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THE VALUE OF COSKEWNESS IN EVALUATING MUTUAL FUNDS*

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Abstract

Recent asset pricing studies demonstrate the relevance of incorporating the coskewness in Asset Pricing Models, and illustrate how this component helps to explain the time variation of ex-ante market risk premiums. This paper analyzes the role of coskewness in mutual funds performance evaluation. We find evidence that adding a coskewness factor is economically and statistically significant. We document that some managers are managing the coskewness and show, in general, a persistent behaviour on time in their coskewness policy. One of the most striking results is that many negative (positive) alpha funds measured relative to the CAPM risk adjustments would be reclassified as positive (negative) alpha funds using a model with coskewness. Therefore, a ranking of funds based on risk adjusted returns without considering coskewness would generate an erroneous classification. Moreover, some fund characteristics, such as the turnover ratio or the category, are related to the likelihood of managing coskewness.

Keywords: Mutual Funds; Performance Measures; Coskewness.
JEL Classification: G12; G11; G23

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1. Introduction

Since the late 1960s, performance measures have been essential tools in the investment process. Their importance has increased from the perspective of both the academic and the professional investor. A performance measure can be defined as a single formula for evaluating the results obtained by an investment portfolio. It allows investors to compare different managers or management strategies by ranking portfolios on their performance. In addition, such performance measures can be employed to determine the remunerations of mutual fund managers according to their past performance.

Classic performance measures have been developed, in general, under the assumption of normality in the distribution of returns and have been used in the literature to evaluate the active portfolio management of professional managers. Among these measures, we can highlight Jensen's Alpha (Jensen, 1968) from the CAPM, Sharpe's Ratio (Sharpe, 1966) and the Treynor measure (Treynor, 1965). During the 1970s, some authors realized that these traditional performance measures did not evaluate fund performance accurately because the distribution of funds returns was not Gaussian[1]. Klemkosky (1973) and Ang and Chua (1979) demonstrated that ignoring the third moment of the distribution of returns would generate a bias in the evaluation of the fund managers' performance. This bias could also affect investors directly, by leading them to create their portfolios in a manner that would cause a suboptimal asset allocation. Along the same lines, other authors such as Prakash and Bear (1986) or Leland (1999) have developed performance measures incorporating skewness, and Stephens and Proffitt (1991) generalized the performance measure to account for any number of moments. All these results indicate that ignoring higher moments could have a significant impact upon the performance rankings of these funds.

[1] In fact, Markowitz (1991) recognizes that the normality assumption is not realistic from a theoretical, practical, or empirical perspective, and that other measures, in particular semi-variance, might be more plausible.

In order to find the best model to evaluate the performance of mutual funds, we must review the literature of asset pricing related with coskewness. Thus, Kraus and Litzenberger (1976) document the importance of considering the third moment (skewness) of returns in asset pricing. They developed a model where investors are compensated for holding systematic risk and coskewness risk, such that they require a higher (lower) return whenever the systematic risk is higher (lower) and the coskewness risk is lower (higher). The negative price of risk in the second component indicates that investors dislike assets with negative coskewness and therefore require higher returns. For those readers unfamiliar with coskewness we must indicate that an asset with negative coskewness is an asset, such that, incorporating it into a portfolio would add negative skewness, increasing the probability of obtaining undesired extreme values (left tail of the distribution).

Recent literature on asset pricing has demonstrated the convenience of using coskewness models instead of the popular Fama and French (1993) three-factor model. Thus, Harvey and Siddique (2000) test the three-moment CAPM's implication that a stock with a negative coskewness with the market will earn a higher risk premium. They formed a coskewness factor following the methodology that Fama and French used in constructing the SMB and HML factors and found that coskewness is economically significant. Barone-Adesi (2004) using a quadratic model find that additional variables representing portfolio characteristics (such as those considered in the Fama and French model) have no explanatory power for expected returns when coskewness is taken in account. Chung et al (2006) suggest that higher order co-moments are important for risk-averse investors concerned about extreme outcomes. The authors also find that the risk factors of Fama and French approximate these higher order co-moments especially when using low frequencies. In this sense, Vanden (2006) also points out that SMB and HML measure coskewness risk, but they are imperfect proxies. More recently, Smith (2007) finds that while the conditional two-moment CAPM and the conditional Fama and French three-factor model are rejected, a model which includes coskewness is not rejected by the data[2].

Given this agreement regarding the importance of coskewness, it seems clear that the third moment would have to be used in the evaluation of the performance of Hedge Funds, since they can employ dynamic strategies: leverage, short-selling and investing in illiquid assets (see Ranaldo and Favre, 2005; and Ding and Shawky, 2007) and therefore the return distribution will be clearly non-normal. Nevertheless, it is not so evident that this model also generates changes in the performance of common mutual funds, since they cannot make use of all those strategies[3]. In spite of this, some authors (Stephens and Proffitt, 1991; or Moreno and Rodríguez, 2006) have taken a first step in analyzing the effect of nonsymmetrical distributions in mutual funds. These works find, in general, some differences in performance when these new measures are taken into consideration. Nevertheless, neither of them analyzes the implications of coskewness in the management and valuation of the investment funds. Moreover, the samples of data used in these studies are small, and the number of analyzed funds is reduced[4].

Some important questions about the role of coskewness are still unanswered in the mutual funds literature. For example, does the average performance of funds change? Are there variations in the ranking of mutual fund managers? Are these changes in rankings statistically significant, or could some characteristics such as turnover of the portfolio, size, or even the category of the fund be related to a certain strategy of management of coskewness? In this paper we try to shed some light on all these issues using a sufficiently wide sample in number of funds and time period. Thus, we investigate the role of coskewness in portfolio management and study

[2] Coskewness is also considered relevant in some other economic areas. For example, Vines et al. (1994) study the importance of coskewness in the pricing of real estate and Christie-David and Chaudhry (2001) examine it in explaining the return-generating process in future markets.

[3] However it must be noted that fund managers could use, for example, derivatives (as Koski and Pontiff (1999) point out approximately 21 percent of equity mutual funds use derivatives) biasing the distribution of fund returns to the left or right, generating coskewness in distribution of returns.

[4] For example, Stephens and Proffitt (1991) use a sample consisting of only 27 internationally diversified mutual funds from January 1976 to June 1982, and Moreno and Rodríguez (2006) employ only 370 Spanish mutual funds from January 1999 to January 2003.

whether some fund managers are profiting from a coskewness spread. Hereinafter, we will understand managing coskewness as having a specific policy regarding the assets incorporated into the fund's portfolio to achieve higher or lower portfolio coskewness.

In order to thoroughly study the relevance of including the third co-moment of asset returns in issues of performance evaluation, we consider two different multifactor asset pricing models, the CAPM and the Carhart (1997) four-factor model [5]. In both models we add a coskewness factor and look for the best adjustment of risk[6]. Our results reveal many interesting findings. First, we find that the coskewness factor is both economically and statistically significant. Second, the average funds' performance will change when coskewness is taken into account, this change being greater when it is compared with the alpha from a CAPM (the average alpha for all Equity funds is moved to the left side more than double) than in a Carhart model (the average alpha is modified by approximately 6%). Third, in general, these movements in the alpha might affect categories of equity mutual funds in different ways, so that in our sample, the Aggressive Growth funds are made to look better and the rest worse. Fourth, as those variations in performance will have a different sign depending on the loading on the coskewness factor, we find that a ranking based on risk adjusted returns without considering coskewness might result in a misleading classification of the funds. Moreover, one of the most striking results is that many negative (positive) alpha funds measured relative to the CAPM risk adjustments would be reclassified as positive (negative) alpha funds using the CAPM plus coskewness. Fifth, those managers having a specific policy of managing coskewness repeat the same policy over time, thus, persistence in coskewness policy appears for the majority of the

[5] This model has been widely used in the literature to measure mutual funds performance. For example, Wermers (2000), Kothari and Warner (2001), Kacperczyk et al. (2005) and Kosowsky et al. (2006), are some recent examples of papers employing Carhart's model.

[6] An alternative way to take into account the skewness of the distribution of returns could be in an equilibrium framework like that of Leland (1999). However, this performance measure would require two assumptions: the rate of return on the market portfolio must be independently and identically distributed and perfect markets must exist. Moreover, many of the econometric problems related to the estimation of the CAPM alpha will also be presented in estimating this performance measure, including finding an appropriate proxy for the market portfolio (as mentioned in Leland (1999), footnote 22). In contrast, multifactor pricing models, such as the ones proposed in this paper are not subject to those problems.

time periods. Sixth, we find that some funds' characteristics (turnover and fund's category) are related to having a specific policy of managing the coskewness.

The remainder of this paper is organized as follows. The following section describes the coskewness measure and the models used to analyze its effect on performance evaluation. Section 3 presents the database of mutual funds and the benchmarks used. Section 4 provides the empirical evidence. Summaries and conclusions are presented in Section 5.

2. The effect of the coskewness factor on performance evaluation

2.1. The coskewness

Kraus and Litzenberger (1976) extend the CAPM to incorporate the effect of skewness in asset pricing, developing the three-moment CAPM (3MCAPM). Thus, in equilibrium, the expected returns of a risk asset satisfy:

$$R_i - R_f = \lambda_1 \beta_i + \lambda_2 \gamma_i, \tag{1}$$

where R_i is one plus the expected return of the risk asset, R_f denotes one plus the return of the risk free asset, β_i is the systematic risk and γ_i indicates the systematic skewness (standardised coskewness) of the asset, a measure of the asset's coskewness risk [7]. The risk premiums of each risk factor are λ_1 and λ_2. Therefore, investors are compensated by means of expected excess returns for bearing the relative risks measured by beta and gamma. Given that the investor requires higher returns for securities with higher betas, we expect a positive risk

[7] According to Kraus and Litzenberger (1976) the expressions are: $\beta_i = \frac{E\left[\left(R_i - \overline{R}_i\right)\left(R_M - \overline{R}_M\right)\right]}{E\left[\left(R_M - \overline{R}_M\right)^2\right]}$ and $\gamma_i = \frac{E\left[\left(R_i - \overline{R}_i\right)\left(R_M - \overline{R}_M\right)^2\right]}{E\left[\left(R_M - \overline{R}_M\right)^3\right]}$, where γ_i is defined as the ratio of the coskewness of that asset's return with the market to the market's skewness. In the same way that the covariance (numerator of beta) represents the marginal contribution of an asset to the variance of the market portfolio return, the coskewness (numerator of gamma) represents the contribution of an asset to the skewness of the market portfolio return.

premium $\lambda_1 > 0$. However, we expect a negative risk premium for assets with positive systematic skewness $\lambda_2 < 0$.

