ESTUDIOS DE ECONOMÍA APLICADA VOL. 23 - 2, 2005. PÁGS. 495-506

Are Style Factors exclusive, exhaustive and independent in Spanish Domestic Equity Funds?

FERRUZ AGUDO, LUIS* y VICENTE GIMENO, LUIS A.**

[*]University of Zaragoza, Spain, Faculty of Economics and Business Studies, Department of Accounting and Finance

C/ Gran Vía, 2, 50005 – Zaragoza (Spain). E-mail: [*]lferruz@unizar.es ; [**] lavicent@unizar.es

ABSTRACT

This paper is an approach to the management styles followed by Spanish mutual funds investing in domestic equities. The methodology applied is based on Sharpe's Style Analysis proposed in 1992.

Sharpe establishes three conditions for the explanatory factors used in this method if the results are to be meaningful: 1)exclusive benchmarks, 2)exhaustive benchmarks and 3)independent benchmarks

The results show that the benchmarks used in the more exhaustive models are not sufficiently independent in the Spanish case to obtain statistically significant management styles.

Keywords: style analysis, investment funds, benchmarks

¿Son los factores de estilo exclusivos, exhaustivos e independientes en los fondos de inversión españoles de renta variable macional?

RESUMEN

Este trabajo es una aproximación a los estilos de gestión desarrollados por los fondos de inversión españoles en renta variable nacional. La metodología aplicada está basada en el análisis de estilos propuesto por Sharpe en 1992.

Sharpe exige tres características a los factores explicativos utilizados en este método con el objeto de que los resultados sean significativos: 1) exclusividad, 2) exhaustividad e 3) independencia.

Los resultados muestran que para el caso español, los índices utilizados en los modelos más exhaustivos no son lo suficientemente independientes para obtener estilos de gestión estadísticamente significativos.

Palabras Clave: Análisis de estilos, Fondos de inversión, Índices de referencia.

Clasificación JEL: G11, G23

Artículo recibido en noviembre de 2004 y aprobado en abril de 2005.

Artículo disponible en versión electrónica en la página www.revista-eea.net, ref.: e-23207.

ISSN 1697-5731 (online) – ISSN 1133-3197 (print)

1.INTRODUCTION

The "style analysis" approach originally proposed by Sharpe (1988, 1992) builds a model that reflects mutual fund strategies without requiring data on the historical portfolio holdings. The basic elements used in modelling are the historical returns obtained by the fund and the returns of representative benchmarks for the basic asset classes included in the portfolio.

The return for a given portfolio is thus described by the expression:

$$\tilde{R}_{p,t} = \left[b_{p,1} \cdot \tilde{I}_{1,t} + b_{p,2} \cdot \tilde{I}_{2,t} + \cdots + b_{p,n} \cdot \tilde{I}_{n,t}\right] + \tilde{e}_{p,t} \qquad \textbf{(1)}$$

Where:

$\tilde{R}_{p,t}$ *i*s the actual return obtained by a portfolio p over a period t,

$\tilde{I}_{i,t}$ is the return on the benchmark for a given asset class i in period t,

$b_{p,i}$ is the percentage of the portfolio returns explained by the returns on the asset class *i*,

$\tilde{e}_{p,t}$ represents the residual component of the model.

Sharpe's style analysis model proposes that the best explanation of the return generated by the portfolio is given by the style factors $b_{p,i}$ which minimise the residual variance of the model, as conditioned by the restrictions that 100% of the portfolio be invested (portfolio constraint) and short positions excluded (positivity constraint).

$$Min \sum_{t=1}^{T} \tilde{e}_{pt}^2 = Min \sum_{t=1}^{T} (\tilde{R}_{pt} - (b_{p1} \cdot \tilde{I}_{1t} + b_{p2} \cdot \tilde{I}_{2t} + \cdots + b_{pn} \cdot \tilde{I}_{nt}))^2 \qquad \textbf{(2)}$$

$$\text{Subject to} \qquad \sum_{i=1}^{n} b_{p,i} = 1 \quad 0 \le b_{p,i} \le 1 \qquad \text{i = 1, 2, ..., } n \qquad \textbf{(3)}$$

Where *n* represents the basic asset classes included in the model, and *T* is the total number of periods considered in the analysis.

This quadratic model including the two restrictions on style factors is what De Roon, Nijman and Ter Horst (2004) term "strong style analysis". They have produced evidence that strong style analysis produces much more accurate estimates of the style weights when the actual portfolios fulfil these restrictions.

