The Attributes, Behavior and Performance of U.S. Mutual Funds

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Abstract

This paper examines the risk and return characteristics of U.S. mutual funds using fifteen years of monthly return data. We employ an equilibrium version of the Arbitrage Pricing Theory (APT) and a principal components-based statistical technique to identify performance benchmarks. We also consider the Capital Asset Pricing Model (CAPM) as an alternative. Performance measurement with the CAPM is compromised by the size effect and a size bias is also evident but smaller with the APT. We re-estimate Henriksson and Merton's timing test for the CAPM and extend it to the APT. We find that this timing test is misspecified due to non-information-based changes in mutual fund betas. We develop a modification to the Henriksson-Merton procedure which under certain conditions distinguishes true timing from non-information-based beta changes.
1. Introduction

This paper examines the risk and return characteristics of a sample of 130 U.S. mutual funds using 15 years of monthly return data. We use an equilibrium version of the Arbitrage Pricing Theory (APT) and a principal components-based statistical methodology to develop our performance benchmarks. We also consider the Capital Asset Pricing Model (CAPM) as an alternative model.

In section 2 we develop and apply a new instrumental variables procedure to transform the factor betas of the APT into "economically meaningful" categories of risk in capital markets (such as inflation risk, term structure risk, industrial output risk).

In section 3 we estimate betas and selectivity-based performance measures for both the CAPM and APT. We find that selectivity-based performance measurement with the CAPM is compromised by the size effect in asset returns. Our APT also shows a smaller, but still significant, size-related bias.

Section 4 presents estimates of timing performance for the mutual funds. We use the model developed by Merton (1981) and Henriksson and Merton (1981) and estimated by Henriksson (1984). We re-estimate their model with our larger data set and some new techniques. We confirm and, in fact, strengthen Henriksson's key findings. We also apply the methodology to the APT and find results very similar to those for the CAPM.

Dynamic trading strategies and/or nonlinearities in the return generating process can invalidate the measures of timing and selectivity proposed by Henriksson and Merton. We
describe an aggregate measure of total performance (timing plus selectivity) which remains valid under certain types of dynamic trading strategies or return nonlinearities. With this new version of the Henriksson-Merton model, we examine the dynamic risk adjustments undertaken by mutual funds, and evaluate the effect of this dynamic behavior on the measurement of their timing performance. We uncover strong evidence that mutual fund betas co-vary with movements in the market portfolio return. However, we also find convincing evidence that this correlation between mutual fund beta and market return is not caused by superior timing ability on the part of mutual fund managers. Rather, it arises from one of several possible sources of misspecification in the Henriksson-Merton model.

Section 5 summarizes the findings of the paper.

2. Measuring the Risk of Mutual Funds

2a. Risk Measurement with the CAPM and APT

Under the CAPM, the compensated risk of an asset is measured by its market beta. Let \( r_i \) denote the excess return (the return above the riskless return) on an asset or unchanging portfolio of assets. The CAPM assumes that the returns on assets have a multivariate normal distribution and that investors have one-period investment horizons. It is shown under these assumptions that all investors will hold combinations of the market portfolio of risky assets and the risk-free asset. Given joint normality of returns, one can always decompose asset excess returns into a constant, sensitivity to the market, and a conditionally mean-zero residual term:
\[ r_i = \alpha_i + \beta_i r_q + \epsilon_i, \]  

\[ E[\epsilon_i | r_q] = 0, \]  

where \( r_q \) is the excess return to the market portfolio and \( \beta_i = \text{cov}(r_i, r_q) / \text{var}(r_q) \). In competitive equilibrium, the CAPM pricing relationship will hold and \( \alpha_i = 0 \) for all \( i = 1, \ldots, n \). The CAPM also implies that an investor need only consider the beta of an asset or collection of assets to gauge its marginal impact on the risk of his optimal portfolio.

The APT begins with an assumption that the unexpected return of each asset is a linear combination of a set of \( k \) factor shocks plus an asset-specific shock.

\[ r_i = E[r_i] + B_{i1} f_1^* + \ldots + B_{ik} f_k^* + \epsilon_i, \quad i = 1, \ldots, n \]  

\[ E[\epsilon_i | f^*] = 0 \]  

Let \( f = (f_1, \ldots, f_k) \) denote the excess returns to a set of \( k \) portfolios with unit correlation to the factors \( f_1^*, \ldots, f_k^* \). Given (3) there exist factor betas \( \beta_i = (\beta_{i1}, \ldots, \beta_{ik}) \quad i = 1, \ldots, n \) such that:

\[ r_i = \alpha_i + \beta_{i1} f_1 + \ldots + \beta_{ik} f_k + \epsilon_i, \quad i = 1, \ldots, n. \]

The equilibrium APT version of the APT predicts \( \alpha_i = 0 \) for all \( i \). It also asserts that an uninformed investor can determine the marginal risk contribution to his optimal portfolio of an asset from the \( k \)-vector of factor betas \( \beta_i \).
The CAPM and APT assume that all investors know the parameters in (1) and (5), respectively. In practice, these parameters must be estimated. One obvious means of estimation for mutual funds is time series regression applied to (1) or (5). Under the assumptions of the model, this will provide consistent and unbiased estimates of the betas.

2b. Identifying the Market Portfolio and APT Factors

The estimated betas from the CAPM are only reliable to the extent that the market index return used in (1) provides an accurate proxy for the true market portfolio return. Some authors argue that this is a severe shortcoming of the model whereas others feel that available proxies may be sufficiently accurate for most purposes (see Roll (1978) and Shanken (1987)).

One of the problems in using the APT to measure risk lies in the rotational indeterminacy in the definition of the factor model (5). Let \( L \) denote a \( k \times k \) nonsingular matrix and define the new set of mean-zero random variates \( g^* = Lf^* \). Define the excess returns to a set of mimicking portfolios by \( g = Lf \). If we define \( \gamma = \beta L^{-1} \), then we can rewrite (5) using \( g \) and \( \gamma \) in place of \( f \) and \( \beta \). This implies that our estimated betas are specific to the particular rotation we use in identifying the factors. Hence, the beta estimates have little if any economic meaning since they depend on an arbitrary rotation. Also, estimates of \( \beta \) from different time periods will not be comparable since the factors will have a different rotation.