From an empirical point of view, asset pricing models can be tested through the restrictions that they impose on the coefficients of the return generating process. Thus, the return generating processes consistent with the CAPM and the 3MCAPM are the market model and the quadratic model, respectively. Whereas the market model assumes that the return of a risk asset is linearly related to the return of a stock index representative of the market, the quadratic model establishes a nonlinear relationship expressed as:

$$R_{i,t} - R_{f,t} = c_{0i} + c_{1i}\left[R_{M,t} - R_{f,t}\right] + c_{2i}\left[R_{M,t} - \overline{R}_{M,t}\right]^2 + \nu_{it}\,. \qquad (2)$$

The estimation of c_{2i} in the quadratic model (2) gives us a coskewness measure. Through the use of a partitioned regressions argument (Frisch-Waugh-Lovell theorem) it is easy to verify that c_{2i} is equal to $\mathrm{E}(\varepsilon_{i,t+1}\varepsilon^2_{M,t+1}) / \mathrm{V}(\varepsilon^2_{M,t+1})$, where $\varepsilon_{i,t+1}$ represents the residuals from the regression of the excess return on the contemporaneous market excess return and $\varepsilon_{M,t+1}$ represents the residuals of the excess market return over its mean.

Harvey and Siddique (2000) compute the standardized unconditional coskewness as

$$S_i = \frac{E(\varepsilon_{i,t+1}\varepsilon^2_{M,t+1})}{\sqrt{E(\varepsilon^2_{i,t+1})}\,E(\varepsilon^2_{M,t+1})}\,, \qquad (3)$$

where $\varepsilon_{M,t+1}$ and $\varepsilon_{i,t+1}$ were defined previously in this section. The information given by the coskewness allows the construction of a risk factor in the same way that the Fama and French (1993) factors were constructed. This risk factor can be replicated by means of a portfolio of assets. In order to elaborate on this factor, we need to compute the coskewness measure for each asset and use it to rank the assets. They form two portfolios: one which comprises of the 30%

of the assets that have the most negative coskewness (S^-) and another which comprises of the 30% of the assets with the most positive coskewness (S^+). The return spread of the two portfolios $(S^- - S^+)$ and the return spread of the portfolio S^- minus the risk free rate $(S^- - R_f)$ are the coskewness risk factors (hereinafter, CSK).

2.2. The Models

In order to analyze the effect of the coskewness factor on performance evaluation, we use as base cases the standard CAPM and the Carhart (1997) four-factor model, which uses the three factors of Fama and French (1993) and an additional one that captures the momentum effect. We use the four-factor model (hereinafter FF4) to adjust the performance of the fund for the regularities found in financial returns. Thus, the models are

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^m \left[R_{M,t} - R_{f,t}\right] + e_{i,t} \tag{4}$$

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^m \left[R_{M,t} - R_{f,t}\right] + \beta_i^{smb} SMB_t + \beta_i^{hml} HML_t + \beta_i^{wml} WML_t + e_{i,t}, \tag{5}$$

where $\left\{ R_{M,t} - R_{f,t}, SMB_t, HML_t, WML_t \right\}$ represents the market, size, book and momentum factors.

When a coskewness factor is included, we have

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^m \left[R_{M,t} - R_{f,t}\right] + \beta_i^{csk} CSK_t + e_{i,t} \tag{6}$$

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^m \left[R_{M,t} - R_{f,t}\right] + \beta_i^{smb} SMB_t + \beta_i^{hml} HML_t + \beta_i^{wml} WML_t + \beta_i^{csk} CSK_t + e_{i,t} \tag{7}$$

To study the effect of adding this new factor to the traditional Jensen's alpha, we must consider the coskewness risk in the same way as the systematic market risk. Just as we require greater returns for managers with larger systematic risks (larger betas), in a model that includes coskewness we require greater returns for managers whose coskewness risks are larger. To illustrate, suppose that we are evaluating two mutual funds with an annual abnormal return of 3% (measured by the classic Jensen's alpha, $\alpha_A=\alpha_B=0.03$). Manager A has over-weighted the portfolio with assets that have negative coskewness, and has therefore obtained a spread by coskewness, whereas Manager B has not given special consideration to coskewness. According to (6), the loading parameter that captures the coskewness risk must be positive for Manager A (e.g. $\beta^{CSK} = 0.20$) and zero for Manager B. Given that the coskewness factor must have a positive mean (e.g. 0.10) – because investors dislike negative coskewness assets and they require greater returns – the final alpha for Manager A will be lower than the alpha for Manager B. Therefore, the abnormal return obtained would be $\alpha_{CSK,A} = \alpha_A - \beta_2(CSK)$ $= 0.03 - 0.2(0.10) = 0.01$ for Manager A and $\alpha_{CSK,B} = \alpha_B - \beta_2(CSK) = 0.03$ for Manager B.

In this example, the manager who tries to profit from the coskewness spread achieves the worse performance. The reason is that alpha is a performance measure that considers risk-adjusted returns, so that just as greater returns are required of a manager assuming larger market risk (and therefore a greater β^m, reducing his Jensen's alpha), greater returns are required of the manager assuming a larger systematic risk of skewness. To complete the argument, it is important to note that Manager A adds negative skewness to the portfolio by incorporating negative coskewness assets – an undesirable situation for investors. Thus, a correct measure of abnormal returns must penalize this strategy.

2.3 Conditional performance evaluation

The models explained above use unconditional expected returns and are based on the assumption that factor loadings are constant. However, if expected returns and risks vary over time, such an unconditional approach may give biased results. Chen and Knez (1996) and Ferson and Schadt (1996) advocate conditional performance evaluation (CPE). In their one- and multi-factor models, factor loadings (betas) are conditioned on public information variables. The obtained conditional Jensen's alphas represent the average difference between the return on a fund and the return of the dynamic strategies based on public information[8].

Thus, in this paper, we analyze the previous models in a conditional and unconditional framework, given the existing evidence that asset pricing models need to be conditional since expected returns vary over time. With this analysis we also contribute to conditional performance evaluation literature by presenting the differences between conditional and unconditional performance evaluation when coskewness is included.

3. Data and benchmarks

3.1. Fund Returns

The database used in this study consists of monthly returns for 6,819 U.S. equity mutual funds obtained from the Center for Research in Security Prices (CRSP) between January 1962 and December 2006. These mutual funds are classified into three categories: Aggressive Growth, Growth Income Funds and Long-Term Growth Funds.

Table 1 provides a complete economic and statistical description of the database. Using rows for each category, we present annualized mean return, risk (measured as the standard deviation), kurtosis, minimum and maximum monthly return during the entire sample period, and the percentage of funds for which the null hypothesis of normality, using a Jarque-Bera test,

[8] Christopherson *et al.* (1998) proposed a refinement of the conditional performance evaluation. Introducing time variation in alpha makes it possible to determine whether managerial performance is indeed constant or varies over time as a function of the conditional information.

is rejected. The table also shows the total number of mutual funds in each category in intervals of 36-84, 84-120, 120-156, 156-288, more than 288 and more than 432 observations.

The figures in Table 1 indicate that the kurtosis is, on average, higher than 3 (a value under the null of a normal distribution) and we reject the null hypothesis of normality for approximately 48% of mutual funds (51% in Aggressive Growth, 53% in Growth Income Funds and 44% in Long-Term Growth Funds). According to this result, the use of a performance measure based on normality should be questioned.

3.2. Benchmarks Portfolios

We use the CRSP NYSE/AMEX/NASDAQ value-weighted index as the market portfolio. To capture the effects of size, book-to-market value and momentum we use the monthly series of SMB and HML and WML factors obtained from Kenneth French’s website. Our short-term risk free security is the one-month Treasury bill, from Ibbotson Associates. The predetermined variables, used as instruments in conditional models are: 1) the lagged level of the one-month Treasury bill yields; 2) the lagged dividend yield of the CRSP value –weighted NYSE/AMEX and NASDAQ stock index; 3) a lagged measure of the slope of the term structure; and 4) a lagged corporate spread on the corporate bond market. The term spread is a constant maturity 10-year Treasury bond yield minus the 3-month T-bill yield. The corporate bond default yield spread is Moody’s BAA – rated corporate bond yield, minus the AAA-rated corporate bond yield. These variables have figured most prominently in studies of mutual fund performance (see Ferson and Schadt 1996; Ferson and Warther, 1996).

Table 2 presents summary statistics on the risk factors. The mean, median and standard deviation return data are in annual percentages. In addition, we show the monthly maximum and minimum return, and the p-value of the Jarque-Bera test. The market factor is the excess return on the value-weighted index; SMB is the factor mimicking portfolio for size; HML is the factor mimicking portfolio for book-to-market, WML is the factor mimicking portfolio for the 1-month return momentum; $(S^{-}-S^{+})$ and $(S^{-}-R_{f})$ are the coskewness factors.

In order to compute the coskewness factor we use monthly U.S. equity returns from CRSP NYSE/AMEX and NASDAQ files from December 1957 to December 2006. We include ordinary common stocks and exclude real state investment trusts, stocks of companies incorporated outside of the United States and close-end funds. For robustness, we investigate various specifications of the coskewness factor to ensure that it is not sensitive to its construction methodology. Thus, we use various cut-off definitions (bottom 15% - top 15%; and bottom 20% - top 20%) in addition to the Harvey and Siddique's factor (bottom 30% - top 30%). Moreover, we also compute these factors by employing the parameter c_2 from the quadratic model (2) to sort the common stocks instead of using the standardised unconditional coskewness (3) proposed by Harvey and Siddique [9].

The risk premium for all these coskewness factors is positive, becoming higher as the cut-off is more extreme. The risk premiums for the $(S^{-}-S^{+})$ are 3.44%, 3.19%, and 2.33% annually for the 15-15, 20-20 and 30-30 cut-offs respectively, and range from 8.9% to 8.30% annually in the case of the $(S^{-}-R_{f})$ coskewness factor. Constructing the coskewness factor from the quadratic model, the premiums, for the different cut-offs, are 3.52% 2.74%, and 2.56% respectively for the $(S^{-}-S^{+})$, and 9.94%, 9.01, and 8.73 for the $(S^{-}-R_{f})$ factor.

In order to analyze the potential impact of the factors when they were added to the models, we compute the correlation coefficient among all of them. The correlation among the same coskewness factor using different cut-offs is very high (e.g. for the $(S^{-}-S^{+})$ 15-15 and 20-20 the correlation is 0.94), allowing us to conclude that the factor is not sensitive to the

[9] The authors are grateful to an anonymous referee for their comments on this section, which have led to substantial improvements in the paper.

selection of different cut-offs. In addition, the correlation between the factors computed using different measures of coskewness is also high (e.g. for the $(S^{-} - S^{+})$ 30-30 from the Harvey and Siddique measure and the measure from the quadratic model is 0.85). Therefore, the coskewness factor is robust to the different ways of measuring the coskewness. In consequence, for the rest of the paper we will show the results only considering two factors $(S^{-} - S^{+})$ and $(S^{-} - R_f)$, where coskewness is computed using (3) and with the intermediate cut-off 20-20[10].