The case where only the portfolio constraint is imposed, will be referred to as "semi-strong analysis", which produces biased results in the case of funds that take leveraged portfolio positions. This result has been shown by Fung and Hsieh (1997) for a sample of US hedge funds.

Agarwal and Naik (2000) have shown in the specific case of hedge funds that excluding the two conditions imposed in Sharpe's strong analysis actually improves the model's capacity to reflect the representative style weights in such funds, producing what these scholars term "a generalised style analysis" or weak version of Sharpe's style analysis.

Authors such as Lieberman (1996) justify the utility of Sharpe's style analysis, owing to the large amount of work involved in processing the historic portfolio composition data.

Brown and Goetzmann (1997), Gallo and Lockwood (1997) and DiBartolomeo and Witkowski (1997) establish that style classifications obtain a better explanatory capacity than the usual fund industry classifications.

De Roon et al. (2004) and Rekenthaler et al. (2002) find that Sharpe's procedure is more valid for predicting future returns than the study of historic composition of portfolios. Anyway, both studies find holdings-based analysis a better tool for sizing up mutual fund portfolios than the results obtained by Sharpe's procedure.

In his seminal work Sharpe (1992) establishes three conditions for the benchmarks used in this method if the results of the proposed model are to be meaningful. These requirements are as follows:

1.- *Exclusive benchmarks*: these may not include any securities that already form part of any other basic asset classes considered in the model.

2.- *Exhaustive benchmarks*: as many securities as possible should be included in the chosen asset classes.

3.- *Benchmarks with differing returns*: the correlation between returns on the basic asset groups considered in the proposed model should be low or, where the correlation is high, at least the standard deviation in returns should differ.

For Lobosco and DiBartolomeo (1997) and Buetow, Johnson and Runkle (2000), these statements are a qualitative description of selecting the benchmarks so as to avoid the likelihood that any index would be a linear combination of others. If this working hypothesis is not fulfilled, it will not be possible to separate out the individual explanatory effects of each basic asset class considered from the overall return obtained by the mutual fund.

The proposed benchmarks must behave with independence of each other, which limits the model's capacity to fine tune management style in the portfolios analysed. However, the method provides a clear delimitation of the main management styles applied by the fund.

To sum up, consideration of the statistic phenomenon of multicollinearity implies a careful balance between the accuracy sought in the analysis and the number of explanatory benchmarks to be included in the model. This is because the accuracy of the style analysis does not necessarily improve simply as a result of adding further benchmarks, as Lobosco and DiBartolomeo (1997) have shown.

Essentially this paper contributes empirical evidence to show that an exhaustive selection of benchmarks may give rise to biased estimates of management styles in a medium sized market such as Spain that are not statistically significant and highly unlikely to meet all three of the conditions proposed by Sharpe (1992) for the considered style factors.

2. DATA

The sample used in the study comprises the monthly returns of all Spanish mutual funds holding domestic equities as the prime component of portfolios during the whole period from January 1996 to June 2002. Specifically, a total of 25 investment funds and 78 monthly returns data for each one.

Based on the criteria of the Spanish National Securities Market Commission (CNMV), these mutual funds had invested over 75% of their total portfolios in Spanish equities over the period of the study.

The assets of the investment funds included in the sample total €2,373 million at June 2002, representing 57% of the total value of assets managed by domestic equity funds in Spain.

We used the monthly returns for the 6 Spanish benchmarks selected by Matallín and Fernández (1999, 2000) for their studies of Spanish investment funds to establish the performance of the various asset classes that explain the styles of the funds analysed.

This initial proposal was then expanded to include two representative benchmarks for European and US equities to provide a more exhaustive range of benchmarks in the model.

Table 1 describes of the 8 benchmarks used in the study, clearly reflecting their exclusive nature as required for the first of the characteristics proposed by Sharpe (1992).

3. METHODOLOGY

3.1 Identifying Multicollinearity of the Models

The application of our models requires a prior analysis of multicollinearity in the benchmarks considered in order to ensure that the proposed models will not generate results that fail to reflect appropriately the actual styles established by the funds. The analysis of multicollinearity is as follows:

1. Calculation of Pearson's correlation coefficients for the benchmarks considered, as well as their significance.
2. Calculation of Variance Inflation Factors (VIF), which reflect the degree to which each of the benchmarks considered contributes to the multicollinearity of the model.