Chen, Roll, and Ross (1986) develop a model which eliminates the rotational indeterminacy of the APT. They propose a set of economic variates whose unexpected shocks can be used in place of \( f^* \). This provides a specific rotation (the same across different time periods) and allows us to interpret the factor betas in terms of meaningful macroeconomic risks.
Chen, Roll, and Ross implicitly assume that the macroeconomic shocks are measured without error. They use the technique due to Fama and MacBeth (1973) to compute the excess returns to mimicking portfolios for these economic shocks.

We will apply a new technique for deriving mimicking portfolios for a given set of economic shocks. An advantage of our procedure is that we can treat the economic shocks as measured with error rather than observed exactly. Our findings are consistent with there being a large amount of measurement error in these series (as indicated by the low $\overline{R}^2$ coefficients in Table 2a).

Our new technique can be viewed as an application of two stage least squares. Let $m^*$ denote a $k$-vector of the true economic shocks and $m$ a set of observable estimates. We assume the following:

$$m = m^* + u$$

$$u \sim N(0, \Delta).$$

The $k$-vector $m^*$ represents the true economies shocks (for example, inflation, output shocks) as they are observed by investors and impact time $t$ asset prices. The vector $m$ represents the measured economic shocks available to the econometrician (for example, government supplied data on prices and output used by the econometrician to estimate inflation and output shocks). The vector $u$ contains the measurement error of the econometrician.

Let $f$ denote the $k$-vector of excess returns to portfolios which mimic $m^*$ exactly:
\[ f = m^* + E[f]. \] (7)

The mimicking portfolio excess returns match \( m^* \) exactly except that their returns include risk premia, captured by \( E[f] \).

Let \( M, F, U \), and \( M^* \) denote the \( k \times T \) matrices of sample realization of \( m, f, u \), and \( m^* \). Let \( e^T \) denote a \( T \)-vector of ones. Combining (6) and (7) for the sample counterparts gives:

\[ M = M^* + U = -E[f]e^T + F + U. \] (8)

In an earlier paper (Connor and Korajczyk (1986)), we describe a procedure for identifying the sample realizations of the statistical factors using a large cross-section of security returns. In the limit as \( n \) approaches infinity, this procedure gives a \( k \times T \)-matrix \( G \) which equals \( F \), subject to a rotational indeterminacy: That is:

\[ G = LF \] (9)

for some nonsingular \( k \times k \) matrix \( L \). Note that we can observe \( G \) and \( M \) and want to observe \( F \). No matter how large the sample size, the factor estimates are subject to a rational indeterminacy captured by the arbitrary nonsingular matrix \( L \). This indeterminacy is shared by other factor-analytic estimation procedures such as those of Chen (1983) and Lehmann and Modest (1985).
Our procedure combines the information in \( G \) and \( M \) to estimate \( F \) without the rotational indeterminacy. In the first stage, we regress each economic variate on the \( k \) statistical factors, with all variates de-meaned before the regression (let \( \sim \) denote a demeaned variable). This gives a \( k \)-vector of estimated coefficients \( \tilde{L}_j \) for each of the \( k \) economic variates:

\[
\tilde{L}_j = \tilde{M}_j \tilde{G} (\tilde{G} \tilde{G})^{-1} \quad j = 1, \ldots, k. \tag{10}
\]

In the second stage we multiply these estimated coefficients by the statistical factor to get the explained economic variates, which we call the rotated factors. These are just a particular rotation of the statistical factors.

\[
\tilde{F}_j = \tilde{L}_j G. \tag{11}
\]

Given a set of portfolio returns \( R \), we use the rotated factors \( \tilde{F} \) to estimate alphas and betas by ordinary least squares applied to (5). The distributions of the resulting alpha and beta estimates are described in the appendix.

The procedure is a conventional two stage least squares estimator except for its use of de-meaned statistical factors in the first step (10) and the factors with their means in the second step (11). This is done so that risk premia of the factors, which appear in \( F \) but not \( M \), will be preserved in the rotated factors.
2c. Choice of Economic Shocks

We follow Chen, Roll, and Ross in our choice of economic shocks with some modifications. We choose four variates as the pervasive shocks: the shock to the term structure, the shock to the junk-bond premium, the shock to unemployment and the shock to inflation.

We measure the shock to the term structure as the difference between the monthly return on long-term government bonds and monthly Treasury Bills. We measure the shock to the junk-bond premium as the monthly return to a portfolio of low-grade corporate bonds minus the monthly return to high-grade corporate bonds.

The variables which Chen, Roll, and Ross employ for expected and unexpected inflation rely on a model developed by Fama and Gibbons (1982). This model uses Fama’s (1975) analysis of the relationship between inflation and short-term interest rates in the post-war period (but prior to 1979). Unfortunately, there is ample evidence that in the post-1979 period the inflation-interest rate relationship shifted dramatically (see, e.g., Huizinga and Mishkin (1985)). For this reason, the Fama-Gibbons estimates of expected and unexpected inflation are unreliable in the post-1979 period. Since this period includes almost one-third of our sample, we did not use their procedure.

We employ a simpler inflation variate. We estimate an autoregressive moving average model for inflation and use the innovations from this model as our inflation shocks. This will not adjust perfectly for any changes in the inflation-interest rate regime in 1979, but should be more robust to such changes than a model which relies on a fixed inflation-interest rate relationship.
Chen, Roll and Ross use the one-month ahead percentage change in the industrial production index as an output shock. In place of this variable we develop an autoregressive model for unemployment and use the one-month ahead innovation from the model as our "output" shock.

2d. Rotation of the Statistical Factors

In our empirical work we use a five-factor version of the APT. Each macro-shock is regressed against five statistical factors. The predicted series from this regression serves as the new factor (see equation (9) above). We call this constructed variable a rotated factor; it is a linear combination of the statistical factors rotated so as to mimic the movements in a macro-shock.

