and financial markets (Mester 1996; Battese et al. 2000). Therefore, the risk-management approach considers both management's decision-making process and the implementation of these decisions as inputs and shareholders' value and bank profit as outputs (the well-known agency problem).

As noted in the above subsection, non-parametric models are usually based on the production or service provision approach and take deposits to be the output based on the positive consumption of labour and materials. Parametric models are based on the asset approach and observe deposits as an input for the production of loans and other financial assets.

Mlima and Hjalmarsson (2002) find that efficiency scores are very sensitive to the choice of input and output variables, similar to Berg et al.'s (1991) findings from their original study. Berger and Humphrey (1997, p. 179) alleged that "it is not possible to determine which of the two major approaches dominates the other since the true level of efficiency is unknown. The solution, in our opinion, lies in adding more flexibility to the parametric approaches and introducing a degree of random error into the non-parametric approaches". Bauer et al. (1998) note that it is not necessary to reach consensus, instead finding consistency to be the most useful approach for regulators and other decision makers. In a study of productivity changes[36] in European banking, Casu et al. (2004) state that both approaches sometimes identify conflicting findings for the sources of productivity for individual years. However, the two different approaches generally do not yield markedly different results in terms of identifying the components of productivity growth.

Holod and Lewis (2011) argue that the primary confusion in the literature has been the disagreement among researchers about the appropriate input and output selection and therefore the conceptual approach used. According to these authors, banks use their employees and fixed assets to obtain deposits and make investments and loans with the purpose of generating profitability. In the first stage, the deposits obtained

[36] Productivity change is decomposed into technological change, which reflects improvement or deterioration in the performance of best-practice decision making units (DMUs), and technical efficiency change, which reflects the convergence towards or divergence from best practices on the part of the remaining DMUs. This decomposition provides useful information on the sources of the overall productivity change.

serve as the principal resource of funding for a bank's lending activity in the 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 literature that treats deposits as a pure input or a pure output, the primary contribution of the Holod and Lewis' (2011) model is the double role of deposits in the bank production process, where deposits are an intermediate product, an output from the first stage and an input to the second stage. As a result, this hypothesis does not impose judgment on whether either larger or smaller values of deposits are more desirable. Furthermore, another essential aspect in this paper is that the proposed DEA methodology evaluates banking efficiency using an unoriented model, thereby identifying a mix of input reductions and output increases that lead to efficiency.

The next section will further discuss our conceptual model and the specific variables used to analyse the efficiency of Spanish mutual fund companies. This model will be based on the interactions between the inputs and outputs of the double-stage production approach of Holod and Lewis (2011).

# 3 Model and Variables

## 3.1 Multi-Management Stages Model in a Mutual Fund Management Company (MFMC)

To establish an appropriate evaluation of the efficiency of an MFMC, it is necessary to have adequate indicators that describe the primary management activities of these firms. However, defining the set of management inputs/outputs is not an easy issue, as we have found from the previous literature on banking and insurance companies. The well-known production and asset approaches considered different models to explore financial institutions, which could report misleading evidence due to the different nature of the core competence of the institutions considered by each of these conceptual models.

As noted in the above section, our proposal for explaining the activity of a MFMC is based on the recent approach of Holod and Lewis (2011), which aims to resolve the discussion of the production and asset models in the banking literature. These authors make a more suitable proposal in which bank deposits are considered to be an intermediate product in the management process of a bank.[37] The model is solved using an unoriented DEA methodology to emphasise the importance of simultaneously decreasing inputs and increasing outputs through a two-stage approach, called a network DEA model.[38]

[37] Holod and Lewis (2011) state that deposits have a dual role in the bank production process and propose the novel idea of analysing a banking organisation through different management sub-stages, i.e., deposits are seen as an intermediate product, that is, an output obtained by the first stage of the bank production process that is then considered to be an input to the second stage. Therefore, the effect of the amount of deposits on bank efficiency depends on the efficiency at both stages of the bank production process. A bank aims to reduce its inputs (employee and fixed assets) and to increase its outputs (loans and other earning assets), given a certain amount of deposits. Holod and Lewis (2011) emphasise that their model has no need to assume whether having a higher or lower value of deposits is better for bank efficiency. Instead, the effect of deposits on overall bank efficiency is determined by the relative efficiency at each stage of production.

[38] The network DEA model allows the analyst to look inside the DMU, thereby offering the best perception as to the sources of organisational efficiency. Each DMU in this model can be comprised of two or more sub-stages. The network DEA model can be input-oriented, output-oriented, or unoriented, and additionally, it may consider different returns-to-scale (CRS or VRS).

According to Zhao and Yue (2010), the core competence of a MFMC is the application of expert knowledge and experience to managing the money collected from the market to pursue both the benefit of fund unit-holders and increasing assets under management. This overview means that the efficiency of these companies could be analysed using a production approach or an asset approach depending on the consideration of the money managed by the company, which might have a very similar interpretation to bank deposits in the earlier literature on the efficiency of banking institutions. This issue could affect the selection of different inputs/outputs to run the DEA model, thereby affecting the interpretation of the efficiency scores obtained by the model. To overcome this problem, we apply the called multi-management stages approach of Holod and Lewis (2011) by considering the interaction between the different management stages within a MFMC.

Based on a stakeholder approach (see Figure I-4), the model of Berkowitz and Qiu (2003) implies three relevant management interactions related to the primary stakeholders in a MFMC, the mutual fund unitholders and the company shareholders. The first management interaction is similar to the first management stage considered by Zhao and Yue (2010), and it refers to the portfolio management competence of a MFMC. This interaction is the most intuitive because it is described as the central activity of the MFMC by the Official Business Registries in Europe. Fund managers should take investment decisions based on professional and technical criteria to obtain good return records with the lowest levels of risk as possible. These returns will be provided to mutual fund unitholders after subtracting the corresponding management fees and other expenses. Secondly, closely linked to this first stage, the fund companies should have an appropriate distribution system for their mutual funds because distribution is a key factor in explaining the increase of assets managed by the MFMC, i.e., it is necessary to sell these mutual funds to gain both money and investor inflows into the mutual funds. As a consequence of the management fees charged by the company, the income derived from these fees will be higher when larger amounts of assets are under management.[39] Finally,

[39] Díaz-Mendoza et al. (2012) find a residual presence of performance-based fees in the Spanish fund industry, where most of the management fees charged by mutual funds are calculated as a percentage of the assets of the fund.

the MFMC shareholders aim to obtain higher profits through the final results of the entire activity of the company, i.e., after taking into account the income and cost structure of the MFMC. This overall stage is included in the management picture of Berkowitz and Qiu (2003) as a key interaction with the owners of the company because it responds to shareholder demands for higher levels of overall efficiency. This latter management interaction between the competence of the company and the shareholders was omitted by Zhao and Yue (2010), but in our opinion, it is also important when evaluating the efficiency of the MFMC as a DMU.

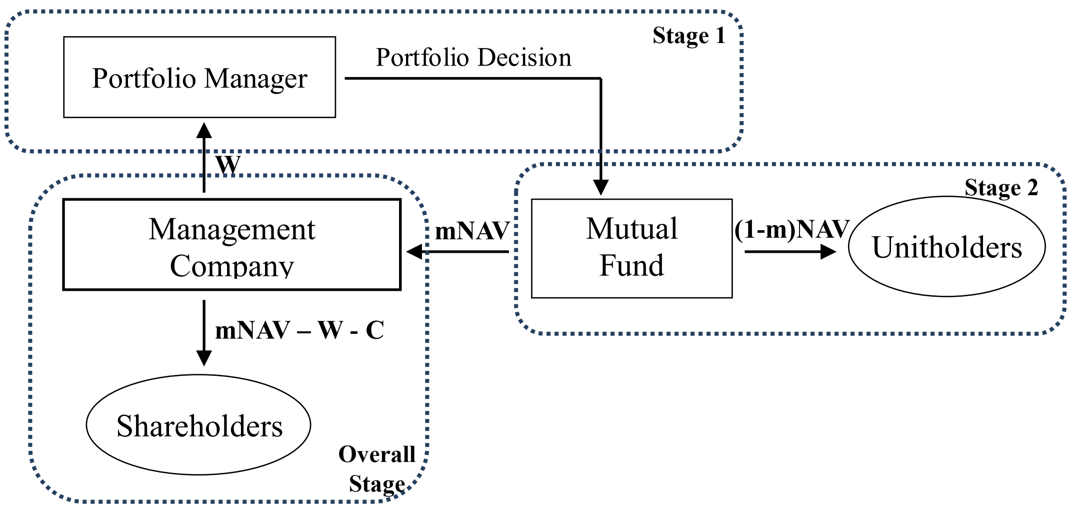



**Figure I-4** MFMC interactions based on Berkowitz and Qiu (2003).

where *m* is the fees ratio of the company, *NAV* is the net asset value of the mutual fund, *W* is company wages, and *C* is total operating expenses. The dotted lines represent Stage 1 (*Portfolio Management stage*), Stage 2 (*Marketing and Service stage*), and the Overall Stage (*Overall Efficiency*).

Based on the unoriented model[40], which was proposed by Holod and Lewis (2011) to end the debate between the production and asset approach, as applied to the banking industry and according to the different management stages within a MFMC proposed by Berkowitz and Qiu (2003), we propose a specific model to capture the interaction between the different demands from the stakeholders of a MFMC and the different sub-

[40] As stated above, Holod and Lewis (2011) claim that the primary advantage of their model is that it does not require a choice between a production and an intermediation approach, therefore leading to less controversial efficiency estimates.

DMUs within the company to appropriately evaluate the efficiency of these financial institutions. Figure I-5 illustrates our conceptual model.

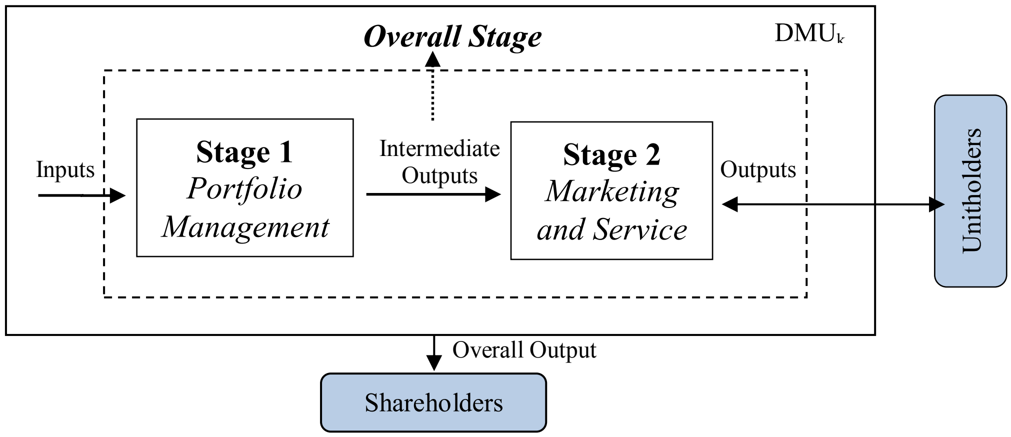



**Figure I-5** Multi-management stages model for a MFMC

Our unoriented model considers two primary steps in the management process of each MFMC analysed (Decision-Making-Unit, DMU$_k$). The first stage in this in-company management process would correspond to the *Portfolio Management stage*. In this stage, the fund managers of the company assume a specific level of risk to obtain higher gross returns in as many mutual funds and types as possible. The rationale behind this first stage is that a company with efficient portfolio management skills is able to obtain better returns before fees and other expenses with controlled levels of risk for a large and well-diversified selection 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 the first stage in-company may be considered to be intermediate outputs of the MFMC, thereby being inputs into the second stage, *Marketing and Service*. In this second step of the management process, efficient distribution attracts both unitholders and money net inflows into every fund managed by the company, thereby generating higher new incomes because of the asset-based fees charged by the company. The resources to obtain the goal of this distribution stage are represented by the company's offer to the market, that is, the intermediate outputs generated by the *Portfolio Management stage* to appropriately sell the mutual funds.

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

Finally, the O*verall Efficiency stage* evaluates the final result reported to the MFMC shareholders as a result of the entire activity of each MFMC or $DMU_k$. This overall stage includes both the *Portfolio Management stage* and the *Marketing stage* as a whole, thereby considering the final profits to be a consequence of the core competence of the MFMC (Stage 1 and Stage 2). These profits will be a more useful indicator for company shareholders and will include the income and cost structure of all resources necessary to manage the capital collected from the market through different mutual funds and investment categories.

## 3.2 Variables of the Model

Once we have described the conceptual framework to evaluate the efficiency of the MFMC, it is necessary to define how we measure the variables, which appropriately represent the inputs and outputs and capture the ideas displayed by Figure I-5.

Figure I-6 illustrates the variables selected to run the model, and Table I-2 lists the inputs and outputs included in this multi-management stage approach to run the different models from 2005 to 2009. All of the data necessary to establish these variables have been obtained from the Iberian Balance Sheets Analysis System (SABI), the Spanish Official Business Registry (Registro Mercantil), and the Spanish Securities Exchange Commission (CNMV).

**Table I-2** Set of Inputs and Outputs

| | | |
|---|---|---|
| ***Portfolio Management*** | Labour: $L_k$ is the number of employees of company $k$ at 31st December. | Assets Managed: $AM_k$ is the total assets managed by company $k$ at 31st December. |
| | Shareholders' Equity: $SE_k$ is the equity capital including reserves and profits of company $k$ at 1st January. [41] | Number of Funds: $NF_k$ is the number of funds managed by company $k$ at 31st December. |
| | Portfolio Risk: $PR_k$ is the fund size-weighted average of the normalised value[42] of the standard deviation of the daily gross returns of all funds managed by company $k$ at 31st December. | Fund Types: $FT_k$ is the number of fund categories according to the official classification of investment objectives[43] covered by company $k$ at 31st December. |
| | | Gross Returns: $GR_k$ is computed by the fund size-weighted average of the normalised value[44] of the daily average gross returns of all funds managed by company $k$ at 31st December. |

[41] This variable considers the equity capital at the end of the previous year, i.e., this input is not influenced by the results of the company during the analysed year.
[42] We agree with Zhue and Yue (2010) that returns weighted by size do to some extent represent the Mutual Fund Management Companies' investment skills. However, the different size and return patterns between the different fund types could bias the weighted returns and the levels of risk associated with the mutual fund companies due to the assorted fund types managed by these companies. For instance, a company with more assets in equity funds than in bond funds would obtain upwards biased size-weighted returns in years with bullish stock markets compared with a company much more focused on bond funds, and the opposite could be found in bearish stock markets. Zhue and Yue (2010) solve this potential problem by using a membership function to characterise fund types. In our case, we compute the normalised standard deviation of the daily gross returns for each mutual fund existing at 31st December with respect to all funds in the market included in the same category and during the same time period. This normalisation provides a value between 0 and 1 that reports more insightful information for the risk skills of the fund with respect to fund competitors with the same investment objective.
[43] These official classifications are reported by the Spanish Securities Exchange Commission (CNMV)
[44] The reason for rejecting 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 from 1st January to 31st December with respect to all funds in the market included in the same official fund category and during the same time period. We then compute the normalised value between 0 and 1 of these average gross returns to obtain the size-weighted value for every mutual fund company.

**Table I-2** Set of Inputs and Outputs (Continued)

| | | |
|---|---|---|
| ***Marketing and Service*** | Assets Managed: $AM_k$<br>Number of Funds: $NF_k$<br>Fund Types: $FT_k$<br>Net Returns: $NR_k$ is the fund size-weighted average of the normalised value[45] of the daily average net returns of all funds managed by company $k$ at 31st December. | Unitholders Net Flows: $UNF_k$ represents the normalised value of unitholder inflows minus unitholder outflows for company $k$ from 1st January to 31st December.<br>Money Net Flows: $MNF_k$represents the normalised value of the implied net money flows[46] for company $k$ from 1st January to 31st December.<br>New Incomes: $NI_k$ computes the new management fees received by the MFMC as a consequence of the net money flows into company $k$ from 1st January to 31st December.[47] |
| ***Overall Efficiency*** | Assets Managed: $AM_k$<br>Number of Funds: $NF_k$<br>Fund Types: $FT_k$<br>Shareholders' Equity: $SE_k$ | Profits: $P_k$ is the normalised value of the profits obtained by the MFMC$k$ from 1st January to 31st December. |

[45] 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.
[46] Implied net flows have been defined as monthly changes in the total assets of each fund net of fund returns. As we do not know the exact moment of flows, we follow the usual approach of the literature and assume that these flows occur at the end of the month for which we are computing this measure. Zheng (1999) determined that this standard approach is robust with other assumptions about the timing of these implied flows.
[47] This variable is proxied by the product of the asset-based management fees of each fund and the implied money flows obtained by $MNF_k$

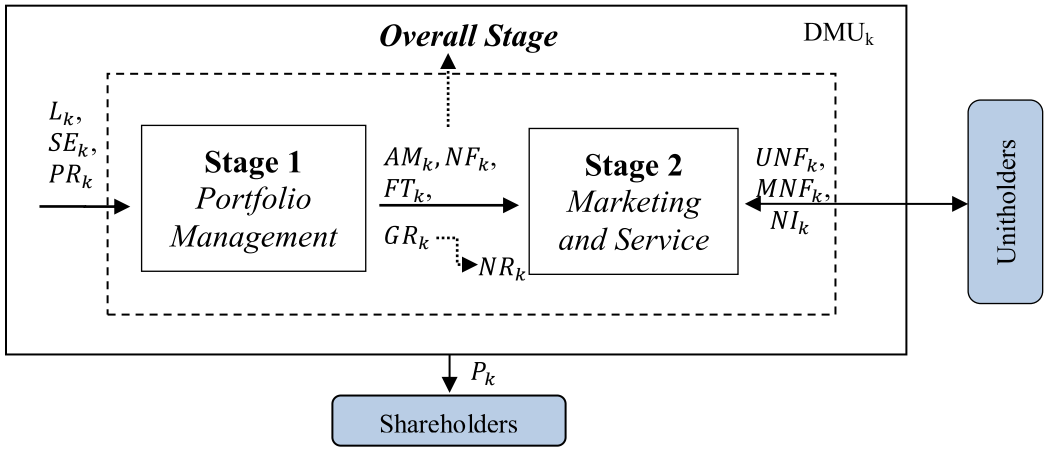



**Figure I-6** Multi-management stages model for a MFMC (including variables)

The rationale behind the selection of these variables is based on the previous DEA literature. According to our conceptual approach to the *Portfolio Management stage* in a fund management company, we should define inputs, which capture the labour, capital and risk assumed in managing the mutual fund portfolios. Labour should be a proxy of the human resources required to appropriately develop the major activity of the MFMC, i.e., the management of financial portfolios. In that sense, the number of employees has been extensively used in the DEA literature to address efficiency (Lang and Welzel, 1996; Hussels and Ward, 2007; Chen et al, 2009). We also find this variable measured as the total expenditure of wages at the end of each fiscal period (Berg et al, 1991; Berg et al, 1993; among other initial studies); as the value of wages as a percentage of total expenses (Cummins et al., 2010); as the weighted average of annual wages per employee (Berger et al., 2009)[48]; and finally as a normalised variable dividing wages by assets under management for the mutual funds (Casu et al., 2004). The availability of the number of employees in our dataset provides more detailed information about the quality of the human resources for a company than other measures related to personnel

[48] Berger et al. (2009) do not consider the DEA methodology. They estimate efficiency levels by specifying the translog functional form for the cost and profit functions based on the SFA method.

expenses, which could be distorted by the mispricing of these resources, i.e., significantly high or low wages could affect these measures.[49]

Since Murthi et al. (1997), other studies have applied variables related to expense ratio as inputs (e.g., Daraio and Simar, 2006). The expense ratio determines the effort associated with portfolio management. However, these studies are related to portfolio performance, and they are not associated with efficiency in management companies as in our case. We also consider the use of the capital variable in our model. Capital has been measured in diverse forms in the DEA efficiency literature linked to the banking and insurance industry (e.g., Berg et al., 1993; Cummins et al., 2004; Hussels and Ward, 2007). It is important to note that in these studies, the amount of capital is defined as the long-term investment or as the book value of equity plus reserves at the beginning of each period. Alternatively, Berg et al. (1993) and Brockett et al. (1997) also used furniture and equipment variables as a proxy for capital to evaluate bank efficiency using DEA methodology. [50]

Finally, and according to the growing body of literature using the DEA methodology to evaluate portfolio performance, it is necessary to compute the risk assumed by the portfolios as a representative input into portfolio management. Firstly, we find studies that consider the standard deviation of mutual fund returns as an appropriate risk measure (Murthi et al., 1997; Choi and Murthi, 2001; Basso and Funari, 2001, 2003; Chang, 2004; Daraio and Simar, 2006; Lozano and Gutiérrez, 2008a) and secondly, we find much more sophisticated and asymmetric risk measures applied to hedge funds (Gregoriou, 2003; Gregoriou et al., 2005; Nguyen-Thi-Thanh, 2008)[51].

[49] The consideration of personnel expenses as an alternative input for labour is not a relevant issue for the efficiency DEA rankings in the *Portfolio Management stage*. Detailed results will be provided in the next empirical section when robustness tests are performed.

[50] Some robustness tests are developed in the next empirical section, in which we analyse the efficiency scores obtained by both equity capital and equipment measures as variables representing the capital effort of the mutual fund management company.

[51] Measures such as MVaR (Modified Value at Risk) and CVaR (Conditional Value at Risk) are examples of the measures applied to hedge funds.

The outputs obtained by this *Portfolio Management stage* should represent the success of the MFMC in managing the greatest amount of assets (total assets managed by the company) with the best (gross) return record possible (Murthi et al., 1997; Choi and Murthi, 2001), enabling potential diversification through the entire set of mutual funds (number of mutual funds) and investment categories (fund types) offered to the market. Then, an efficient MFMC should assume controlled levels of labour, capital and risk to obtain winning return records for a wide-range of mutual funds covering as many fund types as possible to meet the demands of different sets of unitholders with assorted return-risk preferences.

The results of the *Portfolio Management stage* should be an appropriate indicator of the quality of the mutual funds sold during the *Marketing and Service stage*. Unitholders' interest in recent return records as a significant factor to explain money and investor flows into mutual funds has been a well-known hypothesis in the literature since the evidence of Sirri and Tufano (1998), followed by the comparative study of Del Guercio and Tkac (2002). In addition to these return records, the existence of a large and well-diversified set of mutual funds should help marketing management to better collect money and investors from the market. The only relevant difference between the intermediate outputs obtained from the *Portfolio Management stage* and the intermediate inputs of the *Marketing and Service stage* is the nature of the returns because the return records offered to the market to gain both unitholders and money inflows into the company are net of management fees and other expenses. Both unitholders and money net flows into the company should represent the final success or failure of the marketing and distribution of the mutual fund records obtained by the *Portfolio Management stage*. In addition, the new management fees received by the company as a consequence of new money flows into the mutual funds is a step further than the mere consideration of money flows because it also captures the so-called extended asset-based management fee structure in Europe, and especially in the Spanish fund industry. The most accurate measure to proxy for these new fee incomes is the product of the asset-based management fees of each fund and the new implied money flows obtained by the company, which is a unique and useful measure for evaluating the efficiency of the marketing and distribution stage of the MFMC.

Finally, *Overall Efficiency* should consider the final results provided to the shareholders after all of the production processes of the MFMC. Similarly to other banking studies, the most robust variable for measuring the output of this overall stage should include the entire income and cost structure of the company, which is mostly represented by the profits obtained by the shareholders (Hussels and Ward, 2007; Berger et al., 2009; Chen et al., 2009).

Furthermore, the inputs of the *Overall Efficiency* should include a set of indicators that represent the main characteristics of the mutual funds managed by the company. However, we must define these variables with caution to avoid including inputs that could already be included in the final profits, i.e., expenses or other money variables. This *Overall Efficiency* model might be considered to be an extension of the return-on-equity ratio for the MFMC after including these relevant measures for the mutual funds managed by the company as additional inputs to the capital effort of the stockholders (shareholders' equity). We use total assets, the number of funds and the different fund types managed by the company as relevant variables representing the major characteristics of the mutual fund offering to the industry.

Finally, and according to Coelli et al. (2005), it is important to note that our set of variables meets the DEA convention that the minimum number of DMUs in our study (93 in 2008) must be greater than three times the sum of the number of inputs and outputs considered in the different management stages included in our models.

# 4 Data and Empirical Analysis

## 4.1 Data

We work with all Spanish MFMCs registered in the Spanish Securities Exchange Commission (CNMV) on 31st December of each year included in our time horizon 2005-2009. The number of MFMCs ranges from a minimum of 93 in 2008 to a maximum of 102 in 2005. Those companies with more than 15% of assets in hedge funds were excluded to limit the sample to companies primarily focused on the management and distribution of mutual funds. We also exclude those companies with recent inception dates to avoid a possible inception bias in the variables used in our model. In any case, the bias of both exclusions is quite residual in terms of the economic relevance of the sample.

Table I-3 shows the main descriptive statistics for our data set. In general, these statistics show a large dispersion of the data, thereby indicating the assorted characteristics of the companies competing in the Spanish fund industry. Figure I-7 shows in aggregate terms the yearly evolution of some of the major magnitudes for the companies included in our sample.

**Table I-3** Descriptive statistics of the data (31st December)

| Year | Num. of MFMCs | Measure | Num. of Employees ($L_k$) | Shareholders' Equity * ($SE_k$) | Assets Managed** ($AM_k$) | Num. of Funds ($NF_k$) | New Incomes** ($NI_k$) | Profits** ($P_k$) | Num. of Unitholders |
|---|---|---|---|---|---|---|---|---|---|
| 2005 | 102 | Mean | 20 | 9,855,448 | 2,568,985 | 26 | 1,117 | 3,842 | 82,809 |
| | | Std. Dev. | 27 | 18,504,585 | 7,965,647 | 43 | 4,062 | 10,450 | 255,312 |
| | | Minimum | 2 | 333,081 | 4,217 | 1 | -24,529 | -1,431 | 102 |
| | | Maximun | 200 | 130,379,000 | 61,873,451 | 293 | 14,478 | 68,546 | 1,747,614 |
| 2006 | 102 | Mean | 21 | 10,748,921 | 2,651,042 | 28 | -488 | 4,549 | 84,684 |
| | | Std. Dev. | 27 | 20,316,255 | 7,963,606 | 48 | 6,286 | 12,050 | 260,916 |
| | | Minimum | 2 | 322,079 | 4,424 | 1 | -51,255 | -1,069 | 85 |
| | | Maximun | 193 | 146,469,000 | 61,663,399 | 308 | 11,487 | 81,358 | 1,858,235 |
| 2007 | 95 | Mean | 23 | 12,800,419 | 2,682,037 | 31 | -3,558 | 5,146 | 84,749 |
| | | Std. Dev. | 29 | 22,973,569 | 7,415,818 | 53 | 14,847 | 13,390 | 241,650 |
| | | Minimum | 2 | 598,000 | 4,869 | 1 | -127,020 | -1,196 | 100 |
| | | Maximun | 180 | 167,646,000 | 53,063,849 | 324 | 9,770 | 85,724 | 1,690,245 |
| 2008 | 93 | Mean | 23 | 14,829,848 | 1,887,768 | 31 | -7,661 | 3,422 | 63,659 |
| | | Std. Dev. | 29 | 26,704,624 | 5,286,616 | 54 | 24,669 | 9,642 | 177,150 |
| | | Minimum | 2 | 483,941 | 3,734 | 1 | -212,890 | -1,749 | 100 |
| | | Maximun | 161 | 186,439,000 | 34,237,954 | 298 | 1,563 | 65,054 | 1,284,565 |
| 2009 | 95 | Mean | 23 | 15,570,010 | 1,794,888 | 27 | 105 | 1,806 | 57,631 |
| | | Std. Dev. | 27 | 28,842,879 | 4,848,550 | 42 | 3,742 | 5,204 | 154,350 |
| | | Minimum | 2 | 208,337 | 4,457 | 1 | -15,094 | -3,163 | 95 |
| | | Maximun | 145 | 191,655,197 | 32,580,875 | 206 | 24,911 | 36,126 | 1,107,698 |

(*) At beginning of the year; (**) thousand Euros

From a sample of 102 MFMCs in 2005, in economic terms, we found initially that these MFMCs represented an approximate average of 2,569 million Euros of assets managed by approximately 2,700 mutual funds with 8,446 thousand unitholders (see Figure I-7). However, 57.84% of total assets were concentrated in the five largest companies, while 73.88% were managed by the top ten. The distribution of the number of unitholders is similar, with some minor changes in the ranking of the largest companies. In 2005, the 5 largest MFMCs took 52.26% of the sector profits, while the 10 largest took 69.68%. This figure highlights the great concentration in the sector, which may affect the efficiency of the mutual fund industry.

In 2006, with the same number of MFMCs, the mean size increased to 2,651 million Euros, adding 191,220 unitholders since 2005 and with 2,825 mutual funds managed (see Figure I-7). However, the major market share is still held by the largest companies with some minor changes. The top ten largest MFMCs manage approximately 73% of total assets and take approximately 70% of the sector profits. In addition, the average shareholders' equity is approximately 91 million Euros higher than in the previous year.

During 2007, the analysis of 95 MFMC illustrates a slowdown in the mean assets under management (2,682 million Euros) and in global terms, a loss of 15,612 million Euros (see Figure I-7), primarily impacting the largest companies (from a maximum value delivered of 61,663 million Euros to 53,063 in 2007). There was also an important reduction of unitholders in global terms of approximately 586,639 (see also Figure I-7). Moreover, there is a loss in the market share of the top five and top ten largest companies, dropping to 54.78% and 71.54%, respectively. The profits remain at a similar level, but with better participation for the top five and top ten companies, at 56.85% and 73.94%, respectively. However, the MFMCs increased the number of funds to 2,908 compared to 2,825 in 2006 (see also Figure I-7). The positive trend in shareholders' equity remains, reaching a mean of 12,800 thousand Euros since 10,749 in 2006 (in global terms, 119,650 thousand Euros).

For the starting period of the financial crisis (2008), 93 MFMC were analysed and exhibited an important decrease in the asset mean to approximately 1,887 million Euros (in global terms, the companies saw a drop from 254,793 million Euros under management to 175,562 million Euros), primarily due to an outflow of 2.1 million unitholders (see Figure I-7). The market share improved for the top five companies, with 56.69% of assets, and for the top ten, with 73.71%, thereby increasing the concentration of the industry. Sector profits fell by approximately 170 million Euros (see also Figure I-7), but interestingly, the percent of participation for the top five and top ten improved to reach approximately 60% and 79%, respectively. Obviously, one of the most important findings from 2008 are both the dramatic fall in new incomes with a mean value of -7,661 thousand Euros and the outflow of 2,130 million unitholders from 2007 to the end of 2008. The mean number of employees remains quite similar to previous years, although this variable slightly increases as a whole but decreases in the largest companies.

Finally, we analyse 95 MFMC in 2009, managing a mean of approximately 1,794 million Euros (in global terms, 170 MM Euros) with 2,530 mutual funds, in contrast to 2,893 funds in 2008, and with 445,421 fewer unitholders than in 2008 (see Figure I-7). The assets managed by the top five and top ten companies underwent a slight decrease, to 54.82% and 71.38%, respectively. However, the five and ten largest companies took approximately 60% and 83% of the profits, which were low at only 171 million Euros for the entire industry. When reviewing the number of employees, the downward mean trend is even more important in the largest employers (changing from 161 employees in 2008 to 145 in 2009).

Summarising the descriptive analysis above, we find a relevant concentration in the sample and predominantly represented by the banking industry. We also find a significant effect from the financial crisis starting in 2008 on the number of unitholders, and therefore on the profits, assets and funds managed by the MFMCs. Further research could focus on how the crisis may have strengthened the concentration of the Spanish fund industry.

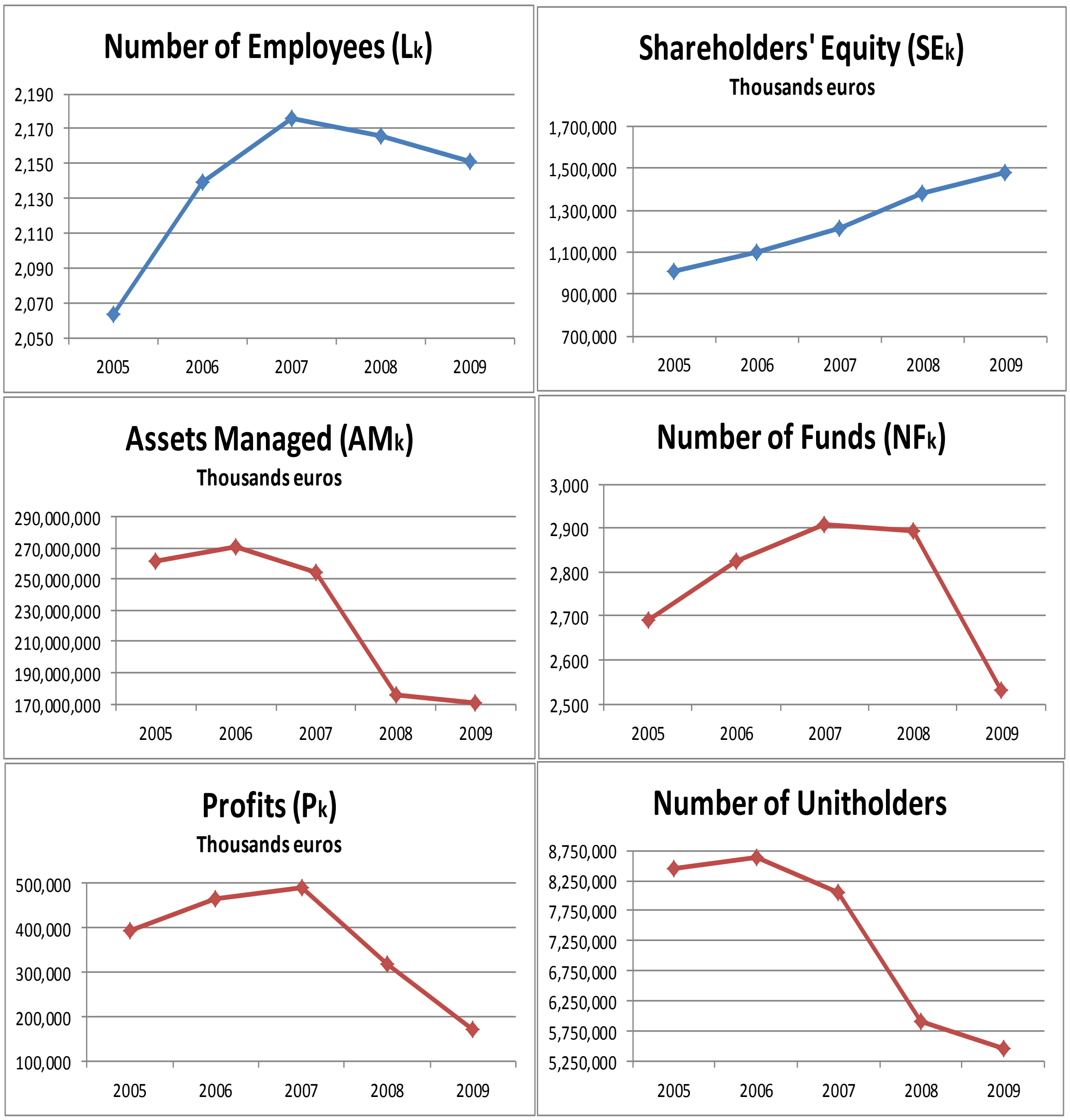



**Figure I-7** Evolution of the mutual fund industry (2005-2009)

## 4.2 Empirical Analysis

We formulate three major assumptions to evaluate the efficiency of the MFMCs based on our unoriented sub-stages model (Figure I-5). First, we consider a portfolio management system to be technically and operationally efficient when it works with fewer employees, lower capital resources and more controlled levels of risk than the competition and at the same time is able to manage more funds with different investment vocations to obtain better return records than the competition. We call this first subsystem *Portfolio management*. Second, we consider a good marketing system to be one that is able to capture as many new unitholders and money flows into the mutual funds managed by the company as possible to generate higher new fee-based incomes. Furthermore, the outputs obtained from the portfolio management subsystem will subsequently determine the quality of the mutual funds sold by the company. We call this second or intermediate subsystem *Marketing and Service stage*. Finally, we consider a company to be globally (overall) efficient for its shareholders if it obtains higher profits than the competition. These profits should be obtained with a precise offer of mutual funds and assets under management, diverse investment categories and suitable capital equity. We call this subsystem *Overall Efficiency*.

First, we run the original SBM-efficiency model under constant returns to scale (equation I.15) for each stage considered in our conceptual model developed in Section 3. The primary results obtained by our multi-management approach for Stage 1: *Portfolio Management*, Stage 2: *Marketing and Service*, and for the *Overall Efficiency* of the company are shown in Table I-4 for each year analysed from 2005 to 2009 (Appendix A includes complete results in Table I-A-1, Table I-A-2, Table I-A-3, Table I-A-4, and Table I-A-5).[52]

[52] The entire empirical analysis has been run using R project software and the specific package "nonparaeff". This package illustrates Nonparametric Methods for Measuring Efficiency and Productivity, version 0.5-8. This package contains functions for measuring the efficiency and productivity of decision making units (DMUs) under the framework of Data Envelopment Analysis (DEA) and its variations, thereby including the Slacks Based Measure (SBM) proposed by Tone (2001).
Details for this package are available at http://cran.r-project.org/web/packages/nonparaeff/index.html.

**Table I-4** Efficient companies by stage and variable (%)

| Year | MMS | Eff. MFMCs | Direct Jobs | Assets | Funds | Unitholders |
|---|---|---|---|---|---|---|
| 2005 | Stage 1 | 28 | 31.90 | 56.48 | 44.56 | 58.63 |
| | Stage 2 | 7 | 2.42 | 0.09 | 0.41 | 0.08 |
| | Overall Eff. | 10 | 17.45 | 41.87 | 17.91 | 41.69 |
| 2006 | Stage 1 | 22 | 28.28 | 53.27 | 41.95 | 56.13 |
| | Stage 2 | 8 | 3.55 | 0.17 | 0.78 | 0.10 |
| | Overall Eff. | 8 | 7.48 | 18.07 | 7.01 | 22.01 |
| 2007 | Stage 1 | 21 | 27.34 | 51.23 | 42.68 | 53.38 |
| | Stage 2 | 6 | 1.79 | 0.17 | 0.58 | 0.46 |
| | Overall Eff. | 6 | 3.72 | 1.53 | 0.52 | 0.57 |
| 2008 | Stage 1 | 13 | 28.81 | 58.22 | 46.18 | 56.27 |
| | Stage 2 | 2 | 0.32 | 0.01 | 0.07 | 0.00 |
| | Overall Eff. | 5 | 2.95 | 0.95 | 0.45 | 0.55 |
| 2009 | Stage 1 | 20 | 18.08 | 34.12 | 30.20 | 37.13 |
| | Stage 2 | 7 | 8.46 | 10.22 | 8.34 | 8.39 |
| | Overall Eff. | 5 | 2.93 | 1.54 | 0.75 | 0.63 |

MMS = Multi-Management Stage

Let us first analyse some aggregate figures shown in Table I-4 before further commenting on some detailed efficiency patterns displayed by the extended tables included in Appendix A. Table I-4 includes the relative percentages of the efficient MFMCs in terms of assets managed, unitholders' accounts, direct jobs, and number of mutual funds as the major variables to describe the characteristics of these efficient MFMCs initially obtained by the CRS-SBM technique.

Table I-4 shows 28 efficient companies at the *Portfolio Management stage* in 2005; these companies managed 56.48% of assets and 58.63% of the unitholders' accounts, represent 44.56% of the number of funds, and maintained approximately 32% of the direct jobs in the Spanish fund industry. These high efficiency percentages were sustained until 2009, when these percentages decreased significantly as a potential consequence of the financial crisis in 2008.

There were significantly fewer efficient companies at the *Marketing and Service stage* than in the previous Stage 1. The relative efficiency percentages in terms of assets, unitholders, and funds remained lower than 1% from 2005 to 2008, but these figures increased to 10.22%, 8.39%, and 8.34%, respectively, in 2009. The explanation of this situation is that some of the largest companies ceased to be inefficient this year. That is, the largest companies appeared to adapt much better to the crisis of confidence in financial markets, at least in terms of selling their mutual funds. However, this conclusion should be considered with caution because further analysis beyond 2009 would be required to confirm this hypothesis.

Table I-4 shows that the overall efficient companies represented an important percentage in 2005 in terms of assets managed and unitholders' accounts, although the number of these overall efficient MFMCs is much lower than in Stage 1. This result provides evidence that large companies in 2005 were efficient overall. However, these large companies ceased to be efficient in the subsequent years, thereby contributing to the dramatic fall of the *Overall Efficiency* percentages. Quite similar trends can be observed in terms of direct jobs and the number of funds managed.

Furthermore, if we extend this analysis to those companies that remain efficient at the different management stages, Table I-A-1 (Appendix A) shows that in 2005, only 3 out of the 28 efficient units at the first stage remain efficient at the second stage. Therefore, only these companies have marketing departments capable of appropriately selling their efficiently managed mutual funds, but these companies managed only a residual percentage of the assets in the Spanish fund industry in December 2005. Table I-A-1 also shows 7 efficient companies at the *Portfolio Management stage* that remain efficient overall; the interesting evidence about these units is that they managed more than 42% of assets and unitholders' accounts and approximately 16% of the direct jobs in the sample. In addition, 4 out of the 7 efficient companies in the marketing stage remain efficient overall, and they only manage 0.06% of the assets, 0.07% of unitholders, and 1.26% of the direct jobs. Finally, we find that there are only three companies that are efficient through the entire multi-stage model previously proposed, but their economic relevance in the market figures is very low.

Again, if we extend this analysis to 2006, Table I-A-2 (Appendix A) shows that only 1 out of the 22 efficient units at the first stage remains efficient at the second stage. Therefore, this is the only company with a marketing department capable of appropriately selling their efficiently managed mutual funds. Similar to 2005, this company managed a residual percentage of the assets in the Spanish fund industry as of December 2006. Table I-A-2 also shows that only 3 companies efficient at the *Portfolio Management stage* remain efficient overall, managing more than 16% of assets and unitholders' accounts and approximately 4% of the direct jobs of the sample. In addition, only 2 out of the 8 efficient companies in the marketing stage remain efficient overall. These overall efficient companies only manage 0.004% of the assets, 0.003% of unitholders, and 0.61% of the direct jobs in the sample. Finally, we find that there is only one company that is efficient throughout the entire multi-stage model, and its participation in the industry is also residual.

Table I-A-3 (Appendix A) illustrates that only 2 out of the 21 efficient units from the first stage in 2007 remain efficient at the second stage. Similar to previous findings, these companies managed a residual percentage of the assets in the Spanish fund industry as of December 2007. Table I-A-3 also shows that only 2 efficient companies at the *Portfolio Management stage* remain efficient overall, managing a residual percentage of the assets, unitholders’ accounts, and direct jobs. Finally, 3 out of the 6 efficient companies in the marketing stage remain efficient overall, with a little relevance in economic terms. Finally, we find that there is only one company, the same unit as in 2006 that is efficient for the entire multi-stage model.

Repeating the analysis for 2008, we find evidence that the effect of the financial crisis on the mutual fund industry is important: Table I-A-4 shows that no company that is efficient at the first stage remains efficient at the second stage. Therefore, the crisis meant that marketing departments were not able to sell their efficiently managed mutual funds. Table I-A-4 also shows that only 1 company that is efficient at the *Portfolio Management stage* remains efficient overall, with a residual percentage of the 2008 figures. In addition, 2 out of the 2 efficient companies in the marketing stage remain efficient overall and also shared a residual percentage of the 2008 figures. Obviously, no company was efficient for the entire multi-stage model for this financial crisis year.

Lastly, Table I-A-5 shows that only 2 out of the 20 companies efficient at the first stage remain efficient at the marketing stage, although managing a residual percentage of the assets in the Spanish fund industry as of December 2009. If we compare the 20 efficient companies at the *Portfolio Management stage* with the 5 overall efficient companies, we find 3 units that are efficient at both stages, with a residual role in the industry in terms of the variables described. In addition, only 1 out of the 7 companies efficient in the marketing stage remains efficient overall. This company is the only efficient unit for our entire multi-stage model and represents a residual percentage of the fund industry figures.

The previous findings show that companies are better portfolio managers than sellers, which appears to affect the *Overall Efficiency* results obtained by our sample. In addition, the detailed explanation in Appendix A demonstrates the difficulty of achieving efficiency at every management stage proposed by our model.

Despite the extended information provided by Appendix A for the efficiency scores, it is also necessary to further discuss the interaction between the different management stages included in our conceptual model to better understand these subsystems as a whole for the company. The Spearman rank correlation is used as a non-parametric tool[53] to verify the robustness of these efficiency rankings across the different

[53] Spearman's rank correlation measures the relationship or dependence between two rankings. If the Spearman correlation obtains values of +1 or −1, each ranking is a perfect monotone function of the other. The measure is obtained as $r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$, where $d^2$ is the difference in paired ranks squared and $n$ is the number of cases.

management stages of the MFMCs. Table I-5 shows this correlation for the different rankings obtained by the CRS-Slacks Based Measures of efficiency.[54]

**Table I-5** Average CRS-SBM scores and Spearman's rank correlation

| Year | MMS | Average CRS-SBM Scores | Eff. | Spearman Rank Corr. (Scores) Stage 1 | Stage 2 | Overall Eff. |
|---|---|---|---|---|---|---|
| 2005 | Stage 1 | 0.53359 | 28 | 1 | -0.405** | -0.194 |
| | Stage 2 | 0.26553 | 7 | | 1 | 0.560** |
| | Overall Eff. | 0.25697 | 10 | | | 1 |
| 2006 | Stage 1 | 0.48751 | 22 | 1 | -0.498** | -0.293** |
| | Stage 2 | 0.32233 | 8 | | 1 | 0.427** |
| | Overall Eff. | 0.26854 | 8 | | | 1 |
| 2007 | Stage 1 | 0.51105 | 21 | 1 | -0.269** | -0.204* |
| | Stage 2 | 0.34870 | 6 | | 1 | 0.370** |
| | Overall Eff. | 0.19564 | 6 | | | 1 |
| 2008 | Stage 1 | 0.37089 | 13 | 1 | -0.640** | -0.214* |
| | Stage 2 | 0.13860 | 2 | | 1 | 0.525** |
| | Overall Eff. | 0.19781 | 5 | | | 1 |
| 2009 | Stage 1 | 0.45114 | 20 | 1 | -0.348** | -0.107 |
| | Stage 2 | 0.26990 | 7 | | 1 | 0.708** |
| | Overall Eff. | 0.19333 | 5 | | | 1 |

MMS = Multi-management stages   * Correlation is significant at the 0.05 level (2-tailed)
Eff. = Number of efficient companies   ** Correlation is significant at the 0.01 level (2-tailed)

Table I-5Table I-5 reports some major findings from our analysis[55]. The efficiency scores in the *Portfolio Management stage* are the highest for any year analysed. This finding proves that companies are much better portfolio managers than sellers. Moreover, the rank correlation coefficient demonstrates a negative relationship between portfolio management and the marketing stage of the companies from 2005 to 2009, which significantly suggests that the commercial skills of the companies are inversely related to the portfolio management abilities of the mutual fund managers. Furthermore, we also find similar evidence, but less significant, after comparing the efficiency ranks

[54] The major interest of this first part of the study is in analysing the efficiency ranks across the different management stages of the company, while the next second part focuses attention on the ranks of the SBM scores along our time horizon from 2005 to 2009 to test the persistence phenomenon for the efficiency of the different stages in our multi-stage management model.
[55] The conclusions are also quite similar after applying the Kendall rank correlation coefficient. Results are available upon request.

between portfolio management and the overall efficiency of the companies from 2005 to 2009. Both previous results provide evidence that pure portfolio management skills are not directly related to either the marketing distribution system or to the overall efficiency of a fund company.

However, we find a significant and positive rank relationship between the commercial and the overall efficiency for the entire time horizon. That is, the ability of a company to sell mutual funds proves to be a much more relevant factor for explaining the profitability of a fund company instead of pure portfolio management skills.

These results show a very interesting efficiency pattern in the Spanish fund industry. In general terms, those companies that best manage mutual funds are not the most efficient distributors of their mutual funds, thereby considerably reducing the company's overall profits. These findings should question the importance attributed to the major activity of the company (portfolio management) in creating the profits generated for the shareholders, i.e., it appears to be much more important to sell than to manage mutual funds. This evidence could severely erode the relevance of the portfolio managers' role in a fund company.

Moreover, during the starting impact of the financial crisis in 2008, marketing efficiency was the lowest for the whole time horizon, thereby highlighting the important negative effects of the global financial crisis on the confidence of mutual fund investors.

## 4.3 Influence of the Variable-Returns-to-Scale on the Efficiency Rankings

As previously discussed in subsection 2.2, the BCC DEA model (equation I.8) proposed by Banker et al. (1984) was suggested for adjusting the CCR DEA model (equation I.6) into variable returns to scale (VRS). The rationale of this VRS approach is that the use of the CCR DEA model results in mistaken measures of scale efficiencies if not all DMUs are operating at the optimal scale. In this section, we extend the analysis of the scale effect in the efficiency rankings obtained by the original SBM approach (equation I.15) applied to our multi-management stages approach (Figure I-5), i.e., we check for the effect of companies with not optimal scale on the efficiency scores and rankings previously obtained in subsection 4.2. Table I-B-1, Table I-B-2, Table I-B-3, Table I-B-4, and Table I-B-5 included in Appendix B show the results.

A preliminary analysis of these tables shows the existence of some changes in the efficiency rankings using SBM under variable returns to scale (VRS) from those previously obtained under the constant returns to scale assumption. The Spearman rank correlation will be applied to better understand the significance of these changes between the different management stages; see Table I-6.

**Table I-6** Average VRS-SBM scores and Spearman rank correlation

| Year | MMS | Average VRS-SBM Scores | Eff. | Spearman Rank Corr. (Scores) | | |
|---|---|---|---|---|---|---|
| | | | | Stage 1 | Stage 2 | Overall Eff. |
| 2005 | Stage 1 | 0.69497 | 41 | 1 | 0.211* | 0.056 |
| | Stage 2 | 0.52572 | 25 | | 1 | 0.451** |
| | Overall Eff. | 0.35588 | 17 | | | 1 |
| 2006 | Stage 1 | 0.62197 | 33 | 1 | 0.081 | -0.008 |
| | Stage 2 | 0.55330 | 26 | | 1 | 0.319** |
| | Overall Eff. | 0.37623 | 18 | | | 1 |
| 2007 | Stage 1 | 0.61534 | 29 | 1 | 0.131 | 0.005 |
| | Stage 2 | 0.52311 | 16 | | 1 | 0.418** |
| | Overall Eff. | 0.28568 | 11 | | | 1 |
| 2008 | Stage 1 | 0.54304 | 27 | 1 | 0.269** | 0.094 |
| | Stage 2 | 0.41883 | 14 | | 1 | 0.246* |
| | Overall Eff. | 0.33042 | 11 | | | 1 |
| 2009 | Stage 1 | 0.58171 | 26 | 1 | 0.168 | 0.111 |
| | Stage 2 | 0.50108 | 20 | | 1 | 0.410** |
| | Overall Eff. | 0.31910 | 15 | | | 1 |

MMS = Multi-management stages
Eff. = Number of efficient companies
* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

Firstly, Table I-6 shows the average SBM scores under the VRS hypothesis and the Spearman rank correlation between the multi-management stages of our model.[56] This table also shows similar trends to those found in Table I-5 for the CRS-SBM scores, i.e., the highest scores are obtained by the portfolio managers of the company while the

[56] The conclusions are also quite similar after applying the Kendall rank correlation coefficient. Results are available upon request.

overall efficiency provides the lowest scores for any year analysed. Moreover, we also find the expected result of higher VRS-SBM average scores than under the CRS assumption as a consequence of the VRS model better capturing the scale. A comparison of Table I-5 and Table I-6 shows that the most important increments in the average scores are obtained for the marketing stage, which may prove the relevance of the fund company's scale to its ability to successfully sell funds. This finding is especially relevant in a concentrated market with heavy bank participation such as the Spanish fund industry.

A more detailed look at Table I-B-1, Table I-B-2, Table I-B-3, Table I-B-4, and Table I-B-5 (Appendix B) shows the increase in the number of efficient companies for every multi-management stage of our model due to better capturing of the scale effect. However, the Spearman rank coefficients prove that the VRS hypothesis does not significantly affect the major findings displayed by Table I-5, i.e., commercial skills appear to be a much more relevant factor for explaining the overall profitability of a MFMC instead of pure portfolio management abilities. Table I-7 provides additional evidence of the similarity in the efficiency rankings obtained by CRS-SBM and VRS-SBM methods for the *Portfolio Management stage* and for the overall results of the company. The lowest correlations detected in the marketing stage provide robustness to the conclusions obtained from the comparison between the average CRS-SBM (Table I-5) and VRS-SBM (Table I-6) scores, that is, size appears to be an important determinant in successfully commercialising funds. This result is even more evident during a period with more difficulties selling funds, such as 2008.[57]

**Table I-7** Spearman rank correlation between CRS-SBM and VRS-SBM eff. scores

| MMS | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|
| Stage 1 | 0.619** | 0.685** | 0.756** | 0.615** | 0.713** |
| Stage 2 | 0.373** | 0.379** | 0.591** | -0.055 | 0.319** |
| Overall Eff. | 0.857** | 0.858** | 0.862** | 0.779** | 0.685** |

** Correlation is significant at the 0.01 level (2-tailed)

[57] The conclusions are also quite similar after applying the Kendall rank correlation coefficient. Results are available upon request.

The previous findings could provide evidence that not all companies are operating at the optimal scale at the commercial stage, which could result in biased efficiency estimates under constant returns to scale. The importance of scale to selling funds justifies the use of more appropriate benchmarks in the SBM approach to find more accurate results. This issue motivates the application, in the next part of the thesis, of those variants to the original SBM recently proposed by Tone (2010).

## 4.4 Robustness of the More Controversial Variables of the Model

It is necessary to evaluate the impact on the efficiency evaluation of new measures for those variables included in our unoriented multi-management stages model. We must control for the changes in the new SBM efficiency rankings to verify the robustness of the variables initially included in our analysis.

According to the review of variables previously included in the financial literature (see section 3 of this first part), the most controversial variables that have been measured in a number of different ways in the efficiency studies are labour, capital and portfolio risk. Regarding this latter variable, portfolio risk was included as an input in the *Portfolio Management* stage, as is done by nearly all DEA studies on mutual funds. This variable has been extensively measured using the standard deviation of fund returns; while other asymmetric measures have been applied to hedge fund studies (see the detailed literature review of Lozano and Gutiérrez, 2008b). According to the construction of our sample previously described in subsection 4.1, this study focuses on those management companies mostly working with mutual funds, which supports the use of the standard deviation of mutual fund returns to measure risk instead of running additional models using asymmetric risk measures that are more suitable to evaluating the efficiency of hedge funds.

Regarding labour, which is used as an input in our *Portfolio Management* stage, we believe that this variable should be a proxy of the human resources necessary to appropriately develop the major activity of the MFMC, i.e., portfolio management. As was discussed in subsection 2.3.2 of this first part, the number of employees has been commonly applied in the DEA efficiency studies (Lang and Welzel, 1996; Hussels and Ward, 2007; Chen et al, 2009). This variable has also been measured as the total expenditure on wages at the end of each fiscal period (Berg et al, 1991; Berg et al, 1993; among other initial studies); as the percentage of wages from total expenses (Cummins et al., 2010); as the weighted average of annual wages per worker (Berger et al., 2009); and finally as a normalised variable of wages considering the assets under management (Casu et al., 2004). According to this literature, we use personnel expenses instead of number of employees as a new measure for the input *labour* to evaluate the efficiency of the *Portfolio Management stage* in our sample of fund companies.

Table I-8 shows the comparison between the new efficiency scores and those initially obtained by our original model in subsection 4.2.[58]

**Table I-8** Stage 1-Robustness analysis based on labour data

| Year | Data | Average CRS-SBM Scores | Eff. | Spearman Rank Corr. |
|---|---|---|---|---|
| 2005 | Number of Employees | 0.53359 | 28 | 0.964** |
| | Personnel Expenses | 0.54475 | 26 | |
| 2006 | Number of employees | 0.48751 | 22 | 0.970** |
| | Personnel Expenses | 0.49152 | 24 | |
| 2007 | Number of Employees | 0.51105 | 21 | 0.975** |
| | Personnel Expenses | 0.50506 | 21 | |
| 2008 | Number of Employees | 0.37089 | 13 | 0.900** |
| | Personnel Expenses | 0.34447 | 13 | |
| 2009 | Number of Employees | 0.45114 | 20 | 0.955** |
| | Personnel Expenses | 0.44970 | 20 | |

Eff. = Number of efficient companies in each model
** Correlation is significant at the 0.01 level (2-tailed)

58 The comparative scores are shown in Appendix C (Table I-C-1, Table I-C-2, Table I-C-3, Table I-C-4, and Table I-C-5). These scores are obtained assuming the Constant-Returns-to-Scale hypothesis.

Table I-8 shows that both the number of efficient MFMCs and the average SBM scores are very similar, thereby providing evidence for the robustness of our variable *Labour*. However, the lower correlations found in 2008 and 2009 appear to be explained by the lower value of the commissions paid to personnel caused by the financial crisis, which should affect the robustness of both measures of labour. In any case, the correlation is higher than 0.9 and still quite significant.

With respect to *Capital*, we use shareholders' equity value as a measure to represent the capital effort of the company to appropriately manage portfolios. To verify the robustness of this input in our *Portfolio Management* stage, we use equipment as a new proxy for this capital effort. This measure has been extensively applied in the DEA banking literature (Berg et al., 1993; Brockett et al., 1997).

Table I-9 shows a comparison between the new efficiency scores for the *Portfolio Management* stage using furniture and equipment and those initially obtained using shareholders' equity.[59]

**Table I-9** Stage 1- Robustness analysis based on the capital effort data

| Year | Data | Average CRS-SBM Scores | Eff. | Spearman Rank Corr. |
|---|---|---|---|---|
| 2005 | Shareholders' equity | 0.53359 | 28 | 0.748** |
| | Equipment | 0.38171 | 21 | |
| 2006 | Shareholders' equity | 0.48751 | 22 | 0.668** |
| | Equipment | 0.43914 | 26 | |
| 2007 | Shareholders' equity | 0.51105 | 21 | 0.637** |
| | Equipment | 0.42300 | 21 | |
| 2008 | Shareholders' equity | 0.37089 | 13 | 0.718** |
| | Equipment. | 0.30537 | 13 | |
| 2009 | Shareholders' equity | 0.45114 | 20 | 0.742** |
| | Equipment | 0.37362 | 20 | |

Eff. = Number of efficient companies in each model
** Correlation is significant at the 0.01 level (2-tailed)

[59] The comparative scores are shown in Appendix D (Table I-D-1, Table I-D-2, Table I-D-3, Table I-D-4, and Table I-D-5). These scores are obtained assuming the Constant-Returns-to-Scale hypothesis.

We find positive and significant rank correlations of approximately 0.7, which rejects any significant changes in the SBM rankings obtained from using equipment instead of shareholders' equity value. However, these changes are more important than those detected in Table I-8, which may be because several companies do not reflect a high value of furniture and equipment in their balance sheet account considering the amount of assets under management. These surprising results could show that some companies use leasing and other financial instruments to invest in the equipment necessary to manage their portfolios. In our view, this potential bias is overcome by a proxy for the financial effort of the company's shareholders, which is traditionally measured in the literature using the shareholders' equity value.[60]

Finally, *Capital* was also included as an input to the *Overall Efficiency* stage. We then run the SBM model using equipment instead of shareholders' equity value to control for the robustness of this variable in the overall stage. The high and significant rank correlations displayed by Table I-10 provide evidence of the robustness of this variable in the *Overall Efficiency* stage, i.e., measuring *Capital* using shareholder's equity value or furniture and equipment is not a very important choice when evaluating the overall efficiency of the fund company.[61]

[60] In accounting terms, all leasing operations should have been recognised as an intangible asset before December 2008. Currently, if a tangible asset is financed by leasing, this asset must be accounted for as a tangible asset.

[61] The comparative scores are shown in Appendix E (Table I-E-1, Table I-E-2, Table I-E-3, Table I-E-4, and Table I-E-5). These scores are obtained assuming the Constant-Returns-to-Scale hypothesis.

**Table I-10** Overall efficiency-robustness analysis based on the capital effort data

| Year | Capital as: | Average CRS-SBM Scores | Eff. | Spearman Rank Corr. |
|---|---|---|---|---|
| 2005 | Shareholders' equity | 0.25697 | 10 | 0.952** |
| | Equipment | 0.12418 | 4 | |
| 2006 | Shareholders' equity | 0.26854 | 8 | 0.953** |
| | Equipment | 0.13192 | 5 | |
| 2007 | Shareholders' equity | 0.19564 | 6 | 0.916** |
| | Equipment | 0.10073 | 5 | |
| 2008 | Shareholders' equity | 0.19781 | 5 | 0.915** |
| | Equipment | 0.08937 | 3 | |
| 2009 | Shareholders' equity | 0.19333 | 5 | 0.894** |
| | Equipment | 0.11569 | 2 | |

Eff. = Number of efficient companies in each model
** Correlation is significant at the 0.01 level (2-tailed)

The above robustness analyses provide reliable measurement for the variables that have traditionally been subject to greater variability in measurement in the DEA efficiency literature, such as *Labour* and *Capital*. That is, the use of the most common measures for these controversial variables does not drive changes to the efficiency evaluations that would significantly affect the findings previously obtained through the original SBM approach in subsection 4.2.

# 5 Conclusion and Summary

To our knowledge, this study is the first analysis of the efficiency of Mutual Fund Management Companies in a relevant Euro fund industry. Based on the sub-DMUs approach of Holod and Lewis (2011), the thesis develops a model that includes three interacting management subsystems within a mutual fund company originally proposed by Berkowitz and Qiu (2003): *Portfolio Management*, *Marketing and Service*, and *Overall Efficiency*. The interaction between the inputs and outputs of these different units attempts to overcome the traditional debate between the production versus the intermediation approach in the financial industry, especially in banking and insurance companies.

We discuss a specific set of variables to be included in this multi-subsystem model. The measures of these variables are not a mere replication of those inputs/outputs traditionally considered in the banking and insurance studies because it is necessary to take into account the particular characteristics of the fund companies to develop an appropriate model. The consistency of the efficiency results obtained using different measures for the more controversial variables in the literature proves the robustness of our findings.

The application of a non-oriented frontier approach using slacks as proposed by Tone (2001) has been discussed in detail to justify using this technique as an appropriate tool to obtain efficiency scores for Mutual Fund Management Companies.

The efficiency rankings provide evidence for the low impact of portfolio management abilities on the efficiency of the marketing and sales process of the mutual funds managed by the company. Furthermore, the lower efficiency scores found in this commercial stage appear 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 in the commercial stage of the company, thereby considerably reducing the overall profits for shareholders. This major finding from this first part is quite robust to the scale effects in the companies and along all of the years considered in our time horizon. However, the influence of returns-to-scale suggests that size appears to be an important variable for successfully selling funds. This issue is especially relevant in a concentrated market with heavy bank participation such as the Spanish fund industry.

Further research to complement the major findings of this first part of the thesis is included in the next second part of the thesis: 1) the application of recent variants to the non-oriented slacks-based measure of efficiency (Tone, 2010) to overcome some of the limitations potentially present in this frontier methodology as a consequence of inappropriate benchmarking of the companies analysed; 2) the persistence of the efficiency results across the time horizon of the study; and 3) a further discussion of the major factors that could potentially drive the efficiency results obtained by the companies.

# Appendix A

**Table I-A-1** SBM-efficiency under CRS for 2005

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | SBM | Ref. | Rank | SBM | Ref. | Rank | SBM | Ref. | Rank |
| 1 | 0.33795 | 12 161 | 66 | 0.08966 | 59 | 91 | 0.04431 | 196 | 99 |
| 2 | 0.40030 | 12 177 | 59 | 0.11600 | 59 | 69 | 0.04597 | 100 | 97 |
| 4 | 0.42223 | 14 161 | 55 | 0.11224 | 59 | 74 | 0.14556 | 125 | 55 |
| 6 | 1.00000 | 6 | 1 | 0.12635 | 59 | 61 | 0.09447 | 196 | 71 |
| 7 | 1.00000 | 7 | 1 | 0.11275 | 59 | 72 | 0.07625 | 100 | 82 |
| 9 | 0.24942 | 12 177 | 78 | 0.18803 | 59 | 47 | 0.27668 | 100 | 25 |
| 12 | 1.00000 | 12 | 1 | 0.01733 | 59 | 102 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 0.12632 | 59 | 62 | 1.00000 | 14 | 1 |
| 15 | 0.54453 | 12 161 | 44 | 0.08926 | 59 | 92 | 0.13830 | 200 | 57 |
| 20 | 0.49983 | 12 161 | 48 | 0.08596 | 59 | 95 | 0.26639 | 196 | 28 |
| 21 | 0.21632 | 161 | 80 | 0.12651 | 59 | 60 | 0.20771 | 125 | 36 |
| 24 | 0.41055 | 12 177 | 56 | 0.10505 | 59 | 78 | 0.06403 | 100 | 89 |
| 29 | 0.45102 | 12 43 177 | 53 | 0.10109 | 59 | 83 | 0.08061 | 100 | 79 |
| 31 | 0.64661 | 12 177 | 36 | 0.14563 | 59 | 54 | 0.07928 | 100 | 80 |
| 34 | 0.20845 | 12 177 | 81 | 0.15740 | 59 | 49 | 0.10354 | 196 | 68 |
| 35 | 0.81735 | 12 40 160 176 177 | 30 | 0.14150 | 59 | 55 | 0.08897 | 100 | 75 |
| 36 | 0.17644 | 12 174 | 85 | 0.48623 | 46 | 14 | 0.34542 | 100 | 19 |
| 37 | 0.32688 | 12 40 174 177 | 68 | 0.26371 | 46 | 30 | 0.17881 | 100 | 43 |
| 38 | 0.12944 | 12 160 176 | 89 | 0.11694 | 59 | 67 | 0.19097 | 100 | 40 |
| 40 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.11366 | 12 55 174 | 93 | 0.48345 | 46 | 15 | 0.33274 | 100 | 20 |
| 43 | 1.00000 | 43 | 1 | 0.08761 | 59 | 93 | 0.05890 | 100 | 90 |
| 45 | 0.55011 | 12 174 177 | 43 | 0.15939 | 59 | 48 | 0.21755 | 100 | 35 |
| 46 | 0.06900 | 12 152 | 96 | 1.00000 | 46 | 1 | 0.58714 | 100 | 14 |
| 47 | 0.48304 | 12 176 | 49 | 0.12083 | 59 | 64 | 0.07059 | 100 | 84 |
| 49 | 0.38867 | 12 40 174 177 | 60 | 0.26299 | 46 | 31 | 0.19546 | 100 | 39 |
| 50 | 0.14370 | 12 177 | 88 | 0.83008 | 46 59 205 | 8 | 0.22464 | 100 | 33 |
| 51 | 0.58078 | 12 40 160 161 | 39 | 0.21977 | 59 | 39 | 0.13051 | 100 | 59 |
| 53 | 1.00000 | 53 | 1 | 0.59927 | 46 196 | 11 | 0.26866 | 100 | 27 |
| 55 | 1.00000 | 55 | 1 | 0.04260 | 59 | 101 | 0.30758 | 196 | 21 |
| 57 | 0.28221 | 12 174 | 74 | 0.20929 | 46 | 42 | 0.15238 | 100 | 51 |
| 58 | 0.70651 | 12 161 | 35 | 0.11267 | 59 | 73 | 0.18955 | 196 | 41 |
| 59 | 0.02740 | 12 161 | 99 | 1.00000 | 59 | 1 | 0.14996 | 125 | 53 |
| 60 | 0.00646 | 12 40 | 102 | 0.58960 | 46 | 12 | 0.35570 | 196 | 18 |
| 61 | 0.31073 | 55 161 | 70 | 0.09937 | 59 | 84 | 0.03392 | 196 | 100 |
| 62 | 0.64389 | 12 160 161 176 | 37 | 0.15399 | 59 | 51 | 0.15798 | 100 | 49 |
| 63 | 0.76928 | 12 43 154 160 | 31 | 0.10850 | 59 | 75 | 0.04542 | 100 | 98 |
| 69 | 0.11333 | 12 174 177 | 94 | 0.41402 | 46 196 | 18 | 0.12470 | 100 | 61 |
| 71 | 1.00000 | 71 | 1 | 0.10392 | 59 | 79 | 0.10305 | 100 | 70 |
| 73 | 0.70830 | 12 174 177 | 33 | 0.20019 | 59 | 44 | 0.17174 | 100 | 45 |
| 75 | 0.47698 | 12 161 | 50 | 0.07912 | 59 | 97 | 0.05309 | 100 | 94 |
| 76 | 1.00000 | 76 | 1 | 0.09364 | 59 | 86 | 0.26174 | 100 | 29 |
| 78 | 0.35690 | 12 174 177 | 63 | 0.23072 | 59 | 37 | 0.12188 | 100 | 62 |
| 83 | 0.61178 | 12 55 161 | 38 | 0.09589 | 59 | 85 | 0.07843 | 100 | 81 |
| 84 | 0.45669 | 14 161 | 52 | 0.09259 | 59 | 87 | 0.49052 | 125 196 | 15 |
| 85 | 0.46772 | 12 161 | 51 | 0.06204 | 59 | 100 | 0.15520 | 196 | 50 |
| 86 | 0.50307 | 161 | 46 | 0.09105 | 59 | 88 | 0.23166 | 100 | 32 |
| 93 | 0.19591 | 12 55 161 | 83 | 0.26485 | 59 | 29 | 0.13984 | 196 | 56 |
| 95 | 0.73830 | 55 161 | 32 | 0.11970 | 59 | 66 | 0.28886 | 100 | 24 |
| 98 | 0.38578 | 12 43 160 | 62 | 0.08995 | 59 | 90 | 0.18462 | 100 | 42 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.03736 | 12 152 | 98 | 0.76026 | 40 196 | 9 | 0.65068 | 100 196 | 13 |
| 103 | 1.00000 | 103 | 1 | 0.15074 | 59 | 52 | 1.00000 | 103 | 1 |
| 105 | 0.41006 | 12 163 177 | 57 | 0.08666 | 59 | 94 | 0.01924 | 100 | 101 |
| 110 | 0.56571 | 12 161 | 40 | 0.10239 | 59 | 81 | 0.08687 | 100 | 77 |
| 113 | 0.17183 | 12 14 161 | 86 | 0.10707 | 59 | 76 | 0.01282 | 196 | 102 |
| 115 | 0.15611 | 12 100 174 | 87 | 0.32630 | 46 | 24 | 0.17119 | 100 | 46 |
| 121 | 0.27680 | 161 | 75 | 0.09003 | 59 | 89 | 0.08832 | 196 | 76 |
| 123 | 0.12551 | 12 160 177 | 91 | 0.19068 | 59 | 46 | 0.11286 | 100 | 63 |
| 125 | 0.01309 | 14 161 | 101 | 0.44341 | 46 | 16 | 1.00000 | 125 | 1 |
| 126 | 0.35117 | 12 177 | 65 | 0.19487 | 59 | 45 | 0.09324 | 100 | 72 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 127 | 1.00000 | 127 | 1 | 0.07950 | 59 | 96 | 0.10429 | 100 | 67 |
| 128 | 1.00000 | 128 | 1 | 0.10130 | 59 | 82 | 0.10884 | 196 | 65 |
| 130 | 1.00000 | 130 | 1 | 0.10245 | 59 | 80 | 0.06501 | 100 | 86 |
| 131 | 0.12109 | 12 152 | 92 | 0.32630 | 46 | 25 | 0.29562 | 100 | 22 |
| 132 | 0.26751 | 12 161 177 | 76 | 0.14965 | 59 | 53 | 0.08999 | 100 | 74 |
| 133 | 0.28577 | 12 40 174 | 73 | 0.38862 | 46 | 22 | 0.24787 | 100 | 31 |
| 137 | 0.30621 | 12 174 | 72 | 0.21974 | 59 | 40 | 0.20631 | 100 | 37 |
| 138 | 0.18856 | 12 152 | 84 | 1.00000 | 138 | 1 | 0.73150 | 100 152 | 11 |
| 139 | 0.20468 | 12 177 | 82 | 0.28047 | 59 | 28 | 0.41251 | 196 | 16 |
| 140 | 1.00000 | 140 | 1 | 0.12058 | 59 | 65 | 0.05620 | 100 | 92 |
| 142 | 0.35601 | 161 | 64 | 0.07777 | 59 | 98 | 0.08564 | 196 | 78 |
| 152 | 1.00000 | 152 | 1 | 0.41096 | 196 | 20 | 1.00000 | 152 | 1 |
| 154 | 1.00000 | 154 | 1 | 0.13565 | 59 | 58 | 0.04904 | 100 | 96 |
| 156 | 0.31727 | 12 55 174 | 69 | 0.24016 | 59 | 35 | 0.11235 | 100 | 64 |
| 159 | 0.32720 | 12 55 174 177 | 67 | 0.25823 | 59 | 33 | 0.10316 | 100 | 69 |
| 160 | 1.00000 | 160 | 1 | 0.25883 | 46 | 32 | 0.15886 | 100 | 48 |
| 161 | 1.00000 | 161 | 1 | 0.07408 | 59 | 99 | 0.07363 | 100 | 83 |
| 162 | 0.70769 | 12 55 154 176 177 | 34 | 0.13594 | 59 | 57 | 0.12509 | 100 | 60 |
| 163 | 1.00000 | 163 | 1 | 0.13043 | 59 | 59 | 0.05362 | 100 | 93 |
| 164 | 0.06441 | 12 174 | 97 | 0.72657 | 40 196 | 10 | 0.69829 | 125 196 | 12 |
| 168 | 0.23644 | 12 55 174 | 79 | 0.23932 | 59 | 36 | 0.15203 | 100 | 52 |
| 173 | 0.30974 | 12 177 | 71 | 0.11520 | 59 | 71 | 0.05016 | 100 | 95 |
| 174 | 1.00000 | 174 | 1 | 0.35947 | 46 | 23 | 0.37122 | 100 205 | 17 |
| 176 | 1.00000 | 176 | 1 | 0.10591 | 59 | 77 | 0.06601 | 100 | 85 |
| 177 | 1.00000 | 177 | 1 | 0.15581 | 59 | 50 | 0.09050 | 100 | 73 |
| 182 | 0.55858 | 12 176 177 | 41 | 0.11549 | 59 | 70 | 0.06486 | 100 | 87 |
| 185 | 0.38616 | 12 43 154 | 61 | 0.20259 | 59 | 43 | 0.27353 | 100 | 26 |
| 189 | 0.12673 | 12 152 | 90 | 0.49939 | 46 196 | 13 | 0.29159 | 100 | 23 |
| 190 | 0.55505 | 12 176 177 | 42 | 0.12094 | 59 | 63 | 0.06482 | 100 | 88 |
| 191 | 0.40856 | 12 174 177 | 58 | 0.28520 | 59 | 27 | 0.16560 | 100 | 47 |
| 192 | 1.00000 | 192 | 1 | 0.14081 | 59 | 56 | 0.10601 | 100 | 66 |
| 193 | 1.00000 | 193 | 1 | 0.11656 | 59 | 68 | 0.05747 | 100 | 91 |
| 194 | 0.82258 | 12 43 174 198 | 29 | 0.21982 | 59 | 38 | 0.17578 | 100 | 44 |
| 195 | 0.53370 | 12 174 198 | 45 | 0.42547 | 46 59 | 17 | 0.24808 | 100 | 30 |
| 196 | 0.01433 | 12 40 152 | 100 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.50042 | 12 174 177 | 47 | 0.25072 | 46 | 34 | 0.13386 | 100 | 58 |
| 198 | 1.00000 | 198 | 1 | 0.30823 | 59 | 26 | 0.14766 | 100 | 54 |
| 200 | 0.42806 | 55 174 177 | 54 | 0.21853 | 59 | 41 | 1.00000 | 200 | 1 |
| 202 | 0.25857 | 12 40 161 174 177 | 77 | 0.41174 | 46 | 19 | 0.22371 | 100 | 34 |
| 205 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 |
| 206 | 0.10614 | 12 152 174 | 95 | 0.39816 | 196 | 21 | 0.20326 | 100 | 38 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-A-2** SBM-efficiency under CRS for 2006

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | SBM | Ref. | Rank | SBM | Ref. | Rank | SBM | Ref. | Rank |
| 2 | 0.44895 | 12 177 205 | 47 | 0.16883 | 196 | 80 | 0.05102 | 100 | 101 |
| 4 | 0.36609 | 14 51 | 57 | 0.20362 | 196 | 63 | 0.20237 | 103 | 41 |
| 6 | 0.24471 | 51 55 161 | 72 | 0.19315 | 196 | 67 | 0.13330 | 100 | 63 |
| 7 | 0.80473 | 12 51 53 154 163 | 26 | 0.18790 | 196 | 68 | 0.08920 | 100 | 82 |
| 9 | 0.21437 | 140 174 | 75 | 0.28269 | 196 | 35 | 0.33738 | 100 | 22 |
| 12 | 1.00000 | 12 | 1 | 0.00577 | 202 | 102 | 0.48454 | 14 103 | 14 |
| 14 | 1.00000 | 14 | 1 | 0.17761 | 202 | 74 | 1.00000 | 14 | 1 |
| 15 | 0.56122 | 12 51 127 | 34 | 0.00899 | 202 | 101 | 0.12844 | 103 | 66 |
| 20 | 0.54491 | 12 51 127 | 36 | 0.14657 | 196 | 93 | 0.32461 | 103 | 25 |
| 21 | 0.24047 | 127 | 73 | 0.17893 | 196 | 72 | 0.28615 | 103 | 31 |
| 24 | 0.42342 | 12 177 205 | 51 | 0.15599 | 196 | 88 | 0.07796 | 100 | 88 |
| 29 | 0.41718 | 12 128 205 | 52 | 0.16855 | 196 | 81 | 0.12851 | 100 | 65 |
| 31 | 0.84051 | 12 51 53 154 163 | 25 | 0.28779 | 196 | 34 | 0.12455 | 100 | 69 |
| 34 | 0.16519 | 12 177 | 84 | 0.47668 | 196 202 | 18 | 0.07962 | 100 | 87 |
| 35 | 0.51953 | 12 174 | 39 | 0.19937 | 196 | 64 | 0.10131 | 100 | 78 |
| 36 | 0.16393 | 12 14 174 | 85 | 0.45964 | 203 | 20 | 0.36283 | 100 | 19 |
| 37 | 0.37920 | 12 174 205 | 56 | 0.25101 | 196 | 45 | 0.19572 | 100 | 43 |
| 38 | 0.10118 | 12 51 163 | 95 | 0.20477 | 196 | 60 | 0.30177 | 100 | 28 |
| 40 | 0.10521 | 174 | 94 | 1.00000 | 40 | 1 | 0.98297 | 100 103 | 9 |
| 42 | 0.14496 | 14 174 | 88 | 0.41011 | 203 | 22 | 0.39169 | 100 | 17 |
| 43 | 0.69014 | 128 154 163 198 205 | 28 | 0.15153 | 196 | 91 | 0.06698 | 100 | 93 |
| 45 | 0.50592 | 12 174 | 41 | 0.21997 | 196 | 54 | 0.32857 | 100 | 23 |
| 46 | 0.12119 | 12 205 | 91 | 0.74057 | 196 203 | 10 | 0.61736 | 100 | 11 |
| 47 | 0.41186 | 12 51 | 53 | 0.19877 | 196 | 66 | 0.11071 | 100 | 72 |
| 49 | 0.32253 | 12 174 | 63 | 0.26393 | 196 | 42 | 0.25735 | 100 | 36 |
| 50 | 0.12725 | 12 174 | 90 | 0.59623 | 196 203 | 13 | 0.22569 | 100 | 38 |
| 51 | 1.00000 | 51 | 1 | 0.16411 | 196 | 83 | 0.11605 | 100 | 71 |
| 53 | 1.00000 | 53 | 1 | 0.48690 | 196 203 | 17 | 0.29695 | 100 | 30 |
| 55 | 1.00000 | 55 | 1 | 0.10510 | 196 | 99 | 0.38660 | 103 | 18 |
| 57 | 0.34304 | 174 | 60 | 0.22792 | 196 | 50 | 0.17904 | 100 | 47 |
| 58 | 0.53423 | 12 51 128 | 38 | 0.17201 | 202 | 78 | 0.27552 | 103 | 34 |
| 59 | 1.00000 | 59 | 1 | 0.71181 | 196 203 | 12 | 0.02049 | 125 | 102 |
| 60 | 0.00147 | 12 205 | 102 | 1.00000 | 60 | 1 | 0.56232 | 100 125 | 13 |
| 61 | 0.20216 | 14 161 | 78 | 0.16816 | 196 | 82 | 0.09254 | 100 | 80 |
| 62 | 1.00000 | 62 | 1 | 0.22136 | 196 | 53 | 0.17945 | 100 | 46 |
| 63 | 0.62818 | 12 53 128 163 205 | 32 | 0.14954 | 202 | 92 | 0.05501 | 100 | 97 |
| 69 | 0.16152 | 12 174 205 | 86 | 0.29226 | 203 | 33 | 0.15998 | 100 | 51 |
| 71 | 1.00000 | 71 | 1 | 0.16032 | 196 | 86 | 0.07392 | 100 | 90 |
| 75 | 0.34772 | 12 51 128 | 59 | 0.15477 | 196 | 90 | 0.05768 | 100 | 96 |
| 76 | 0.64041 | 55 174 | 30 | 0.16160 | 196 | 85 | 0.32722 | 100 | 24 |
| 78 | 0.44933 | 12 174 | 46 | 0.23471 | 196 | 47 | 0.13623 | 100 | 60 |
| 83 | 0.73548 | 12 51 55 127 140 | 27 | 0.22539 | 196 | 51 | 0.12697 | 100 | 68 |
| 84 | 0.44491 | 14 51 127 | 49 | 0.18098 | 196 | 71 | 0.58563 | 103 | 12 |
| 85 | 0.45866 | 12 51 128 | 43 | 0.08541 | 202 | 100 | 0.14745 | 103 | 55 |
| 86 | 0.50058 | 12 51 | 42 | 0.12824 | 196 | 97 | 0.30006 | 100 | 29 |
| 93 | 0.20408 | 14 51 55 | 77 | 0.27776 | 196 | 36 | 0.15319 | 100 | 54 |
| 95 | 0.45104 | 12 14 51 | 45 | 0.19907 | 196 | 65 | 0.43432 | 100 103 | 16 |
| 98 | 0.35902 | 12 51 | 58 | 0.15588 | 196 | 89 | 0.27062 | 100 | 35 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.02073 | 12 174 205 | 99 | 0.53768 | 203 | 14 | 0.33771 | 100 | 21 |
| 103 | 0.17378 | 55 127 | 83 | 0.22883 | 196 | 49 | 1.00000 | 103 | 1 |
| 105 | 0.11507 | 12 174 | 92 | 0.21509 | 196 | 55 | 0.15480 | 100 | 53 |
| 110 | 0.51738 | 12 51 | 40 | 0.16956 | 196 | 79 | 0.13768 | 100 | 59 |
| 113 | 0.19399 | 12 14 51 | 81 | 0.20468 | 196 | 61 | 0.05241 | 100 | 99 |
| 115 | 0.23929 | 14 174 | 74 | 0.26007 | 203 | 43 | 0.17871 | 100 | 48 |
| 121 | 0.19729 | 14 51 | 79 | 0.20370 | 196 | 62 | 0.10587 | 103 | 75 |
| 123 | 0.13253 | 12 177 205 | 89 | 0.21301 | 196 | 56 | 0.10904 | 100 | 74 |
| 125 | 0.01207 | 14 51 | 100 | 0.46693 | 196 | 19 | 1.00000 | 125 | 1 |
| 126 | 0.28710 | 12 174 | 66 | 0.22891 | 196 | 48 | 0.10139 | 100 | 77 |
| 127 | 1.00000 | 127 | 1 | 0.13583 | 196 | 95 | 0.08865 | 100 | 84 |
| 128 | 1.00000 | 128 | 1 | 0.13471 | 202 | 96 | 0.13552 | 103 | 61 |
| 130 | 1.00000 | 130 | 1 | 0.17482 | 196 | 75 | 0.07611 | 100 | 89 |
| 131 | 0.11444 | 12 174 205 | 93 | 0.32372 | 196 | 31 | 0.27757 | 100 | 32 |
| 132 | 0.45200 | 12 51 177 205 | 44 | 0.26697 | 196 | 39 | 0.13370 | 100 | 62 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 133 | 0.26298 | 12 174 | 70 | 0.39194 | 196 | 24 | 0.25268 | 100 | 37 |
| 137 | 0.28825 | 12 174 | 65 | 0.27432 | 196 | 38 | 0.30851 | 100 | 27 |
| 139 | 0.19623 | 12 51 154 | 80 | 0.36027 | 196 | 27 | 0.48390 | 100 | 15 |
| 140 | 1.00000 | 140 | 1 | 0.18767 | 196 | 69 | 0.08654 | 100 | 85 |
| 142 | 0.26240 | 12 51 | 71 | 0.18135 | 196 | 70 | 0.08910 | 100 | 83 |
| 152 | 0.32485 | 12 174 | 62 | 1.00000 | 152 | 1 | 0.34260 | 100 | 20 |
| 154 | 1.00000 | 154 | 1 | 0.13960 | 196 | 94 | 0.05299 | 100 | 98 |
| 156 | 0.27883 | 12 14 174 | 68 | 0.27650 | 196 | 37 | 0.10983 | 100 | 73 |
| 159 | 0.26417 | 12 174 | 69 | 0.33236 | 196 | 30 | 0.09063 | 100 | 81 |
| 160 | 1.00000 | 160 | 1 | 0.26484 | 196 | 40 | 0.18193 | 100 | 45 |
| 161 | 1.00000 | 161 | 1 | 0.11123 | 196 | 98 | 0.09544 | 100 | 79 |
| 162 | 0.54073 | 14 51 55 140 177 | 37 | 0.21295 | 196 | 57 | 0.16337 | 100 | 50 |
| 163 | 1.00000 | 163 | 1 | 0.16022 | 196 | 87 | 0.05147 | 100 | 100 |
| 164 | 0.08552 | 12 174 205 | 97 | 0.71796 | 196 203 | 11 | 1.00000 | 164 | 1 |
| 168 | 0.17788 | 12 14 174 | 82 | 0.49530 | 196 202 | 16 | 0.16436 | 100 | 49 |
| 173 | 0.43200 | 12 177 | 50 | 0.16336 | 196 | 84 | 0.07258 | 100 | 92 |
| 174 | 1.00000 | 174 | 1 | 0.38481 | 196 | 25 | 0.31727 | 100 | 26 |
| 176 | 0.85503 | 12 140 161 177 | 24 | 0.17342 | 196 | 76 | 0.07287 | 100 | 91 |
| 177 | 1.00000 | 177 | 1 | 0.17241 | 196 | 77 | 0.12188 | 100 | 70 |
| 182 | 0.63326 | 12 51 53 163 177 | 31 | 0.20785 | 196 | 59 | 0.10220 | 100 | 76 |
| 185 | 0.28203 | 51 128 | 67 | 0.33509 | 196 202 | 29 | 0.13982 | 103 | 57 |
| 190 | 0.44540 | 12 51 205 | 48 | 0.22225 | 196 | 52 | 0.08337 | 100 | 86 |
| 191 | 0.39387 | 12 174 | 54 | 0.25457 | 196 | 44 | 0.15846 | 100 | 52 |
| 192 | 0.59081 | 161 174 | 33 | 0.17847 | 196 | 73 | 0.12837 | 100 | 67 |
| 193 | 0.54975 | 12 174 177 | 35 | 0.24157 | 196 | 46 | 0.06506 | 100 | 95 |
| 194 | 1.00000 | 194 | 1 | 0.31866 | 196 | 32 | 0.18850 | 100 | 44 |
| 195 | 0.21295 | 12 174 198 | 76 | 0.80293 | 152 196 202 | 9 | 0.21477 | 100 | 40 |
| 196 | 0.04463 | 12 205 | 98 | 1.00000 | 196 | 1 | 0.85674 | 100 125 164 | 10 |
| 197 | 0.38743 | 12 174 | 55 | 0.26409 | 196 | 41 | 0.13269 | 100 | 64 |
| 198 | 1.00000 | 198 | 1 | 0.52403 | 196 202 | 15 | 0.13823 | 100 | 58 |
| 200 | 0.33249 | 55 161 | 61 | 0.34650 | 196 | 28 | 1.00000 | 200 | 1 |
| 202 | 0.30145 | 12 177 205 | 64 | 1.00000 | 202 | 1 | 0.22387 | 100 | 39 |
| 203 | 0.00248 | 205 | 101 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.86527 | 12 14 174 177 205 | 23 | 0.21243 | 196 | 58 | 0.14578 | 100 | 56 |
| 205 | 1.00000 | 205 | 1 | 0.42132 | 203 | 21 | 1.00000 | 205 | 1 |
| 206 | 0.15011 | 12 174 | 87 | 0.39985 | 196 203 | 23 | 0.19629 | 100 | 42 |
| 207 | 0.09895 | 12 205 | 96 | 1.00000 | 207 | 1 | 0.06510 | 100 | 94 |
| 210 | 0.68387 | 12 174 205 | 29 | 0.38090 | 203 | 26 | 0.27657 | 100 | 33 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-A-3** SBM-efficiency under CRS for 2007

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.51806 | 7 12 50 198 | 39 | 0.27159 | 50 | 57 | 0.04937 | 100 | 88 |
| 4 | 0.43624 | 12 14 51 127 | 46 | 0.23952 | 50 | 74 | 0.10488 | 103 | 54 |
| 6 | 0.26835 | 14 174 177 | 69 | 0.26111 | 46 | 61 | 0.12678 | 100 | 42 |
| 7 | 1.00000 | 7 | 1 | 0.30253 | 50 | 37 | 0.06810 | 100 | 75 |
| 9 | 0.25915 | 12 177 | 72 | 0.28129 | 46 | 45 | 0.25633 | 103 | 17 |
| 12 | 1.00000 | 12 | 1 | 0.02373 | 50 | 95 | 0.24853 | 103 | 19 |
| 14 | 1.00000 | 14 | 1 | 0.09046 | 50 | 94 | 0.29689 | 103 | 12 |
| 15 | 0.62492 | 12 51 127 | 34 | 0.18102 | 50 | 92 | 0.05225 | 103 | 86 |
| 20 | 0.17673 | 12 51 | 82 | 0.19869 | 50 | 90 | 0.21514 | 103 | 23 |
| 21 | 0.29413 | 12 51 127 | 66 | 0.27917 | 46 | 50 | 0.11364 | 103 | 49 |
| 24 | 0.39268 | 12 152 | 52 | 0.27726 | 46 | 53 | 0.05693 | 100 | 84 |
| 29 | 0.39638 | 12 50 198 | 51 | 0.26095 | 50 | 62 | 0.09364 | 100 | 58 |
| 31 | 0.38277 | 12 152 177 198 | 56 | 0.29044 | 46 | 42 | 0.08811 | 100 | 59 |
| 34 | 0.16140 | 12 50 | 84 | 0.42903 | 46 50 | 17 | 0.07355 | 100 | 70 |
| 35 | 0.74560 | 12 174 177 198 | 26 | 0.25775 | 46 | 66 | 0.06677 | 100 | 76 |
| 36 | 0.17889 | 12 174 | 80 | 0.46345 | 46 | 13 | 0.34604 | 100 | 11 |
| 37 | 0.35377 | 12 152 198 | 60 | 0.27020 | 46 | 58 | 0.11603 | 100 | 48 |
| 38 | 0.09342 | 12 51 | 90 | 0.27542 | 46 | 56 | 0.21607 | 100 | 22 |
| 40 | 0.13492 | 12 174 | 89 | 0.50290 | 46 50 | 10 | 0.24673 | 100 | 20 |
| 43 | 0.69769 | 12 50 128 198 | 28 | 0.25369 | 50 | 67 | 0.08387 | 100 | 63 |
| 45 | 0.65904 | 12 174 177 198 | 30 | 0.22965 | 46 | 79 | 0.26707 | 100 | 16 |
| 46 | 0.13909 | 12 174 210 | 87 | 1.00000 | 46 | 1 | 0.54995 | 100 | 7 |
| 47 | 0.44036 | 12 51 | 45 | 0.26043 | 50 | 64 | 0.10175 | 103 | 56 |
| 49 | 0.29208 | 12 198 | 67 | 0.42126 | 46 50 | 18 | 0.18861 | 100 | 29 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 | 0.19133 | 100 | 27 |
| 51 | 1.00000 | 51 | 1 | 0.22873 | 46 | 80 | 0.10175 | 100 | 55 |
| 53 | 1.00000 | 53 | 1 | 0.62385 | 46 100 | 8 | 0.22934 | 100 | 21 |
| 55 | 1.00000 | 55 | 1 | 0.18614 | 50 | 91 | 0.17281 | 103 | 32 |
| 57 | 0.29513 | 12 198 | 65 | 0.28414 | 46 | 44 | 0.16067 | 100 | 34 |
| 58 | 0.40114 | 12 51 127 | 50 | 0.21110 | 50 | 88 | 0.20325 | 103 | 25 |
| 59 | 0.03667 | 12 14 51 | 92 | 0.74972 | 46 100 | 7 | 0.02239 | 125 | 95 |
| 61 | 0.23730 | 14 51 | 73 | 0.26365 | 50 | 59 | 0.06150 | 100 | 81 |
| 62 | 0.62576 | 12 50 127 177 | 33 | 0.38723 | 46 50 | 25 | 0.13891 | 100 | 40 |
| 63 | 0.35861 | 12 51 | 59 | 0.22016 | 50 | 85 | 0.02930 | 103 | 94 |
| 69 | 0.47606 | 198 | 42 | 0.44864 | 46 50 | 16 | 0.12486 | 100 | 43 |
| 71 | 0.68783 | 12 14 177 | 29 | 0.27921 | 50 | 49 | 0.14463 | 100 | 37 |
| 75 | 0.39004 | 12 51 128 | 54 | 0.22553 | 50 | 83 | 0.05125 | 103 | 87 |
| 76 | 0.64337 | 14 174 177 | 32 | 0.26010 | 46 | 65 | 0.21237 | 100 | 24 |
| 78 | 1.00000 | 78 | 1 | 0.32589 | 46 50 | 33 | 0.08658 | 100 | 61 |
| 83 | 1.00000 | 83 | 1 | 0.23689 | 50 | 76 | 0.08579 | 103 | 62 |
| 84 | 0.43146 | 12 14 51 127 | 48 | 0.21743 | 50 | 86 | 0.40844 | 103 | 10 |
| 85 | 0.34176 | 12 51 128 | 61 | 0.17989 | 50 | 93 | 0.07036 | 103 | 73 |
| 86 | 0.65432 | 12 50 51 127 | 31 | 0.24629 | 50 | 70 | 0.13901 | 100 | 39 |
| 93 | 0.19031 | 12 14 51 | 78 | 0.45340 | 46 50 | 14 | 0.15701 | 100 | 35 |
| 95 | 0.58126 | 12 51 | 36 | 0.20359 | 50 | 89 | 0.27348 | 103 | 15 |
| 98 | 0.23619 | 12 50 | 74 | 0.27866 | 46 | 51 | 0.27933 | 100 | 14 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 0.49690 | 46 100 | 11 | 1.00000 | 102 | 1 |
| 103 | 0.17974 | 12 51 127 128 | 79 | 0.33876 | 46 | 30 | 1.00000 | 103 | 1 |
| 105 | 0.01915 | 12 14 51 | 93 | 0.38316 | 46 | 26 | 0.28315 | 100 | 13 |
| 110 | 0.45598 | 12 51 | 43 | 0.27668 | 50 | 55 | 0.12210 | 100 | 45 |
| 113 | 0.19658 | 12 14 51 | 77 | 0.22404 | 50 | 84 | 0.04300 | 103 | 90 |
| 115 | 0.17387 | 12 174 | 83 | 0.40079 | 46 | 21 | 0.14418 | 100 | 38 |
| 121 | 0.23576 | 12 51 | 75 | 0.24177 | 50 | 72 | 0.08012 | 103 | 64 |
| 125 | 0.00157 | 14 51 | 95 | 0.52661 | 100 | 9 | 1.00000 | 125 | 1 |
| 126 | 0.30830 | 12 152 177 198 | 63 | 0.23754 | 46 | 75 | 0.07084 | 100 | 72 |
| 127 | 1.00000 | 127 | 1 | 0.24432 | 50 | 71 | 0.07826 | 100 | 67 |
| 128 | 1.00000 | 128 | 1 | 0.22772 | 50 | 81 | 0.05711 | 103 | 83 |
| 130 | 0.55948 | 12 50 51 128 | 38 | 0.23219 | 50 | 77 | 0.06568 | 100 | 79 |
| 131 | 0.14736 | 12 198 | 86 | 0.30184 | 46 | 38 | 0.18744 | 100 | 30 |
| 132 | 0.41934 | 12 51 177 | 49 | 0.21567 | 46 | 87 | 0.10706 | 100 | 53 |
| 133 | 0.36801 | 12 174 198 | 57 | 0.41140 | 46 | 20 | 0.20135 | 100 | 26 |
| 137 | 0.39150 | 12 174 198 | 53 | 0.27974 | 46 | 47 | 0.25393 | 100 | 18 |
| 139 | 0.28044 | 12 51 128 198 | 68 | 0.38813 | 46 | 24 | 0.42997 | 100 | 9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 1.00000 | 140 | 1 | 0.23008 | 50 | 78 | 0.06866 | 100 | 74 |
| 142 | 0.29894 | 12 51 | 64 | 0.24925 | 50 | 69 | 0.05337 | 103 | 85 |
| 152 | 1.00000 | 152 | 1 | 0.44911 | 46 100 | 15 | 0.18678 | 100 | 31 |
| 154 | 0.90413 | 12 51 128 140 198 | 22 | 0.22616 | 50 | 82 | 0.04190 | 100 | 91 |
| 156 | 0.34074 | 12 14 174 177 | 62 | 0.37985 | 46 50 | 28 | 0.09471 | 100 | 57 |
| 159 | 0.17862 | 12 152 198 | 81 | 0.37814 | 46 50 | 29 | 0.08677 | 100 | 60 |
| 160 | 1.00000 | 160 | 1 | 0.39852 | 46 50 | 23 | 0.10742 | 100 | 52 |
| 161 | 0.75521 | 14 51 55 127 174 177 | 24 | 0.32144 | 50 | 34 | 0.07592 | 100 | 68 |
| 162 | 0.47837 | 14 51 127 | 41 | 0.29792 | 50 | 39 | 0.11256 | 100 | 50 |
| 163 | 1.00000 | 163 | 1 | 0.24070 | 50 | 73 | 0.03624 | 100 | 93 |
| 168 | 0.22990 | 12 14 174 177 | 76 | 0.32660 | 46 | 32 | 0.13868 | 100 | 41 |
| 173 | 0.35901 | 12 50 | 58 | 0.27699 | 50 | 54 | 0.06195 | 100 | 80 |
| 174 | 1.00000 | 174 | 1 | 0.40039 | 46 50 | 22 | 0.16349 | 100 | 33 |
| 176 | 0.75386 | 12 51 149 177 198 | 25 | 0.30405 | 50 | 35 | 0.06578 | 100 | 78 |
| 177 | 1.00000 | 177 | 1 | 0.27741 | 46 | 52 | 0.07277 | 100 | 71 |
| 182 | 0.44175 | 12 51 | 44 | 0.28875 | 50 | 43 | 0.07833 | 100 | 65 |
| 185 | 0.26586 | 51 128 | 70 | 0.29669 | 46 | 40 | 0.04871 | 103 | 89 |
| 190 | 0.56018 | 12 50 177 198 | 37 | 0.27991 | 50 | 46 | 0.05825 | 100 | 82 |
| 191 | 0.60545 | 12 174 198 | 35 | 0.25283 | 46 | 68 | 0.12380 | 100 | 44 |
| 192 | 0.38297 | 14 174 177 | 55 | 1.00000 | 192 | 1 | 0.12072 | 100 | 46 |
| 193 | 0.71789 | 12 152 177 198 | 27 | 0.26127 | 50 | 60 | 0.03958 | 100 | 92 |
| 194 | 0.48534 | 12 198 | 40 | 0.27968 | 46 | 48 | 0.11228 | 100 | 51 |
| 196 | 0.04396 | 12 198 | 91 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.43505 | 12 198 | 47 | 0.29052 | 46 | 41 | 0.07830 | 100 | 66 |
| 198 | 1.00000 | 198 | 1 | 0.26090 | 46 | 63 | 0.06653 | 100 | 77 |
| 200 | 0.15380 | 51 127 | 85 | 0.30270 | 46 | 36 | 0.47176 | 103 125 | 8 |
| 203 | 0.00418 | 174 | 94 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.78538 | 12 50 177 198 | 23 | 0.41182 | 46 50 | 19 | 0.11611 | 100 | 47 |
| 206 | 0.26231 | 12 152 174 | 71 | 0.33323 | 46 | 31 | 0.14614 | 100 | 36 |
| 207 | 0.13670 | 12 174 | 88 | 0.38133 | 46 | 27 | 0.07377 | 100 | 69 |
| 210 | 1.00000 | 210 | 1 | 0.47154 | 46 50 | 12 | 0.18937 | 100 | 28 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-A-4** SBM-efficiency under CRS for 2008