Table 1. Description of benchmarks for Sharpe's style analysis

Benchmark	*Description*
Ibex-35 Total ($IBEXT_t$)	This represents the monthly return obtained by investing in the 35 most representative stocks on the Spanish market, including dividend income distributed by the firms included in the index.
MSCI EMU Gross Return Index (EMU_t)	This represents the monthly return obtained by the stock markets of the member States of the European Monetary Union, including dividend income received.
MSCI USA Gross Return Index (USA_t)	This represents the monthly return obtained by the US stock market, including dividend income received.
Índice Total AFI Deuda Española ($GDEBT_t$)	This reflects the monthly return obtained by a portfolio formed by medium and long-term Spanish government debt on the assumption that interest earned is reinvested in the portfolio.
AIAF Obligaciones Simples ($CBONDS_t$)	This represents the monthly internal returns of corporate bonds of more than two years negotiated in the AIAF Spanish market.
Índice Total AFI Letras del Tesoro a 1 año ($1YTB_t$)	This represents the monthly return obtained by a portfolio investing repeatedly in recently issued 1-year Spanish Treasury Bills.
Índice AFI Repos a 1 día ($1DREPOS_t$)	This represents the monthly return obtained by a portfolio acquiring repeatedly 1-year Spanish Treasury Bills for 1 day.
Interest rates on current account deposits at banks ($DEPOSITS_t$)	This is the monthly return on assets invested in current account deposits at banks.

$$VIF = \frac{1}{1 - R_i^2} \qquad \textbf{(4)}$$

R_i^2 is the determinant coefficient in a linear regression of the explanatory index *i* in relation to the other explanatory benchmarks.

3. Calculation of the statistical term proposed by Farrar and Glauber (1967) to identify the possible existence of multicollinearity between the variables proposed in a general linear model.

$$FG = \frac{R_i^2 \Big/ k' - 1}{1 - R_i^2 \Big/ T - k'} \approx F_{k'-1,\,T-k'} \qquad \textbf{(5)}$$

R_i^2 is the determinant coefficient in a linear regression of the explanatory index *i* in relation to the other explanatory benchmarks.

k' is the number of linear regression parameters for an index *i* with regard to the other explanatory benchmarks.

T is the number of observations of the regression.

3.2. Obtaining Style Factors

All the style analysis models applied in this study include the two restrictions originally proposed by Sharpe in his pioneering work. Consequently, the application of these models means accepting the "strong version" of the analysis, which is the most accurate provided that no hedge funds are considered, as has been shown in the financial literature referred to above.

Let us now add the constant b_0 following De Roon, Nijman and Ter Horst (2004) in order to calculate the return added by fund management over and above the returns that would be generated from passive tracking of the management style benchmarks applied by the fund. This transforms Sharpe's original equation (1) as follows:

$$\tilde{R}_{p,t} = b_0 + \left[b_{p,1} \cdot \tilde{I}_{1,t} + b_{p,2} \cdot \tilde{I}_{2,t} + \cdots + b_{p,n} \cdot \tilde{I}_{n,t}\right] + \tilde{e}_{p,t} \qquad \textbf{(6)}$$

Taking into account that the management style of the funds considered as established by the Spanish Securities Market Commission depends basically on their investments in Spanish equities, the various models proposed will seek to identify other possible explanatory factors for style, in terms of either investment in other variable income assets or investment in the different basic classes of fixed interest assets.

Table 2. Proposed style factors for Sharpe's models in Spanish domestic equity funds

Model 1 **IBEXT, EMU, USA, GDEBT, CBONDS, 1YTB, 1DREPOS, DEPOSITS**	*Exclusive* *Exhaustive*
Model 2: Matallín and Fernández (1999,2000) **IBEXT, GDEBT, CBONDS, 1YTB, 1DREPOS, DEPOSITS**	*Exclusive* *Exhaustive in Fixed Income Assets*
Model 3 **IBEXT GDEBT, 1YTB, 1DREPOS**	*Exclusive*
Model 4 **IBEXT, GDEBT, 1DREPOS**	*Exclusive*
Model 5 **IBEXT, 1DREPOS**	*Exclusive* *Independent*
Model 6 **IBEXT, EMU, USA, GDEBT, 1YTB, 1DREPOS**	*Exclusive* *Exhaustive in Variable Income Assets*
Model 7 **IBEXT, EMU, USA, GDEBT, 1DREPOS**	*Exclusive* *Exhaustive in Variable Income Assets*
Model 8 **IBEXT, EMU, USA, 1DREPOS**	*Exclusive* *Exhaustive in Variable Income Assets*

Table 2 shows 8 explanatory models for management style in the sample of Spanish funds. Model 2 reflects the factors originally proposed by Matallín and Fernández (1999, 2000), while model 1 would expand the possible equity investment alternatives available to the funds. This model is thus more exhaustive in terms of the style factors considered.