We only used four macro-shocks in the analysis. For the final rotated factor we relied on the assumption of the equilibrium version of the APT that the market portfolio is a linear combination of the factors. Our fifth and final rotated factor is a "market residual" factor; the part of the value-weighted market index excess return which is not explained by the other four rotated factors. We regressed the value-weighted index on the first four rotated factors and used the residual from this regression as the fifth factor.

Table 2a describes the regressions of the macroeconomic shocks on the statistical factors. We use the statistical factors estimated by Connor and Uhlmaner (1987). The low $\mathcal{R}$-squares imply that most of the variation in the macroeconomic series is "measurement error" with respect to explaining stock market returns: restated in terms of equation (6), this means that the variance of $u$ is large relative to the variance of $m^*$. As discussed above and in the
appendix, the predicted series from these regressions form the rotated factors which we apply in the next section. The correlations of the macro-factors appear in Table 2b. By construction, the market residual factor has a zero correlation with each of the other rotated factors.

3. Selectivity-based Performance Measurement

In an earlier paper (Connor and Korajczyk (1986)) we describe a competitive equilibrium model in which a small number of mutual fund managers possess superior information about the returns on specific securities, i.e., superior selection ability. Following Jensen (1968), we suggest an interpretation of (5) which can be used to detect the presence of superior selectivity. Let \( r \) denote the excess return to the mutual fund under consideration. We show that in a competitive equilibrium model with a small set of informed investors one can write the return on a managed portfolio as:

\[
r = \alpha + \beta f + \epsilon
\]

and that \( \alpha > 0 \) implies that the manager has superior information. Let \( \hat{\alpha} \) denote the estimates from applying ordinary least squares to (5). We show that:

\[
\lim_{T \to \infty} \lim_{n \to \infty} \hat{\alpha} \sim N(\alpha, \sigma_\alpha).
\]

Our data set consists of the monthly returns (including dividends and net of transactions costs) for 130 mutual funds from 1968 to 1982. We also have the Weisenberger Investment Survey classifications of the funds according to their investment objective: income, stability-
growth-income, growth-income, growth, or maximum capital gain. This classification is based on a reading of the fund's prospectus and is released prior to the beginning of the time series sample of returns. Hence, we can use it as an independent source of information on the risk levels of the funds.

First, we perform the regressions on the individual funds. Each regression is over the available sample for that fund (some funds did not exist or their returns were not recorded for the full 15 years). Next, we take cross-sectional averages of the estimated coefficients, estimated $t$-statistics, standard errors of regression, and $R$-squareds. Since the unexplained returns of the funds are less than perfectly correlated, the cross-sectional average $t$-statistics understate the true multivariate significance levels. Using standard significance levels is a conservative procedure.

Before estimating betas, we scaled the factors so that the value-weighted index has a beta of one for each factor. This has no effect on the statistical tests but makes the estimated betas easier to interpret. A mutual fund with an inflation beta greater (less) than one has more (less) inflation sensitivity than the market index.

As an alternative to the individual fund regressions, we construct equally weighted portfolios of all funds of each risk type which have recorded returns for the full 15-year period. We then perform the regressions on these portfolios of mutual funds.

Tables 3 and 4 present the estimates of $a$, $\beta$, and $t$ for the CAPM and APT. Table 3 gives the estimates from individual funds, averaged across all funds of a given risk type. Table 4 gives the estimates from the equally weighted portfolios of the funds of each risk type.
The equally-weighted CAPM shows significantly negative abnormal performance for three of the five semi-passive portfolios (see Table 4a). The value-weighted CAPM finds one significant (negative) abnormal return. The APT shows significantly negative abnormal performance for two portfolios but with low coefficients (Table 4b). All of the significant coefficients for the APT are within the range which might be explained by reasonable mutual fund transactions costs.

It is not clear from Tables 3 and 4 whether the CAPM or APT gives a more reliable measurement of \( \alpha \). However, we also examined ten size-sorted portfolios using the same technique. We divided the NYSE monthly returns available from CRSP into ten equally-weighted portfolios sorted by firm capitalization. Since these portfolios are informationally passive\(^1\) and incur no transactions costs, they should not exhibit significant abnormal performance. Here, the well-known size bias of the CAPM appears (Table 5a). The APT also shows a size-induced bias (Table 5b). The APT produces two individually significant coefficients for the size-decile portfolios and there is a tendency for the estimate of \( \alpha \) to decrease with size. The magnitude of the bias is larger for the CAPM, but the APT does not fully eliminate it.

4. Henriksson-Merton Tests and an Alternative Timing Model

The analysis of the last section treated superior performance due to asset-specific information, whereas in this section we consider factor or market information, known as timing ability. Merton (1981), Henriksson and Merton (1981), and Henriksson (1984) develop and

\(^1\) In fact, these portfolios are not truly informationally passive. In forming them, we were motivated by our \textit{ex-post} knowledge of a size-based return premium for the CAPM during this sample period.
apply an interesting econometric approach to measuring timing ability. In this section, we re-estimate the Henrikkson-Merton (HIM) model with our data set, extend the tests to the multi-factor case, and develop a new version of their model which allows for non-information-based variation in the factor or market risk of the portfolio under consideration.