Table 2 also presents the contemporaneous correlations between the factors included in the models. As we can observe, these correlations are generally small; they range from -0.40 to 0.37. But there is one case in which correlation is not negligible: when the existing correlation between the market factor and the coskewness factor $(S^{-} - R_f)$ is 0.913. In order to avoid possible multicollinearity problems, we orthogonalize this coskewness factor with respect to the market factor. One we have orthogonalized this factor, the correlation with the market changes to zero, and the correlation with the other coskewness factor $(S^{-} - S^{+})$ changes to 0.90 (whereas before it was only 0.37), corroborating again the robustness of the coskewness factor used here.

4. Empirical Results

4.1 The coskewness of mutual funds

Table 3 reports some summary statistics that compare the coskewness measures across the three categories of funds analyzed in this paper. In Panel A we show the unconditional skewness, computed as the third central moment over the mean. The results indicate that, considering all funds jointly, half of the funds have a negative skewness, significant at the 5% level[11]. For each

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[10] The results for the rest of the specifications of the coskewness factor are very similar and are available upon request.

[11] Significance levels for unconditional skewness and coskewness are computed based on bootstrap percentiles methodology (for a more detailed description of this methodology see Efron and Tibshirani,

of the categories, these percentages are 42%, 61% and 49% respectively. This result shows that the skewness of the funds is significant and that the third moment of the return distribution should not be ignored. In Panel B we present the results of measuring the unconditional coskewness of the mutual funds. The mean value for all Equity Mutual Funds is negative (-0.013) and the proportion of funds that have a significant coskewness is, on average, 19.63%. Moreover, it can be observed that each category has a different standardized unconditional coskewness, with the Aggressive Growth being the only one having a negative average coskewness (-0.063) and further, having the greatest number of funds with negative unconditional coskewness (16%). Given that a mutual fund is a portfolio of assets, this finding indicates that approximately 16% of those mutual funds are created investing in assets with negative coskewness and therefore, the required return of these funds according to the 3MCAPM should be higher. When we estimate the quadratic model (2) as an alternative measure of coskewness, the results are similar to those found in Panel B. The mean value estimated for the parameter C_2, shown in panel C, is negative when all categories are considered together and the percentage of funds with a significant parameter is around 10%. Again, the Aggressive Growth category shows a negative value (-0.531) on average and Growth Income and Long-Term Growth funds present a positive one.

The figures in Table 3 might give the impression that very few funds exhibit significant coskewness, and, as a result, the impact of coskewness could be marginal. Given that the main goal of the paper is to analyze the importance of coskewness as an additional factor in performance evaluation, it is interesting to report the funds' exposure to the coskewness factor rather than in the coskewness measures. The sensitivities to the coskewness factor depend on the factor and the funds used. But, in general, the average betas differ significantly from zero for all categories and factors. So, using the $(S^- - S^+)$ factor, between 58% and 64% of the funds

1993), and we find they are -0.40 and 0.40 for the unconditional skewness and -0.20 and 0.20 for the unconditional coskewness at the 5% level.

are statistically significant. When we use the factor $(S^{-} - R_{f})$ these percentages change to 36% and 58%.[12]

Hence, the results suggest that coskewness could play an important role in explaining the performance evaluation of mutual funds and implies that a disregard for this feature will create a bias – perhaps a significant one – in assessing performance evaluation. We test this hypothesis in the following section.

4.2. The performance evaluation of mutual funds

The results of the time-series estimation for the models are reported in Tables 4.a to 4.d (the first table reporting all funds jointly and subsequent tables reporting each category of mutual funds). Rows 1, 2 and 3 of the tables show the unconditional estimation of CAPM and the CAPM plus the coskewness factors. The four-factor model of Carhart (1997) and the same model plus the coskewness factors are in rows 4, 5 and 6. For each model, we report alpha, beta(s), the adjusted R^2 of the regressions and the likelihood ratio test.

An interesting result from Tables 4.a to 4.d, is that, in general, for all the categories of funds used in this paper and for all models, the average coefficient obtained for the CSK factor is statistically different from zero. The values range from -0.09 to 0.10 using $(S^{-} - S^{+})$, and from -0.15 to 0.17 with $(S^{-} - R_{f})$, depending on the category and the model analyzed. In addition to statistical significance, we must study the economic significance. As the coskewness factor is an excess return, we can calculate an approximate value of the coskewness risk premium by multiplying the loadings on the factor by the sample average return of the coskewness portfolio (3.19% when considering the factor, $(S^{-} - S^{+})$). Thus, the average coskewness risk premium ranges from -0.29% to 0.32%.

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[12] These figures are calculated by regressing the fund excess return of each fund on the spread between the returns on the $(S^{-} - S^{+})$ or $(S^{-} - R_{f})$ portfolios.

In Table 4a, where all funds are analyzed jointly, there is a slight increase in the R^2 value when we use a coskewness factor as an additional explanatory variable; this increase being from 0.76 to 0.78 or 0.79 when we incorporate the coskewness factors in the unconditional CAPM, and from 0.84 to 0.85 when we include it in the unconditional FF4 model.

The last column in Tables 4.a to 4.d reports a standard likelihood ratio (LR) test in order to determine whether there is a statistically significant difference between the explanatory power of the new model with coskewness and the previous model. The introduction of this extra factor leads to an increase in log-likelihood, indicating the relevance of the coskewness. We find that the explanatory power of the coskewness model increases significantly over each corresponding model without this new factor, this being especially relevant in the case of the Aggressive Growth and Growth Income funds for every model, and in the Long-Term Growth category only for the CAPM. Therefore, if we do not incorporate the effect of the systematic skewness, we may create a potential problem of specification that biases the risk-adjusted-return obtained by mutual funds.

Tables 4a to 4d also report the average alphas and their *t*-statistic. In general they are close to zero and negative except for the estimation of the CAPM for the Aggressive Growth category where the alphas are positive. Although the average alphas are not statistically significant in any case, the economic significance of the effect of coskewness on the performance of a fund is not negligible. For example, from Table 4.a, if we compare the mean alpha from CAPM and that from CAPM+CSK (using $(S^- - S^+)$), we find that alpha decreases by -0.024, from -0.017 to -0.041, percent per month after coskewness is controlled. Thus, the net effect of coskewness on alpha is approximately 0.28% (0.024*12) annually.

However, it must be noted that the average change in performance, measured by alpha, is not uniform across categories and models. Firstly, when we include coskewness in the CAPM, the change in alpha is always greater than when it is included in the FF4 model. Secondly, comparing performance among different categories we observe that, in general, taking into account the coskewness makes funds belonging to the Growth Income and Long-Term Growth categories look worse, but funds in the Aggressive Growth category look better. Furthermore, it is important to note that looking only at average alphas may erroneously lead to the conclusion that the economic impact of coskewness on performance is negligible. This is due to the fact that within a fund sample, there may exist managers with a positive beta for the coskewness factor (which would imply a decrease in alpha, as these funds have greater exposure to assets with negative coskewness - undesirable for the investor) and managers with a negative beta for the coskewness factor (which would imply an increase in alpha). Therefore, coskewness may have a negligible impact on the average alpha, even if its effect on individual alphas is significant. This argument suggests that a more detailed analysis is needed to assess the impact of coskewness on performance. In particular, the analysis should pay special attention to the coskewness management strategy implemented by fund managers. In the following subsection, the funds will be grouped according to their sensitivity to the coskewness factor.

The estimation of the conditional models presented in Table 5 shows the signs for the loadings on the coskewness factors are the same as in the unconditional estimations, and also they are statistically significant. According to the LR-test we can, in general, accept that there is a statistically significant increment in the explanatory power of the model with coskewness, this being clearer in the CAPM models than in the FF4 ones, and for the Growth Income category. We also perform an F-test for the marginal explanatory power of conditioning information in the models. In our sample, from the F-test we can conclude that the instruments considered together are not significant at the 5% level[13] . Therefore, given that the conditional models seem

[13] Ferson and Schadt (1996) in a different sample from 1968 to 1990 find p-values of 0.06 for this test.

not to contribute significantly, for the rest of the paper we will focus on the unconditional models.

In Table 6 we display the distribution of the *t*-statistics for alpha coefficients, to analyze whether the coskewness factor significantly changes the distribution of alphas. The figures in each column of the body of the table are the percentages of mutual funds in which the *t*-statistics for the alphas fall within the range of values indicated in the far left-hand column. Panel A of Table 6 reports the unconditional models using the CAPM as a base case and Panel B the unconditional FF4 model. In general, when the systematic skewness is considered, we observe that the distribution of the alphas moves slightly to the left side, indicating that the coskewness factor makes the average performance of the fund managers look worse.

If the coskewness factor is added to the unconditional CAPM the percentage of negative and significant alphas increases by between 1% and 8%, depending on the category of funds. The larger increases from 21% to 29% are obtained in the Growth Income funds when the factor $(S^{-} - R_f)$ is used (and from 21% to 27% with the other one). This movement to the left side is also demonstrated by the FF4 model (e.g. the percentage of negative and significant alphas increases from 21% to 23% when all funds are considered jointly and for the $(S^{-} - R_f)$ factor of coskewness). Moreover, in this case the effect of coskewness is different depending on the category. While in Growth Income the negative and significant alphas increases from 21% to 23%, in the Aggressive Growth category it decreases from 20% to 17%, for both factors.

4.3 The effect of coskewness depending on the coskewness policy

As stated in the previous section, the net effect of considering coskewness over the mutual funds performance cannot be analyzed only by the changes in the average alpha, given that different mutual funds have different exposure to the coskewness factor. Thus, funds with negative sensitivity to the coskewness factor add assets with positive coskewness to their portfolios and, therefore, investors will demand lower returns on these funds. The average alpha (adjusted by the risk of coskewness) should then be higher. However, those funds that incorporate negative coskewness assets, must present a positive beta of coskewness and an investor will demand higher returns due to the higher risk of coskewness and the adjusted alpha should therefore be lower. Given this, the net effect over the average alpha may seem small because the effects of both types of funds are mutually balanced. It could be concluded erroneously that the coskewness effect on the mutual fund performance is negligible, when in fact, as we shall show in Table 6, this is not the case.