Models 3, 4 and 5 are progressively less exhaustive in terms of the benchmarks used, since they delete fixed interest benchmarks, which should have less explanatory power given the definition of the funds' investment goals. Finally, model 5 reflects those benchmarks that reflect the only two investments that are specifically required in the Spanish equity funds analysed: cash and Spanish equities.

The last three models proposed reflect the same process of elimination of fixed income benchmarks. However, they have greater explanatory power in terms of equity investment because they include the benchmarks for US and European equities.

3.3. Statistical Significance of the Style Factors

In order to identify the confidence intervals on the resultant style weights, Lobosco and DiBartolomeo (1997) show that the standard error of the style weight on index *i* is given by this expression:

$$\frac{\sigma_p}{\sigma_i \cdot \sqrt{T-k-1}} \qquad (7)$$

Where:

σ_p is the standard deviation of the residuals from the style analysis of mutual fund p using the proposed benchmarks,

σ_i is the standard deviation of the residuals from the style analysis of the index i relative to the remaining benchmarks of the model,

T is the number of observations in the time series of returns,

k denotes the number of indices with non-zero style weights.

The confidence interval for a style weight of a particular market benchmark:

- increases with the standard error of the style analysis, σ_p
- decreases with the number of returns used in the style analysis, T
- decreases with the independence of that benchmark from the other benchmarks used in the model, σ_i

Lobosco and DiBartolomeo (1997) established that this standard deviation makes it possible to calculate confidence intervals for the estimated style parameters, although they recognise that they are overstated when the true style weights are very close either to zero or to one. Except for this limitation, the estimates are approximately normally distributed, and the conventional statistical t can therefore be used.

4. EMPIRICAL ANALYSIS

The exclusive nature of the style factors considered is self-evident from their definition, while the greater or lesser exhaustiveness of the models used is described in section 3.3. above. Finally, we need to establish the degree of independence of the basic assets proposed.

The table 3 show significant Pearson's correlation coefficients for the five equity benchmarks considered, which is contrary to the third condition established by Sharpe (1992) for the explanatory variables considered. This is also the case with the remaining five benchmarks, which track both fixed income and cash investments held in the portfolios, with significant levels of Pearson correlation for these benchmarks.

Table 3. Pearson's correlation coefficients

	IBEXT	EMU	USA	GDEBT	CBONDS	1YTB	1DREPOS	DEPOSITS
IBEXT	1	0,741	0,583	0,077	0,102	0,159	0,099	0,160
(p value)		(0,000)	(0,000)	(0,503)	(0,373)	(0,166)	(0,389)	(0,162)
EMU		1	0,750	0,023	0,081	0,056	0,051	0,099
(p value)			(0,000)	(0,840)	(0,479)	(0,624)	(0,655)	(0,387)
USA			1	0,134	0,040	0,101	0,102	0,121
(p value)				(0,243)	(0,731)	(0,378)	(0,373)	(0,292)
GDEBT				1	0,296	0,571	0,368	0,391
(p value)					(0,009)	(0,000)	(0,001)	(0,000)
CBONDS					1	0,589	0,892	0,882
(p value)						(0,000)	(0,000)	(0,000)
1YTB						1	0,690	0,683
(p value)							(0,000)	(0,000)
1DREPOS							1	0,963
(p value)								(0,000)
DEPOSITS								1
(p value)								

The results presented in table 4 reflect problems of linearity between the benchmarks considered in 7 of the 8 proposed models. Only model 5 in fact exhibits linear independence between the two explanatory style factors (IBEXT and 1DREPOS).

Accordingly, a single model capable of guaranteeing the exclusivity and independence of the proposed factors does exist, although it assumes a lower level of exhaustiveness for the factors.

The next step, then, is to establish whether the elimination of some of the proposed benchmarks in the models will provoke a significant specification bias in results.