The HIM model which we use assumes that the portfolio manager receives a binary signal (high or low) each period which is correlated with the true outcome of the market return realization. He chooses one of two values for the portfolio beta (high or low) in response to the signal received. HIM prove that the following regression gives consistent estimates:

\[ r = \alpha + \beta r^q + \gamma \text{put} (r^q) + \epsilon , \]  

(12)

where

\[ \text{put} (x) = \max (-x, 0) . \]

They show that \( \gamma > 0 \) if and only if the investor possesses superior market timing ability. The extension to a multi-factor model is immediate:

\[ r = \alpha + \beta_1 r^f + \ldots + \beta_k r^{f_k} + \gamma_1 \text{put} (r^f) + \ldots + \gamma_k \text{put} (r^{f_k}) + \epsilon , \]  

(13)

where \( \gamma_j > 0 \) if and only if the manager has superior information about factor \( j \). The \( \alpha \) term is included to measure selection ability and, as in the last section, \( \alpha > 0 \) implies superior selectivity. In the empirical work reported below, we simplified (13) to include only the put on the market portfolio (which is a linear combination of the factor portfolios).
Henriksson (1984) estimates (12) for a sample of 116 mutual funds (all of which are used in this study as well). He finds little evidence of superior timing ability, that is, significantly positive $\gamma$s. In fact, he notes that more of the funds have negative estimated $\gamma$s than positive ones. Also, he provides some evidence that the estimate of $\gamma$ is negatively correlated to the estimate of $\alpha$ across funds. He conjectures that this may be due to errors-in-variables. Chang and Lewellen (1984) also estimate the model and reach conclusions similar to those of Henriksson.

Both Chang and Lewellen and Henriksson use individual mutual fund returns in their empirical tests. We re-estimate the model using our risk-sorted portfolios of mutual funds. This data reduction technique significantly strengthens the findings of the two earlier studies concerning the prevalence of negative estimated $\gamma$s and the negative correlation between estimated $\gamma$ and $\alpha$. The results which were only hinted at in the earlier two studies are now strongly confirmed. Two of the semi-passive funds have significantly negative timing coefficients. The same two funds have significantly positive selectivity coefficients (see Table 6a). The $t$-statistics in Tables 6-8 use the heteroskedasticity-consistent standard error procedure of White (1980).

One possibility is that a significant $\gamma$ coefficient in (12) reflects the multiple factors of the APT which are not adequately captured by the market index. In this case, we would expect the coefficient to disappear in (13). In fact, the coefficient $\gamma$ is little affected in moving from (12) to (13) (see Table 6a versus 6b).

If we accept the HM model, the significantly negative timing coefficients in Table 6 are a paradox for the following reason. The HM model serves to distinguish between significantly positive $\gamma$ (superior information rationally acted upon) and zero $\gamma$ (no superior information).
In order to produce a negative $\gamma$, an investor must possess superior information and employ it irrationally, i.e., raise market risk when he receives a signal that the market will fall and lower market risk when he receives a signal that the market will rise. Following Chang and Lewellen, we will call this behavior "perverse timing." At the same time that the fund manager is engaging in perverse timing, he has excellent selection ability -- the funds have high positive alphas! It seems sensible to search for an alternative explanation for the results of Table 6 which goes outside the original HIM model.

As Henriksson and Merton note, the informational advantage they model is equivalent to the ownership at no cost of a put option on the market portfolio. A negative $\gamma$ is correspondingly equivalent to shorting a market put option without receiving cash.

There are at least three ways besides market timing that a mutual fund portfolio could include put option payoffs in its return. First, the fund could buy or sell marketed puts on individual securities or on market indices. Second, it could follow a dynamic trading strategy that replicates a market put. Third, the underlying return process driving assets could have beta-nonlinearities arising from leverage effects or from other sources which gives rise to a put-like structure to returns. We will call these the marketed options (MO), dynamic trading (DT), and asset beta nonlinearities (ABN) models.

A cursory examination of mutual fund annual reports reveals that the MO model is not reasonable. Mutual funds have very limited holdings of put and call options; most of them hold none at all.

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2 As shown by Grinblatt and Titman (1986), an investor with superior information and increasing absolute risk aversion might rationally choose to engage in perverse market timing. This seems to require extreme assumptions about investor risk aversion.
The DT model, hypothesizing that mutual funds engage in dynamic trading strategies which replicate a put option, cannot be readily dismissed. The original Henriksson-Merton model assumes that the trading decisions of investors are made only at the same intervals as the return observations used in the tests (in our case, monthly). If investors trade more frequently than we measure returns, then their dynamic decisions (without any superior information) can create false evidence of timing. With continuous trading, they can perfectly replicate a put, without any special information. This problem with discretely measured returns and continuously trading investors was analyzed by Pfleiderer and Bhattacharya (1983).

The ABN model is motivated by the put-like properties of debt and equity given a non-zero risk of corporate bankruptcy. Suppose that the return process (1) governs the market value of the firm as a whole and that the firm issues straight debt with a non-zero probability of default. Then the equity of the firm will have a return process which is the return process of the market value of the firm plus a put option. The debt will have a riskless return stream minus the return stream of a put option. If mutual funds purchase debt and equity of leveraged firms, then their return streams will reflect these implicit options. This explanation for Henriksson’s findings of negative γs was noted before in Jagannathan and Konjaczyk (1986). Although it is motivated by the leverage analysis described above, it is not limited to this case. Asset beta nonlinearities could also arise from other sources such as the nature of the production process over the business cycle.

We now have four models to explain the results of an HJM test: the original explanation of superior timing, purchase or sale of marketed options, dynamic trading strategies, and beta nonlinearities in asset returns. We reject the first of these because it cannot explain negative timing coefficients. We reject the second because our examination of mutual fund balance sheets reveals little activity in the options market.
The third and fourth explanation share a common feature. They both imply that the mutual funds are fully compensated for their position in the put option. The HIM model views the funds as owning a free put option. The DT and ABN models view the funds as buying (or shortselling) costly puts. In the absence of selection ability, the cash flow from the costly put makes the models testably distinct from the HIM model. We assume that the mutual funds invest the proceeds from the put transaction (positive or negative) in Treasury Bills. If we assume that the funds have no selection ability, then the HIM model can be distinguished from the DT and ABN models via the following regression:

\[ r = \alpha + \beta r_q + \gamma \text{ put}(r_q) \]  

(14)

where the HIM model predicts \( \alpha = 0 \), whereas the DT and ABN models predict:

\[ \alpha = -(1 + r_0)\gamma P_0, \]  

(15)

where \( P_0 \) is the time-zero market value of the put and \( r_0 \) is the riskless return.