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.33993 | 14 174 | 40 | 0.07661 | 100 | 70 | 0.06936 | 100 | 71 |
| 4 | 0.49801 | 14 127 174 | 22 | 0.05026 | 100 | 88 | 0.12356 | 103 | 45 |
| 6 | 0.15269 | 14 174 | 73 | 0.09354 | 100 | 50 | 0.09404 | 46 | 59 |
| 7 | 0.59259 | 14 15 154 174 | 16 | 0.08171 | 100 | 64 | 0.08422 | 100 | 65 |
| 9 | 0.16354 | 14 174 | 68 | 0.17328 | 100 | 17 | 0.28667 | 46 | 13 |
| 12 | 1.00000 | 12 | 1 | 0.00580 | 100 | 93 | 0.36512 | 103 | 10 |
| 14 | 1.00000 | 14 | 1 | 0.02121 | 100 | 92 | 0.53273 | 46 103 | 7 |
| 15 | 1.00000 | 15 | 1 | 0.04369 | 100 | 91 | 0.06101 | 46 | 82 |
| 20 | 0.27041 | 14 127 174 | 48 | 0.07434 | 100 | 73 | 0.24916 | 46 | 23 |
| 21 | 0.29940 | 14 127 | 43 | 0.08726 | 100 | 56 | 0.10910 | 103 | 52 |
| 24 | 0.18848 | 174 | 63 | 0.09683 | 100 | 47 | 0.06890 | 100 | 72 |
| 29 | 0.16027 | 174 | 69 | 0.08021 | 100 | 67 | 0.05422 | 100 | 86 |
| 31 | 0.23317 | 174 | 55 | 0.10037 | 100 | 46 | 0.05397 | 100 | 87 |
| 34 | 0.15519 | 14 174 | 71 | 0.11094 | 100 | 39 | 0.05629 | 46 | 84 |
| 35 | 0.46813 | 14 174 | 24 | 0.10075 | 100 | 43 | 0.10524 | 100 | 56 |
| 36 | 0.08975 | 14 174 | 84 | 0.29986 | 100 | 5 | 0.37877 | 46 | 9 |
| 37 | 0.21857 | 174 | 58 | 0.10292 | 100 | 42 | 0.11621 | 100 | 48 |
| 38 | 0.06335 | 14 174 | 87 | 0.10059 | 100 | 45 | 0.09978 | 46 | 58 |
| 40 | 0.04120 | 14 174 | 88 | 0.22784 | 100 | 8 | 0.07030 | 46 | 70 |
| 43 | 0.22706 | 14 174 | 57 | 0.08061 | 100 | 66 | 0.06407 | 100 | 79 |
| 45 | 0.28680 | 14 174 | 44 | 0.11144 | 100 | 37 | 0.26292 | 100 | 19 |
| 46 | 0.02133 | 15 210 | 90 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.32840 | 14 154 174 | 41 | 0.08297 | 100 | 62 | 0.08838 | 46 | 62 |
| 49 | 0.16823 | 15 174 | 67 | 0.13015 | 100 | 32 | 0.16023 | 100 | 35 |
| 50 | 0.15546 | 14 174 | 70 | 0.21096 | 100 | 14 | 0.28164 | 100 | 17 |
| 51 | 0.41660 | 14 127 154 174 | 32 | 0.10495 | 100 | 40 | 0.13157 | 100 | 43 |
| 53 | 0.21290 | 210 217 | 59 | 0.22162 | 100 | 10 | 0.40558 | 100 | 8 |
| 55 | 1.00000 | 55 | 1 | 0.05008 | 100 | 89 | 0.22664 | 46 | 26 |
| 57 | 0.24432 | 174 | 52 | 0.13549 | 100 | 29 | 0.11501 | 100 | 49 |
| 58 | 0.43570 | 12 127 160 | 28 | 0.04599 | 100 | 90 | 0.28277 | 103 | 16 |
| 61 | 0.18555 | 14 174 | 65 | 0.08615 | 100 | 59 | 0.06024 | 46 | 83 |
| 62 | 0.36581 | 14 174 | 38 | 0.11135 | 100 | 38 | 0.14484 | 100 | 38 |
| 63 | 0.51151 | 14 154 174 | 20 | 0.06001 | 100 | 82 | 0.02524 | 46 | 91 |
| 69 | 0.15155 | 15 174 | 74 | 0.21138 | 100 | 12 | 0.23610 | 100 | 25 |
| 71 | 0.40797 | 14 174 | 33 | 0.07507 | 100 | 71 | 0.13102 | 46 | 44 |
| 76 | 0.64471 | 14 55 127 174 | 14 | 0.07948 | 100 | 69 | 0.13805 | 100 | 41 |
| 78 | 0.34477 | 14 174 | 39 | 0.09341 | 100 | 51 | 0.09133 | 100 | 61 |
| 83 | 1.00000 | 83 | 1 | 0.05749 | 100 | 84 | 0.06880 | 46 | 73 |
| 84 | 0.39343 | 14 127 174 | 35 | 0.05633 | 100 | 85 | 0.26264 | 46 | 20 |
| 85 | 0.53103 | 12 14 127 160 | 18 | 0.05201 | 100 | 86 | 0.08376 | 46 | 66 |
| 86 | 0.42106 | 14 154 174 | 30 | 0.06724 | 100 | 77 | 0.06671 | 46 | 77 |
| 93 | 0.14790 | 14 174 | 75 | 0.18624 | 100 | 15 | 0.18065 | 46 | 31 |
| 95 | 0.51312 | 14 154 174 | 19 | 0.06332 | 100 | 80 | 0.22117 | 46 | 27 |
| 98 | 0.10369 | 174 | 79 | 0.08690 | 100 | 58 | 0.20722 | 46 | 29 |
| 100 | 0.01315 | 210 | 92 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.08069 | 14 174 | 85 | 0.14642 | 100 | 24 | 1.00000 | 103 | 1 |
| 105 | 0.02505 | 14 174 | 89 | 0.15219 | 100 | 22 | 0.00449 | 46 | 93 |
| 110 | 0.43663 | 14 154 174 | 27 | 0.07954 | 100 | 68 | 0.11121 | 46 | 51 |
| 113 | 0.18537 | 14 174 | 66 | 0.07449 | 100 | 72 | 0.07830 | 46 | 67 |
| 115 | 0.10093 | 14 174 | 80 | 0.16853 | 100 | 19 | 0.19021 | 100 | 30 |
| 121 | 0.13894 | 14 174 | 77 | 0.08205 | 100 | 63 | 0.07646 | 46 | 68 |
| 125 | 0.00112 | 14 174 | 93 | 0.32678 | 100 | 4 | 1.00000 | 125 | 1 |
| 126 | 0.25734 | 14 174 | 50 | 0.09261 | 100 | 52 | 0.09270 | 100 | 60 |
| 127 | 1.00000 | 127 | 1 | 0.05888 | 100 | 83 | 0.06516 | 100 | 78 |
| 128 | 1.00000 | 128 | 1 | 0.05170 | 100 | 87 | 0.06187 | 46 | 81 |
| 130 | 0.56401 | 14 154 174 | 17 | 0.06347 | 100 | 79 | 0.05462 | 100 | 85 |
| 131 | 0.09758 | 15 174 | 82 | 0.17022 | 100 | 18 | 0.21404 | 100 | 28 |
| 132 | 0.15380 | 174 | 72 | 0.10070 | 100 | 44 | 0.10632 | 46 | 55 |
| 133 | 0.23740 | 15 174 | 54 | 0.22745 | 100 | 9 | 0.28295 | 100 | 15 |
| 137 | 0.23982 | 174 | 53 | 0.16323 | 100 | 20 | 0.28322 | 100 | 14 |
| 139 | 0.19390 | 154 174 | 62 | 0.21125 | 100 | 13 | 0.35653 | 46 | 11 |
| 140 | 0.64084 | 14 154 174 | 15 | 0.06216 | 100 | 81 | 0.06238 | 100 | 80 |
| 142 | 0.37973 | 14 154 174 | 37 | 0.07049 | 100 | 75 | 0.14721 | 46 | 37 |
| 152 | 0.20657 | 174 210 217 | 60 | 0.21544 | 100 | 11 | 0.24542 | 100 | 24 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 154 | 1.00000 | 154 | 1 | 0.07043 | 100 | 76 | 0.05124 | 100 | 88 |
| 156 | 0.26916 | 14 174 | 49 | 0.13949 | 100 | 27 | 0.13365 | 100 | 42 |
| 159 | 0.14658 | 14 15 174 | 76 | 0.12133 | 100 | 33 | 0.10815 | 100 | 53 |
| 160 | 1.00000 | 160 | 1 | 0.14901 | 100 | 23 | 0.16151 | 100 | 34 |
| 161 | 0.40556 | 14 55 174 | 34 | 0.08691 | 100 | 57 | 0.07374 | 46 | 69 |
| 162 | 0.28408 | 14 174 | 46 | 0.08763 | 100 | 55 | 0.10303 | 46 | 57 |
| 163 | 0.45947 | 15 154 174 | 26 | 0.06445 | 100 | 78 | 0.05120 | 100 | 89 |
| 168 | 0.18805 | 14 174 | 64 | 0.13937 | 100 | 28 | 0.16156 | 100 | 33 |
| 173 | 0.10768 | 174 | 78 | 0.08971 | 100 | 54 | 0.04383 | 46 | 90 |
| 174 | 1.00000 | 174 | 1 | 0.14526 | 100 | 25 | 0.25869 | 100 | 22 |
| 176 | 0.47612 | 14 154 174 | 23 | 0.08379 | 100 | 61 | 0.08507 | 100 | 64 |
| 177 | 0.46210 | 174 | 25 | 0.09069 | 100 | 53 | 0.10718 | 100 | 54 |
| 182 | 0.24487 | 14 174 | 51 | 0.08063 | 100 | 65 | 0.06770 | 46 | 75 |
| 185 | 0.43031 | 12 127 160 | 29 | 0.09539 | 100 | 49 | 0.01699 | 46 | 92 |
| 190 | 0.49808 | 154 174 | 21 | 0.07405 | 100 | 74 | 0.06689 | 100 | 76 |
| 191 | 0.39324 | 174 | 36 | 0.13382 | 100 | 30 | 0.17292 | 100 | 32 |
| 192 | 0.28529 | 14 174 | 45 | 0.09595 | 100 | 48 | 0.12119 | 46 | 47 |
| 193 | 0.28315 | 174 | 47 | 0.08454 | 100 | 60 | 0.06802 | 100 | 74 |
| 194 | 0.23248 | 174 | 56 | 0.11563 | 100 | 35 | 0.08797 | 100 | 63 |
| 196 | 0.01937 | 15 174 | 91 | 0.56400 | 100 | 3 | 0.56694 | 46 | 6 |
| 197 | 0.32582 | 15 174 | 42 | 0.11451 | 100 | 36 | 0.13962 | 100 | 39 |
| 198 | 1.00000 | 198 | 1 | 0.10335 | 100 | 41 | 0.13824 | 100 | 40 |
| 200 | 0.10051 | 14 174 | 81 | 0.18564 | 100 | 16 | 0.34346 | 103 | 12 |
| 203 | 0.06892 | 15 174 | 86 | 0.22949 | 100 | 7 | 0.26175 | 100 | 21 |
| 204 | 0.41712 | 14 174 | 31 | 0.12076 | 100 | 34 | 0.11325 | 100 | 50 |
| 206 | 0.19500 | 15 174 | 61 | 0.13368 | 100 | 31 | 0.15593 | 100 | 36 |
| 207 | 0.09353 | 14 174 | 83 | 0.16322 | 100 | 21 | 0.12223 | 100 | 46 |
| 210 | 1.00000 | 210 | 1 | 0.14436 | 100 | 26 | 0.26583 | 100 | 18 |
| 217 | 1.00000 | 217 | 1 | 0.27604 | 100 | 6 | 1.00000 | 217 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-A-5** SBM-efficiency under CRS for 2009

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | SBM | Ref. | Rank | SBM | Ref. | Rank | SBM | Ref. | Rank |
| 2 | 0.40521 | 7 14 76 | 42 | 0.14137 | 196 | 76 | 0.06684 | 100 | 74 |
| 4 | 1.00000 | 4 | 1 | 0.09835 | 196 | 90 | 0.07747 | 100 | 64 |
| 6 | 0.13156 | 14 50 76 | 82 | 0.21464 | 196 | 34 | 0.09868 | 100 | 55 |
| 7 | 1.00000 | 7 | 1 | 0.15481 | 196 | 66 | 0.08650 | 100 | 59 |
| 9 | 0.23876 | 76 | 65 | 0.24172 | 196 | 23 | 0.23953 | 100 | 19 |
| 12 | 0.63083 | 14 46 | 25 | 0.00009 | 196 | 94 | 0.00002 | 100 | 95 |
| 14 | 1.00000 | 14 | 1 | 0.00003 | 196 | 95 | 0.24104 | 100 | 18 |
| 15 | 0.24576 | 14 46 | 61 | 1.00000 | 15 | 1 | 0.05933 | 100 | 83 |
| 20 | 0.21855 | 14 46 51 | 69 | 0.18649 | 196 | 49 | 0.23018 | 100 | 20 |
| 21 | 0.23710 | 14 46 | 66 | 0.19100 | 196 | 45 | 0.11611 | 100 | 49 |
| 24 | 0.25751 | 14 46 76 | 57 | 0.14132 | 196 | 77 | 0.06891 | 100 | 72 |
| 29 | 0.38650 | 45 76 131 | 45 | 0.14545 | 196 | 71 | 0.07943 | 100 | 62 |
| 31 | 0.51517 | 7 14 50 51 | 32 | 0.29884 | 196 | 18 | 0.07714 | 100 | 65 |
| 34 | 0.14753 | 14 76 | 79 | 0.15801 | 196 | 64 | 0.08981 | 100 | 57 |
| 35 | 0.56053 | 46 76 210 | 28 | 0.15662 | 196 | 65 | 0.10771 | 100 | 52 |
| 36 | 0.06559 | 46 76 | 89 | 0.44315 | 196 | 11 | 0.31329 | 100 | 14 |
| 37 | 0.24667 | 14 46 76 | 60 | 0.17962 | 196 | 51 | 0.11910 | 100 | 48 |
| 38 | 0.04226 | 14 50 76 | 90 | 0.14600 | 196 | 70 | 0.06778 | 100 | 73 |
| 40 | 0.12595 | 45 46 76 100 | 84 | 0.34411 | 196 | 15 | 0.29908 | 100 | 15 |
| 43 | 0.64348 | 7 14 76 128 | 24 | 0.18516 | 196 | 50 | 0.07326 | 100 | 68 |
| 45 | 1.00000 | 45 | 1 | 0.19426 | 196 | 43 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 0.60339 | 100 | 7 |
| 47 | 0.38456 | 14 46 50 76 | 46 | 0.17026 | 196 | 53 | 0.08880 | 100 | 58 |
| 49 | 0.18292 | 46 76 | 75 | 0.21968 | 196 | 30 | 0.14272 | 100 | 37 |
| 50 | 1.00000 | 50 | 1 | 0.40832 | 196 | 13 | 0.26275 | 100 | 16 |
| 51 | 1.00000 | 51 | 1 | 0.23329 | 196 | 26 | 0.13888 | 100 | 38 |
| 53 | 0.03428 | 45 76 | 92 | 1.00000 | 53 | 1 | 0.35490 | 100 | 11 |
| 55 | 1.00000 | 55 | 1 | 0.11516 | 196 | 89 | 0.12805 | 100 | 42 |
| 57 | 0.36334 | 46 76 210 | 48 | 0.21488 | 196 | 33 | 0.18196 | 100 | 27 |
| 58 | 0.39576 | 14 46 51 | 43 | 0.13294 | 196 | 84 | 0.16127 | 100 | 33 |
| 61 | 0.19978 | 14 50 76 | 73 | 0.13415 | 196 | 82 | 0.00117 | 100 | 94 |
| 62 | 1.00000 | 62 | 1 | 0.21576 | 196 | 32 | 0.17493 | 100 | 28 |
| 63 | 0.45249 | 14 46 51 | 38 | 0.09070 | 196 | 91 | 0.01846 | 100 | 93 |
| 69 | 0.03591 | 45 46 76 | 91 | 0.78075 | 46 53 196 | 10 | 0.32852 | 100 | 13 |
| 71 | 0.70489 | 7 14 50 76 | 22 | 0.15199 | 196 | 68 | 0.12169 | 100 | 46 |
| 76 | 1.00000 | 76 | 1 | 0.16795 | 196 | 54 | 0.12508 | 100 | 44 |
| 78 | 0.30618 | 46 76 | 53 | 0.19213 | 196 | 44 | 0.14369 | 100 | 36 |
| 83 | 0.37017 | 14 46 50 76 | 47 | 0.12291 | 196 | 87 | 0.04583 | 100 | 90 |
| 84 | 0.46416 | 14 46 51 | 36 | 0.19749 | 196 | 40 | 0.17140 | 100 | 30 |
| 85 | 0.52118 | 14 46 51 | 31 | 0.08841 | 196 | 92 | 0.07218 | 100 | 69 |
| 86 | 0.48328 | 14 46 51 | 34 | 0.17899 | 196 | 52 | 0.06392 | 100 | 77 |
| 93 | 0.14737 | 14 50 76 | 80 | 0.29418 | 196 | 20 | 0.19697 | 100 | 26 |
| 95 | 0.60825 | 7 14 46 50 51 140 | 26 | 0.14857 | 196 | 69 | 0.06981 | 100 | 70 |
| 98 | 0.15652 | 7 14 76 | 78 | 0.22425 | 196 | 29 | 0.09003 | 100 | 56 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.18388 | 76 | 74 | 0.15821 | 196 | 63 | 1.00000 | 103 | 1 |
| 105 | 0.01502 | 14 46 | 94 | 0.21197 | 196 | 35 | 0.04605 | 100 | 89 |
| 110 | 0.34448 | 7 14 50 76 | 49 | 0.14326 | 196 | 73 | 0.07889 | 100 | 63 |
| 113 | 0.17287 | 14 51 | 76 | 0.13521 | 196 | 81 | 0.04774 | 100 | 87 |
| 115 | 0.08306 | 46 50 76 100 | 86 | 0.32520 | 196 | 16 | 0.17193 | 100 | 29 |
| 121 | 0.24066 | 14 46 50 | 64 | 0.14466 | 196 | 72 | 0.06331 | 100 | 79 |
| 125 | 0.00176 | 14 46 | 95 | 0.92911 | 46 53 196 | 8 | 1.00000 | 125 | 1 |
| 126 | 0.24345 | 46 76 | 63 | 0.16061 | 196 | 61 | 0.12112 | 100 | 47 |
| 127 | 1.00000 | 127 | 1 | 0.14041 | 196 | 78 | 0.06583 | 100 | 75 |
| 128 | 1.00000 | 128 | 1 | 0.02592 | 196 | 93 | 0.02722 | 100 | 92 |
| 130 | 0.85387 | 7 14 51 128 140 | 21 | 0.15991 | 196 | 62 | 0.05414 | 100 | 84 |
| 131 | 1.00000 | 131 | 1 | 0.18828 | 196 | 48 | 0.83185 | 45 100 217 | 6 |
| 132 | 0.25683 | 76 | 58 | 0.16460 | 196 | 59 | 0.06399 | 100 | 76 |
| 133 | 0.20976 | 45 46 76 | 71 | 0.30729 | 196 | 17 | 0.25524 | 100 | 17 |
| 137 | 0.25320 | 46 76 | 59 | 0.20871 | 196 | 37 | 0.21064 | 100 | 23 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 139 | 0.45351 | 46 76 210 | 37 | 0.24574 | 196 | 22 | 0.34998 | 100 | 12 |
| 140 | 1.00000 | 140 | 1 | 0.13995 | 196 | 79 | 0.04534 | 100 | 91 |
| 142 | 0.28848 | 14 46 51 | 56 | 0.12292 | 196 | 86 | 0.06106 | 100 | 82 |
| 152 | 1.00000 | 152 | 1 | 0.43377 | 196 | 12 | 0.37313 | 100 | 10 |
| 154 | 0.65242 | 14 46 76 | 23 | 0.15444 | 196 | 67 | 0.06351 | 100 | 78 |
| 156 | 0.29329 | 50 76 | 55 | 0.18926 | 196 | 46 | 0.12481 | 100 | 45 |
| 159 | 0.21585 | 14 46 76 | 70 | 0.18860 | 196 | 47 | 0.11241 | 100 | 50 |
| 160 | 0.31310 | 14 46 76 | 51 | 0.21135 | 196 | 36 | 0.13288 | 100 | 41 |
| 161 | 0.54754 | 14 50 76 | 30 | 0.14168 | 196 | 75 | 0.06268 | 100 | 80 |
| 162 | 0.47966 | 14 46 76 | 35 | 0.12123 | 196 | 88 | 0.07697 | 100 | 66 |
| 163 | 0.41834 | 7 14 50 76 | 40 | 0.13196 | 196 | 85 | 0.05326 | 100 | 85 |
| 168 | 0.20792 | 46 76 | 72 | 0.20162 | 196 | 38 | 0.16093 | 100 | 34 |
| 173 | 0.40896 | 14 50 51 | 41 | 0.16598 | 196 | 57 | 0.04681 | 100 | 88 |
| 174 | 1.00000 | 174 | 1 | 0.28618 | 196 | 21 | 0.22081 | 100 | 22 |
| 176 | 0.58569 | 14 50 51 76 | 27 | 0.16460 | 196 | 58 | 0.07694 | 100 | 67 |
| 177 | 0.12601 | 14 50 76 | 83 | 0.23625 | 196 | 25 | 0.12704 | 100 | 43 |
| 182 | 0.38700 | 14 50 76 | 44 | 0.14183 | 196 | 74 | 0.06908 | 100 | 71 |
| 185 | 0.32710 | 14 51 | 50 | 0.13941 | 196 | 80 | 0.04822 | 100 | 86 |
| 190 | 0.49875 | 7 14 50 76 | 33 | 0.13383 | 196 | 83 | 0.06186 | 100 | 81 |
| 191 | 0.55086 | 46 76 174 | 29 | 0.21636 | 196 | 31 | 0.22495 | 100 | 21 |
| 192 | 0.15836 | 14 50 76 | 77 | 0.19708 | 196 | 41 | 0.10456 | 100 | 54 |
| 193 | 1.00000 | 193 | 1 | 0.16678 | 196 | 56 | 0.08055 | 100 | 61 |
| 194 | 0.42958 | 46 76 210 | 39 | 0.16364 | 196 | 60 | 0.10909 | 100 | 51 |
| 195 | 0.30678 | 46 76 210 | 52 | 0.16712 | 196 | 55 | 0.08512 | 100 | 60 |
| 196 | 0.02243 | 14 46 76 | 93 | 1.00000 | 196 | 1 | 0.53158 | 100 | 8 |
| 197 | 0.30023 | 45 76 174 | 54 | 0.24011 | 196 | 24 | 0.15332 | 100 | 35 |
| 198 | 0.22702 | 14 46 50 76 | 68 | 0.20008 | 196 | 39 | 0.10700 | 100 | 53 |
| 200 | 0.11143 | 14 46 | 85 | 0.29435 | 196 | 19 | 0.16554 | 100 | 32 |
| 203 | 0.07050 | 45 46 76 | 88 | 0.37516 | 196 | 14 | 0.20074 | 100 | 25 |
| 204 | 0.24552 | 14 46 76 | 62 | 0.22747 | 196 | 28 | 0.13595 | 100 | 39 |
| 206 | 0.14670 | 45 46 76 | 81 | 0.23200 | 196 | 27 | 0.16866 | 100 | 31 |
| 207 | 0.08097 | 14 46 76 | 87 | 1.00000 | 207 | 1 | 0.13347 | 100 | 40 |
| 210 | 1.00000 | 210 | 1 | 0.19581 | 196 | 42 | 0.20425 | 100 | 24 |
| 217 | 1.00000 | 217 | 1 | 0.90675 | 46 53 196 | 9 | 1.00000 | 217 | 1 |
| 221 | 0.23553 | 50 76 174 | 67 | 1.00000 | 221 | 1 | 0.45852 | 100 103 | 9 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

# Appendix B

**Table I-B-1** SBM-efficiency under VRS for 2005

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | SBM | Ref. | Rank | SBM | Ref. | Rank | SBM | Ref. | Rank |
| 1 | 0.39734 | 50 161 | 87 | 0.11066 | 59 185 | 102 | 0.05293 | 196 200 | 100 |
| 2 | 0.43260 | 12 53 177 | 81 | 0.37702 | 59 142 | 61 | 0.04981 | 100 205 | 101 |
| 4 | 0.45433 | 14 161 | 76 | 0.76897 | 58 59 185 | 27 | 0.25024 | 84 103 | 44 |
| 6 | 1.00000 | 6 | 1 | 0.18046 | 59 103 | 94 | 0.11683 | 125 196 | 75 |
| 7 | 1.00000 | 7 | 1 | 0.15148 | 59 103 | 100 | 0.11135 | 100 200 | 78 |
| 9 | 0.34252 | 12 50 174 177 | 92 | 0.22094 | 59 103 | 84 | 0.34215 | 196 200 | 35 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.63988 | 12 161 | 53 | 0.32240 | 58 59 | 71 | 0.16568 | 103 200 | 60 |
| 20 | 0.51692 | 12 161 | 65 | 0.39990 | 58 59 | 53 | 0.50334 | 84 103 | 26 |
| 21 | 0.28622 | 14 50 161 | 94 | 0.19362 | 59 103 | 92 | 0.21484 | 125 196 | 53 |
| 24 | 0.43524 | 12 177 | 80 | 1.00000 | 24 | 1 | 0.07816 | 196 200 | 94 |
| 29 | 0.46306 | 12 43 177 | 74 | 0.20280 | 59 103 | 89 | 0.17983 | 196 200 | 58 |
| 31 | 0.68268 | 12 53 177 | 50 | 0.38048 | 59 103 | 60 | 0.08929 | 100 205 | 90 |
| 34 | 0.25772 | 174 177 | 97 | 0.54161 | 59 142 | 37 | 0.10711 | 196 200 | 82 |
| 35 | 0.85435 | 12 53 160 176 177 | 42 | 0.20474 | 59 103 | 87 | 0.10534 | 100 196 | 84 |
| 36 | 1.00000 | 36 | 1 | 0.52594 | 40 46 | 40 | 0.37625 | 100 196 | 31 |
| 37 | 0.47087 | 12 53 174 177 205 | 73 | 0.66741 | 40 103 205 | 31 | 0.29904 | 196 200 | 38 |
| 38 | 0.27465 | 12 50 51 154 161 | 96 | 0.38737 | 59 142 | 59 | 0.52222 | 125 196 200 | 25 |
| 40 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.54122 | 50 100 174 | 61 | 0.53447 | 46 60 | 39 | 0.34557 | 100 196 | 34 |
| 43 | 1.00000 | 43 | 1 | 0.16138 | 59 103 | 98 | 0.08579 | 100 200 | 91 |
| 45 | 0.59579 | 12 174 177 | 57 | 0.21028 | 59 103 | 86 | 0.54787 | 196 200 | 23 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.48506 | 161 176 | 71 | 0.50658 | 59 185 | 41 | 0.09238 | 196 200 | 88 |
| 49 | 0.50229 | 12 40 53 174 | 69 | 0.29527 | 40 46 | 75 | 0.23770 | 100 196 | 48 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 | 0.23416 | 100 189 | 49 |
| 51 | 1.00000 | 51 | 1 | 0.35387 | 59 103 | 64 | 0.14536 | 100 196 | 69 |
| 53 | 1.00000 | 53 | 1 | 0.66795 | 46 60 196 | 30 | 0.31657 | 100 189 | 36 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 | 0.62299 | 14 84 103 | 21 |
| 57 | 0.33242 | 12 174 | 93 | 0.45973 | 40 46 | 47 | 0.19057 | 100 196 | 57 |
| 58 | 0.73505 | 12 161 | 46 | 1.00000 | 58 | 1 | 0.27174 | 84 103 | 40 |
| 59 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 |
| 60 | 0.15875 | 46 50 | 101 | 1.00000 | 60 | 1 | 0.43364 | 125 196 | 29 |
| 61 | 0.39978 | 50 161 | 86 | 0.71508 | 59 60 142 | 29 | 0.03559 | 100 196 | 102 |
| 62 | 1.00000 | 62 | 1 | 0.20441 | 59 103 | 88 | 0.24854 | 196 200 | 45 |
| 63 | 0.81975 | 12 43 161 | 44 | 0.55047 | 58 59 | 36 | 0.05347 | 100 200 | 99 |
| 69 | 1.00000 | 69 | 1 | 0.45020 | 46 60 196 | 48 | 0.25188 | 100 189 | 42 |
| 71 | 1.00000 | 71 | 1 | 0.19410 | 59 185 | 91 | 0.15232 | 100 200 | 67 |
| 73 | 0.71778 | 12 43 174 177 | 47 | 0.39312 | 59 142 | 57 | 0.19414 | 100 205 | 55 |
| 75 | 0.50137 | 12 161 | 70 | 0.16392 | 58 59 | 97 | 0.06363 | 196 200 | 96 |
| 76 | 1.00000 | 76 | 1 | 0.17941 | 59 103 | 95 | 0.47644 | 196 200 | 28 |
| 78 | 0.44371 | 12 174 177 | 78 | 0.33894 | 40 46 | 68 | 0.16206 | 100 196 | 61 |
| 83 | 0.64544 | 12 55 128 161 | 52 | 0.56196 | 58 59 185 | 35 | 0.10991 | 196 200 | 79 |
| 84 | 0.50361 | 14 161 | 67 | 0.43501 | 58 185 | 49 | 1.00000 | 84 | 1 |
| 85 | 0.52525 | 12 161 | 64 | 0.39907 | 59 142 | 55 | 0.19952 | 103 200 | 54 |
| 86 | 0.50323 | 161 | 68 | 0.23866 | 59 185 | 81 | 0.47850 | 103 200 | 27 |
| 93 | 0.51361 | 50 51 53 161 | 66 | 0.46400 | 59 142 | 45 | 0.16004 | 46 100 | 64 |
| 95 | 0.77266 | 50 55 161 | 45 | 0.64414 | 58 59 185 | 32 | 0.52372 | 103 200 | 24 |
| 98 | 0.42659 | 12 50 154 160 | 83 | 0.18227 | 59 103 | 93 | 0.36779 | 196 200 | 33 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 1.00000 | 102 | 1 | 0.65068 | 100 196 | 19 |
| 103 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.43223 | 12 50 154 177 | 82 | 1.00000 | 105 | 1 | 1.00000 | 105 | 1 |
| 110 | 0.63046 | 50 161 | 55 | 0.28034 | 59 103 | 76 | 0.12674 | 196 200 | 72 |
| 113 | 0.25329 | 50 161 | 98 | 0.53917 | 59 103 185 | 38 | 1.00000 | 113 | 1 |
| 115 | 0.43550 | 174 | 79 | 0.36456 | 46 60 | 62 | 0.19154 | 100 196 | 56 |
| 121 | 0.27722 | 161 176 | 95 | 0.19692 | 59 185 | 90 | 0.10675 | 196 200 | 83 |
| 123 | 0.23727 | 12 50 53 | 99 | 0.35161 | 40 46 | 65 | 0.11453 | 100 196 | 76 |
| 125 | 0.12736 | 14 50 | 102 | 0.47350 | 46 59 | 44 | 1.00000 | 125 | 1 |
| 126 | 0.45257 | 12 174 177 | 77 | 0.24914 | 40 46 | 80 | 0.12967 | 100 196 | 71 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 127 | 1.00000 | 127 | 1 | 0.21689 | 58 59 | 85 | 0.16059 | 196 200 | 63 |
| 128 | 1.00000 | 128 | 1 | 0.47383 | 58 59 | 43 | 0.13142 | 103 200 | 70 |
| 130 | 1.00000 | 130 | 1 | 0.31322 | 59 185 | 73 | 0.10521 | 100 200 | 85 |
| 131 | 0.22256 | 12 205 | 100 | 0.33505 | 40 46 | 70 | 0.63202 | 125 196 200 | 20 |
| 132 | 0.39645 | 12 50 176 | 88 | 0.22471 | 59 103 | 83 | 0.15230 | 196 200 | 68 |
| 133 | 0.60323 | 53 174 205 | 56 | 0.39218 | 40 46 | 58 | 0.26029 | 100 196 | 41 |
| 137 | 0.38743 | 12 174 | 89 | 0.27511 | 40 46 | 77 | 0.39163 | 196 200 | 30 |
| 138 | 1.00000 | 138 | 1 | 1.00000 | 138 | 1 | 0.74146 | 100 152 205 | 18 |
| 139 | 0.39993 | 12 50 53 177 | 85 | 0.31554 | 40 59 | 72 | 0.61212 | 196 200 | 22 |
| 140 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 | 0.09337 | 100 200 | 87 |
| 142 | 0.36315 | 50 161 | 91 | 1.00000 | 142 | 1 | 0.11308 | 196 200 | 77 |
| 152 | 1.00000 | 152 | 1 | 0.42990 | 60 196 | 50 | 1.00000 | 152 | 1 |
| 154 | 1.00000 | 154 | 1 | 0.39942 | 58 59 | 54 | 0.06079 | 100 200 | 97 |
| 156 | 0.46183 | 12 174 | 75 | 0.25291 | 40 46 | 79 | 0.11686 | 100 196 | 74 |
| 159 | 1.00000 | 159 | 1 | 0.46162 | 40 46 59 | 46 | 0.10955 | 100 189 | 80 |
| 160 | 1.00000 | 160 | 1 | 0.34062 | 40 46 | 67 | 0.16094 | 100 196 | 62 |
| 161 | 1.00000 | 161 | 1 | 0.22820 | 59 142 | 82 | 0.10748 | 196 200 | 81 |
| 162 | 1.00000 | 162 | 1 | 0.73793 | 58 59 103 163 | 28 | 0.22061 | 100 200 | 51 |
| 163 | 1.00000 | 163 | 1 | 1.00000 | 163 | 1 | 0.07851 | 100 200 | 93 |
| 164 | 0.64881 | 40 46 53 100 174 | 51 | 1.00000 | 164 | 1 | 1.00000 | 164 | 1 |
| 168 | 0.41372 | 12 174 | 84 | 0.35529 | 59 60 | 63 | 0.24481 | 125 196 | 46 |
| 173 | 0.38499 | 12 50 53 177 | 90 | 0.12893 | 59 142 | 101 | 0.05623 | 100 196 | 98 |
| 174 | 1.00000 | 174 | 1 | 0.50328 | 40 46 | 42 | 0.37185 | 100 205 | 32 |
| 176 | 1.00000 | 176 | 1 | 0.17768 | 59 103 | 96 | 0.09046 | 100 200 | 89 |
| 177 | 1.00000 | 177 | 1 | 0.34543 | 59 103 | 66 | 0.11894 | 100 200 | 73 |
| 182 | 0.58070 | 12 53 176 177 | 58 | 0.15336 | 59 103 | 99 | 0.10488 | 196 200 | 86 |
| 185 | 0.54027 | 12 50 154 160 | 62 | 1.00000 | 185 | 1 | 0.31444 | 196 200 | 37 |
| 189 | 0.47989 | 100 205 | 72 | 1.00000 | 189 | 1 | 1.00000 | 189 | 1 |
| 190 | 0.63170 | 12 50 53 176 177 | 54 | 0.42191 | 59 103 | 51 | 0.08577 | 196 200 | 92 |
| 191 | 0.53021 | 12 174 | 63 | 0.31025 | 40 46 | 74 | 0.24122 | 100 196 | 47 |
| 192 | 1.00000 | 192 | 1 | 1.00000 | 192 | 1 | 0.17446 | 196 200 | 59 |
| 193 | 1.00000 | 193 | 1 | 0.27291 | 59 103 | 78 | 0.06393 | 100 196 | 95 |
| 194 | 0.82670 | 12 43 152 174 198 | 43 | 0.39790 | 59 103 | 56 | 0.22137 | 100 200 | 50 |
| 195 | 1.00000 | 195 | 1 | 1.00000 | 195 | 1 | 0.28930 | 100 196 | 39 |
| 196 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.69078 | 53 174 177 | 49 | 0.33874 | 40 46 | 69 | 0.15604 | 100 196 | 66 |
| 198 | 1.00000 | 198 | 1 | 0.40775 | 192 205 | 52 | 0.15979 | 100 196 | 65 |
| 200 | 0.57467 | 14 50 53 161 174 | 60 | 0.81630 | 40 59 103 | 26 | 1.00000 | 200 | 1 |
| 202 | 0.69576 | 50 53 | 48 | 0.59748 | 40 46 59 | 34 | 0.25188 | 100 189 | 43 |
| 205 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 |
| 206 | 0.57683 | 53 152 174 205 | 59 | 0.60397 | 40 46 196 | 33 | 0.22016 | 100 196 | 52 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under VRS (Equation I.15 with the restriction $\sum_j \lambda_j = 1$ proposed by Banker et al. (1984) in the called BCC model). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-B-2** SBM-efficiency under VRS for 2006

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.45883 | 12 174 177 | 61 | 0.31221 | 105 196 | 79 | 0.06105 | 100 205 | 98 |
| 4 | 0.43956 | 14 51 127 | 64 | 1.00000 | 4 | 1 | 0.20302 | 40 103 | 60 |
| 6 | 0.34865 | 14 174 | 84 | 0.40960 | 105 196 | 58 | 0.17303 | 100 125 | 62 |
| 7 | 0.81226 | 51 53 154 163 | 37 | 0.19971 | 83 196 | 98 | 0.12452 | 100 103 | 79 |
| 9 | 0.21509 | 12 140 174 | 96 | 0.38067 | 105 203 | 63 | 0.37212 | 100 103 | 35 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 | 0.73274 | 14 103 | 20 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.67038 | 12 51 127 128 161 | 41 | 1.00000 | 15 | 1 | 0.13084 | 40 103 | 77 |
| 20 | 0.55084 | 12 51 127 | 50 | 0.24677 | 83 202 | 93 | 0.32489 | 100 103 | 39 |
| 21 | 0.24959 | 14 51 53 | 91 | 1.00000 | 21 | 1 | 0.29431 | 40 103 | 42 |
| 24 | 0.43343 | 12 177 205 | 66 | 0.54860 | 105 196 | 41 | 0.10677 | 100 200 | 88 |
| 29 | 1.00000 | 29 | 1 | 0.28144 | 83 196 | 86 | 0.28382 | 100 200 | 43 |
| 31 | 0.84179 | 12 53 154 163 205 | 35 | 1.00000 | 31 | 1 | 0.16161 | 100 103 | 69 |
| 34 | 0.18767 | 12 205 | 99 | 1.00000 | 34 | 1 | 0.09654 | 46 100 | 92 |
| 35 | 0.53036 | 12 174 177 | 52 | 0.30998 | 105 196 | 80 | 0.11282 | 100 200 | 84 |
| 36 | 0.61302 | 46 100 174 205 | 44 | 0.46132 | 196 203 | 48 | 0.48417 | 100 200 | 27 |
| 37 | 0.40213 | 12 174 205 | 72 | 0.56139 | 196 204 | 40 | 0.35981 | 100 200 | 36 |
| 38 | 0.21763 | 12 53 128 | 95 | 0.32626 | 105 196 | 74 | 0.54696 | 100 125 200 | 24 |
| 40 | 0.48331 | 14 46 100 205 | 56 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.46173 | 46 100 174 | 59 | 0.42326 | 105 203 | 55 | 0.57538 | 100 125 200 | 22 |
| 43 | 1.00000 | 43 | 1 | 0.15924 | 83 196 | 101 | 0.08950 | 100 200 | 94 |
| 45 | 0.52066 | 12 174 177 | 54 | 0.22665 | 105 196 | 96 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.42104 | 12 51 | 68 | 0.26011 | 105 196 | 91 | 0.13144 | 100 103 | 76 |
| 49 | 0.33546 | 12 174 | 85 | 0.26657 | 196 203 | 89 | 0.39234 | 100 200 | 32 |
| 50 | 1.00000 | 50 | 1 | 0.78554 | 60 105 196 | 27 | 0.31128 | 100 205 | 40 |
| 51 | 1.00000 | 51 | 1 | 0.28786 | 105 203 | 85 | 0.17301 | 100 200 | 63 |
| 53 | 1.00000 | 53 | 1 | 0.51272 | 60 196 203 | 44 | 0.38294 | 100 205 | 34 |
| 55 | 1.00000 | 55 | 1 | 0.43451 | 15 196 | 52 | 0.38677 | 40 103 | 33 |
| 57 | 0.34962 | 12 174 205 | 83 | 0.62217 | 196 204 | 34 | 0.24408 | 100 200 | 49 |
| 58 | 0.74253 | 12 51 128 161 | 38 | 0.67805 | 14 83 202 | 31 | 0.27602 | 40 103 | 45 |
| 59 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 |
| 60 | 0.19902 | 203 205 | 98 | 1.00000 | 60 | 1 | 1.00000 | 60 | 1 |
| 61 | 0.25872 | 14 51 53 | 90 | 0.52730 | 105 196 | 42 | 0.12012 | 100 125 | 81 |
| 62 | 1.00000 | 62 | 1 | 0.45747 | 105 196 | 50 | 0.27787 | 100 200 | 44 |
| 63 | 0.73606 | 12 51 154 163 205 | 40 | 1.00000 | 63 | 1 | 0.05821 | 100 103 | 101 |
| 69 | 0.41408 | 174 205 | 70 | 0.31333 | 196 203 | 78 | 0.33400 | 100 205 | 37 |
| 71 | 1.00000 | 71 | 1 | 0.49325 | 105 196 | 47 | 0.08687 | 100 103 | 95 |
| 75 | 0.41580 | 12 51 | 69 | 0.40463 | 105 196 | 59 | 0.05873 | 100 103 | 100 |
| 76 | 0.65384 | 55 174 177 | 42 | 0.31517 | 105 196 | 77 | 0.48498 | 100 103 | 26 |
| 78 | 0.47813 | 12 174 198 | 58 | 0.34898 | 196 204 | 67 | 0.23014 | 100 200 | 53 |
| 83 | 0.82218 | 12 51 55 127 | 36 | 1.00000 | 83 | 1 | 0.14160 | 100 103 | 72 |
| 84 | 0.52870 | 14 51 127 | 53 | 0.42498 | 83 202 | 53 | 1.00000 | 84 | 1 |
| 85 | 0.57413 | 12 14 51 127 | 48 | 1.00000 | 85 | 1 | 0.14950 | 40 103 | 71 |
| 86 | 0.59759 | 12 51 154 163 | 46 | 0.59068 | 15 105 196 | 38 | 0.46582 | 100 103 | 29 |
| 93 | 0.35722 | 14 53 174 | 80 | 0.59413 | 105 203 | 36 | 0.16837 | 46 100 | 66 |
| 95 | 0.48326 | 12 14 51 | 57 | 0.32196 | 105 196 | 75 | 0.45918 | 100 103 | 30 |
| 98 | 0.35958 | 12 51 53 | 79 | 0.15592 | 196 | 102 | 0.43898 | 100 200 | 31 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 0.59282 | 60 203 | 37 | 1.00000 | 102 | 1 |
| 103 | 0.23983 | 51 53 55 | 92 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.15206 | 12 53 205 | 101 | 1.00000 | 105 | 1 | 1.00000 | 105 | 1 |
| 110 | 0.51753 | 12 51 | 55 | 0.21797 | 83 196 | 97 | 0.18258 | 100 103 | 61 |
| 113 | 0.23335 | 12 14 51 | 94 | 0.24035 | 105 196 | 94 | 0.05560 | 125 164 | 102 |
| 115 | 0.35240 | 174 | 82 | 0.27513 | 196 203 | 88 | 0.22152 | 100 200 | 55 |
| 121 | 0.23817 | 12 51 | 93 | 0.26370 | 83 202 | 90 | 0.10752 | 100 103 | 87 |
| 123 | 0.21151 | 12 53 | 97 | 0.34524 | 105 203 | 68 | 0.12162 | 100 200 | 80 |
| 125 | 0.15186 | 53 59 | 102 | 0.49352 | 105 203 | 46 | 1.00000 | 125 | 1 |
| 126 | 0.35556 | 12 53 174 205 | 81 | 0.38279 | 105 196 | 62 | 0.17156 | 100 200 | 65 |
| 127 | 1.00000 | 127 | 1 | 0.15938 | 105 196 | 100 | 0.11483 | 100 103 | 83 |
| 128 | 1.00000 | 128 | 1 | 0.25199 | 83 202 | 92 | 0.13745 | 40 103 | 74 |
| 130 | 1.00000 | 130 | 1 | 0.18229 | 196 202 | 99 | 0.10772 | 100 103 | 86 |
| 131 | 0.17911 | 12 205 | 100 | 0.32898 | 196 203 | 72 | 1.00000 | 131 | 1 |
| 132 | 0.45214 | 12 51 177 205 | 63 | 0.44244 | 83 196 | 51 | 0.23492 | 100 200 | 52 |
| 133 | 0.42338 | 46 174 205 | 67 | 0.40250 | 196 203 | 60 | 0.25349 | 100 | 48 |
| 137 | 0.29418 | 12 174 | 87 | 0.27940 | 196 203 | 87 | 0.53930 | 100 200 | 25 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 139 | 0.39906 | 14 53 59 | 73 | 0.36266 | 196 203 | 64 | 0.59504 | 100 200 | 21 |
| 140 | 1.00000 | 140 | 1 | 0.51538 | 83 202 | 43 | 0.13933 | 100 103 | 73 |
| 142 | 0.27431 | 12 51 | 88 | 0.71522 | 15 34 105 196 | 29 | 0.10126 | 100 200 | 90 |
| 152 | 1.00000 | 152 | 1 | 1.00000 | 152 | 1 | 0.47039 | 100 200 | 28 |
| 154 | 1.00000 | 154 | 1 | 0.33533 | 83 196 | 71 | 0.06088 | 100 103 | 99 |
| 156 | 0.36219 | 12 174 | 78 | 0.34349 | 105 196 | 70 | 0.11174 | 100 200 | 85 |
| 159 | 0.31987 | 12 174 205 | 86 | 0.35959 | 196 204 | 66 | 0.09153 | 100 200 | 93 |
| 160 | 1.00000 | 160 | 1 | 0.30180 | 196 204 | 81 | 0.21533 | 100 200 | 57 |
| 161 | 1.00000 | 161 | 1 | 0.68683 | 15 105 196 | 30 | 0.13068 | 100 103 | 78 |
| 162 | 0.54232 | 12 14 51 140 177 | 51 | 0.50372 | 105 196 | 45 | 0.25963 | 100 103 | 46 |
| 163 | 1.00000 | 163 | 1 | 0.41717 | 83 196 | 57 | 0.07382 | 100 103 | 97 |
| 164 | 0.57498 | 46 205 | 47 | 1.00000 | 164 | 1 | 1.00000 | 164 | 1 |
| 168 | 0.27328 | 50 174 | 89 | 0.78285 | 34 105 152 | 28 | 0.30055 | 100 200 | 41 |
| 173 | 0.43382 | 12 177 205 | 65 | 0.30042 | 83 196 | 82 | 0.10138 | 100 200 | 89 |
| 174 | 1.00000 | 174 | 1 | 0.38546 | 196 203 | 61 | 0.32698 | 100 205 | 38 |
| 176 | 0.86840 | 51 55 140 174 177 | 34 | 0.34456 | 105 196 | 69 | 0.09672 | 100 200 | 91 |
| 177 | 1.00000 | 177 | 1 | 0.23325 | 105 196 | 95 | 0.20325 | 100 200 | 59 |
| 182 | 0.64430 | 12 51 154 163 177 | 43 | 0.29979 | 83 196 | 83 | 0.17212 | 100 103 | 64 |
| 185 | 0.39705 | 12 53 59 | 74 | 1.00000 | 185 | 1 | 0.16245 | 40 103 | 68 |
| 190 | 0.46094 | 12 51 177 205 | 60 | 0.36108 | 83 196 | 65 | 0.11544 | 100 200 | 82 |
| 191 | 0.45374 | 12 174 | 62 | 0.32728 | 105 203 | 73 | 0.20589 | 100 200 | 58 |
| 192 | 0.60508 | 14 55 161 174 | 45 | 0.45913 | 196 204 | 49 | 0.21577 | 100 200 | 56 |
| 193 | 1.00000 | 193 | 1 | 0.29092 | 105 196 | 84 | 0.07620 | 100 200 | 96 |
| 194 | 1.00000 | 194 | 1 | 0.65016 | 83 196 204 | 32 | 0.25779 | 100 103 | 47 |
| 195 | 0.39469 | 46 174 205 | 75 | 1.00000 | 195 | 1 | 0.24303 | 100 200 | 50 |
| 196 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 | 0.91253 | 100 164 | 19 |
| 197 | 0.41165 | 12 174 | 71 | 0.31801 | 196 204 | 76 | 0.13588 | 100 205 | 75 |
| 198 | 1.00000 | 198 | 1 | 0.62416 | 83 196 202 | 33 | 0.15961 | 100 205 | 70 |
| 200 | 0.57188 | 14 50 53 174 | 49 | 0.41843 | 103 196 | 56 | 1.00000 | 200 | 1 |
| 202 | 1.00000 | 202 | 1 | 1.00000 | 202 | 1 | 0.23816 | 100 205 | 51 |
| 203 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 1.00000 | 204 | 1 | 1.00000 | 204 | 1 | 0.16524 | 100 103 | 67 |
| 205 | 1.00000 | 205 | 1 | 0.60200 | 60 203 | 35 | 1.00000 | 205 | 1 |
| 206 | 0.37016 | 174 205 | 77 | 0.42407 | 196 203 | 54 | 0.22677 | 100 200 | 54 |
| 207 | 0.38073 | 46 202 205 | 76 | 1.00000 | 207 | 1 | 1.00000 | 207 | 1 |
| 210 | 0.73788 | 174 205 | 39 | 0.57338 | 196 204 | 39 | 0.55536 | 100 205 | 23 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under VRS (Equation I.15 with the restriction $\sum_j \lambda_j = 1$ proposed by Banker et al. (1984) in the called BCC model). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-B-3** SBM-efficiency under VRS for 2007

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | SBM | Ref. | Rank | SBM | Ref. | Rank | SBM | Ref. | Rank |
| 2 | 0.53472 | 7 12 50 198 | 47 | 0.31012 | 40 50 | 74 | 0.07813 | 100 103 | 80 |
| 4 | 0.50662 | 12 51 55 127 | 51 | 0.24517 | 12 50 | 92 | 0.11067 | 100 103 | 65 |
| 6 | 0.35797 | 14 50 177 | 73 | 0.35801 | 40 46 | 62 | 0.17805 | 100 125 | 45 |
| 7 | 1.00000 | 7 | 1 | 0.31046 | 40 50 | 73 | 0.08777 | 100 103 | 74 |
| 9 | 0.29805 | 12 50 174 177 | 80 | 0.28527 | 46 103 | 79 | 0.28458 | 100 103 | 28 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 | 0.66053 | 14 103 | 12 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.64789 | 12 51 127 | 42 | 0.42336 | 12 50 | 56 | 0.06074 | 100 103 | 88 |
| 20 | 0.26622 | 12 51 | 84 | 0.24698 | 12 50 | 91 | 0.21900 | 100 103 | 38 |
| 21 | 0.32822 | 12 50 51 | 76 | 0.50820 | 12 40 | 39 | 0.13702 | 100 103 | 59 |
| 24 | 0.39535 | 12 152 | 68 | 0.44813 | 31 40 | 52 | 0.06249 | 100 103 | 87 |
| 29 | 0.39905 | 12 50 198 | 67 | 0.29356 | 40 50 | 78 | 0.18259 | 100 103 | 44 |
| 31 | 0.40268 | 12 50 152 | 65 | 1.00000 | 31 | 1 | 0.09867 | 100 103 | 67 |
| 34 | 0.20994 | 12 50 | 91 | 0.62742 | 40 50 161 | 24 | 0.07564 | 100 103 | 82 |
| 35 | 0.74567 | 12 152 174 177 198 | 33 | 0.27663 | 40 46 | 84 | 0.08945 | 100 103 | 71 |
| 36 | 1.00000 | 36 | 1 | 0.55598 | 57 100 | 30 | 0.50495 | 100 103 | 15 |
| 37 | 0.41139 | 12 50 152 | 64 | 0.63188 | 46 57 | 22 | 0.23170 | 100 103 | 34 |
| 38 | 0.15447 | 12 50 | 94 | 0.27942 | 46 103 | 81 | 0.32278 | 100 103 | 26 |
| 40 | 0.27170 | 12 50 | 83 | 1.00000 | 40 | 1 | 0.41863 | 100 103 | 19 |
| 43 | 0.71184 | 7 12 50 128 198 | 37 | 0.26926 | 50 103 | 87 | 0.14735 | 100 103 | 54 |
| 45 | 0.68430 | 12 152 174 177 | 38 | 0.26316 | 46 103 | 88 | 0.52468 | 100 103 | 14 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.46196 | 12 51 | 56 | 0.45831 | 12 40 | 48 | 0.10355 | 100 103 | 66 |
| 49 | 0.39464 | 12 50 198 | 69 | 0.55462 | 46 50 103 | 31 | 0.32807 | 100 103 | 25 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 | 0.20350 | 100 | 41 |
| 51 | 1.00000 | 51 | 1 | 0.24173 | 46 57 | 93 | 0.16409 | 100 103 | 48 |
| 53 | 1.00000 | 53 | 1 | 0.63850 | 46 100 105 | 21 | 0.44545 | 100 102 | 18 |
| 55 | 1.00000 | 55 | 1 | 0.52758 | 12 50 | 35 | 0.17717 | 100 103 | 46 |
| 57 | 0.33581 | 12 152 198 | 74 | 1.00000 | 57 | 1 | 0.22552 | 100 103 | 36 |
| 58 | 0.44104 | 12 51 127 | 62 | 0.45585 | 12 50 | 49 | 0.20454 | 100 103 | 40 |
| 59 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 |
| 61 | 0.25363 | 14 50 51 | 86 | 0.27729 | 40 50 | 83 | 0.06815 | 100 103 | 85 |
| 62 | 0.62613 | 12 50 127 177 | 43 | 0.45100 | 40 46 50 | 51 | 0.18927 | 100 103 | 43 |
| 63 | 0.47019 | 12 51 | 55 | 0.61199 | 12 50 | 26 | 0.03937 | 100 103 | 95 |
| 69 | 0.72944 | 53 152 210 | 34 | 0.70115 | 46 50 57 102 | 19 | 0.60801 | 102 207 | 13 |
| 71 | 1.00000 | 71 | 1 | 0.53182 | 12 40 50 | 33 | 0.16319 | 100 103 | 49 |
| 75 | 0.44829 | 12 51 127 | 59 | 0.28476 | 12 50 | 80 | 0.05955 | 100 103 | 90 |
| 76 | 0.68177 | 14 174 177 | 39 | 0.27753 | 46 103 | 82 | 0.22398 | 100 103 | 37 |
| 78 | 1.00000 | 78 | 1 | 0.56097 | 46 50 103 | 29 | 0.16483 | 100 103 | 47 |
| 83 | 1.00000 | 83 | 1 | 0.34974 | 50 103 | 65 | 0.09166 | 100 103 | 68 |
| 84 | 0.52118 | 14 51 55 127 | 48 | 0.34101 | 12 50 | 67 | 1.00000 | 84 | 1 |
| 85 | 0.59249 | 12 51 127 | 45 | 0.41610 | 12 50 | 57 | 0.07662 | 100 103 | 81 |
| 86 | 0.67705 | 7 12 51 127 163 | 40 | 0.44507 | 12 40 | 54 | 0.14951 | 100 103 | 53 |
| 93 | 0.30902 | 12 50 | 78 | 0.52315 | 40 46 50 | 38 | 0.16014 | 100 103 | 50 |
| 95 | 0.72377 | 12 51 127 140 | 35 | 0.52639 | 12 40 | 36 | 0.27605 | 100 103 | 29 |
| 98 | 0.23747 | 12 50 | 88 | 0.34048 | 40 46 | 68 | 0.33234 | 100 103 | 24 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 1.00000 | 102 | 1 | 1.00000 | 102 | 1 |
| 103 | 0.21627 | 12 50 127 | 89 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.11383 | 12 50 | 95 | 1.00000 | 105 | 1 | 0.37980 | 100 125 | 22 |
| 110 | 0.45724 | 12 14 51 | 57 | 0.38024 | 31 40 | 60 | 0.13187 | 100 103 | 63 |
| 113 | 0.21013 | 12 51 | 90 | 0.27075 | 40 50 | 86 | 0.04445 | 100 103 | 94 |
| 115 | 0.45071 | 152 174 | 58 | 0.40322 | 46 105 | 58 | 0.34616 | 100 103 | 23 |
| 121 | 0.27893 | 12 51 | 82 | 0.33012 | 12 40 | 71 | 0.08962 | 100 103 | 70 |
| 125 | 0.16271 | 46 50 | 93 | 0.87468 | 100 105 | 17 | 1.00000 | 125 | 1 |
| 126 | 0.38053 | 12 50 152 198 | 70 | 0.23877 | 46 105 | 94 | 0.13530 | 100 103 | 61 |
| 127 | 1.00000 | 127 | 1 | 0.30885 | 40 50 | 75 | 0.08517 | 100 103 | 75 |
| 128 | 1.00000 | 128 | 1 | 0.30422 | 12 50 | 76 | 0.06399 | 100 103 | 86 |
| 130 | 0.72165 | 12 51 140 163 | 36 | 0.33259 | 12 40 | 70 | 0.07227 | 100 103 | 83 |
| 131 | 0.23936 | 12 152 | 87 | 0.34452 | 46 57 | 66 | 0.38450 | 100 103 | 21 |
| 132 | 0.42802 | 12 50 51 177 | 63 | 0.21899 | 46 103 | 95 | 0.14085 | 100 103 | 58 |
| 133 | 0.59230 | 46 50 152 | 46 | 0.50292 | 46 57 | 40 | 0.24999 | 100 103 | 33 |
| 137 | 0.44129 | 12 152 198 | 61 | 0.32158 | 46 103 | 72 | 0.40933 | 100 103 | 20 |
| 139 | 0.33125 | 50 128 | 75 | 0.43419 | 46 103 | 55 | 0.45230 | 100 103 | 17 |
| 140 | 1.00000 | 140 | 1 | 0.44676 | 50 103 | 53 | 0.08431 | 100 103 | 76 |
| 142 | 0.30717 | 12 51 | 79 | 0.50033 | 12 40 | 41 | 0.05969 | 100 103 | 89 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 152 | 1.00000 | 152 | 1 | 0.52855 | 46 100 102 | 34 | 0.30614 | 100 103 | 27 |
| 154 | 0.94650 | 12 51 140 163 198 | 30 | 0.25960 | 40 50 | 90 | 0.04640 | 100 103 | 93 |
| 156 | 0.47794 | 12 50 174 | 54 | 0.48083 | 46 50 57 | 45 | 0.11274 | 100 103 | 64 |
| 159 | 0.31312 | 12 50 152 | 77 | 0.49184 | 40 46 50 | 42 | 0.14318 | 100 103 | 56 |
| 160 | 1.00000 | 160 | 1 | 0.57922 | 46 50 57 | 27 | 0.13508 | 100 103 | 62 |
| 161 | 1.00000 | 161 | 1 | 1.00000 | 161 | 1 | 0.08893 | 100 103 | 73 |
| 162 | 0.48062 | 14 51 127 | 53 | 0.56542 | 40 50 161 | 28 | 0.13616 | 100 103 | 60 |
| 163 | 1.00000 | 163 | 1 | 0.35558 | 50 103 | 63 | 0.05035 | 100 103 | 91 |
| 168 | 0.37464 | 12 50 174 | 71 | 0.33824 | 46 105 | 69 | 0.26687 | 100 103 | 30 |
| 173 | 0.36004 | 12 50 51 | 72 | 0.63161 | 50 57 103 | 23 | 0.07129 | 100 103 | 84 |
| 174 | 1.00000 | 174 | 1 | 0.46193 | 46 50 57 | 47 | 0.22709 | 100 103 | 35 |
| 176 | 0.75805 | 12 50 51 127 140 177 | 32 | 0.54508 | 50 103 | 32 | 0.07997 | 100 103 | 78 |
| 177 | 1.00000 | 177 | 1 | 0.30167 | 40 46 | 77 | 0.14722 | 100 103 | 55 |
| 182 | 0.44513 | 12 50 51 | 60 | 0.48956 | 12 31 40 | 43 | 0.09090 | 100 103 | 69 |
| 185 | 0.27914 | 50 51 128 | 81 | 0.35504 | 46 103 | 64 | 0.08942 | 100 103 | 72 |
| 190 | 0.60713 | 12 51 177 198 | 44 | 0.46622 | 50 103 | 46 | 0.07861 | 100 103 | 79 |
| 191 | 0.66772 | 12 152 174 | 41 | 0.26225 | 46 57 | 89 | 0.20997 | 100 103 | 39 |
| 192 | 0.40238 | 14 50 174 177 | 66 | 1.00000 | 192 | 1 | 0.20013 | 100 103 | 42 |
| 193 | 1.00000 | 193 | 1 | 0.27329 | 40 50 | 85 | 0.04831 | 100 103 | 92 |
| 194 | 0.50928 | 12 50 198 | 50 | 0.36047 | 46 103 | 61 | 0.15354 | 100 103 | 51 |
| 196 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.51857 | 12 152 198 | 49 | 0.39410 | 46 57 | 59 | 0.08052 | 100 102 | 77 |
| 198 | 1.00000 | 198 | 1 | 0.52337 | 46 57 | 37 | 0.15239 | 100 102 | 52 |
| 200 | 0.18653 | 50 127 | 92 | 0.69303 | 12 40 46 | 20 | 0.50396 | 100 103 | 16 |
| 203 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.80813 | 12 50 177 198 | 31 | 0.45206 | 40 46 50 | 50 | 0.14163 | 100 103 | 57 |
| 206 | 0.49552 | 152 | 52 | 0.61382 | 46 57 100 | 25 | 0.25225 | 100 103 | 32 |
| 207 | 0.26542 | 12 152 | 85 | 0.48471 | 46 57 | 44 | 1.00000 | 207 | 1 |
| 210 | 1.00000 | 210 | 1 | 0.72708 | 46 50 57 | 18 | 0.26662 | 100 102 | 31 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under VRS (Equation I.15 with the restriction $\sum_j \lambda_j = 1$ proposed by Banker et al. (1984) in the called BCC model). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-B-4** SBM-efficiency under VRS for 2008

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.35450 | 15 174 198 | 53 | 0.15839 | 83 100 | 81 | 0.15121 | 45 46 | 63 |
| 4 | 0.50020 | 14 127 | 42 | 0.63029 | 12 100 | 18 | 0.12664 | 46 103 | 71 |
| 6 | 0.22888 | 14 174 | 75 | 0.30001 | 83 100 | 51 | 0.15328 | 46 125 | 62 |
| 7 | 0.69705 | 154 174 198 | 32 | 0.20038 | 100 103 | 73 | 0.17458 | 46 103 | 57 |
| 9 | 0.19491 | 14 174 217 | 82 | 0.21948 | 37 100 | 70 | 0.38559 | 46 103 | 24 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 | 0.62204 | 14 103 | 13 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 1.00000 | 15 | 1 | 0.43931 | 12 100 | 29 | 0.09377 | 46 103 | 86 |
| 20 | 0.29217 | 127 174 | 62 | 0.40205 | 12 100 | 35 | 0.25296 | 46 103 | 43 |
| 21 | 0.33957 | 14 127 174 | 56 | 0.23364 | 100 103 | 66 | 0.11110 | 46 103 | 78 |
| 24 | 0.24908 | 14 174 | 70 | 0.41024 | 83 100 | 33 | 0.09542 | 46 103 | 85 |
| 29 | 0.22837 | 14 15 174 | 76 | 0.21373 | 83 100 | 72 | 0.10188 | 46 103 | 83 |
| 31 | 0.29791 | 14 174 | 61 | 0.15646 | 83 100 | 83 | 0.14451 | 40 100 | 64 |
| 34 | 0.16639 | 14 174 | 87 | 0.19510 | 83 100 | 74 | 0.18575 | 40 100 | 52 |
| 35 | 0.77408 | 154 174 177 193 | 29 | 0.18147 | 83 100 | 77 | 0.17492 | 45 46 | 56 |
| 36 | 1.00000 | 36 | 1 | 0.55918 | 83 100 | 20 | 0.61028 | 46 103 | 14 |
| 37 | 0.25407 | 14 174 | 68 | 1.00000 | 37 | 1 | 0.23079 | 46 103 | 45 |
| 38 | 0.14387 | 14 174 | 90 | 0.24811 | 83 100 | 62 | 0.15543 | 46 125 | 61 |
| 40 | 0.28663 | 174 217 | 63 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 43 | 0.27245 | 14 15 174 | 65 | 0.25778 | 83 100 | 58 | 0.10466 | 46 103 | 81 |
| 45 | 0.32624 | 14 174 | 58 | 0.14237 | 83 100 | 88 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.39462 | 14 174 | 51 | 0.46808 | 12 100 103 | 26 | 0.14006 | 46 103 | 69 |
| 49 | 0.17073 | 15 174 | 86 | 0.15618 | 83 100 | 84 | 0.32039 | 46 103 | 29 |
| 50 | 1.00000 | 50 | 1 | 0.24121 | 40 100 | 64 | 0.48814 | 46 103 | 21 |
| 51 | 1.00000 | 51 | 1 | 0.33802 | 83 100 | 46 | 0.30597 | 46 103 | 32 |
| 53 | 1.00000 | 53 | 1 | 0.24435 | 40 100 | 63 | 1.00000 | 53 | 1 |
| 55 | 1.00000 | 55 | 1 | 0.54017 | 12 83 100 | 22 | 0.28299 | 46 103 | 37 |
| 57 | 0.24737 | 15 174 | 73 | 0.65513 | 83 100 103 192 | 17 | 0.11766 | 40 100 | 77 |
| 58 | 0.46243 | 12 127 | 44 | 1.00000 | 58 | 1 | 0.28280 | 46 103 | 38 |
| 61 | 0.20956 | 14 174 | 79 | 0.18033 | 83 100 | 78 | 0.07130 | 46 103 | 91 |
| 62 | 0.40313 | 14 174 | 48 | 0.54068 | 83 100 | 21 | 0.29017 | 46 103 | 36 |
| 63 | 0.58162 | 14 127 154 | 37 | 0.43692 | 12 100 | 31 | 0.02567 | 46 100 | 93 |
| 69 | 0.81256 | 53 174 196 217 | 28 | 0.28416 | 40 100 | 53 | 0.26802 | 40 100 | 40 |
| 71 | 0.71378 | 14 76 177 | 31 | 0.29769 | 100 103 | 52 | 0.26404 | 46 103 | 41 |
| 76 | 1.00000 | 76 | 1 | 0.35235 | 100 103 | 44 | 0.31451 | 46 103 | 30 |
| 78 | 0.34679 | 14 15 174 | 54 | 0.23910 | 83 100 | 65 | 0.16522 | 46 103 | 59 |
| 83 | 1.00000 | 83 | 1 | 1.00000 | 83 | 1 | 0.13315 | 46 103 | 70 |
| 84 | 0.45443 | 14 127 174 | 45 | 0.45349 | 12 100 | 28 | 0.27677 | 46 103 | 39 |
| 85 | 0.62510 | 14 127 | 35 | 0.36975 | 12 100 | 40 | 0.10777 | 46 103 | 79 |
| 86 | 0.45412 | 14 154 174 | 46 | 0.39068 | 83 100 | 36 | 0.12626 | 46 103 | 72 |
| 93 | 0.25066 | 174 217 | 69 | 0.25479 | 100 103 | 61 | 0.19930 | 46 103 | 50 |
| 95 | 0.64120 | 14 154 | 34 | 0.35896 | 12 100 | 43 | 1.00000 | 95 | 1 |
| 98 | 0.11395 | 15 174 | 92 | 0.30296 | 83 100 | 48 | 0.55087 | 45 46 103 | 16 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.08225 | 14 127 174 | 93 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.16609 | 174 217 | 88 | 0.18955 | 83 100 | 76 | 1.00000 | 105 | 1 |
| 110 | 0.44384 | 14 154 174 | 47 | 0.36392 | 100 103 | 42 | 0.22731 | 46 103 | 46 |
| 113 | 0.20802 | 14 174 | 80 | 0.11591 | 83 100 | 91 | 0.10143 | 46 103 | 84 |
| 115 | 1.00000 | 115 | 1 | 0.22695 | 100 192 | 67 | 0.49892 | 46 103 | 20 |
| 121 | 0.22471 | 14 174 | 77 | 0.37307 | 12 100 | 39 | 0.10356 | 46 103 | 82 |
| 125 | 0.19855 | 196 217 | 81 | 0.34792 | 40 100 | 45 | 1.00000 | 125 | 1 |
| 126 | 0.26668 | 14 174 | 67 | 0.09743 | 83 100 | 93 | 0.18466 | 46 103 | 53 |
| 127 | 1.00000 | 127 | 1 | 0.36909 | 83 100 | 41 | 0.14315 | 46 103 | 65 |
| 128 | 1.00000 | 128 | 1 | 0.49501 | 12 100 | 25 | 0.08206 | 46 103 | 89 |
| 130 | 0.65405 | 14 15 154 | 33 | 0.27748 | 12 100 | 54 | 0.10546 | 46 103 | 80 |
| 131 | 0.17218 | 174 217 | 85 | 0.27090 | 83 100 | 55 | 0.52334 | 46 103 | 19 |
| 132 | 0.18146 | 14 174 | 84 | 0.22574 | 83 100 | 68 | 0.19756 | 46 103 | 51 |
| 133 | 0.53391 | 174 217 | 39 | 0.26130 | 83 100 | 57 | 0.44793 | 46 103 | 23 |
| 137 | 0.24868 | 174 217 | 71 | 0.30217 | 83 100 | 50 | 0.80058 | 45 46 103 | 12 |
| 139 | 0.49912 | 14 174 196 | 43 | 0.26666 | 100 103 | 56 | 0.52367 | 46 103 | 18 |
| 140 | 0.75233 | 14 15 127 128 154 | 30 | 0.43718 | 83 100 | 30 | 0.14061 | 46 103 | 68 |
| 142 | 0.40239 | 14 154 174 | 49 | 0.22025 | 12 100 | 69 | 0.22440 | 46 103 | 47 |
| 152 | 1.00000 | 152 | 1 | 0.25736 | 40 100 | 59 | 0.26375 | 46 100 | 42 |
| 154 | 1.00000 | 154 | 1 | 0.11273 | 12 100 | 92 | 0.08012 | 46 103 | 90 |
| 156 | 0.27772 | 14 174 | 64 | 0.17114 | 83 100 | 80 | 0.20856 | 46 103 | 49 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 159 | 0.18165 | 14 174 | 83 | 0.15800 | 83 100 | 82 | 0.15863 | 46 103 | 60 |
| 160 | 1.00000 | 160 | 1 | 0.15392 | 83 100 | 86 | 0.18106 | 46 103 | 55 |
| 161 | 1.00000 | 161 | 1 | 0.43251 | 83 100 | 32 | 0.14086 | 46 103 | 67 |
| 162 | 0.37056 | 14 154 174 | 52 | 0.30249 | 83 100 | 49 | 0.21679 | 46 103 | 48 |
| 163 | 1.00000 | 163 | 1 | 0.38345 | 83 100 | 38 | 0.12269 | 45 46 | 75 |
| 168 | 0.21910 | 174 | 78 | 0.15578 | 83 100 | 85 | 0.33406 | 46 103 | 26 |
| 173 | 0.16180 | 14 174 | 89 | 0.31568 | 83 100 | 47 | 0.05454 | 40 100 | 92 |
| 174 | 1.00000 | 174 | 1 | 0.60208 | 37 100 | 19 | 0.52867 | 45 46 53 | 17 |
| 176 | 0.59752 | 14 154 174 | 36 | 0.14808 | 83 100 | 87 | 0.16796 | 46 103 | 58 |
| 177 | 1.00000 | 177 | 1 | 0.38525 | 83 100 | 37 | 0.32291 | 46 103 | 28 |
| 182 | 0.34271 | 14 154 174 | 55 | 1.00000 | 182 | 1 | 0.09287 | 46 103 | 87 |
| 185 | 0.50956 | 14 154 160 | 40 | 0.49563 | 100 103 | 24 | 0.30836 | 40 105 | 31 |
| 190 | 0.56458 | 154 174 198 | 38 | 0.21676 | 83 100 | 71 | 0.14313 | 46 103 | 66 |
| 191 | 0.40090 | 14 174 | 50 | 0.51205 | 37 100 | 23 | 0.32910 | 45 46 | 27 |
| 192 | 0.31048 | 14 174 | 60 | 1.00000 | 192 | 1 | 0.29656 | 46 103 | 33 |
| 193 | 1.00000 | 193 | 1 | 0.25719 | 83 100 | 60 | 0.12401 | 45 46 | 73 |
| 194 | 0.27151 | 15 174 | 66 | 0.12192 | 83 100 | 90 | 0.08920 | 46 100 | 88 |
| 196 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 | 0.57496 | 46 100 | 15 |
| 197 | 0.32877 | 15 174 | 57 | 0.18999 | 83 100 | 75 | 0.23400 | 45 46 | 44 |
| 198 | 1.00000 | 198 | 1 | 0.12534 | 83 100 | 89 | 0.18140 | 46 100 | 54 |
| 200 | 0.13390 | 14 174 196 | 91 | 0.40705 | 100 103 | 34 | 0.35104 | 46 103 | 25 |
| 203 | 0.31545 | 174 217 | 59 | 0.70986 | 37 100 206 | 16 | 0.29407 | 46 100 | 35 |
| 204 | 0.50569 | 14 174 | 41 | 0.45865 | 83 100 | 27 | 0.11891 | 46 103 | 76 |
| 206 | 0.24767 | 174 217 | 72 | 1.00000 | 206 | 1 | 0.29464 | 46 103 | 34 |
| 207 | 0.24003 | 174 217 | 74 | 0.17539 | 83 100 | 79 | 0.12393 | 46 100 | 74 |
| 210 | 1.00000 | 210 | 1 | 0.80966 | 37 100 206 | 15 | 0.48170 | 45 46 53 | 22 |
| 217 | 1.00000 | 217 | 1 | 1.00000 | 217 | 1 | 1.00000 | 217 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under VRS (Equation I.15 with the restriction $\sum_j \lambda_j = 1$ proposed by Banker et al. (1984) in the called BCC model). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-B-5** SBM-efficiency under VRS for 2009

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.49366 | 7 50 76 | 50 | 0.28606 | 163 196 | 69 | 0.07278 | 100 103 | 88 |
| 4 | 1.00000 | 4 | 1 | 0.77482 | 14 63 128 196 | 22 | 0.09058 | 103 125 | 76 |
| 6 | 0.38080 | 14 50 76 | 69 | 0.21638 | 163 196 | 78 | 0.11434 | 100 125 | 65 |
| 7 | 1.00000 | 7 | 1 | 0.17241 | 31 196 | 89 | 0.11250 | 100 103 | 66 |
| 9 | 0.36710 | 14 50 76 174 217 | 74 | 0.50058 | 63 196 | 35 | 0.35390 | 100 103 | 25 |
| 12 | 0.65098 | 14 46 | 30 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.38669 | 14 46 | 66 | 1.00000 | 15 | 1 | 0.06580 | 100 103 | 92 |
| 20 | 0.22348 | 14 46 51 | 89 | 0.38735 | 15 196 | 50 | 0.35570 | 100 103 | 24 |
| 21 | 0.31174 | 14 51 | 83 | 1.00000 | 21 | 1 | 0.14973 | 100 103 | 57 |
| 24 | 0.31166 | 50 76 | 84 | 0.16051 | 163 196 | 94 | 0.07853 | 100 103 | 85 |
| 29 | 0.38248 | 45 76 131 217 | 68 | 0.15359 | 163 196 | 95 | 0.08399 | 45 100 | 81 |
| 31 | 0.63533 | 14 50 51 196 | 31 | 1.00000 | 31 | 1 | 1.00000 | 31 | 1 |
| 34 | 0.24760 | 50 76 | 86 | 0.16733 | 31 196 | 90 | 0.10130 | 46 100 | 72 |
| 35 | 0.62663 | 50 76 174 | 32 | 0.18766 | 31 196 | 87 | 0.10941 | 46 100 | 70 |
| 36 | 0.56101 | 100 196 217 221 | 35 | 0.55882 | 163 196 | 31 | 0.34123 | 100 125 | 26 |
| 37 | 0.38608 | 14 50 76 | 67 | 0.41286 | 163 196 | 45 | 0.17374 | 100 103 | 50 |
| 38 | 0.19126 | 14 51 | 93 | 0.35894 | 163 196 | 54 | 0.10037 | 100 125 | 74 |
| 40 | 0.31824 | 50 174 217 | 81 | 0.44726 | 31 196 | 40 | 0.40951 | 100 125 | 21 |
| 43 | 1.00000 | 43 | 1 | 0.63853 | 15 31 | 27 | 0.12531 | 100 103 | 61 |
| 45 | 1.00000 | 45 | 1 | 0.20398 | 163 196 | 82 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.38674 | 14 46 50 76 | 65 | 0.20994 | 163 196 | 80 | 0.12354 | 100 103 | 62 |
| 49 | 0.32537 | 50 76 | 80 | 0.43134 | 31 196 | 43 | 0.14991 | 100 103 | 56 |
| 50 | 1.00000 | 50 | 1 | 0.57667 | 46 163 196 | 30 | 0.28761 | 46 100 | 29 |
| 51 | 1.00000 | 51 | 1 | 0.29490 | 163 196 | 68 | 0.16103 | 100 103 | 54 |
| 53 | 1.00000 | 53 | 1 | 1.00000 | 53 | 1 | 0.53502 | 46 100 217 | 19 |
| 55 | 1.00000 | 55 | 1 | 0.30076 | 128 196 | 65 | 0.21466 | 100 103 | 40 |
| 57 | 0.50571 | 76 217 | 47 | 0.28363 | 31 196 | 70 | 0.24496 | 100 103 | 34 |
| 58 | 0.40513 | 14 46 51 | 60 | 0.16446 | 15 196 | 93 | 0.21319 | 100 103 | 41 |
| 61 | 0.23876 | 14 50 | 88 | 0.20141 | 163 196 | 83 | 1.00000 | 61 | 1 |
| 62 | 1.00000 | 62 | 1 | 0.54634 | 163 196 | 32 | 0.21274 | 100 103 | 42 |
| 63 | 0.48459 | 14 46 51 127 | 54 | 1.00000 | 63 | 1 | 0.33965 | 46 61 | 27 |
| 69 | 0.52300 | 46 196 217 | 42 | 1.00000 | 69 | 1 | 0.72186 | 46 105 217 | 16 |
| 71 | 0.74767 | 14 50 76 140 | 27 | 0.30902 | 31 196 | 62 | 0.21485 | 100 103 | 39 |
| 76 | 1.00000 | 76 | 1 | 0.63984 | 15 31 | 26 | 0.21934 | 100 103 | 38 |
| 78 | 0.46832 | 50 76 | 56 | 0.33212 | 31 196 | 57 | 0.15635 | 100 103 | 55 |
| 83 | 0.39232 | 14 50 51 76 | 64 | 0.38804 | 128 196 | 49 | 0.06712 | 100 103 | 91 |
| 84 | 0.50705 | 14 46 51 127 | 46 | 0.71348 | 15 31 196 | 25 | 0.26746 | 100 103 | 31 |
| 85 | 0.54235 | 14 46 51 | 39 | 0.58485 | 128 196 | 28 | 0.10122 | 100 103 | 73 |
| 86 | 0.53105 | 7 14 51 127 | 40 | 0.49635 | 15 31 | 37 | 0.10450 | 100 103 | 71 |
| 93 | 0.34772 | 14 50 217 | 78 | 0.30179 | 163 196 | 64 | 0.22078 | 46 100 | 36 |
| 95 | 0.72751 | 7 14 46 76 140 | 28 | 0.19845 | 15 196 | 84 | 0.11090 | 100 103 | 68 |
| 98 | 0.22035 | 14 46 51 | 90 | 0.34044 | 163 196 | 55 | 0.19212 | 100 125 | 47 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.21496 | 14 50 76 | 91 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.15130 | 14 50 | 95 | 0.44205 | 31 196 | 41 | 1.00000 | 105 | 1 |
| 110 | 0.40325 | 14 50 51 | 61 | 0.75853 | 163 185 196 | 24 | 0.14598 | 100 103 | 58 |
| 113 | 0.20854 | 14 46 50 51 | 92 | 0.23831 | 163 196 | 74 | 0.06517 | 100 125 | 93 |
| 115 | 0.42630 | 50 174 217 | 58 | 0.45508 | 163 196 | 38 | 0.19983 | 100 125 | 45 |
| 121 | 0.24182 | 14 46 50 | 87 | 0.33228 | 15 196 | 56 | 0.08170 | 100 103 | 84 |
| 125 | 0.15351 | 46 50 196 | 94 | 0.95921 | 46 53 69 196 | 21 | 1.00000 | 125 | 1 |
| 126 | 0.37473 | 76 174 | 72 | 0.36162 | 31 196 | 53 | 0.16464 | 100 103 | 53 |
| 127 | 1.00000 | 127 | 1 | 0.40841 | 163 196 | 46 | 0.08722 | 100 103 | 79 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 | 0.02859 | 100 103 | 95 |
| 130 | 1.00000 | 130 | 1 | 0.16453 | 31 196 | 92 | 0.07067 | 100 103 | 89 |
| 131 | 1.00000 | 131 | 1 | 0.30196 | 31 196 | 63 | 1.00000 | 131 | 1 |
| 132 | 0.27014 | 50 76 | 85 | 0.30981 | 31 196 | 61 | 0.07679 | 100 103 | 86 |
| 133 | 0.49312 | 76 217 | 52 | 0.38304 | 163 196 | 52 | 0.27377 | 46 100 | 30 |
| 137 | 0.37597 | 76 174 | 71 | 0.23812 | 163 196 | 75 | 0.38803 | 100 103 | 22 |
| 139 | 0.54358 | 14 46 76 217 | 38 | 0.29894 | 163 196 | 66 | 0.55187 | 100 103 | 18 |
| 140 | 1.00000 | 140 | 1 | 0.19659 | 31 196 | 85 | 0.06871 | 100 103 | 90 |
| 142 | 0.31514 | 14 46 51 | 82 | 0.18666 | 31 196 | 88 | 0.08555 | 100 103 | 80 |
| 152 | 1.00000 | 152 | 1 | 0.51258 | 69 196 | 34 | 0.47555 | 100 131 | 20 |
| 154 | 0.65955 | 14 46 76 128 140 | 29 | 0.22411 | 31 196 | 76 | 0.06359 | 100 | 94 |
| 156 | 0.49467 | 76 174 | 49 | 0.20629 | 31 196 | 81 | 0.13465 | 100 103 | 59 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 159 | 0.51473 | 50 76 128 210 | 44 | 0.45279 | 31 196 | 39 | 0.12255 | 46 100 | 63 |
| 160 | 0.52963 | 50 76 174 | 41 | 0.22078 | 163 196 | 77 | 0.17972 | 46 100 | 48 |
| 161 | 0.54829 | 14 50 76 | 37 | 0.31272 | 163 196 | 59 | 0.08365 | 100 103 | 82 |
| 162 | 0.49604 | 14 50 76 | 48 | 0.18895 | 163 196 | 86 | 0.12971 | 100 103 | 60 |
| 163 | 0.48417 | 7 14 46 51 128 | 55 | 1.00000 | 163 | 1 | 0.08298 | 100 103 | 83 |
| 168 | 0.38066 | 76 174 | 70 | 0.25571 | 163 196 | 73 | 0.25961 | 100 103 | 32 |
| 173 | 0.40898 | 7 14 50 51 | 59 | 1.00000 | 173 | 1 | 0.09736 | 46 61 | 75 |
| 174 | 1.00000 | 174 | 1 | 0.38985 | 163 196 | 48 | 0.22299 | 100 217 | 35 |
| 176 | 0.58991 | 14 50 51 76 | 34 | 0.49979 | 31 196 | 36 | 0.11224 | 100 103 | 67 |
| 177 | 0.35088 | 76 174 | 76 | 0.76668 | 53 163 196 | 23 | 0.22030 | 100 125 | 37 |
| 182 | 0.39349 | 14 50 76 | 63 | 0.16491 | 31 196 | 91 | 0.08757 | 100 103 | 78 |
| 185 | 0.36622 | 14 46 51 | 75 | 1.00000 | 185 | 1 | 0.36445 | 46 61 | 23 |
| 190 | 0.51067 | 7 14 50 76 | 45 | 0.31498 | 31 196 | 58 | 0.07434 | 100 103 | 87 |
| 191 | 0.55785 | 76 174 217 | 36 | 1.00000 | 191 | 1 | 0.32272 | 100 103 | 28 |
| 192 | 0.32577 | 14 174 | 79 | 0.53253 | 163 196 | 33 | 0.16683 | 100 125 | 52 |
| 193 | 1.00000 | 193 | 1 | 0.39059 | 31 196 | 47 | 0.08861 | 45 100 | 77 |
| 194 | 0.51672 | 50 76 210 | 43 | 0.27329 | 31 196 | 71 | 0.11031 | 46 100 | 69 |
| 195 | 0.40166 | 46 76 210 | 62 | 0.43569 | 31 196 | 42 | 1.00000 | 195 | 1 |
| 196 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 | 0.60130 | 46 100 | 17 |
| 197 | 0.43436 | 76 174 217 | 57 | 0.38592 | 31 196 | 51 | 0.20472 | 100 217 | 44 |
| 198 | 0.59498 | 50 51 128 210 | 33 | 0.27306 | 163 196 | 72 | 0.11634 | 46 100 | 64 |
| 200 | 0.49351 | 14 51 196 | 51 | 0.58243 | 163 196 | 29 | 0.17872 | 100 125 | 49 |
| 203 | 0.37215 | 76 217 | 73 | 0.41956 | 163 196 | 44 | 0.25638 | 46 100 | 33 |
| 204 | 0.48731 | 50 76 | 53 | 0.31205 | 163 196 | 60 | 0.16710 | 46 100 | 51 |
| 206 | 0.34988 | 76 217 | 77 | 0.29535 | 163 196 | 67 | 0.19768 | 100 125 | 46 |
| 207 | 1.00000 | 207 | 1 | 1.00000 | 207 | 1 | 1.00000 | 207 | 1 |
| 210 | 1.00000 | 210 | 1 | 0.21562 | 163 196 | 79 | 0.20633 | 100 217 | 43 |
| 217 | 1.00000 | 217 | 1 | 1.00000 | 217 | 1 | 1.00000 | 217 | 1 |
| 221 | 1.00000 | 221 | 1 | 1.00000 | 221 | 1 | 1.00000 | 221 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under VRS (Equation I.15 with the restriction $\sum_j \lambda_j = 1$ proposed by Banker et al. (1984) in the called BCC model). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