Table 4. Multicollinearity in Sharpe's models.

	Model 1		*Model 2*		*Model 3*		*Model 4*	
	VIF	**FG**	**VIF**	**FG**	**VIF**	**FG**	**VIF**	**FG**
IBEXT	2,357	13,57 **	1,087	1,25	1,026	0,64	1,012	0,45
EMU	3,606	26,06 **	-	-	-	-	-	-
USA	2,557	15,57 **	-	-	-	-	-	-
GDEBT	1,554	5,54 **	1,515	7,42 **	1,486	11,99 **	1,159	5,96 **
CBONDS	5,515	45,15 **	5,165	59,98 **	-	-	-	-
1YTB	2,523	15,23 **	2,495	21,53 **	2,487	36,68 **	-	-
1DREPOS	17,842	168,42 **	17,072	231,44 **	1,913	22,52 **	1,164	6,15 **
DEPOSITS	15,628	146,28 **	15,549	209,51 **	-	-	-	-
	Model 5		*Model 6*		*Model 7*		*Model 8*	
	VIF	**FG**	**VIF**	**FG**	**VIF**	**FG**	**VIF**	**FG**
IBEXT	1,010	0,76	2,295	18,65 **	2,246	22,74 **	2,240	30,59 **
EMU	-	-	3,432	35,02 **	3,427	44,29 **	3,376	58,61 **
USA	-	-	2,375	19,80 **	2,368	24,97 **	2,315	32,44 **
GDEBT	-	-	1,523	7,53 **	1,187	3,41 *	-	-
CBONDS	-	-	-	-	-	-	-	-
1YTB	-	-	2,512	21,77 **	-	-	-	-
1DREPOS	1,010	0,76	1,923	13,29 **	1,165	3,01 *	1,019	0,47
DEPOSITS	-	-	-	-	-	-	-	-

Farrar-Glauber Test (FG)

** Significant presence of linearity at a level of 5%.*

*** Significant presence of linearity at a level of 1%.*

Table 5. Style factors in Spanish investment funds (arithmetic mean of monthly returns)

	model 1	**model 2**	**model 3**	**model 4**
b1 (IBEXT)	0,6534 (0,0562) **	0,8378 (0,0431) **	0,8378 (0,0437) **	0,8378 (0,0438) **
b2 (EMU)	0,2670 (0,0841) **	- -	- -	- -
b3 (USA)	0,0477 (0,0819)	- -	- -	- -
b4 (GDEBT)	0,0319 (0,2299)	0,1090 (0,2600)	0,1090 (0,2636)	0,1090 (0,2467)
b5 (CBONDS)	0,0000 (5,2133)	0,0000 (5,9190)	- -	- -
b6 (1YTB)	0,0000 (1,5233)	0,0000 (1,7311)	0,0000 (1,7550)	- -
b7 (1DREPOS)	0,0000 (5,1988)	0,0533 (5,8843)	0,0533 (1,5018)	0,0533 (0,2511)
b8 (DEPOSITS)	0,0000 (4,7178)	0,0000 (5,3572)	- -	- -
b0	-0,0017 (0,0133)	-0,0010 (0,0148)	-0,0010 (0,0092)	-0,0010 (0,0092)
	R^2 adj. 0,8636	R^2 adj. 0,8313	R^2 adj. 0,8359	R^2 adj. 0,8381
	model 5	**model 6**	**model 7**	**model 8**
b1 (IBEXT)	0,8390 (0,0438) **	0,6534 (0,0570) **	0,6534 (0,0574) **	0,6545 (0,0578) **
b2 (EMU)	- -	0,2670 (0,0852) **	0,2669 (0,0858) **	0,2662 (0,0865) **
b3 (USA)	- -	0,0477 (0,0831)	0,0478 (0,0837)	0,0552 (0,0832)
b4 (GDEBT)	- -	0,0319 (0,2331)	0,0318 (0,2183)	- -
b5 (CBONDS)	- -	- -	- -	- -
b6 (1YTB)	- -	0,0000 (1,5449)	- -	- -
b7 (1DREPOS)	0,1610 (0,0438) **	0,0000 (1,3220)	0,0000 (0,2272)	0,0241 (0,0570)
b8 (DEPOSITS)	- -	- -	- -	- -
b0	-0,0006 (0,0091)	-0,0017 (0,0082)	-0,0017 (0,0082)	-0,0016 (0,0081)
	R^2 adj. 0,8398	R^2 adj. 0,8675	R^2 adj. 0,8693	R^2 adj. 0,8708

The values in brackets represent the standard deviation by Lobosco and DiBartolomeo (1997).