The negative correlation between \( \gamma \) and \( \alpha \) evident in Table 6 is consistent with the DT and ABN models (see equation 15). It is only consistent with the HIM model in the presence of perverse timing ability and superior selectivity ability across the whole group of G funds and of MCG funds.

A related test of the DT and ABN models can be formulated by transformation of (14) using (13). We construct a new variable which we call a “net put.” This is the payoff to a market put minus the Treasury Bill return necessary to pay the market price of the put.
\[ \text{put} = \text{put} - (1 + r_0)P_0. \]

This new instrument is widely known by another name -- it is simply a portfolio insurance contract. An investor who holds this instrument and the market portfolio is guaranteed the risk-free return minus the future value (at the riskless rate) of the put price.

In the absence of timing ability, the following equation can be used to test the models:

\[ r = \alpha + \beta(r_q) + \gamma \text{put} + \varepsilon. \]  \hspace{1cm} (16)

Given zero selection ability, the IIM model predicts \( \alpha = \gamma(1 + r_0)P_0 \), whereas the DT or ABN model predicts \( \alpha = 0 \).

Note that equation (16) is consistent with all three suggested models (IIM, DT, ABN) even when the manager has selectivity ability in addition to timing ability. Let \( \alpha^* \) denote the extra return due to selection ability. Note that setting \( \alpha = \alpha^* + \gamma(1 + r_0)P_0 \) gives (14) so that the HM model is identical to (16) with a different interpretation of the intercept. The DT and ABN models are special cases of (16) with \( \alpha^* \) constrained to equal zero. If we allow the investor to have selection ability in the DT or ABN model, then \( \alpha \) can be greater than zero.

The new specification (16) has the disadvantage relative to (14) that only the sum of timing value and selectivity value can be measured. The original IIM model as reflected in (14) allows these two components to be separated when the conditions of the HM model hold. The new model has the advantage over IIM that it still gives a consistent measure of
performance when mutual funds buy or sell costly puts; it has the disadvantage that it cannot separate timing ability from selection ability. Another limitation is that it only allows for one-month-ahead European options whereas the fund’s return could correspond to an infinite variety of options-like patterns. We hope that this simplest option pattern captures the essential part of the nonlinearity in returns.

Table 7 provides evidence on the IIM model versus our model. We use the Black-Scholes formula to price the put option. Note that the put option is a European put option against a non-dividend paying market index and so can be evaluated in closed form, given the risk-free return and the variance of the market index. We use the Treasury Bill return as the risk-free return and we estimate the variance of the market index by the sample variance of the excess return to the market index over the same 15 year period.

Table 7 indicates that the DT or ABN model is superior to the IIM model. The abnormal performance of both the growth and maximum capital gains portfolios are eliminated by allowing for costly market put options in their returns.

The findings in Tables 6 and 7 cast doubt on the interpretation of the estimates by Chang and Lewellen and Henriksson. Our empirical analysis seems to indicate that the IIM model mostly captures non-information-based dynamic variation in the betas of mutual funds rather than any timing ability (pervasive or otherwise) by mutual fund portfolio managers.

The DT and ABN models are also testably distinct from one another. If the put options are impounded in the securities purchased by the mutual funds (ABN), then the timing tests (16) run against unchanging portfolio indices will produce non-zero y.s. If static portfolios
do not exhibit non-zero $\gamma$, then the mutual funds must be creating the put options through their dynamic trading behavior (DT).

We attempted to distinguish between the DT and ABN models. We did this by performing regression (16) on passive indices -- the size decile portfolios described earlier. The ABN model posits that the put options are impounded in the securities purchased by the mutual funds. If this is the case, then these same nonlinearities can be found in unchanging portfolios of assets such as the size decile portfolios. The DT model assumes that the mutual funds create the nonlinearities through their dynamic trading. In this case, the nonlinearities will not appear in the size-decile portfolios.

Table 8 shows these results. This evidence favors the DT model, since there is no evidence of negative $\gamma$’s in the size decile portfolios. This single test is not conclusive evidence for the DT model over the ABN model. It may be that the growth and maximum capital gains mutual funds concentrate in particular industries or types of firms which have nonlinearities in their betas and these are not selected out in the size portfolios. Table 8 only shows that the asset beta nonlinearities, if they exist, are not size-based. Jagannathan and Korajczyk (1986) present evidence in favor of the ABN model in other sample periods.

5. Summary

This paper uses a sample of 130 mutual funds over a 15 year period to analyze portfolio performance measurement with the CAPM and APT. We find that performance measurement with either model is compromised by the size effect in asset returns. The size effect is larger in the CAPM, but is not fully eliminated in the APT.
We develop a new technique to transform the statistical factors of the APT into meaningful categories of economic risk. The technique is a variation on two stage least squares. It uses economic variates as a basis for rotating statistically identified factors.

We re-estimate the timing tests of Henriksson and Merton and extend them to the APT. We find strong empirical evidence that these tests must be adjusted for non-information based changes in mutual fund betas. We develop and implement an adjusted version of the Henriksson-Merton test which allows for these changes and simultaneously measures the sum of timing plus selectivity performance of a fund. Unlike the original Henriksson-Merton test, it does not allow for the separation of superior performance into timing and selectivity components -- only the sum can be measured.
Appendix

This appendix describes the assumptions behind the rotational procedure used in the text and derives the asymptotic distribution of the resulting beta and alpha estimates. We assume:

\[ m = m^* + \eta \]  \hfill (15)

\[ f = E[\eta] + m^* \]  \hfill (16)

\[ r = \alpha + \beta f + \varepsilon \]  \hfill (17)

\( \varepsilon, \eta \) independent and i.i.d. through time \hfill (18)

\[ E[\varepsilon|F] = 0, \ E[\eta|F] = 0. \]  \hfill (19)