# Appendix C

**Table I-C-1** Comparative CRS-SBM scores for 2005 with different measures of labour

Portfolio Management stage

| | Using number of employees | | | Using personnel expenses | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 1 | 0.33795 | 12 161 | 66 | 0.32145 | 12 161 | 71 |
| 2 | 0.40030 | 12 177 | 59 | 0.39290 | 12 163 177 | 63 |
| 4 | 0.42223 | 14 161 | 55 | 0.47356 | 14 161 | 56 |
| 6 | 1.00000 | 6 | 1 | 1.00000 | 6 | 1 |
| 7 | 1.00000 | 7 | 1 | 1.00000 | 7 | 1 |
| 9 | 0.24942 | 12 177 | 78 | 0.22913 | 177 | 81 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.54453 | 12 161 | 44 | 0.54301 | 12 161 | 43 |
| 20 | 0.49983 | 12 161 | 48 | 0.53238 | 12 161 | 45 |
| 21 | 0.21632 | 161 | 80 | 0.18903 | 161 | 87 |
| 24 | 0.41055 | 12 177 | 56 | 0.41069 | 12 177 | 62 |
| 29 | 0.45102 | 12 43 177 | 53 | 0.48605 | 12 163 177 | 50 |
| 31 | 0.64661 | 12 177 | 36 | 0.63676 | 12 177 | 37 |
| 34 | 0.20845 | 12 177 | 81 | 0.14575 | 12 163 | 90 |
| 35 | 0.81735 | 12 40 160 176 177 | 30 | 0.87243 | 12 40 160 161 177 | 29 |
| 36 | 0.17644 | 12 174 | 85 | 0.22517 | 12 55 174 | 82 |
| 37 | 0.32688 | 12 40 174 177 | 68 | 0.33562 | 12 40 174 177 | 70 |
| 38 | 0.12944 | 12 160 176 | 89 | 0.12828 | 7 12 160 | 92 |
| 40 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.11366 | 12 55 174 | 93 | 0.21497 | 55 95 100 174 | 83 |
| 43 | 1.00000 | 43 | 1 | 1.00000 | 43 | 1 |
| 45 | 0.55011 | 12 174 177 | 43 | 0.64783 | 12 55 174 177 | 36 |
| 46 | 0.06900 | 12 152 | 96 | 0.07305 | 12 174 | 97 |
| 47 | 0.48304 | 12 176 | 49 | 0.51298 | 161 177 | 47 |
| 49 | 0.38867 | 12 40 174 177 | 60 | 0.35029 | 112 40 74 177 | 67 |
| 50 | 0.14370 | 12 177 | 88 | 0.19264 | 12 71 163 177 | 85 |
| 51 | 0.58078 | 12 40 160 161 | 39 | 0.57287 | 12 40 160 161 | 41 |
| 53 | 1.00000 | 53 | 1 | 1.00000 | 53 | 1 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 57 | 0.28221 | 12 174 | 74 | 0.26984 | 12 174 | 76 |
| 58 | 0.70651 | 12 161 | 35 | 0.84183 | 12 127 128 161 | 31 |
| 59 | 0.02740 | 12 161 | 99 | 0.02453 | 12 | 99 |
| 60 | 0.00646 | 12 40 | 102 | 0.00630 | 12 40 | 102 |
| 61 | 0.31073 | 55 161 | 70 | 0.30275 | 161 | 73 |
| 62 | 0.64389 | 12 160 161 176 | 37 | 0.67030 | 7 160 161 | 35 |
| 63 | 0.76928 | 12 43 154 160 | 31 | 0.73092 | 12 43 154 160 | 32 |
| 69 | 0.11333 | 12 174 177 | 94 | 0.09783 | 12 163 174 177 | 95 |
| 71 | 1.00000 | 71 | 1 | 1.00000 | 71 | 1 |
| 73 | 0.70830 | 12 174 177 | 33 | 0.59738 | 12 163 174 177 | 39 |
| 75 | 0.47698 | 12 161 | 50 | 0.45885 | 12 161 | 58 |
| 76 | 1.00000 | 76 | 1 | 0.87324 | 95 161 174 | 28 |
| 78 | 0.35690 | 12 174 177 | 63 | 0.38484 | 12 163 174 | 65 |
| 83 | 0.61178 | 12 55 161 | 38 | 0.71653 | 12 127 161 | 33 |
| 84 | 0.45669 | 14 161 | 52 | 0.44921 | 14 161 | 59 |
| 85 | 0.46772 | 12 161 | 51 | 0.48488 | 12 161 | 51 |
| 86 | 0.50307 | 161 | 46 | 0.52822 | 161 | 46 |
| 93 | 0.19591 | 12 55 161 | 83 | 0.18416 | 12 161 | 88 |
| 95 | 0.73830 | 55 161 | 32 | 1.00000 | 95 | 1 |
| 98 | 0.38578 | 12 43 160 | 62 | 0.36293 | 12 43 160 | 66 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.03736 | 12 152 | 98 | 0.07409 | 12 100 174 | 96 |
| 103 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.41006 | 12 163 177 | 57 | 0.41198 | 12 163 177 | 61 |
| 110 | 0.56571 | 12 161 | 40 | 0.55575 | 161 | 42 |
| 113 | 0.17183 | 12 14 161 | 86 | 0.16095 | 12 14 161 | 89 |
| 115 | 0.15611 | 12 100 174 | 87 | 0.18958 | 12 14 100 174 | 86 |
| 121 | 0.27680 | 161 | 75 | 0.24320 | 161 | 80 |
| 123 | 0.12551 | 12 160 177 | 91 | 0.12921 | 12 160 177 | 91 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 125 | 0.01309 | 14 161 | 101 | 0.01252 | 14 161 | 101 |
| 126 | 0.35117 | 12 177 | 65 | 0.39237 | 12 174 177 | 64 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 1.00000 | 130 | 1 | 1.00000 | 130 | 1 |
| 131 | 0.12109 | 12 152 | 92 | 0.12573 | 12 174 | 93 |
| 132 | 0.26751 | 12 161 177 | 76 | 0.27706 | 7 12 161 163 | 75 |
| 133 | 0.28577 | 12 40 174 | 73 | 0.26080 | 12 40 174 | 78 |
| 137 | 0.30621 | 12 174 | 72 | 0.42526 | 12 174 | 60 |
| 138 | 0.18856 | 12 152 | 84 | 0.46963 | 12 100 152 174 | 57 |
| 139 | 0.20468 | 12 177 | 82 | 0.21329 | 154 163 177 | 84 |
| 140 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 |
| 142 | 0.35601 | 161 | 64 | 0.31699 | 161 | 72 |
| 152 | 1.00000 | 152 | 1 | 1.00000 | 152 | 1 |
| 154 | 1.00000 | 154 | 1 | 1.00000 | 154 | 1 |
| 156 | 0.31727 | 12 55 174 | 69 | 0.48112 | 95 174 | 52 |
| 159 | 0.32720 | 12 55 174 177 | 67 | 0.34084 | 12 55 162 174 | 68 |
| 160 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 161 | 1.00000 | 161 | 1 | 1.00000 | 161 | 1 |
| 162 | 0.70769 | 12 55 154 176 177 | 34 | 1.00000 | 162 | 1 |
| 163 | 1.00000 | 163 | 1 | 1.00000 | 163 | 1 |
| 164 | 0.06441 | 12 174 | 97 | 0.05693 | 12 174 | 98 |
| 168 | 0.23644 | 12 55 174 | 79 | 0.26409 | 12 55 174 | 77 |
| 173 | 0.30974 | 12 177 | 71 | 0.28514 | 12 163 177 | 74 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 1.00000 | 176 | 1 | 0.85200 | 7 12 154 160 161 | 30 |
| 177 | 1.00000 | 177 | 1 | 1.00000 | 177 | 1 |
| 182 | 0.55858 | 12 176 177 | 41 | 0.58053 | 7 12 163 177 | 40 |
| 185 | 0.38616 | 12 43 154 | 61 | 0.34024 | 12 43 154 | 69 |
| 189 | 0.12673 | 12 152 | 90 | 0.11684 | 12 152 | 94 |
| 190 | 0.55505 | 12 176 177 | 42 | 0.53645 | 12 160 163 177 | 44 |
| 191 | 0.40856 | 12 174 177 | 58 | 0.50925 | 12 174 | 48 |
| 192 | 1.00000 | 192 | 1 | 0.62273 | 53 161 177 | 38 |
| 193 | 1.00000 | 193 | 1 | 0.70928 | 12 71 174 177 | 34 |
| 194 | 0.82258 | 12 43 174 198 | 29 | 0.93880 | 12 163 174 198 | 27 |
| 195 | 0.53370 | 12 174 198 | 45 | 0.47889 | 12 174 198 | 54 |
| 196 | 0.01433 | 12 40 152 | 100 | 0.01446 | 12 40 152 | 100 |
| 197 | 0.50042 | 12 174 177 | 47 | 0.47555 | 12 163 174 177 | 55 |
| 198 | 1.00000 | 198 | 1 | 1.00000 | 198 | 1 |
| 200 | 0.42806 | 55 174 177 | 54 | 0.50677 | 95 161 174 | 49 |
| 202 | 0.25857 | 12 40 161 174 177 | 77 | 0.24407 | 12 40 174 177 | 79 |
| 205 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 |
| 206 | 0.10614 | 12 152 174 | 95 | 0.48094 | 95 100 174 | 53 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-C-2** Comparative CRS-SBM scores for 2006 with different measures of labour

Portfolio Management stage

| | Using number of employees | | | Using personnel expenses | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.44895 | 12 177 205 | 47 | 0.46489 | 12 53 163 174 | 44 |
| 4 | 0.36609 | 14 51 | 57 | 0.46362 | 14 127 | 45 |
| 6 | 0.24471 | 51 55 161 | 72 | 0.30032 | 53 161 174 | 65 |
| 7 | 0.80473 | 12 51 53 154 163 | 26 | 1.00000 | 7 | 1 |
| 9 | 0.21437 | 140 174 | 75 | 0.16838 | 140 174 | 86 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.56122 | 12 51 127 | 34 | 0.58281 | 12 51 127 | 33 |
| 20 | 0.54491 | 12 51 127 | 36 | 0.56044 | 12 51 127 | 36 |
| 21 | 0.24047 | 127 | 73 | 0.18393 | 127 | 83 |
| 24 | 0.42342 | 12 177 205 | 51 | 0.34341 | 12 53 | 59 |
| 29 | 0.41718 | 12 128 205 | 52 | 0.51418 | 163 174 198 205 | 40 |
| 31 | 0.84051 | 12 51 53 154 163 | 25 | 0.76332 | 12 51 53 154 163 | 26 |
| 34 | 0.16519 | 12 177 | 84 | 0.14001 | 12 53 | 89 |
| 35 | 0.51953 | 12 174 | 39 | 0.48647 | 12 174 | 42 |
| 36 | 0.16393 | 12 14 174 | 85 | 0.19107 | 12 174 | 82 |
| 37 | 0.37920 | 12 174 205 | 56 | 0.38004 | 12 53 174 | 56 |
| 38 | 0.10118 | 12 51 163 | 95 | 0.09838 | 12 51 163 | 95 |
| 40 | 0.10521 | 174 | 94 | 0.09864 | 140 174 | 94 |
| 43 | 0.14496 | 14 174 | 88 | 0.38078 | 55 100 174 | 55 |
| 45 | 0.69014 | 128 154 163 198 205 | 28 | 0.74099 | 163 198 205 | 27 |
| 46 | 0.50592 | 12 174 | 41 | 0.51060 | 14 174 | 41 |
| 47 | 0.12119 | 12 205 | 91 | 0.15967 | 12 174 205 | 87 |
| 49 | 0.41186 | 12 51 | 53 | 0.41732 | 14 53 161 | 50 |
| 50 | 0.32253 | 12 174 | 63 | 0.29871 | 12 174 | 66 |
| 51 | 0.12725 | 12 174 | 90 | 0.17204 | 12 14 71 174 | 85 |
| 53 | 1.00000 | 51 | 1 | 1.00000 | 51 | 1 |
| 55 | 1.00000 | 53 | 1 | 1.00000 | 53 | 1 |
| 57 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 58 | 0.34304 | 174 | 60 | 0.29760 | 174 | 67 |
| 59 | 0.53423 | 12 51 128 | 38 | 0.55523 | 12 51 128 | 37 |
| 61 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 |
| 62 | 0.00147 | 12 205 | 102 | 0.00142 | 12 53 | 102 |
| 63 | 0.20216 | 14 161 | 78 | 0.17845 | 12 14 127 | 84 |
| 69 | 1.00000 | 62 | 1 | 1.00000 | 62 | 1 |
| 71 | 0.62818 | 12 53 128 163 205 | 32 | 0.58582 | 12 53 128 163 205 | 32 |
| 75 | 0.16152 | 12 174 205 | 86 | 0.19461 | 12 174 | 81 |
| 76 | 1.00000 | 71 | 1 | 1.00000 | 71 | 1 |
| 78 | 0.34772 | 12 51 128 | 59 | 0.33210 | 12 51 127 | 61 |
| 83 | 0.64041 | 55 174 | 30 | 0.61961 | 161 174 | 31 |
| 84 | 0.44933 | 12 174 | 46 | 0.46257 | 12 174 | 47 |
| 85 | 0.73548 | 12 51 55 127 140 | 27 | 0.65946 | 12 51 127 | 30 |
| 86 | 0.44491 | 14 51 127 | 49 | 0.46346 | 13 51 127 | 46 |
| 93 | 0.45866 | 12 51 128 | 43 | 0.47604 | 12 51 128 | 43 |
| 95 | 0.50058 | 12 51 | 42 | 0.56373 | 12 51 | 35 |
| 98 | 0.20408 | 14 51 55 | 77 | 0.20056 | 140 161 53 | 78 |
| 100 | 0.45104 | 12 14 51 | 45 | 1.00000 | 95 | 1 |
| 102 | 0.35902 | 12 51 | 58 | 0.32851 | 12 53 | 62 |
| 103 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 105 | 0.02073 | 12 174 205 | 99 | 0.03257 | 174 | 99 |
| 110 | 0.17378 | 55 127 | 83 | 0.07304 | 51 128 | 97 |
| 113 | 0.11507 | 12 174 | 92 | 0.11794 | 12 174 | 92 |
| 115 | 0.51738 | 12 51 | 40 | 0.51552 | 12 53 127 | 39 |
| 121 | 0.19399 | 12 14 51 | 81 | 0.19870 | 12 51 | 79 |
| 125 | 0.23929 | 14 174 | 74 | 0.28386 | 14 174 | 70 |
| 126 | 0.19729 | 14 51 | 79 | 0.15939 | 12 51 | 88 |
| 127 | 0.13253 | 12 177 205 | 89 | 0.12591 | 12 53 | 90 |
| 128 | 0.01207 | 14 51 | 100 | 0.01253 | 14 51 | 100 |
| 130 | 0.28710 | 12 174 | 66 | 0.30671 | 12 174 | 63 |
| 131 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 132 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 133 | 1.00000 | 130 | 1 | 1.00000 | 130 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 137 | 0.11444 | 12 174 205 | 93 | 0.11996 | 12 174 | 91 |
| 139 | 0.45200 | 12 51 177 205 | 44 | 0.37526 | 12 53 154 | 57 |
| 140 | 0.26298 | 12 174 | 70 | 0.22118 | 12 174 | 75 |
| 142 | 0.28825 | 12 174 | 65 | 0.30638 | 174 | 64 |
| 152 | 0.19623 | 12 51 154 | 80 | 0.21397 | 12 140 154 | 77 |
| 154 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 |
| 156 | 0.26240 | 12 51 | 71 | 0.23388 | 12 51 | 74 |
| 159 | 0.32485 | 12 174 | 62 | 0.27817 | 12 174 | 71 |
| 160 | 1.00000 | 154 | 1 | 1.00000 | 154 | 1 |
| 161 | 0.27883 | 12 14 174 | 68 | 0.42966 | 14 55 174 | 49 |
| 162 | 0.26417 | 12 174 | 69 | 0.26863 | 12 174 | 72 |
| 163 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 168 | 1.00000 | 161 | 1 | 1.00000 | 161 | 1 |
| 173 | 0.54073 | 14 51 55 140 177 | 37 | 0.41261 | 12 51 53 154 | 51 |
| 174 | 1.00000 | 163 | 1 | 1.00000 | 163 | 1 |
| 176 | 0.08552 | 12 174 205 | 97 | 0.07647 | 12 174 | 96 |
| 177 | 0.17788 | 12 14 174 | 82 | 0.19703 | 12 174 | 80 |
| 182 | 0.43200 | 12 177 | 50 | 0.37391 | 12 53 154 | 58 |
| 185 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 190 | 0.85503 | 12 140 161 177 | 24 | 0.67773 | 12 53 140 154 | 29 |
| 191 | 1.00000 | 177 | 1 | 1.00000 | 177 | 1 |
| 192 | 0.63326 | 12 51 53 163 177 | 31 | 0.57446 | 12 51 53 163 | 34 |
| 193 | 0.28203 | 51 128 | 67 | 0.25644 | 51 128 | 73 |
| 194 | 0.44540 | 12 51 205 | 48 | 0.39979 | 12 53 154 | 53 |
| 196 | 0.39387 | 12 174 | 54 | 0.38420 | 12 174 | 54 |
| 197 | 0.59081 | 161 174 | 33 | 0.52594 | 53 140 161 174 | 38 |
| 198 | 0.54975 | 12 174 177 | 35 | 0.44945 | 12 53 154 174 | 48 |
| 200 | 1.00000 | 194 | 1 | 1.00000 | 194 | 1 |
| 203 | 0.21295 | 12 174 198 | 76 | 0.21985 | 12 174 | 76 |
| 204 | 0.04463 | 12 205 | 98 | 0.04226 | 12 205 | 98 |
| 206 | 0.38743 | 12 174 | 55 | 0.40529 | 12 174 | 52 |
| 207 | 1.00000 | 198 | 1 | 1.00000 | 198 | 1 |
| 210 | 0.33249 | 55 161 | 61 | 0.34201 | 53 127 161 | 60 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-C-3** Comparative CRS-SBM scores for 2007 with different measures of labour

Portfolio Management stage

| | Using number of employees | | | Using personnel expenses | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.51806 | 7 12 50 198 | 39 | 0.53588 | 7 78 | 39 |
| 4 | 0.43624 | 12 14 51 127 | 46 | 1.00000 | 4 | 1 |
| 6 | 0.26835 | 14 174 177 | 69 | 0.28480 | 83 127 174 | 67 |
| 7 | 1.00000 | 7 | 1 | 1.00000 | 7 | 1 |
| 9 | 0.25915 | 12 177 | 72 | 0.21653 | 7 174 | 76 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.62492 | 12 51 127 | 34 | 0.64370 | 12 51 127 128 | 32 |
| 20 | 0.17673 | 12 51 | 82 | 0.18961 | 12 14 51 | 81 |
| 21 | 0.29413 | 12 51 127 | 66 | 0.24835 | 51 127 | 71 |
| 24 | 0.39268 | 12 152 | 52 | 0.33647 | 7 53 | 58 |
| 29 | 0.39638 | 12 50 198 | 51 | 0.40170 | 7 198 | 52 |
| 31 | 0.38277 | 12 152 177 198 | 56 | 0.32762 | 7 53 | 62 |
| 34 | 0.16140 | 12 50 | 84 | 0.16847 | 7 12 50 | 84 |
| 35 | 0.74560 | 12 174 177 198 | 26 | 0.71677 | 7 174 | 25 |
| 36 | 0.17889 | 12 174 | 80 | 0.22020 | 12 174 | 75 |
| 37 | 0.35377 | 12 152 198 | 60 | 0.38018 | 12 53 78 | 53 |
| 38 | 0.09342 | 12 51 | 90 | 0.09902 | 12 51 | 89 |
| 40 | 0.13492 | 12 174 | 89 | 0.18550 | 7 12 174 | 82 |
| 43 | 0.69769 | 12 50 128 198 | 28 | 0.65573 | 7 128 198 | 30 |
| 45 | 0.65904 | 12 174 177 198 | 30 | 0.69743 | 7 174 177 | 26 |
| 46 | 0.13909 | 12 174 210 | 87 | 0.14997 | 12 102 210 | 85 |
| 47 | 0.44036 | 12 51 | 45 | 0.43671 | 7 50 | 48 |
| 49 | 0.29208 | 12 198 | 67 | 0.29921 | 12 198 | 65 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 |
| 51 | 1.00000 | 51 | 1 | 1.00000 | 51 | 1 |
| 53 | 1.00000 | 53 | 1 | 1.00000 | 53 | 1 |
| 55 | 1.00000 | 55 | 1 | 0.64596 | 12 14 51 83 | 31 |
| 57 | 0.29513 | 12 198 | 65 | 0.36073 | 12 198 | 54 |
| 58 | 0.40114 | 12 51 127 | 50 | 0.42236 | 12 51 127 | 50 |
| 59 | 0.03667 | 12 14 51 | 92 | 0.02283 | 12 51 | 92 |
| 61 | 0.23730 | 14 51 | 73 | 0.17934 | 12 51 127 | 83 |
| 62 | 0.62576 | 12 50 127 177 | 33 | 0.50301 | 7 12 51 | 42 |
| 63 | 0.35861 | 12 51 | 59 | 0.33326 | 12 51 | 60 |
| 69 | 0.47606 | 198 | 42 | 0.57991 | 12 174 198 | 35 |
| 71 | 0.68783 | 12 14 177 | 29 | 0.60046 | 7 83 174 | 34 |
| 75 | 0.39004 | 12 51 128 | 54 | 0.35884 | 12 51 128 | 55 |
| 76 | 0.64337 | 14 174 177 | 32 | 0.53637 | 7 83 174 | 38 |
| 78 | 1.00000 | 78 | 1 | 1.00000 | 78 | 1 |
| 83 | 1.00000 | 83 | 1 | 1.00000 | 83 | 1 |
| 84 | 0.43146 | 12 14 51 127 | 48 | 0.48103 | 12 14 51 83 | 43 |
| 85 | 0.34176 | 12 51 128 | 61 | 0.33368 | 12 51 128 | 59 |
| 86 | 0.65432 | 12 50 51 127 | 31 | 0.66097 | 12 50 51 127 | 29 |
| 93 | 0.19031 | 12 14 51 | 78 | 0.20008 | 7 50 127 | 79 |
| 95 | 0.58126 | 12 51 | 36 | 0.71697 | 7 83 127 | 24 |
| 98 | 0.23619 | 12 50 | 74 | 0.22109 | 7 12 50 | 74 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 1.00000 | 102 | 1 |
| 103 | 0.17974 | 12 51 127 128 | 79 | 0.08077 | 51 128 | 90 |
| 105 | 0.01915 | 12 14 51 | 93 | 0.02273 | 12 14 53 | 93 |
| 110 | 0.45598 | 12 51 | 43 | 0.44396 | 7 | 46 |
| 113 | 0.19658 | 12 14 51 | 77 | 0.19945 | 12 51 | 80 |
| 115 | 0.17387 | 12 174 | 83 | 0.25761 | 14 174 | 70 |
| 121 | 0.23576 | 12 51 | 75 | 0.20063 | 12 51 | 78 |
| 125 | 0.00157 | 14 51 | 95 | 0.00145 | 14 51 | 95 |
| 126 | 0.30830 | 12 152 177 198 | 63 | 0.33316 | 7 12 78 174 | 61 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 0.55948 | 12 50 51 128 | 38 | 0.54276 | 7 12 50 51 | 37 |
| 131 | 0.14736 | 12 198 | 86 | 0.14810 | 12 53 | 86 |
| 132 | 0.41934 | 12 51 177 | 49 | 0.35142 | 7 12 | 56 |
| 133 | 0.36801 | 12 174 198 | 57 | 0.31475 | 12 174 198 | 64 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 137 | 0.39150 | 12 174 198 | 53 | 0.44342 | 12 174 | 47 |
| 139 | 0.28044 | 12 51 128 198 | 68 | 0.27718 | 7 53 | 68 |
| 140 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 |
| 142 | 0.29894 | 12 51 | 64 | 0.27161 | 12 51 | 69 |
| 152 | 1.00000 | 152 | 1 | 1.00000 | 152 | 1 |
| 154 | 0.90413 | 12 51 128 140 198 | 22 | 0.72932 | 7 50 51 | 23 |
| 156 | 0.34074 | 12 14 174 177 | 62 | 0.43167 | 7 14 174 | 49 |
| 159 | 0.17862 | 12 152 198 | 81 | 0.20578 | 12 174 198 | 77 |
| 160 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 161 | 0.75521 | 14 51 55 127 174 177 | 24 | 0.66743 | 7 50 83 127 174 | 28 |
| 162 | 0.47837 | 14 51 127 | 41 | 0.54722 | 7 50 127 | 36 |
| 163 | 1.00000 | 163 | 1 | 1.00000 | 163 | 1 |
| 168 | 0.22990 | 12 14 174 177 | 76 | 0.24531 | 7 12 14 174 | 72 |
| 173 | 0.35901 | 12 50 | 58 | 0.32617 | 12 50 | 63 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 0.75386 | 12 51 149 177 198 | 25 | 0.61769 | 7 50 | 33 |
| 177 | 1.00000 | 177 | 1 | 1.00000 | 177 | 1 |
| 182 | 0.44175 | 12 51 | 44 | 0.42101 | 12 50 | 51 |
| 185 | 0.26586 | 51 128 | 70 | 0.22346 | 51 128 | 73 |
| 190 | 0.56018 | 12 50 177 198 | 37 | 0.44652 | 7 12 | 45 |
| 191 | 0.60545 | 12 174 198 | 35 | 0.51237 | 12 78 174 | 41 |
| 192 | 0.38297 | 14 174 177 | 55 | 0.34289 | 7 174 | 57 |
| 193 | 0.71789 | 12 152 177 198 | 27 | 0.67350 | 7 53 78 174 198 | 27 |
| 194 | 0.48534 | 12 198 | 40 | 0.47500 | 12 198 | 44 |
| 196 | 0.04396 | 12 198 | 91 | 0.03811 | 12 198 | 91 |
| 197 | 0.43505 | 12 198 | 47 | 0.51600 | 12 78 174 198 | 40 |
| 198 | 1.00000 | 198 | 1 | 1.00000 | 198 | 1 |
| 200 | 0.15380 | 51 127 | 85 | 0.12812 | 50 127 | 88 |
| 203 | 0.00418 | 174 | 94 | 0.00343 | 102 | 94 |
| 204 | 0.78538 | 12 50 177 198 | 23 | 0.76028 | 7 53 | 22 |
| 206 | 0.26231 | 12 152 174 | 71 | 0.29213 | 12 53 78 174 | 66 |
| 207 | 0.13670 | 12 174 | 88 | 0.13746 | 12 174 | 87 |
| 210 | 1.00000 | 210 | 1 | 1.00000 | 210 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-C-4** Comparative CRS-SBM scores for 2008 with different measures of labour

Portfolio Management stage

| | Using number of employees | | | Using personnel expenses | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.33993 | 14 174 | 40 | 0.28302 | 14 174 | 40 |
| 4 | 0.49801 | 14 127 174 | 22 | 0.51778 | 14 127 | 19 |
| 6 | 0.15269 | 14 174 | 73 | 0.14590 | 14 174 | 66 |
| 7 | 0.59259 | 14 15 154 174 | 16 | 0.67021 | 14 127 174 | 14 |
| 9 | 0.16354 | 14 174 | 68 | 0.08658 | 14 174 | 79 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 1.00000 | 15 | 1 | 1.00000 | 15 | 1 |
| 20 | 0.27041 | 14 127 174 | 48 | 0.25956 | 127 174 | 43 |
| 21 | 0.29940 | 14 127 | 43 | 0.20925 | 127 | 50 |
| 24 | 0.18848 | 174 | 63 | 0.12290 | 174 | 71 |
| 29 | 0.16027 | 174 | 69 | 0.11933 | 174 | 74 |
| 31 | 0.23317 | 174 | 55 | 0.14881 | 174 | 65 |
| 34 | 0.15519 | 14 174 | 71 | 0.12114 | 174 | 72 |
| 35 | 0.46813 | 14 174 | 24 | 0.30147 | 174 | 37 |
| 36 | 0.08975 | 14 174 | 84 | 0.06627 | 174 | 85 |
| 37 | 0.21857 | 174 | 58 | 0.15638 | 174 | 63 |
| 38 | 0.06335 | 14 174 | 87 | 0.06834 | 14 174 | 84 |
| 40 | 0.04120 | 14 174 | 88 | 0.04951 | 174 | 88 |
| 43 | 0.22706 | 14 174 | 57 | 0.18636 | 14 174 | 54 |
| 45 | 0.28680 | 14 174 | 44 | 0.15522 | 174 | 64 |
| 46 | 0.02133 | 15 210 | 90 | 0.01975 | 15 174 | 91 |
| 47 | 0.32840 | 14 154 174 | 41 | 0.28935 | 14 127 174 | 38 |
| 49 | 0.16823 | 15 174 | 67 | 0.13104 | 174 | 70 |
| 50 | 0.15546 | 14 174 | 70 | 0.13282 | 14 174 | 69 |
| 51 | 0.41660 | 14 127 154 174 | 32 | 0.40076 | 14 127 154 174 | 29 |
| 53 | 0.21290 | 210 217 | 59 | 1.00000 | 53 | 1 |
| 55 | 1.00000 | 55 | 1 | 0.46004 | 14 127 174 | 23 |
| 57 | 0.24432 | 174 | 52 | 0.19104 | 174 | 52 |
| 58 | 0.43570 | 12 127 160 | 28 | 0.44668 | 14 127 160 | 24 |
| 61 | 0.18555 | 14 174 | 65 | 0.17441 | 14 127 174 | 57 |
| 62 | 0.36581 | 14 174 | 38 | 0.35091 | 14 174 | 36 |
| 63 | 0.51151 | 14 154 174 | 20 | 0.47376 | 14 127 160 | 22 |
| 69 | 0.15155 | 15 174 | 74 | 0.13528 | 15 174 | 67 |
| 71 | 0.40797 | 14 174 | 33 | 0.35457 | 14 174 | 35 |
| 76 | 0.64471 | 14 55 127 174 | 14 | 0.56062 | 14 127 174 | 16 |
| 78 | 0.34477 | 14 174 | 39 | 0.26316 | 174 | 42 |
| 83 | 1.00000 | 83 | 1 | 0.40667 | 127 174 | 28 |
| 84 | 0.39343 | 14 127 174 | 35 | 0.38909 | 14 127 174 | 30 |
| 85 | 0.53103 | 12 14 127 160 | 18 | 0.49329 | 14 127 160 | 20 |
| 86 | 0.42106 | 14 154 174 | 30 | 0.41893 | 14 127 174 | 26 |
| 93 | 0.14790 | 14 174 | 75 | 0.10649 | 174 | 77 |
| 95 | 0.51312 | 14 154 174 | 19 | 0.53242 | 14 127 174 | 18 |
| 98 | 0.10369 | 174 | 79 | 0.08455 | 174 | 81 |
| 100 | 0.01315 | 210 | 92 | 1.00000 | 100 | 1 |
| 103 | 0.08069 | 14 174 | 85 | 0.03762 | 127 | 89 |
| 105 | 0.02505 | 14 174 | 89 | 0.02742 | 14 174 | 90 |
| 110 | 0.43663 | 14 154 174 | 27 | 0.38586 | 14 127 174 | 33 |
| 113 | 0.18537 | 14 174 | 66 | 0.21438 | 14 127 174 | 49 |
| 115 | 0.10093 | 14 174 | 80 | 0.11028 | 174 | 75 |
| 121 | 0.13894 | 14 174 | 77 | 0.10823 | 14 174 | 76 |
| 125 | 0.00112 | 14 174 | 93 | 0.00113 | 14 174 | 93 |
| 126 | 0.25734 | 14 174 | 50 | 0.20483 | 174 | 51 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 0.56401 | 14 154 174 | 17 | 0.55809 | 14 154 174 | 17 |
| 131 | 0.09758 | 15 174 | 82 | 0.09485 | 15 174 | 78 |
| 132 | 0.15380 | 174 | 72 | 0.08394 | 174 | 82 |
| 133 | 0.23740 | 15 174 | 54 | 0.16016 | 174 | 60 |
| 137 | 0.23982 | 174 | 53 | 0.17655 | 174 | 56 |
| 139 | 0.19390 | 154 174 | 62 | 0.15675 | 14 174 | 62 |
| 140 | 0.64084 | 14 154 174 | 15 | 0.64631 | 127 154 174 | 15 |
| 142 | 0.37973 | 14 154 174 | 37 | 0.36662 | 127 | 34 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 152 | 0.20657 | 174 210 217 | 60 | 0.15870 | 174 217 | 61 |
| 154 | 1.00000 | 154 | 1 | 1.00000 | 154 | 1 |
| 156 | 0.26916 | 14 174 | 49 | 0.16486 | 174 | 59 |
| 159 | 0.14658 | 14 15 174 | 76 | 0.13415 | 174 | 68 |
| 160 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 161 | 0.40556 | 14 55 174 | 34 | 0.22776 | 14 174 | 46 |
| 162 | 0.28408 | 14 174 | 46 | 0.22662 | 14 174 | 47 |
| 163 | 0.45947 | 15 154 174 | 26 | 0.47424 | 154 174 | 21 |
| 168 | 0.18805 | 14 174 | 64 | 0.11942 | 174 | 73 |
| 173 | 0.10768 | 174 | 78 | 0.06551 | 174 | 86 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 0.47612 | 14 154 174 | 23 | 0.38750 | 14 154 174 | 31 |
| 177 | 0.46210 | 174 | 25 | 0.28557 | 174 | 39 |
| 182 | 0.24487 | 14 174 | 51 | 0.19078 | 14 174 | 53 |
| 185 | 0.43031 | 12 127 160 | 29 | 0.38642 | 14 127 160 | 32 |
| 190 | 0.49808 | 154 174 | 21 | 0.43746 | 154 174 | 25 |
| 191 | 0.39324 | 174 | 36 | 0.23167 | 174 | 45 |
| 192 | 0.28529 | 14 174 | 45 | 0.23386 | 14 174 | 44 |
| 193 | 0.28315 | 174 | 47 | 0.21984 | 174 | 48 |
| 194 | 0.23248 | 174 | 56 | 0.18601 | 174 | 55 |
| 196 | 0.01937 | 15 174 | 91 | 0.01738 | 15 174 | 92 |
| 197 | 0.32582 | 15 174 | 42 | 0.26318 | 174 | 41 |
| 198 | 1.00000 | 198 | 1 | 1.00000 | 198 | 1 |
| 200 | 0.10051 | 14 174 | 81 | 0.07604 | 127 174 | 83 |
| 203 | 0.06892 | 15 174 | 86 | 0.06311 | 15 174 | 87 |
| 204 | 0.41712 | 14 174 | 31 | 0.41643 | 14 174 | 27 |
| 206 | 0.19500 | 15 174 | 61 | 0.16735 | 174 | 58 |
| 207 | 0.09353 | 14 174 | 83 | 0.08551 | 174 | 80 |
| 210 | 1.00000 | 210 | 1 | 1.00000 | 210 | 1 |
| 217 | 1.00000 | 217 | 1 | 1.00000 | 217 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-C-5** Comparative CRS-SBM scores for 2009 with different measures of labour

Portfolio Management stage

| | Using number of employees | | | Using personnel expenses | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.40521 | 7 14 76 | 42 | 0.38819 | 7 14 76 | 44 |
| 4 | 1.00000 | 4 | 1 | 1.00000 | 4 | 1 |
| 6 | 0.13156 | 14 50 76 | 82 | 0.16045 | 14 50 76 | 78 |
| 7 | 1.00000 | 7 | 1 | 1.00000 | 7 | 1 |
| 9 | 0.23876 | 76 | 65 | 0.22978 | 76 | 67 |
| 12 | 0.63083 | 14 46 | 25 | 0.69551 | 14 46 | 23 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.24576 | 14 46 | 61 | 0.26034 | 14 46 | 59 |
| 20 | 0.21855 | 14 46 51 | 69 | 0.23557 | 14 46 51 | 64 |
| 21 | 0.23710 | 14 46 | 66 | 0.24590 | 14 46 | 62 |
| 24 | 0.25751 | 14 46 76 | 57 | 0.27218 | 76 | 57 |
| 29 | 0.38650 | 45 76 131 | 45 | 0.40643 | 45 76 131 | 41 |
| 31 | 0.51517 | 7 14 50 51 | 32 | 0.44427 | 7 14 46 | 35 |
| 34 | 0.14753 | 14 76 | 79 | 0.15063 | 76 | 81 |
| 35 | 0.56053 | 46 76 210 | 28 | 0.54203 | 50 76 174 | 28 |
| 36 | 0.06559 | 46 76 | 89 | 0.07549 | 76 174 | 88 |
| 37 | 0.24667 | 14 46 76 | 60 | 0.27455 | 14 46 76 | 56 |
| 38 | 0.04226 | 14 50 76 | 90 | 0.05607 | 7 14 50 | 91 |
| 40 | 0.12595 | 45 46 76 100 | 84 | 0.15476 | 45 76 174 | 80 |
| 43 | 0.64348 | 7 14 76 128 | 24 | 0.59058 | 7 14 46 128 | 26 |
| 45 | 1.00000 | 45 | 1 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.38456 | 14 46 50 76 | 46 | 0.39978 | 7 14 50 | 42 |
| 49 | 0.18292 | 46 76 | 75 | 0.18258 | 46 76 | 73 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 |
| 51 | 1.00000 | 51 | 1 | 1.00000 | 51 | 1 |
| 53 | 0.03428 | 45 76 | 92 | 0.04477 | 45 76 100 174 | 92 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 57 | 0.36334 | 46 76 210 | 48 | 0.34954 | 46 76 210 | 49 |
| 58 | 0.39576 | 14 46 51 | 43 | 0.41342 | 14 46 51 | 39 |
| 61 | 0.19978 | 14 50 76 | 73 | 0.17760 | 7 14 | 75 |
| 62 | 1.00000 | 62 | 1 | 1.00000 | 62 | 1 |
| 63 | 0.45249 | 14 46 51 | 38 | 0.43186 | 14 46 51 | 37 |
| 69 | 0.03591 | 45 46 76 | 91 | 0.05638 | 45 50 76 174 | 90 |
| 71 | 0.70489 | 7 14 50 76 | 22 | 0.76189 | 7 14 50 76 | 22 |
| 76 | 1.00000 | 76 | 1 | 1.00000 | 76 | 1 |
| 78 | 0.30618 | 46 76 | 53 | 0.31866 | 46 76 | 52 |
| 83 | 0.37017 | 14 46 50 76 | 47 | 0.49336 | 7 127 140 | 32 |
| 84 | 0.46416 | 14 46 51 | 36 | 1.00000 | 84 | 1 |
| 85 | 0.52118 | 14 46 51 | 31 | 0.53493 | 14 46 51 | 29 |
| 86 | 0.48328 | 14 46 51 | 34 | 0.56848 | 14 46 51 | 27 |
| 93 | 0.14737 | 14 50 76 | 80 | 0.14435 | 50 76 | 84 |
| 95 | 0.60825 | 7 14 46 50 51 140 | 26 | 0.62757 | 7 14 46 127 140 | 24 |
| 98 | 0.15652 | 7 14 76 | 78 | 0.14605 | 7 14 | 82 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.18388 | 76 | 74 | 0.13271 | 46 128 | 85 |
| 105 | 0.01502 | 14 46 | 94 | 0.02238 | 14 46 50 | 94 |
| 110 | 0.34448 | 7 14 50 76 | 49 | 0.37690 | 7 14 50 76 | 46 |
| 113 | 0.17287 | 14 51 | 76 | 0.20992 | 14 50 | 69 |
| 115 | 0.08306 | 46 50 76 100 | 86 | 0.11679 | 76 100 174 | 86 |
| 121 | 0.24066 | 14 46 50 | 64 | 0.23113 | 14 46 127 | 65 |
| 125 | 0.00176 | 14 46 | 95 | 0.00175 | 14 46 | 95 |
| 126 | 0.24345 | 46 76 | 63 | 0.24475 | 50 76 | 63 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 0.85387 | 7 14 51 128 140 | 21 | 0.81420 | 7 14 51 128 140 | 21 |
| 131 | 1.00000 | 131 | 1 | 1.00000 | 131 | 1 |
| 132 | 0.25683 | 76 | 58 | 0.23040 | 50 76 | 66 |
| 133 | 0.20976 | 45 46 76 | 71 | 0.17856 | 45 46 76 | 74 |
| 137 | 0.25320 | 46 76 | 59 | 0.27671 | 76 174 | 55 |
| 139 | 0.45351 | 46 76 210 | 37 | 0.44078 | 45 46 76 | 36 |
| 140 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 |
| 142 | 0.28848 | 14 46 51 | 56 | 0.28020 | 14 46 51 | 54 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 152 | 1.00000 | 152 | 1 | 0.16647 | 45 76 100 174 | 77 |
| 154 | 0.65242 | 14 46 76 | 23 | 0.61763 | 7 14 46 76 | 25 |
| 156 | 0.29329 | 50 76 | 55 | 0.35208 | 76 174 | 48 |
| 159 | 0.21585 | 14 46 76 | 70 | 0.22536 | 14 46 76 | 68 |
| 160 | 0.31310 | 14 46 76 | 51 | 0.32353 | 46 76 | 51 |
| 161 | 0.54754 | 14 50 76 | 30 | 0.53026 | 50 76 | 30 |
| 162 | 0.47966 | 14 46 76 | 35 | 0.48333 | 50 76 | 33 |
| 163 | 0.41834 | 7 14 50 76 | 40 | 0.41213 | 7 14 46 76 | 40 |
| 168 | 0.20792 | 46 76 | 72 | 0.20245 | 46 76 | 70 |
| 173 | 0.40896 | 14 50 51 | 41 | 0.36590 | 7 14 46 | 47 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 0.58569 | 14 50 51 76 | 27 | 0.52523 | 7 14 46 50 | 31 |
| 177 | 0.12601 | 14 50 76 | 83 | 0.15941 | 76 174 | 79 |
| 182 | 0.38700 | 14 50 76 | 44 | 0.38750 | 14 46 50 | 45 |
| 185 | 0.32710 | 14 51 | 50 | 0.29825 | 7 14 46 | 53 |
| 190 | 0.49875 | 7 14 50 76 | 33 | 0.46920 | 7 14 46 76 | 34 |
| 191 | 0.55086 | 46 76 174 | 29 | 0.39083 | 45 76 174 | 43 |
| 192 | 0.15836 | 14 50 76 | 77 | 0.17071 | 76 174 | 76 |
| 193 | 1.00000 | 193 | 1 | 1.00000 | 193 | 1 |
| 194 | 0.42958 | 46 76 210 | 39 | 0.43137 | 46 76 210 | 38 |
| 195 | 0.30678 | 46 76 210 | 52 | 0.34296 | 46 76 174 | 50 |
| 196 | 0.02243 | 14 46 76 | 93 | 0.02336 | 14 46 76 | 93 |
| 197 | 0.30023 | 45 76 174 | 54 | 0.26811 | 45 76 | 58 |
| 198 | 0.22702 | 14 46 50 76 | 68 | 0.25106 | 14 46 50 76 | 61 |
| 200 | 0.11143 | 14 46 | 85 | 0.14519 | 14 46 127 | 83 |
| 203 | 0.07050 | 45 46 76 | 88 | 0.06514 | 45 46 76 | 89 |
| 204 | 0.24552 | 14 46 76 | 62 | 0.25271 | 14 50 76 | 60 |
| 206 | 0.14670 | 45 46 76 | 81 | 0.19499 | 76 174 | 71 |
| 207 | 0.08097 | 14 46 76 | 87 | 0.08387 | 14 46 76 | 87 |
| 210 | 1.00000 | 210 | 1 | 1.00000 | 210 | 1 |
| 217 | 1.00000 | 217 | 1 | 1.00000 | 217 | 1 |
| 221 | 0.23553 | 50 76 174 | 67 | 0.19116 | 50 76 174 | 72 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

# Appendix D

**Table I-D-1** Comparative CRS-SBM scores for 2005 with different measures of capital

Portfolio Management stage

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 1 | 0.33795 | 12 161 | 66 | 0.53279 | 58 76 161 | 26 |
| 2 | 0.40030 | 12 177 | 59 | 0.12208 | 14 161 | 73 |
| 4 | 0.42223 | 14 161 | 55 | 0.39042 | 14 161 | 36 |
| 6 | 1.00000 | 6 | 1 | 1.00000 | 6 | 1 |
| 7 | 1.00000 | 7 | 1 | 0.46946 | 58 161 | 27 |
| 9 | 0.24942 | 12 177 | 78 | 0.11632 | 55 161 | 75 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.54453 | 12 161 | 44 | 0.42234 | 14 161 | 31 |
| 20 | 0.49983 | 12 161 | 48 | 0.36019 | 14 161 | 40 |
| 21 | 0.21632 | 161 | 80 | 0.19796 | 161 | 60 |
| 24 | 0.41055 | 12 177 | 56 | 0.20284 | 161 | 59 |
| 29 | 0.45102 | 12 43 177 | 53 | 0.17641 | 58 76 | 64 |
| 31 | 0.64661 | 12 177 | 36 | 0.20623 | 14 161 | 58 |
| 34 | 0.20845 | 12 177 | 81 | 0.16511 | 58 76 | 68 |
| 35 | 0.81735 | 12 40 160 176 177 | 30 | 0.41603 | 76 161 | 33 |
| 36 | 0.17644 | 12 174 | 85 | 0.11162 | 58 76 | 76 |
| 37 | 0.32688 | 12 40 174 177 | 68 | 0.05238 | 14 161 | 88 |
| 38 | 0.12944 | 12 160 176 | 89 | 0.08748 | 14 58 161 | 80 |
| 40 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.11366 | 12 55 174 | 93 | 0.08123 | 58 76 | 81 |
| 43 | 1.00000 | 43 | 1 | 1.00000 | 43 | 1 |
| 45 | 0.55011 | 12 174 177 | 43 | 0.32369 | 58 76 | 43 |
| 46 | 0.06900 | 12 152 | 96 | 0.01116 | 14 161 | 98 |
| 47 | 0.48304 | 12 176 | 49 | 0.26208 | 161 | 50 |
| 49 | 0.38867 | 12 40 174 177 | 60 | 1.00000 | 49 | 1 |
| 50 | 0.14370 | 12 177 | 88 | 0.10637 | 58 76 161 | 77 |
| 51 | 0.58078 | 12 40 160 161 | 39 | 0.26209 | 40 161 | 49 |
| 53 | 1.00000 | 53 | 1 | 0.03129 | 76 161 40 | 93 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 57 | 0.28221 | 12 174 | 74 | 0.07292 | 76 161 | 84 |
| 58 | 0.70651 | 12 161 | 35 | 1.00000 | 58 | 1 |
| 59 | 0.02740 | 12 161 | 99 | 0.02628 | 14 | 95 |
| 60 | 0.00646 | 12 40 | 102 | 0.00536 | 58 161 | 101 |
| 61 | 0.31073 | 55 161 | 70 | 0.32169 | 161 | 44 |
| 62 | 0.64389 | 12 160 161 176 | 37 | 0.29555 | 58 161 | 47 |
| 63 | 0.76928 | 12 43 154 160 | 31 | 0.33739 | 14 161 | 41 |
| 69 | 0.11333 | 12 174 177 | 94 | 0.03724 | 14 76 161 | 90 |
| 71 | 1.00000 | 71 | 1 | 0.75293 | 76 158 161 | 22 |
| 73 | 0.70830 | 12 174 177 | 33 | 0.25351 | 76 161 | 51 |
| 75 | 0.47698 | 12 161 | 50 | 0.38013 | 58 161 | 38 |
| 76 | 1.00000 | 76 | 1 | 1.00000 | 76 | 1 |
| 78 | 0.35690 | 12 174 177 | 63 | 0.11863 | 58 76 | 74 |
| 83 | 0.61178 | 12 55 161 | 38 | 0.37250 | 14 55 161 | 39 |
| 84 | 0.45669 | 14 161 | 52 | 0.45139 | 14 161 | 30 |
| 85 | 0.46772 | 12 161 | 51 | 0.39786 | 14 161 | 35 |
| 86 | 0.50307 | 161 | 46 | 0.38555 | 58 161 | 37 |
| 93 | 0.19591 | 12 55 161 | 83 | 0.17589 | 58 161 | 65 |
| 95 | 0.73830 | 55 161 | 32 | 0.60206 | 14 161 | 24 |
| 98 | 0.38578 | 12 43 160 | 62 | 0.07966 | 14 161 | 82 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.03736 | 12 152 | 98 | 0.01015 | 76 | 99 |
| 103 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.41006 | 12 163 177 | 57 | 0.10630 | 40 58 | 78 |
| 110 | 0.56571 | 12 161 | 40 | 0.56575 | 58 161 | 25 |
| 113 | 0.17183 | 12 14 161 | 86 | 0.14956 | 14 161 | 72 |
| 115 | 0.15611 | 12 100 174 | 87 | 0.06802 | 76 100 | 86 |
| 121 | 0.27680 | 161 | 75 | 0.31817 | 58 76 | 45 |
| 123 | 0.12551 | 12 160 177 | 91 | 0.02579 | 14 161 | 96 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 125 | 0.01309 | 14 161 | 101 | 0.02950 | 40 58 | 94 |
| 126 | 0.35117 | 12 177 | 65 | 0.15364 | 58 76 | 70 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 1.00000 | 130 | 1 | 0.46603 | 58 161 | 28 |
| 131 | 0.12109 | 12 152 | 92 | 0.03915 | 58 76 | 89 |
| 132 | 0.26751 | 12 161 177 | 76 | 0.23848 | 58 161 | 54 |
| 133 | 0.28577 | 12 40 174 | 73 | 0.07821 | 76 161 | 83 |
| 137 | 0.30621 | 12 174 | 72 | 0.15272 | 58 76 | 71 |
| 138 | 0.18856 | 12 152 | 84 | 0.01647 | 58 76 | 97 |
| 139 | 0.20468 | 12 177 | 82 | 0.18147 | 40 58 76 | 61 |
| 140 | 1.00000 | 140 | 1 | 0.41887 | 161 | 32 |
| 142 | 0.35601 | 161 | 64 | 0.27316 | 161 | 48 |
| 152 | 1.00000 | 152 | 1 | 0.06910 | 76 100 | 85 |
| 154 | 1.00000 | 154 | 1 | 0.41481 | 14 161 | 34 |
| 156 | 0.31727 | 12 55 174 | 69 | 0.21961 | 58 76 | 56 |
| 159 | 0.32720 | 12 55 174 177 | 67 | 1.00000 | 159 | 1 |
| 160 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 161 | 1.00000 | 161 | 1 | 1.00000 | 161 | 1 |
| 162 | 0.70769 | 12 55 154 176 177 | 34 | 0.46184 | 161 | 29 |
| 163 | 1.00000 | 163 | 1 | 1.00000 | 163 | 1 |
| 164 | 0.06441 | 12 174 | 97 | 0.03274 | 58 76 | 91 |
| 168 | 0.23644 | 12 55 174 | 79 | 0.17642 | 58 76 | 63 |
| 173 | 0.30974 | 12 177 | 71 | 0.21370 | 58 76 161 | 57 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 1.00000 | 176 | 1 | 0.65023 | 76 161 | 23 |
| 177 | 1.00000 | 177 | 1 | 1.00000 | 177 | 1 |
| 182 | 0.55858 | 12 176 177 | 41 | 0.31532 | 58 161 | 46 |
| 185 | 0.38616 | 12 43 154 | 61 | 0.22769 | 58 161 | 55 |
| 189 | 0.12673 | 12 152 | 90 | 0.00719 | 58 76 | 100 |
| 190 | 0.55505 | 12 176 177 | 42 | 0.24303 | 14 161 | 52 |
| 191 | 0.40856 | 12 174 177 | 58 | 0.17693 | 14 76 161 | 62 |
| 192 | 1.00000 | 192 | 1 | 1.00000 | 192 | 1 |
| 193 | 1.00000 | 193 | 1 | 1.00000 | 193 | 1 |
| 194 | 0.82258 | 12 43 174 198 | 29 | 0.16771 | 58 76 | 67 |
| 195 | 0.53370 | 12 174 198 | 45 | 0.17460 | 58 76 | 66 |
| 196 | 0.01433 | 12 40 152 | 100 | 0.00165 | 14 161 | 102 |
| 197 | 0.50042 | 12 174 177 | 47 | 0.15706 | 58 76 161 | 69 |
| 198 | 1.00000 | 198 | 1 | 0.10180 | 58 161 | 79 |
| 200 | 0.42806 | 55 174 177 | 54 | 0.32734 | 161 174 | 42 |
| 202 | 0.25857 | 12 40 161 174 177 | 77 | 0.24248 | 40 58 76 | 53 |
| 205 | 1.00000 | 205 | 1 | 0.03209 | 58 76 | 92 |
| 206 | 0.10614 | 12 152 174 | 95 | 0.05562 | 58 76 | 87 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-D-2** Comparative CRS-SBM scores for 2006 with different measures of capital

Portfolio Management stage

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | | | | | | |
| 4 | 0.44895 | 12 177 205 | 47 | 0.10996 | 14 161 | 82 |
| 6 | 0.36609 | 14 51 | 57 | 0.34527 | 14 51 | 50 |
| 7 | 0.24471 | 51 55 161 | 72 | 0.28396 | 14 161 | 56 |
| 9 | 0.80473 | 12 51 53 154 163 | 26 | 0.46688 | 58 161 | 38 |
| 12 | 0.21437 | 140 174 | 75 | 0.11370 | 14 161 | 81 |
| 14 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 15 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 20 | 0.56122 | 12 51 127 | 34 | 0.45221 | 12 51 59 127 | 40 |
| 21 | 0.54491 | 12 51 127 | 36 | 0.38326 | 14 127 | 46 |
| 24 | 0.24047 | 127 | 73 | 0.25921 | 14 127 | 59 |
| 29 | 0.42342 | 12 177 205 | 51 | 0.21261 | 14 161 | 62 |
| 31 | 0.41718 | 12 128 205 | 52 | 0.20492 | 58 192 205 | 63 |
| 34 | 0.84051 | 12 51 53 154 163 | 25 | 0.33377 | 14 51 161 | 51 |
| 35 | 0.16519 | 12 177 | 84 | 0.12525 | 58 161 | 80 |
| 36 | 0.51953 | 12 174 | 39 | 0.37968 | 58 76 161 | 47 |
| 37 | 0.16393 | 12 14 174 | 85 | 1.00000 | 36 | 1 |
| 38 | 0.37920 | 12 174 205 | 56 | 0.06105 | 14 51 161 | 90 |
| 40 | 0.10118 | 12 51 163 | 95 | 0.05737 | 14 205 | 91 |
| 42 | 0.10521 | 174 | 94 | 1.00000 | 40 | 1 |
| 43 | 0.14496 | 14 174 | 88 | 0.18994 | 76 100 36 | 67 |
| 45 | 0.69014 | 128 154 163 198 205 | 28 | 0.43122 | 58 161 192 | 44 |
| 46 | 0.50592 | 12 174 | 41 | 0.43185 | 76 174 192 | 43 |
| 47 | 0.12119 | 12 205 | 91 | 0.02474 | 14 205 | 97 |
| 49 | 0.41186 | 12 51 | 53 | 0.29090 | 161 | 53 |
| 50 | 0.32253 | 12 174 | 63 | 1.00000 | 49 | 1 |
| 51 | 0.12725 | 12 174 | 90 | 0.13339 | 58 76 161 205 | 79 |
| 53 | 1.00000 | 51 | 1 | 1.00000 | 51 | 1 |
| 55 | 1.00000 | 53 | 1 | 0.03456 | 14 51 | 95 |
| 57 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 58 | 0.34304 | 174 | 60 | 0.08702 | 14 161 | 85 |
| 59 | 0.53423 | 12 51 128 | 38 | 1.00000 | 58 | 1 |
| 60 | 1.00000 | 59 | 1 | 1.00000 | 59 | 1 |
| 61 | 0.00147 | 12 205 | 102 | 0.00154 | 58 205 | 101 |
| 62 | 0.20216 | 14 161 | 78 | 0.22262 | 14 161 | 60 |
| 63 | 1.00000 | 62 | 1 | 1.00000 | 62 | 1 |
| 69 | 0.62818 | 12 53 128 163 205 | 32 | 0.28924 | 14 51 127 | 54 |
| 71 | 0.16152 | 12 174 205 | 86 | 0.04714 | 14 174 | 93 |
| 75 | 1.00000 | 71 | 1 | 0.72412 | 58 161 | 27 |
| 76 | 0.34772 | 12 51 128 | 59 | 0.36397 | 14 51 | 49 |
| 78 | 0.64041 | 55 174 | 30 | 1.00000 | 76 | 1 |
| 83 | 0.44933 | 12 174 | 46 | 0.16402 | 14 58 161 | 73 |
| 84 | 0.73548 | 12 51 55 127 140 | 27 | 0.47999 | 14 51 127 | 37 |
| 85 | 0.44491 | 14 51 127 | 49 | 0.55870 | 14 51 127 | 29 |
| 86 | 0.45866 | 12 51 128 | 43 | 0.44679 | 14 51 | 41 |
| 93 | 0.50058 | 12 51 | 42 | 0.54407 | 58 161 | 31 |
| 95 | 0.20408 | 14 51 55 | 77 | 0.18631 | 161 205 | 69 |
| 98 | 0.45104 | 12 14 51 | 45 | 0.48983 | 14 161 | 34 |
| 100 | 0.35902 | 12 51 | 58 | 0.07141 | 14 51 | 89 |
| 102 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.02073 | 12 174 205 | 99 | 0.00771 | 76 | 100 |
| 105 | 0.17378 | 55 127 | 83 | 0.19168 | 161 | 66 |
| 110 | 0.11507 | 12 174 | 92 | 1.00000 | 105 | 1 |
| 113 | 0.51738 | 12 51 | 40 | 0.48021 | 58 161 | 36 |
| 115 | 0.19399 | 12 14 51 | 81 | 0.14310 | 14 127 | 78 |
| 121 | 0.23929 | 14 174 | 74 | 1.00000 | 115 | 1 |
| 123 | 0.19729 | 14 51 | 79 | 0.22036 | 161 | 61 |
| 125 | 0.13253 | 12 177 205 | 89 | 0.02708 | 14 51 | 96 |
| 126 | 0.01207 | 14 51 | 100 | 0.04535 | 40 58 139 | 94 |
| 127 | 0.28710 | 12 174 | 66 | 0.08598 | 14 161 | 87 |
| 128 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 130 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 131 | 1.00000 | 130 | 1 | 0.55430 | 14 62 127 | 30 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 132 | 0.11444 | 12 174 205 | 93 | 0.05136 | 58 76 | 92 |
| 133 | 0.45200 | 12 51 177 205 | 44 | 0.36619 | 58 161 | 48 |
| 137 | 0.26298 | 12 174 | 70 | 0.08046 | 161 174 | 88 |
| 139 | 0.28825 | 12 174 | 65 | 0.15316 | 14 58 161 | 76 |
| 140 | 0.19623 | 12 51 154 | 80 | 1.00000 | 139 | 1 |
| 142 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 |
| 152 | 0.26240 | 12 51 | 71 | 0.27109 | 58 161 | 58 |
| 154 | 0.32485 | 12 174 | 62 | 1.00000 | 152 | 1 |
| 156 | 1.00000 | 154 | 1 | 0.46301 | 14 51 161 | 39 |
| 159 | 0.27883 | 12 14 174 | 68 | 0.15089 | 14 161 174 | 77 |
| 160 | 0.26417 | 12 174 | 69 | 0.18317 | 58 76 | 70 |
| 161 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 162 | 1.00000 | 161 | 1 | 1.00000 | 161 | 1 |
| 163 | 0.54073 | 14 51 55 140 177 | 37 | 0.39332 | 161 | 45 |
| 164 | 1.00000 | 163 | 1 | 0.51069 | 58 127 161 | 32 |
| 168 | 0.08552 | 12 174 205 | 97 | 0.08689 | 76 58 161 205 | 86 |
| 173 | 0.17788 | 12 14 174 | 82 | 0.17425 | 58 76 | 71 |
| 174 | 0.43200 | 12 177 | 50 | 0.31460 | 58 161 | 52 |
| 176 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 177 | 0.85503 | 12 140 161 177 | 24 | 0.57588 | 14 161 | 28 |
| 182 | 1.00000 | 177 | 1 | 1.00000 | 177 | 1 |
| 185 | 0.63326 | 12 51 53 163 177 | 31 | 0.48200 | 58 62 161 | 35 |
| 190 | 0.28203 | 51 128 | 67 | 0.20477 | 14 51 127 | 64 |
| 191 | 0.44540 | 12 51 205 | 48 | 0.18754 | 14 161 | 68 |
| 192 | 0.39387 | 12 174 | 54 | 0.20023 | 14 174 | 65 |
| 193 | 0.59081 | 161 174 | 33 | 1.00000 | 192 | 1 |
| 194 | 0.54975 | 12 174 177 | 35 | 0.43266 | 161 174 | 42 |
| 195 | 1.00000 | 194 | 1 | 1.00000 | 194 | 1 |
| 196 | 0.21295 | 12 174 198 | 76 | 0.09168 | 58 76 | 83 |
| 197 | 0.04463 | 12 205 | 98 | 0.00936 | 14 205 | 99 |
| 198 | 0.38743 | 12 174 | 55 | 0.16609 | 58 76 161 | 72 |
| 200 | 1.00000 | 198 | 1 | 0.15397 | 14 58 161 | 75 |
| 202 | 0.33249 | 55 161 | 61 | 0.27155 | 161 | 57 |
| 203 | 0.30145 | 12 177 205 | 64 | 0.15527 | 58 161 205 | 74 |
| 204 | 0.00248 | 205 | 101 | 0.00036 | 205 | 102 |
| 205 | 0.86527 | 12 14 174 177 205 | 23 | 0.50161 | 51 161 174 | 33 |
| 206 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 |
| 207 | 0.15011 | 12 174 | 87 | 0.08915 | 40 58 76 | 84 |
| 210 | 0.09895 | 12 205 | 96 | 0.02457 | 14 205 | 98 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-D-3** Comparative CRS-SBM scores for 2007 with different measures of capital

Portfolio Management stage

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| MFMC | SBM | Ref. | Rank | SBM | Ref. | Rank |
| 2 | 0.51806 | 7 12 50 198 | 39 | 0.12766 | 14 50 127 | 74 |
| 4 | 0.43624 | 12 14 51 127 | 46 | 0.50552 | 12 14 51 127 | 31 |
| 6 | 0.26835 | 14 174 177 | 69 | 0.37524 | 14 152 174 177 | 42 |
| 7 | 1.00000 | 7 | 1 | 0.53578 | 14 50 127 | 27 |
| 9 | 0.25915 | 12 177 | 72 | 0.14459 | 51 55 | 70 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.62492 | 12 51 127 | 34 | 0.53020 | 12 51 127 | 29 |
| 20 | 0.17673 | 12 51 | 82 | 0.14966 | 14 51 | 68 |
| 21 | 0.29413 | 12 51 127 | 66 | 0.35075 | 14 51 127 | 44 |
| 24 | 0.39268 | 12 152 | 52 | 0.16639 | 14 50 177 | 65 |
| 29 | 0.39638 | 12 50 198 | 51 | 0.19723 | 95 | 60 |
| 31 | 0.38277 | 12 152 177 198 | 56 | 0.20128 | 14 51 177 | 58 |
| 34 | 0.16140 | 12 50 | 84 | 0.13508 | 95 | 73 |
| 35 | 0.74560 | 12 174 177 198 | 26 | 0.60963 | 95 152 161 | 26 |
| 36 | 0.17889 | 12 174 | 80 | 0.11796 | 14 174 | 76 |
| 37 | 0.35377 | 12 152 198 | 60 | 0.08321 | 14 51 177 | 82 |
| 38 | 0.09342 | 12 51 | 90 | 0.08357 | 14 50 | 81 |
| 40 | 0.13492 | 12 174 | 89 | 0.04975 | 14 174 | 85 |
| 43 | 0.69769 | 12 50 128 198 | 28 | 0.32216 | 95 | 46 |
| 45 | 0.65904 | 12 174 177 198 | 30 | 0.83944 | 152 161 | 22 |
| 46 | 0.13909 | 12 174 210 | 87 | 0.01078 | 14 174 | 92 |
| 47 | 0.44036 | 12 51 | 45 | 0.31184 | 14 51 | 47 |
| 49 | 0.29208 | 12 198 | 67 | 0.14381 | 95 152 | 72 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 |
| 51 | 1.00000 | 51 | 1 | 1.00000 | 51 | 1 |
| 53 | 1.00000 | 53 | 1 | 0.01003 | 14 51 | 93 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 57 | 0.29513 | 12 198 | 65 | 0.11133 | 14 50 95 | 77 |
| 58 | 0.40114 | 12 51 127 | 50 | 1.00000 | 58 | 1 |
| 59 | 0.03667 | 12 14 51 | 92 | 0.02486 | 14 51 | 89 |
| 61 | 0.23730 | 14 51 | 73 | 0.26096 | 14 50 | 54 |
| 62 | 0.62576 | 12 50 127 177 | 33 | 1.00000 | 62 | 1 |
| 63 | 0.35861 | 12 51 | 59 | 0.28227 | 12 14 51 | 51 |
| 69 | 0.47606 | 198 | 42 | 0.04440 | 14 174 177 | 86 |
| 71 | 0.68783 | 12 14 177 | 29 | 1.00000 | 71 | 1 |
| 75 | 0.39004 | 12 51 128 | 54 | 0.45675 | 14 51 127 | 34 |
| 76 | 0.64337 | 14 174 177 | 32 | 1.00000 | 76 | 1 |
| 78 | 1.00000 | 78 | 1 | 0.33240 | 14 95 161 177 | 45 |
| 83 | 1.00000 | 83 | 1 | 0.68825 | 12 55 127 128 | 24 |
| 84 | 0.43146 | 12 14 51 127 | 48 | 0.53546 | 14 51 127 | 28 |
| 85 | 0.34176 | 12 51 128 | 61 | 0.43828 | 12 14 151 127 | 36 |
| 86 | 0.65432 | 12 50 51 127 | 31 | 1.00000 | 86 | 1 |
| 93 | 0.19031 | 12 14 51 | 78 | 0.23442 | 14 50 95 152 | 56 |
| 95 | 0.58126 | 12 51 | 36 | 1.00000 | 95 | 1 |
| 98 | 0.23619 | 12 50 | 74 | 0.06738 | 12 14 51 | 83 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 0.01355 | 14 174 | 90 |
| 103 | 0.17974 | 12 51 127 128 | 79 | 0.19291 | 14 95 127 | 61 |
| 105 | 0.01915 | 12 14 51 | 93 | 0.03419 | 152 95 | 88 |
| 110 | 0.45598 | 12 51 | 43 | 0.46672 | 50 95 | 33 |
| 113 | 0.19658 | 12 14 51 | 77 | 0.15834 | 14 50 51 | 67 |
| 115 | 0.17387 | 12 174 | 83 | 0.21073 | 152 174 95 | 57 |
| 121 | 0.23576 | 12 51 | 75 | 0.27867 | 14 50 | 52 |
| 125 | 0.00157 | 14 51 | 95 | 0.00596 | 95 | 94 |
| 126 | 0.30830 | 12 152 177 198 | 63 | 0.12524 | 14 174 177 | 75 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 0.55948 | 12 50 51 128 | 38 | 0.44063 | 14 50 | 35 |
| 131 | 0.14736 | 12 198 | 86 | 1.00000 | 131 | 1 |
| 132 | 0.41934 | 12 51 177 | 49 | 0.41650 | 152 95 | 38 |
| 133 | 0.36801 | 12 174 198 | 57 | 0.09574 | 14 174 | 79 |
| 137 | 0.39150 | 12 174 198 | 53 | 0.17360 | 14 174 | 63 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 139 | 0.28044 | 12 51 128 198 | 68 | 0.25274 | 152 95 | 55 |
| 140 | 1.00000 | 140 | 1 | 0.64220 | 14 50 127 | 25 |
| 142 | 0.29894 | 12 51 | 64 | 0.41284 | 50 58 | 39 |
| 152 | 1.00000 | 152 | 1 | 1.00000 | 152 | 1 |
| 154 | 0.90413 | 12 51 128 140 198 | 22 | 0.48836 | 14 50 127 | 32 |
| 156 | 0.34074 | 12 14 174 177 | 62 | 0.19130 | 14 174 177 | 62 |
| 159 | 0.17862 | 12 152 198 | 81 | 0.09006 | 95 152 | 80 |
| 160 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 161 | 0.75521 | 14 51 55 127 174 177 | 24 | 1.00000 | 161 | 1 |
| 162 | 0.47837 | 14 51 127 | 41 | 0.52254 | 14 50 177 | 30 |
| 163 | 1.00000 | 163 | 1 | 0.41073 | 50 95 | 40 |
| 168 | 0.22990 | 12 14 174 177 | 76 | 0.36918 | 95 152 | 43 |
| 173 | 0.35901 | 12 50 | 58 | 0.31172 | 95 | 48 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 0.75386 | 12 51 149 177 198 | 25 | 0.70812 | 14 50 127 177 | 23 |
| 177 | 1.00000 | 177 | 1 | 1.00000 | 177 | 1 |
| 182 | 0.44175 | 12 51 | 44 | 0.38040 | 95 | 41 |
| 185 | 0.26586 | 51 128 | 70 | 0.20105 | 127 | 59 |
| 190 | 0.56018 | 12 50 177 198 | 37 | 0.28572 | 14 127 177 | 50 |
| 191 | 0.60545 | 12 174 198 | 35 | 0.26171 | 14 174 177 | 53 |
| 192 | 0.38297 | 14 174 177 | 55 | 1.00000 | 192 | 1 |
| 193 | 0.71789 | 12 152 177 198 | 27 | 0.41897 | 14 152 161 177 | 37 |
| 194 | 0.48534 | 12 198 | 40 | 0.10803 | 14 51 | 78 |
| 196 | 0.04396 | 12 198 | 91 | 0.01123 | 14 152 | 91 |
| 197 | 0.43505 | 12 198 | 47 | 0.16896 | 95 152 177 | 64 |
| 198 | 1.00000 | 198 | 1 | 0.14829 | 14 51 177 | 69 |
| 200 | 0.15380 | 51 127 | 85 | 0.16180 | 51 127 | 66 |
| 203 | 0.00418 | 174 | 94 | 0.00045 | 174 | 95 |
| 204 | 0.78538 | 12 50 177 198 | 23 | 0.30341 | 14 51 177 | 49 |
| 206 | 0.26231 | 12 152 174 | 71 | 0.06269 | 14 152 174 | 84 |
| 207 | 0.13670 | 12 174 | 88 | 0.03710 | 14 174 | 87 |
| 210 | 1.00000 | 210 | 1 | 0.14448 | 14 95 152 177 | 71 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-D-4** Comparative CRS-SBM scores for 2008 with different measures of capital

Portfolio Management stage

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.33993 | 14 174 | 40 | 0.11392 | 14 174 | 64 |
| 4 | 0.49801 | 14 127 174 | 22 | 0.49613 | 14 127 | 16 |
| 6 | 0.15269 | 14 174 | 73 | 0.18451 | 14 76 174 | 48 |
| 7 | 0.59259 | 14 15 154 174 | 16 | 0.32926 | 127 174 | 30 |
| 9 | 0.16354 | 14 174 | 68 | 0.12050 | 14 174 | 61 |
| 12 | 1.00000 | 12 | 1 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 1.00000 | 15 | 1 | 0.37024 | 12 127 | 25 |
| 20 | 0.27041 | 14 127 174 | 48 | 0.22664 | 127 | 42 |
| 21 | 0.29940 | 14 127 | 43 | 0.24527 | 127 | 39 |
| 24 | 0.18848 | 174 | 63 | 0.11657 | 14 174 | 63 |
| 29 | 0.16027 | 174 | 69 | 0.10700 | 76 | 69 |
| 31 | 0.23317 | 174 | 55 | 0.13988 | 14 174 | 56 |
| 34 | 0.15519 | 14 174 | 71 | 0.10824 | 76 127 | 67 |
| 35 | 0.46813 | 14 174 | 24 | 0.31579 | 76 174 | 31 |
| 36 | 0.08975 | 14 174 | 84 | 0.05197 | 14 174 | 80 |
| 37 | 0.21857 | 174 | 58 | 0.06875 | 14 174 | 75 |
| 38 | 0.06335 | 14 174 | 87 | 0.04548 | 14 174 | 82 |
| 40 | 0.04120 | 14 174 | 88 | 0.01670 | 14 174 | 86 |
| 43 | 0.22706 | 14 174 | 57 | 0.15729 | 127 | 53 |
| 45 | 0.28680 | 14 174 | 44 | 1.00000 | 45 | 1 |
| 46 | 0.02133 | 15 210 | 90 | 0.00248 | 76 | 92 |
| 47 | 0.32840 | 14 154 174 | 41 | 0.24072 | 14 174 | 40 |
| 49 | 0.16823 | 15 174 | 67 | 0.11990 | 76 127 | 62 |
| 50 | 0.15546 | 14 174 | 70 | 1.00000 | 50 | 1 |
| 51 | 0.41660 | 14 127 154 174 | 32 | 0.28915 | 14 127 174 | 33 |
| 53 | 0.21290 | 210 217 | 59 | 0.00573 | 14 174 | 90 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 57 | 0.24432 | 174 | 52 | 0.08907 | 14 127 174 | 72 |
| 58 | 0.43570 | 12 127 160 | 28 | 0.57284 | 14 127 | 15 |
| 61 | 0.18555 | 14 174 | 65 | 0.16743 | 14 174 | 50 |
| 62 | 0.36581 | 14 174 | 38 | 0.19300 | 14 174 | 47 |
| 63 | 0.51151 | 14 154 174 | 20 | 0.35701 | 14 127 | 26 |
| 69 | 0.15155 | 15 174 | 74 | 0.01815 | 14 174 | 85 |
| 71 | 0.40797 | 14 174 | 33 | 0.48912 | 76 174 | 17 |
| 76 | 0.64471 | 14 55 127 174 | 14 | 1.00000 | 76 | 1 |
| 78 | 0.34477 | 14 174 | 39 | 0.17621 | 14 76 174 | 49 |
| 83 | 1.00000 | 83 | 1 | 0.33031 | 14 55 174 | 29 |
| 84 | 0.39343 | 14 127 174 | 35 | 0.37249 | 14 127 174 | 24 |
| 85 | 0.53103 | 12 14 127 160 | 18 | 0.45923 | 14 127 | 18 |
| 86 | 0.42106 | 14 154 174 | 30 | 0.29132 | 127 | 32 |
| 93 | 0.14790 | 14 174 | 75 | 0.13290 | 76 174 | 57 |
| 95 | 0.51312 | 14 154 174 | 19 | 0.39267 | 14 127 174 | 22 |
| 98 | 0.10369 | 174 | 79 | 0.02021 | 14 174 | 84 |
| 100 | 0.01315 | 210 | 92 | 0.00206 | 76 | 93 |
| 103 | 0.08069 | 14 174 | 85 | 0.07972 | 127 | 74 |
| 105 | 0.02505 | 14 174 | 89 | 0.05409 | 127 | 78 |
| 110 | 0.43663 | 14 154 174 | 27 | 0.33701 | 127 174 | 28 |
| 113 | 0.18537 | 14 174 | 66 | 0.14933 | 14 127 174 | 54 |
| 115 | 0.10093 | 14 174 | 80 | 1.00000 | 115 | 1 |
| 121 | 0.13894 | 14 174 | 77 | 0.12597 | 14 174 | 59 |
| 125 | 0.00112 | 14 174 | 93 | 0.00710 | 127 | 89 |
| 126 | 0.25734 | 14 174 | 50 | 0.11030 | 14 76 174 | 65 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 1.00000 | 128 | 1 |
| 130 | 0.56401 | 14 154 174 | 17 | 0.35436 | 14 127 174 | 27 |
| 131 | 0.09758 | 15 174 | 82 | 0.05992 | 127 | 77 |
| 132 | 0.15380 | 174 | 72 | 0.14856 | 76 | 55 |
| 133 | 0.23740 | 15 174 | 54 | 0.05331 | 14 174 | 79 |
| 137 | 0.23982 | 174 | 53 | 0.10837 | 14 76 | 66 |
| 139 | 0.19390 | 154 174 | 62 | 0.16001 | 76 127 | 52 |
| 140 | 0.64084 | 14 154 174 | 15 | 0.37605 | 14 127 174 | 23 |
| 142 | 0.37973 | 14 154 174 | 37 | 0.28503 | 127 | 35 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 152 | 0.20657 | 174 210 217 | 60 | 1.00000 | 152 | 1 |
| 154 | 1.00000 | 154 | 1 | 0.64112 | 14 127 174 | 14 |
| 156 | 0.26916 | 14 174 | 49 | 0.27429 | 76 | 37 |
| 159 | 0.14658 | 14 15 174 | 76 | 0.06350 | 76 | 76 |
| 160 | 1.00000 | 160 | 1 | 1.00000 | 160 | 1 |
| 161 | 0.40556 | 14 55 174 | 34 | 1.00000 | 161 | 1 |
| 162 | 0.28408 | 14 174 | 46 | 0.27717 | 127 174 | 36 |
| 163 | 0.45947 | 15 154 174 | 26 | 0.26390 | 127 | 38 |
| 168 | 0.18805 | 14 174 | 64 | 0.19756 | 76 127 | 46 |
| 173 | 0.10768 | 174 | 78 | 0.10007 | 76 | 70 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 0.47612 | 14 154 174 | 23 | 0.40663 | 127 174 | 21 |
| 177 | 0.46210 | 174 | 25 | 0.45249 | 174 | 19 |
| 182 | 0.24487 | 14 174 | 51 | 0.20698 | 127 | 45 |
| 185 | 0.43031 | 12 127 160 | 29 | 0.28862 | 12 127 160 | 34 |
| 190 | 0.49808 | 154 174 | 21 | 0.24055 | 14 127 174 | 41 |
| 191 | 0.39324 | 174 | 36 | 0.16052 | 14 174 | 51 |
| 192 | 0.28529 | 14 174 | 45 | 0.41315 | 76 174 | 20 |
| 193 | 0.28315 | 174 | 47 | 0.12604 | 14 76 | 58 |
| 194 | 0.23248 | 174 | 56 | 0.12345 | 127 | 60 |
| 196 | 0.01937 | 15 174 | 91 | 0.00485 | 14 174 | 91 |
| 197 | 0.32582 | 15 174 | 42 | 0.08853 | 76 | 73 |
| 198 | 1.00000 | 198 | 1 | 0.10709 | 14 174 | 68 |
| 200 | 0.10051 | 14 174 | 81 | 0.09009 | 14 127 | 71 |
| 203 | 0.06892 | 15 174 | 86 | 0.01158 | 14 76 174 | 87 |
| 204 | 0.41712 | 14 174 | 31 | 0.20905 | 14 174 | 44 |
| 206 | 0.19500 | 15 174 | 61 | 0.04959 | 14 76 174 | 81 |
| 207 | 0.09353 | 14 174 | 83 | 0.02378 | 14 174 | 83 |
| 210 | 1.00000 | 210 | 1 | 0.22426 | 14 76 174 | 43 |
| 217 | 1.00000 | 217 | 1 | 0.00929 | 14 174 | 88 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-D-5** Comparative CRS-SBM scores for 2009 with different measures of capital

Portfolio Management stage

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.40521 | 7 14 76 | 42 | 0.14820 | 14 76 127 | 64 |
| 4 | 1.00000 | 4 | 1 | 1.00000 | 4 | 1 |
| 6 | 0.13156 | 14 50 76 | 82 | 0.14564 | 14 50 76 | 66 |
| 7 | 1.00000 | 7 | 1 | 0.60022 | 12 14 50 76 127 | 23 |
| 9 | 0.23876 | 76 | 65 | 0.13238 | 14 50 76 | 70 |
| 12 | 0.63083 | 14 46 | 25 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.24576 | 14 46 | 61 | 0.19277 | 14 46 | 55 |
| 20 | 0.21855 | 14 46 51 | 69 | 0.18583 | 14 46 | 57 |
| 21 | 0.23710 | 14 46 | 66 | 0.34658 | 12 14 46 127 | 33 |
| 24 | 0.25751 | 14 46 76 | 57 | 0.15320 | 14 50 76 | 63 |
| 29 | 0.38650 | 45 76 131 | 45 | 0.09405 | 76 | 76 |
| 31 | 0.51517 | 7 14 50 51 | 32 | 0.26786 | 14 51 76 | 40 |
| 34 | 0.14753 | 14 76 | 79 | 0.10147 | 76 | 74 |
| 35 | 0.56053 | 46 76 210 | 28 | 0.28415 | 50 76 | 38 |
| 36 | 0.06559 | 46 76 | 89 | 0.03314 | 50 76 | 87 |
| 37 | 0.24667 | 14 46 76 | 60 | 0.06299 | 14 50 76 | 83 |
| 38 | 0.04226 | 14 50 76 | 90 | 0.04588 | 12 14 50 76 | 85 |
| 40 | 0.12595 | 45 46 76 100 | 84 | 0.04379 | 50 76 | 86 |
| 43 | 0.64348 | 7 14 76 128 | 24 | 1.00000 | 43 | 1 |
| 45 | 1.00000 | 45 | 1 | 0.29914 | 76 100 | 36 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.38456 | 14 46 50 76 | 46 | 0.20653 | 14 50 | 51 |
| 49 | 0.18292 | 46 76 | 75 | 0.22863 | 76 139 | 45 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 |
| 51 | 1.00000 | 51 | 1 | 1.00000 | 51 | 1 |
| 53 | 0.03428 | 45 76 | 92 | 0.00379 | 14 50 76 | 95 |
| 55 | 1.00000 | 55 | 1 | 1.00000 | 55 | 1 |
| 57 | 0.36334 | 46 76 210 | 48 | 0.09897 | 14 50 76 | 75 |
| 58 | 0.39576 | 14 46 51 | 43 | 0.50144 | 12 46 127 | 25 |
| 61 | 0.19978 | 14 50 76 | 73 | 0.18283 | 14 50 76 | 58 |
| 62 | 1.00000 | 62 | 1 | 0.20695 | 14 50 51 76 | 50 |
| 63 | 0.45249 | 14 46 51 | 38 | 0.30849 | 14 46 51 | 35 |
| 69 | 0.03591 | 45 46 76 | 91 | 0.00735 | 14 50 | 94 |
| 71 | 0.70489 | 7 14 50 76 | 22 | 0.67773 | 12 43 50 76 | 21 |
| 76 | 1.00000 | 76 | 1 | 1.00000 | 76 | 1 |
| 78 | 0.30618 | 46 76 | 53 | 0.16103 | 14 50 76 | 60 |
| 83 | 0.37017 | 14 46 50 76 | 47 | 0.22730 | 14 50 76 | 46 |
| 84 | 0.46416 | 14 46 51 | 36 | 0.47878 | 14 46 51 | 26 |
| 85 | 0.52118 | 14 46 51 | 31 | 1.00000 | 85 | 1 |
| 86 | 0.48328 | 14 46 51 | 34 | 1.00000 | 86 | 1 |
| 93 | 0.14737 | 14 50 76 | 80 | 0.11659 | 14 50 76 | 72 |
| 95 | 0.60825 | 7 14 46 50 51 140 | 26 | 0.45715 | 14 50 127 | 29 |
| 98 | 0.15652 | 7 14 76 | 78 | 0.02392 | 14 | 89 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.18388 | 76 | 74 | 0.13552 | 76 | 69 |
| 105 | 0.01502 | 14 46 | 94 | 0.46509 | 76 131 139 | 28 |
| 110 | 0.34448 | 7 14 50 76 | 49 | 0.25858 | 14 50 76 127 | 41 |
| 113 | 0.17287 | 14 51 | 76 | 0.15994 | 14 50 | 61 |
| 115 | 0.08306 | 46 50 76 100 | 86 | 1.00000 | 115 | 1 |
| 121 | 0.24066 | 14 46 50 | 64 | 0.24069 | 14 50 | 42 |
| 125 | 0.00176 | 14 46 | 95 | 0.00892 | 76 | 92 |
| 126 | 0.24345 | 46 76 | 63 | 0.14008 | 50 76 | 67 |
| 127 | 1.00000 | 127 | 1 | 1.00000 | 127 | 1 |
| 128 | 1.00000 | 128 | 1 | 0.19289 | 14 46 | 54 |
| 130 | 0.85387 | 7 14 51 128 140 | 21 | 0.32377 | 14 50 127 | 34 |
| 131 | 1.00000 | 131 | 1 | 1.00000 | 131 | 1 |
| 132 | 0.25683 | 76 | 58 | 0.37387 | 76 | 31 |
| 133 | 0.20976 | 45 46 76 | 71 | 0.07055 | 14 50 76 | 82 |
| 137 | 0.25320 | 46 76 | 59 | 0.08798 | 50 76 | 79 |
| 139 | 0.45351 | 46 76 210 | 37 | 1.00000 | 139 | 1 |
| 140 | 1.00000 | 140 | 1 | 1.00000 | 140 | 1 |
| 142 | 0.28848 | 14 46 51 | 56 | 0.55662 | 12 43 50 76 | 24 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 152 | 1.00000 | 152 | 1 | 1.00000 | 152 | 1 |
| 154 | 0.65242 | 14 46 76 | 23 | 0.42598 | 14 50 76 | 30 |
| 156 | 0.29329 | 50 76 | 55 | 0.21282 | 50 76 | 49 |
| 159 | 0.21585 | 14 46 76 | 70 | 0.14749 | 50 76 | 65 |
| 160 | 0.31310 | 14 46 76 | 51 | 0.24032 | 50 76 | 43 |
| 161 | 0.54754 | 14 50 76 | 30 | 0.46896 | 76 | 27 |
| 162 | 0.47966 | 14 46 76 | 35 | 0.35205 | 14 50 76 | 32 |
| 163 | 0.41834 | 7 14 50 76 | 40 | 0.20179 | 12 14 76 127 | 53 |
| 168 | 0.20792 | 46 76 | 72 | 0.11122 | 50 76 | 73 |
| 173 | 0.40896 | 14 50 51 | 41 | 0.16215 | 14 51 | 59 |
| 174 | 1.00000 | 174 | 1 | 1.00000 | 174 | 1 |
| 176 | 0.58569 | 14 50 51 76 | 27 | 0.61178 | 12 50 76 127 | 22 |
| 177 | 0.12601 | 14 50 76 | 83 | 0.08964 | 50 76 | 78 |
| 182 | 0.38700 | 14 50 76 | 44 | 0.23744 | 14 50 76 | 44 |
| 185 | 0.32710 | 14 51 | 50 | 0.20472 | 14 50 127 | 52 |
| 190 | 0.49875 | 7 14 50 76 | 33 | 0.22185 | 14 50 76 | 47 |
| 191 | 0.55086 | 46 76 174 | 29 | 0.28638 | 50 76 | 37 |
| 192 | 0.15836 | 14 50 76 | 77 | 0.15624 | 50 76 | 62 |
| 193 | 1.00000 | 193 | 1 | 1.00000 | 193 | 1 |
| 194 | 0.42958 | 46 76 210 | 39 | 0.18687 | 12 50 76 | 56 |
| 195 | 0.30678 | 46 76 210 | 52 | 0.28313 | 76 139 | 39 |
| 196 | 0.02243 | 14 46 76 | 93 | 0.00822 | 14 46 | 93 |
| 197 | 0.30023 | 45 76 174 | 54 | 0.08343 | 76 | 81 |
| 198 | 0.22702 | 14 46 50 76 | 68 | 0.09032 | 14 50 76 | 77 |
| 200 | 0.11143 | 14 46 | 85 | 0.08670 | 14 46 | 80 |
| 203 | 0.07050 | 45 46 76 | 88 | 0.01689 | 76 | 90 |
| 204 | 0.24552 | 14 46 76 | 62 | 0.13568 | 14 50 76 | 68 |
| 206 | 0.14670 | 45 46 76 | 81 | 0.04676 | 14 76 | 84 |
| 207 | 0.08097 | 14 46 76 | 87 | 0.02679 | 14 50 76 | 88 |
| 210 | 1.00000 | 210 | 1 | 0.22037 | 14 50 76 | 48 |
| 217 | 1.00000 | 217 | 1 | 0.01562 | 14 50 76 | 91 |
| 221 | 0.23553 | 50 76 174 | 67 | 0.12272 | 50 76 | 71 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

# Appendix E

**Table I-E-1** Comparative CRS-SBM scores for 2005 with different measures of capital

Overall Efficiency

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 1 | 0.04431 | 196 | 99 | 0.01636 | 125 | 91 |
| 2 | 0.04597 | 100 | 97 | 0.01384 | 125 | 96 |
| 4 | 0.14556 | 125 | 55 | 0.06605 | 125 | 42 |
| 6 | 0.09447 | 196 | 71 | 0.03841 | 125 | 64 |
| 7 | 0.07625 | 100 | 82 | 0.02039 | 125 | 82 |
| 9 | 0.27668 | 100 | 25 | 0.08061 | 125 | 38 |
| 12 | 1.00000 | 12 | 1 | 0.20643 | 125 | 17 |
| 14 | 1.00000 | 14 | 1 | 0.22107 | 125 | 15 |
| 15 | 0.13830 | 200 | 57 | 0.04611 | 125 | 57 |
| 20 | 0.26639 | 196 | 28 | 0.07839 | 125 | 39 |
| 21 | 0.20771 | 125 | 36 | 0.09288 | 125 | 32 |
| 24 | 0.06403 | 100 | 89 | 0.01842 | 125 | 86 |
| 29 | 0.08061 | 100 | 79 | 0.02533 | 125 | 77 |
| 31 | 0.07928 | 100 | 80 | 0.01951 | 125 | 83 |
| 34 | 0.10354 | 196 | 68 | 0.03391 | 125 | 67 |
| 35 | 0.08897 | 100 | 75 | 0.02425 | 125 | 78 |
| 36 | 0.34542 | 100 | 19 | 0.17869 | 125 | 21 |
| 37 | 0.17881 | 100 | 43 | 0.06041 | 125 | 46 |
| 38 | 0.19097 | 100 | 40 | 0.07535 | 125 | 41 |
| 40 | 1.00000 | 40 | 1 | 0.26513 | 125 | 10 |
| 42 | 0.33274 | 100 | 20 | 0.19157 | 125 | 19 |
| 43 | 0.05890 | 100 | 90 | 0.01534 | 125 | 94 |
| 45 | 0.21755 | 100 | 35 | 0.06559 | 125 | 45 |
| 46 | 0.58714 | 100 | 14 | 0.32322 | 125 | 7 |
| 47 | 0.07059 | 100 | 84 | 0.01946 | 125 | 84 |
| 49 | 0.19546 | 100 | 39 | 0.10952 | 125 | 28 |
| 50 | 0.22464 | 100 | 33 | 0.13513 | 125 | 25 |
| 51 | 0.13051 | 100 | 59 | 0.04299 | 125 | 58 |
| 53 | 0.26866 | 100 | 27 | 0.17546 | 100 | 22 |
| 55 | 0.30758 | 196 | 21 | 0.08741 | 125 | 35 |
| 57 | 0.15238 | 100 | 51 | 0.05290 | 125 | 51 |
| 58 | 0.18955 | 196 | 41 | 1.00000 | 58 | 1 |
| 59 | 0.14996 | 125 | 53 | 0.09780 | 125 | 30 |
| 60 | 0.35570 | 196 | 18 | 0.33940 | 125 | 6 |
| 61 | 0.03392 | 196 | 100 | 0.01289 | 125 | 98 |
| 62 | 0.15798 | 100 | 49 | 0.04718 | 125 | 56 |
| 63 | 0.04542 | 100 | 98 | 0.01184 | 125 | 100 |
| 69 | 0.12470 | 100 | 61 | 0.08549 | 100 | 36 |
| 71 | 0.10305 | 100 | 70 | 0.02828 | 125 | 74 |
| 73 | 0.17174 | 100 | 45 | 0.03774 | 125 | 65 |
| 75 | 0.05309 | 100 | 94 | 0.01535 | 125 | 93 |
| 76 | 0.26174 | 100 | 29 | 0.25594 | 125 | 11 |
| 78 | 0.12188 | 100 | 62 | 0.04133 | 125 | 60 |
| 83 | 0.07843 | 100 | 81 | 0.02277 | 125 | 79 |
| 84 | 0.49052 | 125 196 | 15 | 0.15525 | 125 | 23 |
| 85 | 0.15520 | 196 | 50 | 0.04957 | 125 | 55 |
| 86 | 0.23166 | 100 | 32 | 0.06599 | 125 | 43 |
| 93 | 0.13984 | 196 | 56 | 0.05232 | 125 | 52 |
| 95 | 0.28886 | 100 | 24 | 0.08063 | 125 | 37 |
| 98 | 0.18462 | 100 | 42 | 0.05357 | 125 | 50 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.65068 | 100 196 | 13 | 0.71453 | 100 125 | 5 |
| 103 | 1.00000 | 103 | 1 | 0.24808 | 125 | 12 |
| 105 | 0.01924 | 100 | 101 | 0.00713 | 125 | 101 |
| 110 | 0.08687 | 100 | 77 | 0.02626 | 125 | 75 |
| 113 | 0.01282 | 196 | 102 | 0.00487 | 125 | 102 |
| 115 | 0.17119 | 100 | 46 | 0.11405 | 125 | 27 |
| 121 | 0.08832 | 196 | 76 | 0.02928 | 125 | 73 |
| 123 | 0.11286 | 100 | 63 | 0.04100 | 125 | 61 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 125 | 1.00000 | 125 | 1 | 1.00000 | 125 | 1 |
| 126 | 0.09324 | 100 | 72 | 0.03274 | 125 | 68 |
| 127 | 0.10429 | 100 | 67 | 0.03041 | 125 | 72 |
| 128 | 0.10884 | 196 | 65 | 0.03117 | 125 | 71 |
| 130 | 0.06501 | 100 | 86 | 0.01642 | 125 | 90 |
| 131 | 0.29562 | 100 | 22 | 0.18149 | 125 | 20 |
| 132 | 0.08999 | 100 | 74 | 0.03233 | 125 | 69 |
| 133 | 0.24787 | 100 | 31 | 0.08768 | 125 | 34 |
| 137 | 0.20631 | 100 | 37 | 0.06579 | 125 | 44 |
| 138 | 0.73150 | 100 152 | 11 | 0.27757 | 100 | 9 |
| 139 | 0.41251 | 196 | 16 | 0.21442 | 125 | 16 |
| 140 | 0.05620 | 100 | 92 | 0.01492 | 125 | 95 |
| 142 | 0.08564 | 196 | 78 | 0.02607 | 125 | 76 |
| 152 | 1.00000 | 152 | 1 | 0.24033 | 125 | 13 |
| 154 | 0.04904 | 100 | 96 | 0.01222 | 125 | 99 |
| 156 | 0.11235 | 100 | 64 | 0.05047 | 125 | 54 |
| 159 | 0.10316 | 100 | 69 | 0.04195 | 125 | 59 |
| 160 | 0.15886 | 100 | 48 | 0.05954 | 125 | 48 |
| 161 | 0.07363 | 100 | 83 | 0.02086 | 125 | 81 |
| 162 | 0.12509 | 100 | 60 | 0.03177 | 125 | 70 |
| 163 | 0.05362 | 100 | 93 | 0.01367 | 125 | 97 |
| 164 | 0.69829 | 125 196 | 12 | 0.29307 | 125 | 8 |
| 168 | 0.15203 | 100 | 52 | 0.06025 | 125 | 47 |
| 173 | 0.05016 | 100 | 95 | 0.01666 | 125 | 89 |
| 174 | 0.37122 | 100 205 | 17 | 0.08986 | 125 | 33 |
| 176 | 0.06601 | 100 | 85 | 0.01775 | 125 | 88 |
| 177 | 0.09050 | 100 | 73 | 0.02274 | 125 | 80 |
| 182 | 0.06486 | 100 | 87 | 0.01828 | 125 | 87 |
| 185 | 0.27353 | 100 | 26 | 0.07611 | 125 | 40 |
| 189 | 0.29159 | 100 | 23 | 0.09519 | 100 | 31 |
| 190 | 0.06482 | 100 | 88 | 0.01863 | 125 | 85 |
| 191 | 0.16560 | 100 | 47 | 0.05370 | 125 | 49 |
| 192 | 0.10601 | 100 | 66 | 0.03647 | 125 | 66 |
| 193 | 0.05747 | 100 | 91 | 0.01609 | 125 | 92 |
| 194 | 0.17578 | 100 | 44 | 0.04062 | 125 | 62 |
| 195 | 0.24808 | 100 | 30 | 0.10941 | 125 | 29 |
| 196 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.13386 | 100 | 58 | 0.05123 | 125 | 53 |
| 198 | 0.14766 | 100 | 54 | 0.04012 | 125 | 63 |
| 200 | 1.00000 | 200 | 1 | 0.22458 | 125 | 14 |
| 202 | 0.22371 | 100 | 34 | 0.11967 | 125 | 26 |
| 205 | 1.00000 | 205 | 1 | 0.14654 | 125 | 24 |
| 206 | 0.20326 | 100 | 38 | 0.19859 | 125 | 18 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-E-2** Comparative CRS-SBM scores for 2006 with different measures of capital