** Significantly different from zero at a level of 5%.*

*** Significantly different from zero at a level of 1%.*

Table 6. Style factors in Spanish investment funds (monthly returns weighted for assets)

	model 1	model 2	model 3	model 4
b1 (IBEXT)	0,6707 (0,0570) **	0,8599 (0,0437) **	0,8599 (0,0443) **	0,8599 (0,0445) **
b2 (EMU)	0,2750 (0,0852) **	- -	- -	- -
b3 (USA)	0,0474 (0,0830)	- -	- -	- -
b4 (GDEBT)	0,0069 (0,2329)	0,0881 (0,2641)	0,0881 (0,2678)	0,0881 (0,2506)
b5 (CBONDS)	0,0000 (5,2823)	0,0000 (6,0137)	- -	- -
b6 (1YTB)	0,0000 (1,5435)	0,0000 (1,7588)	0,0000 (1,7831)	- -
b7 (1DREPOS)	0,0000 (5,2676)	0,0520 (5,9784)	0,0520 (1,5258)	0,0520 (0,2551)
b8 (DEPOSITS)	0,0000 (4,7802)	0,0000 (5,4428)	- -	- -
b0	-0,0020 (0,0135)	-0,0013 (0,0150)	-0,0013 (0,0094)	-0,0013 (0,0093)
	R^2 adj. 0,8666	R^2 adj. 0,8341	R^2 adj. 0,8386	R^2 adj. 0,8408
	model 5	**model 6**	**model 7**	**model 8**
b1 (IBEXT)	0,8609 (0,0448) **	0,6707 (0,0578) **	0,6707 (0,0582) **	0,6713 (0,0581) **
b2 (EMU)	- -	0,2750 (0,0863) **	0,2750 (0,0869) **	0,2756 (0,0870) **
b3 (USA)	- -	0,0474 (0,0842)	0,0474 (0,0848)	0,0531 (0,0837)
b4 (GDEBT)	- -	0,0069 (0,2362)	0,0069 (0,2212)	- -
b5 (CBONDS)	- -	- -	- -	- -
b6 (1YTB)	- -	0,0000 (1,5654)	- -	- -
b7 (1DREPOS)	0,1391 (0,0448) **	0,0000 (1,3395)	0,0000 (0,2302)	0,0000 (0,0573)
b8 (DEPOSITS)	- -	- -	- -	- -
b0	-0,0010 (0,0092)	-0,0020 (0,0083)	-0,0020 (0,0083)	-0,0020 (0,0082)
	R^2 adj. 0,8426	R^2 adj. 0,8703	R^2 adj. 0,8721	R^2 adj. 0,8739

The values in brackets represent the standard deviation by Lobosco and DiBartolomeo (1997).
** Significantly different from zero at a level of 5%.*
*** Significantly different from zero at a level of 1%.*

Tables 5 and 6 reflect the style factors obtained, as well as their signification for each of the 8 models proposed in our study. These management styles have been obtained on the basis of the arithmetic mean of monthly returns generated by all mutual funds included in the sample, and a weighted average for fund assets.

In William Sharpe's home page, it is provided a worksheet where the investment styles of a fund may be obtained (see http://www.stanford.edu/~wfsharpe/home.htm).

As was to be expected in view of the investment goals of the portfolios analysed, the management style explained by IBEXT is significantly higher than zero in all of the models considered, while investment in European stocks, EMU, exhibits significant values in all of the models that include it as an explanatory variable.

Only model 5 exhibits statistical validity for all of the benchmarks proposed, which in this case comprise investment in Spanish equities and cash.

The elimination of unrepresentative benchmarks in the models analysed does not have a significant impact on the explanatory power of the results obtained, as can be seen by comparing the R^2 for the 8 style analyses carried out, while the statistical significance of results increases when factors causing linearity in the models are eliminated.

Similarly to the results obtained by De Roon, Nijman and Ter Horst (2004) for a sample of US funds, the analysis of management performance in the Spanish funds

as compared to passive style tracking throws up negative b_0 coefficients in all of the models included in the study, although none of them is statistically significant.