Let \( F, \tilde{F}, \tilde{G}, \tilde{\beta} \) be defined as in the text. We treat \( F \) and \( G \) as nonrandom sequences of matrices as is standard in least squares theory. We make three standard assumptions of least squares theory:

\[ \lim_{T \to \infty} \left( \frac{1}{T} \tilde{F} \tilde{F}' \right)^{-1} = \Lambda_F^* \]  \hfill (20)

\[ \text{dlim } T \to \infty \frac{1}{\sqrt{T}} e' e \sim N(0, \sigma_e^2), \text{ where } e \text{ denotes a } T \text{-vector of ones} \]  \hfill (21)

\[ \text{dlim } T \to \infty \sqrt{T} \beta \tilde{r} \tilde{\eta}' \sim N(0, \Sigma_{\beta F \eta}). \] \hfill (22)

Recall from the text that our beta estimator can be written as:

22
\[ \hat{\beta} = \tilde{R} \tilde{F} \left( \tilde{F} \tilde{F}' \right)^{-1} \]

\[ = \left( \beta \tilde{F} + \tilde{\varepsilon} \right) \tilde{G}'(\tilde{G} \tilde{G}')^{-1} \tilde{G}(\tilde{F} + \tilde{\eta}) \left( \tilde{F} \tilde{F}' \right)^{-1} \tilde{G}(\tilde{F} + \tilde{\eta})' \]

Using \( \tilde{G}'(\tilde{G} \tilde{G}')^{-1} \tilde{G} = \tilde{F}'(\tilde{F} \tilde{F}')^{-1} \tilde{F} \) and combining terms, this becomes:

\[ = \left( \beta \tilde{F} \tilde{F}' + \varepsilon \tilde{F}' + \beta \tilde{F} \tilde{\eta}' + \tilde{\varepsilon} \tilde{F}'(\tilde{F} \tilde{F}')^{-1} \tilde{F} \tilde{\eta}' \right) \]

\[ = \left( \tilde{F} \tilde{F}' + \eta F'(FF)^{-1}F_\eta' + \eta F' + F_\eta' \right)^{-1} . \]  

(23)

We have the following.

**Theorem 1:** Given (15) - (22), \( \underset{T \to \infty}{\text{plim}} \hat{\beta} = \beta \) and

\[ \underset{T \to \infty}{\text{dlim}} \sqrt{T} \left( \hat{\beta} - \beta \right) \sim N \left( 0, \Lambda_F^* \Sigma_F \Lambda_F^* + \sigma_e \Lambda_F^* \right) . \]

**Proof:** From (23) we have

\[ \underset{T \to \infty}{\text{dlim}} \sqrt{T} \left( \hat{\beta} - \beta \right) = \]

\[ = -\sqrt{T} \beta + \left( \sqrt{T} \beta \left( \frac{1}{T} \tilde{F} \tilde{F}' \right) + \frac{1}{\sqrt{T}} \tilde{\varepsilon} \tilde{F}' + \frac{1}{\sqrt{T}} \beta \tilde{F} \tilde{\eta}' + \left( \frac{1}{T} \right)^{3/2} \tilde{\varepsilon} \tilde{F}' \left( \frac{1}{T} \tilde{F} \tilde{F}' \right)^{-1} \tilde{F} \tilde{\eta} \right) \times \]

23
\[
\left( \frac{1}{T} \, \hat{\tilde{F}} \, \hat{\tilde{F}}' + \left( \frac{1}{T} \right)^2 \, \hat{\eta} \, \hat{\tilde{F}}' \left( \frac{1}{T} \, \hat{\tilde{F}} \, \hat{\tilde{F}}' \right)^{-1} \, \hat{\eta}' + \frac{1}{T} \, \hat{\eta} \, \hat{\tilde{F}}' + \frac{1}{T} \, \hat{\tilde{F}} \, \hat{\eta}' \right)^{-1} \quad (24)
\]

We have \( \text{plim} \left( \frac{1}{T} \right)^\gamma \, \hat{\tilde{F}}' = 0 \) and \( \text{plim} \left( \frac{1}{T} \right)^\gamma \, \hat{\tilde{F}} \, \hat{\eta}' = 0 \) for any \( \gamma > 1/2 \). Applying this to (24) above gives

\[
\text{dlim} \quad (24) = -\sqrt{T} \, \beta + \sqrt{T} \, \beta \left( \frac{1}{T} \, \hat{\tilde{F}} \, \hat{\tilde{F}}' \right) + \frac{1}{\sqrt{T}} \, \hat{\tilde{F}}' + \frac{1}{\sqrt{T}} \, \beta \, \hat{\tilde{F}} \, \hat{\eta}'
\]

\[
\text{plim} \quad \left( \frac{1}{T} \, \hat{\tilde{F}} \, \hat{\tilde{F}}' \right)^{-1} \quad .
\]

Since \( \text{dlim} \ AB = \text{dlim} \ A \ \text{plim} \ B \) for fixed dimensional sequences of matrices \( \Lambda \) and \( B \), this gives:

\[
\text{dlim} \quad \sqrt{T} \left( \hat{\beta} - \beta \right) = \text{dlim} \quad \left( \frac{1}{\sqrt{T}} \, \hat{\tilde{F}}' \left( \hat{\tilde{F}} \, \hat{\tilde{F}}' \right)^{-1} + \frac{1}{\sqrt{T}} \, \beta \, \hat{\tilde{F}} \, \hat{\eta}' \left( \hat{\tilde{F}} \, \hat{\tilde{F}}' \right)^{-1} \right) \quad .
\]

This is asymptotically a finite linear combination of multivariate normals and so is asymptotically multivariate normal. Note that it has zero mean. To find the asymptotic covariance matrix, we take the expectation of the outer product:

\[
\lim_{T \to \infty} \text{E} \left[ \left( T (\hat{\beta} - \beta) \right) \left( \hat{\beta} - \beta \right) \right] = \Lambda^*_F \Sigma_F \Lambda^*_F + \sigma_F \Lambda_F^* + \text{E}[\text{mean zero cross-terms}] .
\]

Q.E.D.
Theorem 1 gives the variances of the beta estimates independent of the factor rotation. We can also derive a simpler variance formula which is conditional on the particular rotation. Define $\beta^*$ as the beta vector times the rotational error matrix $\hat{L}$:

$$\beta^* = \beta \left( \hat{F} \hat{F}' (\hat{F}' \hat{F})^{-1} \right) = \beta \hat{L}.$$  

From Theorem 1 we can show $\varlimsup_{T \to \infty} \hat{L} = I_k$. Now we give a result which is conditional on the particular realized value of $\hat{L}$ (or equivalently $\hat{F}$).