Table 7a and 7b show the average estimated alpha in the different models once the funds have been classified into quintiles according to the significance of the beta to the coskewness factor. In Table 7a the analysis is presented using the ($S^- - S^+$) factor and in Table 7b using the ($S^- - R_f$). From these tables, we can first observe that there are clearly opposite effects on the mutual funds alpha depending on the sign of the loading factor of coskewness. For example, in Table 7a, if we consider all funds jointly in the first quintile (that is, the 20% of the funds with the lowest exposure to the CSK factor) the alpha changes from a negative value of -0.14 to a positive value of 0.04, this variation in means being statistically significant at the 5% level. Using the ($S^- - R_f$) factor we obtain the same result, with alpha moving from -0.03% to 0.11% in quintile 1. For the FF4 model the change in alpha is also significant using all the funds jointly. Similarly, for the 20% of funds with the greatest sensitivity to the CSK factor (Q5), the effect on alpha is the opposite, moving from a positive value of 0.21 to a value of 0.00 and the variation in means is also statistically significant with mean alpha moving from 0.07% to -0.04% using the ($S^- - R_f$) factor. Logically, these changes are not statistically significant for the central quintiles formed by funds that do not manage coskewness. Therefore, using the coskewness factor allows us to correct the performance of funds managing coskewness but does not affect those that do not manage coskewness.

A second outcome observed in Tables 7 is that a ranking based on risk adjusted returns without considering coskewness might result in a contrary classification between the funds in the extreme quintiles, where losers would be considered winners and vice versa. For example, in Table 7a and in the CAPM the mean alphas for the quintiles 1 and 5 are -0.14% and 0.21% respectively, but when the coskewness factor is considered the mean alphas change to 0.04% and 0.00% respectively. Moreover, the Wilcoxon test shows how the average alphas are significantly different among these extreme quintiles.

If we carry out the analysis on categories, the conclusions remain identical. However, we must emphasize the different effect obtained in the Aggressive Growth and Growth Income Funds. Thus, in the case of taking into account the coskewness for the former in a FF4 model, the change in alphas is only statistically significant in the first and second quintiles, indicating a better performance for this category of funds. But in the case of the Growth Income category, the change in mean alphas is only statistically significant in the last two Quintiles (Q4 and Q5), generating a worse performance for this category. It must be noted that this result is in accordance with the movement in alphas observer for a FF4 model in the previous Table 6.

As a conclusion drawn from this analysis, we could highlight that, in general, we find evidence of significant changes in mutual funds performance when the systematic skewness is considered, it being of a different sign depending on the fund's exposure to the coskewness factor. Moreover, we find these changes in performance are statistically significant in 80% of the mutual funds sample (Q1, Q2, Q4 and Q5) when the coskewness is introduced in the CAPM, and are statistically significant between 20% and 40% in the FF4 model[14]. Once more, we find that the conclusions are consistent independently of the coskewness factor employed here. Consequently, our results might have serious effects on other mutual funds research where

[14] The lower impact of coskewness in a FF4 model indicates as Chung et all (2006) and Vanden (2006) pointed out, that Fama and French risk factors may be proxing higher order co-moments.

ranking on performance is required, such as persistence studies or studies of investors' selection ability and flow of mutual funds.

4.4 Persistence managing coskewness

Thus far, the analysis of coskewness has considered a 44 year sample. In this long period, it is quite likely that the coskewness of the funds has varied over time[15]. Instead of assuming that the coskewness betas have remained constant over the whole period, it would be interesting to estimate them over shorter periods to appreciate, by categories, whether the coskewness beta changes in magnitude and sign between periods. In this section, we estimate again the models presented in Tables 4 splitting the sample into 3 subsamples: 1962-1976; 1977-1991 and 1992-2006. Table 8 reports these estimations. To analyze the sign and significance of this parameter in each subsample we present, for each model, the alpha with and without coskewness, and the beta of the CSK factor.

The results show that the coskewness policy does not seem constant, given that the beta for the CSK factor has varied over time. Thus, for example for Subperiod 1 to 2, every category changes from a negative and significant beta to a positive one (e.g. Aggressive Growth goes from -0,182 to 0,175), when CAPM is considered. When the FF4 model is considered, there is also a change in sign from subperiod 1 to 2 for the majority of categories. From subperiod 2 to 3, we only find a change in sign of the coskewness beta for the Aggressive Growth and Growth Income category when the FF4 model is used.

Hence, these results highlight the need to consider coskewness when evaluating the performance of mutual funds because, depending on the time period, coskewness affects them

[15] Smith (2007) finds evidence that coskewness is time-varying and rejects the null hypothesis of constant coskewness.

in a different way[16]. In addition, from Table 8 we can observe that the coskewness factor is especially significant in the third time period for all models and categories.[17]

On the other hand, after the previous analysis, we do not know yet if the policy of coskewness of a particular manager remains constant over time, because we have aggregated the funds in categories. However, according to Table 7, we know that within the same category there are funds with positive sensitivity to the coskewness factor and funds with negative sensitivity. Therefore, from an economic point of view it would be interesting to find out if certain managers might be keeping a constant coskewness policy over time and whether they may be profiting from the spread of coskewness.

To study the above question, we use a non-parametric methodology based upon contingency tables. We construct a contingency table of funds called positives and negatives, where a fund is termed positive if its sensitivity to the coskewness factor is positive, otherwise it is negative. The analysis is similar to the persistence performance studies. However, in our context, persistence indicates those funds that are positives in two consecutive periods, denoted by PP, or negatives in two consecutive periods, denoted by NN. Similarly, positives (negatives) in the first period and negatives (positives) in the second period, denoted by PN (NP), indicate a reversal behavior. This contingency analysis requires a division of the sample into subperiods, in addition to needing funds that are alive in two consecutive periods. We have made subperiods of three years, although we work in a context of two periods. Thus, period 62/64-65/67 indicates that the beta of the factor coskewness is considered for period 62/64 and is compared with that obtained in the 65/67 period.[18]

[16] We have also repeated the analysis for only 2 subsamples (1962-1980 and 1981-2006) and the results are very similar. We do not show them here to save space, but they are available upon request.
[17] In the second subsample (January 1977 - December 1991) the absolute t-statistics for coskewness beta are not statistically significant on average, but we have observed that this is because of the extreme return on the crack October 1987. If we estimate the models without this date, then all the t-statistics for beta coskewness are statistically significant, as in the third subsample.
[18] In addition to subperiods of three years, we have also repeated the analysis with subperiods of five years and the results and conclusions are identical. We do not show them to save space.

We use a Cross Product Ratio (CPR) to detect persistence in managing coskewness[19]. The CPR reports the odds ratio of the number of managers that repeat to the number of those that do not repeat; that is, (PP*NN/PN*NP). The null hypothesis that the coskewness policy in the first period is unrelated to the coskewness policy in the second one corresponds to an odds ratio of one. The Tables 9a and 9b report the test statistic for the odds ratio test, using the coskewness factor $(S^{-} - S^{+})$ and $(S^{-} - R_f)$, respectively[20]. In Panel A the analysis is carried out using all mutual funds in the database, and in Panel B only those funds that really manage the coskewness are considered (funds with a statistically significant beta of coskewness).

Independently of the coskewness factor used, in Panel A, in general we find some cases in which there is a persistence in managing coskewness (this number is higher when the CAPM is used) but also a similar number of cases for reversals (e.g. in Table 9a using the CAPM, the proportion of cases of persistence against reversals is 14/1, and using the FF4 model, it decreases to 7/7). Thus, one could conclude erroneously that there is not a persistence behavior from mutual funds managers in managing the coskewness. As we mentioned above, reversals appear when managers change their coskewness policy. However, these reversals could also be generated unintentionally, that is, when we have non significant betas that are changing from positive to negative or vice versa, but that are not statistically significant. In order to verify this issue, we analyze exclusively those funds with a significant beta of coskewness.

In Panel B we present the results for those mutual funds with the coskewness beta statistically significant at 5%. Once we study separately the funds that truly take a policy of coskewness, we observe that in practically all cases, independence is rejected and that the reversal pattern disappears. Therefore, the results indicate that fund managers with a certain policy of managing coskewness tend to maintain it over time (e.g. in Table 9b, for all categories

[19] We also conduct a Chi-square test comparing the observed frequency distribution of PP, PN; NP and NN for each fund with the expected frequency distribution, but given that the conclusions are identical, we do not show them to save space. They are available upon request.
[20] We determine the statistical significance of the CPR by using the standard error of the natural logarithm of the CPR (see Christensen (1990) for more details).

of funds and using the CAPM the proportion of cases of persistence is 7/14 for AG, 9/14 for GI and 11/14 for LTG, and no reversals are found) and this persistence seems to be more relevant in the later time periods (it could also be due to the very low number of funds at the beginning of the sample). Moreover, we also observe that persistence behavior is sensitive to the model used, being clearer when introducing the coskewness factor in a CAPM.

4.5 Mutual Funds Characteristics and Coskewness

The results of the above subsections suggest that some fund managers are managing the coskewness of their portfolios. The next logical objective would be to investigate the characteristics of those funds. Are the funds managing the coskewness the largest or the smallest in size? Do they charge more expenses or are they cheaper? Are they the ones with a higher or lower turnover ratio? To shed some light on these questions, we perform two different analyses: First, a univariate analysis of the mean of some characteristics, once we have separated the funds into three different groups according to their coskewness. Second, we use a Multinominal Logit model to estimate the probability of a fund having a significant coskewness conditional on the explanatory variables.

Now, group (S^-) includes the 15% of the funds with the most negative unconditional coskewness, (S^+) the 15% of those with the most positive coskewness, and (S^0) the rest of the funds. Given the results of Table 3, this result is similar to separating the funds with significant coskewness (especially negative coskewness) from the funds where it is not significant. The characteristics we consider are Total Net Assets (TNA), Expenses and Turnover. They have been obtained from the CRSP database.

The variable TNA is the closing market value of securities owned, plus all assets, minus all liabilities. TNAs from CRSP are reported in millions of dollars. We take logs and multiply them by 10,000. Given that mutual fund sizes have been growing with time and in order to achieve a good measure of the relative size of each mutual fund, we also divided the data by the mean of the market size of the funds in each period. Turnover is the Turnover Ratio of the fund (over the calendar year), that is, the minimum of aggregate purchases of securities or aggregate sales of securities, divided by the average TNA of the fund. The variable Expenses shows the Expense Ratio (over the calendar year), that is, the percentage of the total investment that shareholders pay for the mutual fund's operating expenses. Given the differences over time of some characteristics, such as fund size, we split the sample into three periods: from 1962 to 1976, from 1977 to 1991 and from 1992 to 2006.