4. CONCLUDING COMMENTS

We provide empirical evidence that the best style analysis in the Spanish mutual funds market is not the most exhaustive, but rather the analysis that 1) identifies the fund's investment goals and 2) establishes the main assets targeted for investment by the fund, seeking as far as possible to avoid the presence of significant linearity between the representative benchmarks for such assets.

In the case of Spanish domestic equity funds, the models that only include investment in Spanish equities and money market assets (cash) as investment style factors provide much more statistically significant results and exhibit very similar levels of explanatory power to other models that seek to include all possible investment alternatives.

Taking into account this result, Spanish fund managers should know that the percentage of assets invested in cash or in Spanish stocks is the most important asset allocation decision that they take. This two-asset strategic allocation explains more than 84% of the variability of the total returns obtained by the Spanish funds investing in domestic equities.

As regards the performance analysis proposed in the study, the 8 models showed that the actual results achieved by the funds were lower than the returns that would have been obtained from mere passive tracking of the management style. These negative results were not, however, statistically significant.

Therefore, Spanish managers should make additional efforts in their active management decisions in order to add value to the returns obtained by the Spanish funds investing in domestic stocks.

Future research guides complementing this study, should analyse other type of Spanish mutual funds with different investment goals. It is obvious that the multicollinearity phenomenon detected in the Fixed Income benchmarks will increase the difficulty in applying Sharpe's Style analysis to these funds. Other alternative approaches implementing returns-based style analysis will have to be used to solve this problem.

Gratefulness

The authors would like to express their thanks to the University of Zaragoza and the Financial Group Ibercaja for the award of Projects 268-96 and 268-128. The authors would also thank the useful comments given by two anonymous referees.

A preliminary version of this paper was accepted in the 7th Spanish-Italian Meeting on Financial Mathematics.

Any possible errors contained in this paper are the exclusive responsibility of the authors

REFERENCES

AGARWAL, V. and N.Y. NAIK (2000), Generalised style analysis of hedge funds, Journal of Asset Management, 1(1), pp. 93-109.

BROWN, S. and W. GOETZMANN (1997), Mutual fund styles, Journal of Financial Economics, 43(3), pp. 373-399.

Buetow, G.W., Johnson, R. and D. Runkle (2000), The inconsistency of return-based style analysis, Journal of Portfolio Management, spring, pp. 61-77.

DE ROON, F.A., NIJMAN, T.E. and T.R. TER HORST (2004), Evaluating style analysis, Journal of Empirical Finance, 11(1), pp. 29-53.

DI BARTOLOMEO, D. and E. WITKOWSKI (1997), Mutual fund missclassification: evidence based on style analysis, Financial Analysts Journal, 53, pp. 32-43.

FARRAR, D.E. and R.R. GLAUBER (1967), Multicollinearity in regression analysis: the problem revisited, Review of Economics and Statistics, 49, pp. 92-107.

FUNG, W. and D.A. HSIEH (1997), Empirical characteristics of dynamic trading strategies: the case of hedge funds, Review of Financial Studies, 10, pp. 275-302.

GALLO, J. and L. LOCKWOOD (1997), Benefits of proper style classification of equity portfolio managers, Journal of Portfolio Management, spring, 23, pp. 47-55.

LIEBERMAN, D.L. (1996), Return-based style analysis: are quarterly returns as meaningful?, Journal of Investing, fall, pp. 51-55.

LOBOSCO, A. and D. DI BARTOLOMEO (1997), Approximating the confidence intervals for Sharpe style weights, Financial Analysts Journal, 53 (4), pp. 80-85.

MATALLÍN, J.C. and M.A. FERNÁNDEZ (1999), Análisis de la Performance a través del estilo del fondo de inversión, Revista Española de Financiación y Contabilidad, 99, pp. 413-442.

MATALLÍN, J.C. and M.A. FERNÁNDEZ (2000), Style analysis and performance evaluation of spanish mutual funds, Journal of Asset Management, 1(2), pp. 151-171

REKENTHALER, J., GAMBERA, M. and J. CHARLSON (2002), Estimating portfolio style: a comparative study of portfolio-based fundamental analysis and returns-based style analysis, Morningstar Research Paper

SHARPE, W.F. (1988), Determining a fund's effective asset mix, Investment Management Review, december, pp. 59-69.

SHARPE, W.F. (1992), Asset allocation: management style and performance measurement, Journal of Portfolio Management, summer, pp. 7-19.