Overall Efficiency

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.05102 | 100 | 101 | 0.01256 | 125 | 98 |
| 4 | 0.20237 | 103 | 41 | 0.09519 | 125 | 33 |
| 6 | 0.13330 | 100 | 63 | 0.04547 | 125 | 54 |
| 7 | 0.08920 | 100 | 82 | 0.01846 | 125 | 87 |
| 9 | 0.33738 | 100 | 22 | 0.08048 | 125 | 36 |
| 12 | 0.48454 | 14 103 | 14 | 0.24282 | 125 | 15 |
| 14 | 1.00000 | 14 | 1 | 1.00000 | 14 | 1 |
| 15 | 0.12844 | 103 | 66 | 0.04839 | 125 | 51 |
| 20 | 0.32461 | 103 | 25 | 0.08012 | 125 | 37 |
| 21 | 0.28615 | 103 | 31 | 0.10428 | 125 | 28 |
| 24 | 0.07796 | 100 | 88 | 0.01798 | 125 | 90 |
| 29 | 0.12851 | 100 | 65 | 0.02754 | 125 | 74 |
| 31 | 0.12455 | 100 | 69 | 0.02419 | 125 | 78 |
| 34 | 0.07962 | 100 | 87 | 0.02279 | 125 | 79 |
| 35 | 0.10131 | 100 | 78 | 0.02252 | 125 | 81 |
| 36 | 0.36283 | 100 | 19 | 0.15807 | 125 | 24 |
| 37 | 0.19572 | 100 | 43 | 0.04745 | 125 | 52 |
| 38 | 0.30177 | 100 | 28 | 0.09732 | 125 | 32 |
| 40 | 0.98297 | 100 103 | 9 | 0.29862 | 125 | 9 |
| 42 | 0.39169 | 100 | 17 | 0.18663 | 125 | 19 |
| 43 | 0.06698 | 100 | 93 | 0.01433 | 125 | 96 |
| 45 | 0.32857 | 100 | 23 | 0.07638 | 125 | 39 |
| 46 | 0.61736 | 100 | 11 | 0.26021 | 125 | 12 |
| 47 | 0.11071 | 100 | 72 | 0.02527 | 125 | 76 |
| 49 | 0.25735 | 100 | 36 | 0.10354 | 125 | 29 |
| 50 | 0.22569 | 100 | 38 | 0.12137 | 125 | 25 |
| 51 | 0.11605 | 100 | 71 | 0.03295 | 125 | 65 |
| 53 | 0.29695 | 100 | 30 | 0.17923 | 100 | 21 |
| 55 | 0.38660 | 103 | 18 | 0.10506 | 125 | 27 |
| 57 | 0.17904 | 100 | 47 | 0.03891 | 125 | 57 |
| 58 | 0.27552 | 103 | 34 | 1.00000 | 58 | 1 |
| 59 | 0.02049 | 125 | 102 | 0.01192 | 125 | 99 |
| 60 | 0.56232 | 100 125 | 13 | 0.54996 | 100 125 | 6 |
| 61 | 0.09254 | 100 | 80 | 0.02775 | 125 | 73 |
| 62 | 0.17945 | 100 | 46 | 0.04597 | 125 | 53 |
| 63 | 0.05501 | 100 | 97 | 0.01175 | 125 | 100 |
| 69 | 0.15998 | 100 | 51 | 0.08906 | 125 | 34 |
| 71 | 0.07392 | 100 | 90 | 0.01624 | 125 | 91 |
| 75 | 0.05768 | 100 | 96 | 0.01371 | 125 | 97 |
| 76 | 0.32722 | 100 | 24 | 0.25726 | 125 | 13 |
| 78 | 0.13623 | 100 | 60 | 0.03146 | 125 | 68 |
| 83 | 0.12697 | 100 | 68 | 0.02916 | 125 | 70 |
| 84 | 0.58563 | 103 | 12 | 0.19833 | 125 | 18 |
| 85 | 0.14745 | 103 | 55 | 0.04877 | 125 | 50 |
| 86 | 0.30006 | 100 | 29 | 0.07075 | 125 | 41 |
| 93 | 0.15319 | 100 | 54 | 0.04427 | 125 | 55 |
| 95 | 0.43432 | 100 103 | 16 | 0.10013 | 125 | 30 |
| 98 | 0.27062 | 100 | 35 | 0.06472 | 125 | 43 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.33771 | 100 | 21 | 0.44143 | 100 | 8 |
| 103 | 1.00000 | 103 | 1 | 0.46866 | 125 | 7 |
| 105 | 0.15480 | 100 | 53 | 0.17633 | 125 | 22 |
| 110 | 0.13768 | 100 | 59 | 0.03330 | 125 | 64 |
| 113 | 0.05241 | 100 | 99 | 0.01444 | 125 | 94 |
| 115 | 0.17871 | 100 | 48 | 0.08567 | 125 | 35 |
| 121 | 0.10587 | 103 | 75 | 0.02782 | 125 | 72 |
| 123 | 0.10904 | 100 | 74 | 0.03267 | 125 | 66 |
| 125 | 1.00000 | 125 | 1 | 1.00000 | 125 | 1 |
| 126 | 0.10139 | 100 | 77 | 0.03342 | 125 | 63 |
| 127 | 0.08865 | 100 | 84 | 0.02107 | 125 | 84 |
| 128 | 0.13552 | 103 | 61 | 0.03829 | 125 | 58 |
| 130 | 0.07611 | 100 | 89 | 0.01618 | 125 | 93 |
| 131 | 0.27757 | 100 | 32 | 0.16271 | 125 | 23 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 132 | 0.13370 | 100 | 62 | 0.03155 | 125 | 67 |
| 133 | 0.25268 | 100 | 37 | 0.07176 | 125 | 40 |
| 137 | 0.30851 | 100 | 27 | 0.07655 | 125 | 38 |
| 139 | 0.48390 | 100 | 15 | 0.20724 | 125 | 17 |
| 140 | 0.08654 | 100 | 85 | 0.01843 | 125 | 88 |
| 142 | 0.08910 | 100 | 83 | 0.02212 | 125 | 83 |
| 152 | 0.34260 | 100 | 20 | 0.18371 | 125 | 20 |
| 154 | 0.05299 | 100 | 98 | 0.01063 | 125 | 101 |
| 156 | 0.10983 | 100 | 73 | 0.03368 | 125 | 62 |
| 159 | 0.09063 | 100 | 81 | 0.02972 | 125 | 69 |
| 160 | 0.18193 | 100 | 45 | 0.05281 | 125 | 48 |
| 161 | 0.09544 | 100 | 79 | 0.02213 | 125 | 82 |
| 162 | 0.16337 | 100 | 50 | 0.03661 | 125 | 60 |
| 163 | 0.05147 | 100 | 100 | 0.00971 | 125 | 102 |
| 164 | 1.00000 | 164 | 1 | 0.25196 | 125 | 14 |
| 168 | 0.16436 | 100 | 49 | 0.06011 | 125 | 45 |
| 173 | 0.07258 | 100 | 92 | 0.01809 | 125 | 89 |
| 174 | 0.31727 | 100 | 26 | 0.06407 | 125 | 44 |
| 176 | 0.07287 | 100 | 91 | 0.01619 | 125 | 92 |
| 177 | 0.12188 | 100 | 70 | 0.02655 | 125 | 75 |
| 182 | 0.10220 | 100 | 76 | 0.02256 | 125 | 80 |
| 185 | 0.13982 | 103 | 57 | 0.04944 | 125 | 49 |
| 190 | 0.08337 | 100 | 86 | 0.01897 | 125 | 86 |
| 191 | 0.15846 | 100 | 52 | 0.04188 | 125 | 56 |
| 192 | 0.12837 | 100 | 67 | 0.03725 | 125 | 59 |
| 193 | 0.06506 | 100 | 95 | 0.01441 | 125 | 95 |
| 194 | 0.18850 | 100 | 44 | 0.06658 | 125 | 42 |
| 195 | 0.21477 | 100 | 40 | 0.09957 | 125 | 31 |
| 196 | 0.85674 | 100 125 164 | 10 | 0.26524 | 125 | 11 |
| 197 | 0.13269 | 100 | 64 | 0.03607 | 125 | 61 |
| 198 | 0.13823 | 100 | 58 | 0.02490 | 125 | 77 |
| 200 | 1.00000 | 200 | 1 | 0.28714 | 125 | 10 |
| 202 | 0.22387 | 100 | 39 | 0.05817 | 125 | 46 |
| 203 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.14578 | 100 | 56 | 0.02887 | 125 | 71 |
| 205 | 1.00000 | 205 | 1 | 0.21208 | 100 | 16 |
| 206 | 0.19629 | 100 | 42 | 0.12050 | 125 | 26 |
| 207 | 0.06510 | 100 | 94 | 0.01944 | 125 | 85 |
| 210 | 0.27657 | 100 | 33 | 0.05779 | 125 | 47 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-E-3** Comparative CRS-SBM scores for 2007 with different measures of capital

Overall Efficiency

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.04937 | 100 | 88 | 0.01199 | 125 | 90 |
| 4 | 0.10488 | 103 | 54 | 0.07647 | 125 | 23 |
| 6 | 0.12678 | 100 | 42 | 0.03340 | 125 | 46 |
| 7 | 0.06810 | 100 | 75 | 0.01625 | 125 | 81 |
| 9 | 0.25633 | 103 | 17 | 0.08144 | 125 | 20 |
| 12 | 0.24853 | 103 | 19 | 0.20661 | 103 | 9 |
| 14 | 0.29689 | 103 | 12 | 0.27076 | 125 | 6 |
| 15 | 0.05225 | 103 | 86 | 0.03515 | 125 | 45 |
| 20 | 0.21514 | 103 | 23 | 0.08143 | 125 | 21 |
| 21 | 0.11364 | 103 | 49 | 0.06098 | 125 | 29 |
| 24 | 0.05693 | 100 | 84 | 0.01379 | 125 | 87 |
| 29 | 0.09364 | 100 | 58 | 0.02440 | 125 | 63 |
| 31 | 0.08811 | 100 | 59 | 0.02157 | 125 | 67 |
| 34 | 0.07355 | 100 | 70 | 0.01884 | 125 | 74 |
| 35 | 0.06677 | 100 | 76 | 0.01659 | 125 | 80 |
| 36 | 0.34604 | 100 | 11 | 0.08785 | 125 | 17 |
| 37 | 0.11603 | 100 | 48 | 0.02817 | 125 | 54 |
| 38 | 0.21607 | 100 | 22 | 0.05455 | 125 | 32 |
| 40 | 0.24673 | 100 | 20 | 0.06247 | 125 | 27 |
| 43 | 0.08387 | 100 | 63 | 0.02174 | 125 | 66 |
| 45 | 0.26707 | 100 | 16 | 0.07078 | 125 | 24 |
| 46 | 0.54995 | 100 | 7 | 0.14776 | 125 | 12 |
| 47 | 0.10175 | 103 | 56 | 0.02613 | 125 | 61 |
| 49 | 0.18861 | 100 | 29 | 0.09966 | 125 | 15 |
| 50 | 0.19133 | 100 | 27 | 0.05790 | 125 | 30 |
| 51 | 0.10175 | 100 | 55 | 0.02543 | 125 | 62 |
| 53 | 0.22934 | 100 | 21 | 0.07039 | 125 | 25 |
| 55 | 0.17281 | 103 | 32 | 0.08568 | 125 | 18 |
| 57 | 0.16067 | 100 | 34 | 0.03802 | 125 | 38 |
| 58 | 0.20325 | 103 | 25 | 0.12627 | 125 | 14 |
| 59 | 0.02239 | 125 | 95 | 0.00926 | 125 | 94 |
| 61 | 0.06150 | 100 | 81 | 0.01545 | 125 | 85 |
| 62 | 0.13891 | 100 | 40 | 0.04330 | 125 | 36 |
| 63 | 0.02930 | 103 | 94 | 0.01271 | 125 | 88 |
| 69 | 0.12486 | 100 | 43 | 0.02845 | 125 | 52 |
| 71 | 0.14463 | 100 | 37 | 0.03718 | 125 | 40 |
| 75 | 0.05125 | 103 | 87 | 0.02011 | 125 | 68 |
| 76 | 0.21237 | 100 | 24 | 0.05328 | 125 | 33 |
| 78 | 0.08658 | 100 | 61 | 0.01943 | 125 | 70 |
| 83 | 0.08579 | 103 | 62 | 0.03078 | 125 | 48 |
| 84 | 0.40844 | 103 | 10 | 0.21293 | 125 | 7 |
| 85 | 0.07036 | 103 | 73 | 0.03688 | 125 | 41 |
| 86 | 0.13901 | 100 | 39 | 0.03606 | 125 | 43 |
| 93 | 0.15701 | 100 | 35 | 0.03957 | 125 | 37 |
| 95 | 0.27348 | 103 | 15 | 1.00000 | 95 | 1 |
| 98 | 0.27933 | 100 | 14 | 0.06841 | 125 | 26 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 0.05561 | 125 | 31 |
| 103 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.28315 | 100 | 13 | 0.14629 | 125 | 13 |
| 110 | 0.12210 | 100 | 45 | 0.03074 | 125 | 49 |
| 113 | 0.04300 | 103 | 90 | 0.01127 | 125 | 91 |
| 115 | 0.14418 | 100 | 38 | 0.04481 | 125 | 35 |
| 121 | 0.08012 | 103 | 64 | 0.03084 | 125 | 47 |
| 125 | 1.00000 | 125 | 1 | 1.00000 | 125 | 1 |
| 126 | 0.07084 | 100 | 72 | 0.01814 | 125 | 77 |
| 127 | 0.07826 | 100 | 67 | 0.01932 | 125 | 72 |
| 128 | 0.05711 | 103 | 83 | 0.02771 | 125 | 57 |
| 130 | 0.06568 | 100 | 79 | 0.01591 | 125 | 83 |
| 131 | 0.18744 | 100 | 30 | 0.09602 | 125 | 16 |
| 132 | 0.10706 | 100 | 53 | 0.02830 | 125 | 53 |
| 133 | 0.20135 | 100 | 26 | 0.04851 | 125 | 34 |
| 137 | 0.25393 | 100 | 18 | 0.06135 | 125 | 28 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 139 | 0.42997 | 100 | 9 | 0.18163 | 125 | 10 |
| 140 | 0.06866 | 100 | 74 | 0.01665 | 125 | 79 |
| 142 | 0.05337 | 103 | 85 | 0.01685 | 125 | 78 |
| 152 | 0.18678 | 100 | 31 | 0.07864 | 125 | 22 |
| 154 | 0.04190 | 100 | 91 | 0.01005 | 125 | 92 |
| 156 | 0.09471 | 100 | 57 | 0.02369 | 125 | 65 |
| 159 | 0.08677 | 100 | 60 | 0.02389 | 125 | 64 |
| 160 | 0.10742 | 100 | 52 | 0.02898 | 125 | 51 |
| 161 | 0.07592 | 100 | 68 | 0.01935 | 125 | 71 |
| 162 | 0.11256 | 100 | 50 | 0.02794 | 125 | 55 |
| 163 | 0.03624 | 100 | 93 | 0.00862 | 125 | 95 |
| 168 | 0.13868 | 100 | 41 | 0.08222 | 125 | 19 |
| 173 | 0.06195 | 100 | 80 | 0.01571 | 125 | 84 |
| 174 | 0.16349 | 100 | 33 | 0.03561 | 125 | 44 |
| 176 | 0.06578 | 100 | 78 | 0.01618 | 125 | 82 |
| 177 | 0.07277 | 100 | 71 | 0.01828 | 125 | 76 |
| 182 | 0.07833 | 100 | 65 | 0.01950 | 125 | 69 |
| 185 | 0.04871 | 103 | 89 | 0.02730 | 125 | 58 |
| 190 | 0.05825 | 100 | 82 | 0.01407 | 125 | 86 |
| 191 | 0.12380 | 100 | 44 | 0.02902 | 125 | 50 |
| 192 | 0.12072 | 100 | 46 | 0.03607 | 125 | 42 |
| 193 | 0.03958 | 100 | 92 | 0.00965 | 125 | 93 |
| 194 | 0.11228 | 100 | 51 | 0.02626 | 125 | 60 |
| 196 | 1.00000 | 196 | 1 | 0.17664 | 125 | 11 |
| 197 | 0.07830 | 100 | 66 | 0.01929 | 125 | 73 |
| 198 | 0.06653 | 100 | 77 | 0.01263 | 125 | 89 |
| 200 | 0.47176 | 103 125 | 8 | 0.21214 | 125 | 8 |
| 203 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.11611 | 100 | 47 | 0.02723 | 125 | 59 |
| 206 | 0.14614 | 100 | 36 | 0.03751 | 125 | 39 |
| 207 | 0.07377 | 100 | 69 | 0.01879 | 125 | 75 |
| 210 | 0.18937 | 100 | 28 | 0.02775 | 125 | 56 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-E-4** Comparative CRS-SBM scores for 2008 with different measures of capital

Overall Efficiency

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.06936 | 100 | 71 | 0.01722 | 125 | 81 |
| 4 | 0.12356 | 103 | 45 | 0.06909 | 125 | 31 |
| 6 | 0.09404 | 46 | 59 | 0.03344 | 125 | 49 |
| 7 | 0.08422 | 100 | 65 | 0.02102 | 125 | 70 |
| 9 | 0.28667 | 46 | 13 | 0.09187 | 125 | 22 |
| 12 | 0.36512 | 103 | 10 | 0.16784 | 125 | 9 |
| 14 | 0.53273 | 46 103 | 7 | 0.21310 | 125 | 5 |
| 15 | 0.06101 | 46 | 82 | 0.01877 | 125 | 77 |
| 20 | 0.24916 | 46 | 23 | 0.08615 | 125 | 26 |
| 21 | 0.10910 | 103 | 52 | 0.03974 | 125 | 42 |
| 24 | 0.06890 | 100 | 72 | 0.01847 | 125 | 78 |
| 29 | 0.05422 | 100 | 86 | 0.01409 | 125 | 87 |
| 31 | 0.05397 | 100 | 87 | 0.01484 | 125 | 85 |
| 34 | 0.05629 | 46 | 84 | 0.01756 | 125 | 80 |
| 35 | 0.10524 | 100 | 56 | 0.02399 | 125 | 65 |
| 36 | 0.37877 | 46 | 9 | 0.12109 | 125 | 14 |
| 37 | 0.11621 | 100 | 48 | 0.03123 | 125 | 53 |
| 38 | 0.09978 | 46 | 58 | 0.03506 | 125 | 48 |
| 40 | 0.07030 | 46 | 70 | 0.02407 | 125 | 64 |
| 43 | 0.06407 | 100 | 79 | 0.01787 | 125 | 79 |
| 45 | 0.26292 | 100 | 19 | 0.19856 | 125 | 7 |
| 46 | 1.00000 | 46 | 1 | 0.36614 | 125 | 4 |
| 47 | 0.08838 | 46 | 62 | 0.02710 | 125 | 61 |
| 49 | 0.16023 | 100 | 35 | 0.10846 | 125 | 17 |
| 50 | 0.28164 | 100 | 17 | 0.08747 | 125 | 25 |
| 51 | 0.13157 | 100 | 43 | 0.03678 | 125 | 47 |
| 53 | 0.40558 | 100 | 8 | 0.10806 | 125 | 19 |
| 55 | 0.22664 | 46 | 26 | 0.07580 | 125 | 28 |
| 57 | 0.11501 | 100 | 49 | 0.03019 | 125 | 55 |
| 58 | 0.28277 | 103 | 16 | 0.11274 | 125 | 15 |
| 61 | 0.06024 | 46 | 83 | 0.02081 | 125 | 71 |
| 62 | 0.14484 | 100 | 38 | 0.03998 | 125 | 41 |
| 63 | 0.02524 | 46 | 91 | 0.00790 | 125 | 91 |
| 69 | 0.23610 | 100 | 25 | 0.06510 | 125 | 32 |
| 71 | 0.13102 | 46 | 44 | 0.03890 | 125 | 44 |
| 76 | 0.13805 | 100 | 41 | 0.15211 | 125 | 10 |
| 78 | 0.09133 | 100 | 61 | 0.02323 | 125 | 67 |
| 83 | 0.06880 | 46 | 73 | 0.02047 | 125 | 73 |
| 84 | 0.26264 | 46 | 20 | 0.09085 | 125 | 23 |
| 85 | 0.08376 | 46 | 66 | 0.02746 | 125 | 59 |
| 86 | 0.06671 | 46 | 77 | 0.01943 | 125 | 76 |
| 93 | 0.18065 | 46 | 31 | 0.06087 | 125 | 35 |
| 95 | 0.22117 | 46 | 27 | 0.06249 | 125 | 34 |
| 98 | 0.20722 | 46 | 29 | 0.06341 | 125 | 33 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 1.00000 | 103 | 1 | 1.00000 | 103 | 1 |
| 105 | 0.00449 | 46 | 93 | 0.00347 | 125 | 93 |
| 110 | 0.11121 | 46 | 51 | 0.03205 | 125 | 51 |
| 113 | 0.07830 | 46 | 67 | 0.02713 | 125 | 60 |
| 115 | 0.19021 | 100 | 30 | 0.11197 | 125 | 16 |
| 121 | 0.07646 | 46 | 68 | 0.02534 | 125 | 62 |
| 125 | 1.00000 | 125 | 1 | 1.00000 | 125 | 1 |
| 126 | 0.09270 | 100 | 60 | 0.02429 | 125 | 63 |
| 127 | 0.06516 | 100 | 78 | 0.12292 | 125 | 13 |
| 128 | 0.06187 | 46 | 81 | 0.01992 | 125 | 74 |
| 130 | 0.05462 | 100 | 85 | 0.01473 | 125 | 86 |
| 131 | 0.21404 | 100 | 28 | 0.12670 | 125 | 12 |
| 132 | 0.10632 | 46 | 55 | 0.03324 | 125 | 50 |
| 133 | 0.28295 | 100 | 15 | 0.07277 | 125 | 30 |
| 137 | 0.28322 | 100 | 14 | 0.07351 | 125 | 29 |
| 139 | 0.35653 | 46 | 11 | 0.19691 | 125 | 8 |
| 140 | 0.06238 | 100 | 80 | 0.01671 | 125 | 83 |
| 142 | 0.14721 | 46 | 37 | 0.04807 | 125 | 36 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 152 | 0.24542 | 100 | 24 | 0.10526 | 125 | 20 |
| 154 | 0.05124 | 100 | 88 | 0.01323 | 125 | 89 |
| 156 | 0.13365 | 100 | 42 | 0.08957 | 125 | 24 |
| 159 | 0.10815 | 100 | 53 | 0.03058 | 125 | 54 |
| 160 | 0.16151 | 100 | 34 | 0.04409 | 125 | 38 |
| 161 | 0.07374 | 46 | 69 | 0.02077 | 125 | 72 |
| 162 | 0.10303 | 46 | 57 | 0.02931 | 125 | 57 |
| 163 | 0.05120 | 100 | 89 | 0.01256 | 125 | 90 |
| 168 | 0.16156 | 100 | 33 | 0.10839 | 125 | 18 |
| 173 | 0.04383 | 46 | 90 | 0.01347 | 125 | 88 |
| 174 | 0.25869 | 100 | 22 | 0.04636 | 125 | 37 |
| 176 | 0.08507 | 100 | 64 | 0.02256 | 125 | 69 |
| 177 | 0.10718 | 100 | 54 | 0.02757 | 125 | 58 |
| 182 | 0.06770 | 46 | 75 | 0.01975 | 125 | 75 |
| 185 | 0.01699 | 46 | 92 | 0.00561 | 125 | 92 |
| 190 | 0.06689 | 100 | 76 | 0.01716 | 125 | 82 |
| 191 | 0.17292 | 100 | 32 | 0.03918 | 125 | 43 |
| 192 | 0.12119 | 46 | 47 | 0.03743 | 125 | 45 |
| 193 | 0.06802 | 100 | 74 | 0.01493 | 125 | 84 |
| 194 | 0.08797 | 100 | 63 | 0.02352 | 125 | 66 |
| 196 | 0.56694 | 46 | 6 | 0.21053 | 125 | 6 |
| 197 | 0.13962 | 100 | 39 | 0.02973 | 125 | 56 |
| 198 | 0.13824 | 100 | 40 | 0.02285 | 125 | 68 |
| 200 | 0.34346 | 103 | 12 | 0.13114 | 125 | 11 |
| 203 | 0.26175 | 100 | 21 | 0.08139 | 125 | 27 |
| 204 | 0.11325 | 100 | 50 | 0.03138 | 125 | 52 |
| 206 | 0.15593 | 100 | 36 | 0.04029 | 125 | 40 |
| 207 | 0.12223 | 100 | 46 | 0.03733 | 125 | 46 |
| 210 | 0.26583 | 100 | 18 | 0.04244 | 125 | 39 |
| 217 | 1.00000 | 217 | 1 | 0.09226 | 125 | 21 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

**Table I-E-5** Comparative CRS-SBM scores for 2009 with different measures of capital

Overall Efficiency

| | Using shareholders' equity | | | Using furniture and equipment | | |
|---|---|---|---|---|---|---|
| **MFMC** | **SBM** | **Ref.** | **Rank** | **SBM** | **Ref.** | **Rank** |
| 2 | 0.06684 | 100 | 74 | 0.02964 | 125 | 83 |
| 4 | 0.07747 | 100 | 64 | 0.05435 | 125 | 57 |
| 6 | 0.09868 | 100 | 55 | 0.07137 | 125 | 46 |
| 7 | 0.08650 | 100 | 59 | 0.03606 | 125 | 78 |
| 9 | 0.23953 | 100 | 19 | 0.13264 | 125 | 23 |
| 12 | 0.00002 | 100 | 95 | 0.00002 | 125 | 95 |
| 14 | 0.24104 | 100 | 18 | 0.15410 | 125 | 19 |
| 15 | 0.05933 | 100 | 83 | 0.03893 | 125 | 70 |
| 20 | 0.23018 | 100 | 20 | 0.14711 | 125 | 21 |
| 21 | 0.11611 | 100 | 49 | 0.07845 | 125 | 40 |
| 24 | 0.06891 | 100 | 72 | 0.03643 | 125 | 77 |
| 29 | 0.07943 | 100 | 62 | 0.02987 | 125 | 82 |
| 31 | 0.07714 | 100 | 65 | 0.03996 | 125 | 69 |
| 34 | 0.08981 | 100 | 57 | 0.05520 | 125 | 56 |
| 35 | 0.10771 | 100 | 52 | 0.04227 | 125 | 65 |
| 36 | 0.31329 | 100 | 14 | 0.20167 | 125 | 14 |
| 37 | 0.11910 | 100 | 48 | 0.06094 | 125 | 53 |
| 38 | 0.06778 | 100 | 73 | 0.04835 | 125 | 61 |
| 40 | 0.29908 | 100 | 15 | 0.17298 | 125 | 16 |
| 43 | 0.07326 | 100 | 68 | 0.03872 | 125 | 71 |
| 45 | 1.00000 | 45 | 1 | 0.27930 | 125 | 7 |
| 46 | 0.60339 | 100 | 7 | 0.50343 | 100 | 3 |
| 47 | 0.08880 | 100 | 58 | 0.04872 | 125 | 60 |
| 49 | 0.14272 | 100 | 37 | 0.17812 | 125 | 15 |
| 50 | 0.26275 | 100 | 16 | 0.16986 | 125 | 17 |
| 51 | 0.13888 | 100 | 38 | 0.07283 | 125 | 45 |
| 53 | 0.35490 | 100 | 11 | 0.16249 | 100 | 18 |
| 55 | 0.12805 | 100 | 42 | 0.07477 | 125 | 42 |
| 57 | 0.18196 | 100 | 27 | 0.07367 | 125 | 43 |
| 58 | 0.16127 | 100 | 33 | 0.10611 | 125 | 30 |
| 61 | 0.00117 | 100 | 94 | 0.00077 | 125 | 94 |
| 62 | 0.17493 | 100 | 28 | 0.07133 | 125 | 47 |
| 63 | 0.01846 | 100 | 93 | 0.01111 | 125 | 93 |
| 69 | 0.32852 | 100 | 13 | 0.23460 | 100 | 10 |
| 71 | 0.12169 | 100 | 46 | 0.06453 | 125 | 51 |
| 76 | 0.12508 | 100 | 44 | 0.20537 | 125 | 13 |
| 78 | 0.14369 | 100 | 36 | 0.07108 | 125 | 48 |
| 83 | 0.04583 | 100 | 90 | 0.02682 | 125 | 87 |
| 84 | 0.17140 | 100 | 30 | 0.11114 | 125 | 29 |
| 85 | 0.07218 | 100 | 69 | 0.04625 | 125 | 62 |
| 86 | 0.06392 | 100 | 77 | 0.03720 | 125 | 73 |
| 93 | 0.19697 | 100 | 26 | 0.12886 | 125 | 24 |
| 95 | 0.06981 | 100 | 70 | 0.03573 | 125 | 79 |
| 98 | 0.09003 | 100 | 56 | 0.05198 | 125 | 59 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 1.00000 | 103 | 1 | 0.45490 | 125 | 4 |
| 105 | 0.04605 | 100 | 89 | 0.08273 | 125 | 36 |
| 110 | 0.07889 | 100 | 63 | 0.04400 | 125 | 64 |
| 113 | 0.04774 | 100 | 87 | 0.03168 | 125 | 80 |
| 115 | 0.17193 | 100 | 29 | 0.20953 | 125 | 12 |
| 121 | 0.06331 | 100 | 79 | 0.04149 | 125 | 66 |
| 125 | 1.00000 | 125 | 1 | 1.00000 | 125 | 1 |
| 126 | 0.12112 | 100 | 47 | 0.06260 | 125 | 52 |
| 127 | 0.06583 | 100 | 75 | 0.03676 | 125 | 76 |
| 128 | 0.02722 | 100 | 92 | 0.01534 | 125 | 92 |
| 130 | 0.05414 | 100 | 84 | 0.02593 | 125 | 88 |
| 131 | 0.83185 | 45 100 217 | 6 | 0.21834 | 125 | 11 |
| 132 | 0.06399 | 100 | 76 | 0.13910 | 125 | 22 |
| 133 | 0.25524 | 100 | 17 | 0.12715 | 125 | 25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 137 | 0.21064 | 100 | 23 | 0.10192 | 125 | 31 |
| 139 | 0.34998 | 100 | 12 | 0.29046 | 125 | 6 |
| 140 | 0.04534 | 100 | 91 | 0.02156 | 125 | 91 |
| 142 | 0.06106 | 100 | 82 | 0.04010 | 125 | 68 |
| 152 | 0.37313 | 100 | 10 | 0.24035 | 125 | 9 |
| 154 | 0.06351 | 100 | 78 | 0.03116 | 125 | 81 |
| 156 | 0.12481 | 100 | 45 | 0.06802 | 125 | 50 |
| 159 | 0.11241 | 100 | 50 | 0.05814 | 125 | 54 |
| 160 | 0.13288 | 100 | 41 | 0.07944 | 125 | 38 |
| 161 | 0.06268 | 100 | 80 | 0.03720 | 125 | 74 |
| 162 | 0.07697 | 100 | 66 | 0.03751 | 125 | 72 |
| 163 | 0.05326 | 100 | 85 | 0.02524 | 125 | 90 |
| 168 | 0.16093 | 100 | 34 | 0.08328 | 125 | 34 |
| 173 | 0.04681 | 100 | 88 | 0.02550 | 125 | 89 |
| 174 | 0.22081 | 100 | 22 | 0.07887 | 125 | 39 |
| 176 | 0.07694 | 100 | 67 | 0.04082 | 125 | 67 |
| 177 | 0.12704 | 100 | 43 | 0.07637 | 125 | 41 |
| 182 | 0.06908 | 100 | 71 | 0.03681 | 125 | 75 |
| 185 | 0.04822 | 100 | 86 | 0.02917 | 125 | 84 |
| 190 | 0.06186 | 100 | 81 | 0.02746 | 125 | 86 |
| 191 | 0.22495 | 100 | 21 | 0.10010 | 125 | 32 |
| 192 | 0.10456 | 100 | 54 | 0.09520 | 125 | 33 |
| 193 | 0.08055 | 100 | 61 | 0.02817 | 125 | 85 |
| 194 | 0.10909 | 100 | 51 | 0.04433 | 125 | 63 |
| 195 | 0.08512 | 100 | 60 | 0.11509 | 125 | 27 |
| 196 | 0.53158 | 100 | 8 | 0.38728 | 125 | 5 |
| 197 | 0.15332 | 100 | 35 | 0.05612 | 125 | 55 |
| 198 | 0.10700 | 100 | 53 | 0.05371 | 125 | 58 |
| 200 | 0.16554 | 100 | 32 | 0.11288 | 125 | 28 |
| 203 | 0.20074 | 100 | 25 | 0.11956 | 125 | 26 |
| 204 | 0.13595 | 100 | 39 | 0.07327 | 125 | 44 |
| 206 | 0.16866 | 100 | 31 | 0.08298 | 125 | 35 |
| 207 | 0.13347 | 100 | 40 | 0.07961 | 125 | 37 |
| 210 | 0.20425 | 100 | 24 | 0.06813 | 125 | 49 |
| 217 | 1.00000 | 217 | 1 | 0.15366 | 100 | 20 |
| 221 | 0.45852 | 100 103 | 9 | 0.26628 | 125 | 8 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). SBM corresponds to the efficiency score obtained by the Slacks-Based-Measure under CRS (Equation I.15). Ref. corresponds to the reference set for each company obtained by the SBM approach (Equation I.21). Rank represents the ranking of the SBM scores which have been sorted by value, where SBM scores with value of 1.00000 obtain the highest ranking 1.

# PART II: FURTHER EVALUATION OF EFFICIENCY OF MUTUAL FUND MANAGEMENT COMPANIES

# 1 Introduction

In Part I, we proposed a new specific model suitable for the banking industry to evaluate for the first time the efficiency of MFMCs based on the unoriented methodology proposed by Holod and Lewis (2011), which aims to close the debate between production and asset approaches. We also applied different management stages to an MFMC based on the ideas by Berkowitz and Qiu (2003). Therefore, our specific model captures the interaction between the different requirements of the stakeholders of an MFMC and the diverse sub-decisions making units (DMUs) within a company to properly evaluate the efficiency of these financial institutions (see Figure I-5, Part I).

To appropriately evaluate the efficiency of the MFMC, it was necessary to develop adequate indicators to describe the main management activities of these firms. Previously published DEA banking and insurance literature were the sources of the variables selected and appropriately represent the inputs and outputs in our original model. In our first management stage (portfolio management), we defined inputs that captured the labour, capital and risk that are assumed in the management of mutual fund portfolios and outputs that represented the success of this management, such as the amount of assets, gross return records, diversification capacity and investment categories in the market. As outlined in our unoriented model, the results of this *Portfolio Management stage* should be appropriate indicators of the quality of the mutual funds that will be sold by the *Marketing and Service stage* of the company. Therefore, in our second management stage, we used intermediate inputs coming from outputs of the previous *Portfolio Management stage*, with the only difference being the nature of the returns (net return records). These inputs were considered to evaluate the success or failure of the marketing and distribution of the company, which was measured by the unitholder flows and the net money flows, as well as by the new management fees received. Finally, the *Overall Efficiency* of the MFMCs considered the final profits obtained by the company shareholders after the whole production process, i.e., after the *Portfolio Management* and Marketing stages of the mutual funds managed by the company.

The application of a non-oriented frontier approach using the slacks-based measure of the DEA model proposed by Tone (2001) was discussed in detail in Part I to justify this technique as an initial and appropriate tool to obtain the efficiency scores of the MFMCs. The consistency of the efficiency results obtained by using different measures of the most controversial variables included in our model proved the robustness of our findings. Although the returns-to-scale influence suggests that size seems to be an important variable to successfully sell mutual funds, we provide evidence that the best-managed funds are not the most-efficient sellers. This considerably reduces overall shareholder profits. This major finding of the study is consistent for all the years analysed in Part I of this thesis.

However, DEA and the following extensions of this method fail to identify the 'best practice' competitors that can serve as a benchmark for the companies analysed in light of the striking differences potentially found between the characteristics of the companies evaluated and those considered as 'best practice' competitors. This failure could limit the accuracy of some results in the literature. This problem is especially relevant in those industries where competitors show assorted characteristics, such as the Spanish fund industry. That is, the set of a DEA 'best practice' frontier formed by bank-owned large fund companies offering an assorted range of large funds might not be an appropriate benchmark for small-sized independent managers focused on a small number of funds, thereby offering misleading efficiency rankings of fund families.

In other words, the original SBM model evaluates the efficiency of the MFMCs, referring to the furthest frontier point within a range, but this evaluation approach may go to a remote point of the frontier and therefore to an inappropriate identification of the reference set, i.e., the 'best practice' benchmark for each MFMC analysed. This problem may be particularly important in the Spanish fund industry, where the selection of appropriate benchmarks is very important due to both the high concentration and assorted characteristics of the management companies.

In this part of the thesis, we overcome this limitation by using recent and unexplored variations of the original slacks-based measure (SBM) proposed by Tone (2010). These new and innovative variations allow for the comparison of fund companies with their true ‘best practice’ competitors (benchmark) according to both management resources and objectives, thereby fitting fully to the assorted characteristics of the Spanish mutual funds industry. We will also analyse the effect of these variants on the efficiency rankings obtained by the original SBM as a first step to quantifying the bias because of the use of inappropriate reference sets of competitors. The application of these new SBM techniques will improve the accuracy of results and will complement the mere consideration of variable-returns-to-scale to evaluate the efficiency of DMUs with different scale features. These variations proposed by Tone (2010) are based on the hyperplanes rather than the vertices of the frontier, allowing the method to find more suitable facets with respect to the analysed DMU.

Finally, applying the clustering process originally proposed by Tone (2010), we achieve a refined evaluation of efficient companies focused only on those facets formed by competitors with similar characteristics. Our clustering proposal is based on the assets managed and labour effort by the companies because, as we found in Part I (Table I-3), a large number of small fund companies managing a residual market share and a reduced number of huge fund companies dominate the industry. Under these clustering criteria, we assume the hypothesis that fund companies with clustering-homogeneous size should have similar opportunities to reach efficiency at every management stage, thereby solving the potential scale effects in the distribution and marketing stage that were anticipated in Part I. The use of this clustering variation of Tone (2010) allows for the identification of locally efficient companies in relation to competitors with similar clustering characteristics.

Tone (2010) used different variations versus the original SBM (Tone, 2001) as a good approach to determine potential benchmark bias in this efficiency methodology. It is necessary to check in this Part II whether the patterns of efficiency obtained by the above techniques are persistent over time, i.e., if the efficiency results obtained by the different stages and companies correspond to stable patterns of the management process. Otherwise, if these efficiency results were subject to a considerable variability along time, that would question the conclusions obtained for specific dates and companies; that is, it would not be possible to differentiate efficient management strategies from other temporary factors and results. This analysis should separate those companies that follow clearly efficient management patterns from other companies with much more erratic management results in relation to competitors. This persistence phenomenon has been extensively discussed in the literature on mutual funds but, as far as we know, never applied to fund management companies. To test this hypothesis, we will use a nonparametric approach based on clusters of efficiency instead of mere ranking quartiles or quintiles, allowing us to identify homogeneous groups of efficiency to provide greater reliability to our conclusions.

Finally, we aim to identify those major factors that seem mainly to drive the efficiency results of the fund management companies. This issue is particularly important in those financial markets with assorted competitors and characteristics, such as the Spanish fund industry. This analysis will be conducted based on the efficiency clusters designed in the previous persistence analysis, which will allow us to draw conclusions based on similar working groups and to further contrast those relevant factors in the efficiency scores over our time horizon.

This Part II unfolds as follows: Section 2 reviews the major concepts of the Variations to the original SBM approach and the empirical results of these variants in the Spanish mutual fund companies. Section 3 illustrates the persistence phenomenon in the efficiency scores and determines those relevant factors which may potentially drive the persistence results obtained by the companies along our horizon of study. Finally, Section 4 concludes and summarises the major findings of the study.

# 2 Variations of the Slacks-based measure (SBM) of efficiency

## 2.1 Basic concepts of the new measures

Part I has shown that there are many approaches to implement DEA methodology. 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 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 addresses the slacks of each input and output individually and independently to integrate them into an efficiency measure (SBM). However, Tone (2010) states that the problem with this slacks-based measure is that it aims to minimise this score, and the appropriate referent point could be far from the DMU analysed.

In most DEA models, the production possibility set is a polyhedral convex set with vertices corresponding 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 (See Figure II-1, Figure II-2). Tone (2010) then proposes variants of the original SBM of efficiency (Tone, 2001), which are based on the hyperplanes instead of the vertices of the reference frontier. The first variation (Variation I) aims to obtain the minimum slacks-based measure point on the facet (supporting the hyperplane) that the SBM finds for the objective DMU – that is, to find the nearest referent point on the efficient frontier. 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 might need huge computing resources: Variation III clusters all facets based on common characteristics of their components, and Variation IV makes a random search of these facets.

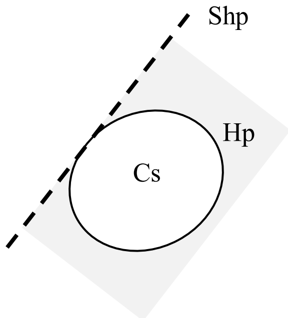



**Figure II-1** Convex set

Cs = Convex set
Shp = Supporting hyperplane
Hp = the half-space delimited by the hyperplane that contains Cs

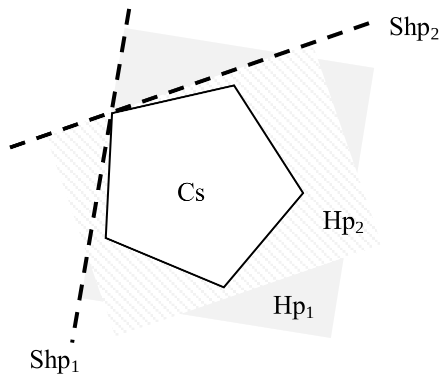



**Figure II-2** Convex set with two Shp

Cs = Convex set
$Shp_1$ = Supporting hyperplane 1
$Shp_2$ = Supporting hyperplane 2
$Hp_1$ = Hyperplane 1
$Hp_2$ = Hyperplane 2

As mentioned above, a major contribution by Tone (2010) is that in his new proposal he considers supporting hyperplanes such as the facets of production possibility set *P* (see Figure II-1, Figure II-2). Let $P_0 = (\xi_j, \eta_j)$ $(j = 1, \dots, k)$ be *k* DMUs in *P*. Tone (2010) makes a linear combination of these *k* DMUs with positive coefficients as

$$\xi_0 = w_1\xi_1 + \cdots + w_k\xi_k,$$
$$\eta_0 = w_1\eta_1 + \cdots + w_k\eta_k$$
$$\text{where } w_j > 0 \ (j = 1, \dots k) \qquad \textbf{(II.1)}$$

Tone (2010) shows in his Theorem 2 that if $(\xi_0, \eta_0)$ defined above is CRS-efficient, then $(\xi_j, \eta_j)$ $(j = 1, \dots, k)$ must be CRS-efficient, and in Theorem 3 that there exists a supporting hyperplane to *P* at $(\xi_0, \eta_0)$ that also supports *P* at $(\xi_j, \eta_j)$ $(j = 1, \dots, k)$.[62]

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

As previously noted in Part I of this thesis, 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. $\lambda$ is a non-negative set of variables $(\lambda_1, \dots, \lambda_n)$ that represents the intensity vector;[63] $s^-$and $s^+$ are the non-negative sets of input excesses and output shortfalls, respectively.

Under the hypothesis of constant returns to scale, the production possibility set *P* was defined in Part I of this thesis as expression (I.7):

$$P = \left\{ (x, y) \backslash \, x \geq \sum_j X_j \lambda_j \, , \qquad y \leq \sum_j Y_j \lambda_j, \; \lambda_j \geq 0 \right\} \qquad \textbf{(I. 7)}$$

Let us review the SBM model (equation I.15) proposed by Tone (2001) to present further variations (Tone, 2010) to this original approach. In this model, an objective DMU $(x_o, y_o)$ 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 $p_o^{min} = 0$

$$minimise \qquad p = \frac{1-(1/m)\sum_{i=1}^{m} s_i^- / x_{io}}{1+(1/s)\sum_{r=1}^{s} s_r^+ / y_{ro}}$$

s.t.

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

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

$$\lambda_j, s_i^-, s_r^+ \geq 0 \qquad \textbf{(I.15)}$$

[63] We can impose some constraints on λ-weights, such as $\sum_j \lambda_j = 1$ (see expression (I.8), the BCC approach), to modify the constant-returns-to-scale production possibility set *P*.

The reference-set $R_0$ to the objective DMU being analysed in equation (I.15) was already presented in the expression (I.21) of Part I; it is defined as the set of DMUs corresponding to positive $\lambda_j^*$

$$R_o = \{j | \lambda_j^* > 0,\ j = 1, \dots n\} \qquad \textbf{(I.21)}$$

According to the following expressions (I.24) and (I.25), the objective DMU can be projected in terms of the reference-set $R_0$, this being projection efficient (see Theorem 1 of Tone, 2010):

$$\bar{x}_0 = x_0 - s^{-*} = \sum_{j \in R_0} x_j \lambda_j^* \qquad (\mathbf{I.24})$$

$$\bar{y}_0 = y_0 + s^{+*} = \sum_{j \in R_0} y_j \lambda_j^* \qquad (\mathbf{I.25})$$

Tone (2010) states that the objective function expressed by the original SBM might project the objective DMU $(\bar{x}_o, \bar{y}_o)$ 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 (equation I.15). These remote projections could sometimes be hard to interpret in terms of appropriate efficiency comparisons.

To overcome this limitation, as previously explained (see expression II.1), Tone (2010) explores facets 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 analysed.

For each inefficient DMU detected in the original SBM expression (I.15), the reference set $R_o$ is obtained according to expression (I.21), which includes only efficient DMUs (see Theorem 2 of Tone, 2010). Next, **SBM Variation I** looks for the nearest point on this reference set by minimising the slacks-based measure from the frontier.

Therefore, this variant modifies the basic SBM model, maximising the objective function rather than minimising it. That is, it evaluates the minimum slacks-based measure and hence the maximum score $p_o^{max}$ on the efficient supporting hyperplane as follows:

$$maximise \qquad p = \frac{1 - {}^{1}/_{m} \sum_{i=1}^{m} {}^{s_i^-}/_{x_{io}}}{1 + {}^{1}/_{s} \sum_{r=1}^{s} {}^{s_r^+}/_{y_{ro}}}$$

s. t.

$$\sum_{j \in R_0} x_j \lambda_j + s^- = x_o$$

$$\sum_{j \in R_0} y_j \lambda_j - s^+ = y_o$$

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

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

$$p_o^{max} \geq p_o^{min} \qquad \textbf{(II.3)}$$

However, there might be other facets of production possibility set *P* apart from those defined by 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 the result of any addition of an efficient DMU (not in *friends*) to *friends* is no more *friends*. Finally, a *friends* is dominated by other friends (*dominated friends*) if the set of efficient DMUs is a subset of others.

Let $P_j = (\xi_j, \eta_j)$ $(j = 1, \dots, K)$ be the CRS-efficient DMUs in the production possibility set *P,* where *K* is the number of efficient DMUs. Tone (2010) defines the following algorithm to find the *maximal friends* facets:[64]

Begin

For $k = 1\ to\ K$

Find *maximal friends* of $P_k$

Next $k$

Delete *dominated friends* from the set of *friends*

Obtain the set of facets from the final set of *friends*

End

Subroutine Find *maximal friends* of $P_k$

Excluded $P_1, \dots, P_{k-1}$ from the candidates of *friends*

Enumerate all *friends* of $P_k$

Remove *dominated friends* from the set of *friends*

Exit sub **(II.4)**

**SBM Variation II** searches while minimising the SBM score obtained from all facets through three steps. First, this variant finds the set of efficient DMUs by solving the basic SBM expression (I.15) and finding the maximal friends of $P_j = (\xi_j, \eta_j)$ $(j = 1, \dots, K)$. Then, this variant enumerates all facets and only selects those *maximal friends*. This second step requires the application of the aforementioned algorithm (II.4). Finally, for each inefficient DMU, Variation I is applied but only for those facets (*h*) selected in the previous step as *maximal friends*.

[64] Additional explanations of this algorithm can be found in section 4 of Tone (2010).

$$p_o^{(h)} = max \frac{1 - {}^1/_m \sum_{i=1}^{m} {}^{s_i^-}/_{x_{io}}}{1 + {}^1/_s \sum_{r=1}^{s} {}^{s_r^+}/_{y_{ro}}}$$

s.t.

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

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

$$\lambda_j, s_i^-, s_r^+ \geq 0 \qquad \textbf{(II.5)}$$

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 *maximal friends* facets (*h*).

$$p_o^{all} = max_h \left\{ p_0^{(h)} \right\} \qquad \textbf{(II.6)}$$

Therefore, Tone (2010) finds the following inequalities among the three SBM scores:[65]

$$p_o^{all} \geq p_o^{max} \geq p_o^{min} \qquad \textbf{(II.7)}$$

However, the enumeration of facets required by Variation II might 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 again requires three steps. First, it is necessary to classify all DMUs in clusters. Second, this variant obtains the efficient DMUs according to the basic SBM model. Observe that this step is similar to the first step of Variation II. Therefore, this variant obtains efficiency scores $p_o^{(h)}$ (equation II.5) for each inefficient DMU with respect to

[65] See brief examples 1 and 2 in Tone's (2010) study for further details of these inequalities.

the *maximal friends* facets composed by efficient DMUs included in the same cluster that each inefficient DMU analysed.[66]

If this model finds no feasible solution for the new within-cluster facets, the DMU analysed is considered to be efficient in its cluster, that is, globally inefficient but locally efficient in relation to the DMUs with common clustering characteristics. The contribution of this variation is quite relevant for homogeneous reference frontiers with regard to the characteristics of those DMUs analysed because it represents a more accurate analysis when working with heterogeneous industry samples.

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.

Tone (2010) proposed another modified version of Variation II that requires much less time and space in computing terms in the enumeration of facets. Thus, **SBM Variation IV** approximates a random search method for enumerating all facets of *P*. Based on the creation of random directions around efficient DMUs obtained from the basic SBM, this variant finds facets by repeating this random search until a sufficiently large number of facets is found. After that, the efficiency scores $p_o^{(h)}$ of Variation II are obtained for each inefficient DMU for those *maximal friends* facets randomly obtained.

[66] If none of the DMUs in the Cluster analysed is efficient, Tone (2010) proposes to pick up the efficient DMUs in the adjacent clusters to form the *maximal friends* facets.

The steps proposed by Tone (2010) are as follows (see the illustrative example in Figure II-3): (1) Let us use the set of $K$ efficient DMUs $P_j = (\xi_j, \eta_j)$ $(j = 1, \dots, K)$ to find the centre of gravity $G$ for inputs and outputs.

$$X_G = (\xi_1 + \cdots + \xi_K)/K, \qquad \textbf{(II.8)}$$

$$Y_G = (\eta_1 + \cdots + \eta_K)/K \qquad \textbf{(II.9)}$$

(2) Create random directions around each efficient DMU, where for each efficient DMU included in set $P_j = (\xi_j, \eta_j)$, the direction from $G$ to $P_j$ is computed as $(\xi_j - X_G, \eta_j - Y_G)$; then, using random numbers, this direction is slightly disturbed $(d_x, d_y)$.

(3) Find a facet by solving the following linear program in $t \in R$ and $\lambda \in R^k$:

$$\begin{aligned} &\max t \\ \text{s.t.}\quad & X_G + d_x t \geq \xi_1\lambda_1 + \cdots + \xi_k\lambda_k \\ & Y_G + d_y t \geq \eta_1\lambda_1 + \cdots + \eta_k\lambda_k \\ & t, \lambda \geq 0 \end{aligned} \qquad \textbf{(II.10)}$$

Let an optimal solution be $(t^*, \eta^*)$. Tone (2010) states that $t^* = 0$ implies that the centre $G$ is efficient and all $P_j = (\xi_j, \eta_j)$ $(j = 1, \dots, K)$ are *friends*. Otherwise, if $t^* > 0$, then the reference DMUs corresponding to positive $\lambda_j^* s$ form a facet of $P$, because the optimal solution is obtained on a limit of $P$.

(4) Repeat the random search around the $K$ efficient DMUs until a sufficient number of facets is found.

(5) Apply Variation II to determine the efficiency scores of the inefficient DMUs.[67]

[67] Details of this random search procedure may be found in section 6.2 of Tone (2010).

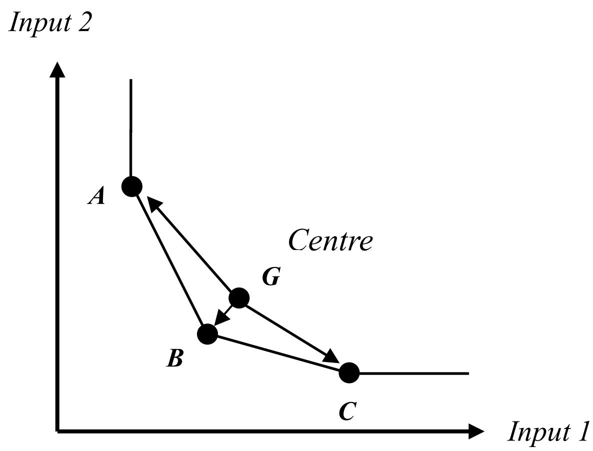



**Figure II-3** Random search around efficient DMUs (Tone, 2010)

The rationale behind this random search is that the perturbed direction around vertices of the reference frontier allows for the probable finding of facets because several facets may be connected at the same vertex. Tone (2010) confirms the possibility of utilising any positive linear combination of efficient DMUs instead of the centre of gravity for Variation IV resolution.[68]

To summarise, this section has reviewed the methodological variations proposed by Tone (2010) to find the nearest point on the efficiency frontier. First, the original SBM is modified to obtain the minimum slacks-based point on the supporting hyperplane (facet) that the SBM found for each DMU (Variation I). Then, this modification is extended to all facets to the production possibility set (Variation II). Finally, due to the massive enumeration of facets required by Variation II, Tone (2010) proposes two additional variations to save computing resources: the clustering process (Variation III) and the random exploration (Variation IV).

[68] Similarly to Part I, the empirical application of the SBM variations proposed by Tone (2010) has been run by the R project software because of adaptation of the R library package "nonparaeff" to the characteristics required by the new SBM variants. More details about this package are in Footnote 52 of Part I.

## 2.2 Comparative evaluation between the SBM original model and SBM Variation I

First, for each Stage considered in the conceptual model developed in Section 3 of Part I (see Figure I-5), we run the original SBM-efficiency model under constant-returns-to-scale (equation I.15). After that, we run SBM Variation I, thereby maximising the objective function for the reference set obtained for each SBM-inefficient company (equation II.2). 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 II-F-1, Table II-F-2, Table II-F-3, Table II-F-4, and Table II-F-5, respectively (Appendix F).

According to Tone (2010), the scores are higher or equal in Variation I than in SBM ($p_o^{max} \geq p_o^{min}$); therefore, they show an improvement of the average efficiency score as a consequence of the new approach for every stage. Table II-1 shows this same finding in aggregate terms. Table II-1 shows that the Spearman rank correlations[69] for both SBM and Variation I are nearly equal to 1 for every stage and year analysed, which raises questions regarding the relevance of this variant in the empirical results of our study.

These rank correlation patterns are also quite visible when we plot the scores obtained by the original SBM and Variation I. In Figure II-G-1, Figure II-G-2, Figure II-G-3, Figure II-G-4, and Figure II-G-5 (Appendix G), the comparative plots appear to be around a straight line, almost perfect for *Marketing* and *Overall Efficiency stages*, which provides evidence of the high degree of similarity between the SBM and Variation I scores obtained in our sample. As in Table II-1, the portfolio management is the stage where graphs show more changes in Variation I scores with respect to those obtained by the original SBM. Nonetheless, the effect is not relevant in the new efficiency rankings as the Spearman rank correlation demonstrates by finding significant and positive correlation coefficients quite close to 1. On the other hand, both *Marketing stage* and *Overall Efficiency* show comparative plots that form almost perfect straight lines, which

[69] The conclusions provided by the Kendall rank correlation coefficients are quite similar. Detailed results are available upon request.

provide evidence of the residual effect of Variation I on the original SBM scores previously obtained.

**Table II-1** Comparative findings between SBM and Variation I scores

| Year | MMS | Average CRS-SBM Scores | Eff. | Average CRS-VAR I Scores | Eff. | Spearman Rank Corr. |
|---|---|---|---|---|---|---|
| 2005 | Stage 1 | 0.53359 | 28 | 0.61504 | 28 | 0.949** |
| | Stage 2 | 0.26553 | 7 | 0.26975 | 7 | 0.999** |
| | Overall Eff. | 0.25697 | 10 | 0.26012 | 10 | 0.999** |
| 2006 | Stage 1 | 0.48751 | 22 | 0.55256 | 22 | 0.961** |
| | Stage 2 | 0.32233 | 8 | 0.33223 | 8 | 0.999** |
| | Overall Eff. | 0.26854 | 8 | 0.27322 | 8 | 0.999** |
| 2007 | Stage 1 | 0.51105 | 21 | 0.57980 | 21 | 0.956** |
| | Stage 2 | 0.34870 | 6 | 0.36163 | 6 | 0.997** |
| | Overall Eff. | 0.19564 | 6 | 0.19665 | 6 | 0.999** |
| 2008 | Stage 1 | 0.37089 | 13 | 0.41167 | 13 | 0.976** |
| | Stage 2 | 0.13860 | 2 | 0.13860 | 2 | 1.000** |
| | Overall Eff. | 0.19781 | 5 | 0.19785 | 5 | 0.999** |
| 2009 | Stage 1 | 0.45114 | 20 | 0.53649 | 20 | 0.929** |
| | Stage 2 | 0.26990 | 7 | 0.27195 | 7 | 0.999** |
| | Overall Eff. | 0.19333 | 5 | 0.19650 | 5 | 0.999** |

MMS = Multi-Management Stages
Eff. = Number of Efficient Companies
** Correlation is significant at the 0.01 level (2-tailed)

Table II-1 supports all the major findings already obtained by the original SBM in Part I (Subsection 4.2). The new approach also highlights the fact that companies seem to be worse mutual fund sellers than portfolio managers, thereby reducing considerably the overall profits of the company shareholders. Similarly to previous SBM findings, the Variation I' scores also show a decreasing efficiency pattern in the Spanish fund industry. Table II-1 also reports that lower efficiency scores involve mostly higher rank correlations. For example, the *Marketing and Service stage* in 2008 shows the lowest average efficiency for the entire sample while the correlation is perfect and positive. On the other hand, in the *Portfolio Management stage* where we find the highest levels of efficiency, the Spearman rank correlation is slightly lower than the other results, but still quite significant.

Furthermore, Table II-2 supports evidence obtained by Variation I comparable to that found by the original SBM in Part I (see Table I-5), where the efficiency scores in the *Portfolio Management stage* are the highest for any year analysed. The rank correlation coefficient obtained by Variation I also provides a negative relationship between the *Portfolio Management* and the *Marketing and Service stage* of the companies from 2005 to 2009. We also find similar evidence but less significance between *Portfolio Management stage* and *Overall Efficiency* of the companies, and a strongly significant and positive rank relationship between the commercial skills and the overall efficiency for the entire time horizon. Table II-2 therefore provides robustness to the major conclusions in the original SBM results in terms of the relationship among the different stages of the model raised in Part I.

**Table II-2** Average CRS-Variation I scores and Spearman's rank correlation

| Year | MMS | Average CRS-VAR I Scores | Eff. | Spearman Rank Corr. (Scores) | | |
|---|---|---|---|---|---|---|
| | | | | Stage 1 | Stage 2 | Overall Eff. |
| 2005 | Stage 1 | 0.61504 | 28 | 1 | -0.281** | -0.147 |
| | Stage 2 | 0.26975 | 7 | | 1 | 0.560** |
| | Overall Eff. | 0.26012 | 10 | | | 1 |
| 2006 | Stage 1 | 0.55256 | 22 | 1 | -0.451** | -0.287** |
| | Stage 2 | 0.33223 | 8 | | 1 | 0.419** |
| | Overall Eff. | 0.27322 | 8 | | | 1 |
| 2007 | Stage 1 | 0.57980 | 21 | 1 | -0.254** | -0.187 |
| | Stage 2 | 0.36163 | 6 | | 1 | 0.359** |
| | Overall Eff. | 0.19665 | 6 | | | 1 |
| 2008 | Stage 1 | 0.41167 | 13 | 1 | -0.643** | -0.220* |
| | Stage 2 | 0.13860 | 2 | | 1 | 0.525** |
| | Overall Eff. | 0.19785 | 5 | | | 1 |
| 2009 | Stage 1 | 0.53649 | 20 | 1 | -0.243* | -0.055 |
| | Stage 2 | 0.27195 | 7 | | 1 | 0.708** |
| | Overall Eff. | 0.19650 | 5 | | | 1 |

MMS = Multi-Management Stages
Eff. = Number of Efficient Companies
* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

## 2.3 Random searches for facets (Variation IV)

As previously discussed, Tone (2010) suggests two modified versions to compute SBM Variation II that reduce the massive enumeration of the required facets to obtain the efficiency scores, i.e., a random search for facets (Variation IV) and clustering facets (Variation III). This subsection details the empirical application of the random search approach to find the facets required for the Variation II efficiency scores. After that, the Variation II efficiency scores will be obtained and compared with the conclusions drawn by the original SBM rankings in Part I of this thesis for the different years and management stages analysed.

According to Tone (2010), the SBM Variation II could be directly applied (equation II.5) if we found a few efficient MFMCs, which would not require huge computation resources to obtain the *maximal friends* solution of the algorithm (II.4). By contrast, the application of the random search Variation IV approach would be necessary if we found a large number of efficient MFMCs and the *maximal friends* facets were difficult to obtain in terms of computing resources.

The SBM efficiency results obtained in our model (Table II-1) show an important number of efficient companies for Stage 1, which implies a massive enumeration of facets in that stage to obtain the *maximal friends* required to apply Variation II. For instance, consider the *Portfolio Management stage* in 2005, where we have $m = 3$ inputs, $s = 4$ outputs, and $k = 28$ efficient companies, which would suppose a total enumeration of 268,435,455 facets.[70] This problem of the massive enumeration of facets does not appear to be important for the *Marketing* and *Overall Efficiency stages*, which provide far fewer efficient companies. Nevertheless, we apply random search-Variation IV to the whole model to provide uniformity to our methodology and results, although the enumeration of facets is not a computing resources problem in both *Marketing* and *Overall Efficiency stages*. In any case, the facets obtained are similar.

[70] In the worst case, we should enumerate $_{28}C_{14}$ = 40,116,600 combinations of 14 MFMCs. Logically, most of these are not efficient cases.

Therefore, the creation of random directions around the centre of gravity of each efficient company allows for the enumeration of facets using much less computing resources and time, this being an issue especially relevant for the *Portfolio Management stage* (Stage 1) of our mutual fund company model.

In our case, we conduct 50,000 simulations inside ±40% bounds around the gravity centre for each SBM-efficient company obtained in the different stages of our model.[71] Therefore, we identify those *maximal friends* facets based on the *friends* obtained in the above-mentioned simulations. Table II-3 details the number of *friends* and *maximal friends* found in our simulations for each different stage and year analysed (see Appendix H where the *maximal friends* facets are detailed for each period). Although the total number of simulations amounts to 8,400,000, the advantage in terms of computing is huge, considering that, just for Stage 1 in 2005, we would have worked with more than 268 million possible combinations.

[71] To test the robustness of this random search, we further compute 25,000 simulations for each efficient company with random limits to 20% and 30%, respectively. Detailed results are available upon request.

**Table II-3** Friends and Maximal Friends (Variation IV)

| Year | MMS | Friends | Maximal friends | # simulations (perturbed direction ±40%) |
|---|---|---|---|---|
| 2005 | Stage 1 | 391 | 55 | 1,400,000 |
| | Stage 2 | 16 | 6 | 350,000 |
| | Overall Eff. | 27 | 8 | 500,000 |
| 2006 | Stage 1 | 436 | 81 | 1,100,000 |
| | Stage 2 | 33 | 4 | 400,000 |
| | Overall Eff. | 23 | 6 | 400,000 |
| 2007 | Stage 1 | 323 | 40 | 1,050,000 |
| | Stage 2 | 11 | 4 | 300,000 |
| | Overall Eff. | 14 | 5 | 300,000 |
| 2008 | Stage 1 | 131 | 15 | 650,000 |
| | Stage 2 | 4 | 1 | 100,000 |
| | Overall Eff. | 12 | 3 | 250,000 |
| 2009 | Stage 1 | 280 | 47 | 1,000,000 |
| | Stage 2 | 18 | 4 | 350,000 |
| | Overall Eff. | 13 | 2 | 250,000 |

MMS = Multi-Management Stages

Once we have identified the *maximal friends* facets randomly obtained, we apply Variation II (equation II.5) to obtain the efficiency scores $p_o^{(h)}$ for each inefficient MFMC. According to Tone (2010), the new Variation II results provided in Appendix I confirm the inequalities (II.7) among the three SBM scores, i.e., $p_o^{all} \geq p_o^{max} \geq p_o^{min}$, and therefore display an additional improvement of the average efficiency score in the new approach for every stage (see Table II-4).

As with the previous comparison between the original SBM and Variation I scores (Table II-1), we also checked for Spearman rank correlation between both efficiency rankings, and again we found evidence of high and significantly positive correlations. This result raises questions regarding the relevance of this modification in practical terms for our study. However, the correlation between Variation I and Variation II scores is still high but lower than that existing between SBM and Variation I. This is an expected result given that the modification proposed by Tone (2010) in Variation II is greater than in Variation I. Finally, although these results call into question the relevance of Variation II in relation to the conclusions obtained by the original SBM in terms of our study, it seems that Variation II provides the most reliable scores according to Tone (2010).

**Table II-4** Comparative findings between Variation I and Variation II scores

| Year | MMS | Average CRS-VAR I Scores | Eff. | Average CRS-VAR II Scores | Eff. | Spearman Rank Corr. |
|---|---|---|---|---|---|---|
| 2005 | Stage 1 | 0.61504 | 28 | 0.76477 | 28 | 0.930** |
| | Stage 2 | 0.26975 | 7 | 0.45864 | 7 | 0.959** |
| | Overall Eff. | 0.26012 | 10 | 0.60882 | 10 | 0.853** |
| 2006 | Stage 1 | 0.55256 | 22 | 0.71020 | 22 | 0.942** |
| | Stage 2 | 0.33223 | 8 | 0.53522 | 8 | 0.913** |
| | Overall Eff. | 0.27322 | 8 | 0.55799 | 8 | 0.887** |
| 2007 | Stage 1 | 0.57980 | 21 | 0.71353 | 21 | 0.945** |
| | Stage 2 | 0.36163 | 6 | 0.61103 | 6 | 0.778** |
| | Overall Eff. | 0.19665 | 6 | 0.46422 | 6 | 0.899** |
| 2008 | Stage 1 | 0.41167 | 13 | 0.57478 | 13 | 0.902** |
| | Stage 2 | 0.13860 | 2 | 0.25275 | 2 | 0.973** |
| | Overall Eff. | 0.19785 | 5 | 0.42443 | 5 | 0.877** |
| 2009 | Stage 1 | 0.53649 | 20 | 0.73151 | 20 | 0.851** |
| | Stage 2 | 0.27195 | 7 | 0.66851 | 7 | 0.822** |
| | Overall Eff. | 0.19650 | 5 | 0.49584 | 5 | 0.911** |

MMS = Multi-Management Stages
Eff. = Number of Efficient Companies
Average CRS-VAR II Scores are based on *maximal friends* facets randomly obtained by Variation IV
** Correlation is significant at the 0.01 level (2-tailed)

Finally, Table II-5 also shows evidence similar to that found both in Part I (Table I-5) and in the previous subsection (Table II-2), where the highest efficiency scores are obtained by the *Portfolio Management stage*. This stage proves to be quite independent of the efficiency of the marketing and distribution of the mutual funds, and therefore of the overall efficiency of the company. Moreover, Table II-5 shows the positive and significant relationship between the marketing and distribution skills of the company and overall efficiency for the whole time horizon. That is, the most refined measure proposed by Tone (2010) confirms the major findings obtained in Part I by using the original SBM approach. This result verifies the robustness of our main conclusion, such as the apparent dichotomy between the efficiency of portfolio management and the distribution and marketing skills in the Spanish mutual fund industry.

**Table II-5** Average CRS-Variation II scores and Spearman's rank correlation

| Year | MMS | Average CRS-VAR II Scores | Eff. | Spearman Rank Corr. (Scores) | | |
|---|---|---|---|---|---|---|
| | | | | Stage 1 | Stage 2 | Overall Eff. |
| 2005 | Stage 1 | 0.76477 | 28 | 1 | -0.294** | -0.089 |
| | Stage 2 | 0.45864 | 7 | | 1 | 0.467** |
| | Overall Eff. | 0.60882 | 10 | | | 1 |
| 2006 | Stage 1 | 0.71020 | 22 | 1 | -0.470** | -0.316** |
| | Stage 2 | 0.53522 | 8 | | 1 | 0.499** |
| | Overall Eff. | 0.55799 | 8 | | | 1 |
| 2007 | Stage 1 | 0.71353 | 21 | 1 | -0.121 | -0.156 |
| | Stage 2 | 0.61103 | 6 | | 1 | 0.426** |
| | Overall Eff. | 0.46422 | 6 | | | 1 |
| 2008 | Stage 1 | 0.57478 | 13 | 1 | -0.659** | -0.424** |
| | Stage 2 | 0.25275 | 2 | | 1 | 0.603** |
| | Overall Eff. | 0.42443 | 5 | | | 1 |
| 2009 | Stage 1 | 0.73151 | 20 | 1 | -0.049 | 0.051 |
| | Stage 2 | 0.66851 | 7 | | 1 | 0.601** |
| | Overall Eff. | 0.49584 | 5 | | | 1 |

MMS = Multi-Management Stages
Eff. = Number of Efficient Companies
Average CRS-VAR II Scores are based on *maximal friends* facets randomly obtained by Variation IV
** Correlation is significant at the 0.01 level (2-tailed)

## 2.4 The search for locally efficient companies applying Variation III

As in the previous section, 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 more homogeneous characteristics than the evaluated fund company. That is, this variant compares competitors with quite similar resources and therefore opportunities to gain efficiency.

Variation III is in fact a refinement of SBM Variation II (equation II.5) proposed by Tone (2010), which enumerates all the facets of the efficient frontier (*maximal friends*). However, Variation III will only enumerate those facets formed by companies with similar characteristics based on specific clustering standards. Therefore, the scores obtained by this variant may be extremely sensitive to the clustering process, which highlights the relevance of a proper clustering methodology.

A cluster process consists of finding groups in data. This idea has been applied in many areas including astronomy, archaeology, medicine, chemistry, education, psychology, linguistics and sociology. The objective of our study is to set groups in such a way that MFMCs in the same group have similar management resources. The need to classify cases in line with the objectivity standards of modern science has given rise to automatic and sophisticated classification procedures. The present study is based on the well-known ideas of Kaufman and Rousseeuw (2005).

Several clustering techniques may be applicable, and a priori arguments may not suffice to narrow down the choice of a single method. According to Kaufman and Rousseeuw (2005), it is necessary to run more than one method and to carefully analyse and compare the resulting classifications, making use of their graphical displays and other statistical measures, i.e., review what the data are trying to tell us before selecting the clustering technique. Studies in other scientific fields (e.g., Ahlquist and Breuning, 2012) have already argued that a priori generation of equal-size clusters may be a serious shortcoming. Therefore, it is necessary to identify the main data attributes as a prerequisite step in clustering analysis because the lack of this previous work may lead to important limitations of the clustering results.

We can find two major types of clustering techniques, depending on both the type of data available and the particular purpose of the research: 1) partitioning and 2) hierarchical techniques. A brief explanation of both techniques is necessary to determine which best fits our analysis.

A partitioning technique constructs $K$ clusters (groups) that together satisfy the requirements of a partition:

Each group must contain at least one object;
Each object must belong to exactly one group

These conditions imply that there are equal or fewer clusters $K$ than there are objects $n$:

$$K \leq n \tag{II.11}$$

According to the clustering standards, two different clusters cannot have any object in common, and the $K$ groups together must add up to the full dataset.

Partitioning techniques are applied if we want to classify the objects into $K$ clusters, where $K$ is fixed. The algorithms used here aim to find a "good" partition in the sense that objects of the same cluster should be very close or related to each other. The purpose is to uncover a structure already present in the data. Let us briefly examine each technique:

The PAM technique (Partitioning Around Medoids) can be applied when the data are a dissimilarity matrix, i.e., objects within a cluster show a high degree of similarity, while objects belonging to different clusters are as dissimilar as possible. This technique is an improvement of the well-known $K$-means clustering process where each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. In other words, PAM is based on the search for $K$ representative objects among the objects of the dataset. The algorithm used by PAM represents objects that are often called centrotypes or medoids of the clusters. The $K$-medoid method tries to find "spherical" clusters, that is, clusters that have roughly ball-shaped forms. To be accurate, the average distance or dissimilarity (using $K$-medoid technique) of the representative object ($K$) to all the other objects of the same cluster is minimised to obtain accurate "spherical" clusters. The PAM technique is especially recommended if a researcher is also interested in the representative objects themselves, which may be very useful for data reduction or characterisation purposes.

An extension of PAM is the technique called CLARA (Clustering Large Applications), which was developed to analyse large datasets. Its clustering objective is the same as in the above-mentioned $K$-medoid. That is, CLARA tries to find $K$ representative objects that are centrally located in the clusters previously determined.

Finally, fuzzy analysis may be considered in these partitioning techniques. It can be applied to the same datasets as the PAM approach, but the nature of its algorithm is different. For example, instead of confirming that "object $n$ belongs to cluster 1", fuzzy analysis could state that "object $n$ belongs for 90% to cluster 1, for 5% to cluster 2, and for 5% to cluster 3". This implies that this object is mostly assigned to cluster 1, but that there is still a glimpse of doubt in favour of clusters 2 and 3. Thus, intermediate objects that are not clearly assigned can be described by a means called membership coefficients (Kaufman and Rousseeuw, 2005).[72]

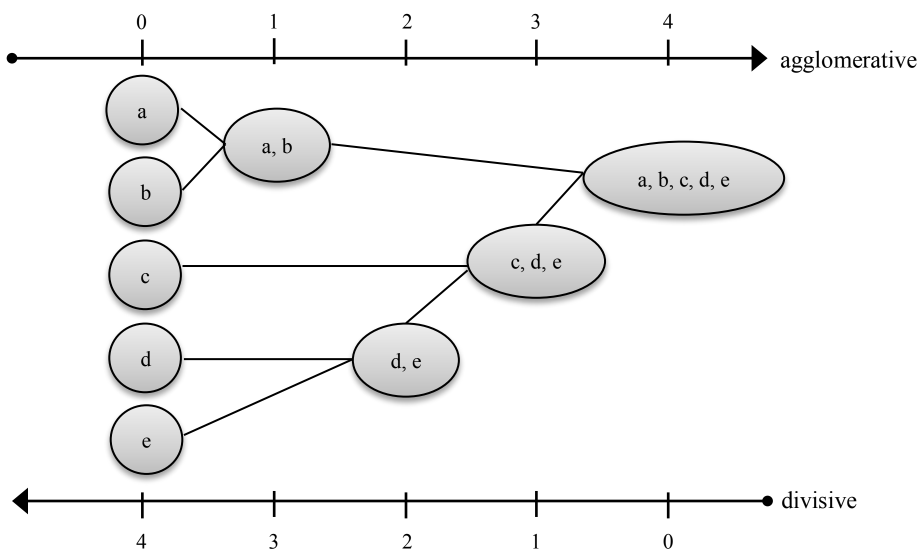
On the other hand, hierarchical techniques do not construct a single partition with $K$ clusters, as they address all values of $K$ in the same run. That is, in the partition with $K = n$, each object forms a separate cluster with only a single element. All values of $K = 2,3, \dots, n - 1$ are covered in a type of gradual transition. The only difference between $K = r$ and $K = r + 1$ is that one (two) of the $K$ clusters splits up (combine) to obtain $r + 1$ $(r)$ clusters. A hierarchical technique suffers from the defect that it can never repair what was done in previous steps, i.e., once a hierarchical technique has joined/split up two or more objects, the clustering process can no longer be reversed.

There are two types of hierarchical techniques: agglomerative and divisive. They construct their hierarchies in opposite directions, potentially yielding different results. The agglomerative approach starts when all objects are separate, and the divisive

[72] The PAM, CLARA and FANNY partitioning techniques are available in the Cluster package (Version 1.14.4, August 2013) available in the R project library (URL http://www.r-project.org). Additional explanations of these partitioning techniques are included in Kaufman and Rousseeuw (2005).

techniques start when all objects are together. Figure II-4 shows an example process with a dataset of $n = 5$ objects. In the upper arrow, the agglomerative technique starts when all objects are separate; then in the first step, two clusters are merged, and so on until only one cluster is left. Otherwise, the divisive technique starts with all objects together in one group; in each following step, a cluster is split up until there are $n$ clusters. The agglomerative and divisive hierarchies coincide in the illustration of Figure II-4, but they usually are different.

**Figure II-4** Distinction between agglomerative and divisive techniques




Note: The scheme is a replication of Figure 11 from Kaufman and Rousseeuw (2005, p.45)

The agglomerative nesting technique (AGNES) accepts the same data as the aforementioned partitioning techniques (Partitioning around medoids, and Fuzzy Analysis). However, the number of clusters is no longer requested because of the hierarchical nature of this agglomerative technique. Therefore, this approach executes a complete sequence of cluster combinations. In a first step, those closest objects are joined in $r$ clusters, and in all succeeding steps, the $r$ closest clusters are merged. All these mergers are based on the dissimilarities among their objects. There exist different agglomerative nesting algorithms that differ only in their definition of among-cluster dissimilarity.[73]

On the other hand, the divisive approach of the hierarchical clustering methods is covered by the DIANA technique.[74] The qualitative advantage of this divisive analysis consists of the fact that most users are interested in the major structure of their data, which is drawn by a few large clusters in the first steps, rather than in a detailed description of the individual objects. According to Kaufman and Rousseeuw (2005, p.49), the agglomerative techniques start with the details and then works its way up to large clusters, which may however be affected by unfortunate clustering decisions in the first steps of the process. Agglomerative techniques suffer from the defect that once two or more objects have been joined in a new cluster, they can no longer be separated. Instead, the divisive techniques start with the main large clusters. That is, the first step consists of splitting up all the objects included in the dataset into two major groups, and then the divisive method goes on to divide them further into smaller clusters. Based on observations made by Kaufman and Rousseeuw (2005), the large clusters are determined first and thereby are less likely to suffer from earlier steps.

Therefore, it is often useful to compare the clusters provided by the agglomerative nesting technique (AGNES) with those obtained by the divisive analysis (DIANA) to identify potential clustering bias resulting from the different natures of the two hierarchical methods. Such a comparison should be based on the results of both techniques, which are displayed in a similar banner (dendrogram[75]).

[73] AGNES technique allows calculating dissimilarities between observations by using sum-of-squares of differences (Euclidean distance), and sum of absolute differences (Manhattan distance). This technique also allows the definition of clustering rules to group a set of objects, such as the unweighted pair-group average, single linkage (nearest neighbour method), complete linkage (furthest neighbour method), ward's method, weighted average linkage, and flexible method.

[74] The AGNES and DIANA techniques are available in the Cluster package (Version 1.14.4, August 2013) available in the R project library (URL http://www.r-project.org). Additional explanations of these hierarchical techniques are included in Kaufman and Rousseeuw (2005).

[75] A dendrogram is the graphical representation of the clusters produced by a hierarchical clustering process. The bottom row usually represents individual objects displaying a 0 similarity. The distances among a merged group increases with the level of the merger; i.e., the height of each cluster displayed in the dendrogram is proportional to the value of the dissimilarity between the clusters at that height. In past years, dendrograms were frequently produced with printers without graphic capability; therefore, the lines were obtained by

Our clustering proposal is based on two dimensions of the sample: the assets under management and the number of employees of each fund company. Either variable may be considered an appropriate proxy for the management resources of a mutual fund company to determine the most suitable number of clusters for our study. As we have previously discussed along these lines, the Spanish fund industry is extremely concentrated, thereby generating a competition map wherein a large number of small companies manage a residual market share and a reduced number of huge companies dominate the industry. Because of this concentration, opportunities and resources to gain efficiency seem to be quite different for both groups. In this sense, fund companies will employ mainly skilled labour, which is a major determinant of the production function of this industry.

Consequently, we assume the hypothesis that fund companies with both clustering-homogeneous assets under management and labour size should have similar opportunities to reach efficiency at every management stage proposed in our conceptual model (Figure I-5). Therefore, our intention is to set clusters formed by fund companies with similar typologies based on management resources, which are determined by both assets and labour variables.

An a priori determination of *Z* clusters using partitioning methods could provide an inappropriate number of clusters. According to examples provided by Kaufman and Rousseeuw (2005, chapter 6), divisive techniques (DIANA) obtain very similar results to those yielded by partitioning methods (PAM and FANNY) and agglomerative nesting techniques (AGNES). Apparently, DIANA is sufficiently clear-cut to uncover "right" clusters in the first steps of the process.[76] According to the usual standards in the clustering process (Kaufman and Rousseeuw (2005, p.37), developing hierarchical techniques and comparing the resulting classifications is recommended, making use of the graphical displays before forcing the number of clusters. That is, our clustering

means of the usual alphabetic characters. Currently, dendrograms are much better developed to provide more illustrative displays of hierarchical results (see further details in Forina et al., 2002).

[76] It obtains a similar picture using AGNES, although with a reversed process.

objective is not to force $Z$ clusters, but rather that the clusters obtained are well made and reasonable.[77]

Our clustering procedure starts by running both agglomerative nesting (AGNES) and divisive (DIANA) techniques to compare results and thereby identify the most appropriate $Z$ clusters. As previously discussed, the divisive analysis run by the DIANA technique seems to be more useful in our concentrated industry because it starts by finding a few large clusters rather than with an exhaustive description of the individual companies. In our case, the sample presents two well-identified major groups: the largest companies and the remaining competitors in the fund industry. According to Kaufman and Rousseeuw (2005), these first clusters are less likely to suffer from earlier wrong decisions than agglomerative techniques. That is, DIANA primarily splits our sample into two major groups and then goes on to divide them further into smaller parts. In other words, the largest and best-identified clusters are found first, which makes it less susceptible to being affected in the initial steps.[78] Despite the above statement, we also run both hierarchical techniques to compare the dendrograms and to analyse the robustness of the clusters obtained. The MFMCs sorted by both clustering AGNES (Agglomerative Nesting) and DIANA (Divisive Analysis) show similar classifications in approximately 90% of cases, which provides robustness to the results provided by both hierarchical techniques.[79]

[77] In the past, divisive clustering techniques were not generally available and rarely were applied due to huge computation time requirements for the first steps. Because of the good results provided by Mcnaughton-Smith et al. (1964), divisive clustering techniques have become more accessible. More recently, Bradley et al. (1998) presented a fast, scalable and single-pass version of K-means with fewer data requirements; Scholkopf et al. (1998) proposed a Kernel K-means to detect arbitrarily-shaped clusters with an appropriate choice of kernel similarity function; and Steinbach et al. (2000) proposed a hierarchical divisive version of K-means, called bisecting K-means, which recursively partitions the data into two clusters at each step.

[78] To divide the selected cluster, the algorithm in DIANA first looks for its most disparate observation (i.e., which has the largest average dissimilarity to the other observations of the selected cluster).This observation initiates the "splinter group". In subsequent steps, the algorithm reassigns observations that are closer to the "splinter group" than to the "old party". The result is a division of the selected cluster into two new clusters.

[79] AGNES technique was applied by using a Manhattan metric and the unweighted pair-group average method (by default in the Cluster package of the R program). Using the unweighted average linkage method (see Figure II-4), when two clusters $a$ and $b$ are joined into new cluster $(a, b)$, the position of $(a, b)$ is between the positions of $a$ and $b$, weighted for the number of objects in the two joined clusters (roughly ball-shaped). In evaluating the position of $(a, b)$, all the original objects have the same weight (this is the reason for the name “unweighted”). DIANA technique use the inverse approach; it starts when all objects are together by splitting up and forming approximately similar ball-shaped clusters with the objects, such as the unweighted average method implemented by AGNES which allows their banners to be highly comparable.

The aim of Variation III proposed by Tone (2010) is to solve the problem of massive enumeration of facets potentially present in Variation II because of the combination of several efficient companies. Therefore, if we consider only a few clusters, this analysis would make little sense to solve the aforementioned problem because a relevant number of efficient companies might still be present in the same cluster, and the decrease of the enumerated facets could be residual. On the other hand, if we consider many clusters, we could find many locally efficient MFMCs in our analysis, thereby distorting the appropriate identification of locally efficient companies because of mere excessive clustering (see subsection 2.1 for details).

To address this problematic issue, choice of the number of clusters is based on the dendrograms found by the divisive hierarchical approach included in the divisive technique (DIANA).[80] After drawing a line at the same height (approximately 5) for each dendrogram and period, we could generally identify four major clusters for each year based on the mix of assets and labour variables. That is, we usually identified four major groups at the same proportional value of the dissimilarity between the clusters. The presence of this stable clustering pattern along our time horizon seems to provide robustness to our clustering proposal.[81] Finally, we named each cluster according to the characteristics found in the group.

However, MFMCs in 2005 and 2006 were divided into additional clusters for an appropriate search for locally efficient companies.[82] Five clusters were initially obtained in 2005 at the same dendrogram's height = 5. However, the number of Stage1-efficient

[80] Dendrograms are shown in Appendix J. To calculate dissimilarities among observations, we used the sum of absolute differences; i.e., we applied the "Manhattan metric" rather than the sum-of-squares of differences "Euclidean distances". Roughly speaking, the latter is similar to considering a straight line between the objects, whereas Manhattan distance defines proximity like a city block distance. In our case, we obtained quite similar cluster results for both measures (more than 97% of cases). Details about the DIANA program are available in Cluster package (Version 1.14.4, August 2013) available in the R project library (URL http://www.r-project.org).

[81] Cluster 2 (corresponding to large firms) seems to be divided into two sub-clusters, but nevertheless we decided to keep it as a whole due to its small number of components (generally five companies) to avoid any bias in the search for locally efficient companies as a consequence of few components in the cluster.

[82] This additional sub-division in 2005 and 2006 was only considered for stage 1 due to the incidence of the high number of efficient companies in the original clusters, which involved computing problems to enumerate all the facets required by Variation II.

companies included in Cluster #5 was still quite important, thereby involving a problem of computing resources to enumerate all the required facets to run Variation III. This is the reason for sub-dividing Cluster #5 in the subsequent three dendrogram branches. This additional split solved the massive enumeration problem of the facets required by Variation III without forcing the appropriate clusters drawn by the 2005 dendrogram (see details in Appendix J).[83]

Four clusters were initially obtained in 2006 at the same dendrogram height. In 2005, we found the same problem: a large number of Stage1-efficient companies present in a cluster enumerated all the facets required to search for locally efficient companies. In this case, we split up Cluster #4 into the following two branches to solve the massive enumeration of facets (see details in Appendix J).

For the remaining years (2007 to 2009), the number of efficient companies was low enough to enumerate all the facets required by Variation III without computing resource problems. Therefore, no additional division was required of the clusters initially obtained at height 5 by the dendrograms in that period. The following Table II-6 shows the entire cluster classification.

**Table II-6** Cluster classification by year

| **2005** | **2006** | **2007 to 2009** |
|---|---|---|
| Cluster of the largest firms (C1) | Cluster of the largest firms (C1) | Cluster of the largest firms (C1) |
| Cluster of large firms (C2) | Cluster of large firms (C2) | Cluster of large firms (C2) |
| Cluster of large-midsize firms (C3)<br>Cluster of small-midsize firms (C4) | Cluster of midsize firms (C3) | Cluster of midsize firms (C3) |
| Cluster of large-small sized firms (C5.1)<br>Cluster of mid-small sized firms (C5.2)<br>Cluster of small-small sized firms (C5.3) | Cluster of large-small sized firms (C4.1)<br>Cluster of small-small sized firms (C4.2) | Cluster of small firms (C4) |

[83] The dendrograms displayed in Appendix J show the hierarchy of clusters, which is quite similar to a tree. The banner plots the diameter of each cluster being split. The observations are listed in the order found by the DIANA algorithm, and the numbers in the height vector are represented as bars between the observations. The leaves of the clustering tree are the original observations. A branch splits up at the diameter of the cluster being split.

The overall findings after applying the divisive clustering procedure previously described (without considering additional sub-clusters) show that Cluster #1 includes the two largest fund companies within the sample in 2005, 2006 and 2007, and the three largest companies in 2008 and 2009. Cluster #2 includes five large companies within the sample in 2005 and 2006, and four large companies in 2007, 2008 and 2009. Cluster #3 of midsize companies (C3 and C4 were joined in 2005) includes a range from 14 to 19 companies for our whole time horizon. Finally, to differentiate the extremely small companies existing in Spain, Cluster 4 (named C5.1, C5.2, C5.3 in 2005) integrates a range of from 69 to 76 companies in all the years analysed.

Table II-7 shows some descriptive statistics of these clusters, thereby highlighting the assorted characteristics of these major groups by their main management variables. The data sample figures show the extreme concentration of the Spanish fund industry. Note both average assets and unitholders, where the proportional difference between the largest and the smallest companies is more than 100 to 1, although this difference is lower after 2008. We also find mean differences of approximately 20 to 1 in variables such as shareholder equity and the number of funds managed by the companies. In the case of profits, the proportional difference is approximately 60 to 1; in number of employees, the proportion is approximately 12 to 1.

Under our clustering hypothesis, the extreme differences between the assets managed by each cluster included in Table II-7 should confirm the different resources available to each company to gain efficiency in the three stages considered in our model (see Figure I-5, Part I). Likewise, the clustering hypothesis also applies to the number of employees (named labour above) because this factor of production is one of the most important for this financial industry, as was previously said, due to the high qualifications required of the employees.

**Table II-7** Descriptive Statistics of Clusters

| Year | Cluster | Num. of MFMCs | Num. of Employees ($L_k$) | Shareholders' Equity (1)** ($SE_k$) | Assets Managed** ($AM_k$) | Num. of Funds ($NF_k$) | Num. of Unitholders |
|---|---|---|---|---|---|---|---|
| 2005 | 1 | 2 | 144 | 77,507 | 53,319,085 | 229 | 1,740,660 |
| | 2 | 5 | 82 | 54,869 | 13,145,941 | 127 | 416,610 |
| | 3 and 4 | 19 | 34 | 15,797 | 2,753,956 | 38 | 86,906 |
| | 5 | 76 | 9 | 3,628 | 491,361 | 12 | 16,197 |
| 2006 | 1 | 2 | 140 | 84,806 | 53,145,598 | 244 | 1,766,859 |
| | 2 | 5 | 87 | 59,163 | 13,679,317 | 146 | 444,456 |
| | 3 | 18 | 34 | 18,671 | 3,378,712 | 39 | 98,641 |
| | 4 | 77 | 11 | 3,830 | 453,269 | 12 | 14,367 |
| 2007 | 1 | 2 | 133 | 82,014 | 47,743,697 | 263 | 1,560,868 |
| | 2 | 4 | 110 | 42,492 | 13,820,432 | 175 | 419,612 |
| | 3 | 19 | 36 | 29,387 | 3,789,362 | 42 | 115,841 |
| | 4 | 70 | 11 | 4,624 | 457,521 | 13 | 15,000 |
| 2008 | 1 | 3 | 128 | 72,848 | 27,361,780 | 245 | 874,034 |
| | 2 | 4 | 92 | 87,217 | 8,206,037 | 145 | 313,397 |
| | 3 | 17 | 36 | 26,132 | 2,187,013 | 40 | 71,855 |
| | 4 | 69 | 12 | 5,326 | 340,199 | 13 | 11,929 |
| 2009 | 1 | 3 | 123 | 93,625 | 26,021,083 | 202 | 787,505 |
| | 2 | 4 | 88 | 94,090 | 7,342,766 | 113 | 269,509 |
| | 3 | 14 | 37 | 29,239 | 2,545,975 | 41 | 84,597 |
| | 4 | 74 | 12 | 5,575 | 370,762 | 12 | 11,486 |

Figures are shown as the mean of the cluster.
(1) At beginning of the year; ** Thousand Euros

After the exhaustive clustering process previously defined, we continue to identify locally efficient companies, i.e., those companies that cannot be referred to the efficient frontier formed by companies belonging to the same cluster as the target company. Therefore, it is necessary to identify the efficient companies within each cluster. Then, according to Variation III, we must enumerate all the facets to be potentially compared with each target company analysed within each cluster. After that, we should select those efficient combinations (*friends*) for each cluster that are not dominated by any other efficient combination (*maximal friends*). That is, we will select those *maximal friends* for every cluster to run Variation III instead of searching for all the *maximal friends* combinations of all SBM-efficient companies (Variation II, equation II.5).

The search for the *maximal friend* facets has been quite different for each stage. For the case of the marketing and distribution 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 (II.5) was easily developed. For the case of the portfolio management unit (stage 1), the existence of a much higher number of efficient companies involved huge computational resources. Indeed, the consideration of four clusters aims to reduce largely the enumeration of facets and the identification of *maximal friends*. As stated above, this is an important contribution because it has allowed finding locally efficient companies with regard to similar competitors that otherwise would not have been possible to identify.

The results found by Variation III in the different management stages are displayed in Appendix K. To clarify the major findings, Table II-8 summarises globally efficient, globally inefficient, and locally efficient companies for each management stage. For example, reports that there were 74 globally inefficient companies but 26 locally efficient companies in the *Portfolio Management stage* in 2005. That is, the analysis of efficiency restricted to homogeneous competitors reveals that 26 out of 74 initially considered inefficient companies are efficient in their *Portfolio Management stage*, which might be considered a relevant percentage. The average ratio of locally efficient companies to globally inefficient companies in Stage 1 is 26.19% for the entire time horizon. This might be considered measurement bias due to inappropriate reference frontiers with different characteristics from the evaluated company. This potential bias seems quite important in the *Portfolio Management stage* with so many efficient companies previously found with the different SBM variations.

Table II-8 also indicates that this potential measurement bias is not relevant in the overall efficiency analysis. For example, other than 10 companies overall efficient in 2005, there was just one other company which was locally overall efficient, according to homogeneous reference sets. The aforementioned measurement bias provided by the average ratio of globally overall-inefficient companies that become locally overall efficient is approximately 2.42% for the whole time horizon.

Regarding the second management stage (*Marketing and Service stage*), the concentration of all globally efficient companies in one cluster from 2005 to 2008 does not permit finding locally efficient companies in an accurate way (see details in Appendix L). This unique efficient cluster was Cluster #3 in 2005, and Cluster #4 for the remaining years. According to Tone (2010), if none of the DMUs in a cluster is efficient, we should take the efficient DMUs in the adjacent clusters as appropriate reference sets. Because of this approach, the results should be similar to those previously obtained by Variation II because the efficient reference set is unique for the whole dataset (see Table II-L-1, Appendix L). Only for 2009 was it possible to properly follow this approach. We take the adjacent Cluster #1 (with one efficient company) to search for locally efficient companies in Cluster #2, whilst Cluster #4 (with 6 efficient companies) was considered an adjacent cluster to search for locally efficient companies in Cluster #3 (see Table II-L-1, Appendix L).

In our opinion, the aforementioned adjacent-cluster process in Stage 2 could not be very suitable because of the excessive differences previously found in the clusters. We should at least be cautious with the results in those adjacent clusters with striking differences. That is, to find locally efficient companies based on reference frontiers with extremely different characteristics from the target companies' does not seem to be the best solution when a cluster does not have any efficient company to form part of the frontier. Therefore, we note the measurement bias obtained in the 2009 sample, where we find that the average ratio of locally efficient (Stage 2) companies to globally inefficient companies was approximately 0.68%.