**Theorem 2:** Given (15) - (22), $\left[ (\hat{\beta} - \beta^*) \bigg| \hat{F} \right] \sim N\left(0, \sigma_e (\hat{F}' \hat{F}')^{-1}\right)$.

**Proof:** Using the definitions of $\hat{\beta}$ and $\beta^*$:

$$\left( \hat{\beta} - \beta^* \right) = \left( \hat{\epsilon} \hat{F}' (\hat{F}' \hat{F}')^{-1} \right),$$

which is normally distributed conditional on $\hat{F}$. It has covariance matrix

$$E \left[ (\hat{F}' \hat{F}^{-1} \hat{F} \hat{\epsilon}' \hat{F}' (\hat{F}' \hat{F}')^{-1} \bigg| \hat{F} \right]$$

$$= (\hat{F}' \hat{F}^{-1} \hat{F} \sigma_e I_T \hat{F}' (\hat{F}' \hat{F}')^{-1} = \sigma_e (\hat{F}' \hat{F}')^{-1}.$$  

Q.E.D.
This theorem can easily be extended to the case where \( \varepsilon \) is not normal but \( \sqrt{T \varepsilon \hat{F}'} \) is asymptotically normal.

The distributions of \( \hat{\alpha} \) and \( \hat{\varepsilon} \) are the easiest to derive since they do not depend on the rotation.

**Theorem 3:** Let \( \hat{\alpha} \) be estimated by applying ordinary least squares to \( R = \hat{\alpha} + \hat{\beta} F + \hat{\varepsilon} \) and \( \hat{\alpha}, \hat{\varepsilon} \) from \( R = \hat{\alpha} + \hat{\beta} F + \hat{\varepsilon} \). Then \( \hat{\alpha} = \hat{\alpha} \) and \( \hat{\varepsilon} = \hat{\varepsilon} \).

**Proof:** The intercept and residual estimates in ordinary least squares are unaffected by a rotation of the independent variables. See Theil (1971, pp. 39-41).

Q.E.D.
Bibliography


Table 1
Estimates of the Macroeconomic Shocks and Their Correlations
1968,1 - 1982,12

Table 1a

<table>
<thead>
<tr>
<th></th>
<th>IF_{t-1}</th>
<th>IF_{t-2}</th>
<th>( R^2 )</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{Constant}</td>
<td>\text{IF}_{t}</td>
<td>.138 (3.28)</td>
<td>.324 (4.46)</td>
<td>.443</td>
<td>2.01</td>
</tr>
<tr>
<td>\text{IF}_{t}</td>
<td>\text{DUN}_{t-1}</td>
<td>.437 (6.07)</td>
<td>.205 (2.78)</td>
<td>.088</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Table 1a shows the two autoregressive models used to find the unexpected components of inflation and unemployment. \text{IF} denotes the monthly percentage increase in the consumer price index; \text{DUN} is the change in the civilian unemployment rate. In all the table, the t-statistics of the coefficients are in parentheses. The \( R \)-bar squared coefficient (\( R^2 \)), Durbin-Watson statistic (DW), and standard error of estimate (SEE) are also given.

Table 1b

<table>
<thead>
<tr>
<th></th>
<th>UIF</th>
<th>UPR</th>
<th>UTS</th>
<th>UDUN</th>
<th>EWV</th>
<th>EEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIF</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPR</td>
<td>.007</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UTS</td>
<td>-.167</td>
<td>-.620</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UDUN</td>
<td>.046</td>
<td>-.062</td>
<td>.008</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EWV</td>
<td>-.240</td>
<td>.049</td>
<td>.350</td>
<td>-.193</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>EEW</td>
<td>-.245</td>
<td>.074</td>
<td>.311</td>
<td>.242</td>
<td>.913</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 1b shows the correlation matrix of the four macroeconomic shocks and two market portfolio indices. The four shocks are unexpected inflation (UIF), unexpected change in unemployment (UDUN), unexpected change in the bond risk premium (UPR), and the unexpected change in the term premium (UTS). See the text for further description of these variables. EVW and EEW are the excess returns to the value-weighted and equally-weighted market indices.
Table 2
Regressions of the Macroeconomic Shocks on the Statistical Factors
1968,1 - 1982,12