Results from the univariate analysis are presented in Table 10. Columns 3, 4 and 5 in this table report the mean of every characteristic in each period. We test the equality of the means and (**) indicates the rejection at the 95% level of the null hypothesis of the equality of means between (S^-) and (S^0), or between (S^+) and (S^0). The last column presents the equality test for the means of the groups (S^-) and (S^+). Thus, for the first characteristic analyzed, TNA, and for all periods we can observe that funds managing the negative coskewness (funds in groups (S^-)) show the smallest sizes. But the mean equality test indicates that the average sizes in the three groups of coskewness are not statistically different among them. The operating Expenses for funds in (S^+) are the lowest in the first period, the means being statistically different. And in the last period the expenses for the funds in (S^-) are higher than in the rest. Finally, the Turnover ratio is statistically different in mean between the groups (S^-) and (S^0) in the last period, the turnover of funds with a negative coskewness being the lowest. Moreover in all periods the Turnover is statistically different in mean between (S^+) and (S^-) in all periods.

The univariate analysis indicates some differences in the characteristics of funds related to coskewness. To clarify the influence on the coskewness of all these characteristics together, we perform a logit analysis. Logit can be viewed as a generalization of the linear regression model to situations where the dependent variable takes on only a finite number of discrete values. Thus, the variable to explain is a dummy variable equal to one where the fund belongs to the 15% of the data with the most extreme negative coskewness (S^-), three if the fund belongs to the 15% of the most positive coskewness (S^+) and two for the rest, that is (S^0) (the comparison group). The reason for performing a logit analysis is to estimate the probability of a fund having a significant coskewness conditional on the explanatory variables. The negative (positive) sign of the coefficient of a characteristic indicates that this characteristic has a negative (positive) impact on the probability of significantly managing coskewness.

In addition to the characteristic considered in the previous univariate analysis and in order to address the different role of fund categories for the coskewness observed in Tables 4a to 4d, we include as an explanatory variable a dummy variable equal to one where the fund belongs to Aggressive Growth (DB1) and another dummy variable equal to one where the fund belongs to Growth Income (DB2). When both dummies are equal to zero the funds belong to Long Term Growth.

The main results from Table 11 for the last two subsmaples (Panels B and C) are two[21]. First, increasing the turnover ratio of the funds, decreases the probability of having a significant negative coskewness and increases the probability of having a significant positive coskewness. This could be interpreted as those funds managers who are managing the coskewness and profiting from the coskewness spread, are those funds which are more passive. Second, being an Aggressive Growth fund increases the probability of having negative coskewness and decreases the probability of having a positive and significant coskewness. Finally, the TNA and the expense ratio are not significant variables to explain the coskewness of the funds.

[21] The great difference in the number of available funds during the last two periods and the first one (169, 411 and 4688 observations respectively) makes us more confident of the results obtained from the latter two periods.

5. Concluding remarks

Recent asset pricing studies have shown that systematic skewness is important and that it helps to explain the time variation of risk premiums. This paper explores the role of coskewness in the analysis of mutual funds performance evaluation by examining a sample of 6,819 equity mutual funds between January 1962 and December 2006.

The results demonstrate that incorporating a coskewness factor as an additional variable increases the explanatory power of the model in both an unconditional and a conditional framework. The coskewness factor is significant even when factors based on size, book-to-market and momentum are included. Therefore, a failure to consider systematic skewness could create a potential problem of specification that could bias the risk-adjusted return obtained by mutual funds and provide investors with inaccurate information about the past performance of mutual fund managers.

From this analysis we could highlight that, in general, we find evidence of significant changes in mutual funds performance when the systematic skewness is taken into account. The sign of the variation in the performance is determined by the loading on the coskewness factor. Thus, if the beta of the coskewness factor is positive, indicating greater exposure of the fund to assets with negative coskewness, the adjusted alpha will decrease, whereas a negative loading in the coskewness factor increases the alpha. These changes in performances are statistically significant in 80% of the mutual funds sample when the coskewness is introduced in the CAPM, and is statistically significant between 20% and 40% in the FF4 model. Furthermore, a ranking based on risk adjusted returns without considering coskewness will generate a misleading classification and may have serious implications for other mutual funds research where ranking on performance is required, such as performance persistence studies or studies of investors' selection ability and flow of mutual funds.

Finally, we document that once managers have decided to employ a certain policy of coskewness, betting on assets with positive or negative coskewness, they continue with that policy over the time. The following step was therefore to identify which class of funds uses one policy or another through a logit analysis. We find that some funds' characteristics are related to the likelihood of managing coskewness. These are the turnover ratio (being the more passive funds, the funds managers who are managing the coskewness and profiting from the coskewness spread) and the category indicator.

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Table 1: Summary Statistics of Mutual Funds: January 1962 - March 2006

	Mean Return	Standard Deviation	Kurtosis	Max. Losses	Max. Returns	Test Normality	
Aggressive Growth	11.038	21.698	4.272	-18.777	17.574	51	
Growth/Income	7.610	14.662	4.191	-13.416	10.624	53	
Long-term Growth	7.441	17.674	4.215	-15.132	13.749	44	
All Funds	8.595	18.206	4.272	-15.854	14.192	48	
	Number of Funds	**36-84**	**84-120**	**120-156**	**156-288**	**>288**	**>432**
Aggressive Growth	2112	1054	600	244	169	45	18
Growth/Income	1617	751	426	197	167	76	50
Long-term Growth	3090	1708	715	366	196	105	61
All Funds	6819	3513	1741	807	532	226	129

The table reports summary statistics for 6819 mutual funds in the database categorised by investment objectives: “Aggressive Growth”, “Income”, “Growth & Income” and “Long-Term Growth”. A fund is included in the investment universe if it contains at least 36 consecutive monthly return observations. For each category, we present in columns the annualized mean return (as a %), standard deviation (as a %), kurtosis, monthly minimum return (*Max. Losses*) and monthly maximum return (*Max. Return*) during the entire sample period, and the percentage of funds for which the null hypothesis of normality of a Jarque-Bera test is rejected at the 10% level of significance. The table also shows the total number of mutual funds in each category in intervals of 36-84, 84-120, 120-156, 156-288 and more than 288 and 432 observations.

Table 2: Summary Statistics of Risk Factors and Instruments

	Market	SMB	HML	WML	$S^- - S^+$	$S^- - R_f$
Mean	5.453	6.118	1.973	10.184	3.190	8.755
Median	9.251	6.000	1.560	10.680	2.239	8.608
Maximum	16.049	13.630	13.420	18.400	16.384	23.005
Minimum	-23.134	-9.840	-21.850	-25.050	-13.422	-19.070
Std. Dev.	15.370	9.975	11.113	13.825	10.033	16.721
Skewness	-0.480	0.274	-0.595	-0.650	0.481	0.007
Kurtosis	4.933	5.380	8.675	8.470	6.747	4.763
Jarque-Bera	0.000	0.000	0.000	0.000	0.000	0.000

Cross Correlations

	Market	**SBM**	**HML**	**WML**	$S^- - S^+$	$S^- - Rf$
EXRM	1.000					
SBM	-0.402	1.000				
HML	0.290	-0.271	1.000			
WML	-0.079	-0.041	-0.103	1.000		
$S^- - S^+$	0.005	0.109	0.126	0.055	1.000	
$S^- - Rf^+$	0.913	-0.310	0.277	-0.132	0.371	1.000

This table reports summary statistics on the risk factors. The mean, median and std. dev. are represented in annual percentages. We show the monthly maximum and minimum return, and the p-value of the Jarque-Bera test. The Market factor is the excess return on the value-weighted CRSP NYSE/AMEX/Nasdaq portfolio; SMB is the factor mimicking portfolio for size; HML is the factor mimicking portfolio for book-to-market, WML is the factor mimicking portfolio for the 1-month return momentum; $S^- - S^+$ and $S^- - R_f$ are the coskewness factors. Table 2 also presents the contemporaneous correlations between the factors included in the models.

Table 3: Skewness and Coskewness of Mutual Funds.

	All Funds	Aggressive Growth	Growth/ Income	Long-term Growth
Panel A: Unconditional Skewness				
Mean	-0.355	-0.299	-0.455	-0.340
Median	-0.399	-0.327	-0.470	-0.391
Positive and Sign. at 5%	4.458	7.955	1.546	3.592
Negative and Sign. at 5%	49.890	42.330	61.534	48.964
Panel B: Unconditional Coskewness				
Mean	-0.013	-0.063	0.016	0.006
Median	-0.006	-0.065	0.029	0.014
Positive and Sign. at 5%	7.626	4.545	8.534	9.256
Negative and Sign. at 5%	12.011	16.241	9.895	10.227
Panel C: C_{2i}				
Mean	-0.134	-0.531	0.093	0.018
Median	-0.018	-0.543	0.127	0.083
Positive and Sign. at 5%	4.355	1.847	5.937	5.243
Negative and Sign. at 5%	5.954	8.665	5.318	4.434
t-statistic	0.826	0.841	0.857	0.800

The unconditional skewness is computed as the third central moment over the mean. The unconditional coskewness is defined as $E(\varepsilon_{i,t+1}\varepsilon^2_{M,t+1}) / \sqrt{E(\varepsilon^2_{i,t+1})}E(\varepsilon^2_{M,t+1})$, where $\varepsilon_{i,t+1}$ is the residual from the regression of the excess return on the contemporaneous market excess return and $\varepsilon_{M,t+1}$ is the residual of the excess market return over its mean. c_{2i} is an alternative measure of coskewness from the quadratic model consistent with the three-moment CAPM, $R_{i,t} - R_{f,t} = c_{0i} + c_{1i}\left[R_{M,t} - R_{f,t}\right] + c_{2i}\left[R_{M,t} - \overline{R}_{M,t}\right]^2 + \nu_{it}$. Significance levels for unconditional skewness and coskewness are computed based on bootstrap percentiles methodology (for a more detailed description on this methodology see Efron and Tibshirani, 1993), and we find that at 5% they are -0.40 and 0.40 for the unconditional skewness and 0.20 and 0.20 for the unconditional coskewness.

Table 4.a: Measures of Performance Using Models With and Without Coskewness. All Funds

	Alpha	R_m	SMB	HML	WML	CSK	R^2_{ADJ}	LR-test
CAPM	-0.017	0.997					76%	
	(1.28)	(21.47)						
CAPM + (S^-S^+)	-0.041	1.004				0.043	78%	0.023
	(1.23)	(21.42)				(2.54)		
CAPM + $(S^-\text{-}Rf)$	-0.019	0.992				0.013	79%	0.012
	(1.32)	(22.21)				(3.03)		
FF4	-0.140	1.015	0.144	0.077	0.036		84%	
	(1.14)	(21.64)	(3.70)	(3.64)	(3.16)			
FF4 + (S^-S^+)	-0.132	1.011	0.144	0.078	0.031	-0.004	85%	0.104
	(1.15)	(21.90)	(3.64)	(3.28)	(3.05)	(1.89)		
FF4 + $(S^-\text{-}Rf)$	-0.131	1.010	0.143	0.080	0.028	-0.015	85%	0.080
	(1.17)	(21.96)	(3.74)	(3.43)	(2.46)	(2.09)		

This table shows the OLS estimates of the models (4)-(7) for all funds analyzed in this paper. Alpha is in monthly units and in percentages. The absolute *t*-statistics are in parentheses. LR_test is the median right-tail probability value of a standard likelihood ratio test in order to determine whether there is a statistically significant difference between the explanatory power of the model with or without the coskewness factor.