**Table II-8** Efficient Companies by Stage

| Year | MMS | Total Companies | Globally Efficient | Globally Inefficient | Locally Efficient |
|---|---|---|---|---|---|
| 2005 | Stage 1 | 102 | 28 | 74 | 26 |
| | Stage 2 | | 7 | 95 | 0 |
| | Overall Eff. | | 10 | 92 | 1 |
| 2006 | Stage 1 | 102 | 22 | 80 | 22 |
| | Stage 2 | | 8 | 94 | 0 |
| | Overall Eff. | | 8 | 94 | 4 |
| 2007 | Stage 1 | 95 | 21 | 74 | 19 |
| | Stage 2 | | 6 | 89 | 0 |
| | Overall Eff. | | 6 | 89 | 2 |
| 2008 | Stage 1 | 93 | 13 | 80 | 16 |
| | Stage 2 | | 2 | 91 | 0 |
| | Overall Eff. | | 5 | 88 | 3 |
| 2009 | Stage 1 | 95 | 20 | 75 | 17 |
| | Stage 2 | | 7 | 88 | 3 |
| | Overall Eff. | | 5 | 90 | 1 |

Previous findings seem to provide evidence that the efficiency measurement of the *Portfolio Management stage* is quite sensitive to inappropriate reference frontiers. That is, an appropriate SBM evaluation of the *Portfolio Management stage* should consider homogeneous sets of companies with similar management resources that may be proxied by the assets under management. Therefore, in the case that the reference companies included in the efficient frontier do not belong to the same cluster as the target company, traditional SBM scores could be biased in favour of efficient companies in this *Portfolio Management stage*. Otherwise, this bias appears to be less important to both the *Marketing and Service stage* and the *Overall stage*. However, these results may be affected in the *Marketing and Service stage* by the high concentration of efficient companies in few clusters, which could be problematic if we consider adjacent clusters with striking differences to search for locally efficient companies.

# 3 Persistence in funds management companies: Do the best winners and losers usually repeat?

Performance persistence in mutual funds has been extensively analysed by researchers since the first studies by Sharpe (1966) and Jensen (1968). This phenomenon refers to the hypothesis that mutual funds with better (worse) performance records than competitors will keep these better (worse) performance records over time. The importance of this hypothesis is very relevant in the mutual fund industry in terms of prediction of future performance based on mutual funds' past reputation, i.e., the accepted wisdom in the fund industry that winners repeat (Kahn and Rudd, 1995). This abovementioned importance is highlighted by financial marketing because past results are one of the major factors that drive investors to choose a mutual fund (Ippolito, 1992; Capon et al., 1996; and Sirri and Tufano, 1998).

Later studies in the 1980s and 1990s found contradictory results in this field, some supporting the persistence hypothesis (e.g., Lehman and Modest, 1987; Grinblatt and Titman, 1992; Brown and Goetzmann, 1995; Malkiel, 1995; Elton et al., 1996; and Gruber, 1996), but some also rejecting this "hot hands phenomenon"[84] (e.g., Bogle, 1992; and Carhart, 1997).[85] More recently, Busse et al. (2010) and Fama and French (2010) applied Carhart's four-factor model (1997) to find little evidence of persistence. However, Cohen et al. (2005) found that fund returns exhibit significant persistence, even after adjusting for momentum in stock returns. Lynch and Musto (2003) provided evidence of more sensitive persistence in winner funds than in losers. Kosowski et al. (2006) found that growth-oriented funds exhibit strong persistence, while income-oriented funds exhibit little evidence of this phenomenon.

[84] "Hot hands phenomenon" was first used in the Hendricks and Zeckhauser' (1993) study.

[85] According to Carhart (1997), the persistence could be caused by managers' costs and the momentum effect, rather than managers' ability. Recently, Gottesman and Morey (2007) and Fama and French (2010) identify costs as the source of persistence. Andreu et al. (2007) also found similar evidence for Spanish money market funds.

The assorted conclusions can be explained by the different characteristics of the portfolios examined, the different evaluation periods, and the survivorship bias influence. The incidence of terminated mutual funds being excluded from the sample (survivorship bias) on persistence results has been addressed by different authors including Grinblatt and Titman (1992); Brown et al. (1992); Malkiel (1995); Blake and Timmermann (1998); and Hallahan and Faff (2001); and more recently Rohleder, et al. (2011). The magnitude of this bias in persistence findings is still a controversial topic in this field.

The analysis of this persistence phenomenon has also been extensively analysed in Europe in recent decades. Studies include Ter Horst et al. (1998) for the Dutch market, Cortez et al. (1999) and Cortez and Silva (2002) for the Portuguese market, Dahlquist et al. (2000) for the Swedish market, Otten and Bams (2001) for European industry considering different countries, Giles et al. (2002) for the U.K. market, Casarin et al. (2005) for the Italian market, Christensen (2005) for Danish industry, and Ciriaco and Santamaria (2005) and Vicente and Ferruz (2005) for the Spanish market.

Although most studies have focused on persistence equity mutual funds, there are also works on bond mutual funds and money market funds (e.g., Blake et al., 1993; Domian and Reichenstein, 1998; Philpot et al., 2000; Christoffersen and Musto, 2002; and Polwitoon and Tawatnuntachai, 2006).

The literature provides evidence that previous persistence research focused on mutual funds but not on the fund companies' efficiency over time. Taking into account our efficiency model (Figure I-5), the persistence analysis of fund companies should test for this persistence hypothesis in the efficiency achieved by the portfolios managed by the company (*Portfolio Management* stage, Stage 1) together with the efficiency in the company's abilities to sell these funds (Stage 2). In addition, our analysis should also consider the overall persistence hypothesis for the company as a whole (*Overall Efficiency* stage). That is, our innovative approach can more completely approximate this phenomenon by including in some way the traditional persistence idea related to portfolio management ability and also by considering the remaining management stages that also add value to a fund company.

Therefore, the aim of this section is to test for whether mutual funds management companies maintain their relative efficiency rankings over time for the different management stages considered in our model. If the persistence hypothesis is accepted, then those companies with high efficiency scores in a specific management stage will keep their high efficiency rankings over time.

Our study fills this gap in the literature by analysing the persistence phenomenon based on the efficiency scores obtained by the SBM variants for the different management stages considered in our model. This analysis aims to be an original and further contribution to mutual fund literature because evidence on the compelling topic of performance persistence is inconclusive, and this phenomenon has never been explored for mutual fund companies.

## 3.1 Methodology of performance persistence

The metrics employed to measure the persistence phenomenon in the performance mutual funds industry have been determined by parametric and non-parametric techniques. Parametric techniques have focused on the use of recursive portfolios to test this phenomenon. Recursive portfolios proposed by Grinblatt and Titman (1993) and Hendricks et al. (1993), then improved by Carhart (1997) evaluate persistence by estimating their future performance according to the past performance of the mutual funds. These techniques have been applied in different markets in recent years by Bollen and Busse (2004), Cohen et al. (2005), Kacperczyk et al. (2008), Busse et al. (2010), Fama and French (2010), and Benos and Jochec (2011).

Recent studies distinguish among different management-style groups and consider the cross-sectional significance of recursive portfolios to measure the persistence hypothesis (Matallín et al., 2014a). Matallín et al. (2014b) also apply recursive portfolios to evaluate the persistence of mutual fund performance obtained by partial frontiers based in DEA and FDH methodology.

On the other hand, the use of non-parametric techniques based on contingency tables widely used in other scientific disciplines has also been very frequent in mutual funds literature (Brown et al., 1992; Brown and Goetzmann, 1995; Allen and Tan, 1999; Silva et al., 2005; and Elyasiani and Jia, 2011, among others). However, a potential weak point of contingency tables is the a priori determination of groups to be compared to other groups in subsequent years. Therefore, those groups based on medians, quartiles, quintiles and other breakpoints may be discretionary elements that could affect the robustness of the persistence results in the sense that there may be miniscule differences in the performance records among some funds included in adjacent groups. Cortez et al. (1999) already noted how results from contingency tables for small mutual fund samples should be interpreted with caution. Furthermore, there are studies which question the application of some non-parametric tests to aggregated tables because this aggregated information could lead to the existence of this phenomenon solely due to the consideration of a high number of portfolios (Andreu et al., 2007; Cuthbertson et al., 2010).

Taken into account the aforementioned limitations, our approach to persistence is based on analysis of contingency tables, but efficiency groups are consistent in terms of their efficiency scores instead of the definition of predetermined groups through median or quartile breakpoints. In our approach, we propose cluster techniques as a first step to design robust efficiency groups in contingency tables rather than mere upper and lower median-groups.

These cluster techniques have been applied to the SBM Variation II efficiency scores obtained for each management stage included in our model.[86] We run divisive clustering

[86] The scores obtained by SBM Variation II were used to obtain the efficiency clusters, specifically those obtained from the random search approach (Variation IV). According to Tone (2010), this variant evaluates each MFMC from all facets, thereby finding the most accurate SBM efficiency scores.

algorithms (DIANA) to identify the most suitable efficiency groups.[87] Note that this divisive technique is based on the natural search for $Z$ representative objects among all the objects of the dataset initially included in one group (see details in section 2.4). The DIANA algorithm seems again to be more useful than agglomerative techniques in our concentrated efficiency results because it starts by finding a few large clusters rather than an exhaustive description of the individual efficiency results.

Our clustering approach first finds two major efficiency groups for each management stage, the *winners* companies and the *losers* companies. Then, the divisive technique splits up these groups to obtain four efficiency groups for each management stage (*Top Winners, Winners, Losers, and Bottom Losers*). The main advantage of this clustering process is that we obtain consistent efficiency groups rather than the mere consideration of median or quartile groups with the same number of companies. Appendix M shows the dendrograms of the efficiency clusters obtained by the DIANA technique for each management stage and year.

Non-parametric statistics applied to *winners* and *losers* efficiency clusters in 2x2 contingency tables include the following:

- The Z-test applied by Malkiel (1995):

$$Z = \frac{(\mathrm{Y} - np)}{\sqrt{np(1-p)}}$$

$$Z \approx N(0,1) \qquad \textbf{(II.12)}$$

If we want to contrast the winners' persistence, then Y is the number of *winner* companies in two consecutive periods, $n$ is the total number of *winners* in the first period, and $p$ is the probability of a *winner* mutual fund company being a *winner* in the

[87] The DIANA algorithm was applied in the Cluster package of R program (Version 1.14.4, August 2013) under the same conditions as the aforementioned clustering process to find the groups of companies required by Variation III in section 2.4 of this chapter.

next period under the null hypothesis of no persistence. In the case of *losers'* persistence, Y is the number of *loser* companies in two consecutive periods, $n$ is the total number of *loser* in the first period, and $p$ is the probability of a *loser* mutual fund company being a *loser* in the next period under the null hypothesis of no persistence.[88]

- The OR ratio applied by Brown and Goetzmann (1995):

$$OR = \frac{WW * LL}{WL * LW} \qquad \textbf{(II.13)}$$

where $WW$ ($LL$) represents the number of fund companies that are *winners* (*losers*) in two consecutive periods and $WL$ ($LW$) represents the number of mutual fund companies which were *winners* (*losers*) in the first period but then were *losers* (*winners*) in the next year.

This expression is the ratio of mutual fund companies that show persistence relative to those that do not. If the ratio equals one, each category is implied to have half the number of companies included in the winners and losers in the first year, and no persistence is therefore found. That is, if there are *n* (*n'*) companies in the winners' (losers') cluster in period t, the lack of persistence will involve *n/2* (*n'/2*) companies in both *WL* (*LW*) and *WW* (*LL*) groups. In this case, the null hypothesis (no persistence) cannot be rejected. Brown and Goetzmann (1995) use the subsequent Z-statistic based on OR ratio to develop an accurate persistence test as follows:

$$Z = \frac{\ln(OR)}{\sigma_{\log OR}}$$

$$Z \approx N(0,1) \qquad \textbf{(II.14)}$$

[88] In our equations, $p$ takes different values for each compared period, because the number of winners and losers is different due to our efficiency cluster approach; i.e., both the probability of a winner company being a winner in the following period and the probability of a loser company being a loser in the following period were calculated for each period.

Additionally, to test persistence based on 2x2 contingency tables is possible by using chi-square as follows:

- The chi-square applied by Kahn and Rudd (1995):

$$X^2 = \sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}}$$

$$X^2 \approx X^2_{(r-1)(c-1)} \qquad \textbf{(II.15)}$$

where $O_{ij}$ ($E_{ij}$) is the actual (expected) frequency in the $i^{th}$ row and $j^{th}$ column in the contingency table, $r$ is the number of rows and $c$ is the number of columns. Thus, in the case of a 2x2 contingency table, this distribution presents one degree of freedom.[89]

Application of the previous tests provides information about the existence of persistence for two consecutive periods, but it does not provide an overall result for longer time horizons. To overcome this limitation, aggregating results provided by the contingency tables in different periods is a common practice employed in the financial literature to produce an overall finding that allows us to conclude whether efficiency persistence exists for the entire period. As previously addressed in the literature, conclusions obtained from this practice should be interpreted with caution because the aggregation of information could lead to confirming the existence of this phenomenon solely due to the consideration of a high number of mutual fund companies.

In this sense, although Cochran's test (1954) also uses aggregate information which could provide biased evidence of the persistence hypothesis, it is a comprehensive measure that provides an overall result for the entire time period. This statistic is calculated as follows:

[89] Carpenter and Lynch (1999) studied the power of several tests used in persistence studies. They found that the chi-square test is powerful and more robust to the presence of survivorship bias compared to other tests.

- Overall results using Cochran's test (1954):

$$Y = \frac{\sum_{i=1}^{g} w_i d_i}{\left[\sum_{i=1}^{g} w_i P_i Q_i\right]^{1/2}}$$

$$Y \approx N(0,1) \qquad \textbf{(II.16)}$$

where:

$$P_i = \frac{n_{i1}P_{i1} + n_{i2}P_{i2}}{(n_{i1} + n_{i2})} \qquad (\textbf{II.17})$$

$$Q_i = (1 - P_i) \qquad \textbf{(II.18)}$$

$$d_i = (P_{i1} - P_{i2}) \qquad \textbf{(II.19)}$$

$$w_i = \frac{n_{i1}n_{i2}}{(n_{i1} + n_{i2})} \qquad (\textbf{II.20})$$

$g$ is the number of 2x2 contingency tables, $n_{i1}$ and $n_{i2}$ are the sample sizes in the two groups $(WW + WL)$ and $(LL + LW)$, respectively, and $p_{i1}$ $(p_{i2})$ is the relationship between $WW$ $(WL)$ and $n_{i1}$ $(n_{i2})$.

To further refine the persistence conclusions, we develop 4x4 contingency tables. A 4x4 contingency table splits the mutual fund companies of each period into four subsets by considering DIANA clustering methodology. Therefore, $Q_i$ is the subset of companies' scores included in the $i^{th}$ groups of the cluster studied (previously called *Top Winners, Winners, Losers and Bottom Losers*), where $i$ takes values from 1 to 4. In this case, two non-parametric tests are applied: the chi-square test and the residual analysis proposal by Haberman (1973).

The chi-square test involves comparing expected and observed frequencies similarly to 2x2 contingency tables. In the case of a 4x4 contingency table, this distribution presents nine degree of freedom (see expression II.15).

On the other hand, Haberman's (1973) residual analysis identifies the categories responsible for a significant chi-square value, i.e., this analysis makes it easier to identify those groups most responsible for the phenomenon of efficiency persistence. One adjusted residual $d_{ij}$ can be calculated for each cell in the 4x4 contingency tables as follows:

- Residual analysis applying Haberman's test (1973):

$$d_{ij} = \frac{e_{ij}}{\sqrt{v_{ij}}}$$

$$d_{ij} \approx N(0,1) \qquad \textbf{(II.21)}$$

where:

$$e_{ij} = \frac{n_{ij} - E_{ij}}{\sqrt{E_{ij}}} \qquad (\mathbf{II.22})$$

$$v_{ij} = \left(1 - \frac{n_i}{N}\right)\left(1 - \frac{n_j}{N}\right) \qquad \textbf{(II.23)}$$

$n_{ij}$ ($E_{ij}$) is the observed (expected) frequency in the $i^{th}$ row and $j^{th}$ column of the contingency table, and $n_i$ ($n_j$) is the total number of observations in the $i^{th}$ row and $j^{th}$ column.

## 3.2 Empirical results of efficiency persistence

After proper identification of *winners* and *losers* in clusters from 2005 to 2009 (see Appendix M), we first apply the previous non-parametric tests for 2x2 contingency tables individually for each management stage. Table II-9, Table II-10, and Table II-11 show the results of these metrics to test for the persistence phenomenon.

The first column of the following 2x2 tables shows the consecutive annual periods analysed. The following four columns report the number of companies included in each category of the 2x2 contingency tables. That is, WW reports the number of *winners* companies in year *t* and *t+1*. WL reports the number of *winners* companies in year t but *losers* in *t+1*. LW reports the number of *losers* in year t but *winners* in *t+1*. LL reports the number of *losers* companies in year *t* and *t+1*. Then, columns 6 and 7 report the Z-test of Malkiel for both *winners* and *losers*. Columns 8 and 9 report both the Brown and Goetzmann statistic as the Kahn and Rudd chi-square test. Finally, the result for the entire period (2005-2009) is reported in the last column of the table using the Y-test of Cochran.

Table II-9 and Table II-11 show a significant persistence phenomenon in efficiency scores clustered, i.e., both the *Portfolio Management stage* (Stage 1) and *Overall Efficiency*, although less significance is observed between 2008 and 2009. Cochran's test also confirms this evidence for the whole period from 2005 to 2009. These findings support the proposition that those companies that manage their mutual funds better than their competitors are usually the same during the time horizon analysed. A similar conclusion could be drawn for the efficiency of a mutual fund company as a whole. On the other hand, the aforementioned conclusions could also be extended to those companies with worse efficiency records than their competitors.

Table II-10 shows significant persistence in the marketing and distribution stage (Stage 2) for the first two comparative periods (2005-2006, 2006-2007). However, there is a lack of this persistence phenomenon in 2007-2008 and 2008-2009, which might be driven by the consequences of the financial crisis affecting the successful distribution of mutual funds managed by the company.[90] This finding on the persistence phenomenon is achieved for the entire period when Cochran's test is used. However, this result must be taken with caution, considering the limitations previously indicated for the Cochran's measure; i.e., aggregate consideration of information tends to skew towards persistence.

**Table II-9** Efficiency persistence for stage 1 based on 2x2 contingency tables

| Stage 1 | WW | WL | LW | LL | Malkiel Z-test Winners | Malkiel Z-test Losers | B&G Z-statistic | K&R $\chi 2$-test | Cochran Y-test |
|---|---|---|---|---|---|---|---|---|---|
| **2005-2006** | 37 | 33 | 1 | 27 | 2.418* | 3.823** | 3.260** | 20.464** | 9.146** |
| **2006-2007** | 36 | 3 | 18 | 38 | 4.472** | 3.732** | 4.856** | 33.922** | |
| **2007-2008** | 25 | 27 | 0 | 40 | 3.388** | 3.863** | N.A. | 26.406** | |
| **2008-2009** | 14 | 12 | 17 | 50 | 2.219* | 1.382 | 2.551* | 6.834** | |

**Table II-10** Efficiency persistence for stage 2 based on 2x2 contingency tables

| Stage 2 | WW | WL | LW | LL | Malkiel Z-test Winners | Malkiel Z-test Losers | B&G Z-statistic | K&R $\chi 2$-test | Cochran Y-test |
|---|---|---|---|---|---|---|---|---|---|
| **2005-2006** | 27 | 2 | 8 | 61 | 6.450** | 4.181** | 5.626** | 59.085** | 8.160** |
| **2006-2007** | 30 | 2 | 35 | 28 | 3.082** | 2.197* | 3.214** | 14.328** | |
| **2007-2008** | 3 | 60 | 0 | 29 | 0.671 | 0.989 | N.A. | 1.428 | |
| **2008-2009** | 3 | 0 | 87 | 3 | 0.316 | 0.058 | N.A. | 0.103 | |

**Table II-11** Efficiency persistence for overall efficiency based on 2x2 contingency tables

| Overall eff. | WW | WL | LW | LL | Malkiel Z-test Winners | Malkiel Z-test Losers | B&G Z-statistic | K&R $\chi 2$-test | Cochran Y-test |
|---|---|---|---|---|---|---|---|---|---|
| **2005-2006** | 13 | 4 | 1 | 80 | 7.327** | 3.357** | 4.805** | 64.954** | 14.804** |
| **2006-2007** | 9 | 3 | 1 | 82 | 7.278** | 2.767** | 4.561** | 60.621** | |
| **2007-2008** | 7 | 2 | 2 | 81 | 6.866** | 2.261* | 4.609** | 52.259** | |
| **2008-2009** | 10 | 0 | 8 | 75 | 6.455** | 2.241* | N.A. | 46.687** | |

* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)
N.A. in the Brown and Goetzmann test represents unrealisable calculations as a consequence of a zero value in any category considered in the OR ratio.

[90] Further research for longer time horizons will be necessary to test this hypothesis more appropriately.

To look more deeply at the persistence effect using non-parametric measures, we use 4x4 contingency tables. The results are presented in, Table II-12, Table II-13 and Table II-14. Columns 2 to 5 contain the 4x4 contingency tables that result when comparing the four efficiency clusters (*Top Winners* or "*Top W*", *Winners* or "*W*", *Losers* or "*L*", *Bottom Losers* or "*Bott L*") in the two consecutive annual periods analysed (*t, t-1*). The analysis of residuals of Haberman is shown in parentheses. These latter statistics identify the categories responsible for a significant chi-square value, which is presented in the last column of the table.

First, we find a significant value of the chi-square test for all comparative periods and for each fund management company. This result provides evidence of a significant persistence in efficiency records obtained by the companies in the different management stages. The analysis of residuals provides some relevant findings to identify those efficiency clusters responsible for these significant results. We find significant persistence of those companies included in the "*Top W*" clusters in two consecutive years. This finding indicates that the best-managed companies persist over time, and that this result is robust for portfolio management and distribution of mutual funds as well as the overall efficiency of the company as a whole. That is, the significant persistence results previously obtained might be strongly caused by the best mutual fund companies in efficiency terms. However, the significant results found for the "*Bott L*" clusters in two consecutive years also support the significant role of the worst-managed companies in this persistence phenomenon (with the exception of Stage 2).

**Table II-12** Performance persistence for stage 1 based on 4x4 contingency tables

| 2005-2006 | Top W | W | L | Bott L | χ2 |
|---|---|---|---|---|---|
| **Top W** | 22 (6.176)** | 4 (0.200) | 4 (-4.249)** | 3 (-1.837) | 72.704** |
| **W** | 4 (-2.889)** | 7 (1.879) | 24 (3.599)** | 2 (-2.727)** | |
| **L** | 0 (-3.285)** | 0 (-1.894) | 13 (1.863) | 9 (2.899)** | |
| **Bott L** | 1 (-0.616) | 0 (-0.899) | 0 (-2.144)* | 5 (4.089)** | |
| **2006-2007** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 19 (5.924)** | 6 (-0.977) | 1 (-4.439)** | 1 (-0.155) | 72.036** |
| **W** | 1 (-1.582) | 10 (4.378)** | 1 (-2.327)* | 0 (-0.777) | |
| **L** | 4 (-3.006)** | 12 (0.367) | 22 (3.092)** | 0 (-1.668) | |
| **Bott L** | 2 (-1.718) | 0 (-3.046)** | 13 (3.216)** | 3 (2.923)** | |
| **2007-2008** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 11 (5.386)** | 4 (0.314) | 6 (-2.670)** | 4 (-1.346) | 57.880** |
| **W** | 1 (-1.714) | 9 (3.408)** | 15 (1.092) | 2 (-2.630)** | |
| **L** | 0 (-3.047)** | 0 (-3.191)** | 22 (2.006)* | 15 (2.590)** | |
| **Bott L** | 0 (-0.682) | 0 (0.714) | 0 (-1.650) | 3 (2.964)** | |
| **2008-2009** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 7 (3.060)** | 1 (-0.498) | 5 (-1.193) | 0 (-1.496) | 31.460** |
| **W** | 3 (0.149) | 3 (1.354) | 7 (0.006) | 0 (-1.496) | |
| **L** | 5 (-2.150)* | 7 (1.233) | 28 (2.036)* | 3 (-1.581) | |
| **Bott L** | 5 (-0.093) | 0 (-2.083)* | 10 (-1.380) | 9 (4.173)** | |

* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

**Table II-13** Performance persistence for stage 2 based on 4x4 contingency tables

| **2005-2006** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
|---|---|---|---|---|---|
| **Top W** | 11 (6.952)** | 0 (-1.496) | 0 (-1.782) | 0 (-3.112)** | 131.312** |
| **W** | 9 (3.448)** | 7 (3.076)** | 2 (-1.083) | 0 (-4.152)** | |
| **L** | 0 (-2.214)* | 8 (4.214)** | 8 (3.211)** | 0 (-3.867)** | |
| **Bott L** | 0 (-5.440)** | 0 (-4.567)** | 10 (-0.411) | 43 (8.066)** | |
| **2006-2007** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 7 (3.910)** | 10 (0.278) | 0 (-2.942)** | 0 (-0.667) | 46.918** |
| **W** | 2 (0.089) | 11 (1.491) | 2 (-1.494) | 0 (-0.619) | |
| **L** | 3 (0.359) | 16 (2.454)* | 1 (-2.702)** | 0 (-0.738) | |
| **Bott L** | 0 (-3.370)** | 16 (-3.316)** | 25 (5.573)** | 2 (1.572) | |
| **2007-2008** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 2 (3.692)** | 1 (2.596)** | 3 (0.192) | 6 (-2.023)* | 27.505** |
| **W** | 0 (-1.595) | 0 (-1.121) | 16 (2.178)* | 35 (-1.288) | |
| **L** | 0 (-0.922) | 0 (-0.648) | 2 (-2.271)* | 25 (2.630)** | |
| **Bott L** | 0 (-0.213) | 0 (-0.150) | 0 (-0.778) | 2 (0.849) | |
| **2008-2009** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 2 (4.119)** | 0 (-3.547)** | 0 (-0.149) | 0 (-0.212) | 33.242** |
| **W** | 1 (2.897)** | 0 (-2.494)* | 0 (-0.105) | 0 (-0.149) | |
| **L** | 5 (2.075)* | 17 (-1.354) | 0 (-0.560) | 0 (-0.796) | |
| **Bott L** | 2 (-4.011)** | 63 (3.039)** | 1 (0.610) | 2 (0.867) | |

* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

**Table II-14** Performance persistence for overall efficiency based on 4x4 contingency tables

| **2005-2006** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
|---|---|---|---|---|---|
| **Top W** | 9 (8.328)** | 1 (0.891) | 1 (-3.418)** | 0 (-2.226)* | 119.873** |
| **W** | 1 (0.540) | 2 (3.737)** | 2 (-1.216) | 1 (-0.666) | |
| **L** | 0 (-4.906)** | 1 (-1.904) | 52 (6.020)** | 14 (-2.473)* | |
| **Bott L** | 0 (-1.362) | 0 (-0.834) | 1 (-4.083)** | 13 (5.751)** | |
| **2006-2007** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 6 (7.157)** | 1 (1.434) | 2 (-1.081) | 0 (-3.186)** | 95.425** |
| **W** | 1 (1.749) | 1 (3.037)** | 1 (-0.203) | 0 (-1.779) | |
| **L** | 0 (-3.155)** | 1 (-0.835) | 32 (4.659)** | 21 (-2.604)** | |
| **Bott L** | 0 (-1.822) | 0 (-1.167) | 2 (-4.247)** | 27 (5.502)** | |
| **2007-2008** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 5 (8.705)** | 1 (1.530) | 0 (-1.895) | 0 (-2.764)** | 115.598** |
| **W** | 0 (-0.422) | 1 (2.503)* | 2 (1.131) | 0 (-1.921) | |
| **L** | 0 (-1.886) | 2 (0.408) | 24 (4.756)** | 11 (-3.888)** | |
| **Bott L** | 0 (-2.299)* | 0 (-2.045)* | 7 (-4.130)** | 39 (5.861)** | |
| **2008-2009** | **Top W** | **W** | **L** | **Bott L** | **χ2** |
| **Top W** | 6 (8.255)** | 0 (-0.879) | 0 (-2.013)* | 0 (-2.152)* | 116.221** |
| **W** | 1 (1.196) | 3 (4.240)** | 0 (-1.625) | 0 (-1.737) | |
| **L** | 1 (-1.421) | 7 (2.415)* | 20 (3.215)** | 5 (-3.882)** | |
| **Bott L** | 0 (-3.190)** | 0 (-3.610)** | 16 (-1.432) | 34 (5.493)** | |

* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

A more detailed analysis of the residuals of the main diagonals (from "*Top W*" to "*Bott L*") of the 4x4 contingency tables should provide evidence about the probability of a mutual fund company remaining in the same efficiency cluster in the next year. That is, the significance of positive values in the main diagonals of the contingency tables shows that it is quite difficult for a company to change its efficiency category in relation to competitors. Table II-14 shows that the main diagonal of the *Overall Efficiency stage* provides positive and significant values in all years, indicating that the efficiency clusters remains quite similar without many changes. This result is somewhat less evident for the *Portfolio Management stage* (stage 1).

Supporting the robustness of these previous results, negative and significant values are obtained in some cases when the opposite diagonal (from "*Bott L*" to "*Bott L*") is traced. This finding indicates that efficiency scores are unlikely to change to a very different efficiency cluster. Similarly, when we compare two opposite categories ("*Top W*" to "*Bott L*") the results show negative and significant values in most figures.

Furthermore, it will be interesting to analyse the effect of the companies' resources in the different categories of persistence studied. These management resources were approximated by different variables such as number of employees, shareholders' equity, assets managed and number of funds.[91] These proxy variables make sense because all of them are very close to the company's size; that is, the larger a company is, the more resources the company has to manage and sell their mutual funds. The following tables (Table II-15, Table II-16, Table II-17, and Table II-18) show the aggregate mean values of these proxy variables after considering whole-year frequencies of each 4x4 persistence cell for each stage. After that, a two-tailed t-statistic was used to check for the null hypothesis that the aggregate mean of any cell is different from the aggregate mean of the remaining 15 persistence categories.

[91] Other potential variables such as number of unitholders are not shown here, because the results are very similar to those obtained from assets managed and number of funds. Detailed results are available upon request.

**Table II-15** Aggregate mean and deviation value by number of employees

| Stage 1 | Top W | W | L | Bott L | Mean(sd) |
|---|---|---|---|---|---|
| Top W | 33 (48)** | 20 (18) | 28 (46) | 7 (5)** | 19 (20) |
| W | 25 (38) | 31 (28)* | 20 (20) | 8 (4)** | |
| L | 12 (13)** | 15 (16)* | 21 (21) | 23 (15) | |
| Bott L | 7 (7)** | *N.A.* | 17 (12)** | 20 (12) | |
| **Stage 2** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 6 (5)** | 10 (7)** | 7 (4)** | 8 (5)** | 21 (17) |
| W | 7 (6)** | 9 (4)** | 11 (7)** | 15 (10)** | |
| L | 10 (7)** | 11 (8)** | 17 (11)* | 43 (33)** | |
| Bott L | 76 (75) | 21 (18) | 36 (32)** | 46 (48)** | |
| **Overall eff.** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 15 (17)** | 72 (96) | 33 (42) | *N.A.* | 24 (26) |
| W | 6 (1)** | 12 (10)** | 50 (73) | 29 (7) | |
| L | 6 (0)** | 7 (6)** | 18 (24)** | 21 (27) | |
| Bott L | *N.A.* | *N.A.* | 12 (10)** | 32 (29)** | |

Significance is the result of a test cell average of aggregated data from other cells; N.A. represents unrealisable calculations because of not any company in the category; values are rounded.
* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

**Table II-16** Aggregate mean and deviation value by shareholder equity

| Stage 1 | Top W | W | L | Bott L | Mean(sd) |
|---|---|---|---|---|---|
| Top W | 17,600 (27,190)* | 7,620 (7,030)** | 14,040 (28,301) | 3,633 (5,638)** | 10,657 (17,261) |
| W | 9,024 (12,161) | 14,306 (15,499) | 8,587 (13,602)** | 2,956 (2,750)** | |
| L | 22,860 (60,471) | 8,418 (14,198) | 17,315 (31,819)* | 9,880 (11,827) | |
| Bott L | 1,848 (2,705)** | *N.A.* | 7,017 (8,918)** | 14,756 (16,804) | |
| **Stage 2** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 1,536 (2,167)** | 6,449 (11,846)* | 1,759 (882)** | 2,424 (1,679)** | 10,845 (14,773) |
| W | 3,533 (7,541)** | 1,922 (1,234)** | 6,581 (12,039)** | 5,412 (5,366)** | |
| L | 7,769 (15,800) | 5,453 (8,282) | 4,985 (5,573)** | 30,254 (35,335)** | |
| Bott L | 32,238 (41,794) | 13,530 (25,560) | 21,414 (27,393)** | 28,259 (33,880)** | |
| **Overall eff.** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 14,442 (22,255) | 29,386 (35,770) | 30,699 (45,648) | *N.A.* | 13,890 (18,894) |
| W | 705 (80)** | 15,555 (23,311) | 32,497 (33,190) | 6,735 (3,812) | |
| L | 2,736 (6)** | 1,440 (626) | 9,330 (20,089)** | 15,190 (29,842) | |
| Bott L | *N.A.* | *N.A.* | 4,594 (5,111)** | 17,262 (25,885)** | |

Significance is the result of a test cell average of aggregated data from other cells; N.A. represents unrealisable calculations because of not any company in the category; Figures at beginning of the year and in Thousand Euros.
* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

**Table II-17** Aggregate mean and deviation value by assets managed

| Stage 1 | Top W | W | L | Bott L | Mean(sd) |
|---|---|---|---|---|---|
| Top W | 7,539,816 (14,975,718)** | 2,499,459 (3,201,010) | 3,325,931 (8,192,804) | 378,302 (953,669)** | 1,785,673 (3,343,212) |
| W | 2,823,376 (5,207,405) | 3,515,910 (4,994,322) | 1,424,367 (2,727,004)** | 179,167 (212,571)** | |
| L | 976,676 (2,281,639)* | 1,375,273 (2,723,223) | 1,287,945 (2,382,732)** | 631,778 (822,021)** | |
| Bott L | 25,296 (25,754)** | *N.A.* | 597,174 (997,307)** | 204,622 (451,003)** | |
| **Stage 2** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 25,310 (33,572)** | 39,984 (25,595)** | 45,585 (46,153)** | 184,752 (111,506)** | 1,889,355 (2,397,924) |
| W | 62,322 (42,010)** | 149,904 (134,241)** | 276,866 (653,622)** | 431,404 (322,675)** | |
| L | 140,571 (169,060)** | 344,061 (616,185) | 589,123 (807,103)** | 4,400,304 (4,105,803)** | |
| Bott L | 8,098,920 (8,931,617) | 1,181,748 (1,648,450)** | 4,097,127 (4,499,935)** | 10,161,691 (16,219,252)** | |
| **Overall eff.** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 2,190,088 (8,648,521) | 20,835,636 (31,708,106) | 14,560,510 (22,447,224) | *N.A.* | 4,717,816 (8,088,991) |
| W | 11,987 (4,073)** | 1,682,461 (2,725,110) | 12,635,747 (23,743,689) | 2,025,700 (414,881) | |
| L | 265,705 (30,428)** | 43,118 (36,207) | 1,929,439 (6,241,025) | 2,147,219 (4,760,439) | |
| Bott L | *N.A.* | *N.A.* | 272,582 (348,713)** | 2,731,413 (4,048,466) | |

Significance is the result of a test cell average of aggregated data from other cells; N.A. represents unrealisable calculations because of not any company in the category; Figures in Thousand Euros.
* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

**Table II-18** Aggregate mean and deviation value by number of funds

| Stage 1 | Top W | W | L | Bott L | Mean(sd) |
|---|---|---|---|---|---|
| Top W | 71 (93)** | 34 (27) | 45 (75) | 3 (2)** | 24 (29) |
| W | 45 (62) | 46 (39)** | 24 (28) | 9 (7)** | |
| L | 16 (19)** | 23 (28) | 18 (19)** | 13 (12)** | |
| Bott L | 3 (3)** | *N.A.* | 10 (10)** | 6 (8)** | |
| **Stage 2** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 2 (1)** | 3 (2)** | 4 (2)** | 8 (2)** | 26 (24) |
| W | 4 (2)** | 6 (3)** | 5 (2)** | 16 (7)** | |
| L | 6 (3)** | 8 (4) | 10 (2)** | 66 (62)** | |
| Bott L | 113 (118) | 26 (21) | 56 (62)** | 78 (87)** | |
| **Overall eff.** | **Top W** | **W** | **L** | **Bott L** | **Mean(sd)** |
| Top W | 9 (33)** | 103 (153) | 66 (97) | *N.A.* | 31 (45) |
| W | 2 (1)** | 18 (25) | 79 (128) | 9 (1)** | |
| L | 8 (1)** | 4 (2) | 21 (41)** | 30 (40) | |
| Bott L | *N.A.* | *N.A.* | 12 (7)** | 47 (56)** | |

Significance is the result of a test cell average of aggregated data from other cells; N.A. represents unrealisable calculations because of not any company in the category; the values are rounded.
* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)

The above aggregate tables show a high persistence for the biggest companies located in the extreme cell *Top Winners–Top Winners* for the *Portfolio Management stage* (Stage 1). This result is robust in terms of employees, assets, equity and number of funds. That is, the size, as a proxy for portfolio management resources, seems to play an important role in the portfolio management persistence of the best fund companies. On the other hand, the aggregate concentration in the extreme cell *Bottom Losers–Bottom Losers* shows not-significant differences in terms of labour and capital in contrast with the remaining variables (number of funds and assets), where the aggregate values show significantly lower values than the overall average.

The opposite pattern is found in the *Marketing and Service stage* (Stage 2), where size, as a proxy for resources, seems to play a significant and negative role in the persistence of this stage. Therefore, the bigger a company is, the more problems it will have in efficiently distributing mutual funds. This result is robust in terms of employees, assets, equity and number of funds. Note that these findings are very consistent with those found in Table I-4 of this thesis.

The aforementioned pattern is also found in the *Overall Efficiency stage*, although the results are not so significantly clear for all persistence cells and variables. This situation could suggest that the marketing and service of the fund companies also affect considerably the persistence of the overall efficiency of the companies. This result is consistent with those obtained in Table I-5 of Part I.

Looking in more detail at the results from persistently extreme winners and losers, the null hypothesis that the aggregate mean of the characteristics of *Top Winners–Top Winners* is different from the aggregate mean of *Bottom Losers–Bottom Losers* is shown in Table II-19. The table is constructed by subtracting mean values of both extreme persistence groups, then determining the statistical significance for each difference. The results are robust with those provided by the previous comparisons and suggest that companies with more resources are better at managing than at selling their portfolios, and therefore impacting in the overall efficiency levels. The differences in these extreme persistence categories are significantly important for the *Marketing and Service stage*.

**Table II-19** Comparison of mean values between "*Top W - Top W*" and "*Bott L – Bott L*" companies

| | Employees | Equity | Assets | Funds | Unitholders |
|---|---|---|---|---|---|
| Stage 1 | 14 | 2,844** | 7,335,194 | 65** | 247,956** |
| Stage 2 | -40** | -26,723** | -10,136,381** | -76** | -332,479** |
| Overall eff. | -17** | -2,820 | -541,325 | -38** | -11,320 |

* Statistically significant at 0.05 level (2-tailed)
** Statistically significant at 0.01 level (2-tailed)
Figures of equity and assets are in thousand Euros.

In general, the results of this sub-section provide evidence of persistence in efficiency records obtained by the companies in the different management stages. Residual analysis of the main diagonals (from "Top W" to "Bott L") also shows evidence about the significant probability of a mutual fund company to remain in the same efficiency cluster in the next year. Likewise, negative and significant values are obtained in some cases when the opposite diagonal (from "Bott L" to "Bott L") is traced, indicating that those efficiency scores are unlikely to change to a very different efficiency cluster. Further research involving parametric tools could be useful to test for the robustness of these major findings.

# 4 Conclusions and Summaries

Based on the sub-DMUs approach of Holod and Lewis (2011) and considering the interaction between the different management subsystems within a mutual fund company proposed by Berkowitz and Qiu (2003), Part I of this thesis evaluated the efficiency of Spanish Mutual Fund Companies by applying the slack-based measure (SBM) approach proposed by Tone (2001). In Part II, we go a step further by developing a study that overcomes the limitation of an appropriate reference set identification. This problem is particularly important in the Spanish fund industry due to both the high concentration and assorted characteristics of the management companies. We use for this purpose the recent and unexplored variations of SBM proposed by Tone (2010), which allow comparing fund companies with their true 'best practice' competitors by similar management resources.

We analysed the effect of these variations (based on the hyperplanes instead of the vertices of the frontier) on efficiency rankings previously obtained by the original SBM. First, Variation I improves the average efficiency score as a consequence of the new approach for every stage, although the Spearman rank correlation for both SBM and Variation I are nearly to 1 for every stage and year analysed. On the other hand, the comparative plots for *Marketing* and *Overall Efficiency stages* provided evidence of the high degree of similarity between the SBM and Variation I scores obtained in our sample; i.e., we found evidence of the residual effect of Variation I on the original SBM scores previously obtained. The aforementioned finding raises questions regarding the relevance of this variant in the empirical results of our study.

Similarly to previous SBM findings, the Variation I scores also show a decreasing efficiency pattern in the Spanish fund industry. In the same line, this variant highlights the fact that companies seem to be worse mutual fund sellers than portfolio managers, thereby reducing considerably the overall profits of company shareholders.

Continuing with the SBM variants proposed by Tone (2010), we applied SBM Variation II, which minimises the SBM score obtained from all facets found. SBM Variation II was computed using both *maximal friend* facets randomly obtained (Variation IV) and clustering facets search (Variation III) as suggested in the aforementioned model. Variation IV again improves the average efficiency scores for every stage, and the Spearman rank correlation between efficiency rankings (SBM original and Variation IV), again showed evidence of both high and significantly positive correlations. However, the correlation between Variation I and Variation IV scores, while still high, is lower than that between SBM original and Variation I.

Furthermore, Variation IV also showed a positive and significant relationship between the marketing and distribution skills of the company and overall efficiency for the entire time horizon. Therefore, this new measure proposed by Tone (2010) confirms the major findings obtained in Part I by using the SBM original. This result verifies the robustness of our previous conclusions, such as the apparent dichotomy between the efficiency of portfolio management and the distribution and marketing skills in the Spanish mutual fund industry.

On the other hand, we conducted a refined search for locally efficient companies by applying a clustering process (Variation III) based on a divisive hierarchical technique and different measurement dimensions (assets under management and number of employees of each fund company). This approach allowed us to find evidence that an appropriate evaluation of the *Portfolio Management stage* should consider homogeneous sets of companies with similar management resources. Therefore, when the reference companies included in the efficient frontier do not belong to the same cluster as the target company, traditional SBM scores could be biased. Otherwise, this bias appeared to be less important to both the *Marketing* and *Overall stages*.

In addition to the use of the different variations (Tone, 2010) versus the SBM original (Tone, 2001), we also analysed whether the patterns of efficiency obtained are persistent over time. Our persistence analysis is an innovative and complete approach due to the inclusion in certain respects of the traditional performance persistence idea related to portfolio management abilities and also due to the consideration of the remaining management stages, which also add value to a fund company. The main advantage of our clustering approach has been that we obtained consistent efficiency groups rather than the mere consideration of median or quartile groups with the same number of companies.

First, using 2x2 contingency tables, we found a significant phenomenon of persistence in the efficiency clusters, both in the *Portfolio Management* and in *Overall Efficiency stage*, although less significance is observed between 2008 and 2009. Cochran's test also confirmed this evidence for the entire period from 2005 to 2009. These findings supported the underlying hypothesis that those companies that manage their mutual funds better than their competitors are usually the same during the time horizon analysed. These conclusions could also be extended to those companies with worse efficiency records than their competitors.

Regarding persistence of the marketing and distribution stage, results showed significant persistence for the first two comparative periods (2005-2006, 2006-2007). However, there is a lack of this persistence phenomenon in 2007-2008 and 2008-2009, which might be driven by the consequences of the financial crisis in the successful distribution of mutual funds managed by the company.

Moreover, 4x4 contingency tables provided evidence of a significant persistence in the efficiency records obtained by the companies in the different management stages. We found a significant value of the chi-square test for all comparative periods and for each fund management company. Additionally, we found significant persistence of both the best-and worst-managed companies in two consecutive years. This finding is robust for portfolio management and distribution of mutual funds as well as the overall efficiency of the company as a whole. A more detailed analysis of the residuals of these 4x4 contingency tables indicates that the efficiency scores are unlikely to change to a very different efficiency cluster.

Furthermore, we found that size, as a proxy for portfolio management resources, seems to play an important and positive role in the portfolio management persistence of the best fund companies. This result was robust in terms of employees, assets, equity and number of funds. On the other hand, we found that companies with fewer management resources are consistently the worst fund companies, especially in terms of number of funds and assets managed.

An opposite pattern was found in the *Marketing and Service stage*, where size, as a proxy for resources, seems to play a significant and negative role in the persistence of this stage. Therefore, the bigger a company is, the more problems it has efficiently distributing their mutual funds. This result is robust in terms of employees, assets, equity and number of funds. Noteworthy is that the same pattern was also found in the O*verall Efficiency stage*, although the results are not so significantly clear for every persistence cell and variable. This situation suggests that the marketing and service of fund companies is also considerably affecting the persistence of the overall efficiency of the companies.

Finally, looking in more detail at the difference in management resources from extreme persistence groups, we found robust results with those provided by the previous comparisons, thereby suggesting that companies with more resources are better at managing than at selling their portfolios, therefore impacting in the overall efficiency levels. The differences in these extreme persistence categories are significantly important for the *Marketing and Service stage*.

# Appendix F

**Table II-F-1** Variation I-efficiency under CRS for 2005

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR I | Ref. | Rank | VAR I | Ref. | Rank | VAR I | Ref. | Rank |
| 1 | 0.38665 | 161 | 79 | 0.08966 | 59 | 91 | 0.04431 | 196 | 99 |
| 2 | 0.50263 | 177 | 66 | 0.11600 | 59 | 69 | 0.04597 | 100 | 97 |
| 4 | 0.47083 | 14 161 | 68 | 0.11224 | 59 | 74 | 0.14556 | 125 | 55 |
| 6 | 1.00000 | 6 | 1 | 0.12635 | 59 | 61 | 0.09447 | 196 | 71 |
| 7 | 1.00000 | 7 | 1 | 0.11275 | 59 | 72 | 0.07625 | 100 | 82 |
| 9 | 0.26032 | 12 177 | 88 | 0.18803 | 59 | 47 | 0.27668 | 100 | 25 |
| 12 | 1.00000 | 12 | 1 | 0.01733 | 59 | 102 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 0.12632 | 59 | 62 | 1.00000 | 14 | 1 |
| 15 | 0.66942 | 12 161 | 39 | 0.08926 | 59 | 92 | 0.13830 | 200 | 57 |
| 20 | 0.53726 | 12 161 | 57 | 0.08596 | 59 | 95 | 0.26639 | 196 | 28 |
| 21 | 0.21632 | 161 | 94 | 0.12651 | 59 | 60 | 0.20771 | 125 | 36 |
| 24 | 0.44598 | 12 177 | 72 | 0.10505 | 59 | 78 | 0.06403 | 100 | 89 |
| 29 | 0.55348 | 43 | 53 | 0.10109 | 59 | 83 | 0.08061 | 100 | 79 |
| 31 | 0.66068 | 12 177 | 40 | 0.14563 | 59 | 54 | 0.07928 | 100 | 80 |
| 34 | 0.23310 | 177 | 93 | 0.15740 | 59 | 49 | 0.10354 | 196 | 68 |
| 35 | 0.94340 | 40 160 176 177 | 29 | 0.14150 | 59 | 55 | 0.08897 | 100 | 75 |
| 36 | 0.31692 | 174 | 83 | 0.48623 | 46 | 14 | 0.34542 | 100 | 19 |
| 37 | 0.62130 | 40 174 177 | 44 | 0.26371 | 46 | 30 | 0.17881 | 100 | 43 |
| 38 | 0.35231 | 160 176 | 81 | 0.11694 | 59 | 67 | 0.19097 | 100 | 40 |
| 40 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.20996 | 174 | 95 | 0.48345 | 46 | 15 | 0.33274 | 100 | 20 |
| 43 | 1.00000 | 43 | 1 | 0.08761 | 59 | 93 | 0.05890 | 100 | 90 |
| 45 | 0.65554 | 12 174 177 | 41 | 0.15939 | 59 | 48 | 0.21755 | 100 | 35 |
| 46 | 0.25689 | 152 | 90 | 1.00000 | 46 | 1 | 0.58714 | 100 | 14 |
| 47 | 0.53955 | 12 176 | 56 | 0.12083 | 59 | 64 | 0.07059 | 100 | 84 |
| 49 | 0.57863 | 40 177 | 49 | 0.26299 | 46 | 31 | 0.19546 | 100 | 39 |
| 50 | 0.30691 | 177 | 85 | 0.84876 | 59 205 | 9 | 0.22464 | 100 | 33 |
| 51 | 0.65158 | 40 160 161 | 43 | 0.21977 | 59 | 39 | 0.13051 | 100 | 59 |
| 53 | 1.00000 | 53 | 1 | 0.61620 | 46 | 11 | 0.26866 | 100 | 27 |
| 55 | 1.00000 | 55 | 1 | 0.04260 | 59 | 101 | 0.30758 | 196 | 21 |
| 57 | 0.42220 | 174 | 76 | 0.20929 | 46 | 42 | 0.15238 | 100 | 51 |
| 58 | 0.74463 | 12 161 | 35 | 0.11267 | 59 | 73 | 0.18955 | 196 | 41 |
| 59 | 0.08443 | 161 | 101 | 1.00000 | 59 | 1 | 0.14996 | 125 | 53 |
| 60 | 0.12200 | 40 160 | 99 | 0.58960 | 46 | 13 | 0.35570 | 196 | 18 |
| 61 | 0.33483 | 161 | 82 | 0.09937 | 59 | 84 | 0.03392 | 196 | 100 |
| 62 | 0.74987 | 160 161 176 | 34 | 0.15399 | 59 | 51 | 0.15798 | 100 | 49 |
| 63 | 0.83527 | 12 43 154 | 31 | 0.10850 | 59 | 75 | 0.04542 | 100 | 98 |
| 69 | 0.31002 | 174 177 | 84 | 0.41929 | 46 | 18 | 0.12470 | 100 | 61 |
| 71 | 1.00000 | 71 | 1 | 0.10392 | 59 | 79 | 0.10305 | 100 | 70 |
| 73 | 0.71078 | 12 174 177 | 37 | 0.20019 | 59 | 44 | 0.17174 | 100 | 45 |
| 75 | 0.53706 | 12 161 | 58 | 0.07912 | 59 | 97 | 0.05309 | 100 | 94 |
| 76 | 1.00000 | 76 | 1 | 0.09364 | 59 | 86 | 0.26174 | 100 | 29 |
| 78 | 0.53648 | 174 177 | 59 | 0.23072 | 59 | 37 | 0.12188 | 100 | 62 |
| 83 | 0.65236 | 12 55 161 | 42 | 0.09589 | 59 | 85 | 0.07843 | 100 | 81 |
| 84 | 0.52326 | 14 161 | 63 | 0.09259 | 59 | 87 | 0.52573 | 125 196 | 15 |
| 85 | 0.55414 | 12 161 | 52 | 0.06204 | 59 | 100 | 0.15520 | 196 | 50 |
| 86 | 0.50307 | 161 | 64 | 0.09105 | 59 | 88 | 0.23166 | 100 | 32 |
| 93 | 0.20083 | 161 | 96 | 0.26485 | 59 | 29 | 0.13984 | 196 | 56 |
| 95 | 0.77913 | 55 161 | 33 | 0.11970 | 59 | 66 | 0.28886 | 100 | 24 |
| 98 | 0.52763 | 12 43 160 | 61 | 0.08995 | 59 | 90 | 0.18462 | 100 | 42 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.15566 | 152 | 97 | 0.81978 | 40 196 | 10 | 0.70115 | 100 196 | 13 |
| 103 | 1.00000 | 103 | 1 | 0.15074 | 59 | 52 | 1.00000 | 103 | 1 |
| 105 | 0.54799 | 163 177 | 54 | 0.08666 | 59 | 94 | 0.01924 | 100 | 101 |
| 110 | 0.57282 | 161 | 51 | 0.10239 | 59 | 81 | 0.08687 | 100 | 77 |
| 113 | 0.23546 | 161 | 92 | 0.10707 | 59 | 76 | 0.01282 | 196 | 102 |
| 115 | 0.52512 | 100 174 | 62 | 0.32630 | 46 | 24 | 0.17119 | 100 | 46 |
| 121 | 0.27680 | 161 | 87 | 0.09003 | 59 | 89 | 0.08832 | 196 | 76 |
| 123 | 0.38691 | 160 | 78 | 0.19068 | 59 | 46 | 0.11286 | 100 | 63 |
| 125 | 0.02147 | 161 | 102 | 0.44341 | 46 | 16 | 1.00000 | 125 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 126 | 0.45016 | 177 | 71 | 0.19487 | 59 | 45 | 0.09324 | 100 | 72 |
| 127 | 1.00000 | 127 | 1 | 0.07950 | 59 | 96 | 0.10429 | 100 | 67 |
| 128 | 1.00000 | 128 | 1 | 0.10130 | 59 | 82 | 0.10884 | 196 | 65 |
| 130 | 1.00000 | 130 | 1 | 0.10245 | 59 | 80 | 0.06501 | 100 | 86 |
| 131 | 0.28311 | 152 | 86 | 0.32630 | 46 | 25 | 0.29562 | 100 | 22 |
| 132 | 0.45702 | 177 | 69 | 0.14965 | 59 | 53 | 0.08999 | 100 | 74 |
| 133 | 0.61604 | 40 174 | 45 | 0.38862 | 46 | 22 | 0.24787 | 100 | 31 |
| 137 | 0.43701 | 12 174 | 73 | 0.21974 | 59 | 40 | 0.20631 | 100 | 37 |
| 138 | 0.39042 | 152 | 77 | 1.00000 | 138 | 1 | 0.78334 | 100 152 | 11 |
| 139 | 0.24469 | 177 | 91 | 0.28047 | 59 | 28 | 0.41251 | 196 | 17 |
| 140 | 1.00000 | 140 | 1 | 0.12058 | 59 | 65 | 0.05620 | 100 | 92 |
| 142 | 0.35601 | 161 | 80 | 0.07777 | 59 | 98 | 0.08564 | 196 | 78 |
| 152 | 1.00000 | 152 | 1 | 0.41096 | 196 | 20 | 1.00000 | 152 | 1 |
| 154 | 1.00000 | 154 | 1 | 0.13565 | 59 | 58 | 0.04904 | 100 | 96 |
| 156 | 0.54752 | 55 174 | 55 | 0.24016 | 59 | 35 | 0.11235 | 100 | 64 |
| 159 | 0.50301 | 174 177 | 65 | 0.25823 | 59 | 33 | 0.10316 | 100 | 69 |
| 160 | 1.00000 | 160 | 1 | 0.25883 | 46 | 32 | 0.15886 | 100 | 48 |
| 161 | 1.00000 | 161 | 1 | 0.07408 | 59 | 99 | 0.07363 | 100 | 83 |
| 162 | 0.72785 | 12 55 154 177 | 36 | 0.13594 | 59 | 57 | 0.12509 | 100 | 60 |
| 163 | 1.00000 | 163 | 1 | 0.13043 | 59 | 59 | 0.05362 | 100 | 93 |
| 164 | 0.12391 | 174 | 98 | 0.94237 | 40 196 | 8 | 0.75246 | 125 196 | 12 |
| 168 | 0.48103 | 12 174 | 67 | 0.23932 | 59 | 36 | 0.15203 | 100 | 52 |
| 173 | 0.45081 | 177 | 70 | 0.11520 | 59 | 71 | 0.05016 | 100 | 95 |
| 174 | 1.00000 | 174 | 1 | 0.35947 | 46 | 23 | 0.50134 | 205 | 16 |
| 176 | 1.00000 | 176 | 1 | 0.10591 | 59 | 77 | 0.06601 | 100 | 85 |
| 177 | 1.00000 | 177 | 1 | 0.15581 | 59 | 50 | 0.09050 | 100 | 73 |
| 182 | 0.60649 | 176 177 | 47 | 0.11549 | 59 | 70 | 0.06486 | 100 | 87 |
| 185 | 0.43585 | 12 43 | 74 | 0.20259 | 59 | 43 | 0.27353 | 100 | 26 |
| 189 | 0.25766 | 152 | 89 | 0.60172 | 46 196 | 12 | 0.29159 | 100 | 23 |
| 190 | 0.67208 | 12 176 177 | 38 | 0.12094 | 59 | 63 | 0.06482 | 100 | 88 |
| 191 | 0.57749 | 174 177 | 50 | 0.28520 | 59 | 27 | 0.16560 | 100 | 47 |
| 192 | 1.00000 | 192 | 1 | 0.14081 | 59 | 56 | 0.10601 | 100 | 66 |
| 193 | 1.00000 | 193 | 1 | 0.11656 | 59 | 68 | 0.05747 | 100 | 91 |
| 194 | 0.83731 | 12 43 174 198 | 30 | 0.21982 | 59 | 38 | 0.17578 | 100 | 44 |
| 195 | 0.78890 | 174 198 | 32 | 0.43738 | 59 | 17 | 0.24808 | 100 | 30 |
| 196 | 0.11880 | 40 152 | 100 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.60959 | 174 177 | 46 | 0.25072 | 46 | 34 | 0.13386 | 100 | 58 |
| 198 | 1.00000 | 198 | 1 | 0.30823 | 59 | 26 | 0.14766 | 100 | 54 |
| 200 | 0.42880 | 55 174 177 | 75 | 0.21853 | 59 | 41 | 1.00000 | 200 | 1 |
| 202 | 0.58329 | 40 177 | 48 | 0.41174 | 46 | 19 | 0.22371 | 100 | 34 |
| 205 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 |
| 206 | 0.52945 | 152 174 | 60 | 0.39816 | 196 | 21 | 0.20326 | 100 | 38 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR I corresponds to the efficiency score obtained by the Variation I maximizing the objective function for the reference set obtained for each SBM-inefficient company (equation II.2). Ref. corresponds to the reference set for each company obtained by the VAR I approach. Rank represents the ranking of the VAR I scores which have been sorted by value, where VAR I scores with value of 1.00000 obtain the highest ranking 1.

**Table II-F-2** Variation I-efficiency under CRS for 2006

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR I | Ref. | Rank | VAR I | Ref. | Rank | VAR I | Ref. | Rank |
| 2 | 0.55640 | 177 | 40 | 0.16883 | 196 | 80 | 0.05102 | 100 | 101 |
| 4 | 0.40949 | 14 51 | 61 | 0.20362 | 196 | 63 | 0.20237 | 103 | 41 |
| 6 | 0.33720 | 51 161 | 69 | 0.19315 | 196 | 67 | 0.13330 | 100 | 63 |
| 7 | 0.89402 | 12 53 163 | 25 | 0.18790 | 196 | 68 | 0.08920 | 100 | 82 |
| 9 | 0.23473 | 140 174 | 89 | 0.28269 | 196 | 35 | 0.33738 | 100 | 22 |
| 12 | 1.00000 | 12 | 1 | 0.00577 | 202 | 102 | 0.74887 | 14 | 11 |
| 14 | 1.00000 | 14 | 1 | 0.17761 | 202 | 74 | 1.00000 | 14 | 1 |
| 15 | 0.72103 | 12 127 | 31 | 0.00899 | 202 | 101 | 0.12844 | 103 | 66 |
| 20 | 0.61056 | 12 127 | 37 | 0.14657 | 196 | 93 | 0.32461 | 103 | 25 |
| 21 | 0.24047 | 127 | 87 | 0.17893 | 196 | 72 | 0.28615 | 103 | 31 |
| 24 | 0.45168 | 12 177 | 56 | 0.15599 | 196 | 88 | 0.07796 | 100 | 88 |
| 29 | 0.41895 | 128 205 | 59 | 0.16855 | 196 | 81 | 0.12851 | 100 | 65 |
| 31 | 0.91759 | 12 53 163 | 23 | 0.28779 | 196 | 34 | 0.12455 | 100 | 69 |
| 34 | 0.21397 | 177 | 93 | 0.53787 | 202 | 17 | 0.07962 | 100 | 87 |
| 35 | 0.53292 | 12 174 | 41 | 0.19937 | 196 | 64 | 0.10131 | 100 | 78 |
| 36 | 0.21919 | 174 | 92 | 0.45964 | 203 | 21 | 0.36283 | 100 | 19 |
| 37 | 0.49610 | 12 174 205 | 53 | 0.25101 | 196 | 45 | 0.19572 | 100 | 43 |
| 38 | 0.28681 | 51 163 | 84 | 0.20477 | 196 | 60 | 0.30177 | 100 | 28 |
| 40 | 0.12219 | 12 174 | 99 | 1.00000 | 40 | 1 | 0.98315 | 100 103 | 9 |
| 42 | 0.17388 | 174 | 96 | 0.41011 | 203 | 24 | 0.39169 | 100 | 17 |
| 43 | 0.85881 | 128 198 205 | 28 | 0.15153 | 196 | 91 | 0.06698 | 100 | 93 |
| 45 | 0.51323 | 12 174 | 46 | 0.21997 | 196 | 54 | 0.32857 | 100 | 23 |
| 46 | 0.33416 | 205 | 71 | 0.89877 | 196 203 | 10 | 0.61736 | 100 | 13 |
| 47 | 0.45723 | 12 51 | 55 | 0.19877 | 196 | 66 | 0.11071 | 100 | 72 |
| 49 | 0.35110 | 174 | 67 | 0.26393 | 196 | 42 | 0.25735 | 100 | 36 |
| 50 | 0.38948 | 174 | 63 | 0.61073 | 196 | 15 | 0.22569 | 100 | 38 |
| 51 | 1.00000 | 51 | 1 | 0.16411 | 196 | 83 | 0.11605 | 100 | 71 |
| 53 | 1.00000 | 53 | 1 | 0.62849 | 196 203 | 14 | 0.29695 | 100 | 30 |
| 55 | 1.00000 | 55 | 1 | 0.10510 | 196 | 99 | 0.38660 | 103 | 18 |
| 57 | 0.34766 | 12 174 | 68 | 0.22792 | 196 | 50 | 0.17904 | 100 | 47 |
| 58 | 0.61071 | 12 51 128 | 36 | 0.17201 | 202 | 78 | 0.27552 | 103 | 34 |
| 59 | 1.00000 | 59 | 1 | 0.74001 | 196 | 12 | 0.02049 | 125 | 102 |
| 60 | 0.09444 | 205 | 100 | 1.00000 | 60 | 1 | 0.63776 | 100 125 | 12 |
| 61 | 0.28675 | 161 | 85 | 0.16816 | 196 | 82 | 0.09254 | 100 | 80 |
| 62 | 1.00000 | 62 | 1 | 0.22136 | 196 | 53 | 0.17945 | 100 | 46 |
| 63 | 0.82739 | 12 128 163 | 29 | 0.14954 | 202 | 92 | 0.05501 | 100 | 97 |
| 69 | 0.52203 | 174 205 | 43 | 0.29226 | 203 | 33 | 0.15998 | 100 | 51 |
| 71 | 1.00000 | 71 | 1 | 0.16032 | 196 | 86 | 0.07392 | 100 | 90 |
| 75 | 0.44193 | 12 51 128 | 57 | 0.15477 | 196 | 90 | 0.05768 | 100 | 96 |
| 76 | 0.67039 | 55 174 | 34 | 0.16160 | 196 | 85 | 0.32722 | 100 | 24 |
| 78 | 0.51700 | 12 174 | 45 | 0.23471 | 196 | 47 | 0.13623 | 100 | 60 |
| 83 | 0.88700 | 12 55 127 140 | 26 | 0.22539 | 196 | 51 | 0.12697 | 100 | 68 |
| 84 | 0.55934 | 14 127 | 39 | 0.18098 | 196 | 71 | 0.58563 | 103 | 14 |
| 85 | 0.50734 | 12 51 128 | 49 | 0.08541 | 202 | 100 | 0.14745 | 103 | 55 |
| 86 | 0.50325 | 12 51 | 51 | 0.12824 | 196 | 97 | 0.30006 | 100 | 29 |
| 93 | 0.31691 | 51 | 74 | 0.27776 | 196 | 36 | 0.15319 | 100 | 54 |
| 95 | 0.49968 | 12 14 51 | 52 | 0.19907 | 196 | 65 | 0.46012 | 103 | 16 |
| 98 | 0.38824 | 12 51 | 64 | 0.15588 | 196 | 89 | 0.27062 | 100 | 35 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.29598 | 205 | 80 | 0.53768 | 203 | 18 | 0.33771 | 100 | 21 |
| 103 | 0.19099 | 55 127 | 95 | 0.22883 | 196 | 49 | 1.00000 | 103 | 1 |
| 105 | 0.16744 | 12 174 | 98 | 0.21509 | 196 | 55 | 0.15480 | 100 | 53 |
| 110 | 0.51800 | 12 51 | 44 | 0.16956 | 196 | 79 | 0.13768 | 100 | 59 |
| 113 | 0.23504 | 12 51 | 88 | 0.20468 | 196 | 61 | 0.05241 | 100 | 99 |
| 115 | 0.35917 | 174 | 66 | 0.26007 | 203 | 43 | 0.17871 | 100 | 48 |
| 121 | 0.29824 | 14 51 | 77 | 0.20370 | 196 | 62 | 0.10587 | 103 | 75 |
| 123 | 0.31644 | 12 205 | 75 | 0.21301 | 196 | 56 | 0.10904 | 100 | 74 |
| 125 | 0.06359 | 51 | 102 | 0.46693 | 196 | 20 | 1.00000 | 125 | 1 |
| 126 | 0.29205 | 12 174 | 81 | 0.22891 | 196 | 48 | 0.10139 | 100 | 77 |
| 127 | 1.00000 | 127 | 1 | 0.13583 | 196 | 95 | 0.08865 | 100 | 84 |
| 128 | 1.00000 | 128 | 1 | 0.13471 | 202 | 96 | 0.13552 | 103 | 61 |
| 130 | 1.00000 | 130 | 1 | 0.17482 | 196 | 75 | 0.07611 | 100 | 89 |
| 131 | 0.23051 | 174 205 | 90 | 0.32372 | 196 | 31 | 0.27757 | 100 | 32 |
| 132 | 0.51123 | 12 51 177 | 48 | 0.26697 | 196 | 39 | 0.13370 | 100 | 62 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 133 | 0.33064 | 174 | 72 | 0.39194 | 196 | 25 | 0.25268 | 100 | 37 |
| 137 | 0.29792 | 174 | 78 | 0.27432 | 196 | 38 | 0.30851 | 100 | 27 |
| 139 | 0.28955 | 51 | 82 | 0.36027 | 196 | 28 | 0.48390 | 100 | 15 |
| 140 | 1.00000 | 140 | 1 | 0.18767 | 196 | 69 | 0.08654 | 100 | 85 |
| 142 | 0.29763 | 12 51 | 79 | 0.18135 | 196 | 70 | 0.08910 | 100 | 83 |
| 152 | 0.36580 | 174 | 65 | 1.00000 | 152 | 1 | 0.34260 | 100 | 20 |
| 154 | 1.00000 | 154 | 1 | 0.13960 | 196 | 94 | 0.05299 | 100 | 98 |
| 156 | 0.43289 | 174 | 58 | 0.27650 | 196 | 37 | 0.10983 | 100 | 73 |
| 159 | 0.32332 | 12 174 | 73 | 0.33236 | 196 | 30 | 0.09063 | 100 | 81 |
| 160 | 1.00000 | 160 | 1 | 0.26484 | 196 | 40 | 0.18193 | 100 | 45 |
| 161 | 1.00000 | 161 | 1 | 0.11123 | 196 | 98 | 0.09544 | 100 | 79 |
| 162 | 0.67058 | 55 140 177 | 33 | 0.21295 | 196 | 57 | 0.16337 | 100 | 50 |
| 163 | 1.00000 | 163 | 1 | 0.16022 | 196 | 87 | 0.05147 | 100 | 100 |
| 164 | 0.22963 | 205 | 91 | 0.76309 | 196 | 11 | 1.00000 | 164 | 1 |
| 168 | 0.26852 | 174 | 86 | 0.70646 | 196 202 | 13 | 0.16436 | 100 | 49 |
| 173 | 0.51246 | 12 177 | 47 | 0.16336 | 196 | 84 | 0.07258 | 100 | 92 |
| 174 | 1.00000 | 174 | 1 | 0.38481 | 196 | 26 | 0.31727 | 100 | 26 |
| 176 | 0.87968 | 140 177 | 27 | 0.17342 | 196 | 76 | 0.07287 | 100 | 91 |
| 177 | 1.00000 | 177 | 1 | 0.17241 | 196 | 77 | 0.12188 | 100 | 70 |
| 182 | 0.70413 | 12 51 163 177 | 32 | 0.20785 | 196 | 59 | 0.10220 | 100 | 76 |
| 185 | 0.28944 | 51 128 | 83 | 0.46887 | 202 | 19 | 0.13982 | 103 | 57 |
| 190 | 0.46243 | 12 51 205 | 54 | 0.22225 | 196 | 52 | 0.08337 | 100 | 86 |
| 191 | 0.52271 | 174 | 42 | 0.25457 | 196 | 44 | 0.15846 | 100 | 52 |
| 192 | 0.63720 | 161 174 | 35 | 0.17847 | 196 | 73 | 0.12837 | 100 | 67 |
| 193 | 0.56544 | 174 177 | 38 | 0.24157 | 196 | 46 | 0.06506 | 100 | 95 |
| 194 | 1.00000 | 194 | 1 | 0.31866 | 196 | 32 | 0.18850 | 100 | 44 |
| 195 | 0.39708 | 174 198 | 62 | 0.90278 | 152 196 202 | 9 | 0.21477 | 100 | 40 |
| 196 | 0.17049 | 205 | 97 | 1.00000 | 196 | 1 | 0.96884 | 100 125 164 | 10 |
| 197 | 0.50619 | 174 | 50 | 0.26409 | 196 | 41 | 0.13269 | 100 | 64 |
| 198 | 1.00000 | 198 | 1 | 0.60641 | 202 | 16 | 0.13823 | 100 | 58 |
| 200 | 0.33604 | 161 | 70 | 0.34650 | 196 | 29 | 1.00000 | 200 | 1 |
| 202 | 0.41224 | 177 205 | 60 | 1.00000 | 202 | 1 | 0.22387 | 100 | 39 |
| 203 | 0.07730 | 205 | 101 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.90701 | 14 174 177 205 | 24 | 0.21243 | 196 | 58 | 0.14578 | 100 | 56 |
| 205 | 1.00000 | 205 | 1 | 0.42132 | 203 | 23 | 1.00000 | 205 | 1 |
| 206 | 0.31628 | 174 | 76 | 0.43377 | 196 | 22 | 0.19629 | 100 | 42 |
| 207 | 0.19626 | 205 | 94 | 1.00000 | 207 | 1 | 0.06510 | 100 | 94 |
| 210 | 0.76209 | 174 205 | 30 | 0.38090 | 203 | 27 | 0.27657 | 100 | 33 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR I corresponds to the efficiency score obtained by the Variation I maximizing the objective function for the reference set obtained for each SBM-inefficient company (equation II.2). Ref. corresponds to the reference set for each company obtained by the VAR I approach. Rank represents the ranking of the VAR I scores which have been sorted by value, where VAR I scores with value of 1.00000 obtain the highest ranking 1.

**Table II-F-3** Variation I-efficiency under CRS for 2007

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR I | Ref. | Rank | VAR I | Ref. | Rank | VAR I | Ref. | Rank |
| 2 | 0.63460 | 7 50 198 | 37 | 0.27159 | 50 | 57 | 0.04937 | 100 | 88 |
| 4 | 0.55677 | 12 14 127 | 44 | 0.23952 | 50 | 74 | 0.10488 | 103 | 54 |
| 6 | 0.54725 | 174 177 | 46 | 0.26111 | 46 | 61 | 0.12678 | 100 | 42 |
| 7 | 1.00000 | 7 | 1 | 0.30253 | 50 | 37 | 0.06810 | 100 | 75 |
| 9 | 0.27374 | 12 177 | 82 | 0.28129 | 46 | 45 | 0.25633 | 103 | 17 |
| 12 | 1.00000 | 12 | 1 | 0.02373 | 50 | 95 | 0.24853 | 103 | 19 |
| 14 | 1.00000 | 14 | 1 | 0.09046 | 50 | 94 | 0.29689 | 103 | 12 |
| 15 | 0.77309 | 12 127 | 27 | 0.18102 | 50 | 92 | 0.05225 | 103 | 86 |
| 20 | 0.29695 | 12 51 | 77 | 0.19869 | 50 | 90 | 0.21514 | 103 | 23 |
| 21 | 0.32596 | 12 51 | 72 | 0.27917 | 46 | 50 | 0.11364 | 103 | 49 |
| 24 | 0.39582 | 12 152 | 67 | 0.27726 | 46 | 53 | 0.05693 | 100 | 84 |
| 29 | 0.42171 | 12 50 198 | 65 | 0.26095 | 50 | 62 | 0.09364 | 100 | 58 |
| 31 | 0.50438 | 12 152 | 51 | 0.29044 | 46 | 42 | 0.08811 | 100 | 59 |
| 34 | 0.30280 | 12 50 | 76 | 0.43667 | 50 | 22 | 0.07355 | 100 | 70 |
| 35 | 0.82942 | 12 174 177 | 23 | 0.25775 | 46 | 66 | 0.06677 | 100 | 76 |
| 36 | 0.29045 | 174 | 81 | 0.46345 | 46 | 18 | 0.34604 | 100 | 11 |
| 37 | 0.51333 | 12 152 198 | 49 | 0.27020 | 46 | 58 | 0.11603 | 100 | 48 |
| 38 | 0.24290 | 51 | 85 | 0.27542 | 46 | 56 | 0.21607 | 100 | 22 |
| 40 | 0.29544 | 174 | 79 | 0.66181 | 50 | 8 | 0.24673 | 100 | 20 |
| 43 | 0.73357 | 50 128 198 | 30 | 0.25369 | 50 | 67 | 0.08387 | 100 | 63 |
| 45 | 0.72216 | 12 174 177 | 31 | 0.22965 | 46 | 79 | 0.26707 | 100 | 16 |
| 46 | 0.19931 | 174 | 89 | 1.00000 | 46 | 1 | 0.54995 | 100 | 8 |
| 47 | 0.46521 | 12 51 | 60 | 0.26043 | 50 | 64 | 0.10175 | 103 | 56 |
| 49 | 0.34824 | 198 | 70 | 0.50501 | 50 | 16 | 0.18861 | 100 | 29 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 | 0.19133 | 100 | 27 |
| 51 | 1.00000 | 51 | 1 | 0.22873 | 46 | 80 | 0.10175 | 100 | 55 |
| 53 | 1.00000 | 53 | 1 | 0.65008 | 46 100 | 9 | 0.22934 | 100 | 21 |
| 55 | 1.00000 | 55 | 1 | 0.18614 | 50 | 91 | 0.17281 | 103 | 32 |
| 57 | 0.34003 | 12 198 | 71 | 0.28414 | 46 | 44 | 0.16067 | 100 | 34 |
| 58 | 0.54674 | 12 127 | 47 | 0.21110 | 50 | 88 | 0.20325 | 103 | 25 |
| 59 | 0.08603 | 51 | 92 | 0.75383 | 100 | 7 | 0.02239 | 125 | 95 |
| 61 | 0.29518 | 14 51 | 80 | 0.26365 | 50 | 59 | 0.06150 | 100 | 81 |
| 62 | 0.71958 | 12 50 177 | 33 | 0.41194 | 50 | 24 | 0.13891 | 100 | 40 |
| 63 | 0.47037 | 12 51 | 57 | 0.22016 | 50 | 85 | 0.02930 | 103 | 94 |
| 69 | 0.47715 | 198 | 55 | 0.63894 | 50 | 10 | 0.12486 | 100 | 43 |
| 71 | 0.71594 | 14 177 | 34 | 0.27921 | 50 | 49 | 0.14463 | 100 | 37 |
| 75 | 0.46734 | 12 51 128 | 58 | 0.22553 | 50 | 83 | 0.05125 | 103 | 87 |
| 76 | 0.70046 | 14 174 177 | 35 | 0.26010 | 46 | 65 | 0.21237 | 100 | 24 |
| 78 | 1.00000 | 78 | 1 | 0.33522 | 50 | 31 | 0.08658 | 100 | 61 |
| 83 | 1.00000 | 83 | 1 | 0.23689 | 50 | 76 | 0.08579 | 103 | 62 |
| 84 | 0.59960 | 14 51 127 | 41 | 0.21743 | 50 | 86 | 0.40844 | 103 | 10 |
| 85 | 0.48836 | 12 51 128 | 54 | 0.17989 | 50 | 93 | 0.07036 | 103 | 73 |
| 86 | 0.72143 | 12 50 127 | 32 | 0.24629 | 50 | 70 | 0.13901 | 100 | 39 |
| 93 | 0.31287 | 51 | 73 | 0.62909 | 50 | 11 | 0.15701 | 100 | 35 |
| 95 | 0.58787 | 12 51 | 42 | 0.20359 | 50 | 89 | 0.27348 | 103 | 15 |
| 98 | 0.30854 | 12 50 | 75 | 0.27866 | 46 | 51 | 0.27933 | 100 | 14 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 0.53741 | 46 | 14 | 1.00000 | 102 | 1 |
| 103 | 0.23013 | 12 51 | 86 | 0.33876 | 46 | 30 | 1.00000 | 103 | 1 |
| 105 | 0.08895 | 51 | 91 | 0.38316 | 46 | 28 | 0.28315 | 100 | 13 |
| 110 | 0.46244 | 12 51 | 61 | 0.27668 | 50 | 55 | 0.12210 | 100 | 45 |
| 113 | 0.22104 | 14 51 | 87 | 0.22404 | 50 | 84 | 0.04300 | 103 | 90 |
| 115 | 0.37316 | 174 | 68 | 0.40079 | 46 | 26 | 0.14418 | 100 | 38 |
| 121 | 0.29673 | 12 51 | 78 | 0.24177 | 50 | 72 | 0.08012 | 103 | 64 |
| 125 | 0.01458 | 51 | 94 | 0.52661 | 100 | 15 | 1.00000 | 125 | 1 |
| 126 | 0.61450 | 152 177 198 | 40 | 0.23754 | 46 | 75 | 0.07084 | 100 | 72 |
| 127 | 1.00000 | 127 | 1 | 0.24432 | 50 | 71 | 0.07826 | 100 | 67 |
| 128 | 1.00000 | 128 | 1 | 0.22772 | 50 | 81 | 0.05711 | 103 | 83 |
| 130 | 0.63996 | 12 50 128 | 36 | 0.23219 | 50 | 77 | 0.06568 | 100 | 79 |
| 131 | 0.20083 | 198 | 88 | 0.30184 | 46 | 38 | 0.18744 | 100 | 30 |
| 132 | 0.57854 | 12 51 177 | 43 | 0.21567 | 46 | 87 | 0.10706 | 100 | 53 |
| 133 | 0.47351 | 174 | 56 | 0.41140 | 46 | 25 | 0.20135 | 100 | 26 |
| 137 | 0.46543 | 12 174 | 59 | 0.27974 | 46 | 47 | 0.25393 | 100 | 18 |
| 139 | 0.35828 | 12 51 | 69 | 0.38813 | 46 | 27 | 0.42997 | 100 | 9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 1.00000 | 140 | 1 | 0.23008 | 50 | 78 | 0.06866 | 100 | 74 |
| 142 | 0.31110 | 12 51 | 74 | 0.24925 | 50 | 69 | 0.05337 | 103 | 85 |
| 152 | 1.00000 | 152 | 1 | 0.45273 | 46 | 20 | 0.18678 | 100 | 31 |
| 154 | 0.97396 | 12 51 128 140 198 | 22 | 0.22616 | 50 | 82 | 0.04190 | 100 | 91 |
| 156 | 0.52434 | 174 177 | 48 | 0.44584 | 50 | 21 | 0.09471 | 100 | 57 |
| 159 | 0.39990 | 152 198 | 66 | 0.42791 | 50 | 23 | 0.08677 | 100 | 60 |
| 160 | 1.00000 | 160 | 1 | 0.46731 | 50 | 17 | 0.10742 | 100 | 52 |
| 161 | 0.77077 | 14 55 127 177 | 28 | 0.32144 | 50 | 34 | 0.07592 | 100 | 68 |
| 162 | 0.61857 | 51 127 | 39 | 0.29792 | 50 | 39 | 0.11256 | 100 | 50 |
| 163 | 1.00000 | 163 | 1 | 0.24070 | 50 | 73 | 0.03624 | 100 | 93 |
| 168 | 0.50159 | 174 177 | 52 | 0.32660 | 46 | 33 | 0.13868 | 100 | 41 |
| 173 | 0.42885 | 12 50 | 64 | 0.27699 | 50 | 54 | 0.06195 | 100 | 80 |
| 174 | 1.00000 | 174 | 1 | 0.58505 | 50 | 12 | 0.16349 | 100 | 33 |
| 176 | 0.80657 | 12 51 140 177 | 25 | 0.30405 | 50 | 35 | 0.06578 | 100 | 78 |
| 177 | 1.00000 | 177 | 1 | 0.27741 | 46 | 52 | 0.07277 | 100 | 71 |
| 182 | 0.44739 | 12 51 | 62 | 0.28875 | 50 | 43 | 0.07833 | 100 | 65 |
| 185 | 0.27039 | 51 128 | 84 | 0.29669 | 46 | 40 | 0.04871 | 103 | 89 |
| 190 | 0.62888 | 12 50 198 | 38 | 0.27991 | 50 | 46 | 0.05825 | 100 | 82 |
| 191 | 0.73583 | 174 198 | 29 | 0.25283 | 46 | 68 | 0.12380 | 100 | 44 |
| 192 | 0.43269 | 177 | 63 | 1.00000 | 192 | 1 | 0.12072 | 100 | 46 |
| 193 | 0.77926 | 152 177 198 | 26 | 0.26127 | 50 | 60 | 0.03958 | 100 | 92 |
| 194 | 0.49623 | 12 198 | 53 | 0.27968 | 46 | 48 | 0.11228 | 100 | 51 |
| 196 | 0.06738 | 198 | 93 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.50973 | 198 | 50 | 0.29052 | 46 | 41 | 0.07830 | 100 | 66 |
| 198 | 1.00000 | 198 | 1 | 0.26090 | 46 | 63 | 0.06653 | 100 | 77 |
| 200 | 0.18292 | 51 127 | 90 | 0.30270 | 46 | 36 | 0.56729 | 103 125 | 7 |
| 203 | 0.01218 | 174 | 95 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.82784 | 12 50 177 198 | 24 | 0.45445 | 50 | 19 | 0.11611 | 100 | 47 |
| 206 | 0.55269 | 152 | 45 | 0.33323 | 46 | 32 | 0.14614 | 100 | 36 |
| 207 | 0.27342 | 174 | 83 | 0.38133 | 46 | 29 | 0.07377 | 100 | 69 |
| 210 | 1.00000 | 210 | 1 | 0.56271 | 50 | 13 | 0.18937 | 100 | 28 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR I corresponds to the efficiency score obtained by the Variation I maximizing the objective function for the reference set obtained for each SBM-inefficient company (equation II.2). Ref. corresponds to the reference set for each company obtained by the VAR I approach. Rank represents the ranking of the VAR I scores which have been sorted by value, where VAR I scores with value of 1.00000 obtain the highest ranking 1.

**Table II-F-4** Variation I-efficiency under CRS for 2008

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **VAR I** | **Ref.** | **Rank** | **VAR I** | **Ref.** | **Rank** | **VAR I** | **Ref.** | **Rank** |
| 2 | 0.34102 | 14 174 | 43 | 0.07661 | 100 | 70 | 0.06936 | 100 | 71 |
| 4 | 0.50953 | 14 127 | 27 | 0.05026 | 100 | 88 | 0.12356 | 103 | 45 |
| 6 | 0.30824 | 174 | 48 | 0.09354 | 100 | 50 | 0.09404 | 46 | 59 |
| 7 | 0.65044 | 154 174 | 17 | 0.08171 | 100 | 64 | 0.08422 | 100 | 65 |
| 9 | 0.27604 | 14 174 | 53 | 0.17328 | 100 | 17 | 0.28667 | 46 | 13 |
| 12 | 1.00000 | 12 | 1 | 0.00580 | 100 | 93 | 0.36512 | 103 | 10 |
| 14 | 1.00000 | 14 | 1 | 0.02121 | 100 | 92 | 0.53627 | 46 103 | 7 |
| 15 | 1.00000 | 15 | 1 | 0.04369 | 100 | 91 | 0.06101 | 46 | 82 |
| 20 | 0.32022 | 14 127 174 | 47 | 0.07434 | 100 | 73 | 0.24916 | 46 | 23 |
| 21 | 0.30457 | 127 | 49 | 0.08726 | 100 | 56 | 0.10910 | 103 | 52 |
| 24 | 0.18848 | 174 | 72 | 0.09683 | 100 | 47 | 0.06890 | 100 | 72 |
| 29 | 0.16027 | 174 | 78 | 0.08021 | 100 | 67 | 0.05422 | 100 | 86 |
| 31 | 0.23317 | 174 | 61 | 0.10037 | 100 | 46 | 0.05397 | 100 | 87 |
| 34 | 0.17439 | 174 | 75 | 0.11094 | 100 | 39 | 0.05629 | 46 | 84 |
| 35 | 0.51037 | 14 174 | 26 | 0.10075 | 100 | 43 | 0.10524 | 100 | 56 |
| 36 | 0.12706 | 174 | 81 | 0.29986 | 100 | 5 | 0.37877 | 46 | 9 |
| 37 | 0.21857 | 174 | 67 | 0.10292 | 100 | 42 | 0.11621 | 100 | 48 |
| 38 | 0.19608 | 174 | 69 | 0.10059 | 100 | 45 | 0.09978 | 46 | 58 |
| 40 | 0.08362 | 174 | 88 | 0.22784 | 100 | 8 | 0.07030 | 46 | 70 |
| 43 | 0.25822 | 14 174 | 54 | 0.08061 | 100 | 66 | 0.06407 | 100 | 79 |
| 45 | 0.33274 | 14 174 | 46 | 0.11144 | 100 | 37 | 0.26292 | 100 | 19 |
| 46 | 0.03121 | 210 | 91 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.46085 | 14 154 | 36 | 0.08297 | 100 | 62 | 0.08838 | 46 | 62 |
| 49 | 0.17135 | 174 | 76 | 0.13015 | 100 | 32 | 0.16023 | 100 | 35 |
| 50 | 0.20987 | 174 | 68 | 0.21096 | 100 | 14 | 0.28164 | 100 | 17 |
| 51 | 0.56217 | 127 174 | 22 | 0.10495 | 100 | 40 | 0.13157 | 100 | 43 |
| 53 | 0.21879 | 210 217 | 66 | 0.22162 | 100 | 10 | 0.40558 | 100 | 8 |
| 55 | 1.00000 | 55 | 1 | 0.05008 | 100 | 89 | 0.22664 | 46 | 26 |
| 57 | 0.24432 | 174 | 56 | 0.13549 | 100 | 29 | 0.11501 | 100 | 49 |
| 58 | 0.48977 | 12 127 | 31 | 0.04599 | 100 | 90 | 0.28277 | 103 | 16 |
| 61 | 0.24133 | 14 174 | 57 | 0.08615 | 100 | 59 | 0.06024 | 46 | 83 |
| 62 | 0.44015 | 14 174 | 37 | 0.11135 | 100 | 38 | 0.14484 | 100 | 38 |
| 63 | 0.61609 | 14 154 | 21 | 0.06001 | 100 | 82 | 0.02524 | 46 | 91 |
| 69 | 0.19360 | 174 | 71 | 0.21138 | 100 | 12 | 0.23610 | 100 | 25 |
| 71 | 0.46351 | 14 174 | 34 | 0.07507 | 100 | 71 | 0.13102 | 46 | 44 |
| 76 | 0.76308 | 14 55 127 174 | 14 | 0.07948 | 100 | 69 | 0.13805 | 100 | 41 |
| 78 | 0.35198 | 174 | 42 | 0.09341 | 100 | 51 | 0.09133 | 100 | 61 |
| 83 | 1.00000 | 83 | 1 | 0.05749 | 100 | 84 | 0.06880 | 46 | 73 |
| 84 | 0.47955 | 14 127 | 32 | 0.05633 | 100 | 85 | 0.26264 | 46 | 20 |
| 85 | 0.68399 | 12 127 | 16 | 0.05201 | 100 | 86 | 0.08376 | 46 | 66 |
| 86 | 0.47427 | 14 154 | 33 | 0.06724 | 100 | 77 | 0.06671 | 46 | 77 |
| 93 | 0.18364 | 174 | 74 | 0.18624 | 100 | 15 | 0.18065 | 46 | 31 |
| 95 | 0.64537 | 14 154 | 18 | 0.06332 | 100 | 80 | 0.22117 | 46 | 27 |
| 98 | 0.10369 | 174 | 87 | 0.08690 | 100 | 58 | 0.20722 | 46 | 29 |
| 100 | 0.01982 | 210 | 92 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.11734 | 14 174 | 82 | 0.14642 | 100 | 24 | 1.00000 | 103 | 1 |
| 105 | 0.08180 | 174 | 89 | 0.15219 | 100 | 22 | 0.00449 | 46 | 93 |
| 110 | 0.50199 | 154 | 28 | 0.07954 | 100 | 68 | 0.11121 | 46 | 51 |
| 113 | 0.22532 | 14 174 | 63 | 0.07449 | 100 | 72 | 0.07830 | 46 | 67 |
| 115 | 0.16674 | 174 | 77 | 0.16853 | 100 | 19 | 0.19021 | 100 | 30 |
| 121 | 0.24507 | 14 174 | 55 | 0.08205 | 100 | 63 | 0.07646 | 46 | 68 |
| 125 | 0.01161 | 174 | 93 | 0.32678 | 100 | 4 | 1.00000 | 125 | 1 |
| 126 | 0.28950 | 174 | 50 | 0.09261 | 100 | 52 | 0.09270 | 100 | 60 |
| 127 | 1.00000 | 127 | 1 | 0.05888 | 100 | 83 | 0.06516 | 100 | 78 |
| 128 | 1.00000 | 128 | 1 | 0.05170 | 100 | 87 | 0.06187 | 46 | 81 |
| 130 | 0.64198 | 14 154 | 19 | 0.06347 | 100 | 79 | 0.05462 | 100 | 85 |
| 131 | 0.11549 | 174 | 83 | 0.17022 | 100 | 18 | 0.21404 | 100 | 28 |
| 132 | 0.15380 | 174 | 79 | 0.10070 | 100 | 44 | 0.10632 | 46 | 55 |
| 133 | 0.23824 | 174 | 59 | 0.22745 | 100 | 9 | 0.28295 | 100 | 15 |
| 137 | 0.23982 | 174 | 58 | 0.16323 | 100 | 20 | 0.28322 | 100 | 14 |
| 139 | 0.19445 | 154 174 | 70 | 0.21125 | 100 | 13 | 0.35653 | 46 | 11 |
| 140 | 0.69896 | 154 | 15 | 0.06216 | 100 | 81 | 0.06238 | 100 | 80 |
| 142 | 0.42401 | 14 154 174 | 38 | 0.07049 | 100 | 75 | 0.14721 | 46 | 37 |
| 152 | 0.23478 | 174 217 | 60 | 0.21544 | 100 | 11 | 0.24542 | 100 | 24 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 154 | 1.00000 | 154 | 1 | 0.07043 | 100 | 76 | 0.05124 | 100 | 88 |
| 156 | 0.27965 | 174 | 52 | 0.13949 | 100 | 27 | 0.13365 | 100 | 42 |
| 159 | 0.18658 | 174 | 73 | 0.12133 | 100 | 33 | 0.10815 | 100 | 53 |
| 160 | 1.00000 | 160 | 1 | 0.14901 | 100 | 23 | 0.16151 | 100 | 34 |
| 161 | 0.49258 | 14 55 174 | 30 | 0.08691 | 100 | 57 | 0.07374 | 46 | 69 |
| 162 | 0.35985 | 14 174 | 41 | 0.08763 | 100 | 55 | 0.10303 | 46 | 57 |
| 163 | 0.49559 | 154 174 | 29 | 0.06445 | 100 | 78 | 0.05120 | 100 | 89 |
| 168 | 0.22249 | 174 | 65 | 0.13937 | 100 | 28 | 0.16156 | 100 | 33 |
| 173 | 0.10768 | 174 | 85 | 0.08971 | 100 | 54 | 0.04383 | 46 | 90 |
| 174 | 1.00000 | 174 | 1 | 0.14526 | 100 | 25 | 0.25869 | 100 | 22 |
| 176 | 0.63727 | 154 174 | 20 | 0.08379 | 100 | 61 | 0.08507 | 100 | 64 |
| 177 | 0.46210 | 174 | 35 | 0.09069 | 100 | 53 | 0.10718 | 100 | 54 |
| 182 | 0.33530 | 14 174 | 44 | 0.08063 | 100 | 65 | 0.06770 | 46 | 75 |
| 185 | 0.55629 | 12 127 160 | 23 | 0.09539 | 100 | 49 | 0.01699 | 46 | 92 |
| 190 | 0.53469 | 154 174 | 25 | 0.07405 | 100 | 74 | 0.06689 | 100 | 76 |
| 191 | 0.39324 | 174 | 39 | 0.13382 | 100 | 30 | 0.17292 | 100 | 32 |
| 192 | 0.38279 | 174 | 40 | 0.09595 | 100 | 48 | 0.12119 | 46 | 47 |
| 193 | 0.28315 | 174 | 51 | 0.08454 | 100 | 60 | 0.06802 | 100 | 74 |
| 194 | 0.23248 | 174 | 62 | 0.11563 | 100 | 35 | 0.08797 | 100 | 63 |
| 196 | 0.05126 | 174 | 90 | 0.56400 | 100 | 3 | 0.56694 | 46 | 6 |
| 197 | 0.33478 | 174 | 45 | 0.11451 | 100 | 36 | 0.13962 | 100 | 39 |
| 198 | 1.00000 | 198 | 1 | 0.10335 | 100 | 41 | 0.13824 | 100 | 40 |
| 200 | 0.11153 | 14 174 | 84 | 0.18564 | 100 | 16 | 0.34346 | 103 | 12 |
| 203 | 0.10584 | 174 | 86 | 0.22949 | 100 | 7 | 0.26175 | 100 | 21 |
| 204 | 0.53757 | 14 174 | 24 | 0.12076 | 100 | 34 | 0.11325 | 100 | 50 |
| 206 | 0.22317 | 174 | 64 | 0.13368 | 100 | 31 | 0.15593 | 100 | 36 |
| 207 | 0.13731 | 174 | 80 | 0.16322 | 100 | 21 | 0.12223 | 100 | 46 |
| 210 | 1.00000 | 210 | 1 | 0.14436 | 100 | 26 | 0.26583 | 100 | 18 |
| 217 | 1.00000 | 217 | 1 | 0.27604 | 100 | 6 | 1.00000 | 217 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR I corresponds to the efficiency score obtained by the Variation I maximizing the objective function for the reference set obtained for each SBM-inefficient company (equation II.2). Ref. corresponds to the reference set for each company obtained by the VAR I approach. Rank represents the ranking of the VAR I scores which have been sorted by value, where VAR I scores with value of 1.00000 obtain the highest ranking 1.

**Table II-F-5** Variation I-efficiency under CRS for 2009

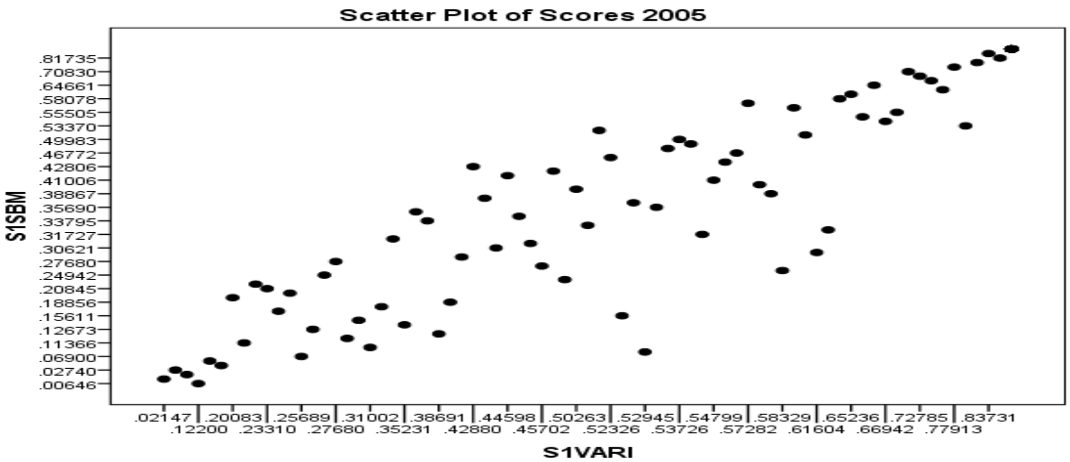
| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR I | Ref. | Rank | VAR I | Ref. | Rank | VAR I | Ref. | Rank |
| 2 | 0.41886 | 7 76 | 56 | 0.14137 | 196 | 76 | 0.06684 | 100 | 74 |
| 4 | 1.00000 | 4 | 1 | 0.09835 | 196 | 90 | 0.07747 | 100 | 64 |
| 6 | 0.41433 | 50 76 | 59 | 0.21464 | 196 | 34 | 0.09868 | 100 | 55 |
| 7 | 1.00000 | 7 | 1 | 0.15481 | 196 | 66 | 0.08650 | 100 | 59 |
| 9 | 0.23876 | 76 | 85 | 0.24172 | 196 | 23 | 0.23953 | 100 | 19 |
| 12 | 0.66097 | 14 46 | 29 | 0.00009 | 196 | 94 | 0.00002 | 100 | 95 |
| 14 | 1.00000 | 14 | 1 | 0.00003 | 196 | 95 | 0.24104 | 100 | 18 |
| 15 | 0.45053 | 14 | 50 | 1.00000 | 15 | 1 | 0.05933 | 100 | 83 |
| 20 | 0.30511 | 14 51 | 74 | 0.18649 | 196 | 49 | 0.23018 | 100 | 20 |
| 21 | 0.24252 | 14 46 | 83 | 0.19100 | 196 | 45 | 0.11611 | 100 | 49 |
| 24 | 0.34371 | 46 76 | 64 | 0.14132 | 196 | 77 | 0.06891 | 100 | 72 |
| 29 | 0.42025 | 45 76 131 | 54 | 0.14545 | 196 | 71 | 0.07943 | 100 | 62 |
| 31 | 0.66870 | 7 51 | 27 | 0.29884 | 196 | 18 | 0.07714 | 100 | 65 |
| 34 | 0.15321 | 76 | 89 | 0.15801 | 196 | 64 | 0.08981 | 100 | 57 |
| 35 | 0.75657 | 76 210 | 25 | 0.15662 | 196 | 65 | 0.10771 | 100 | 52 |
| 36 | 0.15772 | 46 76 | 87 | 0.44315 | 196 | 11 | 0.31329 | 100 | 14 |
| 37 | 0.36394 | 46 76 | 62 | 0.17962 | 196 | 51 | 0.11910 | 100 | 48 |
| 38 | 0.12349 | 14 50 | 93 | 0.14600 | 196 | 70 | 0.06778 | 100 | 73 |
| 40 | 0.56056 | 45 46 76 100 | 34 | 0.34411 | 196 | 15 | 0.29908 | 100 | 15 |
| 43 | 0.64809 | 7 14 128 | 31 | 0.18516 | 196 | 50 | 0.07326 | 100 | 68 |
| 45 | 1.00000 | 45 | 1 | 0.19426 | 196 | 43 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 0.60339 | 100 | 8 |
| 47 | 0.44254 | 76 | 52 | 0.17026 | 196 | 53 | 0.08880 | 100 | 58 |
| 49 | 0.38321 | 46 76 | 61 | 0.21968 | 196 | 30 | 0.14272 | 100 | 37 |
| 50 | 1.00000 | 50 | 1 | 0.40832 | 196 | 13 | 0.26275 | 100 | 16 |
| 51 | 1.00000 | 51 | 1 | 0.23329 | 196 | 26 | 0.13888 | 100 | 38 |
| 53 | 0.05305 | 45 | 95 | 1.00000 | 53 | 1 | 0.35490 | 100 | 11 |
| 55 | 1.00000 | 55 | 1 | 0.11516 | 196 | 89 | 0.12805 | 100 | 42 |
| 57 | 0.55684 | 46 76 210 | 35 | 0.21488 | 196 | 33 | 0.18196 | 100 | 27 |
| 58 | 0.41861 | 14 51 | 58 | 0.13294 | 196 | 84 | 0.16127 | 100 | 33 |
| 61 | 0.32884 | 50 76 | 66 | 0.13415 | 196 | 82 | 0.00117 | 100 | 94 |
| 62 | 1.00000 | 62 | 1 | 0.21576 | 196 | 32 | 0.17493 | 100 | 28 |
| 63 | 0.50707 | 14 51 | 43 | 0.09070 | 196 | 91 | 0.01846 | 100 | 93 |
| 69 | 0.27015 | 45 46 | 78 | 0.91835 | 46 53 196 | 10 | 0.32852 | 100 | 13 |
| 71 | 0.87395 | 7 14 50 76 | 21 | 0.15199 | 196 | 68 | 0.12169 | 100 | 46 |
| 76 | 1.00000 | 76 | 1 | 0.16795 | 196 | 54 | 0.12508 | 100 | 44 |
| 78 | 0.48283 | 46 76 | 46 | 0.19213 | 196 | 44 | 0.14369 | 100 | 36 |
| 83 | 0.41918 | 14 76 | 55 | 0.12291 | 196 | 87 | 0.04583 | 100 | 90 |
| 84 | 0.48720 | 14 51 | 44 | 0.19749 | 196 | 40 | 0.17140 | 100 | 30 |
| 85 | 0.54846 | 14 51 | 37 | 0.08841 | 196 | 92 | 0.07218 | 100 | 69 |
| 86 | 0.51972 | 14 51 | 40 | 0.17899 | 196 | 52 | 0.06392 | 100 | 77 |
| 93 | 0.32194 | 14 50 | 68 | 0.29418 | 196 | 20 | 0.19697 | 100 | 26 |
| 95 | 0.81564 | 7 14 140 | 23 | 0.14857 | 196 | 69 | 0.06981 | 100 | 70 |
| 98 | 0.24244 | 7 | 84 | 0.22425 | 196 | 29 | 0.09003 | 100 | 56 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.18388 | 76 | 86 | 0.15821 | 196 | 63 | 1.00000 | 103 | 1 |
| 105 | 0.14898 | 14 46 | 90 | 0.21197 | 196 | 35 | 0.04605 | 100 | 89 |
| 110 | 0.58006 | 7 | 32 | 0.14326 | 196 | 73 | 0.07889 | 100 | 63 |
| 113 | 0.31340 | 14 51 | 71 | 0.13521 | 196 | 81 | 0.04774 | 100 | 87 |
| 115 | 0.25544 | 50 76 100 | 81 | 0.32520 | 196 | 16 | 0.17193 | 100 | 29 |
| 121 | 0.25098 | 14 50 | 82 | 0.14466 | 196 | 72 | 0.06331 | 100 | 79 |
| 125 | 0.13837 | 46 | 91 | 0.97340 | 46 53 196 | 8 | 1.00000 | 125 | 1 |
| 126 | 0.33415 | 46 76 | 65 | 0.16061 | 196 | 61 | 0.12112 | 100 | 47 |
| 127 | 1.00000 | 127 | 1 | 0.14041 | 196 | 78 | 0.06583 | 100 | 75 |
| 128 | 1.00000 | 128 | 1 | 0.02592 | 196 | 93 | 0.02722 | 100 | 92 |
| 130 | 0.86584 | 7 14 128 140 | 22 | 0.15991 | 196 | 62 | 0.05414 | 100 | 84 |
| 131 | 1.00000 | 131 | 1 | 0.18828 | 196 | 48 | 0.84278 | 45 100 217 | 6 |
| 132 | 0.25683 | 76 | 80 | 0.16460 | 196 | 59 | 0.06399 | 100 | 76 |
| 133 | 0.45421 | 45 46 76 | 49 | 0.30729 | 196 | 17 | 0.25524 | 100 | 17 |
| 137 | 0.28537 | 46 76 | 77 | 0.20871 | 196 | 37 | 0.21064 | 100 | 23 |
| 139 | 0.48051 | 46 76 210 | 47 | 0.24574 | 196 | 22 | 0.34998 | 100 | 12 |

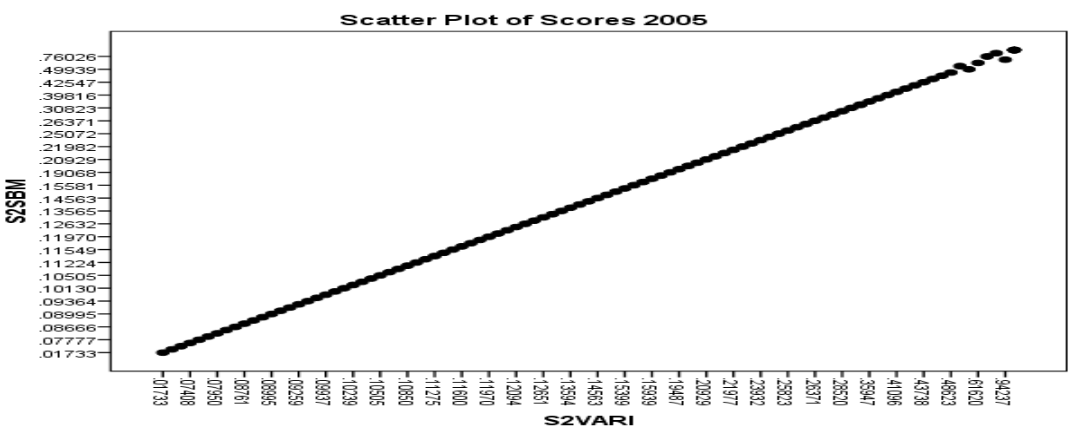
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 1.00000 | 140 | 1 | 0.13995 | 196 | 79 | 0.04534 | 100 | 91 |
| 142 | 0.41864 | 14 51 | 57 | 0.12292 | 196 | 86 | 0.06106 | 100 | 82 |
| 152 | 1.00000 | 152 | 1 | 0.43377 | 196 | 12 | 0.37313 | 100 | 10 |
| 154 | 0.66777 | 14 46 76 | 28 | 0.15444 | 196 | 67 | 0.06351 | 100 | 78 |
| 156 | 0.54375 | 50 76 | 38 | 0.18926 | 196 | 46 | 0.12481 | 100 | 45 |
| 159 | 0.32656 | 46 76 | 67 | 0.18860 | 196 | 47 | 0.11241 | 100 | 50 |
| 160 | 0.31841 | 46 76 | 69 | 0.21135 | 196 | 36 | 0.13288 | 100 | 41 |
| 161 | 0.56409 | 76 | 33 | 0.14168 | 196 | 75 | 0.06268 | 100 | 80 |
| 162 | 0.51520 | 46 76 | 41 | 0.12123 | 196 | 88 | 0.07697 | 100 | 66 |
| 163 | 0.47683 | 7 14 | 48 | 0.13196 | 196 | 85 | 0.05326 | 100 | 85 |
| 168 | 0.26591 | 46 76 | 79 | 0.20162 | 196 | 38 | 0.16093 | 100 | 34 |
| 173 | 0.52658 | 14 51 | 39 | 0.16598 | 196 | 57 | 0.04681 | 100 | 88 |
| 174 | 1.00000 | 174 | 1 | 0.28618 | 196 | 21 | 0.22081 | 100 | 22 |
| 176 | 0.76119 | 14 51 76 | 24 | 0.16460 | 196 | 58 | 0.07694 | 100 | 67 |
| 177 | 0.31780 | 50 76 | 70 | 0.23625 | 196 | 25 | 0.12704 | 100 | 43 |
| 182 | 0.42454 | 50 76 | 53 | 0.14183 | 196 | 74 | 0.06908 | 100 | 71 |
| 185 | 0.44913 | 14 51 | 51 | 0.13941 | 196 | 80 | 0.04822 | 100 | 86 |
| 190 | 0.69864 | 7 | 26 | 0.13383 | 196 | 83 | 0.06186 | 100 | 81 |
| 191 | 0.65853 | 46 76 174 | 30 | 0.21636 | 196 | 31 | 0.22495 | 100 | 21 |
| 192 | 0.38878 | 50 76 | 60 | 0.19708 | 196 | 41 | 0.10456 | 100 | 54 |
| 193 | 1.00000 | 193 | 1 | 0.16678 | 196 | 56 | 0.08055 | 100 | 61 |
| 194 | 0.54980 | 76 210 | 36 | 0.16364 | 196 | 60 | 0.10909 | 100 | 51 |
| 195 | 0.48317 | 76 210 | 45 | 0.16712 | 196 | 55 | 0.08512 | 100 | 60 |
| 196 | 0.29905 | 46 76 | 75 | 1.00000 | 196 | 1 | 0.53158 | 100 | 9 |
| 197 | 0.50977 | 174 | 42 | 0.24011 | 196 | 24 | 0.15332 | 100 | 35 |
| 198 | 0.30795 | 14 50 76 | 72 | 0.20008 | 196 | 39 | 0.10700 | 100 | 53 |
| 200 | 0.11656 | 14 46 | 94 | 0.29435 | 196 | 19 | 0.16554 | 100 | 32 |
| 203 | 0.12525 | 45 46 76 | 92 | 0.37516 | 196 | 14 | 0.20074 | 100 | 25 |
| 204 | 0.34667 | 46 76 | 63 | 0.22747 | 196 | 28 | 0.13595 | 100 | 39 |
| 206 | 0.29661 | 45 46 76 | 76 | 0.23200 | 196 | 27 | 0.16866 | 100 | 31 |
| 207 | 0.15729 | 46 76 | 88 | 1.00000 | 207 | 1 | 0.13347 | 100 | 40 |
| 210 | 1.00000 | 210 | 1 | 0.19581 | 196 | 42 | 0.20425 | 100 | 24 |
| 217 | 1.00000 | 217 | 1 | 0.92002 | 46 53 | 9 | 1.00000 | 217 | 1 |
| 221 | 0.30515 | 50 76 | 73 | 1.00000 | 221 | 1 | 0.74804 | 100 103 | 7 |

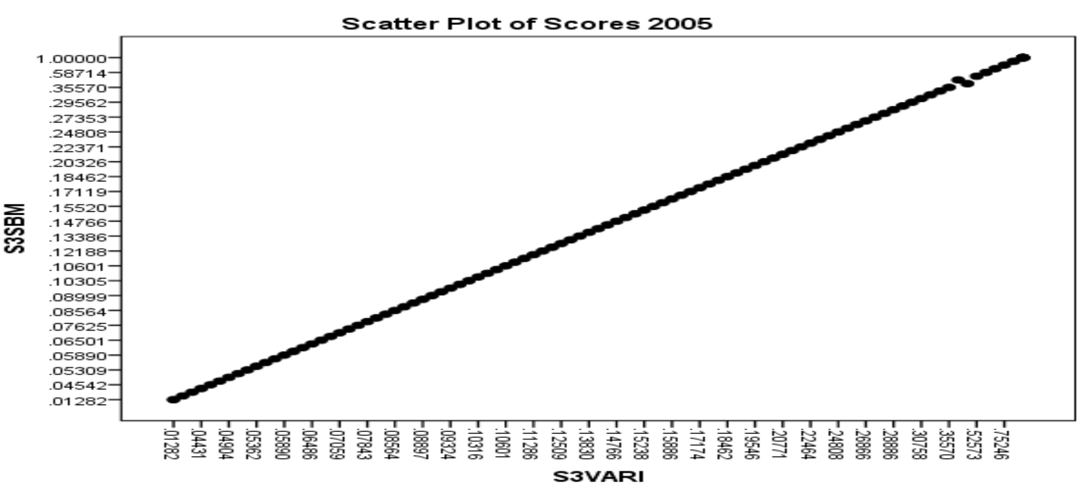
MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR I corresponds to the efficiency score obtained by the Variation I maximizing the objective function for the reference set obtained for each SBM-inefficient company (equation II.2). Ref. corresponds to the reference set for each company obtained by the VAR I approach. Rank represents the ranking of the VAR I scores which have been sorted by value, where VAR I scores with value of 1.00000 obtain the highest ranking 1.

# Appendix G

**Figure II-G-1** Comparative graphs between SBM and Variation I scores for 2005

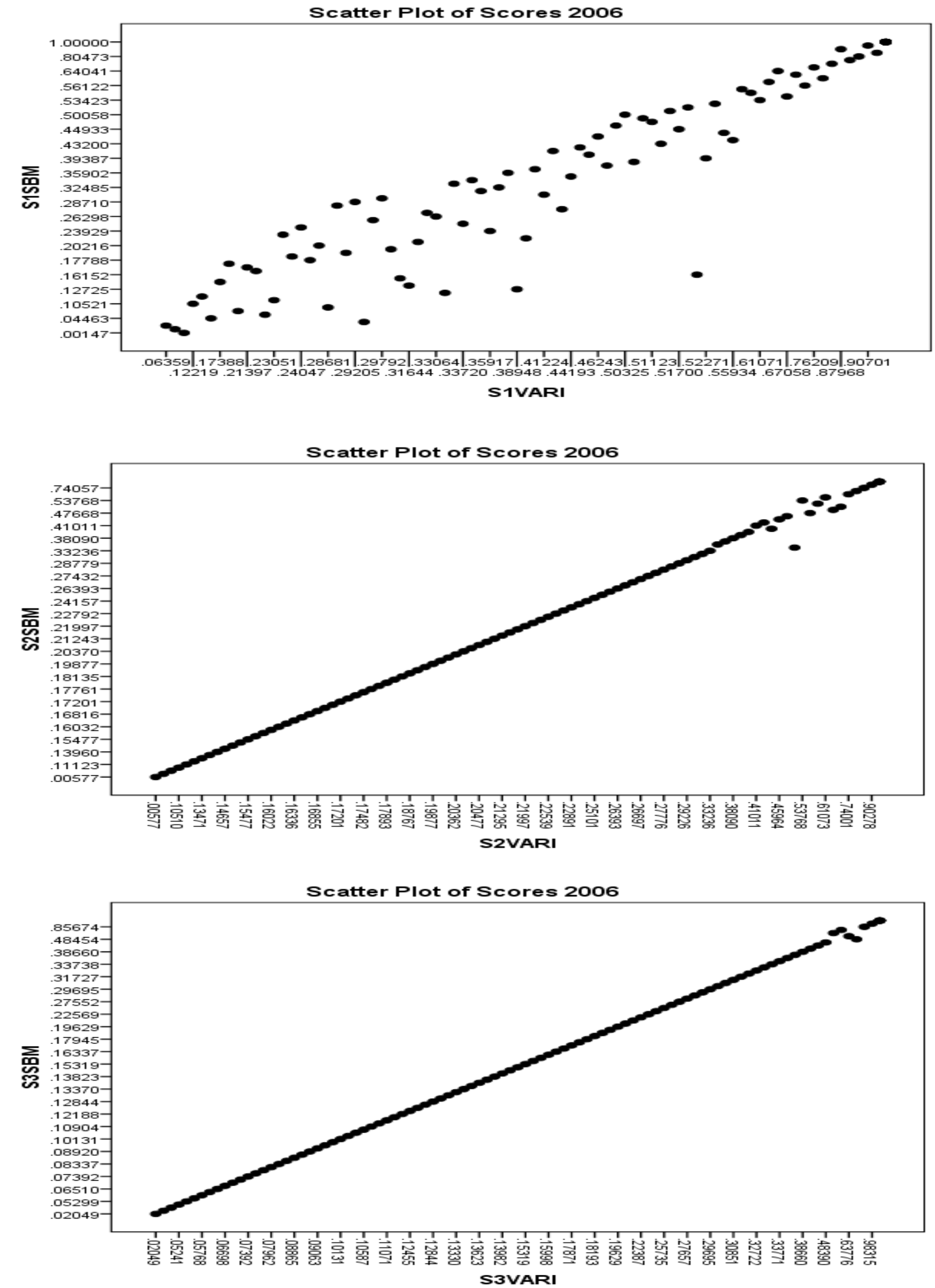


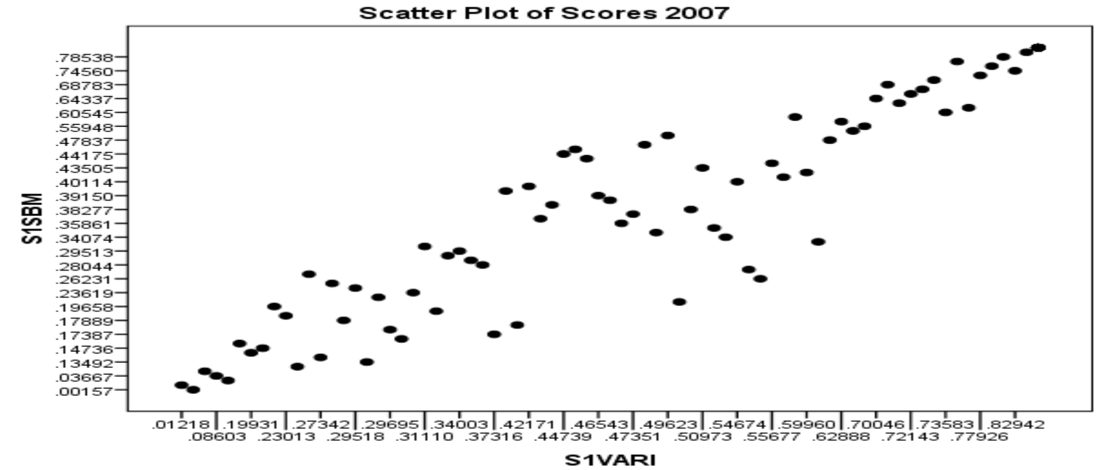

S#SBM = efficiency scores obtained by the CRS-SBM for Stage # of the multi-manag. stage model
S#VARI = efficiency scores obtained by the CRS-Var. I for Stage # of the multi-manag. stage model

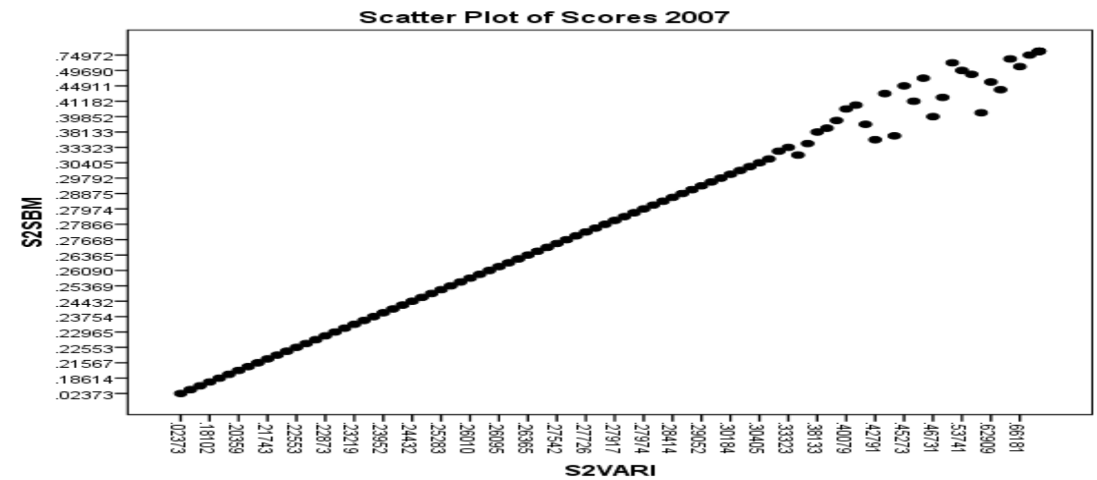
**Figure II-G-2** Comparative graphs between SBM and Variation I scores for 2006

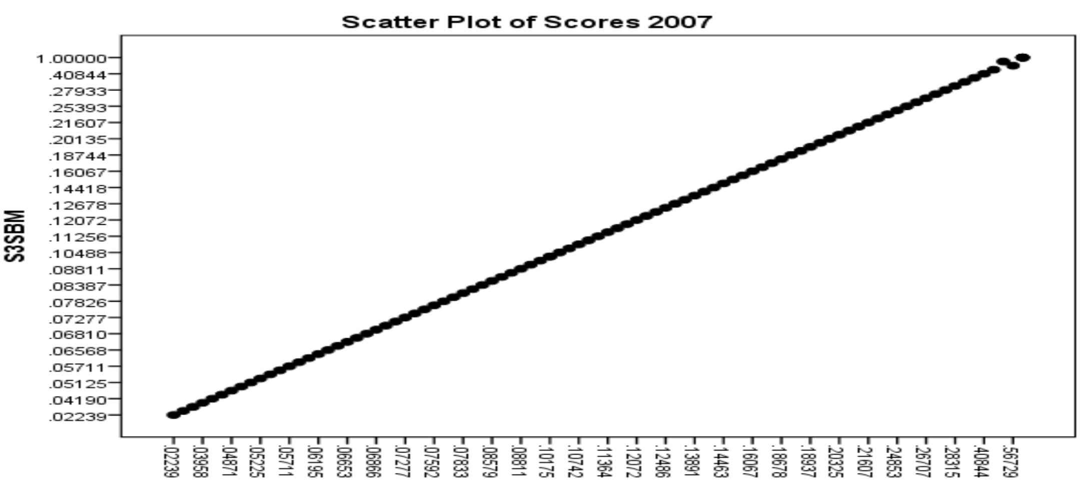



S#SBM = efficiency scores obtained by the CRS-SBM for Stage # of the multi-manag. stage model
S#VARI = efficiency scores obtained by the CRS-Var. I for Stage # of the multi-manag. stage model

**Figure II-G-3** Comparative graphs between SBM and Variation I scores for 2007

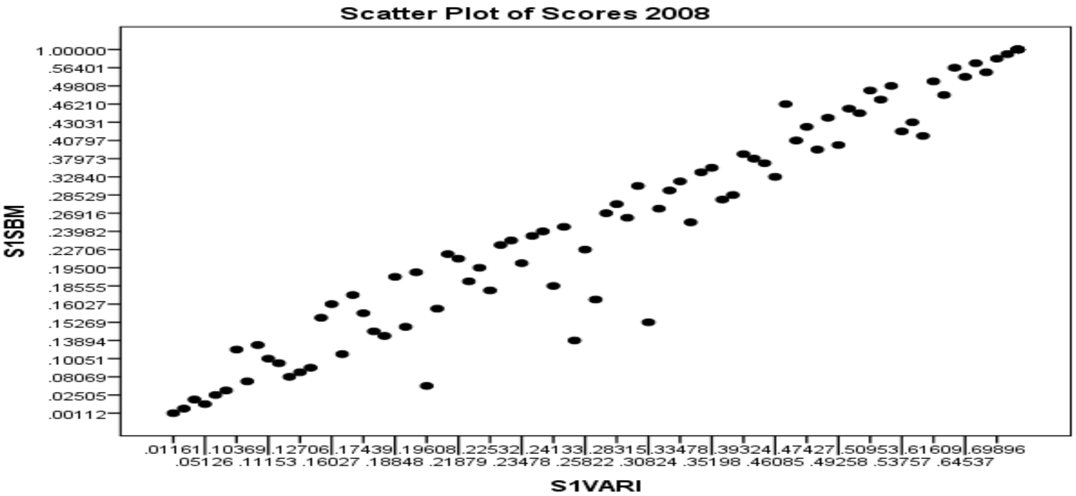


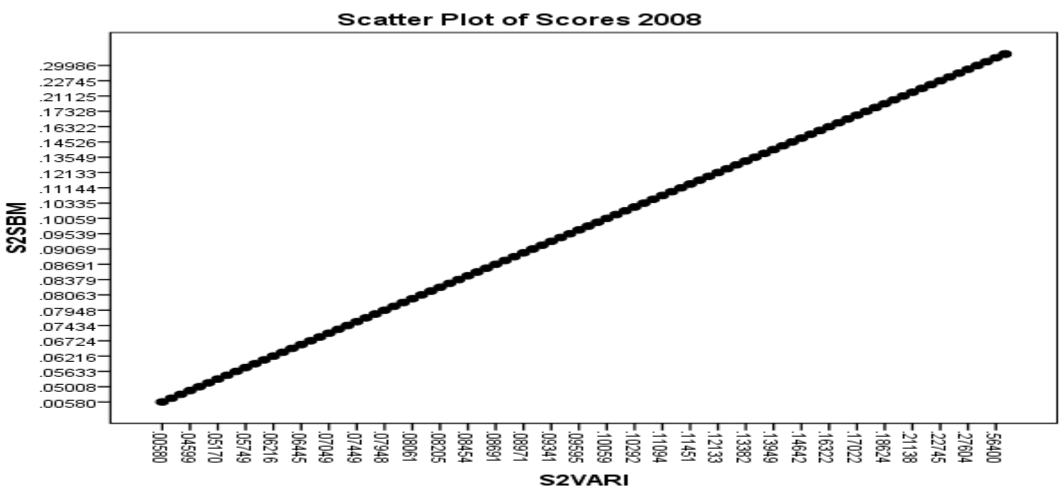



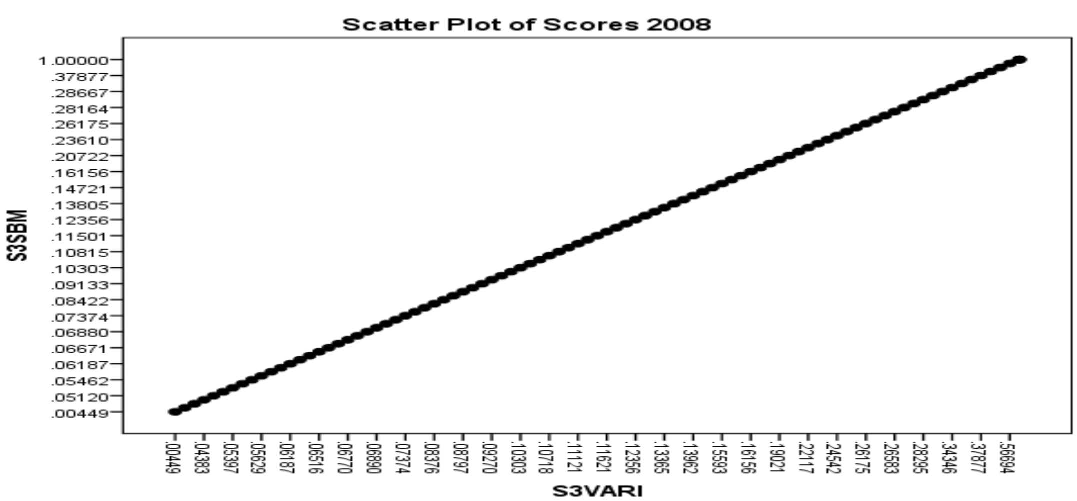




S#SBM = efficiency scores obtained by the CRS-SBM for Stage # of the multi-manag. stage model
S#VARI = efficiency scores obtained by the CRS-Var. I for Stage # of the multi-manag. stage model

**Figure II-G-4** Comparative graphs between SBM and Variation I scores for 2008

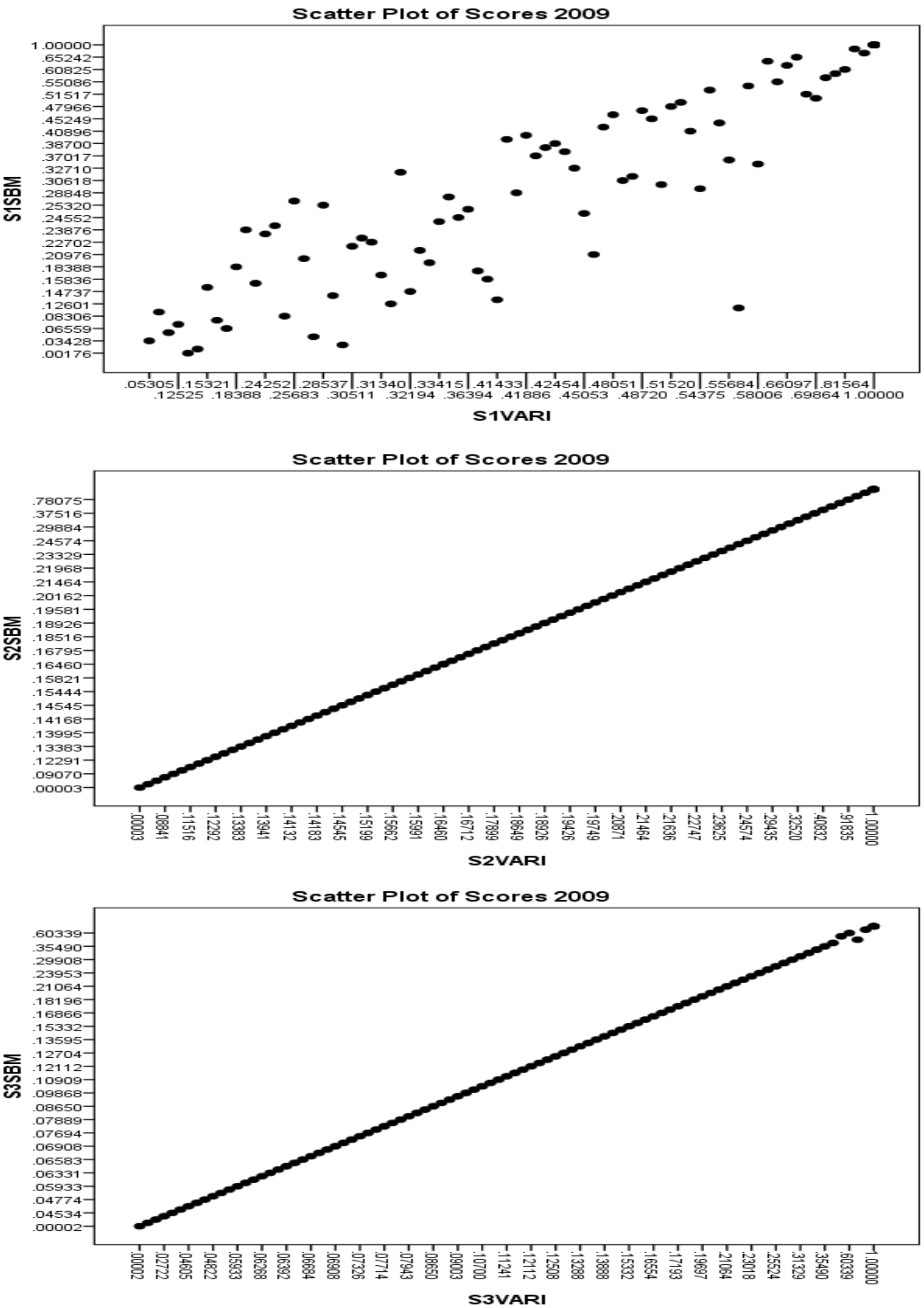



S#SBM = efficiency scores obtained by the CRS-SBM for Stage # of the multi-manag. stage model
S#VARI = efficiency scores obtained by the CRS-Var. I for Stage # of the multi-manag. stage model

**Figure II-G-5** Comparative graphs between SBM and Variation I scores for 2009




S#SBM = efficiency scores obtained by the CRS-SBM for Stage # of the multi-manag. stage model
S#VARI = efficiency scores obtained by the CRS-Var. I for Stage # of the multi-manag. stage model

# Appendix H

Code inside are the identifying number of the mutual fund management company (Official registers, CNMV).

**Table II-H-1** Maximal Friends found for 2005

| Stage 1 | Stage 2 | Overall Eff. |
|---|---|---|
| 6 40 160 161 | 40 46 59 | 12 14 200 |
| 53 160 174 177 | 40 100 196 | 12 14 125 |
| 55 76 100 174 | 40 46 196 | 14 125 200 |
| 12 100 152 174 | 46 59 205 | 100 152 205 |
| 7 154 160 163 176 | 46 138 205 | 40 100 200 |
| 7 160 161 163 176 | 46 138 196 | 100 196 200 |
| 7 154 160 161 176 | | 40 103 125 200 |
| 7 154 161 163 176 | | 40 125 196 200 |
| 12 71 161 176 177 | | |
| 12 55 128 154 161 | | |
| 12 55 154 176 177 | | |
| 12 128 130 154 161 | | |
| 12 40 43 174 177 | | |
| 12 55 154 161 176 | | |
| 12 55 161 176 177 | | |
| 12 40 43 160 177 | | |
| 12 40 160 174 177 | | |
| 12 40 43 174 205 | | |
| 6 40 161 174 192 | | |
| 43 163 174 177 205 | | |
| 40 161 174 177 192 | | |
| 55 127 128 154 161 | | |
| 12 55 71 161 177 | | |
| 55 140 154 176 177 | | |
| 55 76 161 177 193 | | |
| 55 76 161 174 193 | | |
| 55 76 174 177 193 | | |
| 55 161 174 177 193 | | |
| 6 161 174 177 192 | | |
| 55 76 161 174 177 | | |
| 12 14 55 100 174 | | |
| 12 152 174 198 205 | | |
| 12 14 103 160 161 | | |
| 12 128 154 160 161 | | |
| 12 43 128 154 160 | | |
| 12 40 152 174 205 | | |
| 76 161 174 177 193 | | |
| 43 163 177 198 205 | | |
| 40 43 160 174 177 | | |
| 163 174 177 198 205 | | |
| 12 43 160 163 176 177 | | |
| 12 154 160 161 163 176 | | |
| 12 43 154 160 163 176 | | |
| 7 12 154 160 161 163 | | |
| 12 43 154 163 176 177 | | |
| 12 43 163 174 177 198 | | |
| 12 14 55 161 174 177 | | |
| 12 14 40 55 161 174 | | |
| 12 40 55 161 174 177 | | |
| 12 14 55 127 128 161 | | |
| 12 43 163 174 198 205 | | |
| 14 40 55 76 161 174 | | |
| 55 127 140 154 161 176 | | |
| 7 12 130 154 161 163 | | |
| 12 40 160 161 176 177 | | |

**Table II-H-2** Maximal Friends found for 2006

| Stage 1 | Stage 2 | Overall Eff. |
|---|---|---|
| 12 100 174 205 | 60 196 203 | 100 203 |
| 12 14 100 174 | 60 152 196 | 100 205 |
| 14 55 100 174 | 152 196 202 | 14 103 125 |
| 12 14 71 174 177 | 40 100 196 203 207 | 100 125 164 |
| 12 14 55 127 128 | | 103 125 164 200 |
| 12 14 174 177 205 | | 100 103 164 200 |
| 12 14 51 127 128 | | |
| 12 51 59 127 128 | | |
| 12 51 59 128 160 | | |
| 51 62 130 160 163 | | |
| 12 14 51 59 127 | | |
| 53 163 177 198 205 | | |
| 128 154 177 198 205 | | |
| 12 174 194 198 205 | | |
| 51 62 140 161 177 | | |
| 51 127 130 140 163 | | |
| 51 62 140 163 177 | | |
| 14 71 161 174 177 | | |
| 62 127 130 140 163 | | |
| 51 62 127 140 163 | | |
| 51 62 127 130 163 | | |
| 53 174 177 198 205 | | |
| 128 174 177 198 205 | | |
| 53 163 174 198 205 | | |
| 12 51 55 127 128 140 | | |
| 12 14 55 140 174 177 | | |
| 12 128 140 154 174 198 | | |
| 12 128 140 174 177 205 | | |
| 12 163 174 177 198 205 | | |
| 12 128 154 174 198 205 | | |
| 12 140 154 174 177 198 | | |
| 12 128 154 163 198 205 | | |
| 12 154 174 177 198 205 | | |
| 12 14 51 55 127 140 | | |
| 12 14 51 55 140 177 | | |
| 12 51 55 140 177 205 | | |
| 12 51 53 154 163 177 | | |
| 12 51 53 128 154 163 | | |
| 12 51 128 140 154 205 | | |
| 12 128 140 154 177 205 | | |
| 12 51 53 154 177 205 | | |
| 12 14 51 55 177 205 | | |
| 14 51 55 161 174 177 | | |
| 12 51 53 128 160 163 | | |
| 12 53 163 174 177 205 | | |
| 12 51 140 154 177 205 | | |
| 12 53 128 160 163 205 | | |
| 12 14 51 140 161 177 | | |
| 12 14 51 127 140 161 | | |
| 12 51 53 128 154 205 | | |
| 12 51 128 130 154 163 | | |
| 12 51 71 140 163 177 | | |
| 12 53 128 154 163 205 | | |
| 12 51 140 154 163 177 | | |
| 12 51 128 130 140 154 | | |
| 12 51 128 130 160 163 | | |
| 12 51 71 140 161 177 | | |
| 12 154 163 177 198 205 | | |
| 12 53 154 163 177 205 | | |
| 12 51 127 128 130 140 | | |
| 12 128 140 154 174 177 | | |
| 14 51 55 140 161 177 | | |
| 14 51 55 174 177 205 | | |
| 12 128 154 174 177 205 | | |
| 14 51 55 127 140 161 | | |
| 14 55 140 161 174 177 | | |
| 12 51 71 140 161 163 | | |

| |
|---|
| 12 14 71 140 161 177 |
| 12 140 154 163 177 198 |
| 12 51 130 140 154 163 |
| 51 55 127 140 161 177 |
| 12 51 127 130 140 161 |
| 12 128 140 154 163 198 |
| 12 128 130 140 154 163 |
| 12 51 130 140 161 163 |
| 51 128 130 140 154 163 |
| 51 128 140 154 177 205 |
| 128 140 154 174 177 198 |
| 12 51 53 128 160 205 |
| 51 62 127 130 140 161 |
| 51 62 130 140 161 163 |

**Table II-H-3** Maximal Friends found for 2007

| Stage 1 | Stage 2 | Overall Eff. |
|---|---|---|
| 12 14 100 174 | 46 50 | 100 102 |
| 50 51 128 160 | 50 192 | 103 125 196 |
| 50 128 160 198 | 46 100 196 | 100 103 196 |
| 12 100 174 210 | 100 196 203 | 100 125 203 |
| 100 102 174 210 | | 100 125 196 |
| 100 174 198 210 | | |
| 51 127 128 140 198 | | |
| 7 12 128 163 198 | | |
| 7 50 78 163 198 | | |
| 7 12 78 163 198 | | |
| 12 50 53 152 198 | | |
| 12 53 102 152 198 | | |
| 12 102 152 174 198 | | |
| 12 102 174 198 210 | | |
| 102 152 174 198 210 | | |
| 53 102 152 198 210 | | |
| 12 51 127 140 174 177 | | |
| 7 12 50 128 140 198 | | |
| 7 12 50 140 177 198 | | |
| 12 50 51 128 140 198 | | |
| 12 51 140 174 177 198 | | |
| 7 12 50 78 177 198 | | |
| 12 51 128 140 174 198 | | |
| 12 14 51 127 174 177 | | |
| 12 50 51 140 177 198 | | |
| 7 12 50 127 128 140 | | |
| 12 14 50 51 127 177 | | |
| 12 50 51 127 140 177 | | |
| 12 50 51 127 128 140 | | |
| 12 14 83 127 174 177 | | |
| 12 14 51 83 127 174 | | |
| 14 51 55 127 174 177 | | |
| 14 51 55 83 127 174 | | |
| 12 14 51 152 174 177 | | |
| 12 50 51 152 177 198 | | |
| 12 51 152 174 177 198 | | |
| 12 51 55 83 127 128 | | |
| 14 55 83 127 174 177 | | |
| 12 14 51 55 83 127 | | |
| 51 127 140 174 177 198 | | |

**Table II-H-4** Maximal Friends found for 2008

| Stage 1 | Stage 2 | Overall Eff. |
|---|---|---|
| 14 55 127 174 | 46 100 | 100 217 |
| 15 198 210 217 | | 46 103 125 |
| 55 83 127 174 | | 46 100 125 |
| 15 174 198 210 | | |
| 15 174 210 217 | | |
| 15 174 198 217 | | |
| 14 15 154 160 174 | | |
| 15 128 154 174 198 | | |
| 15 128 154 160 174 | | |
| 12 14 127 154 160 | | |
| 14 127 154 160 174 | | |
| 127 128 154 160 174 | | |
| 12 14 15 128 154 160 | | |
| 12 15 127 128 154 160 | | |
| 12 14 15 127 128 154 | | |

**Table II-H-5** Maximal Friends found for 2009

| Stage 1 | Stage 2 | Overall Eff. |
|---|---|---|
| 4 14 127 | 15 196 207 | 45 100 217 |
| 14 45 46 76 | 46 53 196 | 100 103 125 |
| 14 45 76 100 | 100 196 221 | |
| 45 174 193 217 | 46 100 196 | |
| 45 100 152 174 | | |
| 46 50 100 152 | | |
| 46 50 152 174 | | |
| 46 100 152 174 | | |
| 50 100 152 174 | | |
| 174 193 210 217 | | |
| 7 46 76 128 210 | | |
| 7 62 76 193 210 | | |
| 7 76 128 193 210 | | |
| 14 51 127 128 140 | | |
| 7 14 51 76 193 | | |
| 7 76 128 140 193 | | |
| 14 46 50 76 100 | | |
| 14 50 76 100 174 | | |
| 45 46 76 131 210 | | |
| 45 76 131 193 210 | | |
| 46 76 128 131 210 | | |
| 45 46 76 174 210 | | |
| 45 46 152 174 217 | | |
| 7 46 50 51 62 | | |
| 7 46 50 76 210 | | |
| 50 62 76 193 210 | | |
| 45 76 174 193 210 | | |
| 7 50 62 76 193 | | |
| 7 50 51 62 193 | | |
| 7 50 76 193 210 | | |
| 45 46 131 210 217 | | |
| 45 131 193 210 217 | | |
| 50 76 174 193 210 | | |
| 7 50 62 193 210 | | |
| 45 46 100 152 217 | | |
| 50 51 76 174 193 | | |
| 7 46 50 62 210 | | |
| 45 46 174 210 217 | | |
| 46 50 76 174 210 | | |
| 7 14 46 76 128 140 | | |
| 7 14 46 51 128 140 | | |
| 7 14 50 51 76 140 | | |
| 7 14 46 50 76 140 | | |
| 7 14 46 50 51 140 | | |
| 14 46 50 55 76 140 | | |
| 7 50 51 76 140 193 | | |
| 45 46 50 76 100 174 | | |

# Appendix I

**Table II-I-1** Variation II-efficiency under CRS for 2005

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **VAR II** | **Ref.** | **Rank** | **VAR II** | **Ref.** | **Rank** | **VAR II** | **Ref.** | **Rank** |
| 1 | 0.62660 | 7 12 130 163 | 83 | 0.27981 | 40 59 | 86 | 0.35942 | 12 125 | 96 |
| 2 | 0.75563 | 43 163 198 205 | 52 | 0.31795 | 40 59 | 63 | 0.52468 | 12 125 | 77 |
| 4 | 0.66861 | 12 161 163 176 | 74 | 0.22070 | 138 205 | 97 | 0.53497 | 12 125 | 72 |
| 6 | 1.00000 | 6 | 1 | 0.34996 | 40 59 | 53 | 0.41680 | 12 125 | 94 |
| 7 | 1.00000 | 7 | 1 | 0.30571 | 40 59 | 68 | 0.56110 | 14 125 200 | 53 |
| 9 | 0.63778 | 14 40 76 | 79 | 0.42290 | 138 | 43 | 0.72773 | 14 125 200 | 19 |
| 12 | 1.00000 | 12 | 1 | 0.03048 | 59 205 | 102 | 1.00000 | 12 | 1 |
| 14 | 1.00000 | 14 | 1 | 0.15673 | 59 205 | 100 | 1.00000 | 14 | 1 |
| 15 | 0.82141 | 14 55 128 | 41 | 0.26393 | 138 196 | 91 | 0.36761 | 12 | 95 |
| 20 | 0.72579 | 127 128 | 64 | 0.27083 | 40 59 | 88 | 0.67038 | 14 125 200 | 27 |
| 21 | 0.50003 | 103 | 89 | 0.32631 | 40 59 | 60 | 0.65387 | 12 14 125 | 30 |
| 24 | 0.75395 | 12 163 198 205 | 54 | 0.29171 | 40 59 | 78 | 0.50810 | 12 125 | 81 |
| 29 | 0.71638 | 43 163 198 205 | 66 | 0.31670 | 40 59 | 64 | 0.53732 | 14 125 200 | 71 |
| 31 | 0.86055 | 12 43 163 174 205 | 36 | 0.33585 | 40 59 | 58 | 0.55487 | 14 125 200 | 56 |
| 34 | 0.55701 | 6 40 161 192 | 85 | 0.35654 | 40 59 | 51 | 0.51384 | 12 125 | 78 |
| 35 | 0.94340 | 40 160 176 | 30 | 0.34986 | 40 59 | 54 | 0.55032 | 14 125 200 | 61 |
| 36 | 0.70789 | 6 40 174 | 68 | 0.74505 | 40 46 59 | 14 | 0.71421 | 125 196 200 | 21 |
| 37 | 0.75725 | 40 160 174 | 51 | 0.54733 | 40 59 | 31 | 0.58279 | 125 196 200 | 43 |
| 38 | 0.44163 | 6 161 177 | 96 | 0.33099 | 40 59 | 59 | 0.58539 | 40 103 125 | 41 |
| 40 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 | 1.00000 | 40 | 1 |
| 42 | 0.55395 | 6 40 174 | 86 | 0.76168 | 59 205 | 13 | 0.70030 | 125 196 200 | 23 |
| 43 | 1.00000 | 43 | 1 | 0.30158 | 40 59 | 71 | 0.53175 | 14 125 200 | 73 |
| 45 | 0.83581 | 40 161 174 177 192 | 38 | 0.37312 | 40 59 | 48 | 0.61285 | 100 196 200 | 36 |
| 46 | 0.40978 | 76 100 174 | 97 | 1.00000 | 46 | 1 | 0.89171 | 100 196 200 | 12 |
| 47 | 0.72792 | 12 163 177 | 62 | 0.30867 | 138 196 | 67 | 0.48598 | 12 125 | 85 |
| 49 | 0.82668 | 40 160 174 | 40 | 0.56928 | 40 59 | 29 | 0.60595 | 125 196 200 | 39 |
| 50 | 0.47064 | 53 160 177 | 92 | 0.84876 | 59 205 | 11 | 0.62303 | 125 196 200 | 33 |
| 51 | 0.73582 | 40 160 176 | 61 | 0.41680 | 40 59 | 46 | 0.56549 | 14 125 200 | 51 |
| 53 | 1.00000 | 53 | 1 | 0.85623 | 46 138 205 | 10 | 0.75751 | 100 152 205 | 18 |
| 55 | 1.00000 | 55 | 1 | 0.14995 | 100 196 | 101 | 0.71366 | 14 125 200 | 22 |
| 57 | 0.76376 | 40 160 174 | 49 | 0.57301 | 40 59 | 28 | 0.57366 | 125 196 200 | 49 |
| 58 | 0.91842 | 14 127 128 | 32 | 0.20126 | 59 205 | 99 | 0.61374 | 12 125 | 34 |
| 59 | 0.30026 | 163 177 198 205 | 99 | 1.00000 | 59 | 1 | 0.51300 | 100 152 | 79 |
| 60 | 0.26563 | 100 152 174 | 101 | 0.83982 | 138 205 | 12 | 0.59208 | 100 200 | 40 |
| 61 | 0.63330 | 12 43 163 177 | 81 | 0.28864 | 40 59 | 82 | 0.33033 | 12 125 | 99 |
| 62 | 0.75193 | 7 160 176 | 55 | 0.36214 | 40 59 | 50 | 0.60902 | 14 125 200 | 38 |
| 63 | 0.90147 | 12 154 163 | 33 | 0.28119 | 138 196 | 85 | 0.19893 | 12 | 101 |
| 69 | 0.46557 | 53 174 177 | 93 | 0.58979 | 40 46 196 | 26 | 0.55364 | 125 196 200 | 58 |
| 71 | 1.00000 | 71 | 1 | 0.28994 | 138 196 | 80 | 0.66885 | 12 125 | 28 |
| 73 | 0.92704 | 12 40 43 174 177 | 31 | 0.43503 | 40 59 | 42 | 0.44003 | 100 200 | 91 |
| 75 | 0.74529 | 127 128 | 56 | 0.25971 | 40 59 | 93 | 0.30949 | 12 | 100 |
| 76 | 1.00000 | 76 | 1 | 0.30367 | 40 59 | 70 | 0.68595 | 12 14 200 | 25 |
| 78 | 0.75539 | 12 40 160 174 | 53 | 0.46455 | 40 59 | 39 | 0.55339 | 125 196 200 | 60 |
| 83 | 0.85938 | 127 128 | 37 | 0.25938 | 138 196 | 94 | 0.44032 | 12 125 | 90 |
| 84 | 0.68312 | 12 55 154 177 | 72 | 0.26262 | 138 196 | 92 | 0.79814 | 14 125 200 | 15 |
| 85 | 0.73626 | 14 55 128 | 60 | 0.22043 | 100 196 | 98 | 0.52740 | 12 125 | 75 |
| 86 | 0.71626 | 12 43 163 205 | 67 | 0.28257 | 40 59 | 84 | 0.65912 | 14 125 200 | 29 |
| 93 | 0.79252 | 6 40 161 | 46 | 0.51670 | 138 | 32 | 0.50436 | 152 205 | 82 |
| 95 | 0.89153 | 12 55 71 161 | 34 | 0.29656 | 138 205 | 74 | 0.71739 | 14 125 200 | 20 |
| 98 | 0.70620 | 6 161 174 177 192 | 70 | 0.29607 | 40 59 | 75 | 0.61333 | 14 125 200 | 35 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.31407 | 100 152 | 98 | 0.87433 | 40 100 196 | 9 | 0.85804 | 100 196 200 | 14 |
| 103 | 1.00000 | 103 | 1 | 0.36319 | 138 | 49 | 1.00000 | 103 | 1 |
| 105 | 0.57865 | 43 163 177 | 84 | 0.29383 | 40 59 | 77 | 0.33605 | 12 125 | 98 |
| 110 | 0.82896 | 6 40 161 192 | 39 | 0.29750 | 40 59 | 73 | 0.54501 | 12 125 | 64 |
| 113 | 0.47324 | 43 163 198 | 91 | 0.28964 | 40 59 | 81 | 0.15111 | 12 | 102 |
| 115 | 0.63595 | 152 174 198 | 80 | 0.59846 | 40 46 196 | 25 | 0.58144 | 40 125 196 | 44 |
| 121 | 0.63208 | 12 163 198 205 | 82 | 0.29020 | 40 59 | 79 | 0.45007 | 12 125 | 89 |
| 123 | 0.65598 | 6 40 161 174 | 76 | 0.42226 | 40 59 | 44 | 0.52713 | 12 125 | 76 |
| 125 | 0.29971 | 40 152 | 100 | 0.74046 | 40 46 59 | 15 | 1.00000 | 125 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 126 | 0.73891 | 12 152 174 198 | 59 | 0.40895 | 40 59 | 47 | 0.53913 | 14 125 200 | 70 |
| 127 | 1.00000 | 127 | 1 | 0.27067 | 40 59 | 89 | 0.54432 | 12 125 | 66 |
| 128 | 1.00000 | 128 | 1 | 0.23907 | 138 205 | 96 | 0.34918 | 12 | 97 |
| 130 | 1.00000 | 130 | 1 | 0.27649 | 138 196 | 87 | 0.50369 | 12 125 | 84 |
| 131 | 0.49723 | 6 40 174 | 90 | 0.63725 | 40 46 59 | 21 | 0.67312 | 125 196 200 | 26 |
| 132 | 0.70784 | 6 161 174 177 192 | 69 | 0.34403 | 40 59 | 56 | 0.54441 | 14 125 200 | 65 |
| 133 | 0.77377 | 6 40 174 | 47 | 0.66087 | 40 46 59 | 19 | 0.63329 | 125 196 200 | 31 |
| 137 | 0.76210 | 6 40 161 174 192 | 50 | 0.45070 | 40 59 | 41 | 0.61074 | 125 196 200 | 37 |
| 138 | 0.52947 | 100 174 | 88 | 1.00000 | 138 | 1 | 0.87403 | 100 152 205 | 13 |
| 139 | 0.65153 | 6 40 161 192 | 77 | 0.57697 | 138 196 | 27 | 0.75887 | 125 196 200 | 17 |
| 140 | 1.00000 | 140 | 1 | 0.28707 | 138 205 | 83 | 0.48565 | 12 125 | 86 |
| 142 | 0.63993 | 12 43 163 205 | 78 | 0.25835 | 40 59 | 95 | 0.46239 | 12 125 | 88 |
| 152 | 1.00000 | 152 | 1 | 0.67312 | 138 205 | 18 | 1.00000 | 152 | 1 |
| 154 | 1.00000 | 154 | 1 | 0.31909 | 138 205 | 62 | 0.43217 | 12 125 | 92 |
| 156 | 0.87372 | 6 40 161 174 | 35 | 0.47301 | 40 59 | 38 | 0.55355 | 14 125 200 | 59 |
| 159 | 0.55228 | 6 174 177 | 87 | 0.48575 | 40 59 | 35 | 0.54168 | 14 125 200 | 68 |
| 160 | 1.00000 | 160 | 1 | 0.60223 | 40 46 59 | 24 | 0.57909 | 125 196 200 | 45 |
| 161 | 1.00000 | 161 | 1 | 0.26421 | 40 59 | 90 | 0.51171 | 12 125 | 80 |
| 162 | 0.72785 | 12 55 154 177 | 63 | 0.31282 | 138 205 | 66 | 0.57846 | 14 125 200 | 46 |
| 163 | 1.00000 | 163 | 1 | 0.30099 | 138 205 | 72 | 0.55365 | 12 14 125 | 57 |
| 164 | 0.45298 | 6 40 | 95 | 0.99062 | 40 46 196 | 8 | 0.96576 | 125 196 200 | 11 |
| 168 | 0.79636 | 6 40 174 192 | 45 | 0.46296 | 40 59 | 40 | 0.57214 | 14 125 200 | 50 |
| 173 | 0.71892 | 43 163 198 205 | 65 | 0.31924 | 40 59 | 61 | 0.46823 | 12 125 | 87 |
| 174 | 1.00000 | 174 | 1 | 0.61053 | 40 46 59 | 23 | 0.50420 | 152 | 83 |
| 176 | 1.00000 | 176 | 1 | 0.30501 | 40 59 | 69 | 0.55930 | 12 14 125 | 54 |
| 177 | 1.00000 | 177 | 1 | 0.35193 | 40 59 | 52 | 0.54031 | 14 125 200 | 69 |
| 182 | 0.79826 | 163 177 198 205 | 44 | 0.29527 | 138 196 | 76 | 0.54738 | 14 125 200 | 63 |
| 185 | 0.67524 | 12 14 40 161 | 73 | 0.48411 | 138 | 36 | 0.78413 | 14 125 200 | 16 |
| 189 | 0.46387 | 100 152 174 | 94 | 0.70898 | 138 196 | 16 | 0.57592 | 100 196 200 | 47 |
| 190 | 0.80388 | 160 163 | 43 | 0.31498 | 40 59 | 65 | 0.54755 | 12 125 | 62 |
| 191 | 0.76970 | 6 40 161 174 192 | 48 | 0.50057 | 40 59 | 33 | 0.57575 | 40 103 125 | 48 |
| 192 | 1.00000 | 192 | 1 | 0.34489 | 40 59 | 55 | 0.56362 | 14 125 200 | 52 |
| 193 | 1.00000 | 193 | 1 | 0.33926 | 40 59 | 57 | 0.52845 | 14 125 200 | 74 |
| 194 | 0.96417 | 12 43 163 205 | 29 | 0.42058 | 40 59 | 45 | 0.43186 | 100 200 | 93 |
| 195 | 0.81140 | 12 152 174 198 205 | 42 | 0.62417 | 40 46 59 | 22 | 0.58317 | 100 200 | 42 |
| 196 | 0.17975 | 53 | 102 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.74443 | 53 174 177 | 57 | 0.56574 | 40 46 59 | 30 | 0.55629 | 125 196 200 | 55 |
| 198 | 1.00000 | 198 | 1 | 0.48037 | 40 59 | 37 | 0.54342 | 100 200 | 67 |
| 200 | 0.74171 | 14 40 76 174 | 58 | 0.48832 | 138 | 34 | 1.00000 | 200 | 1 |
| 202 | 0.70264 | 40 43 160 174 | 71 | 0.68120 | 40 46 59 | 17 | 0.62341 | 40 125 196 | 32 |
| 205 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 | 1.00000 | 205 | 1 |
| 206 | 0.66200 | 53 174 | 75 | 0.65272 | 59 205 | 20 | 0.69738 | 152 205 | 24 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR II corresponds to the efficiency score obtained by the Variation II were obtained for each inefficient MFMC for those maximal friends facets randomly obtained (equation II.5). Ref. corresponds to the reference set for each company obtained by the VAR II approach. Rank represents the ranking of the VAR II scores which have been sorted by value, where VAR II scores with value of 1.00000 obtain the highest ranking 1.

**Table II-I-2** Variation II-efficiency under CRS for 2006

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR II | Ref. | Rank | VAR II | Ref. | Rank | VAR II | Ref. | Rank |
| 2 | 0.76302 | 12 194 198 205 | 39 | 0.38246 | 40 207 | 62 | 0.45674 | 14 125 | 74 |
| 4 | 0.65677 | 12 71 140 163 | 61 | 0.28594 | 60 152 | 89 | 0.54439 | 14 125 | 52 |
| 6 | 0.62620 | 12 174 194 198 | 64 | 0.43680 | 40 207 | 55 | 0.43127 | 205 | 77 |
| 7 | 0.92460 | 51 62 130 161 163 | 25 | 0.35240 | 40 207 | 64 | 0.47971 | 14 125 | 70 |
| 9 | 0.47173 | 12 51 59 160 | 87 | 0.64083 | 152 | 35 | 0.66103 | 14 103 125 | 21 |
| 12 | 1.00000 | 12 | 1 | 0.01947 | 100 | 102 | 0.75389 | 14 125 | 12 |
| 14 | 1.00000 | 14 | 1 | 0.17987 | 152 202 | 99 | 1.00000 | 14 | 1 |
| 15 | 0.79851 | 12 163 198 | 33 | 0.02534 | 40 207 | 101 | 0.29632 | 100 205 | 98 |
| 20 | 0.72182 | 12 128 130 160 163 | 45 | 0.26938 | 40 207 | 94 | 0.64227 | 14 103 125 | 24 |
| 21 | 0.55499 | 12 194 198 205 | 81 | 0.32579 | 40 207 | 74 | 0.64913 | 14 125 | 22 |
| 24 | 0.67410 | 12 174 194 198 | 55 | 0.33449 | 40 207 | 72 | 0.45021 | 14 125 | 76 |
| 29 | 0.71728 | 12 194 198 | 46 | 0.34337 | 40 207 | 66 | 0.52976 | 14 103 125 | 58 |
| 31 | 0.92942 | 12 128 163 198 205 | 24 | 0.46282 | 152 | 53 | 0.55008 | 14 125 | 50 |
| 34 | 0.41117 | 194 | 92 | 0.55128 | 152 202 | 44 | 0.40819 | 14 125 | 82 |
| 35 | 0.72666 | 51 53 163 177 | 44 | 0.43514 | 40 207 | 56 | 0.53537 | 14 103 125 | 56 |
| 36 | 0.61475 | 12 100 174 205 | 68 | 0.87299 | 40 100 203 207 | 14 | 0.70620 | 100 164 200 | 16 |
| 37 | 0.66009 | 51 128 160 205 | 60 | 0.55942 | 40 207 | 42 | 0.55590 | 100 103 164 | 47 |
| 38 | 0.47039 | 59 128 160 | 88 | 0.42218 | 40 207 | 58 | 0.59579 | 103 125 164 | 30 |
| 40 | 0.32999 | 12 100 205 | 100 | 1.00000 | 40 | 1 | 0.98433 | 100 103 164 | 9 |
| 42 | 0.61532 | 12 100 174 205 | 67 | 0.87276 | 40 100 203 207 | 16 | 0.72530 | 125 164 200 | 15 |
| 43 | 0.85881 | 128 198 205 | 29 | 0.33644 | 40 207 | 71 | 0.46221 | 14 125 | 73 |
| 45 | 0.63289 | 55 100 174 | 63 | 0.47303 | 40 207 | 51 | 0.55619 | 100 205 | 46 |
| 46 | 0.44947 | 12 100 205 | 91 | 0.99975 | 40 100 196 203 207 | 9 | 0.92683 | 100 164 200 | 11 |
| 47 | 0.70298 | 12 174 194 198 | 50 | 0.32133 | 40 207 | 78 | 0.37733 | 14 | 85 |
| 49 | 0.66715 | 12 53 160 205 | 57 | 0.69934 | 40 207 | 29 | 0.58445 | 100 103 | 35 |
| 50 | 0.58216 | 53 174 | 73 | 0.94882 | 152 196 202 | 12 | 0.61515 | 100 164 200 | 28 |
| 51 | 1.00000 | 51 | 1 | 0.50674 | 40 | 48 | 0.52860 | 14 103 125 | 59 |
| 53 | 1.00000 | 53 | 1 | 0.84560 | 60 152 196 | 19 | 0.64044 | 100 164 200 | 26 |
| 55 | 1.00000 | 55 | 1 | 0.25899 | 40 207 | 95 | 0.68509 | 14 103 125 | 17 |
| 57 | 0.62520 | 160 163 205 | 65 | 0.57878 | 40 207 | 39 | 0.49194 | 100 103 | 67 |
| 58 | 0.85071 | 12 163 198 205 | 30 | 0.23559 | 60 152 | 96 | 0.58768 | 14 125 | 34 |
| 59 | 1.00000 | 59 | 1 | 0.99682 | 40 100 203 207 | 11 | 0.29920 | 14 125 | 97 |
| 60 | 0.24630 | 100 205 | 102 | 1.00000 | 60 | 1 | 0.64109 | 100 125 164 | 25 |
| 61 | 0.59269 | 12 163 198 205 | 72 | 0.33426 | 40 207 | 73 | 0.37193 | 14 125 | 86 |
| 62 | 1.00000 | 62 | 1 | 0.47263 | 40 207 | 52 | 0.56125 | 14 103 125 | 42 |
| 63 | 0.91481 | 12 128 163 198 205 | 28 | 0.21810 | 60 203 | 98 | 0.17987 | 125 | 101 |
| 69 | 0.66627 | 100 174 205 | 59 | 0.79356 | 152 202 | 24 | 0.56488 | 100 164 200 | 39 |
| 71 | 1.00000 | 71 | 1 | 0.32165 | 40 207 | 77 | 0.30128 | 14 125 | 96 |
| 75 | 0.75271 | 12 128 163 198 205 | 40 | 0.27509 | 40 207 | 92 | 0.16342 | 205 | 102 |
| 76 | 0.78042 | 55 100 174 | 36 | 0.33718 | 40 207 | 70 | 0.51453 | 203 | 66 |
| 78 | 0.67956 | 53 163 198 | 53 | 0.50595 | 40 207 | 49 | 0.52076 | 103 125 200 | 64 |
| 83 | 0.91684 | 55 127 128 140 | 27 | 0.31079 | 60 152 | 81 | 0.34769 | 14 | 87 |
| 84 | 0.70903 | 12 130 140 161 163 | 48 | 0.27195 | 40 207 | 93 | 0.73148 | 14 103 125 | 14 |
| 85 | 0.73183 | 12 128 130 163 | 43 | 0.17243 | 40 207 | 100 | 0.33784 | 14 | 89 |
| 86 | 0.76417 | 130 163 | 38 | 0.28051 | 40 207 | 90 | 0.47574 | 203 | 71 |
| 93 | 0.57992 | 14 51 59 | 74 | 0.65739 | 152 196 202 | 33 | 0.48836 | 100 205 | 68 |
| 95 | 0.76530 | 12 140 163 198 | 37 | 0.29491 | 40 207 | 85 | 0.66212 | 14 103 125 | 20 |
| 98 | 0.55810 | 12 59 128 160 | 80 | 0.34177 | 40 207 | 68 | 0.57258 | 14 103 125 | 38 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 0.51440 | 100 205 | 83 | 0.87296 | 60 196 203 | 15 | 0.73669 | 100 205 | 13 |
| 103 | 0.38528 | 14 51 59 | 94 | 0.50826 | 152 | 47 | 1.00000 | 103 200 | 1 |
| 105 | 0.36626 | 198 | 97 | 0.43115 | 40 207 | 57 | 0.56422 | 103 125 164 | 41 |
| 110 | 0.73521 | 12 163 174 198 205 | 41 | 0.34326 | 40 207 | 67 | 0.54138 | 14 125 | 55 |
| 113 | 0.52875 | 12 128 163 198 205 | 82 | 0.31169 | 40 207 | 79 | 0.23904 | 14 | 100 |
| 115 | 0.66654 | 100 174 205 | 58 | 0.73514 | 152 202 | 25 | 0.57794 | 100 164 200 | 36 |
| 121 | 0.50667 | 12 194 | 85 | 0.31118 | 40 207 | 80 | 0.33765 | 205 | 90 |
| 123 | 0.60074 | 12 59 128 160 | 71 | 0.54124 | 40 207 | 45 | 0.48363 | 14 125 | 69 |
| 125 | 0.36668 | 59 | 96 | 0.87219 | 40 100 203 207 | 17 | 1.00000 | 125 | 1 |
| 126 | 0.65378 | 53 198 | 62 | 0.55886 | 40 207 | 43 | 0.52118 | 103 125 200 | 62 |
| 127 | 1.00000 | 127 | 1 | 0.29025 | 40 207 | 87 | 0.32800 | 14 | 92 |
| 128 | 1.00000 | 128 | 1 | 0.22138 | 40 207 | 97 | 0.31909 | 14 125 | 94 |
| 130 | 1.00000 | 130 | 1 | 0.28851 | 40 207 | 88 | 0.32748 | 14 125 | 93 |
| 131 | 0.41081 | 59 160 | 93 | 0.72486 | 152 202 | 27 | 0.64591 | 100 103 164 | 23 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 132 | 0.78740 | 12 194 198 205 | 35 | 0.39001 | 60 152 | 60 | 0.54244 | 14 103 125 | 54 |
| 133 | 0.67243 | 12 51 53 160 | 56 | 0.83003 | 40 100 203 207 | 22 | 0.61416 | 100 103 200 | 29 |
| 137 | 0.69427 | 51 62 130 160 163 | 52 | 0.63603 | 202 | 36 | 0.62216 | 100 103 200 | 27 |
| 139 | 0.61652 | 12 51 59 160 | 66 | 0.67829 | 152 196 | 31 | 0.67693 | 103 125 200 | 18 |
| 140 | 1.00000 | 140 | 1 | 0.29186 | 40 207 | 86 | 0.41418 | 14 125 | 80 |
| 142 | 0.56461 | 12 194 198 | 79 | 0.29926 | 40 207 | 84 | 0.31907 | 14 | 95 |
| 152 | 0.50657 | 100 174 205 | 86 | 1.00000 | 152 | 1 | 0.67646 | 100 205 | 19 |
| 154 | 1.00000 | 154 | 1 | 0.30893 | 40 207 | 82 | 0.27667 | 14 125 | 99 |
| 156 | 0.57239 | 51 62 177 | 77 | 0.59897 | 40 207 | 38 | 0.52733 | 14 103 125 | 60 |
| 159 | 0.57673 | 194 198 205 | 75 | 0.56534 | 202 | 40 | 0.51875 | 14 103 125 | 65 |
| 160 | 1.00000 | 160 | 1 | 0.71811 | 152 202 | 28 | 0.55753 | 100 103 200 | 45 |
| 161 | 1.00000 | 161 | 1 | 0.27822 | 40 207 | 91 | 0.38533 | 14 | 84 |
| 162 | 0.79632 | 62 127 130 140 163 | 34 | 0.32401 | 40 207 | 75 | 0.56472 | 14 103 125 | 40 |
| 163 | 1.00000 | 163 | 1 | 0.30353 | 40 207 | 83 | 0.33355 | 14 125 | 91 |
| 164 | 0.36081 | 12 100 205 | 99 | 0.99912 | 40 100 203 207 | 10 | 1.00000 | 164 | 1 |
| 168 | 0.45616 | 12 174 194 198 | 90 | 0.72728 | 152 202 | 26 | 0.55156 | 103 125 200 | 49 |
| 173 | 0.69672 | 12 194 198 205 | 51 | 0.34740 | 40 207 | 65 | 0.45029 | 14 125 | 75 |
| 174 | 1.00000 | 174 | 1 | 0.82887 | 152 202 | 23 | 0.59514 | 205 | 31 |
| 176 | 0.92048 | 127 140 177 | 26 | 0.33870 | 40 207 | 69 | 0.41192 | 14 125 | 81 |
| 177 | 1.00000 | 177 | 1 | 0.45706 | 40 207 | 54 | 0.52306 | 14 103 125 | 61 |
| 182 | 0.83536 | 62 127 140 163 | 31 | 0.32289 | 40 207 | 76 | 0.55880 | 14 103 125 | 43 |
| 185 | 0.50748 | 14 51 161 174 | 84 | 0.55976 | 60 152 196 | 41 | 0.41422 | 100 205 | 79 |
| 190 | 0.73438 | 12 194 198 205 | 42 | 0.36147 | 40 207 | 63 | 0.46594 | 14 125 | 72 |
| 191 | 0.70352 | 12 100 174 205 | 49 | 0.65664 | 40 100 207 | 34 | 0.54423 | 100 103 200 | 53 |
| 192 | 0.71115 | 51 161 174 177 | 47 | 0.41637 | 40 207 | 59 | 0.54855 | 14 103 125 | 51 |
| 193 | 0.56809 | 51 161 174 177 | 78 | 0.38680 | 40 207 | 61 | 0.52093 | 14 103 125 | 63 |
| 194 | 1.00000 | 194 | 1 | 0.52539 | 152 | 46 | 0.39306 | 205 | 83 |
| 195 | 0.46293 | 53 198 | 89 | 0.90278 | 152 196 202 | 13 | 0.59030 | 100 103 164 | 32 |
| 196 | 0.37136 | 12 100 174 205 | 95 | 1.00000 | 196 | 1 | 0.96884 | 100 125 164 | 10 |
| 197 | 0.67727 | 53 163 177 198 | 54 | 0.66382 | 40 100 207 | 32 | 0.53292 | 100 103 200 | 57 |
| 198 | 1.00000 | 198 | 1 | 0.60641 | 202 | 37 | 0.42886 | 100 103 | 78 |
| 200 | 0.57644 | 12 100 174 205 | 76 | 0.67928 | 60 152 | 30 | 1.00000 | 200 | 1 |
| 202 | 0.60647 | 194 205 | 70 | 1.00000 | 202 | 1 | 0.55534 | 103 125 164 | 48 |
| 203 | 0.31533 | 100 205 | 101 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.93688 | 14 51 174 205 | 23 | 0.49157 | 40 207 | 50 | 0.55792 | 14 103 125 | 44 |
| 205 | 1.00000 | 205 | 1 | 0.85146 | 60 196 203 | 18 | 1.00000 | 205 | 1 |
| 206 | 0.61435 | 51 53 128 160 | 69 | 0.84098 | 152 202 | 20 | 0.58777 | 100 164 200 | 33 |
| 207 | 0.36325 | 59 128 160 | 98 | 1.00000 | 207 | 1 | 0.34119 | 14 125 | 88 |
| 210 | 0.80531 | 12 100 174 205 | 32 | 0.83242 | 40 100 196 207 | 21 | 0.57738 | 100 205 | 37 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR II corresponds to the efficiency score obtained by the Variation II were obtained for each inefficient MFMC for those maximal friends facets randomly obtained (equation II.5). Ref. corresponds to the reference set for each company obtained by the VAR II approach. Rank represents the ranking of the VAR II scores which have been sorted by value, where VAR II scores with value of 1.00000 obtain the highest ranking 1.

**Table II-I-3** Variation II-efficiency under CRS for 2007

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR II | Ref. | Rank | VAR II | Ref. | Rank | VAR II | Ref. | Rank |
| 2 | 0.73765 | 50 128 160 198 | 45 | 0.71470 | 50 192 | 29 | 0.32951 | 103 125 | 68 |
| 4 | 0.57473 | 12 55 127 128 | 66 | 0.34536 | 192 | 87 | 0.32190 | 203 | 71 |
| 6 | 0.62460 | 12 174 177 198 | 63 | 0.75677 | 50 192 | 22 | 0.44004 | 102 | 45 |
| 7 | 1.00000 | 7 | 1 | 0.59117 | 50 192 | 52 | 0.30129 | 125 203 | 75 |
| 9 | 0.50099 | 12 100 174 210 | 78 | 0.62241 | 50 192 | 45 | 0.53460 | 125 203 | 31 |
| 12 | 1.00000 | 12 | 1 | 0.05120 | 203 | 95 | 0.53552 | 103 125 196 | 30 |
| 14 | 1.00000 | 14 | 1 | 0.16538 | 100 203 | 94 | 0.55875 | 103 125 196 | 24 |
| 15 | 0.81201 | 12 51 55 127 128 | 32 | 0.27005 | 192 | 92 | 0.29333 | 100 102 | 81 |
| 20 | 0.49159 | 12 128 163 | 83 | 0.33632 | 192 | 88 | 0.52517 | 125 203 | 33 |
| 21 | 0.49170 | 7 12 50 78 | 82 | 0.54681 | 50 192 | 66 | 0.49030 | 100 102 | 38 |
| 24 | 0.55148 | 78 163 | 71 | 0.58997 | 50 192 | 53 | 0.28080 | 103 125 | 85 |
| 29 | 0.58382 | 128 160 198 | 65 | 0.58586 | 192 | 56 | 0.37154 | 103 125 | 61 |
| 31 | 0.64518 | 12 53 102 152 198 | 60 | 0.62189 | 50 192 | 46 | 0.30853 | 103 125 | 74 |
| 34 | 0.42337 | 12 53 102 198 | 89 | 0.77819 | 50 192 | 15 | 0.25152 | 125 | 89 |
| 35 | 0.88065 | 51 127 174 177 198 | 26 | 0.71950 | 50 192 | 27 | 0.34709 | 103 125 | 63 |
| 36 | 0.43001 | 100 102 174 210 | 88 | 0.71030 | 46 50 | 30 | 0.70994 | 100 103 196 | 8 |
| 37 | 0.70727 | 50 51 128 160 | 52 | 0.76821 | 50 192 | 18 | 0.47679 | 103 125 | 40 |
| 38 | 0.43082 | 128 160 | 87 | 0.57132 | 50 192 | 61 | 0.40318 | 100 102 | 53 |
| 40 | 0.52373 | 12 53 102 198 | 73 | 0.66697 | 50 192 | 37 | 0.61079 | 103 125 196 | 15 |
| 43 | 0.83502 | 128 163 198 | 29 | 0.58218 | 50 192 | 59 | 0.33799 | 103 125 | 66 |
| 45 | 0.80771 | 14 51 152 174 177 | 33 | 0.77842 | 50 192 | 14 | 0.58336 | 100 103 196 | 20 |
| 46 | 0.46034 | 12 50 53 | 85 | 1.00000 | 46 | 1 | 0.94814 | 100 103 196 | 7 |
| 47 | 0.72840 | 55 174 177 | 48 | 0.52426 | 192 | 68 | 0.32168 | 102 | 72 |
| 49 | 0.56269 | 50 160 198 | 69 | 0.85213 | 50 192 | 7 | 0.55088 | 103 125 196 | 26 |
| 50 | 1.00000 | 50 | 1 | 1.00000 | 50 | 1 | 0.63371 | 100 103 196 | 13 |
| 51 | 1.00000 | 51 | 1 | 0.67947 | 50 192 | 35 | 0.41695 | 103 125 | 49 |
| 53 | 1.00000 | 53 | 1 | 0.66656 | 46 100 196 | 38 | 0.64932 | 100 103 196 | 12 |
| 55 | 1.00000 | 55 | 1 | 0.29344 | 192 | 91 | 0.51499 | 125 203 | 35 |
| 57 | 0.56745 | 12 53 102 | 68 | 0.66007 | 50 192 | 40 | 0.43161 | 100 102 | 47 |
| 58 | 0.59534 | 12 14 127 | 64 | 0.29991 | 192 | 90 | 0.55795 | 103 125 196 | 25 |
| 59 | 0.20928 | 12 50 53 | 94 | 0.76049 | 100 196 203 | 21 | 0.13339 | 102 | 94 |
| 61 | 0.65556 | 78 163 | 58 | 0.58806 | 192 | 55 | 0.19836 | 102 | 92 |
| 62 | 0.74013 | 14 50 177 | 44 | 0.82177 | 50 192 | 10 | 0.40030 | 100 102 | 54 |
| 63 | 0.77048 | 12 78 163 | 39 | 0.36025 | 192 | 85 | 0.15150 | 125 | 93 |
| 69 | 0.84198 | 12 53 102 152 198 | 27 | 0.78601 | 50 192 | 13 | 0.56487 | 100 103 196 | 23 |
| 71 | 0.73057 | 14 55 174 177 | 47 | 0.52268 | 192 | 69 | 0.44667 | 100 102 | 43 |
| 75 | 0.77490 | 7 12 128 163 198 | 36 | 0.38798 | 192 | 82 | 0.22771 | 102 | 90 |
| 76 | 0.74769 | 14 55 83 174 177 | 41 | 0.55710 | 50 192 | 64 | 0.50166 | 100 102 | 37 |
| 78 | 1.00000 | 78 | 1 | 0.83755 | 50 192 | 9 | 0.38602 | 103 125 | 56 |
| 83 | 1.00000 | 83 | 1 | 0.37920 | 192 | 83 | 0.34001 | 102 | 65 |
| 84 | 0.69572 | 12 127 140 177 | 53 | 0.35162 | 192 | 86 | 0.67157 | 103 125 196 | 10 |
| 85 | 0.74094 | 51 55 128 | 43 | 0.26762 | 192 | 93 | 0.31229 | 100 102 | 73 |
| 86 | 0.76915 | 7 127 128 140 | 40 | 0.43898 | 192 | 77 | 0.40687 | 102 | 52 |
| 93 | 0.64192 | 12 53 102 | 61 | 0.62965 | 50 192 | 44 | 0.44328 | 100 102 | 44 |
| 95 | 0.82524 | 14 50 127 177 | 30 | 0.37658 | 192 | 84 | 0.54674 | 125 203 | 28 |
| 98 | 0.50222 | 55 174 177 | 77 | 0.61237 | 50 192 | 49 | 0.48859 | 125 203 | 39 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 102 | 1.00000 | 102 | 1 | 0.74881 | 46 50 | 23 | 1.00000 | 102 | 1 |
| 103 | 0.38590 | 14 152 174 | 91 | 0.60408 | 50 192 | 50 | 1.00000 | 103 | 1 |
| 105 | 0.42317 | 12 53 102 | 90 | 0.77192 | 50 192 | 16 | 0.60386 | 103 125 196 | 16 |
| 110 | 0.73395 | 7 12 50 78 198 | 46 | 0.58880 | 192 | 54 | 0.38347 | 102 | 57 |
| 113 | 0.49210 | 78 163 | 81 | 0.46282 | 192 | 75 | 0.12981 | 102 | 95 |
| 115 | 0.57373 | 50 51 152 198 | 67 | 0.74013 | 50 192 | 25 | 0.59204 | 100 103 196 | 18 |
| 121 | 0.49686 | 12 78 163 | 79 | 0.45278 | 192 | 76 | 0.37729 | 102 | 58 |
| 125 | 0.31214 | 100 102 | 92 | 0.74850 | 100 196 203 | 24 | 1.00000 | 125 | 1 |
| 126 | 0.71590 | 50 51 152 | 50 | 0.61982 | 50 192 | 47 | 0.47491 | 103 125 | 41 |
| 127 | 1.00000 | 127 | 1 | 0.41057 | 192 | 79 | 0.29344 | 125 203 | 79 |
| 128 | 1.00000 | 128 | 1 | 0.32087 | 192 | 89 | 0.29224 | 125 203 | 82 |
| 130 | 0.84006 | 7 128 140 198 | 28 | 0.40548 | 192 | 81 | 0.28628 | 125 203 | 84 |
| 131 | 0.43938 | 12 102 198 | 86 | 0.49739 | 46 50 | 72 | 0.59029 | 103 125 196 | 19 |
| 132 | 0.69070 | 7 12 50 78 198 | 54 | 0.55510 | 50 192 | 65 | 0.32925 | 102 | 69 |
| 133 | 0.67784 | 12 50 53 152 | 55 | 0.70848 | 46 50 | 32 | 0.59726 | 100 103 196 | 17 |
| 137 | 0.67767 | 12 102 152 174 | 56 | 0.63246 | 50 192 | 42 | 0.56702 | 103 125 196 | 22 |
| 139 | 0.53612 | 12 53 102 | 72 | 0.65211 | 46 50 | 41 | 0.65452 | 125 203 | 11 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 1.00000 | 140 | 1 | 0.40860 | 192 | 80 | 0.29458 | 125 203 | 78 |
| 142 | 0.56049 | 7 12 128 163 198 | 70 | 0.48064 | 192 | 73 | 0.20124 | 102 | 91 |
| 152 | 1.00000 | 152 | 1 | 0.72640 | 46 50 | 26 | 0.61575 | 100 103 196 | 14 |
| 154 | 0.97683 | 12 51 128 140 174 198 | 22 | 0.46331 | 192 | 74 | 0.26783 | 125 203 | 88 |
| 156 | 0.63676 | 50 51 127 177 | 62 | 0.76939 | 50 192 | 17 | 0.41831 | 103 125 | 48 |
| 159 | 0.49528 | 102 174 198 | 80 | 0.71629 | 50 192 | 28 | 0.52105 | 103 125 196 | 34 |
| 160 | 1.00000 | 160 | 1 | 0.63034 | 50 192 | 43 | 0.44869 | 103 125 | 42 |
| 161 | 0.77271 | 14 55 83 177 | 37 | 0.54232 | 192 | 67 | 0.29672 | 125 203 | 76 |
| 162 | 0.71521 | 140 174 177 198 | 51 | 0.58285 | 192 | 58 | 0.33519 | 102 | 67 |
| 163 | 1.00000 | 163 | 1 | 0.42417 | 192 | 78 | 0.27186 | 125 203 | 86 |
| 168 | 0.66091 | 12 174 198 210 | 57 | 0.79909 | 50 192 | 12 | 0.53806 | 103 125 196 | 29 |
| 173 | 0.64626 | 50 78 163 | 59 | 0.56997 | 50 192 | 62 | 0.27104 | 103 125 | 87 |
| 174 | 1.00000 | 174 | 1 | 0.82051 | 50 192 | 11 | 0.55003 | 100 103 | 27 |
| 176 | 0.90774 | 50 127 140 177 | 24 | 0.60172 | 50 192 | 51 | 0.29180 | 125 203 | 83 |
| 177 | 1.00000 | 177 | 1 | 0.70883 | 50 192 | 31 | 0.41100 | 103 125 | 50 |
| 182 | 0.74126 | 7 50 78 163 | 42 | 0.58327 | 50 192 | 57 | 0.29466 | 125 203 | 77 |
| 185 | 0.51114 | 14 51 55 174 | 74 | 0.50878 | 50 192 | 70 | 0.34318 | 102 | 64 |
| 190 | 0.79102 | 7 78 177 | 35 | 0.61930 | 192 | 48 | 0.29341 | 103 125 | 80 |
| 191 | 0.89363 | 12 51 152 174 198 | 25 | 0.76480 | 50 192 | 20 | 0.53023 | 103 125 196 | 32 |
| 192 | 0.48852 | 12 78 177 | 84 | 1.00000 | 192 | 1 | 0.39958 | 100 102 | 55 |
| 193 | 0.82010 | 78 177 198 | 31 | 0.66960 | 50 192 | 36 | 0.32915 | 103 125 | 70 |
| 194 | 0.72245 | 12 127 140 174 177 | 49 | 0.58009 | 50 192 | 60 | 0.37199 | 103 125 | 60 |
| 196 | 0.25515 | 12 53 102 | 93 | 1.00000 | 196 | 1 | 1.00000 | 196 | 1 |
| 197 | 0.79756 | 12 50 53 152 198 | 34 | 0.69763 | 50 192 | 33 | 0.51077 | 103 125 | 36 |
| 198 | 1.00000 | 198 | 1 | 0.66168 | 50 192 | 39 | 0.40700 | 100 103 | 51 |
| 200 | 0.50988 | 12 53 102 | 75 | 0.50841 | 50 192 | 71 | 0.70358 | 103 125 196 | 9 |
| 203 | 0.09050 | 100 102 | 95 | 1.00000 | 203 | 1 | 1.00000 | 203 | 1 |
| 204 | 0.90917 | 12 50 78 177 | 23 | 0.68795 | 50 192 | 34 | 0.37510 | 102 | 59 |
| 206 | 0.77102 | 12 50 53 | 38 | 0.76548 | 50 192 | 19 | 0.58287 | 100 103 196 | 21 |
| 207 | 0.50417 | 12 102 198 | 76 | 0.56816 | 46 50 | 63 | 0.36365 | 103 125 | 62 |
| 210 | 1.00000 | 210 | 1 | 0.84159 | 50 192 | 8 | 0.43365 | 102 | 46 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR II corresponds to the efficiency score obtained by the Variation II were obtained for each inefficient MFMC for those maximal friends facets randomly obtained (equation II.5). Ref. corresponds to the reference set for each company obtained by the VAR II approach. Rank represents the ranking of the VAR II scores which have been sorted by value, where VAR II scores with value of 1.00000 obtain the highest ranking 1.