Table 4.b: Measures of Performance Using Models With and Without Coskewness. Aggressive Growth

	Alpha	R_m	SMB	HML	WML	CSK	R^2_{ADJ}	LR-test
CAPM	0.145	1.101					66%	
	(1.20)	(14.54)						
CAPM + (S^-S^+)	0.133	1.096				0.033	69%	0.020
	(1.12)	(14.42)				(2.37)		
CAPM + $(S^-\text{-}Rf)$	0.179	1.068				-0.099	69%	0.016
	(1.22)	(14.55)				(2.73)		
FF4	-0.174	1.118	0.406	0.134	0.131		80%	
	(1.14)	(16.14)	(5.75)	(4.00)	(3.10)			
FF4 + (S^-S^+)	-0.143	1.100	0.427	0.176	0.117	-0.090	81%	0.097
	(1.12)	(16.09)	(5.72)	(3.83)	(2.95)	(1.78)		
FF4 + $(S^-\text{-}Rf)$	-0.134	1.097	0.414	0.173	0.092	-0.149	81%	0.090
	(1.13)	(16.04)	(5.81)	(3.89)	(2.42)	(1.93)		

This table shows the OLS estimates of the models (4)-(7) for the Aggressive Growth funds. Alpha is in monthly units and in percentages. The absolute *t*-statistics are in parentheses. LR_test is the median right-tail probability value of a standard likelihood ratio test in order to determine whether there is a statistically significant difference between the explanatory power of the model with or without the coskewness factor.

Table 4.c: Measures of Performance Using Models With and Without Coskewness. Growth Income

	Alpha	R_m	SMB	HML	WML	CSK	R^2_{ADJ}	LR-test
CAPM	-0.071	0.855					82%	
	(1.23)	(28.81)						
CAPM + (S^-S^+)	-0.132	0.884				0.099	85%	0.015
	(1.27)	(29.21)				(2.94)		
CAPM + $(S^-$-$Rf)$	-0.116	0.883				0.168	86%	0.001
	(1.36)	(30.92)				(3.90)		
FF4	-0.102	0.891	-0.020	0.129	-0.069		88%	
	(1.13)	(29.47)	(2.85)	(3.54)	(3.71)			
FF4 + (S^-S^+)	-0.117	0.900	-0.038	0.093	-0.066	0.074	89%	0.034
	(1.19)	(30.28)	(2.92)	(3.04)	(3.64)	(2.34)		
FF4 + $(S^-$-$Rf)$	-0.125	0.903	-0.029	0.098	-0.048	0.118	89%	0.016
	(1.23)	(30.58)	(2.99)	(3.27)	(2.74)	(2.72)		

This table shows the OLS estimates of the models (4)-(7) for the Growth Income funds. Alpha is in monthly units and in percentages. The absolute *t*-statistics are in parentheses. LR_test is the median right-tail probability value of a standard likelihood ratio test in order to determine whether there is a statistically significant difference between the explanatory power of the model with or without the coskewness factor.

Table 4.d: Measures of Performance Using Models With and Without Coskewness. Long Term Growth

	Alpha	R_m	SMB	HML	WML	CSK	R^2_{ADJ}	LR-test
CAPM	-0.099	1.000					79%	
	(1.36)	(22.36)						
CAPM + (S^-S^+)	-0.111	1.004				0.021	81%	0.033
	(1.29)	(22.12)				(2.44)		
CAPM + $(S^-$-$Rf)$	-0.104	0.998				0.008	82%	0.030
	(1.38)	(22.88)				(2.78)		
FF4	-0.136	1.008	0.051	0.011	0.027		86%	
	(1.14)	(21.29)	(2.73)	(3.45)	(2.92)			
FF4 + (S^-S^+)	-0.132	1.007	0.046	0.002	0.023	0.014	86%	0.148
	(1.16)	(21.49)	(2.60)	(3.02)	(2.81)	(1.72)		
FF4 + $(S^-$-$Rf)$	-0.133	1.007	0.048	0.007	0.024	0.007	86%	0.124
	(1.18)	(21.50)	(2.73)	(3.19)	(2.34)	(1.87)		

This table shows the OLS estimates of the models (4)-(7) for the Long Term Growth funds. Alpha is in monthly units and in percentages. The absolute *t*-statistics are in parentheses. LR_test is the median right-tail probability value of a standard likelihood ratio test in order to determine whether there is a statistically significant difference between the explanatory power of the model with or without the coskewness factor.

Table 5: Measures of Performance Using Conditional Models With and Without Coskewness.

	Alpha	CSK	R^2_{ADJ}	LR-test	Pval_F	Alpha	CSK	R^2_{ADJ}	LR-test	Pval_F
	Panel a: All Funds					Panel b: Aggressive Growth				
CAPM	-0.012		78%		0.10	0.178		68%		0.18
	(1.21)					(1.06)				
CAPM + $(S^{-}-S^{+})$	-0.034	0.040	80%	0.04	0.16	0.149	0.042	70%	0.040	0.26
	(1.20)	(2.24)				(1.01)	(2.10)			
CAPM + $(S^{-}-Rf)$	-0.017	0.008	80%	0.016	0.16	0.188	-0.093	71%	0.018	0.26
	(1.27)	(2.75)				(1.08)	(2.51)			
FF4	-0.117		85%		0.17	-0.114		81%		0.22
	(1.10)					(1.03)				
FF4 + $(S^{-}-S^{+})$	-0.113	-0.009	86%	0.103	0.18	-0.093	-0.094	82%	0.104	0.24
	(1.14)	(1.81)				(1.05)	(1.69)			
FF4 + $(S^{-}-Rf)$	-0.113	-0.020	86%	0.081	0.18	-0.084	-0.147	82%	0.094	0.25
	(1.11)	(1.20)				(1.05)	(1.85)			
	Panel c: Growth Income					Panel d: Long Term Growth				
CAPM	-0.122		84%		0.05	-0.084		81%		0.10
	(1.26)					(1.28)				
CAPM + $(S^{-}-S^{+})$	-0.157	0.081	86%	0.026	0.08	-0.095	0.017	83%	0.049	0.14
	(1.33)	(2.57)			0.10	(1.25)	(2.16)			
CAPM + $(S^{-}-Rf)$	-0.142	0.143	87%	0.001		-0.091	0.007	83%	0.038	0.15
	(1.39)	(3.53)				(1.33)	(2.50)			
FF4	-0.128		89%		0.09	-0.114		87%		0.16
	(1.19)					(1.10)				
FF4 + $(S^{-}-S^{+})$	-0.138	0.069	90%	0.034	0.09	-0.113	0.007	87%	0.143	0.17
	(1.27)	(2.25)				(1.13)	(1.66)			
FF4 + $(S^{-}-Rf)$	-0.146	0.107	90%	0.021	0.10	-0.114	0.001	87%	0.114	0.16
	(1.31)	(2.56)				(1.15)	(1.81)			

This table shows the OLS estimates of the conditional models (4)-(7) for all funds analyzed in this paper. We use the lagged level of the one-month Treasury bill yield, the lagged dividend yield of the CRSP value –weighted NYSE/AMEX and NASDAQ stock index, a lagged measure of the slope of the term structure and a lagged corporate spread on the corporate bond market as instruments. Alpha is in monthly units and in percentages and CSK is the coskewness loading factor. The absolute *t*-statistics are in parentheses. LR_test is the median right-tail probability value of a standard likelihood ratio test in order to determine whether there is a statistically significant difference between the explanatory power of the model with or without the coskewness factor. Pval_F is the median right-tail probability value of the F-test for the marginal significance of the term including the instruments.

Table 6: Distribution of *t*-statistics for the Alpha Coefficients

Panel A:		**CAPM**			**CAPM +(*S*—*S*+)**				**CAPM +(*S*--*Rf*)**			
	ALL	**AG**	**GI**	**LTG**	**ALL**	**AG**	**GI**	**LTG**	**ALL**	**AG**	**GI**	**LTG**
Bonferroni *p*-value	0	0	0	0	0	0	0	0	0	0	0	0
***t*<-2.291**	10	3	12	15	10	3	13	14	12	3	16	16
-2.291<*t*<-1.995	4	1	4	5	5	2	6	5	4	1	6	5
-1.995<*t*<-1.666	5	2	5	6	5	2	8	6	5	2	7	5
-1.666<t<0	37	32	43	38	40	31	49	42	37	29	43	38
0<*t*<1.666	33	40	30	28	32	46	21	27	31	42	22	27
1.666<*t*<1.995	3	6	2	2	3	6	1	2	4	7	3	3
1.995<*t*<2.291	3	5	2	2	2	5	1	1	3	6	1	2
***t*>2.291**	6	11	2	4	3	6	1	3	5	10	1	4
Bonferroni *p*-value	0	0	0.01	0.02	0	0	0	0.19	0	0	0.02	0.04

Panel B:		**FF4**			**FF4 +(*S*—*S*+)**				**FF4+(*S*--*Rf*)**			
	ALL	**AG**	**GI**	**LTG**	**ALL**	**AG**	**GI**	**LTG**	**ALL**	**AG**	**GI**	**LTG**
Bonferroni *p*-value	0	0	0	0	0	0	0	0	0	0	0	0
***t*<-2.291**	10	9	10	11	10	8	11	10	11	8	13	11
-2.291<*t*<-1.995	4	4	5	5	5	4	5	6	5	3	5	5
-1.995<*t*<-1.666	7	7	6	7	6	5	7	7	7	6	7	7
-1.666<*t*<0	50	50	52	49	49	49	52	49	49	48	52	48
0<*t*<1.666	26	27	26	25	25	29	22	24	25	28	22	24
1.666<*t*<1.995	1	2	1	1	2	2	1	2	2	2	1	2
1.995<*t*<2.291	1	1	0	1	1	1	0	1	1	1	0	1
***t*>2.291**	1	1	1	1	1	2	1	1	1	2	1	1
Bonferroni *p*-value	0	0	1	1	0	0	0.51	1	0	0	1	1

The numbers in each column of the table are the percentages of mutual funds for which the *t*-statistics for the alphas fell within the range of values indicated in the far-left-hand column. In Panel A we show the unconditional models using the CAPM as a case base. In Panel B the base case is the unconditional FF4 model Inside each type of model, in columns, we present each of the categories of funds: ALL (All Funds), AG (Aggressive Growth Funds), GI (Growth Income Funds) and LTG (Long-Term Growth Funds). The Bonferroni *p*-value indicates the p-values based on the Bonferroni inequality. This is computed as the p-value (one-tailed) associated with the maximum or minimum t-statistic, multiplied by the number of funds. It tests the hypothesis that all the alphas are zero against the alternative that at least one is positive (maximum value) or negative (minimum value).