**Table II-I-4** Variation II-efficiency under CRS for 2008

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR II | Ref. | Rank | VAR II | Ref. | Rank | VAR II | Ref. | Rank |
| 2 | 0.59550 | 15 198 217 | 35 | 0.18218 | 46 | 71 | 0.35560 | 46 103 | 53 |
| 4 | 0.59201 | 14 15 127 154 | 37 | 0.13894 | 46 | 88 | 0.33284 | 100 217 | 62 |
| 6 | 0.52650 | 174 198 217 | 51 | 0.19828 | 46 | 60 | 0.34609 | 103 125 | 56 |
| 7 | 0.80925 | 128 154 198 | 14 | 0.18782 | 46 | 67 | 0.30599 | 46 103 | 70 |
| 9 | 0.36174 | 15 174 217 | 82 | 0.29425 | 46 | 21 | 0.49467 | 100 125 | 24 |
| 12 | 1.00000 | 12 | 1 | 0.01660 | 46 | 93 | 0.52390 | 46 103 125 | 20 |
| 14 | 1.00000 | 14 | 1 | 0.06160 | 46 | 92 | 0.54483 | 46 103 125 | 17 |
| 15 | 1.00000 | 15 | 1 | 0.12520 | 46 | 91 | 0.27193 | 100 125 | 84 |
| 20 | 0.50616 | 55 83 | 56 | 0.19250 | 46 | 63 | 0.40915 | 100 125 | 40 |
| 21 | 0.46699 | 15 154 198 | 65 | 0.18760 | 46 | 68 | 0.31530 | 217 | 67 |
| 24 | 0.47246 | 15 174 198 217 | 64 | 0.23225 | 46 | 37 | 0.32907 | 103 125 | 64 |
| 29 | 0.39322 | 15 198 217 | 76 | 0.20744 | 46 | 53 | 0.33364 | 103 125 | 60 |
| 31 | 0.56887 | 15 174 198 217 | 44 | 0.21456 | 46 | 45 | 0.28657 | 103 125 | 76 |
| 34 | 0.48287 | 15 198 217 | 61 | 0.21542 | 46 | 44 | 0.27285 | 103 125 | 83 |
| 35 | 0.65590 | 127 154 160 174 | 27 | 0.21600 | 46 | 43 | 0.33305 | 46 103 | 61 |
| 36 | 0.37063 | 15 174 217 | 81 | 0.42683 | 46 | 6 | 0.74420 | 46 103 125 | 7 |
| 37 | 0.54192 | 15 198 217 | 49 | 0.21401 | 46 | 46 | 0.38167 | 46 103 | 47 |
| 38 | 0.40115 | 15 198 217 | 73 | 0.21218 | 46 | 50 | 0.26958 | 103 | 85 |
| 40 | 0.38246 | 15 217 | 77 | 0.38420 | 46 | 8 | 0.40095 | 103 125 | 41 |
| 43 | 0.51454 | 127 160 | 54 | 0.19313 | 46 | 62 | 0.30974 | 103 125 | 69 |
| 45 | 0.43452 | 83 174 | 68 | 0.23430 | 46 | 34 | 0.46843 | 100 217 | 31 |
| 46 | 0.13920 | 217 | 91 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 |
| 47 | 0.69560 | 83 174 | 25 | 0.20112 | 46 | 57 | 0.30029 | 100 125 | 71 |
| 49 | 0.41917 | 15 198 217 | 71 | 0.24778 | 46 | 30 | 0.47155 | 46 103 | 29 |
| 50 | 0.33344 | 174 217 | 83 | 0.32421 | 46 | 16 | 0.63336 | 46 103 | 10 |
| 51 | 0.59562 | 127 160 174 | 34 | 0.20762 | 46 | 52 | 0.47268 | 46 103 | 28 |
| 53 | 0.27972 | 174 210 217 | 87 | 0.36566 | 46 | 11 | 0.73957 | 100 217 | 8 |
| 55 | 1.00000 | 55 | 1 | 0.13828 | 46 | 89 | 0.41880 | 100 125 | 37 |
| 57 | 0.51792 | 15 198 217 | 53 | 0.24767 | 46 | 31 | 0.38191 | 46 103 | 46 |
| 58 | 0.54024 | 12 15 127 | 50 | 0.12830 | 46 | 90 | 0.47641 | 100 125 | 27 |
| 61 | 0.51851 | 15 198 217 | 52 | 0.20001 | 46 | 58 | 0.16347 | 217 | 90 |
| 62 | 0.56954 | 127 160 174 | 43 | 0.21331 | 46 | 49 | 0.41870 | 46 103 | 38 |
| 63 | 0.69772 | 12 127 128 160 | 24 | 0.15966 | 46 | 82 | 0.11021 | 125 | 91 |
| 69 | 0.37146 | 174 217 | 80 | 0.32570 | 46 | 15 | 0.55941 | 46 103 | 14 |
| 71 | 0.59620 | 14 55 127 174 | 33 | 0.18551 | 46 | 70 | 0.34417 | 100 125 | 57 |
| 76 | 0.76308 | 14 55 127 174 | 17 | 0.17985 | 46 | 73 | 0.34996 | 100 125 | 55 |
| 78 | 0.55830 | 15 174 198 217 | 46 | 0.20161 | 46 | 56 | 0.37182 | 46 103 | 50 |
| 83 | 1.00000 | 83 | 1 | 0.15958 | 46 | 83 | 0.28480 | 100 125 | 79 |
| 84 | 0.71522 | 55 83 | 19 | 0.15451 | 46 | 85 | 0.42505 | 100 125 | 34 |
| 85 | 0.78333 | 14 127 128 | 15 | 0.14807 | 46 | 87 | 0.27668 | 125 | 82 |
| 86 | 0.70258 | 83 127 174 | 21 | 0.17407 | 46 | 76 | 0.28630 | 103 125 | 77 |
| 93 | 0.55008 | 15 210 217 | 48 | 0.28808 | 46 | 23 | 0.48933 | 100 217 | 26 |
| 95 | 0.70181 | 14 15 127 154 | 22 | 0.16317 | 46 | 81 | 0.42574 | 100 125 | 33 |
| 98 | 0.29633 | 15 198 217 | 86 | 0.19082 | 46 | 64 | 0.52056 | 46 103 | 21 |
| 100 | 0.10899 | 217 | 93 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 |
| 103 | 0.26652 | 15 217 | 88 | 0.29630 | 46 | 20 | 1.00000 | 103 | 1 |
| 105 | 0.37281 | 198 217 | 79 | 0.29949 | 46 | 19 | 0.02662 | 103 | 93 |
| 110 | 0.69063 | 83 127 174 | 26 | 0.18667 | 46 | 69 | 0.33768 | 103 125 | 59 |
| 113 | 0.45911 | 15 198 217 | 67 | 0.18797 | 46 | 66 | 0.20438 | 217 | 89 |
| 115 | 0.31358 | 174 217 | 85 | 0.33163 | 46 | 12 | 0.60425 | 46 103 125 | 11 |
| 121 | 0.43192 | 55 83 | 69 | 0.22563 | 46 | 40 | 0.23755 | 125 | 86 |
| 125 | 0.15207 | 217 | 90 | 0.52552 | 46 | 4 | 1.00000 | 125 | 1 |
| 126 | 0.59300 | 174 198 217 | 36 | 0.19841 | 46 | 59 | 0.42103 | 46 103 | 35 |
| 127 | 1.00000 | 127 | 1 | 0.15643 | 46 | 84 | 0.28702 | 103 125 | 75 |
| 128 | 1.00000 | 128 | 1 | 0.14927 | 46 | 86 | 0.22909 | 125 | 87 |
| 130 | 0.75219 | 128 154 198 | 18 | 0.16639 | 46 | 79 | 0.27833 | 100 125 | 80 |
| 131 | 0.32688 | 198 217 | 84 | 0.32618 | 46 | 14 | 0.60183 | 46 103 | 12 |
| 132 | 0.42043 | 127 160 | 70 | 0.23296 | 46 | 36 | 0.36365 | 103 125 | 52 |
| 133 | 0.56980 | 15 174 217 | 42 | 0.38054 | 46 | 9 | 0.49075 | 46 103 | 25 |
| 137 | 0.58753 | 15 198 217 | 38 | 0.29120 | 46 | 22 | 0.51351 | 100 217 | 23 |
| 139 | 0.40092 | 15 210 217 | 74 | 0.32356 | 46 | 17 | 0.56555 | 100 125 | 13 |
| 140 | 0.77594 | 127 128 154 160 | 16 | 0.16461 | 46 | 80 | 0.28761 | 103 125 | 74 |
| 142 | 0.61804 | 55 83 127 174 | 30 | 0.17190 | 46 | 78 | 0.36644 | 217 | 51 |
| 152 | 0.23478 | 174 217 | 89 | 0.40889 | 46 100 | 7 | 0.55702 | 217 | 15 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 154 | 1.00000 | 154 | 1 | 0.17462 | 46 | 75 | 0.27780 | 100 125 | 81 |
| 156 | 0.49718 | 15 174 217 | 58 | 0.28576 | 46 | 24 | 0.43458 | 46 103 | 32 |
| 159 | 0.48231 | 198 217 | 62 | 0.25591 | 46 | 26 | 0.53258 | 46 103 | 18 |
| 160 | 1.00000 | 160 | 1 | 0.24419 | 46 | 33 | 0.39589 | 46 103 | 42 |
| 161 | 0.50774 | 14 55 127 174 | 55 | 0.23221 | 46 | 38 | 0.29603 | 103 125 | 72 |
| 162 | 0.61621 | 83 174 | 31 | 0.22271 | 46 | 41 | 0.33100 | 103 125 | 63 |
| 163 | 0.62352 | 128 154 198 | 29 | 0.17247 | 46 | 77 | 0.29260 | 103 125 | 73 |
| 168 | 0.49062 | 15 174 217 | 59 | 0.27420 | 46 | 25 | 0.51716 | 46 103 | 22 |
| 173 | 0.37833 | 127 160 | 78 | 0.20908 | 46 | 51 | 0.22665 | 125 | 88 |
| 174 | 1.00000 | 174 | 1 | 0.24848 | 46 | 29 | 0.38556 | 217 | 44 |
| 176 | 0.70863 | 127 154 160 174 | 20 | 0.19609 | 46 | 61 | 0.31188 | 103 125 | 68 |
| 177 | 0.46210 | 174 | 66 | 0.20414 | 46 | 55 | 0.41989 | 46 103 | 36 |
| 182 | 0.57534 | 15 198 217 | 41 | 0.17979 | 46 | 74 | 0.28550 | 100 125 | 78 |
| 185 | 0.55629 | 12 127 160 | 47 | 0.19053 | 46 | 65 | 0.05271 | 125 | 92 |
| 190 | 0.65080 | 154 174 198 | 28 | 0.18093 | 46 | 72 | 0.31696 | 103 125 | 66 |
| 191 | 0.55974 | 127 160 174 | 45 | 0.25448 | 46 | 27 | 0.38501 | 46 103 | 45 |
| 192 | 0.48496 | 174 198 217 | 60 | 0.20662 | 46 | 54 | 0.52659 | 103 125 | 19 |
| 193 | 0.47632 | 174 198 217 | 63 | 0.21399 | 46 | 47 | 0.35046 | 46 103 | 54 |
| 194 | 0.59765 | 127 160 174 | 32 | 0.23202 | 46 | 39 | 0.34000 | 103 125 | 58 |
| 196 | 0.11883 | 174 217 | 92 | 0.73057 | 46 | 3 | 0.90450 | 46 103 125 | 6 |
| 197 | 0.57689 | 174 198 217 | 39 | 0.23425 | 46 | 35 | 0.37717 | 46 103 | 48 |
| 198 | 1.00000 | 198 | 1 | 0.21346 | 46 | 48 | 0.32454 | 46 103 | 65 |
| 200 | 0.39916 | 15 198 217 | 75 | 0.31903 | 46 | 18 | 0.41811 | 100 125 | 39 |
| 203 | 0.41864 | 15 198 217 | 72 | 0.36829 | 46 | 10 | 0.65514 | 46 103 125 | 9 |
| 204 | 0.69810 | 14 160 174 | 23 | 0.22154 | 46 | 42 | 0.39463 | 46 103 | 43 |
| 206 | 0.57541 | 15 174 198 217 | 40 | 0.25430 | 46 | 28 | 0.46986 | 46 103 | 30 |
| 207 | 0.50317 | 15 198 217 | 57 | 0.32682 | 46 | 13 | 0.54926 | 46 103 125 | 16 |
| 210 | 1.00000 | 210 | 1 | 0.24506 | 46 | 32 | 0.37691 | 100 125 | 49 |
| 217 | 1.00000 | 217 | 1 | 0.45084 | 46 | 5 | 1.00000 | 217 | 1 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR II corresponds to the efficiency score obtained by the Variation II were obtained for each inefficient MFMC for those maximal friends facets randomly obtained (equation II.5). Ref. corresponds to the reference set for each company obtained by the VAR II approach. Rank represents the ranking of the VAR II scores which have been sorted by value, where VAR II scores with value of 1.00000 obtain the highest ranking 1.

**Table II-I-5** Variation II-efficiency under CRS for 2009

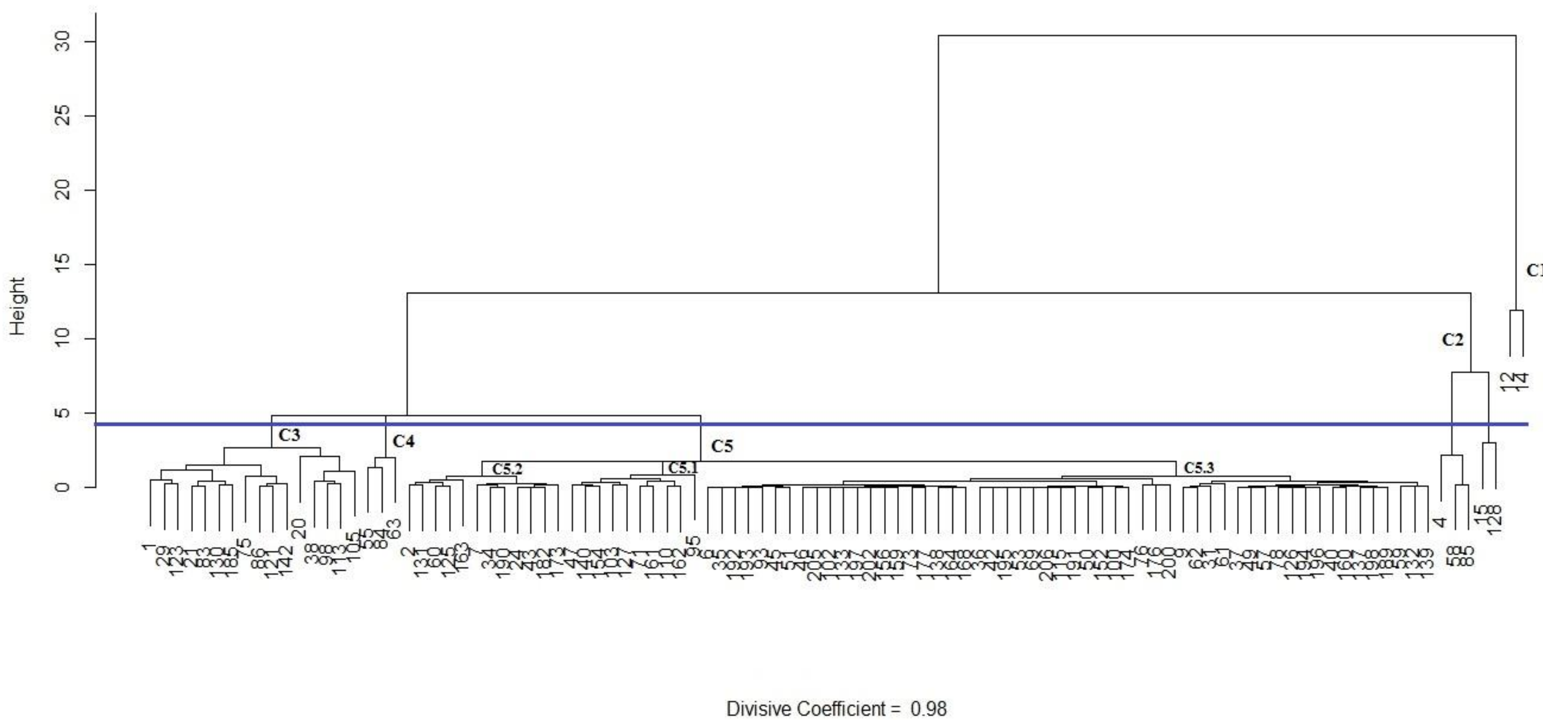
| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | |
|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR II | Ref. | Rank | VAR II | Ref. | Rank | VAR II | Ref. | Rank |
| 2 | 0.80165 | 51 174 193 | 30 | 0.53660 | 15 207 | 83 | 0.46496 | 103 125 | 50 |
| 4 | 1.00000 | 4 | 1 | 0.45781 | 15 207 | 89 | 0.25551 | 45 | 83 |
| 6 | 0.68003 | 45 131 193 210 217 | 55 | 0.74818 | 15 207 | 22 | 0.55521 | 45 217 | 44 |
| 7 | 1.00000 | 7 | 1 | 0.64147 | 15 207 | 61 | 0.36724 | 103 125 | 62 |
| 9 | 0.48553 | 14 50 100 | 87 | 0.56584 | 46 53 | 79 | 0.58148 | 103 125 | 29 |
| 12 | 0.71522 | 4 14 127 | 45 | 0.00027 | 15 | 94 | 0.00008 | 217 | 95 |
| 14 | 1.00000 | 14 | 1 | 0.00018 | 100 | 95 | 0.42524 | 125 | 56 |
| 15 | 0.67725 | 14 128 | 56 | 1.00000 | 15 | 1 | 0.18579 | 217 | 89 |
| 20 | 0.58430 | 76 128 131 210 | 78 | 0.75497 | 15 207 | 19 | 0.44927 | 103 125 | 52 |
| 21 | 0.59559 | 4 14 127 | 76 | 0.58665 | 15 207 | 73 | 0.38989 | 45 | 58 |
| 24 | 0.71157 | 45 76 131 193 | 47 | 0.61761 | 15 207 | 65 | 0.34035 | 103 125 | 68 |
| 29 | 0.44229 | 45 76 131 193 | 89 | 0.52118 | 15 207 | 85 | 0.44744 | 103 125 | 53 |
| 31 | 0.70822 | 7 51 193 | 49 | 0.82770 | 15 196 207 | 11 | 0.34294 | 103 125 | 66 |
| 34 | 0.64106 | 45 76 131 193 210 | 67 | 0.68499 | 15 196 207 | 47 | 0.44694 | 103 125 | 54 |
| 35 | 0.91060 | 50 51 76 174 193 | 21 | 0.63656 | 15 207 | 62 | 0.54157 | 103 125 | 46 |
| 36 | 0.61199 | 14 46 50 100 | 72 | 0.79022 | 46 53 196 | 13 | 0.77096 | 45 100 217 | 15 |
| 37 | 0.60574 | 128 131 210 | 74 | 0.70827 | 15 207 | 38 | 0.56360 | 103 125 | 39 |
| 38 | 0.41354 | 50 51 193 | 90 | 0.54374 | 15 207 | 82 | 0.45210 | 45 217 | 51 |
| 40 | 0.73725 | 46 50 76 100 | 40 | 0.76303 | 15 196 207 | 17 | 0.74270 | 45 100 217 | 16 |
| 43 | 0.76939 | 7 51 140 193 | 34 | 0.59379 | 15 207 | 70 | 0.36933 | 103 125 | 61 |
| 45 | 1.00000 | 45 | 1 | 0.70201 | 15 196 207 | 40 | 1.00000 | 45 | 1 |
| 46 | 1.00000 | 46 | 1 | 1.00000 | 46 | 1 | 0.95419 | 103 125 | 6 |
| 47 | 0.70415 | 76 128 131 210 | 51 | 0.71053 | 15 207 | 37 | 0.33056 | 103 125 | 71 |
| 49 | 0.57460 | 76 131 193 210 | 79 | 0.73296 | 15 196 207 | 29 | 0.58896 | 45 | 26 |
| 50 | 1.00000 | 50 | 1 | 0.66915 | 100 196 221 | 48 | 0.80871 | 45 100 217 | 12 |
| 51 | 1.00000 | 51 | 1 | 0.80063 | 15 207 | 12 | 0.58029 | 103 125 | 31 |
| 53 | 0.60637 | 45 46 100 217 | 73 | 1.00000 | 53 | 1 | 0.87864 | 100 217 | 8 |
| 55 | 1.00000 | 55 | 1 | 0.49118 | 15 207 | 87 | 0.35383 | 103 125 | 64 |
| 57 | 0.74001 | 45 76 131 193 210 | 37 | 0.71742 | 15 196 207 | 34 | 0.59213 | 45 217 | 25 |
| 58 | 0.65633 | 4 14 127 | 61 | 0.58506 | 15 207 | 74 | 0.32319 | 45 100 | 73 |
| 61 | 0.55714 | 128 193 210 | 83 | 0.59357 | 15 207 | 71 | 0.00520 | 45 | 94 |
| 62 | 1.00000 | 62 | 1 | 0.71535 | 15 196 207 | 35 | 0.58407 | 103 125 | 28 |
| 63 | 0.75616 | 14 127 128 | 35 | 0.45738 | 15 207 | 90 | 0.05511 | 125 | 93 |
| 69 | 0.67247 | 45 46 100 217 | 58 | 0.91835 | 46 53 196 | 10 | 0.82493 | 45 100 217 | 10 |
| 71 | 0.89938 | 7 14 51 76 193 | 22 | 0.68735 | 15 196 207 | 46 | 0.38014 | 103 125 | 59 |
| 76 | 1.00000 | 76 | 1 | 0.69840 | 15 207 | 44 | 0.37976 | 103 125 | 60 |
| 78 | 0.77159 | 45 46 76 131 210 | 33 | 0.75114 | 15 196 207 | 20 | 0.57683 | 103 125 | 34 |
| 83 | 0.69211 | 128 140 193 | 54 | 0.49672 | 15 207 | 86 | 0.16020 | 125 | 91 |
| 84 | 0.72170 | 4 14 127 | 43 | 0.71102 | 15 207 | 36 | 0.34288 | 125 | 67 |
| 85 | 0.63040 | 4 14 127 | 68 | 0.41993 | 15 207 | 92 | 0.21711 | 217 | 84 |
| 86 | 0.71752 | 127 128 | 44 | 0.66287 | 15 207 | 52 | 0.26866 | 125 | 82 |
| 93 | 0.60112 | 45 46 76 131 | 75 | 0.77985 | 15 196 207 | 14 | 0.55912 | 45 100 | 41 |
| 95 | 0.88045 | 7 14 76 128 140 | 24 | 0.63096 | 15 207 | 63 | 0.30047 | 103 125 | 76 |
| 98 | 0.40837 | 45 76 193 | 91 | 0.72137 | 15 207 | 32 | 0.44385 | 103 125 | 55 |
| 100 | 1.00000 | 100 | 1 | 1.00000 | 100 | 1 | 1.00000 | | 1 |
| 103 | 0.39396 | 14 45 46 76 | 94 | 0.44139 | 196 207 | 91 | 1.00000 | 103 | 1 |
| 105 | 0.50767 | 46 131 210 217 | 86 | 0.74032 | 15 207 | 26 | 0.39596 | 45 217 | 57 |
| 110 | 0.70307 | 7 62 193 | 53 | 0.58784 | 15 207 | 72 | 0.34908 | 103 125 | 65 |
| 113 | 0.54074 | 128 193 210 | 84 | 0.55092 | 15 207 | 81 | 0.18844 | 45 | 88 |
| 115 | 0.62486 | 152 174 217 | 71 | 0.60497 | 100 196 221 | 68 | 0.63983 | 45 217 | 19 |
| 121 | 0.55843 | 4 127 | 82 | 0.65608 | 15 207 | 55 | 0.21266 | 45 | 85 |
| 125 | 0.35004 | 45 100 152 | 95 | 0.97340 | 46 53 196 | 8 | 1.00000 | 125 | 1 |
| 126 | 0.72582 | 7 14 46 50 51 | 42 | 0.70387 | 15 207 | 39 | 0.56625 | 103 125 | 36 |
| 127 | 1.00000 | 127 | 1 | 0.64348 | 15 207 | 59 | 0.28922 | 103 125 | 78 |
| 128 | 1.00000 | 128 | 1 | 0.13037 | 15 | 93 | 0.10484 | 125 | 92 |
| 130 | 0.86584 | 7 14 128 140 | 25 | 0.57746 | 15 207 | 76 | 0.28600 | 103 125 | 79 |
| 131 | 1.00000 | 131 | 1 | 0.69936 | 15 207 | 41 | 0.84278 | 45 100 217 | 9 |
| 132 | 0.58555 | 51 127 128 140 | 77 | 0.61431 | 15 207 | 66 | 0.31978 | 103 125 | 74 |
| 133 | 0.78873 | 45 46 50 76 100 | 31 | 0.71854 | 15 196 207 | 33 | 0.77101 | 45 100 217 | 14 |
| 137 | 0.70913 | 45 46 50 76 100 | 48 | 0.69888 | 15 196 207 | 43 | 0.72495 | 45 217 | 17 |
| 139 | 0.64264 | 14 45 46 76 | 66 | 0.69907 | 221 | 42 | 0.62223 | 103 | 20 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 1.00000 | 140 | 1 | 0.52274 | 15 207 | 84 | 0.27316 | 103 125 | 81 |
| 142 | 0.55940 | 4 127 | 81 | 0.65658 | 15 196 207 | 54 | 0.20576 | 45 | 87 |
| 152 | 1.00000 | 152 | 1 | 0.62595 | 100 196 221 | 64 | 0.82462 | 45 217 | 11 |
| 154 | 0.88375 | 76 128 131 210 | 23 | 0.65029 | 15 207 | 57 | 0.29836 | 103 125 | 77 |
| 156 | 0.73884 | 45 174 193 210 | 39 | 0.73722 | 15 196 207 | 27 | 0.56776 | 103 125 | 35 |
| 159 | 0.66175 | 51 174 193 | 60 | 0.64653 | 15 207 | 58 | 0.55737 | 103 125 | 42 |
| 160 | 0.73983 | 51 62 193 | 38 | 0.75677 | 15 196 207 | 18 | 0.56508 | 103 125 | 37 |
| 161 | 0.70324 | 45 76 193 | 52 | 0.60253 | 15 207 | 69 | 0.28188 | 125 | 80 |
| 162 | 0.81092 | 14 51 193 | 29 | 0.57762 | 15 207 | 75 | 0.36112 | 103 125 | 63 |
| 163 | 0.65303 | 51 140 193 | 62 | 0.46335 | 15 207 | 88 | 0.32834 | 103 125 | 72 |
| 168 | 0.70472 | 7 50 51 62 193 | 50 | 0.75065 | 15 196 207 | 21 | 0.62107 | 45 217 | 22 |
| 173 | 0.62974 | 7 128 140 193 | 69 | 0.64152 | 15 207 | 60 | 0.20992 | 125 | 86 |
| 174 | 1.00000 | 174 | 1 | 0.77893 | 15 196 207 | 15 | 0.61036 | 45 217 | 24 |
| 176 | 0.85227 | 14 51 76 193 | 26 | 0.66611 | 15 207 | 50 | 0.33760 | 103 125 | 69 |
| 177 | 0.57134 | 45 152 174 217 | 80 | 0.74047 | 15 207 | 25 | 0.57753 | 103 125 | 33 |
| 182 | 0.64577 | 128 193 210 | 65 | 0.66032 | 15 207 | 53 | 0.30782 | 103 125 | 75 |
| 185 | 0.53409 | 4 127 | 85 | 0.56639 | 15 196 | 78 | 0.16341 | 45 | 90 |
| 190 | 0.81579 | 14 51 193 | 28 | 0.57629 | 15 207 | 77 | 0.33619 | 103 125 | 70 |
| 191 | 0.82468 | 46 50 76 100 | 27 | 0.76499 | 15 196 207 | 16 | 0.61675 | 103 125 | 23 |
| 192 | 0.66503 | 45 174 193 217 | 59 | 0.72330 | 15 207 | 30 | 0.54223 | 45 217 | 45 |
| 193 | 1.00000 | 193 | 1 | 0.55944 | 15 207 | 80 | 0.52702 | 103 125 | 47 |
| 194 | 0.73075 | 7 62 76 193 | 41 | 0.65390 | 15 207 | 56 | 0.51501 | 103 125 | 48 |
| 195 | 0.62920 | 76 131 193 210 | 70 | 0.66586 | 15 207 | 51 | 0.49744 | 103 125 | 49 |
| 196 | 0.40002 | 14 50 100 174 | 92 | 1.00000 | 196 | 1 | 0.94074 | 103 125 | 7 |
| 197 | 0.64604 | 174 193 217 | 64 | 0.73452 | 15 196 207 | 28 | 0.56290 | 103 125 | 40 |
| 198 | 0.74111 | 51 174 193 | 36 | 0.66901 | 15 207 | 49 | 0.55700 | 103 125 | 43 |
| 200 | 0.39727 | 7 46 128 210 | 93 | 0.74663 | 15 196 | 23 | 0.56407 | 45 100 | 38 |
| 203 | 0.64785 | 46 131 217 | 63 | 0.61395 | 100 196 221 | 67 | 0.66650 | 45 217 | 18 |
| 204 | 0.71249 | 45 76 131 193 210 | 46 | 0.74594 | 15 196 207 | 24 | 0.58105 | 45 | 30 |
| 206 | 0.67473 | 45 46 50 100 174 | 57 | 0.69600 | 15 196 207 | 45 | 0.62200 | 45 217 | 21 |
| 207 | 0.45493 | 131 193 | 88 | 1.00000 | 207 | 1 | 0.58658 | 45 217 | 27 |
| 210 | 1.00000 | 210 | 1 | 0.72176 | 15 196 207 | 31 | 0.57897 | 103 125 | 32 |
| 217 | 1.00000 | 217 | 1 | 0.92002 | 46 53 | 9 | 1.00000 | 217 | 1 |
| 221 | 0.78730 | 14 46 50 100 | 32 | 1.00000 | 221 | 1 | 0.80444 | 103 125 | 13 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR II corresponds to the efficiency score obtained by the Variation II were obtained for each inefficient MFMC for those maximal friends facets randomly obtained (equation II.5). Ref. corresponds to the reference set for each company obtained by the VAR II approach. Rank represents the ranking of the VAR II scores which have been sorted by value, where VAR II scores with value of 1.00000 obtain the highest ranking 1.

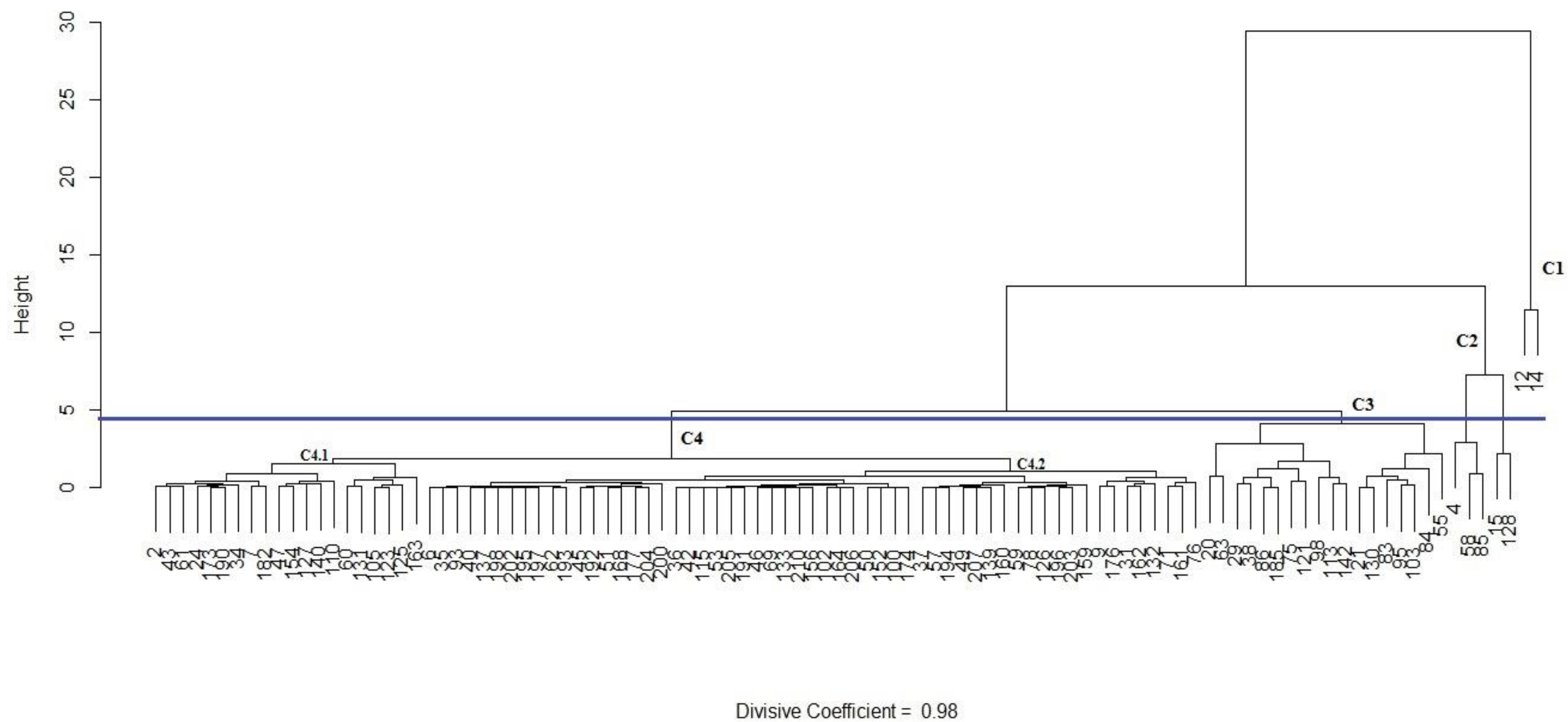
# Appendix J

**Figure II-J-1** Dendrogram (Divisive Analysis) DIANA for 2005



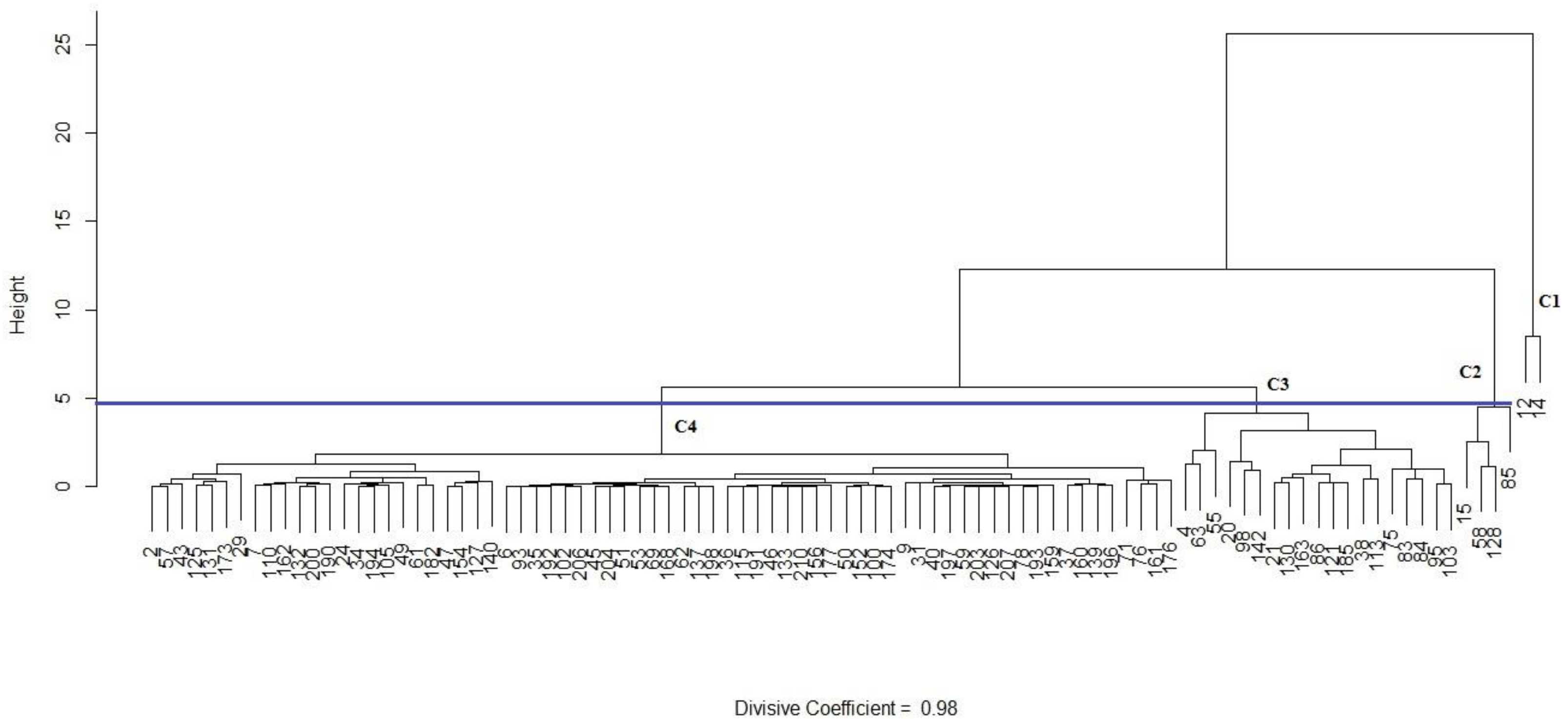

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). C1 = Cluster of the largest firms, C2 = Cluster of large firms, C3 = Cluster of large-midsize firms, C4 = Cluster of small-midsize firms, C5 (small firms) where C5.1 Cluster of large-small sized firms, C5.2 = Cluster of mid-small sized firms, C5.3 = Cluster of small-small sized firms.. The values consider the assets and labour amounts. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-J-2** Dendrogram (Divisive Analysis) DIANA for 2006



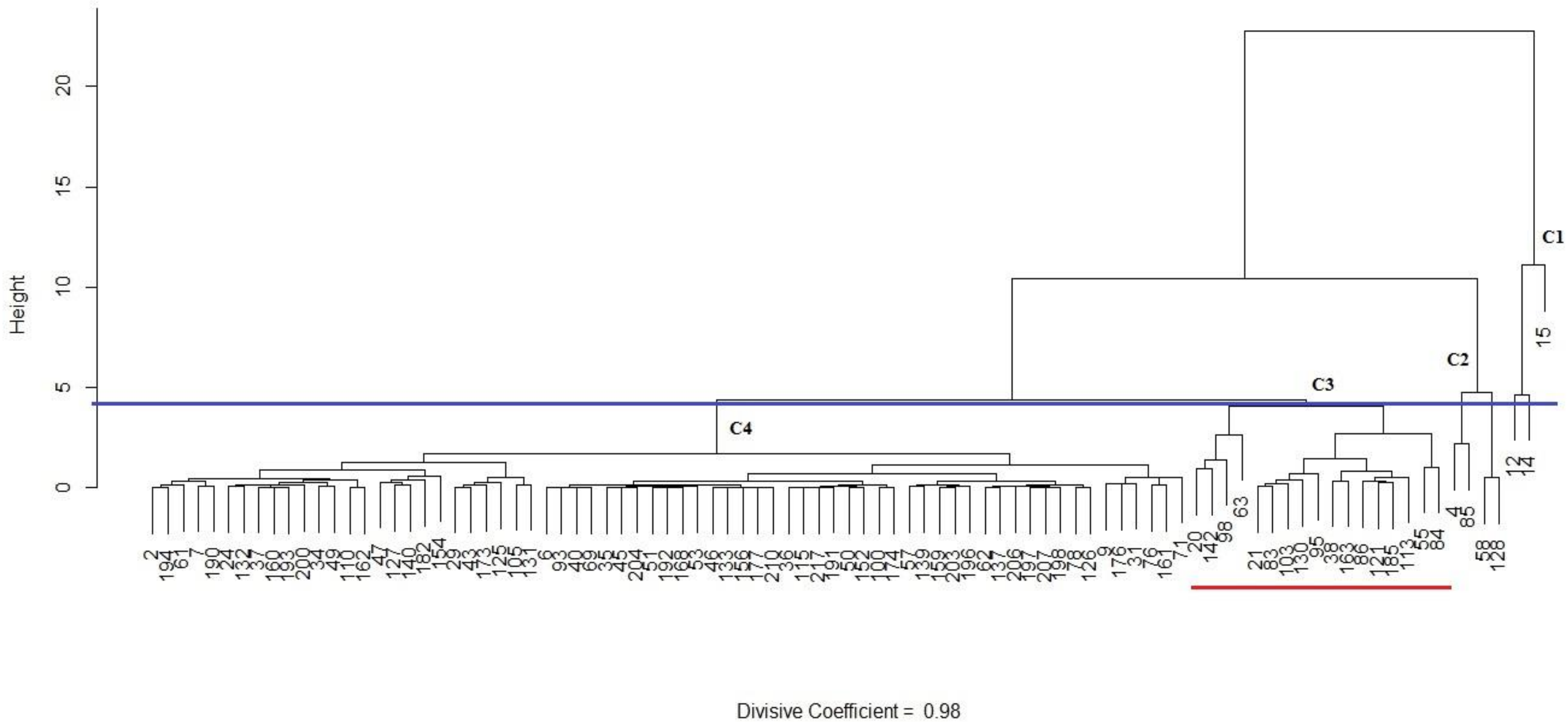

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). C1 = Cluster of the largest firms, C2 = Cluster of large firms, C3 = Cluster of large-midsize firms, C4 = Cluster of small-midsize firms, C5 (small firms) where C5.1 Cluster of large-small sized firms, C5.2 = Cluster of mid-small sized firms, C5.3 = Cluster of small-small sized firms.. The values consider the assets and labour amounts. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-J-3** Dendrogram (Divisive Analysis) DIANA for 2007



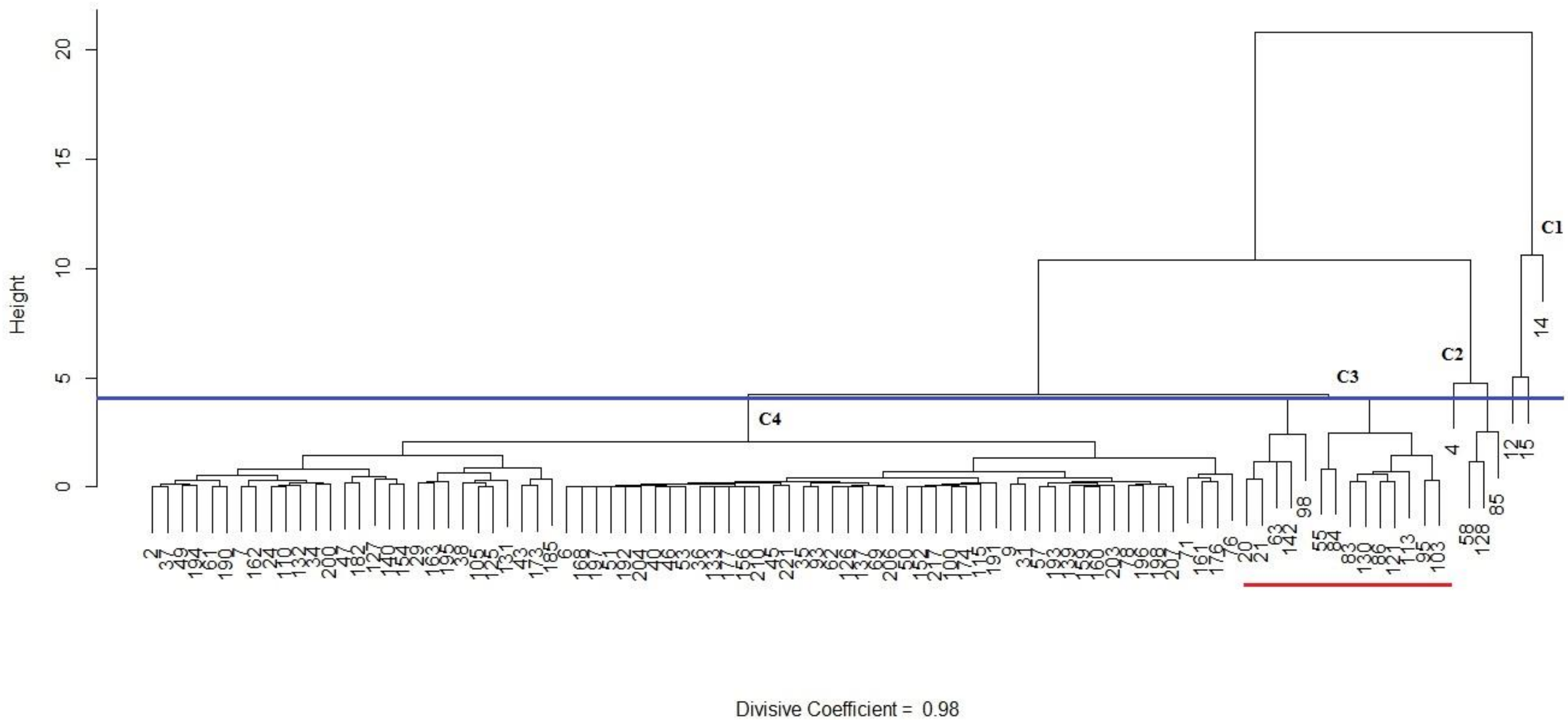

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). C1 = Cluster of the largest firms, C2 = Cluster of large firms, C3 = Cluster of large-midsize firms, C4 = Cluster of small-midsize firms, C5 (small firms) where C5.1 Cluster of large-small sized firms, C5.2 = Cluster of mid-small sized firms, C5.3 = Cluster of small-small sized firms.. The values consider the assets and labour amounts. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $\boldsymbol{DC} = \frac{1}{n}\sum_{i=1}^{n} \boldsymbol{\iota}(\boldsymbol{i})$. For each object $\boldsymbol{i}$ it measures the length $\boldsymbol{\iota}(\boldsymbol{i})$ of its line in the banner, with respect to normalized scale, i.e. all $\boldsymbol{\iota}(\boldsymbol{i})$ lie between 0 and 1.

**Figure II-J-4** Dendrogram (Divisive Analysis) DIANA for 2008




The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). C1 = Cluster of the largest firms, C2 = Cluster of large firms, C3 = Cluster of large-midsize firms, C4 = Cluster of small-midsize firms, C5 (small firms) where C5.1 Cluster of large-small sized firms, C5.2 = Cluster of mid-small sized firms, C5.3 = Cluster of small-small sized firms.. The values consider the assets and labour amounts. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-J-5** Dendrogram (Divisive Analysis) DIANA for 2009




The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). C1 = Cluster of the largest firms, C2 = Cluster of large firms, C3 = Cluster of large-midsize firms, C4 = Cluster of small-midsize firms, C5 (small firms) where C5.1 Cluster of large-small sized firms, C5.2 = Cluster of mid-small sized firms, C5.3 = Cluster of small-small sized firms.. The values consider the assets and labour amounts. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n}\iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

# Appendix K

**Table II-K-1** Variation III-efficiency under CRS for 2005

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR III | Ref. | Remark | VAR III | Ref. | Remark | VAR III | Ref. | Remark | Cluster |
| 1 | 1.00000 | 1 | locally eff. | 0.27981 | 40 59 | | 0.15860 | 152 | | 3 |
| 2 | 0.53841 | 43 163 | | 0.31795 | 40 59 | | 0.29616 | 103 125 | | 5.2 |
| 4 | 1.00000 | 4 | locally eff. | 0.22070 | 138 205 | | 1.00000 | 4 | locally eff. | 2 |
| 6 | 1.00000 | 6 | | 0.34996 | 40 59 | | 0.36169 | 152 | | 5.3 |
| 7 | 1.00000 | 7 | | 0.30571 | 40 59 | | 0.33222 | 103 125 | | 5.2 |
| 9 | 0.62045 | 40 76 | | 0.42290 | 138 | | 0.55360 | 103 125 | | 5.3 |
| 12 | 1.00000 | 12 | | 0.03048 | 59 205 | | 1.00000 | 12 | | 1 |
| 14 | 1.00000 | 14 | | 0.15673 | 59 205 | | 1.00000 | 14 | | 1 |
| 15 | 1.00000 | 15 | locally eff. | 0.26393 | 138 196 | | 0.36761 | 12 | | 2 |
| 20 | 1.00000 | 20 | locally eff. | 0.27083 | 40 59 | | 0.48653 | 103 125 | | 3 |
| 21 | 1.00000 | 21 | locally eff. | 0.32631 | 40 59 | | 0.38557 | 100 205 | | 3 |
| 24 | 0.60829 | 7 | | 0.29171 | 40 59 | | 0.27904 | 103 125 | | 5.2 |
| 29 | 1.00000 | 29 | locally eff. | 0.31670 | 40 59 | | 0.44023 | 103 125 | | 3 |
| 31 | 1.00000 | 31 | locally eff. | 0.33585 | 40 59 | | 0.36068 | 103 125 | | 5.3 |
| 34 | 0.29414 | 43 163 | | 0.35654 | 40 59 | | 0.34552 | 152 | | 5.2 |
| 35 | 0.94340 | 40 160 176 177 | | 0.34986 | 40 59 | | 0.42367 | 103 125 | | 5.3 |
| 36 | 0.70789 | 6 40 174 | | 0.74505 | 40 46 59 | | 0.71421 | 125 196 200 | | 5.3 |
| 37 | 0.75725 | 40 160 174 | | 0.54733 | 40 59 | | 0.58279 | 125 196 200 | | 5.3 |
| 38 | 1.00000 | 38 | locally eff. | 0.33099 | 40 59 | | 0.58539 | 40 103 125 | | 3 |
| 40 | 1.00000 | 40 | | 1.00000 | 40 | | 1.00000 | 40 | | 5.3 |
| 42 | 0.55395 | 6 40 174 | | 0.76168 | 59 205 | | 0.70030 | 125 196 200 | | 5.3 |
| 43 | 1.00000 | 43 | | 0.30158 | 40 59 | | 0.33802 | 103 125 | | 5.2 |
| 45 | 0.76627 | 40 174 177 192 | | 0.37312 | 40 59 | | 0.61285 | 100 196 200 | | 5.3 |
| 46 | 0.40978 | 76 100 174 | | 1.00000 | 46 | | 0.89171 | 100 196 200 | | 5.3 |
| 47 | 0.63152 | 127 140 | | 0.30867 | 138 196 | | 0.25011 | 125 | | 5.1 |
| 49 | 0.82668 | 40 160 174 | | 0.56928 | 40 59 | | 0.60595 | 125 196 200 | | 5.3 |
| 50 | 0.47064 | 53 160 177 | | 0.84876 | 59 205 | | 0.62303 | 125 196 200 | | 5.3 |
| 51 | 0.73582 | 40 160 176 177 | | 0.41680 | 40 59 | | 0.50581 | 103 125 | | 5.3 |
| 53 | 1.00000 | 53 | | 0.85623 | 46 138 205 | | 0.75751 | 100 152 205 | | 5.3 |
| 55 | 1.00000 | 55 | | 0.14995 | 100 196 | | 0.48570 | 103 125 | | 4 |
| 57 | 0.76376 | 40 160 174 | | 0.57301 | 40 59 | | 0.57366 | 125 196 200 | | 5.3 |
| 58 | 1.00000 | 58 | locally eff. | 0.20126 | 59 205 | | 0.59002045 | 12 14 | | 2 |
| 59 | 0.25762 | 6 174 | | 1.00000 | 59 | | 0.51300 | 100 152 | | 5.3 |
| 60 | 0.03124 | 43 | | 0.83982 | 138 205 | | 0.59208 | 100 200 | | 5.2 |
| 61 | 0.53174 | 40 160 176 177 | | 0.28864 | 40 59 | | 0.12951 | 152 | | 5.3 |
| 62 | 0.74709 | 160 176 | | 0.36214 | 40 59 | | 0.51844 | 103 125 | | 5.3 |
| 63 | 1.00000 | 63 | locally eff. | 0.28119 | 138 196 | | 0.16068 | 125 | | 4 |
| 69 | 0.46557 | 53 174 177 | | 0.58979 | 40 46 196 | | 0.55364 | 125 196 200 | | 5.3 |
| 71 | 1.00000 | 71 | | 0.28994 | 138 196 | | 0.32593 | 103 125 | | 5.1 |
| 73 | 1.00000 | 73 | locally eff. | 0.43503 | 40 59 | | 0.44003 | 100 200 | | 5.3 |
| 75 | 1.00000 | 75 | locally eff. | 0.25971 | 40 59 | | 0.17286 | 152 | | 3 |
| 76 | 1.00000 | 76 | | 0.30367 | 40 59 | | 0.54259 | 103 200 | | 5.3 |
| 78 | 0.75348 | 40 160 174 177 | | 0.46455 | 40 59 | | 0.55339 | 125 196 200 | | 5.3 |
| 83 | 1.00000 | 83 | locally eff. | 0.25938 | 138 196 | | 0.25339 | 152 | | 3 |
| 84 | 1.00000 | 84 | locally eff. | 0.26262 | 138 196 | | 0.67584 | 103 | | 4 |
| 85 | 1.00000 | 85 | locally eff. | 0.22043 | 100 196 | | 0.51800 | 12 14 | | 2 |
| 86 | 0.61898 | 130 | | 0.28257 | 40 59 | | 0.52340 | 103 200 | | 3 |
| 93 | 0.70410 | 6 40 192 | | 0.51670 | 138 | | 0.50436 | 152 205 | | 5.3 |
| 95 | 1.00000 | 95 | locally eff. | 0.29656 | 138 205 | | 0.53526 | 40 103 | | 5.1 |
| 98 | 1.00000 | 98 | locally eff. | 0.29607 | 40 59 | | 0.56935 | 103 125 | | 3 |
| 100 | 1.00000 | 100 | | 1.00000 | 100 | | 1.00000 | 100 | | 5.3 |
| 102 | 0.31407 | 100 152 | | 0.87433 | 40 100 196 | | 0.85804 | 100 196 200 | | 5.3 |
| 103 | 1.00000 | 103 | | 0.36319 | 138 | | 1.00000 | 103 | | 5.1 |
| 105 | 1.00000 | 105 | locally eff. | 0.29383 | 40 59 | | 0.12083 | 125 | | 3 |
| 110 | 0.70524 | 71 161 | | 0.29750 | 40 59 | | 0.28489 | 103 125 | | 5.1 |
| 113 | 0.34055 | 130 | | 0.28964 | 40 59 | | 0.05145 | 152 | | 3 |
| 115 | 0.63595 | 152 174 198 | | 0.59846 | 40 46 196 | | 0.58144 | 40 125 196 | | 5.3 |
| 121 | 1.00000 | 121 | locally eff. | 0.29020 | 40 59 | | 0.32436 | 152 | | 3 |
| 123 | 1.00000 | 123 | locally eff. | 0.42226 | 40 59 | | 0.41587 | 103 125 | | 3 |
| 125 | 0.05083 | 43 | | 0.74046 | 40 46 59 | | 1.00000 | 125 | | 5.2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 126 | 0.72349 | 174 177 198 205 | | 0.40895 | 40 59 | 0.53698 | 40 103 125 | 5.3 |
| 127 | 1.00000 | 127 | | 0.27067 | 40 59 | 0.32729 | 152 205 | 5.1 |
| 128 | 1.00000 | 128 | | 0.23907 | 138 205 | 0.34918 | 12 | 2 |
| 130 | 1.00000 | 130 | | 0.27649 | 138 196 | 0.28981 | 103 125 | 3 |
| 131 | 1.00000 | 131 | locally eff. | 0.63725 | 40 46 59 | 0.67312 | 125 196 200 | 5.2 |
| 132 | 0.69072 | 6 174 177 192 | | 0.34403 | 40 59 | 0.39513 | 103 | 5.3 |
| 133 | 0.77377 | 6 40 174 | | 0.66087 | 40 46 59 | 0.63329 | 125 196 200 | 5.3 |
| 137 | 0.75743 | 6 40 174 192 | | 0.45070 | 40 59 | 0.61074 | 125 196 200 | 5.3 |
| 138 | 0.52947 | 100 174 | | 1.00000 | 138 | 0.87403 | 100 152 205 | 5.3 |
| 139 | 0.51429 | 6 40 192 | | 0.57697 | 138 196 | 0.75887 | 125 196 200 | 5.3 |
| 140 | 1.00000 | 140 | | 0.28707 | 138 205 | 0.27982 | 103 125 | 5.1 |
| 142 | 0.48450 | 130 | | 0.25835 | 40 59 | 0.28830 | 152 | 3 |
| 152 | 1.00000 | 152 | | 0.67312 | 138 205 | 1.00000 | 152 | 5.3 |
| 154 | 1.00000 | 154 | | 0.31909 | 138 205 | 0.26866 | 103 125 | 5.1 |
| 156 | 0.85809 | 6 40 174 192 | | 0.47301 | 40 59 | 0.54651 | 40 103 125 | 5.3 |
| 159 | 0.55228 | 6 174 177 | | 0.48575 | 40 59 | 0.54150 | 40 103 125 | 5.3 |
| 160 | 1.00000 | 160 | | 0.60223 | 40 46 59 | 0.57909 | 125 196 200 | 5.3 |
| 161 | 1.00000 | 161 | | 0.26421 | 40 59 | 0.27909 | 103 125 | 5.1 |
| 162 | 1.00000 | 162 | locally eff. | 0.31282 | 138 205 | 0.40292 | 103 125 | 5.1 |
| 163 | 1.00000 | 163 | | 0.30099 | 138 205 | 0.30286 | 103 125 | 5.2 |
| 164 | 0.45298 | 6 40 | | 0.99062 | 40 46 196 | 0.96576 | 125 196 200 | 5.3 |
| 168 | 0.79636 | 6 40 174 192 | | 0.46296 | 40 59 | 0.57055 | 40 103 125 | 5.3 |
| 173 | 0.50520 | 43 163 | | 0.31924 | 40 59 | 0.24158 | 125 | 5.2 |
| 174 | 1.00000 | 174 | | 0.61053 | 40 46 59 | 0.50420 | 152 | 5.3 |
| 176 | 1.00000 | 176 | | 0.30501 | 40 59 | 0.30895 | 103 125 | 5.3 |
| 177 | 1.00000 | 177 | | 0.35193 | 40 59 | 0.46910 | 103 200 | 5.3 |
| 182 | 1.00000 | 182 | locally eff. | 0.29527 | 138 196 | 0.31234 | 103 125 | 5.2 |
| 185 | 1.00000 | 185 | locally eff. | 0.48411 | 138 | 0.46112 | 103 125 | 3 |
| 189 | 0.46387 | 100 152 174 | | 0.70898 | 138 196 | 0.57592 | 100 196 200 | 5.3 |
| 190 | 1.00000 | 190 | locally eff. | 0.31498 | 40 59 | 0.30322 | 103 125 | 5.2 |
| 191 | 0.76134 | 6 40 174 192 | | 0.50057 | 40 59 | 0.57575 | 40 103 125 | 5.3 |
| 192 | 1.00000 | 192 | | 0.34489 | 40 59 | 0.44654 | 103 125 | 5.3 |
| 193 | 1.00000 | 193 | | 0.33926 | 40 59 | 0.39558 | 103 125 | 5.3 |
| 194 | 1.00000 | 194 | locally eff. | 0.42058 | 40 59 | 0.43186 | 100 200 | 5.3 |
| 195 | 0.80340 | 174 177 198 205 | | 0.62417 | 40 46 59 | 0.58317 | 100 200 | 5.3 |
| 196 | 0.17975 | 53 | | 1.00000 | 196 | 1.00000 | 196 | 5.3 |
| 197 | 0.74443 | 53 174 177 | | 0.56574 | 40 46 59 | 0.55629 | 125 196 200 | 5.3 |
| 198 | 1.00000 | 198 | | 0.48037 | 40 59 | 0.54342 | 100 200 | 5.3 |
| 200 | 0.63774 | 40 76 | | 0.48832 | 138 | 1.00000 | 200 | 5.3 |
| 202 | 0.69287 | 40 160 174 177 | | 0.68120 | 40 46 59 | 0.62341 | 40 125 196 | 5.3 |
| 205 | 1.00000 | 205 | | 1.00000 | 205 | 1.00000 | 205 | 5.3 |
| 206 | 0.66200 | 53 174 | | 0.65272 | 59 205 | 0.69738 | 152 205 | 5.3 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR III corresponds to the efficiency score obtained by the Variation II. But this VAR III was obtained for each inefficient MFMC referred to those maximal friends facets formed by efficient companies belonging to the same cluster (adjacent clusters when no efficient MFMC is found in the objective cluster). Ref. corresponds to the reference set for each company obtained by the VAR III approach. Remark represents the locally efficient companies found in each cluster. Cluster is the group where each company was classified.

**Table II-K-2** Variation III-efficiency under CRS for 2006

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR III | Ref. | Remarkk | VAR III | Ref. | Remark | VAR III | Ref. | Remark | Cluster |
| 2 | 1.00000 | 2 | locally eff. | 0.38246 | 40 207 | | 0.28124 | 125 200 | | 4.1 |
| 4 | 1.00000 | 4 | locally eff. | 0.28594 | 60 152 | | 1.00000 | 4 | locally eff. | 2 |
| 6 | 0.51667 | 71 174 177 | | 0.43680 | 40 207 | | 0.43127 | 205 | | 4.2 |
| 7 | 1.00000 | 7 | locally eff. | 0.35240 | 40 207 | | 0.29915 | 125 200 | | 4.1 |
| 9 | 0.39342 | 62 161 | | 0.64083 | 152 | | 0.49644 | 100 205 | | 4.2 |
| 12 | 1.00000 | 12 | | 0.01947 | 100 | | 0.74887 | 14 | | 1 |
| 14 | 1.00000 | 14 | | 0.17987 | 152 202 | | 1.00000 | 14 | | 1 |
| 15 | 1.00000 | 15 | locally eff. | 0.02534 | 40 207 | | 0.25515 | 14 | | 2 |
| 20 | 1.00000 | 20 | locally eff. | 0.26938 | 40 207 | | 0.32461 | 103 | | 3 |
| 21 | 0.27350 | 55 | | 0.32579 | 40 207 | | 0.28615 | 103 | | 3 |
| 24 | 0.54664 | 154 163 | | 0.33449 | 40 207 | | 0.28839 | 125 200 | | 4.1 |
| 29 | 1.00000 | 29 | locally eff. | 0.34337 | 40 207 | | 0.38344 | 103 | | 3 |
| 31 | 1.00000 | 31 | locally eff. | 0.46282 | 152 | | 0.31676 | 125 200 | | 4.2 |
| 34 | 0.25657 | 163 | | 0.55128 | 152 202 | | 0.24943 | 205 | | 4.1 |
| 35 | 0.63503 | 62 161 177 | | 0.43514 | 40 207 | | 0.33791 | 125 200 | | 4.2 |
| 36 | 0.42176 | 51 160 205 | | 0.87299 | 40 100 203 207 | | 0.70620 | 100 164 200 | | 4.2 |
| 37 | 0.63828 | 194 205 | | 0.55942 | 40 207 | | 0.48986 | 100 200 | | 4.2 |
| 38 | 0.20847 | 130 | | 0.42218 | 40 207 | | 1.00000 | 38 | locally eff. | 3 |
| 40 | 0.14162 | 51 177 205 | | 1.00000 | 40 | | 1.00000 | 40 | locally eff. | 4.2 |
| 42 | 0.41864 | 100 174 205 | | 0.87276 | 40 100 203 207 | | 0.72530 | 125 164 200 | | 4.2 |
| 43 | 1.00000 | 43 | locally eff. | 0.33644 | 40 207 | | 0.29143 | 125 200 | | 4.1 |
| 45 | 0.59881 | 51 161 174 | | 0.47303 | 40 207 | | 0.55619 | 100 205 | | 4.2 |
| 46 | 0.39304 | 53 160 205 | | 0.99975 | 40 100 196 203 207 | | 0.92683 | 100 164 200 | | 4.2 |
| 47 | 0.59045 | 127 140 163 | | 0.32133 | 40 207 | | 0.31518 | 205 | | 4.1 |
| 49 | 0.45957 | 194 205 | | 0.69934 | 40 207 | | 0.51549 | 100 205 | | 4.2 |
| 50 | 0.58216 | 53 174 | | 0.94882 | 152 196 202 | | 0.61515 | 100 164 200 | | 4.2 |
| 51 | 1.00000 | 51 | | 0.50674 | 40 | | 0.39651 | 125 200 | | 4.2 |
| 53 | 1.00000 | 53 | | 0.84560 | 60 152 196 | | 0.64044 | 100 164 200 | | 4.2 |
| 55 | 1.00000 | 55 | | 0.25899 | 40 207 | | 0.38660 | 103 | | 3 |
| 57 | 0.51530 | 194 205 | | 0.57878 | 40 207 | | 0.45669 | 205 | | 4.2 |
| 58 | 1.00000 | 58 | locally eff. | 0.23559 | 60 152 | | 0.57232 | 14 | | 2 |
| 59 | 1.00000 | 59 | | 0.99682 | 40 100 203 207 | | 0.12718 | 205 | | 4.2 |
| 60 | 0.00543 | 163 | | 1.00000 | 60 | | 0.64109 | 100 125 164 | | 4.1 |
| 61 | 0.47405 | 163 | | 0.33426 | 40 207 | | 0.28923 | 205 | | 4.1 |
| 62 | 1.00000 | 62 | | 0.47263 | 40 207 | | 0.46243 | 100 205 | | 4.2 |
| 63 | 1.00000 | 63 | locally eff. | 0.21810 | 60 203 | | 0.06122 | 103 | | 3 |
| 69 | 0.66627 | 100 174 205 | | 0.79356 | 152 202 | | 0.56488 | 100 164 200 | | 4.2 |
| 71 | 1.00000 | 71 | | 0.32165 | 40 207 | | 0.27198 | 100 125 | | 4.2 |
| 75 | 1.00000 | 75 | locally eff. | 0.27509 | 40 207 | | 0.05953 | 103 | | 3 |
| 76 | 0.69875 | 51 71 161 177 | | 0.33718 | 40 207 | | 0.51453 | 203 | | 4.2 |
| 78 | 0.67742 | 174 194 198 | | 0.50595 | 40 207 | | 0.43966 | 100 200 | | 4.2 |
| 83 | 1.00000 | 83 | locally eff. | 0.31079 | 60 152 | | 0.14432 | 103 | | 3 |
| 84 | 1.00000 | 84 | locally eff. | 0.27195 | 40 207 | | 0.58563 | 103 | | 3 |
| 85 | 1.00000 | 85 | locally eff. | 0.17243 | 40 207 | | 0.33784 | 14 | | 2 |
| 86 | 1.00000 | 86 | locally eff. | 0.28051 | 40 207 | | 1.00000 | 86 | locally eff. | 3 |
| 93 | 0.41423 | 51 62 160 | | 0.65739 | 152 196 202 | | 0.48836 | 100 205 | | 4.2 |
| 95 | 1.00000 | 95 | locally eff. | 0.29491 | 40 207 | | 0.46012 | 103 | | 3 |
| 98 | 1.00000 | 98 | locally eff. | 0.34177 | 40 207 | | 0.47299 | 103 | | 3 |
| 100 | 1.00000 | 100 | | 1.00000 | 100 | | 1.00000 | 100 | | 4.2 |
| 102 | 0.51440 | 100 205 | | 0.87296 | 60 196 203 | | 0.73669 | 100 205 | | 4.2 |
| 103 | 1.00000 | 103 | locally eff. | 0.50826 | 152 | | 1.00000 | 103 | | 3 |
| 105 | 0.19031 | 127 163 | | 0.43115 | 40 207 | | 0.56404 | 125 164 200 | | 4.1 |
| 110 | 0.58597 | 140 154 163 | | 0.34326 | 40 207 | | 0.40015 | 205 | | 4.1 |
| 113 | 0.36528 | 130 | | 0.31169 | 40 207 | | 0.06916 | 103 | | 3 |
| 115 | 0.66654 | 100 174 205 | | 0.73514 | 152 202 | | 0.57794 | 100 164 200 | | 4.2 |
| 121 | 0.37387 | 130 | | 0.31118 | 40 207 | | 0.10587 | 103 | | 3 |
| 123 | 0.20823 | 127 163 | | 0.54124 | 40 207 | | 0.33986 | 205 | | 4.1 |
| 125 | 0.05088 | 163 | | 0.87219 | 40 100 203 207 | | 1.00000 | 125 | | 4.1 |
| 126 | 0.65378 | 53 198 | | 0.55886 | 40 207 | | 0.47035 | 125 200 | | 4.2 |
| 127 | 1.00000 | 127 | | 0.29025 | 40 207 | | 0.26964 | 125 | | 4.1 |
| 128 | 1.00000 | 128 | | 0.22138 | 40 207 | | 0.25396 | 14 | | 2 |
| 130 | 1.00000 | 130 | | 0.28851 | 40 207 | | 0.12687 | 103 | | 3 |
| 131 | 1.00000 | 131 | locally eff. | 0.72486 | 152 202 | | 0.64583 | 100 164 200 | | 4.1 |
| 132 | 0.56536 | 62 161 177 | | 0.39001 | 60 152 | | 0.36749 | 125 200 | | 4.2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 133 | 0.54528 | 51 53 177 205 | | 0.83003 | 40 100 203 207 | 0.60502 | 100 200 | 4.2 |
| 137 | 0.47453 | 51 62 177 | | 0.63603 | 202 | 0.56537 | 100 200 | 4.2 |
| 139 | 0.43850 | 62 160 | | 0.67829 | 152 196 | 0.66774 | 125 200 | 4.2 |
| 140 | 1.00000 | 140 | | 0.29186 | 40 207 | 0.29023 | 125 200 | 4.1 |
| 142 | 0.42262 | 130 | | 0.29926 | 40 207 | 0.10846 | 103 | 3 |
| 152 | 0.50657 | 100 174 205 | | 1.00000 | 152 | 0.67646 | 100 205 | 4.2 |
| 154 | 1.00000 | 154 | | 0.30893 | 40 207 | 0.26309 | 125 200 | 4.1 |
| 156 | 0.57239 | 51 62 177 | | 0.59897 | 40 207 | 0.39479 | 125 200 | 4.2 |
| 159 | 0.57673 | 194 198 205 | | 0.56534 | 202 | 0.39265 | 125 200 | 4.2 |
| 160 | 1.00000 | 160 | | 0.71811 | 152 202 | 0.54804 | 100 200 | 4.2 |
| 161 | 1.00000 | 161 | | 0.27822 | 40 207 | 0.28819 | 100 125 | 4.2 |
| 162 | 0.58751 | 62 161 177 | | 0.32401 | 40 207 | 0.40770 | 100 205 | 4.2 |
| 163 | 1.00000 | 163 | | 0.30353 | 40 207 | 0.27019 | 125 200 | 4.1 |
| 164 | 0.27403 | 51 160 205 | | 0.99912 | 40 100 203 207 | 1.00000 | 164 | 4.2 |
| 168 | 0.45032 | 174 194 198 | | 0.72728 | 152 202 | 0.54093 | 125 200 | 4.2 |
| 173 | 0.54079 | 154 163 | | 0.34740 | 40 207 | 0.28408 | 125 200 | 4.1 |
| 174 | 1.00000 | 174 | | 0.82887 | 152 202 | 0.59514 | 205 | 4.2 |
| 176 | 1.00000 | 176 | locally eff. | 0.33870 | 40 207 | 0.28461 | 125 200 | 4.2 |
| 177 | 1.00000 | 177 | | 0.45706 | 40 207 | 0.40245 | 125 200 | 4.2 |
| 182 | 0.81727 | 127 140 163 | | 0.32289 | 40 207 | 0.31414 | 125 200 | 4.1 |
| 185 | 1.00000 | 185 | locally eff. | 0.55976 | 60 152 196 | 0.13982 | 103 | 3 |
| 190 | 0.63175 | 127 163 | | 0.36147 | 40 207 | 0.29285 | 125 200 | 4.1 |
| 191 | 0.69915 | 51 174 177 205 | | 0.65664 | 40 100 207 | 0.51609 | 100 200 | 4.2 |
| 192 | 0.71115 | 51 161 174 177 | | 0.41637 | 40 207 | 0.37779 | 205 | 4.2 |
| 193 | 0.56809 | 51 161 174 177 | | 0.38680 | 40 207 | 0.32269 | 125 200 | 4.2 |
| 194 | 1.00000 | 194 | | 0.52539 | 152 | 0.39306 | 205 | 4.2 |
| 195 | 0.46293 | 53 198 | | 0.90278 | 152 196 202 | 0.58970 | 100 164 200 | 4.2 |
| 196 | 0.33785 | 59 160 | | 1.00000 | 196 | 0.96884 | 100 125 164 | 4.2 |
| 197 | 0.67523 | 53 177 198 | | 0.66382 | 40 100 207 | 0.50211 | 100 200 | 4.2 |
| 198 | 1.00000 | 198 | | 0.60641 | 202 | 0.37287 | 100 200 | 4.2 |
| 200 | 0.44056 | 71 174 | | 0.67928 | 60 152 | 1.00000 | 200 | 4.2 |
| 202 | 0.60647 | 194 205 | | 1.00000 | 202 | 0.50382 | 125 200 | 4.2 |
| 203 | 0.31533 | 100 205 | | 1.00000 | 203 | 1.00000 | 203 | 4.2 |
| 204 | 1.00000 | 204 | locally eff. | 0.49157 | 40 207 | 0.37110 | 205 | 4.2 |
| 205 | 1.00000 | 205 | | 0.85146 | 60 196 203 | 1.00000 | 205 | 4.2 |
| 206 | 0.61428 | 51 53 160 205 | | 0.84098 | 152 202 | 0.58777 | 100 164 200 | 4.2 |
| 207 | 0.35137 | 51 59 160 | | 1.00000 | 207 | 0.18664 | 205 | 4.2 |
| 210 | 0.78713 | 174 194 205 | | 0.83242 | 40 100 196 207 | 0.57738 | 100 205 | 4.2 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR III corresponds to the efficiency score obtained by the Variation II. But this VAR III was obtained for each inefficient MFMC referred to those maximal friends facets formed by efficient companies belonging to the same cluster (adjacent clusters when no efficient MFMC is found in the objective cluster). Ref. corresponds to the reference set for each company obtained by the VAR III approach. Remark represents the locally efficient companies found in each cluster. Cluster is the group where each company was classified.

**Table II-K-3** Variation III-efficiency under CRS for 2007

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR III | Ref. | Remark | VAR III | Ref. | Remark | VAR III | Ref. | Remark | Cluster |
| 2 | 0.65477 | 50 140 177 198 | | 0.71470 | 50 192 | | 0.28714 | 125 196 | | 4 |
| 4 | 1.00000 | 4 | locally eff. | 0.34536 | 192 | | 0.10488 | 103 | | 3 |
| 6 | 0.62132 | 140 174 177 198 | | 0.75677 | 50 192 | | 0.44004 | 102 | | 4 |
| 7 | 1.00000 | 7 | | 0.59117 | 50 192 | | 0.30129 | 125 203 | | 4 |
| 9 | 0.32111 | 50 51 127 140 | | 0.62241 | 50 192 | | 0.53460 | 125 203 | | 4 |
| 12 | 1.00000 | 12 | | 0.05120 | 203 | | 0.24853 | 103 | | 1 |
| 14 | 1.00000 | 14 | | 0.16538 | 100 203 | | 0.29689 | 103 | | 1 |
| 15 | 1.00000 | 15 | locally eff. | 0.27005 | 192 | | 0.05225 | 103 | | 2 |
| 20 | 0.45726 | 55 83 | | 0.33632 | 192 | | 0.21514 | 103 | | 3 |
| 21 | 1.00000 | 21 | locally eff. | 0.54681 | 50 192 | | 0.11364 | 103 | | 3 |
| 24 | 0.52280 | 7 78 | | 0.58997 | 50 192 | | 0.27964 | 125 203 | | 4 |
| 29 | 0.55646 | 127 174 198 | | 0.58586 | 192 | | 0.32535 | 125 196 | | 4 |
| 31 | 0.54201 | 7 78 177 | | 0.62189 | 50 192 | | 0.30370 | 125 203 | | 4 |
| 34 | 0.40615 | 78 | | 0.77819 | 50 192 | | 0.25152 | 125 | | 4 |
| 35 | 0.88065 | 51 127 174 177 198 | | 0.71950 | 50 192 | | 0.30511 | 125 196 | | 4 |
| 36 | 0.43001 | 100 102 174 210 | | 0.71030 | 46 50 | | 0.58785 | 100 196 | | 4 |
| 37 | 0.63106 | 51 127 174 | | 0.76821 | 50 192 | | 0.38249 | 102 | | 4 |
| 38 | 1.00000 | 38 | locally eff. | 0.57132 | 50 192 | | 1.00000 | 38 | locally eff. | 3 |
| 40 | 0.42644 | 50 160 | | 0.66697 | 50 192 | | 0.49023 | 100 102 | | 4 |
| 43 | 0.78265 | 127 140 198 | | 0.58218 | 50 192 | | 0.31926 | 125 203 | | 4 |
| 45 | 0.78175 | 51 127 140 174 177 | | 0.77842 | 50 192 | | 0.49991 | 100 203 | | 4 |
| 46 | 0.45504 | 50 53 198 | | 1.00000 | 46 | | 0.79692 | 100 196 | | 4 |
| 47 | 0.66235 | 140 174 | | 0.52426 | 192 | | 0.32168 | 102 | | 4 |
| 49 | 0.56269 | 50 160 198 | | 0.85213 | 50 192 | | 0.42513 | 100 102 | | 4 |
| 50 | 1.00000 | 50 | | 1.00000 | 50 | | 0.50655 | 100 102 | | 4 |
| 51 | 1.00000 | 51 | | 0.67947 | 50 192 | | 0.33298 | 125 196 | | 4 |
| 53 | 1.00000 | 53 | | 0.66656 | 46 100 196 | | 0.64187 | 100 102 | | 4 |
| 55 | 1.00000 | 55 | | 0.29344 | 192 | | 0.17281 | 103 | | 3 |
| 57 | 0.49022 | 127 140 174 | | 0.66007 | 50 192 | | 0.43161 | 100 102 | | 4 |
| 58 | 1.00000 | 58 | locally eff. | 0.29991 | 192 | | 0.20325 | 103 | | 2 |
| 59 | 0.17313 | 50 53 198 | | 0.76049 | 100 196 203 | | 0.13339 | 102 | | 4 |
| 61 | 0.60290 | 7 78 | | 0.58806 | 192 | | 0.19836 | 102 | | 4 |
| 62 | 0.72003 | 7 50 140 177 | | 0.82177 | 50 192 | | 0.40030 | 100 102 | | 4 |
| 63 | 1.00000 | 63 | locally eff. | 0.36025 | 192 | | 0.02930 | 103 | | 3 |
| 69 | 0.82772 | 50 53 152 198 | | 0.78601 | 50 192 | | 0.41821 | 102 | | 4 |
| 71 | 1.00000 | 71 | locally eff. | 0.52268 | 192 | | 0.44667 | 100 102 | | 4 |
| 75 | 0.65472 | 55 83 | | 0.38798 | 192 | | 0.05125 | 103 | | 3 |
| 76 | 1.00000 | 76 | locally eff. | 0.55710 | 50 192 | | 0.50166 | 100 102 | | 4 |
| 78 | 1.00000 | 78 | | 0.83755 | 50 192 | | 0.32337 | 100 203 | | 4 |
| 83 | 1.00000 | 83 | | 0.37920 | 192 | | 0.08579 | 103 | | 3 |
| 84 | 0.62812 | 55 | | 0.35162 | 192 | | 0.40844 | 103 | | 3 |
| 85 | 1.00000 | 85 | locally eff. | 0.26762 | 192 | | 0.07036 | 103 | | 2 |
| 86 | 1.00000 | 86 | locally eff. | 0.43898 | 192 | | 0.15163 | 103 | | 3 |
| 93 | 0.44678 | 7 50 78 177 | | 0.62965 | 50 192 | | 0.44328 | 100 102 | | 4 |
| 95 | 1.00000 | 95 | locally eff. | 0.37658 | 192 | | 0.27348 | 103 | | 3 |
| 98 | 1.00000 | 98 | locally eff. | 0.61237 | 50 192 | | 0.34052 | 103 | | 3 |
| 100 | 1.00000 | 100 | | 1.00000 | 100 | | 1.00000 | 100 | | 4 |
| 102 | 1.00000 | 102 | | 0.74881 | 46 50 | | 1.00000 | 102 | | 4 |
| 103 | 1.00000 | 103 | locally eff. | 0.60408 | 50 192 | | 1.00000 | 103 | | 3 |
| 105 | 0.41569 | 53 102 210 | | 0.77192 | 50 192 | | 0.49546 | 100 102 | | 4 |
| 110 | 0.64117 | 140 174 198 | | 0.58880 | 192 | | 0.38347 | 102 | | 4 |
| 113 | 0.47913 | 163 | | 0.46282 | 192 | | 0.04300 | 103 | | 3 |
| 115 | 0.57373 | 50 51 152 198 | | 0.74013 | 50 192 | | 0.54797 | 102 | | 4 |
| 121 | 0.36385 | 55 83 | | 0.45278 | 192 | | 0.08012 | 103 | | 3 |
| 125 | 0.31214 | 100 102 | | 0.74850 | 100 196 203 | | 1.00000 | 125 | | 4 |
| 126 | 0.71590 | 50 51 152 | | 0.61982 | 50 192 | | 0.32017 | 125 196 | | 4 |
| 127 | 1.00000 | 127 | | 0.41057 | 192 | | 0.29344 | 125 203 | | 4 |
| 128 | 1.00000 | 128 | | 0.32087 | 192 | | 0.05711 | 103 | | 2 |
| 130 | 1.00000 | 130 | locally eff. | 0.40548 | 192 | | 0.07581 | 103 | | 3 |
| 131 | 0.39274 | 100 102 210 | | 0.49739 | 46 50 | | 0.45212 | 100 102 | | 4 |
| 132 | 0.68160 | 7 50 78 177 | | 0.55510 | 50 192 | | 0.32925 | 102 | | 4 |
| 133 | 0.59676 | 51 127 174 | | 0.70848 | 46 50 | | 0.44049 | 100 102 | | 4 |
| 137 | 0.55419 | 51 127 174 | | 0.63246 | 50 192 | | 0.48915 | 100 203 | | 4 |
| 139 | 0.41263 | 51 127 174 | | 0.65211 | 46 50 | | 0.65452 | 125 203 | | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 1.00000 | 140 | | 0.40860 | 192 | 0.29458 | 125 203 | | 4 |
| 142 | 1.00000 | 142 | locally eff. | 0.48064 | 192 | 0.05337 | 103 | | 3 |
| 152 | 1.00000 | 152 | | 0.72640 | 46 50 | 0.58499 | 100 102 | | 4 |
| 154 | 1.00000 | 154 | locally eff. | 0.46331 | 192 | 0.26783 | 125 203 | | 4 |
| 156 | 0.63676 | 50 51 127 177 | | 0.76939 | 50 192 | 0.32770 | 125 196 | | 4 |
| 159 | 0.49528 | 102 174 198 | | 0.71629 | 50 192 | 0.34083 | 125 196 | | 4 |
| 160 | 1.00000 | 160 | | 0.63034 | 50 192 | 0.34623 | 125 196 | | 4 |
| 161 | 1.00000 | 161 | locally eff. | 0.54232 | 192 | 0.29672 | 125 203 | | 4 |
| 162 | 0.71521 | 140 174 177 198 | | 0.58285 | 192 | 0.33519 | 102 | | 4 |
| 163 | 1.00000 | 163 | | 0.42417 | 192 | 0.07466 | 103 | | 3 |
| 168 | 0.58851 | 100 174 198 | | 0.79909 | 50 192 | 0.47483 | 100 102 | | 4 |
| 173 | 0.59978 | 127 174 177 | | 0.56997 | 50 192 | 0.27086 | 125 203 | | 4 |
| 174 | 1.00000 | 174 | | 0.82051 | 50 192 | 0.50130 | 102 | | 4 |
| 176 | 0.90774 | 50 127 140 177 | | 0.60172 | 50 192 | 0.29180 | 125 203 | | 4 |
| 177 | 1.00000 | 177 | | 0.70883 | 50 192 | 0.31705 | 125 196 | | 4 |
| 182 | 0.68433 | 7 78 | | 0.58327 | 50 192 | 0.29466 | 125 203 | | 4 |
| 185 | 1.00000 | 185 | locally eff. | 0.50878 | 50 192 | 0.04871 | 103 | | 3 |
| 190 | 0.79102 | 7 78 177 | | 0.61930 | 192 | 0.28609 | 125 203 | | 4 |
| 191 | 0.86966 | 51 140 174 198 | | 0.76480 | 50 192 | 0.40536 | 102 | | 4 |
| 192 | 0.47765 | 7 78 177 | | 1.00000 | 192 | 0.39958 | 100 102 | | 4 |
| 193 | 0.82010 | 78 177 198 | | 0.66960 | 50 192 | 0.28237 | 125 196 | | 4 |
| 194 | 0.70433 | 127 140 174 | | 0.58009 | 50 192 | 0.34829 | 125 203 | | 4 |
| 196 | 0.24555 | 53 102 210 | | 1.00000 | 196 | 1.00000 | 196 | | 4 |
| 197 | 0.71777 | 51 152 174 177 | | 0.69763 | 50 192 | 0.32651 | 100 196 | | 4 |
| 198 | 1.00000 | 198 | | 0.66168 | 50 192 | 0.29946 | 100 196 | | 4 |
| 200 | 0.26175 | 51 140 174 | | 0.50841 | 50 192 | 1.00000 | 200 | locally eff. | 4 |
| 203 | 0.09050 | 100 102 | | 1.00000 | 203 | 1.00000 | 203 | | 4 |
| 204 | 1.00000 | 204 | locally eff. | 0.68795 | 50 192 | 0.37510 | 102 | | 4 |
| 206 | 0.70215 | 50 53 152 198 | | 0.76548 | 50 192 | 0.49278 | 100 102 | | 4 |
| 207 | 0.48356 | 50 160 | | 0.56816 | 46 50 | 0.29845 | 125 196 | | 4 |
| 210 | 1.00000 | 210 | | 0.84159 | 50 192 | 0.43365 | 102 | | 4 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR III corresponds to the efficiency score obtained by the Variation II. But this VAR III was obtained for each inefficient MFMC referred to those maximal friends facets formed by efficient companies belonging to the same cluster (adjacent clusters when no efficient MFMC is found in the objective cluster). Ref. corresponds to the reference set for each company obtained by the VAR III approach. Remark represents the locally efficient companies found in each cluster. Cluster is the group where each company was classified.

**Table II-K-4** Variation III-efficiency under CRS for 2008

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **MFMC** | **VAR III** | **Ref.** | **Remark** | **VAR III** | **Ref.** | **Remark** | **VAR III** | **Ref.** | **Remark** | **Cluster** |
| 2 | 0.55475 | 198 210 217 | | 0.18218 | 46 | | 0.29286 | 100 125 | | 4 |
| 4 | 1.00000 | 4 | locally eff. | 0.13894 | 46 | | 0.12356 | 103 | | 2 |
| 6 | 0.52650 | 174 198 217 | | 0.19828 | 46 | | 0.27098 | 217 | | 4 |
| 7 | 0.74892 | 154 198 | | 0.18782 | 46 | | 0.30478 | 100 125 | | 4 |
| 9 | 0.28569 | 154 160 174 | | 0.29425 | 46 | | 0.49467 | 100 125 | | 4 |
| 12 | 1.00000 | 12 | | 0.01660 | 46 | | 0.36512 | 103 | | 1 |
| 14 | 1.00000 | 14 | | 0.06160 | 46 | | 1.00000 | 14 | locally eff. | 1 |
| 15 | 1.00000 | 15 | | 0.12520 | 46 | | 0.10475 | 103 | | 1 |
| 20 | 0.50616 | 55 83 | | 0.19250 | 46 | | 0.25325 | 103 | | 3 |
| 21 | 1.00000 | 21 | locally eff. | 0.18760 | 46 | | 0.10910 | 103 | | 3 |
| 24 | 0.43788 | 127 160 174 | | 0.23225 | 46 | | 0.29213 | 100 125 | | 4 |
| 29 | 0.37074 | 198 210 217 | | 0.20744 | 46 | | 0.28128 | 100 125 | | 4 |
| 31 | 0.52841 | 127 160 174 | | 0.21456 | 46 | | 0.27733 | 100 125 | | 4 |
| 34 | 0.39259 | 198 210 217 | | 0.21542 | 46 | | 0.26941 | 100 125 | | 4 |
| 35 | 0.65590 | 127 154 160 174 | | 0.21600 | 46 | | 0.31635 | 100 125 | | 4 |
| 36 | 0.36531 | 174 210 217 | | 0.42683 | 46 | | 0.57524 | 100 125 | | 4 |
| 37 | 0.48326 | 127 160 174 | | 0.21401 | 46 | | 0.33161 | 100 125 | | 4 |
| 38 | 1.00000 | 38 | locally eff. | 0.21218 | 46 | | 0.26958 | 103 | | 3 |
| 40 | 0.36682 | 210 217 | | 0.38420 | 46 | | 0.27632 | 100 125 | | 4 |
| 43 | 0.51454 | 127 160 | | 0.19313 | 46 | | 0.28628 | 100 125 | | 4 |
| 45 | 0.42642 | 127 174 | | 0.23430 | 46 | | 0.46843 | 100 217 | | 4 |
| 46 | 0.13920 | 217 | | 1.00000 | 46 | | 1.00000 | 46 | | 4 |
| 47 | 0.54379 | 127 160 | | 0.20112 | 46 | | 0.30029 | 100 125 | | 4 |
| 49 | 0.39555 | 210 217 | | 0.24778 | 46 | | 0.38283 | 217 | | 4 |
| 50 | 0.33344 | 174 217 | | 0.32421 | 46 | | 0.55068 | 100 217 | | 4 |
| 51 | 0.59562 | 127 160 174 | | 0.20762 | 46 | | 0.34480 | 100 125 | | 4 |
| 53 | 0.27972 | 174 210 217 | | 0.36566 | 46 | | 0.73957 | 100 217 | | 4 |
| 55 | 1.00000 | 55 | | 0.13828 | 46 | | 0.28478 | 103 | | 3 |
| 57 | 0.51225 | 127 160 174 | | 0.24767 | 46 | | 0.33010 | 100 125 | | 4 |
| 58 | 1.00000 | 58 | locally eff. | 0.12830 | 46 | | 0.28277 | 103 | | 2 |
| 61 | 0.39352 | 154 198 | | 0.20001 | 46 | | 0.16347 | 217 | | 4 |
| 62 | 0.56954 | 127 160 174 | | 0.21331 | 46 | | 0.35607 | 100 125 | | 4 |
| 63 | 1.00000 | 63 | locally eff. | 0.15966 | 46 | | 0.04286 | 103 | | 3 |
| 69 | 0.37146 | 174 217 | | 0.32570 | 46 | | 0.53336 | 100 217 | | 4 |
| 71 | 1.00000 | 71 | locally eff. | 0.18551 | 46 | | 0.34417 | 100 125 | | 4 |
| 76 | 1.00000 | 76 | locally eff. | 0.17985 | 46 | | 0.34996 | 100 125 | | 4 |
| 78 | 0.54594 | 174 198 210 217 | | 0.20161 | 46 | | 0.31020 | 100 125 | | 4 |
| 83 | 1.00000 | 83 | | 0.15958 | 46 | | 0.16334 | 103 | | 3 |
| 84 | 0.71522 | 55 83 | | 0.15451 | 46 | | 0.27710 | 103 | | 3 |
| 85 | 1.00000 | 85 | locally eff. | 0.14807 | 46 | | 0.11254 | 103 | | 2 |
| 86 | 1.00000 | 86 | locally eff. | 0.17407 | 46 | | 0.17864 | 103 | | 3 |
| 93 | 0.35103 | 154 160 174 | | 0.28808 | 46 | | 0.48933 | 100 217 | | 4 |
| 95 | 1.00000 | 95 | locally eff. | 0.16317 | 46 | | 1.00000 | 95 | locally eff. | 3 |
| 98 | 1.00000 | 98 | locally eff. | 0.19082 | 46 | | 1.00000 | 98 | locally eff. | 3 |
| 100 | 0.10899 | 217 | | 1.00000 | 100 | | 1.00000 | 100 | | 4 |
| 103 | 0.12726 | 55 | | 0.29630 | 46 | | 1.00000 | 103 | | 3 |
| 105 | 0.37281 | 198 217 | | 0.29949 | 46 | | 0.01290 | 217 | | 4 |
| 110 | 0.60674 | 154 198 | | 0.18667 | 46 | | 0.32598 | 100 125 | | 4 |
| 113 | 0.42956 | 55 83 | | 0.18797 | 46 | | 0.11492 | 103 | | 3 |
| 115 | 0.31358 | 174 217 | | 0.33163 | 46 | | 0.48571 | 217 | | 4 |
| 121 | 0.43192 | 55 83 | | 0.22563 | 46 | | 0.11745 | 103 | | 3 |
| 125 | 0.15207 | 217 | | 0.52552 | 46 | | 1.00000 | 125 | | 4 |
| 126 | 0.59300 | 174 198 217 | | 0.19841 | 46 | | 0.31147 | 100 125 | | 4 |
| 127 | 1.00000 | 127 | | 0.15643 | 46 | | 0.28638 | 100 125 | | 4 |
| 128 | 1.00000 | 128 | | 0.14927 | 46 | | 0.08928 | 103 | | 2 |
| 130 | 1.00000 | 130 | locally eff. | 0.16639 | 46 | | 0.16835 | 103 | | 3 |
| 131 | 0.32688 | 198 217 | | 0.32618 | 46 | | 0.41567 | 100 125 | | 4 |
| 132 | 0.42043 | 127 160 | | 0.23296 | 46 | | 0.31888 | 100 125 | | 4 |
| 133 | 0.52102 | 210 217 | | 0.38054 | 46 | | 0.49028 | 100 217 | | 4 |
| 137 | 0.52200 | 127 160 174 | | 0.29120 | 46 | | 0.51351 | 100 217 | | 4 |
| 139 | 0.37404 | 154 160 174 | | 0.32356 | 46 | | 0.56555 | 100 125 | | 4 |
| 140 | 0.75356 | 127 154 160 | | 0.16461 | 46 | | 0.28568 | 100 125 | | 4 |
| 142 | 1.00000 | 142 | locally eff. | 0.17190 | 46 | | 0.24264 | 103 | | 3 |
| 152 | 0.23478 | 174 217 | | 0.40889 | 46 100 | | 0.55702 | 217 | | 4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 154 | 1.00000 | 154 | | 0.17462 | 46 | 0.27780 | 100 125 | 4 |
| 156 | 0.43426 | 127 160 174 | | 0.28576 | 46 | 0.34638 | 100 125 | 4 |
| 159 | 0.48231 | 198 217 | | 0.25591 | 46 | 0.32472 | 100 125 | 4 |
| 160 | 1.00000 | 160 | | 0.24419 | 46 | 0.36959 | 100 125 | 4 |
| 161 | 1.00000 | 161 | locally eff. | 0.23221 | 46 | 0.29284 | 100 125 | 4 |
| 162 | 0.59302 | 127 160 | | 0.22271 | 46 | 0.31872 | 100 125 | 4 |
| 163 | 1.00000 | 163 | locally eff. | 0.17247 | 46 | 0.24790 | 103 | 3 |
| 168 | 0.45170 | 174 210 217 | | 0.27420 | 46 | 0.38043 | 217 | 4 |
| 173 | 0.37833 | 127 160 | | 0.20908 | 46 | 0.22665 | 125 | 4 |
| 174 | 1.00000 | 174 | | 0.24848 | 46 | 0.38556 | 217 | 4 |
| 176 | 0.70863 | 127 154 160 174 | | 0.19609 | 46 | 0.30540 | 100 125 | 4 |
| 177 | 0.46210 | 174 | | 0.20414 | 46 | 0.32165 | 100 125 | 4 |
| 182 | 0.53107 | 127 160 | | 0.17979 | 46 | 0.28550 | 100 125 | 4 |
| 185 | 1.00000 | 185 | locally eff. | 0.19053 | 46 | 0.02283 | 103 | 3 |
| 190 | 0.65080 | 154 174 198 | | 0.18093 | 46 | 0.29108 | 100 125 | 4 |
| 191 | 0.55974 | 127 160 174 | | 0.25448 | 46 | 0.36215 | 100 125 | 4 |
| 192 | 0.48496 | 174 198 217 | | 0.20662 | 46 | 0.33380 | 100 125 | 4 |
| 193 | 0.47632 | 174 198 217 | | 0.21399 | 46 | 0.28834 | 100 125 | 4 |
| 194 | 0.59765 | 127 160 174 | | 0.23202 | 46 | 0.30790 | 100 125 | 4 |
| 196 | 0.11883 | 174 217 | | 0.73057 | 46 | 0.74770 | 100 125 | 4 |
| 197 | 0.57689 | 174 198 217 | | 0.23425 | 46 | 0.33082 | 100 125 | 4 |
| 198 | 1.00000 | 198 | | 0.21346 | 46 | 0.31557 | 100 125 | 4 |
| 200 | 0.24084 | 154 160 | | 0.31903 | 46 | 0.41811 | 100 125 | 4 |
| 203 | 0.41566 | 198 210 217 | | 0.36829 | 46 | 0.50574 | 100 217 | 4 |
| 204 | 0.69701 | 127 160 174 | | 0.22154 | 46 | 0.32886 | 100 125 | 4 |
| 206 | 0.56438 | 174 210 217 | | 0.25430 | 46 | 0.35660 | 100 125 | 4 |
| 207 | 0.48295 | 198 217 | | 0.32682 | 46 | 0.33694 | 100 125 | 4 |
| 210 | 1.00000 | 210 | | 0.24506 | 46 | 0.37691 | 100 125 | 4 |
| 217 | 1.00000 | 217 | | 0.45084 | 46 | 1.00000 | 217 | 4 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR III corresponds to the efficiency score obtained by the Variation II. But this VAR III was obtained for each inefficient MFMC referred to those maximal friends facets formed by efficient companies belonging to the same cluster (adjacent clusters when no efficient MFMC is found in the objective cluster). Ref. corresponds to the reference set for each company obtained by the VAR III approach. Remark represents the locally efficient companies found in each cluster. Cluster is the group where each company was classified.

**Table II-K-5** Variation III-efficiency under CRS for 2009

| | Stage 1 Portfolio Management | | | Stage 2 Marketing and Service | | | Overall Efficiency | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MFMC | VAR III | Ref. | Remark | VAR III | Ref. | Remark | VAR III | Ref. | Remark | Cluster |
| 2 | 0.80165 | 51 174 193 | | 0.45045 | 196 221 | | 0.28627 | 45 | | 4 |
| 4 | 1.00000 | 4 | | 1.00000 | 4 | locally eff. | 0.10309 | 103 | | 2 |
| 6 | 0.68003 | 45 131 193 210 217 | | 0.59040 | 100 196 221 | | 0.55521 | 45 217 | | 4 |
| 7 | 1.00000 | 7 | | 0.35864 | 46 53 | | 0.29391 | 100 125 | | 4 |
| 9 | 0.45885 | 45 76 131 | | 0.56584 | 46 53 | | 0.54143 | 100 217 | | 4 |
| 12 | 1.00000 | 12 | locally eff. | 0.00027 | 15 | | 0.00002 | 103 | | 1 |
| 14 | 1.00000 | 14 | | 0.00014 | 15 | | 0.26384 | 103 | | 1 |
| 15 | 0.45053 | 14 | | 1.00000 | 15 | | 0.06753 | 103 | | 1 |
| 20 | 1.00000 | 20 | locally eff. | 0.36956 | 46 53 | | 0.36525 | 103 | | 3 |
| 21 | 1.00000 | 21 | locally eff. | 0.38580 | 46 53 | | 0.16846 | 103 | | 3 |
| 24 | 0.71157 | 45 76 131 193 | | 0.41924 | 196 221 | | 0.28916 | 100 125 | | 4 |
| 29 | 0.44229 | 45 76 131 193 | | 0.39140 | 196 221 | | 0.28534 | 100 125 | | 4 |
| 31 | 0.70822 | 7 51 193 | | 0.58216 | 207 | | 0.29484 | 100 125 | | 4 |
| 34 | 0.64106 | 45 76 131 193 210 | | 0.59045 | 100 196 221 | | 0.42434 | 45 | | 4 |
| 35 | 0.91060 | 50 51 76 174 193 | | 0.47228 | 196 221 | | 0.32496 | 45 | | 4 |
| 36 | 0.60312 | 45 46 50 100 | | 0.79022 | 46 53 196 | | 0.77096 | 45 100 217 | | 4 |
| 37 | 0.60235 | 51 62 | | 0.51933 | 196 221 | | 0.47989 | 45 | | 4 |
| 38 | 0.41354 | 50 51 193 | | 0.54099 | 100 196 221 | | 0.45210 | 45 217 | | 4 |
| 40 | 0.73725 | 46 50 76 100 | | 0.71830 | 100 196 221 | | 0.74270 | 45 100 217 | | 4 |
| 43 | 0.76939 | 7 51 140 193 | | 0.34648 | 46 53 | | 0.28897 | 100 125 | | 4 |
| 45 | 1.00000 | 45 | | 0.53343 | 196 207 | | 1.00000 | 45 | | 4 |
| 46 | 1.00000 | 46 | | 1.00000 | 46 | | 0.90408 | 100 125 | | 4 |
| 47 | 0.62314 | 51 127 140 | | 0.38054 | 46 53 | | 0.30395 | 100 125 | | 4 |
| 49 | 0.57460 | 76 131 193 210 | | 0.61111 | 196 221 | | 0.58896 | 45 | | 4 |
| 50 | 1.00000 | 50 | | 0.66915 | 100 196 221 | | 0.80871 | 45 100 217 | | 4 |
| 51 | 1.00000 | 51 | | 0.60758 | 207 | | 0.57433 | 45 217 | | 4 |
| 53 | 0.60637 | 45 46 100 217 | | 1.00000 | 53 | | 0.87864 | 100 217 | | 4 |
| 55 | 1.00000 | 55 | | 0.27712 | 46 53 | | 0.22358 | 103 | | 3 |
| 57 | 0.74001 | 45 76 131 193 210 | | 0.56961 | 196 221 | | 0.59213 | 45 217 | | 4 |
| 58 | 1.00000 | 58 | locally eff. | 1.00000 | 58 | locally eff. | 0.21441 | 103 | | 2 |
| 61 | 0.55229 | 76 131 193 | | 0.35523 | 196 221 | | 0.00520 | 45 | | 4 |
| 62 | 1.00000 | 62 | | 0.56781 | 196 221 | | 0.58257 | 45 217 | | 4 |
| 63 | 1.00000 | 63 | locally eff. | 0.23863 | 46 53 | | 0.03139 | 103 | | 3 |
| 69 | 0.67247 | 45 46 100 217 | | 0.91835 | 46 53 196 | | 0.82493 | 45 100 217 | | 4 |
| 71 | 1.00000 | 71 | locally eff. | 0.35200 | 46 53 | | 0.31971 | 100 125 | | 4 |
| 76 | 1.00000 | 76 | | 0.36153 | 46 53 | | 0.31078 | 100 125 | | 4 |
| 78 | 0.77159 | 45 46 76 131 210 | | 0.61132 | 100 196 221 | | 0.52772 | 45 | | 4 |
| 83 | 1.00000 | 83 | locally eff. | 0.30583 | 46 53 | | 0.12077 | 103 | | 3 |
| 84 | 1.00000 | 84 | locally eff. | 0.27599 | 207 | | 0.26888 | 103 | | 3 |
| 85 | 1.00000 | 85 | locally eff. | 1.00000 | 85 | locally eff. | 0.10838 | 103 | | 2 |
| 86 | 1.00000 | 86 | locally eff. | 0.33126 | 46 53 | | 0.16316 | 103 | | 3 |
| 93 | 0.60112 | 45 46 76 131 | | 0.71798 | 100 196 221 | | 0.55912 | 45 100 | | 4 |
| 95 | 1.00000 | 95 | locally eff. | 0.31710 | 46 53 | | 0.15341 | 103 | | 3 |
| 98 | 1.00000 | 98 | locally eff. | 0.44361 | 207 | | 1.00000 | 98 | locally eff. | 3 |
| 100 | 1.00000 | 100 | | 1.00000 | 100 | | 1.00000 | 100 | | 4 |
| 103 | 1.00000 | 103 | locally eff. | 0.44139 | 196 207 | | 1.00000 | 103 | | 3 |
| 105 | 0.50767 | 46 131 210 217 | | 0.65357 | 207 | | 0.39596 | 45 217 | | 4 |
| 110 | 0.70307 | 7 62 193 | | 0.36270 | 196 221 | | 0.30384 | 45 | | 4 |
| 113 | 1.00000 | 113 | locally eff. | 0.32354 | 46 53 | | 0.14210 | 103 | | 3 |
| 115 | 0.62486 | 152 174 217 | | 0.60497 | 100 196 221 | | 0.63983 | 45 217 | | 4 |
| 121 | 1.00000 | 121 | locally eff. | 0.35047 | 46 53 | | 0.11456 | 103 | | 3 |
| 125 | 0.35004 | 45 100 152 | | 0.97340 | 46 53 196 | | 1.00000 | 125 | | 4 |
| 126 | 0.71705 | 7 46 50 51 140 | | 0.59395 | 100 196 221 | | 0.52596 | 45 217 | | 4 |
| 127 | 1.00000 | 127 | | 0.33133 | 46 53 | | 0.28610 | 100 125 | | 4 |
| 128 | 1.00000 | 128 | | 0.13037 | 15 | | 0.04659 | 103 | | 2 |
| 130 | 1.00000 | 130 | locally eff. | 0.32431 | 46 53 | | 0.13988 | 103 | | 3 |
| 131 | 1.00000 | 131 | | 0.59530 | 100 196 221 | | 0.84278 | 45 100 217 | | 4 |
| 132 | 0.57406 | 51 127 140 | | 0.36288 | 46 53 | | 0.28538 | 100 125 | | 4 |
| 133 | 0.78873 | 45 46 50 76 100 | | 0.67852 | 100 196 221 | | 0.77101 | 45 100 217 | | 4 |
| 137 | 0.70913 | 45 46 50 76 100 | | 0.63224 | 100 196 221 | | 0.72495 | 45 217 | | 4 |
| 139 | 0.64247 | 45 46 76 131 | | 0.69907 | 221 | | 0.61289 | 45 100 | | 4 |
| 140 | 1.00000 | 140 | | 0.31064 | 46 53 | | 0.27153 | 100 125 | | 4 |
| 142 | 1.00000 | 142 | locally eff. | 0.32615 | 46 53 | | 0.13536 | 103 | | 3 |
| 152 | 1.00000 | 152 | | 0.62595 | 100 196 221 | | 0.82462 | 45 217 | | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 154 | 0.78907 | 7 76 140 193 | 0.35833 | 46 53 | 0.28402 | 100 125 | 4 |
| 156 | 0.74473 | 45 174 193 210 217 | 0.59156 | 100 196 221 | 0.52874 | 45 217 | 4 |
| 159 | 0.66175 | 51 174 193 | 0.57533 | 100 196 221 | 0.48137 | 45 217 | 4 |
| 160 | 0.73983 | 51 62 193 | 0.54640 | 207 | 0.50979 | 45 | 4 |
| 161 | 0.70324 | 45 76 193 | 0.34344 | 46 53 | 0.28188 | 125 | 4 |
| 162 | 0.78837 | 51 76 140 193 | 0.36431 | 196 221 | 0.29290 | 100 125 | 4 |
| 163 | 0.65303 | 51 140 193 | 0.31209 | 196 221 | 0.27689 | 100 125 | 4 |
| 168 | 0.70472 | 7 50 51 62 193 | 0.61646 | 196 207 | 0.62107 | 45 217 | 4 |
| 173 | 0.62145 | 7 140 193 | 0.34721 | 46 53 | 0.20992 | 125 | 4 |
| 174 | 1.00000 | 174 | 0.67633 | 196 207 | 0.61036 | 45 217 | 4 |
| 176 | 0.80912 | 51 76 140 193 | 0.35737 | 46 53 | 0.29385 | 100 125 | 4 |
| 177 | 0.57134 | 45 152 174 217 | 0.62044 | 207 | 0.56870 | 45 217 | 4 |
| 182 | 0.61293 | 51 127 140 | 0.35425 | 46 53 | 0.28889 | 100 125 | 4 |
| 185 | 0.48127 | 127 | 0.34498 | 46 53 | 0.16341 | 45 | 4 |
| 190 | 0.81471 | 7 51 140 193 | 0.35306 | 196 221 | 0.28141 | 100 125 | 4 |
| 191 | 0.82468 | 46 50 76 100 | 0.63640 | 196 221 | 0.58315 | 45 100 | 4 |
| 192 | 0.66503 | 45 174 193 217 | 0.58396 | 100 196 221 | 0.54223 | 45 217 | 4 |
| 193 | 1.00000 | 193 | 0.39889 | 196 221 | 0.28332 | 100 125 | 4 |
| 194 | 0.73075 | 7 62 76 193 | 0.45032 | 196 221 | 0.31870 | 45 | 4 |
| 195 | 0.62920 | 76 131 193 210 | 0.50625 | 196 221 | 0.29604 | 45 | 4 |
| 196 | 0.39988 | 45 50 100 174 | 1.00000 | 196 | 0.70665 | 100 125 | 4 |
| 197 | 0.64604 | 174 193 217 | 0.60156 | 196 207 | 0.50871 | 45 217 | 4 |
| 198 | 0.74111 | 51 174 193 | 0.57329 | 100 196 221 | 0.48466 | 45 217 | 4 |
| 200 | 0.39610 | 7 46 62 | 0.62489 | 46 53 | 0.56407 | 45 100 | 4 |
| 203 | 0.64785 | 46 131 217 | 0.61395 | 100 196 221 | 0.66650 | 45 217 | 4 |
| 204 | 0.71249 | 45 76 131 193 210 | 0.59055 | 196 221 | 0.58105 | 45 | 4 |
| 206 | 0.67473 | 45 46 50 100 174 | 0.60713 | 100 196 221 | 0.62200 | 45 217 | 4 |
| 207 | 0.45493 | 131 193 | 1.00000 | 207 | 0.58658 | 45 217 | 4 |
| 210 | 1.00000 | 210 | 0.59377 | 100 196 221 | 0.56867 | 45 217 | 4 |
| 217 | 1.00000 | 217 | 0.92002 | 46 53 | 1.00000 | 217 | 4 |
| 221 | 0.51774 | 46 76 100 | 1.00000 | 221 | 0.60895 | 100 125 | 4 |

MFMC is the identifying number of the mutual fund management company (Official registers, CNMV). VAR III corresponds to the efficiency score obtained by the Variation II. But this VAR III was obtained for each inefficient MFMC referred to those maximal friends facets formed by efficient companies belonging to the same cluster (adjacent clusters when no efficient MFMC is found in the objective cluster). Ref. corresponds to the reference set for each company obtained by the VAR III approach. Remark represents the locally efficient companies found in each cluster. Cluster is the group where each company was classified.

# Appendix L

**Table II-L-1** Efficient Companies by Clusters

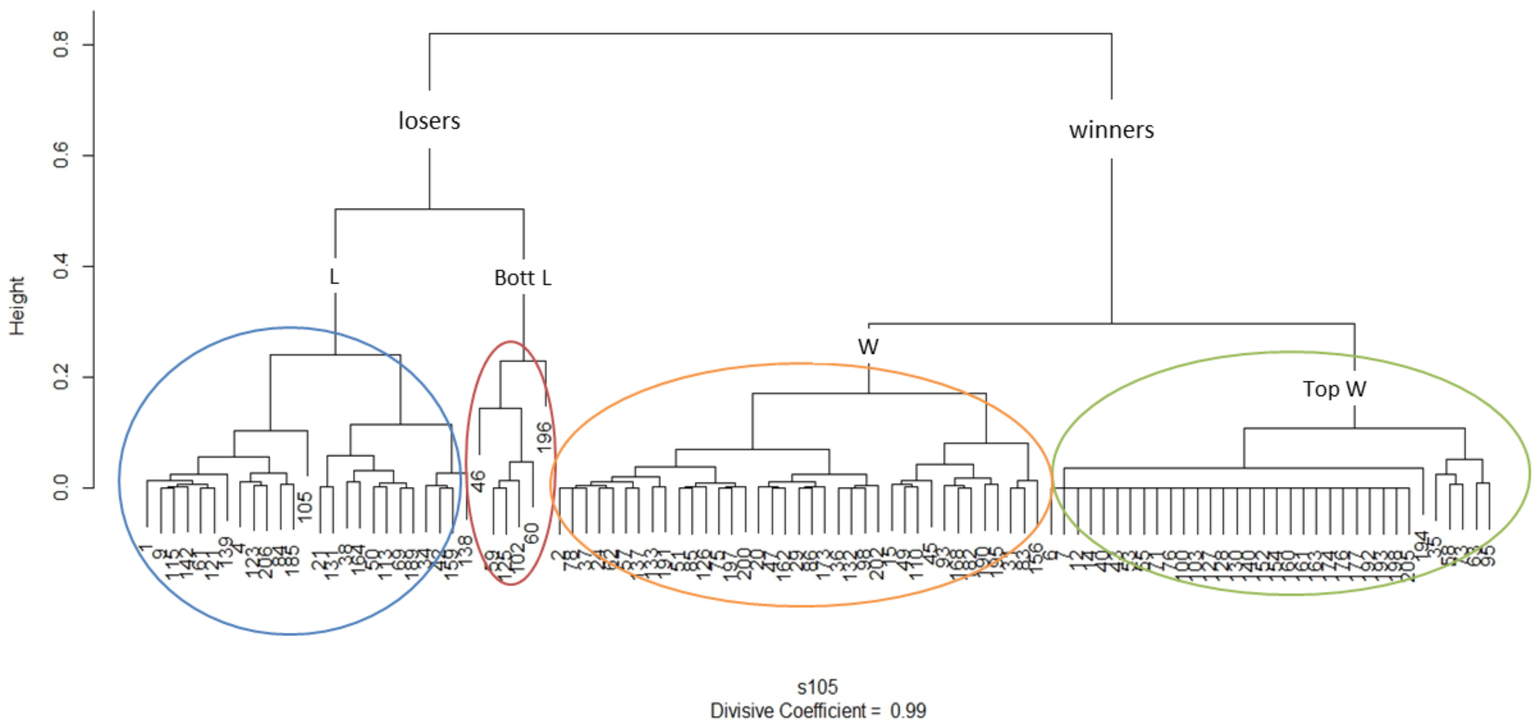
| Year | MMS | Clusters | Total Companies | Globally Efficient | Globally Inefficient | Locally Efficient |
|---|---|---|---|---|---|---|
| 2005 | Stage 1 | 1 | 2 | 2 | 0 | 0 |
| | | 2 | 5 | 1 | 4 | 4 |
| | | 3 | 16 | 1 | 15 | 12 |
| | | 4 | 3 | 1 | 2 | 2 |
| | | 5.1 | 10 | 6 | 4 | 2 |
| | | 5.2 | 12 | 3 | 9 | 3 |
| | | 5.3 | 54 | 14 | 40 | 3 |
| | Stage 2 | 1 | 2 | 0 | 2 | 0 |
| | | 2 | 5 | 0 | 5 | 0 |
| | | 3 and 4 | 19 | 0 | 19 | 0 |
| | | 5 | 76 | 7 | 69 | 0 |
| | Overall Eff. | 1 | 2 | 2 | 0 | 0 |
| | | 2 | 5 | 0 | 5 | 1 |
| | | 3 and 4 | 19 | 0 | 19 | 0 |
| | | 5 | 76 | 8 | 68 | 0 |
| 2006 | Stage 1 | 1 | 2 | 2 | 0 | 0 |
| | | 2 | 5 | 1 | 4 | 4 |
| | | 3 | 18 | 2 | 16 | 11 |
| | | 4.1 | 20 | 4 | 16 | 4 |
| | | 4.2 | 57 | 13 | 44 | 3 |
| | Stage 2 | 1 | 2 | 0 | 2 | 0 |
| | | 2 | 5 | 0 | 5 | 0 |
| | | 3 | 18 | 0 | 18 | 0 |
| | | 4 | 77 | 8 | 69 | 0 |
| | Overall Eff. | 1 | 2 | 1 | 1 | 0 |
| | | 2 | 5 | 0 | 5 | 1 |
| | | 3 | 18 | 1 | 17 | 2 |
| | | 4 | 77 | 6 | 71 | 1 |
| 2007 | Stage 1 | 1 | 2 | 2 | 0 | 0 |
| | | 2 | 4 | 1 | 3 | 3 |
| | | 3 | 19 | 3 | 16 | 11 |
| | | 4 | 70 | 15 | 55 | 5 |
| | Stage 2 | 1 | 2 | 0 | 2 | 0 |
| | | 2 | 4 | 0 | 4 | 0 |
| | | 3 | 19 | 0 | 19 | 0 |
| | | 4 | 70 | 6 | 64 | 0 |
| | Overall Eff. | 1 | 2 | 0 | 2 | 0 |
| | | 2 | 4 | 0 | 4 | 0 |
| | | 3 | 19 | 1 | 18 | 1 |
| | | 4 | 70 | 5 | 65 | 1 |
| 2008 | Stage 1 | 1 | 3 | 3 | 0 | 0 |
| | | 2 | 4 | 1 | 3 | 3 |
| | | 3 | 17 | 2 | 15 | 10 |
| | | 4 | 69 | 7 | 62 | 3 |
| | Stage 2 | 1 | 3 | 0 | 3 | 0 |
| | | 2 | 4 | 0 | 4 | 0 |
| | | 3 | 17 | 0 | 17 | 0 |
| | | 4 | 69 | 2 | 67 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Overall Eff. | 1 | 3 | 0 | 3 | 1 |
| | | 2 | 4 | 0 | 4 | 0 |
| | | 3 | 17 | 1 | 16 | 2 |
| | | 4 | 69 | 4 | 65 | 0 |
| 2009 | Stage 1 | 1 | 3 | 1 | 2 | 1 |
| | | 2 | 4 | 2 | 2 | 2 |
| | | 3 | 14 | 1 | 13 | 13 |
| | | 4 | 74 | 16 | 58 | 1 |
| | Stage 2 | 1 | 3 | 1 | 2 | 0 |
| | | 2 | 4 | 0 | 4 | 3 |
| | | 3 | 14 | 0 | 14 | 0 |
| | | 4 | 74 | 6 | 68 | 0 |
| | Overall Eff. | 1 | 3 | 0 | 3 | 0 |
| | | 2 | 4 | 0 | 4 | 0 |
| | | 3 | 14 | 1 | 13 | 1 |
| | | 4 | 74 | 4 | 70 | 0 |

Highlighted in grey we can see that whole the sample of globally inefficient companies become in locally efficient.

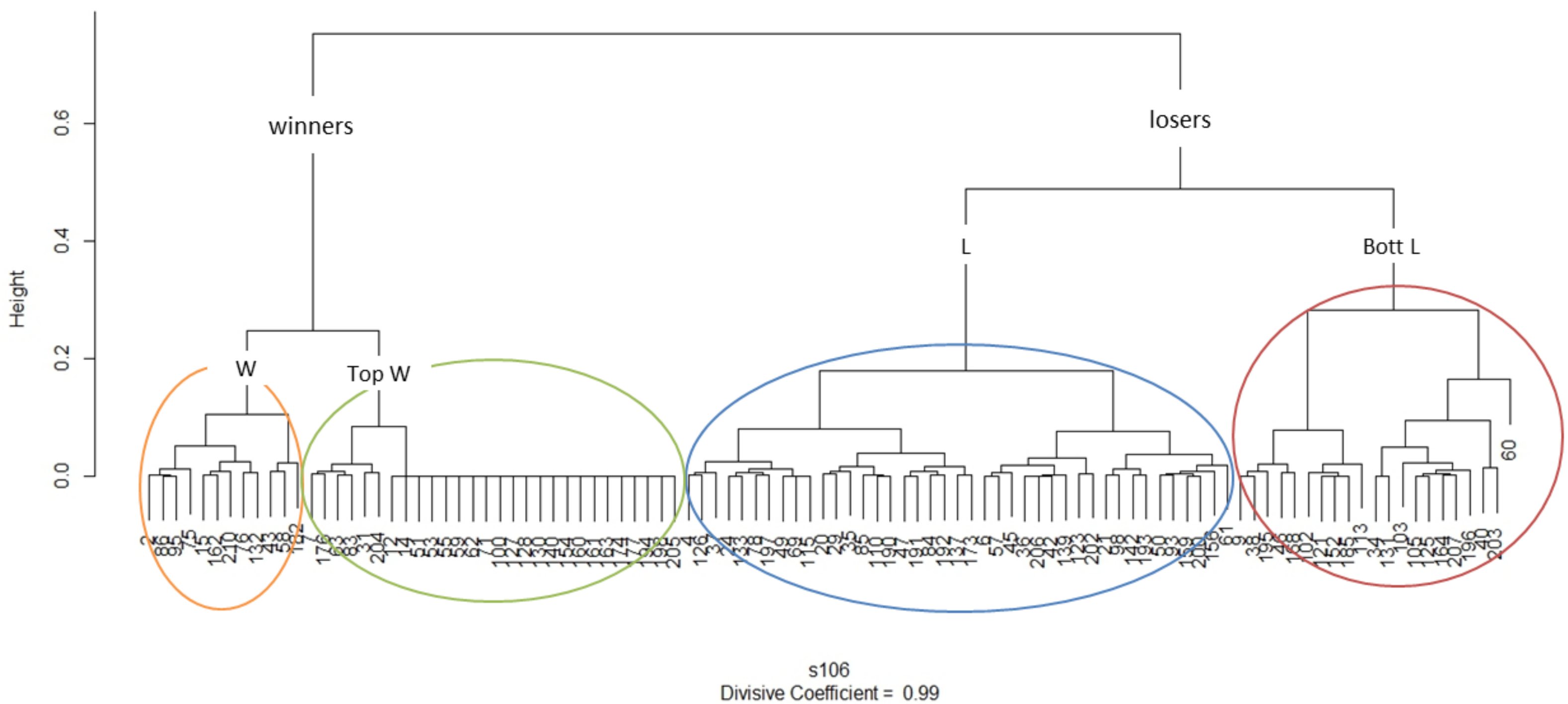
# Appendix M

**Figure II-M-1** Dendrogram DIANA of efficiency scores for stage 1 of 2005



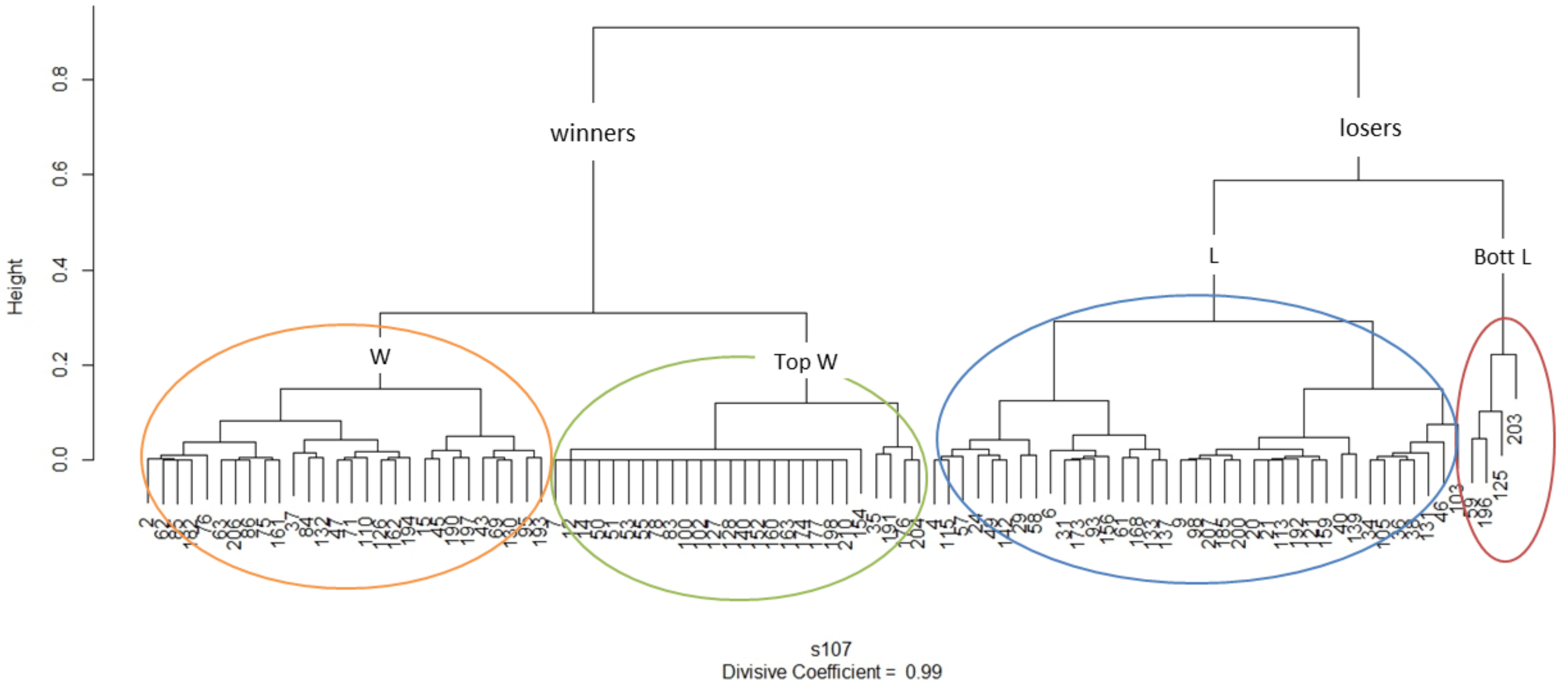

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-2** Dendrogram DIANA of efficiency scores for stage 1 of 2006



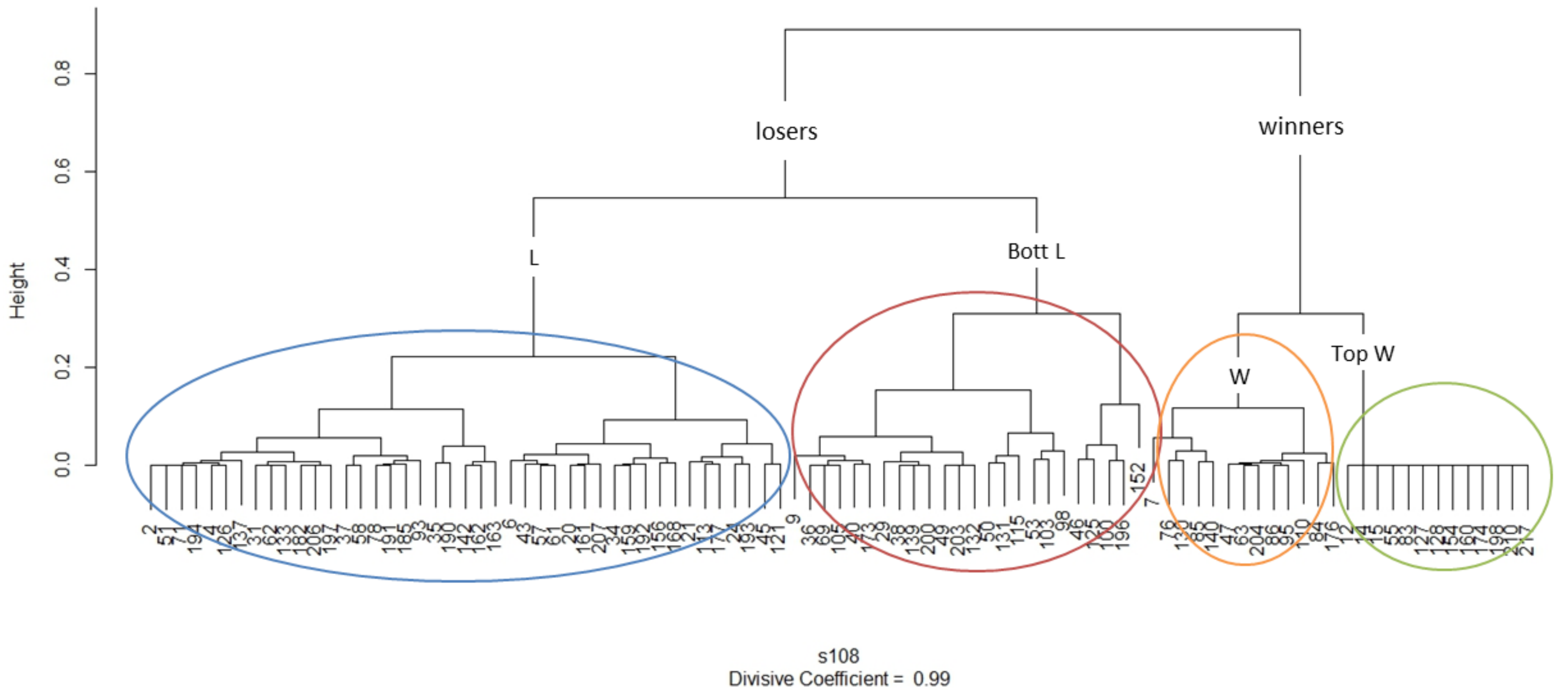

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n}\iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-3** Dendrogram DIANA of efficiency scores for stage 1 of 2007



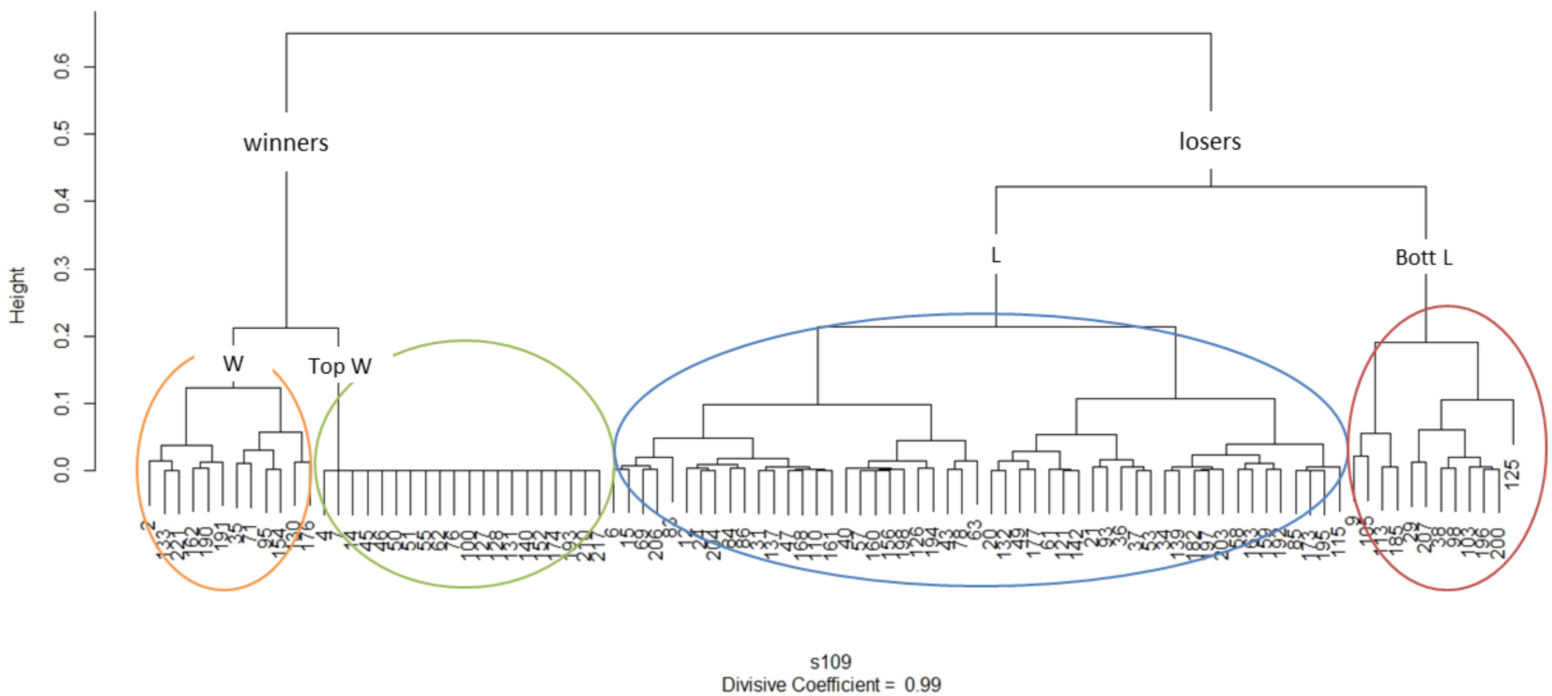

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-4** Dendrogram DIANA of efficiency scores for stage 1 of 2008



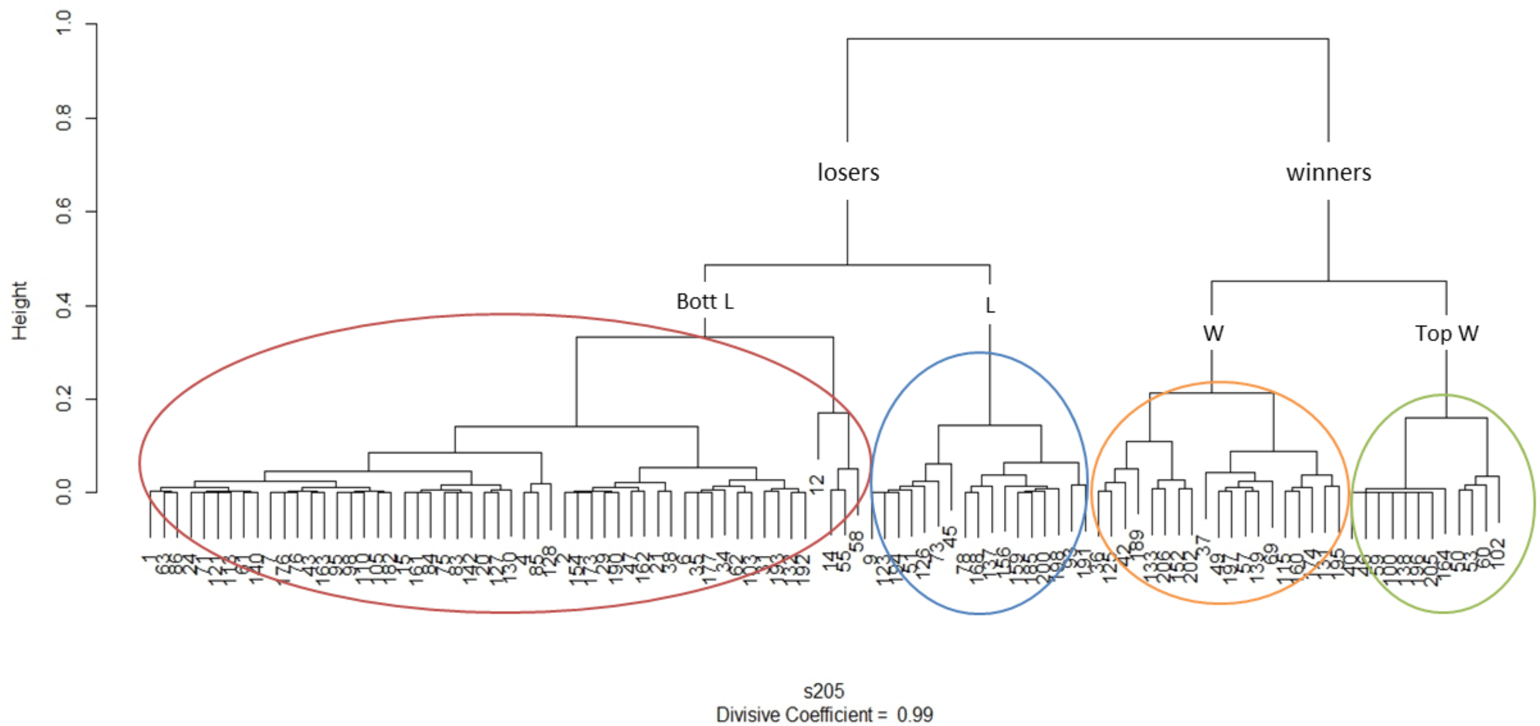

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-5** Dendrogram DIANA of efficiency scores for stage 1 of 2009



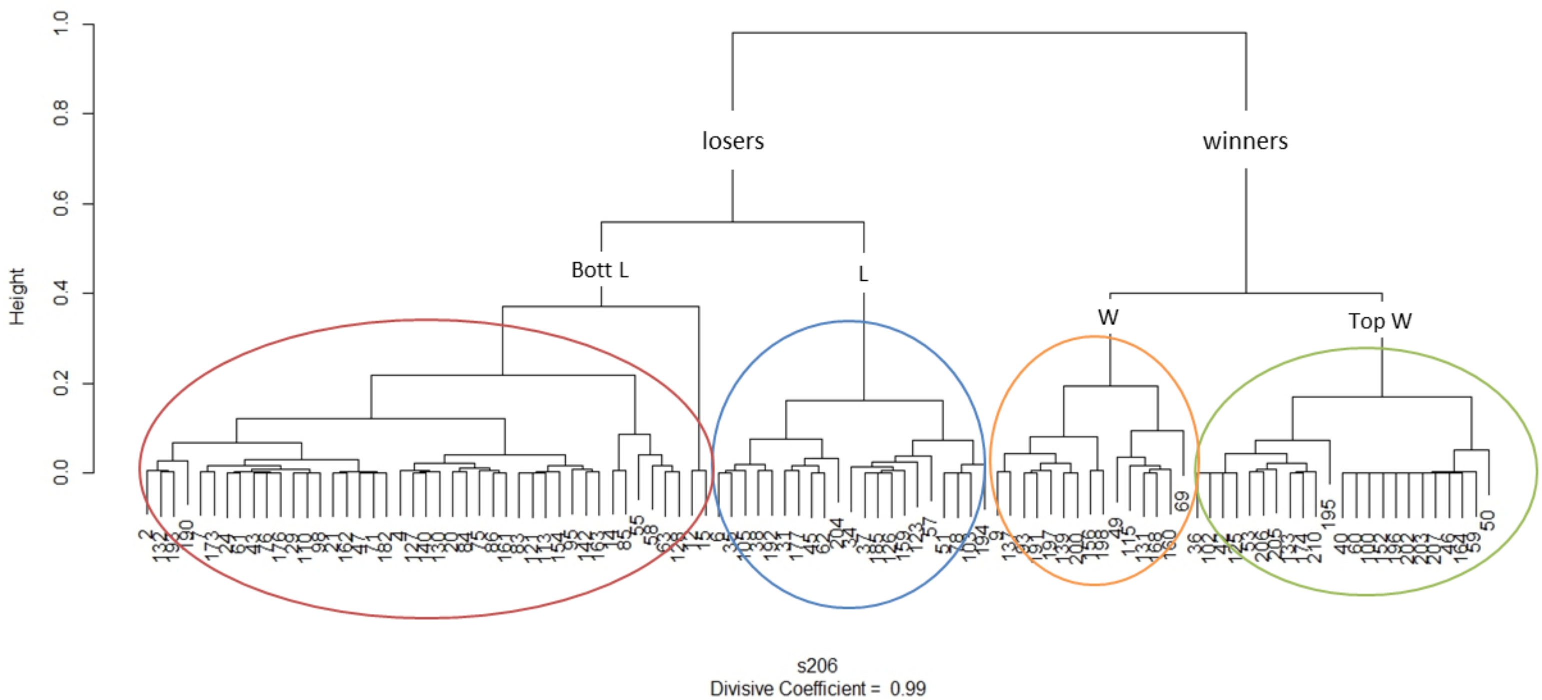

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-6** Dendrogram DIANA of efficiency scores for stage 2 of 2005



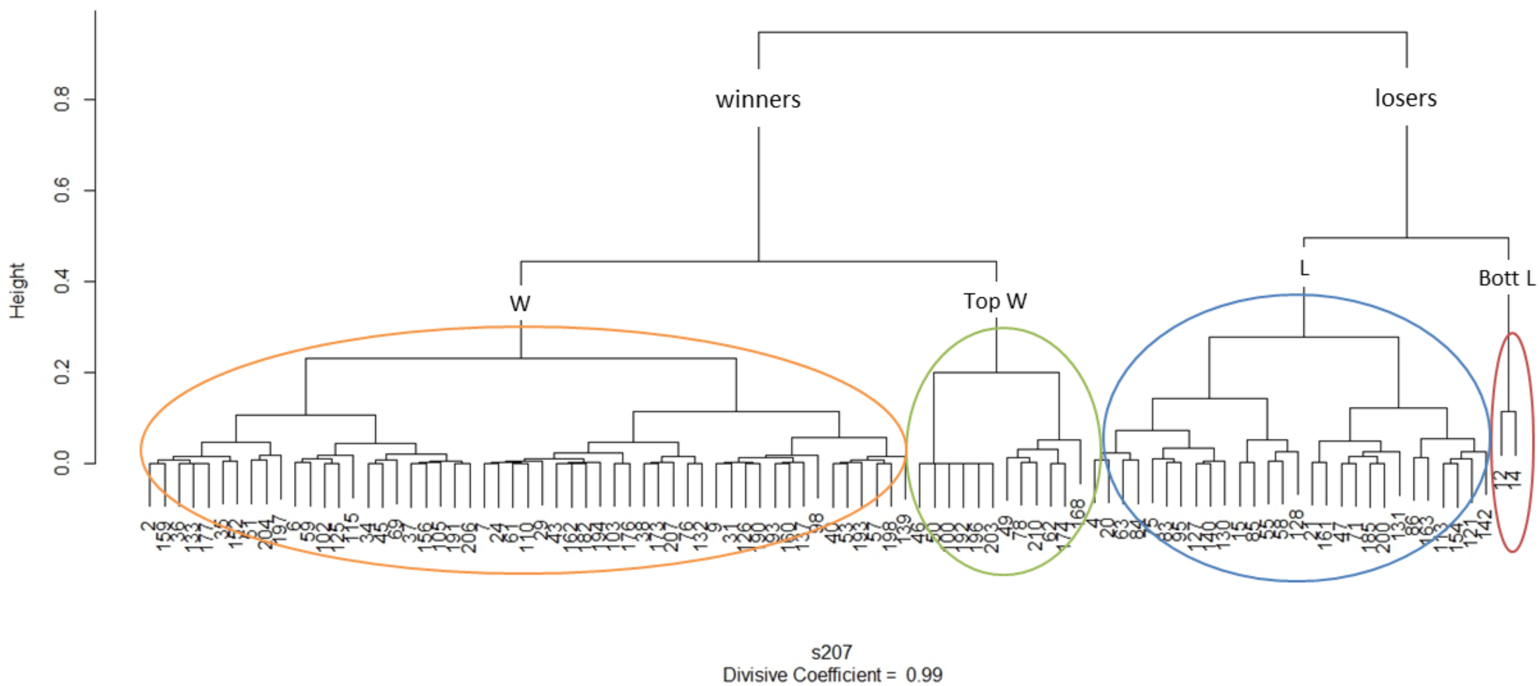

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-7** Dendrogram DIANA of efficiency scores for stage 2 of 2006



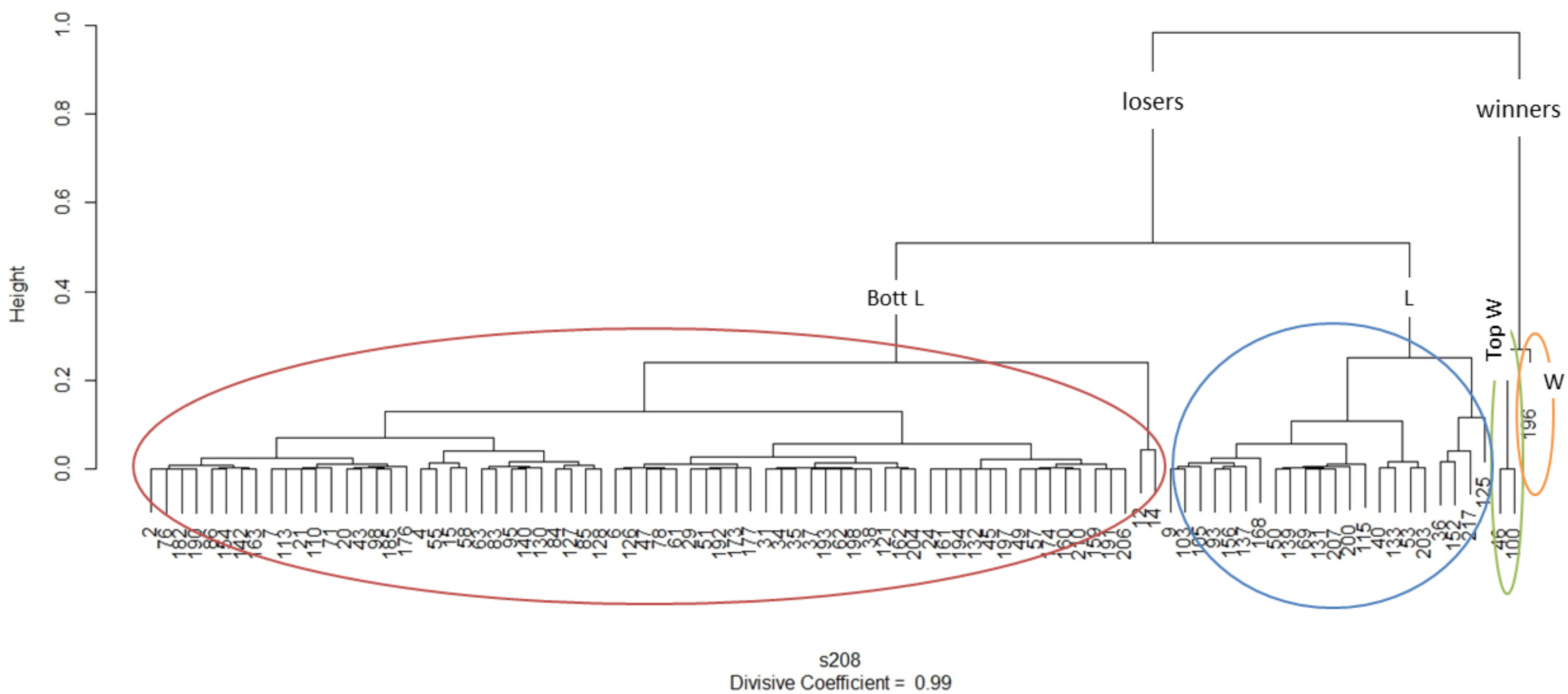

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-8** Dendrogram DIANA of efficiency scores for stage 2 of 2007



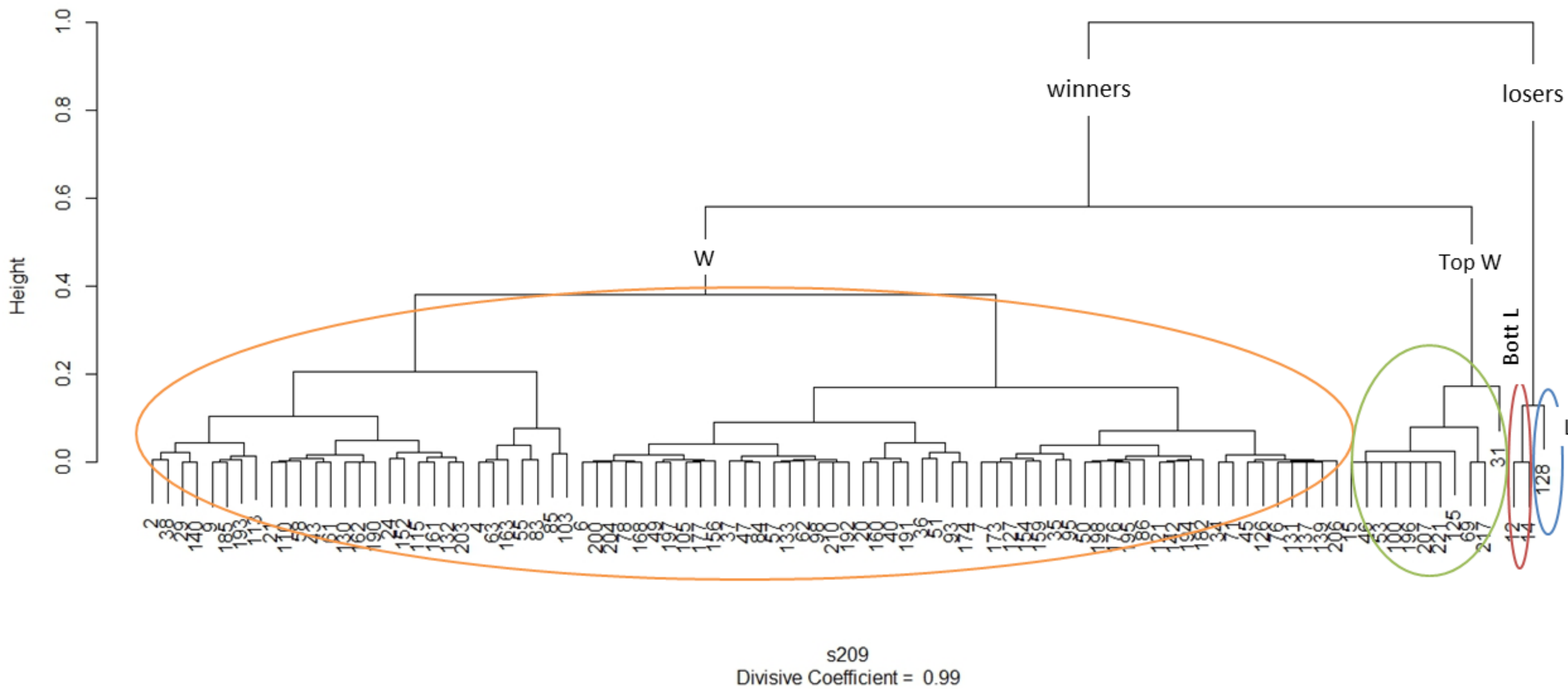

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). "winners" = cluster of the companies with best efficiency scores, "losers" = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; "Top W" = cluster of the companies with top efficiency scores, "W" = cluster of the companies with high efficiency scores, "Bott L" = cluster of the companies with bottom efficiency scores, "L" = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-9** Dendrogram DIANA of efficiency scores for stage 2 of 2008



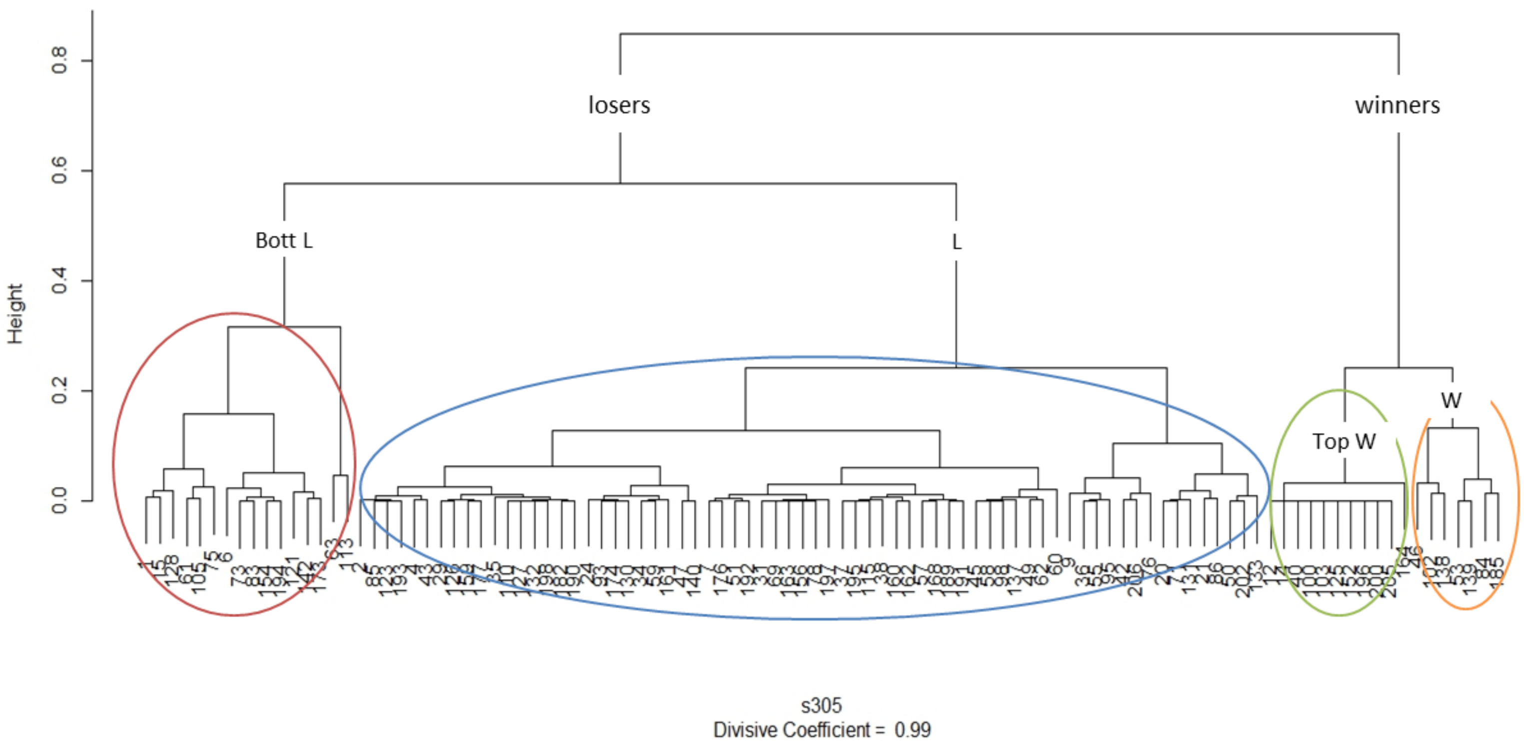

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-10** Dendrogram DIANA of efficiency scores for stage 2 of 2009



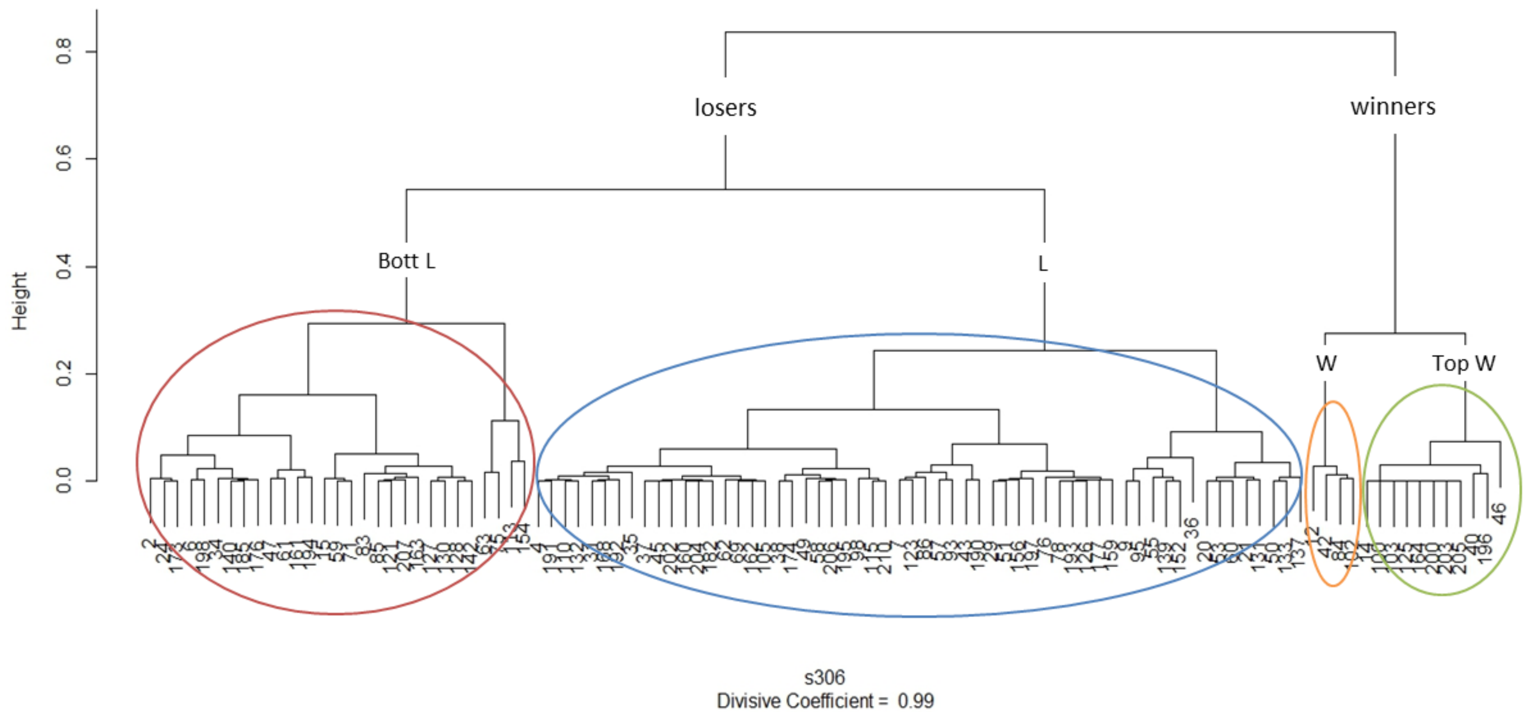

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-11** Dendrogram DIANA of efficiency scores for overall efficiency of 2005



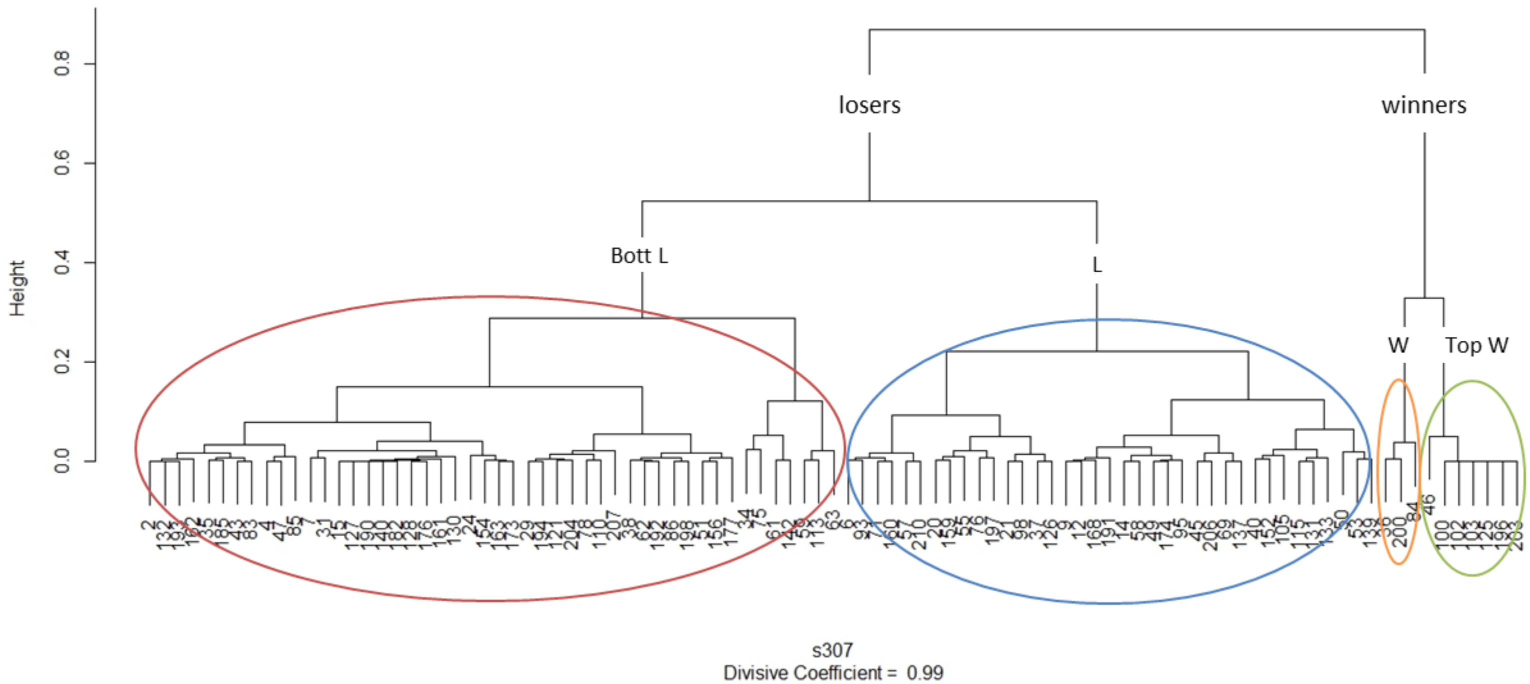

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-12** Dendrogram DIANA of efficiency scores for overall efficiency of 2006



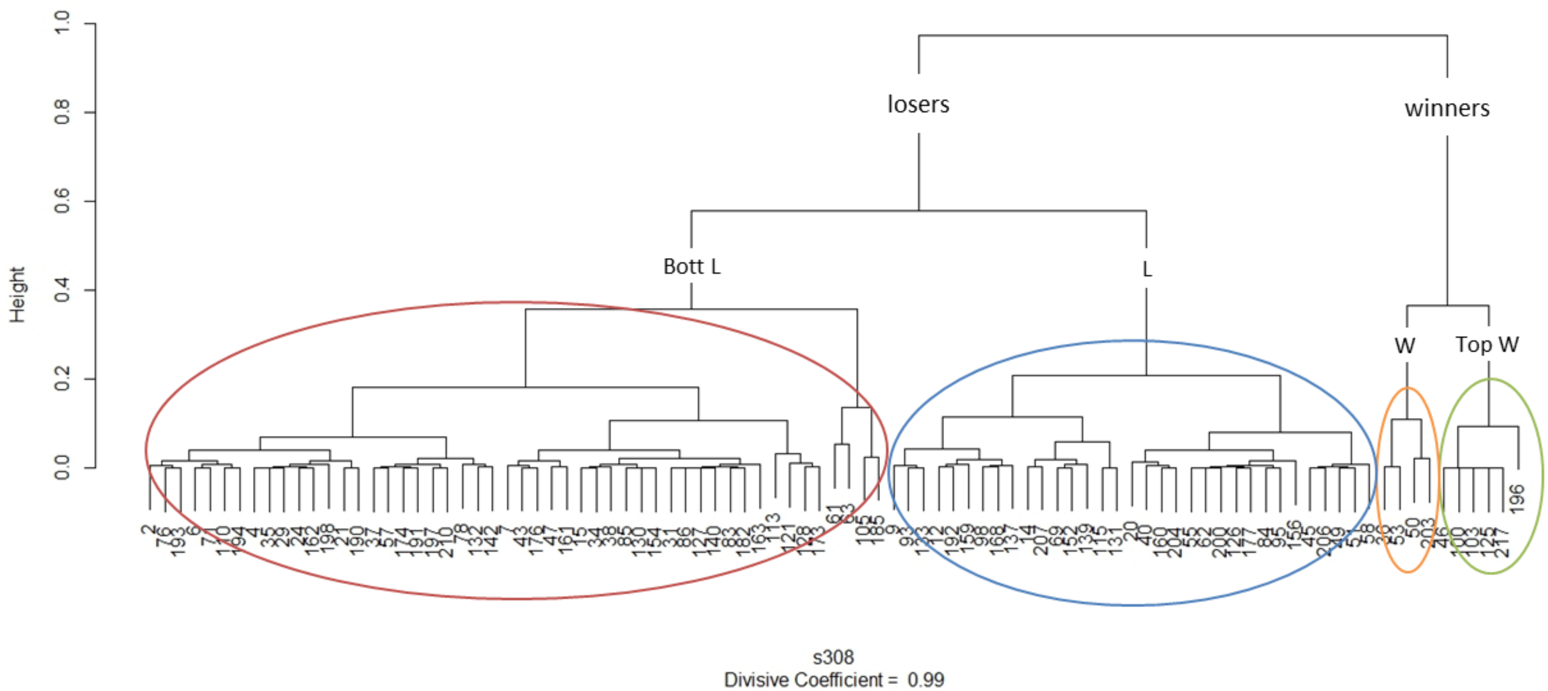

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-13** Dendrogram DIANA of efficiency scores for overall efficiency of 2007



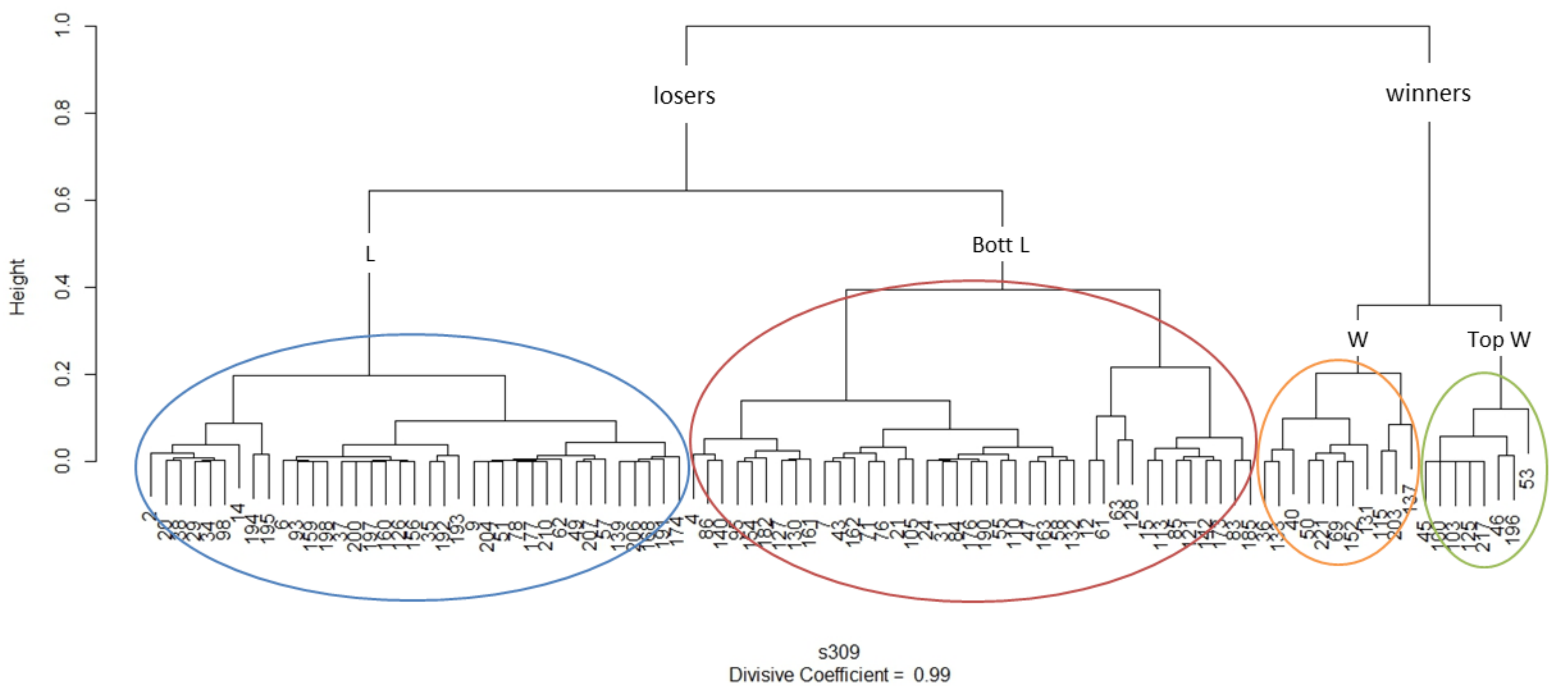

The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-14** Dendrogram DIANA of efficiency scores for overall efficiency of 2008




The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). "winners" = cluster of the companies with best efficiency scores, "losers" = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; "Top W" = cluster of the companies with top efficiency scores, "W" = cluster of the companies with high efficiency scores, "Bott L" = cluster of the companies with bottom efficiency scores, "L" = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

**Figure II-M-15** Dendrogram DIANA of efficiency scores for overall efficiency of 2009




The code classified is the identifying number of the mutual fund management company (Official registers, CNMV). “winners” = cluster of the companies with best efficiency scores, “losers” = cluster of the companies with poor efficiency scores, this last for 2x2 contingency tables; “Top W” = cluster of the companies with top efficiency scores, “W” = cluster of the companies with high efficiency scores, “Bott L” = cluster of the companies with bottom efficiency scores, “L” = cluster of the companies with low efficiency scores, this last for 4x4 contingency tables. Metric used was Manhattan. The Divisive Coefficient (DC) is defined by $DC = \frac{1}{n}\sum_{i=1}^{n} \iota(i)$. For each object $i$ it measures the length $\iota(i)$ of its line in the banner, with respect to normalized scale, i.e. all $\iota(i)$ lie between 0 and 1.

# Final conclusions and further research

The main conclusions and contributions of this dissertation are summarised in this section. The main objective of the thesis was to fill a gap in the financial literature and to shed additional light by analysing the efficiency of mutual fund companies in Spain, one of the most relevant fund industries in the Euro market. The important market concentration of Spanish mutual fund companies was a challenging feature in the effort to obtain an appropriate evaluation for this industry. In this industry, a few, very large and well-diversified Mutual Fund Management Companies coexist together with a huge number of small managers specialising in fund strategy by sector and/or geographical area. Therefore, the question arose as to how to select an accurate methodology and management variables to analyse appropriately so heterogeneous a set of Spanish mutual fund companies.

To address the above issues, the first part of the thesis presented a review of the early DEA efficiency literature, a brief explanation of the basic efficiency models and a review of major contributions for the financial industry, finishing with a discussion of the two most traditional approaches to measuring the efficiency of financial institutions. The study then incorporated an innovative model that includes three interacting management subsystems within a mutual fund company: *Portfolio Management*, *Marketing and Service*, and *Overall Efficiency*. This model provides a successful interaction between the inputs and outputs selected for the different units, thereby attempting to overcome the traditional debate between the production and intermediation approaches in banking and insurance companies. The application of a non-oriented frontier approach based in the slacks proposed by Tone (2001) has been discussed in detail and tested in the efficiency scores found in our sample based on the Mutual Fund Management Companies. The consistency of the efficiency results obtained using additional measures proved the robustness of the results.

The results provided evidence for the low impact of portfolio management abilities on the efficiency of the marketing and sales process of the mutual funds managed by the company. Furthermore, the results supported evidence that the best-managed funds are not the most efficient sellers of their products, thereby considerably reducing overall profits for shareholders. Analysing the influence of returns-to-scale, we found that size appears to be an important variable for successfully selling funds, which takes on more relevance in a concentrated market with heavy bank participation such as the Spanish fund industry.

As was explained, the DEA methodology and the following extensions fail to identify 'best practice' competitors who can serve as benchmarks of the companies analysed. This limitation could therefore limit the accuracy of some results in the previous literature. This is a relevant problem in industries where competitors show assorted characteristics, such as the Spanish fund industry. To provide a solution to the above problem, the second part of the thesis tries to overcome this limitation by using recent and unexplored variations of the original slacks-based measure (SBM) proposed by Tone (2010).

Thus, the second part of the thesis starts with a review of the major concepts of the SBM Variations. These variants were developed as a complementary methodology. Finally, we made a comparative analysis of the results of these variants with the original model. We then developed a study of persistence phenomena based on the previously found efficiency scores. Finally, those factors that might drive persistence results were analysed.

We do not find significant differences between the efficiency scores of the original SBM found in the first part and the SBM variations of the second part. Additionally, the results obtained using the more refined evaluation proposed by Tone (2010) in the SBM Variations model, i.e., based in the clustering process approach, showed evidence that an appropriate SBM evaluation of the *Portfolio Management stage* should consider homogeneous sets of companies with similar management resources. However, this issue appeared to be less important to both the *Marketing* and *Overall stages*.

Furthermore, we analysed whether the patterns of efficiency obtained were persistent over time using a non-parametric test. The results provided evidence of significant persistence in the efficiency records obtained by the companies in the different management stages. Additionally, analysing in more detail with 4x4 contingency tables, we found significant persistence of those companies included in the “Top Winners” and “Bottom Losers” clusters over several years. This finding indicated that the best-managed and worst-managed companies persist over time; this result was robust for the portfolio management and distribution of mutual funds as well as for the overall efficiency of the company as a whole. Otherwise, the study of the residuals of the main diagonals of the 4x4 contingency tables showed that the main diagonal of the *Overall Efficiency stage* provides positive and significant values in all years, indicating that the efficiency clusters remain quite similar without many changes. This finding indicated that the efficiency scores are unlikely to change to a very different efficiency cluster.

In the study of the effect of the companies’ resources on the different categories of persistence studied, we found a high persistence for the biggest companies located in the extreme cell of Top Winners–Top Winners for the *Portfolio Management stage*. Moreover, the aggregate concentration in the extreme cell of Bottom Losers–Bottom Losers shows not-significant differences in terms of some variables. An opposite pattern was found in the *Marketing and Service stage*, where size as a proxy for resources seems to play a significant and negative role in the persistence of the stage. The same pattern was also found in the *Overall Efficiency stage*, although the results are not so significantly clear for all persistence cells and variables. The above results suggest that the marketing and service of the fund companies considerably affects persistence of the overall efficiency of the companies.

In summary, the thesis contributes to the literature in several ways. First, we developed a brief but complete literature review of measures of efficiency and approaches commonly used in the literature. Based on different approaches to core competencies of the mutual fund companies, the study included an innovative model that considered multiple management stages. Within the DEA methodology, we applied a measure for the first time because basic concepts of the most sophisticated measure were developed recently. This allowed us overcome some of the limitations present in the frontier efficiency studies because of inappropriate benchmarking of the companies analysed. In addition, we found interesting results of the persistence phenomenon in the mutual fund industry that will contribute in several ways to the studies of efficiency in the fields of banking and insurance.

Several areas can be addressed in other further studies, such as the following: the use of alternative variables to measure the inputs and outputs that lead to an efficiency and productivity complementary analysis; developing a study with a different time horizon, which could consider analyses by sectors or by investment vocations; testing efficiency scores with other models or using parametric measures; or evaluating the productivity of companies over the time, and comparing these results with other sectors or other companies in the same industry.

# Resumen y Conclusiones

A continuación se presenta un resumen en español de la tesis doctoral con el fin de dar cumplimiento a la normativa de tesis doctorales escritas en otros idiomas de la Universidad de Zaragoza. El este apartado se dará una visión general de la tesis, sin entrar en detalles de la versión en inglés, y sin hacer extensivas referencias bibliográficas y/o insertar gráficos y tablas.

La tesis estuvo compuesta de dos partes principales. La primera titulada Eficiencia en las Empresas Españolas Gestoras de Fondos Mutuos: Enfoque Basado en los Slacks, estuvo compuesta de cuatro secciones o capítulos de la siguiente manera: La sección 2 ofreció una revisión de la literatura temprana del Análisis Envolvente de Datos (DEA), una breve explicación de los modelos básicos, una breve reseña de las principales contribuciones a la eficiencia en las instituciones financieras, y una discusión de los dos métodos más populares. La sección 3 describió el modelo teórico propuesto y las variables utilizadas en el análisis. Sección 4 ilustró los datos, el análisis empírico y los resultados, la influencia de las variables-retornos a escala, y los análisis de robustez. Finalmente, la sección 5 concluyó y resumió las principales conclusiones del estudio.

La segunda parte llamada Evaluación Adicional de la Eficiencia en las EGFMs, se compuso de tres secciones o capítulos, la sección 2 se examinaron los principales conceptos de las variaciones al enfoque SBM original y los resultados empíricos de estas variaciones en las EGFMs españolas. La sección 3 ilustró el fenómeno de la persistencia en los scores de eficiencia y determinó aquellos factores relevantes que podrían potencialmente conducir a los resultados de persistencia obtenidos por las empresas a lo largo de nuestro horizonte de estudio. Finalmente, la Sección 4 concluyó y resumió las principales conclusiones del estudio.

# Primera Parte de la Tesis

# Resumen

Desde principios de 1990 hasta mediados de 2007, la industria de fondos mutuos mostró un notable crecimiento en todo el mundo. La exitosa expansión implicó tanto la proliferación de fondos mutuos y empresas de gestión, como la creación de un gran número de fondos de inversión. Más tarde, cuando los mercados experimentaron la crisis financiera de las hipotecas sub-prime, la industria de fondos de inversión sufrió una disminución significativa en el total de activos bajo gestión, sobre todo en 2008, impulsado principalmente por una caída en las inversiones financieras de los hogares. Ello se debió a una mayor aversión al riesgo provocado por la alta volatilidad y a una caída de la confianza en los instrumentos financieros como consecuencia de la crisis. Este escenario del mercado detuvo la creación de nuevas empresas de gestión y en otros casos a su fusión o cierre, y por consiguiente a la reordenación del mapa competitivo de la industria. Por consiguiente la caída de activos bajo la administración de las gestoras, al igual que el número de inversores se explica no sólo por la mala imagen de los fondos de inversión, sino también por la falta de confianza en los mercados globales. En muchos casos, esta situación obligó a las instituciones financieras a repensar sus estructuras de producción y a la creación de nuevos productos no sólo por su propia iniciativa, sino también impulsados por las nuevas exigencias legislativas y normativas impuestas por las autoridades de supervisión que intentaban restaurar la confianza en los mercados financieros.

Más recientemente, los activos de fondos de inversión de todo el mundo han estado regresando lentamente a las cifras de éxito alcanzados antes de la crisis, es decir, $ 28.4 billones administrados en septiembre de 2012, lo que representó más de un tercio del PIB mundial. Por otro lado esta industria emplea a mano de obra calificada, tiene efectos indirectos en otros sectores, proporciona liquidez importante para el sistema financiero y da riqueza para los inversores minoristas e institucionales. El análisis de la eficiencia de la industria de fondos mutuos ha sido muy similar a la extensamente desarrollada en la banca y los seguros. Es claro afirmar que si los bancos y compañías de seguros son más productivos, entonces pueden obtener mejor rendimiento y ofrecer así productos nuevos y más seguros a sus clientes con precios más bajos. De acuerdo con este argumento, las Empresas de Gestoras de Fondos Mutuos (EGFMs) deben trabajar para ofrecer una amplia gama de fondos de alto rendimiento con características diversas de inversión para los diferentes tipos de inversores, manteniendo las tasas y los gastos lo más bajo posible. Por lo cual la expansión de una apropiada gestión debe dar lugar a mayores niveles de eficiencia global en la industria de fondos mutuos. Es importante señalar que las actividades de los fondos de inversión reducen la exposición de los bancos, a economías de escala y por consiguiente a un aumento de rentabilidad, repercutiendo todo ello en la mejora de su rendimiento operativo (Gallo et al, 1996;. Asaftei, 2008).

El análisis de las diferencias de productividad entre las empresas en los últimos años podría hacer posible identificar el éxito o fracaso de las iniciativas de gestión y también puede poner de relieve las diferentes estrategias adoptadas por las empresas durante la crisis financiera.

En la literatura observamos que una amplia investigación se ha dedicado a la productividad en las instituciones financieras, por lo que sabemos, sólo Zhao Yue (2010) y Medeiros (2010) han estudiado la eficiencia de las empresas de fondos de inversión y compañías de fondos de pensiones, respectivamente. Por una parte, Zhao y Yue (2010) examinan la eficiencia de los fondos en china basados en sus competencias básicas, analizando tanto la inversión / investigación y los subsistemas de marketing / servicio. Mientras que Medeiros (2010) analiza los cambios en la productividad total de una muestra de empresas portuguesas de fondos de pensiones desde 1994 hasta 2007 a través las medidas DEA y el índice de Malmquist. Una posible explicación de esta escasa literatura puede ser la dificultad de identificar las variables específicas para la evaluación adecuada de estas empresas, sin llegar sólo a la réplica de los estudios anteriores centrados bancos y compañías de seguros. Desarrollar modelos de evaluación adecuados para las empresas de fondos de inversión para disponer de un abanico de posibilidades con variables específicas de la industria, complementaría los modelos analizados en otros sectores financieros. Por lo tanto, se convierte en un reto el desarrollar nuevas propuestas específicas para la industria de fondos, que consideren adecuada selección de inputs y outputs propios para las empresas gestoras en lugar de la simple replica de los modelos previamente estudiados en banca y seguros.

En el presente estudio se llena este vacío de la literatura financiera, pretendiendo arrojar una luz adicional mediante el análisis de la eficiencia de las empresas de fondos de inversión en España, la cual es una de las industrias de fondos más relevantes en el mercado Europeo. La coexistencia de pocas, muy grandes y bien diversificadas EGFMs, junto con un gran número de pequeños gestores especializados hace que sea difícil obtener evaluaciones apropiadas de la industria. Por lo tanto, se plantó una metodología propia para el estudio y una selección de variables específicas para analizar adecuadamente de modo heterogéneo el conjunto de empresas españolas del sector de fondos de inversión.

Para llevar a cabo el estudio, fue aplicado Análisis Envolvente de Datos (DEA), uno de los métodos más populares de las últimas décadas para la evaluación de la eficiencia en el sector financiero (ver por ejemplo estudios como los de: Berg et al, 1991; Berg et al, 1993 ; Schaffnit et al, 1997; Mlima y Hjalmarsson, 2002; Cummins et al, 2004; Casu et al, 2004; Cummins y Xie, 2008; Cummins et al, 2010; Holod y Lewis, 2011), y por otro lado el análisis de rendimiento de las carteras institucionales con enfoque alternativo a las tradicionales medidas de desempeño, es decir el desempeño de las carteras se trabajó con las relaciones funcionales entre rentabilidad y riesgo asociadas con la hipótesis de comportamiento (ejemplos de estudios: Murthi et al, 1997; Basso y Funari, 2001; Gregoriou et al, 2005; Eling, 2006; Lozano y Gutiérrez, 2008a, 2008b).

En esta primera parte del estudio se aplicó el modelo original (Tone, 2001) y un conjunto único de variables específicas propias para la industria de fondos que complementan los modelos tradicionales de la banca y los seguros, lo cual permitió una evaluación precisa y completa de la eficiencia global de las EGFMs.

Se utilizó este enfoque innovador para abordar una serie de cuestiones en relación con la eficiencia de las EGFMs en el mercado español y para discutir más a fondo las implicaciones de los resultados obtenidos en este análisis se plantearon las siguientes preguntas: ¿Cuáles son las etapas claves de gestión que impulsan la eficiencia de una empresa gestora de fondos mutuos?, Es robusta la eficiencia a través de las diferentes etapas de gestión dentro de una empresa gestora de fondos mutuos?, ¿Cómo afecta los resultados las escalas de eficiencia?

# Conclusiones

A nuestro entender, este estudio es el primer análisis de eficiencia en las EGFMs en una industria de fondos europeos relevante. Con base en el enfoque de sub-DMU de Holod y Lewis (2011), la tesis desarrolla un modelo que incluye tres subsistemas de gestión que interactúan dentro de una EGFMs originalmente propuestas por Berkowitz y Qiu (2003): Gestión de la Cartera, Marketing y Servicio, y Eficiencia Global. La interacción entre los inputs y outputs de las diferentes etapas trata de superar el debate tradicional entre el enfoque basado en la producción y el enfoque de la intermediación en el sector financiero, sobre todo en las empresas bancarias y de seguros.

Discutimos un conjunto específico de variables que se incluyeron en el modelo de subsistemas-múltiples. Las medidas de estas variables no fueron una sencilla repetición de los inputs / outputs tradicionalmente considerados en los estudios de banca y seguros, ya que fue necesario tener en cuenta las características particulares de las empresas de fondos para desarrollar un modelo adecuado. La consistencia de los resultados de eficiencia obtenidos utilizando diferentes medidas para las variables demostró robustez en nuestros resultados.

La aplicación de un enfoque de frontera eficiente no-orientado basado en los Slacks (SBM) propuesto por Tone (2001) se discutió en detalle para justificar su como una herramienta adecuada para obtener los scores de eficiencia de las EGFMs.

Los scores de eficiencia demostraron el bajo impacto de la capacidad de gestión de carteras en la eficiencia del proceso de comercialización y venta de los fondos de inversión gestionados por la empresa. Por otra parte, los índices de eficiencia más bajos se encontraron en la etapa de comercialización y venta y ello pareció afectar a los beneficios totales reportados a los accionistas de la compañía. Es decir, los resultados apoyan la evidencia de que los fondos mejor administrados no son vendidos de manera más eficiente en la etapa comercialización de las empresas, lo que redujo considerablemente la eficiencia global de las mismas. Este importante hallazgo de esta primera parte es bastante robusto considerando los efectos de escala en las empresas y a lo largo de todos los años considerados en nuestro horizonte de análisis. Sin embargo, la influencia de los retornos a escala sugirió que el tamaño parece ser una variable importante para el éxito la venta de fondos. Este problema es especialmente relevante en un mercado concentrado, con participación amplia de la banca, como es la industria de fondos española.

# Segunda Parte de la Tesis

# Resumen

La aplicación de un enfoque de frontera eficiente no-orientado utilizando el SBM dentro de la metodología DEA, propuesto por Tone (2001), se discutió en detalle en la Parte I para justificar esta técnica como una herramienta inicial y apropiada para obtener los índices de eficiencia de las EGFMs. La consistencia de los resultados de eficiencia obtenidos mediante el uso de diferentes medidas de las variables más polémicas incluidas en nuestro modelo demostró la solidez de nuestros resultados. Sin embargo, el DEA y sus diversos modelos no pueden identificar a los competidores «más similares» que pueden servir como punto de referencia para las empresas analizadas a la luz de las diferencias notables que potencialmente se encuentren entre las empresas evaluadas. Este aspecto podría limitar la exactitud de algunos resultados en la literatura, además es especialmente importante en aquellos sectores donde los competidores muestran características variadas, tales como la industria de fondos española. Por lo cual, el conjunto empresas que conforman la frontera eficiente del DEA puede estar formado por grandes empresas de fondos de propiedad de bancos y ello puede no ser una referencia adecuada para los pequeños gestores independientes, repercutiendo entonces en engañosos rankings de eficiencia.

En segunda parte de la tesis, logramos superar esta limitación utilizando las variaciones recientes e inexploradas del SBM original, propuestas por Tone (2010). Estas variaciones permitieron la comparación de las empresas de fondos con los competidores de su verdadera referencia «más similares» de acuerdo con los recursos y los objetivos de gestión, logrando con ello trabajar con las diversas características de la industria de los fondos de inversión españoles. Como un primer paso para cuantificar el sesgo debido a la utilización de los conjuntos de referencia inadecuados de los competidores, se analizó el efecto de las mencionadas variaciones en los scores de eficiencia obtenidos por el SBM original. La aplicación de estas nuevas técnicas del SBM mejoró la precisión de los resultados y complementó la simple consideración de los retornos a escala variable (VRS) para evaluar la eficiencia de las DMUs con diferentes características de escala. Estas variaciones propuestas por Tone (2010)  basan en los hiperplanos en lugar de los vértices de la frontera, lo le permite el método descubrir los competidores (facets) más adecuados con respecto cada DMU analizada.

Por último, la aplicación del proceso de agrupamiento (clustering) propuesto por Tone (2010), nos permitió una evaluación refinada de empresas eficientes, centrando el análisis únicamente en los competidores de similares características. Nuestra propuesta de agrupamiento se basó en los activos administrados y esfuerzo en personal de las EGFMs, ya que, como se encontró en la Parte I (Cuadro I-3), un gran número de empresas pequeñas de fondos gestionan una cuota de mercado residual y por otro lado un número reducido de grandes empresas de fondos dominan la industria. Bajo estos criterios de agrupamiento, asumimos la hipótesis de que las empresas de fondos con tamaño homogéneos deberían tener las mismas oportunidades de alcanzar la eficiencia en todas las fases de gestión, resolviendo así los posibles efectos de escala en la etapa de distribución y comercialización que se hayan contemplado en la Parte I. Adicionalmente el uso de esta variación basada en agrupamientos de Tone (2010) permitió la identificación de las empresas localmente eficientes en relación con los competidores con características similares de agrupamiento.

Adicionalmente se planteó la necesidad de comprobar en esta segunda parte del estudio si los patrones de eficiencia obtenidos por las técnicas anteriores son persistentes en el tiempo, es decir, si los resultados de eficiencia obtenidos por las diferentes etapas corresponden a patrones estables del proceso de gestión. De lo contrario, si los resultados de eficiencia estuvieron sujetos a una variabilidad considerable a lo largo del tiempo, que pondría en duda las conclusiones obtenidas para cada año y en determinadas EGFMs; es decir, no sería posible diferenciar las estrategias de gestión eficaces de otros factores temporales. El resultado buscado fue la separación de aquellas empresas que siguen claramente los patrones de gestión eficientes de otras empresas con resultados de gestión mucho más erráticos en relación con sus competidores. Este fenómeno de persistencia se ha debatido ampliamente en la literatura sobre los fondos de inversión, pero, hasta donde sabemos, nunca aplicado a las EGFMs. Para probar esta hipótesis, se utilizó un enfoque no paramétrico basado en grupos de eficiencia en lugar de corrientes cuartiles o quintiles de clasificación empleados en la literatura, ello nos permitió identificar grupos homogéneos de eficiencia para proporcionar una mayor fiabilidad a nuestras conclusiones.

Por último, en esta segunda parte de la tesis se identificaron los principales factores que parecen para conducir a los resultados de eficiencia de las EGFMs. Este estudio toma especial importancia en mercados financieros con los competidores y características variadas, tales como la industria de fondos española.

# Conclusiones

Con base en el enfoque de sub-DMUs de Holod y Lewis (2011) y teniendo en cuenta la interacción entre los diferentes subsistemas de gestión dentro de una EGFMs propuestas por Berkowitz y Qiu (2003), la primera parte de la tesis se evaluó la eficiencia de las EGFMs españolas mediante la aplicación de la medida basada en el enfoque de holgura (SBM), propuesto por Tone (2001). En esta segunda parte, se llegó más allá mediante el desarrollo de un estudio que supera la limitación de tomar un conjunto de referencia como identificación adecuada para el universo de empresas evaluadas. Vimos como este problema es especialmente importante en la industria de fondos española debido tanto a la alta concentración como a las características variadas las EGFMs. Se utilizaron para ello las variaciones inexploradas y recientemente propuestas por Tone (2010) en el modelo SBM, ello nos permitió comparar las EGFMs con sus verdaderos competidores «más similares» que contaban con recursos de gestión equivalentes.

Se analizaron los efectos de estas variaciones (sobre la base de los hiperplanos en lugar de los vértices de la frontera eficiente) basados en los scores de eficiencia previamente obtenidos por el SBM originales. En primer se encontró que la Variación I mejora los scores medios de eficiencia (scores) para cada etapa (subsistemas-múltiples planteados) como consecuencia del nuevo enfoque, aunque el rango de correlación de Spearman para ambos SBM y Variación I fue cercano a 1 para cada etapa y año analizado. Por otro lado, las comparativas para la etapa de comercialización y etapa de eficiencia global proporcionaron evidencia del alto grado de similitud entre los scores del SBM original y la Variación I; es decir, se encontró evidencia del efecto residual de Variación I en los scores de eficiencia de SBM originales obtenidos previamente. El hallazgo mencionado plantea preguntas acerca de la relevancia de esta variante en los resultados empíricos de nuestro estudio.

De manera similar a los hallazgos de SBM original, los scores de eficiencia de la Variación I también muestran un patrón de eficiencia decreciente en el sector de los fondos españoles. En la misma línea, esta variación destaca el hecho de que las empresas parecen ser peores vendiendo de fondos mutuos que gestionando sus carteras, lo que reduce considerablemente las ganancias generales de accionistas de las compañías.

Continuando con las variaciones del SBM propuestas por Tone (2010), se aplicó SBM Variación II, la cual minimiza el score del SBM obtenido a partir de todas las “facets” que encontradas. SBM-Variación II se calculó utilizando los “maximal friends facets” obtenidas aleatoriamente (pasando a ser Variación IV) y por otra parte por la agrupación de la “facets” (pasando a ser Variación III) como se plantea en el modelo propuesto por Tone (2010). Por una parte la Variación IV mejora de nuevo los índices de eficiencia promedio para todas las etapas de gestión, mostrando de nuevo un alto y significativo rango de correlación de Spearman entre los rankings de eficiencia (SBM originales y Variación IV). Sin embargo, la correlación entre la variación de los rankings de la Variación I y IV, es algo menor que la existente entre SBM original y Variación I.

Por otro lado la Variación IV también mostró una relación positiva y significativa entre la capacidad de comercialización y distribución las empresas y la eficacia global para todo el horizonte de tiempo. Por lo tanto, esta nueva medida propuesta por Tone (2010) confirma los principales resultados obtenidos en la primera parte con el SBM original. Este resultado verifica la robustez de las conclusiones del primer estudio, como son la aparente dicotomía entre la eficiencia de la gestión de las carteras y de la capacidad de comercialización de la industria de fondos de inversión española.

Adicionalmente se realizó una búsqueda refinada de las empresas localmente eficientes dentro de los grupos encontrados (Variación III), ello realizado con base en la técnica jerárquica divisiva y bajo diferentes dimensiones de medición (activos gestionados y número de empleados de cada EGFMs). Este enfoque nos permitió encontrar algunas evidencias vinculadas a que la adecuada evaluación en la etapa de gestión de carteras, debe considerar conjuntos homogéneos de empresas con recursos de gestión similares. Por lo tanto, cuando las empresas de referencia incluidas en la frontera eficiente no pertenecen al mismo grupo que la empresa objetivo, los scores del SBM original podrían estar sesgados.

El análisis de la persistencia en el tiempo de los scores de eficacia obtenidos, por medio de un enfoque innovador y completo debido a la inclusión de grupos de eficiencia consistentes en lugar de la sencilla consideración de la mediana o cuartil con igual número de empresas, nos permitió encontrar evidencia de persistencia. En primer lugar, con el uso de tablas de contingencia 2x2, se halló un fenómeno importante de la persistencia en los grupos de eficiencia, tanto en la etapa de gestión de cartera como en la etapa eficiencia global, aunque se observó menos importancia entre 2008 y 2009. La prueba de Cochran también confirmó esta evidencia para todo el período 2005-2009. Estos hallazgos apoyan la hipótesis subyacente de que las empresas que gestionan sus fondos de inversión mejor que sus competidores suelen ser los mismos durante todo el horizonte de tiempo analizado. Estas conclusiones también podrían extenderse a aquellas empresas con scores de eficiencia peores que sus competidores.

En cuanto a la persistencia en la etapa de comercialización y distribución, los resultados mostraron la persistencia significativa para los dos primeros períodos comparativos (2005-2006, 2006-2007). Sin embargo, se observó falta de persistencia en 2007-2008 y 2008-2009, lo que pudo haber sido impulsado por las consecuencias de la crisis financiera.

Por otra parte, las tablas de contingencia 4x4 proporcionaron pruebas de una persistencia significativa en los scores de eficiencia obtenidos por las empresas en las diferentes etapas de la gestión. Encontramos un significativo valor de la prueba chi-cuadrado para todos los períodos comparativos y para cada EGFMs. Además, encontramos persistencia significativa tanto de las mejores y peores empresas en dos años consecutivos. Este resultado es robusto para la etapa de gestión de cartera y para la etapa de distribución y comercialización, así como para la eficiencia global de las empresas en su conjunto. Un análisis más detallado de los residuos de estas tablas de contingencia 4x4 indica que los índices de eficiencia tienen poca probabilidad de cambio a un clúster de eficiencia muy diferente.

Adicionalmente se ha encontrado que el tamaño (recursos gestionados) parece jugar un papel positivo y significativo en la persistencia de la etapa de gestión de cartera en las mejores EGFMs. Este resultado fue consistente en cuanto al número de empleados, los activos de cada empresa, el patrimonio y la cantidad de fondos ofrecidos. Por otra parte, encontramos que las empresas con menos recursos de gestión son consistentemente las peores EGFMs, especialmente en términos de número de fondos y activos administrados.

Un patrón opuesto fue encontrado en la etapa de comercialización y servicio, donde el tamaño, como “proxy” de los recursos, parece jugar un papel negativo y significativo en la persistencia de esta etapa. Por lo tanto, cuanto más grande es una empresa, más problemas tiene vendiendo y distribuyendo eficientemente sus fondos de inversión. Este resultado es robusto en términos de número de empleados, de los activos, del patrimonio y de la cantidad de fondos. Es de destacar que el mismo patrón se encuentra también en la etapa de eficiencia global, aunque los resultados no son tan significativamente claros para cada celda y variable. Lo anterior podría adicionalmente sugerir que la comercialización de las EGFMs también está afectando considerablemente la persistencia de la eficiencia global de las empresas.

Por último, observando con más detalle la diferencia en los recursos de gestión de los diferentes grupos de persistencia extrema (Top de ganadores y los más bajos perdedores), encontramos resultados robustos con los proporcionados por las comparaciones anteriores, lo que sugiere que las empresas con más recursos son mejores en la gestión de su cartera que en la venta de las mismas, y por lo tanto generan un impacto importante en los niveles de eficiencia general. Las diferencias en estas categorías de persistencia extrema son de significativa importancia la etapa de comercialización y servicio.

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