Table 7a: The significance of Coskewness in performance with factor (S^{-} - S^{+})

	$\beta^{(S-S+)}$	CAPM (α%)	CAMP+ (S^{-}-S^{+}) (α%)	$\beta^{(S-S+)}$	FF4 (α%)	FF4 + (S^{-}-S^{+}) (α%)
All Funds						
Q1	-0.30	-0.14	0.04**	-0.27	-0.15	-0.08**
Q2	-0.09	-0.14	-0.09**	-0.09	-0.16	-0.14
Q3	0.07	-0.08	-0.12**	0.02	-0.13	-0.13
Q4	0.19	0.07	-0.04**	0.12	-0.16	-0.16
Q5	0.35	0.21	0.00**	0.20	-0.11	-0.14**
Aggressive Growth						
Q1	-0.44	-0.04	0.22**	-0.37	-0.14	-0.06**
Q2	-0.17	0.04	0.14**	-0.23	-0.16	-0.11*
Q3	0.06	0.06	0.03	-0.10	-0.16	-0.15
Q4	0.27	0.17	0.05**	0.04	-0.16	-0.16
Q5	0.44	0.50	0.23**	0.21	-0.24	-0.24
Growth Income						
Q1	-0.13	-0.19	-0.13**	-0.08	-0.15	-0.14
Q2	0.02	-0.17	-0.18	0.02	-0.13	-0.13
Q3	0.09	-0.11	-0.16**	0.09	-0.09	-0.11
Q4	0.20	0.04	-0.08**	0.13	-0.06	-0.09*
Q5	0.32	0.07	-0.12**	0.22	-0.07	-0.12**
Long-Term Growth						
Q1	-0.27	-0.22	-0.07**	-0.20	-0.14	-0.09**
Q2	-0.11	-0.21	-0.14**	-0.07	-0.15	-0.14
Q3	0.03	-0.18	-0.20	0.02	-0.12	-0.12
Q4	0.14	-0.04	-0.12**	0.11	-0.15	-0.16
Q5	0.31	0.15	-0.03**	0.21	-0.12	-0.15**

This table presents the average estimated alphas in the different models once funds have been classified into quintiles based on the t-statistic of the beta coefficient of the coskewness factor (S^{-}-S^{+}). The $\beta^{(S-S+)}$ column presents the value of the beta coefficient of the coskewness factor in each quintile. CAPM (α%) indicates the average alpha using the CAPM in each quintile. CAMP+(S^{-}-S^{+}) (α%) is the average alpha as a using the CAPM with an additional coskewness factor (S^{-}-S^{+}), FF4 (α%) is the average alpha form the Carhart model, and FF4+(S^{-}-S^{+}) (α%) is the average alpha form a Carhart model including the coskewness factor.

** means significance at the 5% level and * at the 10% level for the Wilcoxon test of differences in alpha distribution between the model with and without coskewness.

Table 7b: The significance of Coskewness in performance with factor (S^{-}-Rf)

	$\beta^{((S^{-}-Rf)}$	CAPM (α%)	CAMP+(S^{-}-Rf) (α%)	$\beta^{(S^{-}-Rf)}$	FF4 (α%)	FF4 + (S^{-}-Rf) (α%)
All Funds						
Q1	-0.57	-0.03	0.11**	-0.41	-0.17	-0.07**
Q2	-0.15	-0.16	-0.13*	-0.12	-0.15	-0.14
Q3	0.09	-0.06	-0.07	0.03	-0.15	-0.16
Q4	0.30	0.10	0.03**	0.16	-0.14	-0.16
Q5	0.40	0.07	-0.04**	0.27	-0.08	-0.13**
Aggressive Growth						
Q1	-0.81	0.07	0.28**	-0.57	-0.17	-0.04**
Q2	-0.42	0.01	0.12**	-0.34	-0.15	-0.07**
Q3	-0.05	0.00	0.01	-0.13	-0.15	-0.14
Q4	0.29	0.19	0.15	0.04	-0.22	-0.22
Q5	0.49	0.46	0.33**	0.25	-0.17	-0.19
Growth Income						
Q1	-0.18	-0.15	-0.12	-0.11	-0.15	-0.13
Q2	0.06	-0.15	-0.16	0.05	-0.12	-0.13
Q3	0.21	-0.07	-0.13**	0.15	-0.11	-0.14*
Q4	0.26	-0.04	-0.11**	0.20	-0.06	-0.10**
Q5	0.49	0.05	-0.06**	0.30	-0.06	-0.12**
Long-Term Growth						
Q1	-0.47	-0.12	-0.01**	-0.33	-0.15	-0.08**
Q2	-0.15	-0.26	-0.23	-0.09	-0.18	-0.17
Q3	0.04	-0.15	-0.16	0.03	-0.12	-0.12
Q4	0.21	-0.01	-0.06*	0.15	-0.14	-0.16
Q5	0.40	0.05	-0.06**	0.28	-0.08	-0.13**

This table presents the average estimated alphas in the different models once funds have been classified into quintiles based on the t-statistic of the beta coefficient of the coskewness factor (S^{-}-R^{f}). The $\beta^{((S^{-}-Rf)}$ column presents the value of the beta coefficient of the coskewness factor in each quintile. CAPM (α%) indicates the average alpha using the CAPM in each quintile. CAMP+(**S^{-}-Rf**) (α%) is the average alpha as a using the CAPM with an additional coskewness factor, FF4 (α%) is the average alpha form the Carhart model, and FF4+(**S^{-}-Rf**) (α%) is the average alpha form a Carhart model including the coskewness factor.

** means significance at the 5% level and * at the 10% level for the Wilcoxon test of differences in alpha distribution between the model with and without coskewness.

Table 8: The Coskewness beta by subperiods

	Panel A: 1962-1976		Panel B: 1977-1991		Panel C: 1992-2006	
	(α%)	$\beta^{(S-S+)}$	(α%)	$\beta^{(S-S+)}$	(α%)	$\beta^{(S-S+)}$
All Funds						
CAPM	0.063		0.013		-0.022	
CAPM + (S^{-}–S^{+})	0.074	-0.089**	0.009	0.079	-0.046	0.043**
CAPM + (S^{-}-Rf)	0.051	-0.191**	0.021	0.076	-0.024	0.012**
FF4	0.067		0.056		-0.152	
FF4 + (S^{-}–S^{+})	0.081	-0.085**	0.054	0.011	-0.144	-0.005**
FF4 + (S^{-}-Rf)	0.061	-0.106	0.055	0.005	-0.144	-0.016**
Aggressive Growth						
CAPM	-0.070		0.016		0.146	
CAPM + (S^{-}–S^{+})	-0.048	-0.182**	0.007	0.175*	0.136	0.030**
CAPM + (S^{-}-Rf)	-0.096	-0.401**	0.036	0.179	0.184	-0.109**
FF4	-0.007		0.129		-0.192	
FF4 + (S^{-}–S^{+})	0.020	-0.159**	0.125	0.017	-0.159	-0.097**
FF4 + (S^{-}-Rf)	-0.018	-0.220*	0.127	0.007	-0.149	-0.157**
Growth Income						
CAPM	0.046		-0.028		-0.073	
CAPM + (S^{-}–S^{+})	0.052	-0.072**	-0.022	0.007	-0.140	0.106**
CAPM + (S^{-}-Rf)	0.036	-0.102*	-0.022	0.014	-0.123	0.179**
FF4	-0.007		-0.021		-0.108	
FF4 + (S^{-}–S^{+})	0.005	-0.067**	-0.019	-0.003	-0.124	0.079**
FF4 + (S^{-}-Rf)	-0.012	-0.074*	-0.020	-0.001	-0.134	0.125**
Long-Term Growth						
CAPM	0.129		0.044		-0.108	
CAPM + (S^{-}–S^{+})	0.139	-0.062*	0.035	0.067	-0.121	0.020**
CAPM + (S^{-}-Rf)	0.120	-0.166*	0.045	0.050	-0.113	0.008**
FF4	0.148		0.064		-0.149	
FF4 + (S^{-}–S^{+})	0.158	-0.068**	0.060	0.018	-0.144	0.013*
FF4 + (S^{-}-Rf)	0.143	-0.083	0.062	0.009	-0.146	0.007**

This table presents the average estimated alphas (in percentage and monthly units) and the coskewness loading factors for the models indicated in the far-left-column and for three subsamples (Panel A: 1962-1976; Panel B: 1977-1991; and Panel C: 1992-2006). ** means significance at the 5% level and * at the 10% level.

Table 9.a: Non Parametric Tests of Persistence in Coskewness Policy - Using factor ($S^- - S^+$)

Panel A: Analysis with all mutual funds in the database.

	CAPM			FF4		
	Aggressive Growth	**Growth Income**	**Long-Term Growth**	**Aggressive Growth**	**Growth Income**	**Long-Term Growth**
62/64-65/67	-0.23	1.05	0.81	0.49	-0.70	0.35
65/67-68/70	-0.41	1.18	0.00	**1.65***	0.92	**2.16***
68/70-71/73	0.36	0.31	0.22	-0.92	-0.24	-0.54
71/73-74/76	0.15	0.62	0.51	0.93	0.05	0.46
74/76-77/79	-0.12	**1.67***	-0.82	1.24	-0.91	0.23
77/79-80/82	0.60	1.10	0.37	-0.52	**1.46***	1.15
80/82-83/85	0.47	**2.17****	**3.62****	0.65	**2.42****	**1.35***
83/85-86/88	-0.20	**1.95****	1.22	-2.35	<u>-1.66*</u>	0.08
86/88-89/91	-0.75	0.46	-0.95	0.67	-0.47	<u>-1.36*</u>
89/91-92/94	**4.47****	**5.32****	**4.47****	-0.98	0.90	<u>-1.60*</u>
92/94-95/97	0.13	**2.82****	**3.64****	**2.56****	**3.58****	3.10**
95/97-98/00	-1.49	-0.63	<u>-1.83**</u>	<u>-1.60*</u>	-1.00	<u>-2.21**</u>
98/00-01/03	**2.22****	0.48	**7.50****	-1.06	<u>-3.68**</u>	<u>-3.71**</u>
01/03-04/06	**8.87****	**7.45****	**10.66****	**3.85****	0.08	0.27

Panel B: Analysis with only those mutual funds with a significant beta of coskewness.

	CAPM			FF4		
	Aggressive Growth	**Growth Income**	**Long-Term Growth**	**Aggressive Growth**	**Growth Income**	**Long-Term Growth**
62/64-65/67	-0.47	**2.00****	-0.33	0.00	1.24	-1.01
65/67-68/70	0.47	**1.99****	1.06	**1.55***	**2.28****	**2.00***
68/70-71/73	0.24	**2.21****	1.30	-0.42	0.94	0.30
71/73-74/76	0.31	**1.43***	**1.55***	0.85	0.68	0.79
74/76-77/79	0.26	0.81	**1.56***	0.74	0.76	**1.59***
77/79-80/82	0.53	**1.76****	**3.12****	0.19	1.06	0.39
80/82-83/85	**1.55***	**3.46****	**4.27****	0.37	**3.07****	**2.03****
83/85-86/88	**2.20****	**2.72****	**2.81****	0.86	**1.38***	**2.48****
86/88-89/91	1.15	**3.84****	**1.66***	1.29	1.13	**3.06****
89/91-92/94	**3.43****	**5.85****	**6.19****	1.24	**2.96****	**3.61****
92/94-95/97	**2.08****	**5.75****	**7.10****	**3.70****	**4.07****	**4.37****
95/97-98/00	<u>-1.73**</u>	**2.03****	**1.64***	0.90	1.37	**3.13***
98/00-01/03	**3.91****	**4.41****	**12.75****	-0.87	-0.55	<u>-1.73**</u>
01/03-04/06	**10.82****	**8.57****	**14.89****	**3.24****	**3.58****	**5.91****

This table reports the Cross-Product ratio (CPR), a non-parametric test based upon contingency tables which are computed as indicated in section 4.4. In Panel A the analysis is carried out using all mutual funds in the database, and in Panel B only funds that really manage the coskewness are considered (funds with a statistically significant beta of coskewness at 5%). Bold numbers indicate the cases where persistence in coskewness policy is accepted at 5% or 10%, and underlined numbers denote a statistically significant reversal in coskewness policy at 5% or 10%. * indicates statistical significant at 5%. ** show statistical significant at 10%.

Table 9.b: Non Parametric Tests of Persistence in Coskewness Policy - Using factor (S- - R_f)

Panel A: Analysis with all mutual funds in the database.

	CAPM			FF4		
	Aggressive Growth	**Growth Income**	**Long-Term Growth**	**Aggressive Growth**	**Growth Income**	**Long-Term Growth**
62/64-65/67	-0.87	0.58	-0.53	-0.84	0.25	-1.29
65/67-68/70	-0.41	**1.54***	-0.57	**1.55***	1.16	1.09
68/70-71/73	-0.39	0.08	**1.79****	0.07	0.32	0.00
71/73-74/76	0.45	-0.71	0.96	0.64	-1.19	0.14
74/76-77/79	0.16	**1.50***	**1.81****	**1.80****	-1.26	0.00
77/79-80/82	-0.16	-0.39	0.06	0.16	0.81	1.19
80/82-83/85	-0.39	0.39	**2.75****	-0.10	0.85	**2.18****
83/85-86/88	-0.10	1.54*	1.49*	-0.92	**-1.49***	**1.90****
86/88-89/91	1.01	1.56*	0.64	0.56	-0.15	-0.80
89/91-92/94	**4.97****	**3.91****	**6.08****	-1.82**	-0.50	-0.33
92/94-95/97	-0.70	**3.92****	**3.79****	**3.40****	**1.69***	**2.24****
95/97-98/00	1.05	-0.38	1.42*	-1.72**	1.30	-0.12
98/00-01/03	0.23	-1.10	**4.76****	-2.91**	-2.19**	**3.43****
01/03-04/06	-0.38	**2.90****	0.68	-3.73**	-7.72**	**-3.29****

Panel B: Analysis with only those mutual funds with a significant beta of coskewness.

	CAPM			FF4		
	Aggressive Growth	**Growth Income**	**Long-Term Growth**	**Aggressive Growth**	**Growth Income**	**Long-Term Growth**
62/64-65/67	-0.24	**1.76****	-0.61	-0.37	-0.77	-1.18
65/67-68/70	0.00	0.82	-0.70	1.40*	**1.42***	1.02
68/70-71/73	1.25	0.30	**1.44***	0.19	0.68	-0.11
71/73-74/76	0.32	0.54	0.72	**1.83****	0.49	0.36
74/76-77/79	1.08	**1.97****	**2.15****	0.69	0.12	**1.62***
77/79-80/82	0.56	**2.04****	**1.99****	-1.25	0.80	0.78
80/82-83/85	**1.62***	**3.13****	**3.11****	0.37	**1.46***	**2.11****
83/85-86/88	**2.08****	**1.99****	**3.57****	0.56	1.23	**2.74****
86/88-89/91	**2.34****	**3.63****	**3.68****	**2.35****	**2.59****	**3.70****
89/91-92/94	**3.84****	**4.82****	**5.54****	1.23	**3.18****	**3.17****
92/94-95/97	**2.80****	**5.60****	**5.90****	**3.83****	**4.05****	**4.42****
95/97-98/00	0.00	0.47	**2.67****	0.24	1.10	**3.77****
98/00-01/03	**2.22****	1.12	**6.24****	0.79	0.50	**6.98****
01/03-04/06	**2.87****	**6.76****	**7.25****	**1.65***	**4.20****	**5.82****

This table reports the Cross-Product ratio (CPR), a non-parametric test based upon contingency tables which are computed as indicated in section 4.4. In Panel A the analysis is carried out using all mutual funds in the database, and in Panel B only funds that really manage the coskewness are considered (funds with a statistically significant beta of coskewness at 5%). Bold numbers indicate the cases where persistence in coskewness policy is accepted at 5% or 10%, and underlined numbers denote a statistically significant reversal in coskewness policy at 5% or 10%. * indicates statistical significant at 5%. ** show statistical significant at 10%.

Table 10: Means of the Mutual fund Characteristics grouped by coskewness

Variables		S^-	S^0	S^+	Equally test
TNA	**1962-1976**	7.376	7.457	7.957	0.200
	1977-1991	7.523	7.748	7.683	0.592
	1992-2006	6.596	6.648	6.648	0.624
Expenses	**1962-1976**	0.009	0.009	0.007**	0.002
	1977-1991	0.011	0.011	0.011	0.585
	1992-2006	0.015**	0.014	0.014	0.004
Turnover	**1962-1976**	0.837*	0.642	0.491	0.002
	1977-1991	0.680	0.823	0.850	0.091
	1992-2006	0.856**	0.953	0.948	0.078

We present the mean of several characteristics of mutual funds separated into three groups of coskewness:, S^- includes the 15% of the funds with the most negative coskewness, S^+ the 15% of those with the most positive coskewness, and S^0 the rest of the funds. TNA is the closing market value of securities owned, plus all assets, minus all liabilities. We take logs and multiply by 10,000 and also divide the data by the mean of the market size of the funds in each period. The variable Expenses shows the Expense Ratio (over the calendar year), that is, the percentage of the total investment that shareholders pay for the mutual fund's operating expenses. Turnover is the Turnover Ratio of the Fund (over the calendar year), that is, the minimum of aggregate purchases of securities or aggregate sales of securities, divided by the average TNA of the fund.

** indicates the rejection, at 95%, of the null hypothesis of the equality of means between S^- and S^0, or between S^+ and S^0. The last column, presents the equality test for the means of the groups S^- and S^+.

Table 11: Relation between characteristics of Funds and Coskewness

Panel A: 1962-1976			Panel B: 1977-1991			Panel C: 1992-2006		
Variable	**Marg. Prob.**	**p-val.**	**Variable**	**Marg. Prob.**	**p-val.**	**Variable**	**Marg. Prob.**	**p-val.**
$S^- = 1$			$S^- = 1$			$S^- = 1$		
Intercept	-1.029	0.533	Intercept	-1.485	0.215	Intercept	-1.651	<0.000
TNA	-0.042	0.79	TNA	-0.069	0.534	TNA	-0.011	0.626
Turnover	1.239	0.01	Turnover	-0.604	0.025	Turnover	-0.359	<0.000
Expenses	-84.69	0.317	Expenses	27.433	0.487	Expenses	9.361	0.221
DB1	-1.508	0.075	DB1	0.958	0.01	DB1	0.959	<0.000
DB2	-0.523	0.354	DB2	0.876	0.018	DB2	-0.22	0.094
$S^+ = 3$			$S^+ = 3$			$S^+ = 3$		
Intercept	1.513	0.42	Intercept	-1.58	0.066	Intercept	-1.332	<0.000
TNA	-0.2069	0.193	TNA	-0.04	0.643	TNA	-0.005	0.797
Turnover	0.452	0.541	Turnover	0.207	0.302	Turnover	0.1603	0.007
Expenses	-301.19	0.006	Expenses	4.268	0.902	Expenses	-3.971	0.585
DB1	-1.11	0.368	DB1	-0.379	0.314	DB1	-1.423	<0.000
DB2	1.426	0.003	DB2	0.687	0.034	DB2	0.131	0.186
Number of obs	169		Number of obs	411		Number of obs	4688	
Wald $chi^2(10)$	28.53		Wald $chi^2(10)$	23		Wald $chi^2(10)$	345	
Prob $>chi^2$	0.0015		Prob $>chi^2$	0.0107		Prob $>chi^2$	<0.000	
Log likelihood	-121.4		Log likelihood	-324.51		Log likelihood	-3658	
Pseudo R^2	0.115		Pseudo R^2	0.034		Pseudo R^2	0.05	

The Table reports results of a multinomial logit analysis for individual funds in which the dependent variable equals one if the coskewness of the fund belongs to the 15% of the funds with the most negative coskewness and equals three if the coskewness of the fund belongs to the 15% of those with the most positive coskewness, and zero otherwise (this is the comparison group). TNA is the closing market value of securities owned, plus all assets, minus all liabilities. We take logs and multiply by 10,000 and also divide the data by the mean of the market size of the funds in each period. The variable Expenses shows the Expense Ratio (over the calendar year), that is, the percentage of the total investment that shareholders pay for the mutual fund's operating expenses. Turnover is the Turnover Ratio of the Fund (over the calendar year), that is, the minimum of aggregate purchases of securities or aggregate sales of securities, divided by the average TNA of the fund. DB1 is a dummy variable equal to one if the fund belongs to Aggressive Growth and DB2 is equal to one if the fund belongs to Growth Income. When both dummies are equal to zero the funds belong to Long Term Growth. Number of obs indicates the number of funds available for that time period. This table also shows the Wald test for testing equality of logit coefficients and the pseudo R^2 for the regressions.