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>SF1</th>
<th>SF2</th>
<th>SF3</th>
<th>SF4</th>
<th>SF5</th>
<th>R²</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTS</td>
<td>-0.192 x 10^-2 (-.877)</td>
<td>.134 (4.64)</td>
<td>.623 x 10^-1 (2.60)</td>
<td>-.102 (-5.31)</td>
<td>-.299 x 10^2 (-.168)</td>
<td>.123 x 10^1 (.954)</td>
<td>.202</td>
<td>2.07</td>
<td>.289 x 10^-1</td>
</tr>
<tr>
<td>UPR</td>
<td>.594 x 10^-3 (.385)</td>
<td>.222 x 10^-1 (1.09)</td>
<td>-.305 x 10^-2 (-.180)</td>
<td>.593 x 10^-1 (4.39)</td>
<td>.145 x 10^-2 (.115)</td>
<td>-.162 x 10^-1 (-1.77)</td>
<td>.099</td>
<td>2.33</td>
<td>.204 x 10^-1</td>
</tr>
<tr>
<td>UIF</td>
<td>.416 x 10^-2 (.259)</td>
<td>-.814 (-3.47)</td>
<td>-.771 x 10^-1 (-.394)</td>
<td>.296 (1.90)</td>
<td>.176 (1.21)</td>
<td>-.902 x 10^-1 (-.856)</td>
<td>.063</td>
<td>2.06</td>
<td>.236</td>
</tr>
<tr>
<td>UDIP</td>
<td>-.215 x 10^-3 (.343)</td>
<td>.186 x 10^-1 (2.25)</td>
<td>-.717 x 10^-2 (-1.04)</td>
<td>-.403 x 10^-2 (.735)</td>
<td>.161 x 10^-2 (.316)</td>
<td>.245 x 10^-2 (.663)</td>
<td>.016</td>
<td>2.07</td>
<td>.828 x 10^-2</td>
</tr>
<tr>
<td>UDUN</td>
<td>.117 x 10^-2 (.526)</td>
<td>-.995 x 10^-1 (-3.41)</td>
<td>.341 x 10^-1 (1.40)</td>
<td>-.177 x 10^-1 (-.913)</td>
<td>-.561 x 10^-1 (-3.12)</td>
<td>.282 x 10^-2 (.216)</td>
<td>.086</td>
<td>2.03</td>
<td>.293 x 10^-1</td>
</tr>
<tr>
<td>EVW</td>
<td>-.481 x 10^-3 (-.618)</td>
<td>.587 (57.3)</td>
<td>.159 (18.6)</td>
<td>-.874 x 10^-1 (-12.6)</td>
<td>-.602 x 10^-1 (-9.51)</td>
<td>-.140 x 10^-1 (-3.05)</td>
<td>.954</td>
<td>1.87</td>
<td>.103 x 10^-1</td>
</tr>
<tr>
<td>EEW</td>
<td>.435 x 10^-2 (1.21)</td>
<td>.822 (173.5)</td>
<td>-.139 x 10^-1 (-3.51)</td>
<td>-.109 x 10^-1 (-3.45)</td>
<td>.160 x 10^-1 (5.49)</td>
<td>-.778 x 10^-1 (-3.66)</td>
<td>.994</td>
<td>2.13</td>
<td>.475 x 10^-2</td>
</tr>
</tbody>
</table>

Table 2a shows the ordinary least squares regressions of the macroeconomic shocks and market indices on the first five statistical factors (SF1, ..., SF5) and an intercept.
Table 2b shows the correlation matrix of the macrofactors and market indices. The macrofactors are UIFF (unexpected inflation factor), UPRF (unexpected change in the bond risk premium factor), UTSF (unexpected change in the term structure factor), UDUNF (unexpected change in unemployment factor), and MKTRES (market residual factor). See the text for a further description of the macrofactors.
### Table 3a

CAPM Alpha and Beta Estimates for Individual Mutual Funds
1968,1 - 1982,12

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>EVW</th>
<th>R²</th>
<th>SEE</th>
<th>Intercept</th>
<th>EEW</th>
<th>R²</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>.190 x 10⁻³ (.343)</td>
<td>.693 (10.2)</td>
<td>.710</td>
<td>.198 x 10⁻¹</td>
<td>-.163 x 10⁻² (-2.75)</td>
<td>.53 (10.6)</td>
<td>.702</td>
<td>.202 x 10⁻¹</td>
</tr>
<tr>
<td>SGI</td>
<td>-.317 x 10⁻³ (-.536)</td>
<td>.747 (10.3)</td>
<td>.851</td>
<td>.146 x 10⁻¹</td>
<td>-.211 x 10⁻² (-3.33)</td>
<td>.541 (10.2)</td>
<td>.752</td>
<td>.190 x 10⁻¹</td>
</tr>
<tr>
<td>GI</td>
<td>.716 x 10⁻⁴ (.171)</td>
<td>.905 (17.6)</td>
<td>.889</td>
<td>.149 x 10⁻¹</td>
<td>-.205 x 10⁻² (-4.59)</td>
<td>.642 (17.1)</td>
<td>.757</td>
<td>.224 x 10⁻¹</td>
</tr>
<tr>
<td>G</td>
<td>.597 x 10⁻⁴ (.173)</td>
<td>1.03 (24.2)</td>
<td>.808</td>
<td>.232 x 10⁻¹</td>
<td>-.243 x 10⁻² (-6.59)</td>
<td>.741 (23.9)</td>
<td>.708</td>
<td>.293 x 10⁻¹</td>
</tr>
<tr>
<td>MCG</td>
<td>-.758 x 10⁻³ (-1.33)</td>
<td>1.16 (16.6)</td>
<td>.769</td>
<td>.305 x 10⁻¹</td>
<td>-.370 x 10⁻² (-6.04)</td>
<td>.866 (16.9)</td>
<td>.715</td>
<td>.333 x 10⁻¹</td>
</tr>
</tbody>
</table>

Table 3a summarizes the time series regressions of individual mutual fund excess return on the value-weighted and equally-weighted market portfolio excess return. The mutual funds are sorted into five risk classes: I (income), SGI (stability-growth-income), GI (growth-income), G (growth), and MCG (maximum capital gain). All of the estimates are the averages (across all of the mutual funds within each risk class) of the corresponding estimates for the individual time series regressions. The t-statistics computed with this averaging technique give a lower bound to the true multivariate significance of the cross-section of estimated coefficients.
Table 3b

APT Alpha and Beta Estimates for Individual Mutual Funds
1968,1 - 1982,12

<table>
<thead>
<tr>
<th></th>
<th>alpha</th>
<th>UTSF</th>
<th>UPRF</th>
<th>UIFF</th>
<th>UNUNF</th>
<th>MKTRES</th>
<th>R²</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>-0.651x10^{-3} (-0.369)</td>
<td>.508 (5.77)</td>
<td>.504 (7.84)</td>
<td>.864 (6.73)</td>
<td>-2.39 (-3.58)</td>
<td>.174 (1.30)</td>
<td>.773</td>
<td>.169x10^{-1}</td>
</tr>
<tr>
<td>SGI</td>
<td>-0.999x10^{-3} (-0.913)</td>
<td>.696 (9.77)</td>
<td>.642 (12.0)</td>
<td>.813 (6.76)</td>
<td>-1.167 (-0.013)</td>
<td>.361 (3.84)</td>
<td>.868</td>
<td>.135x10^{-1}</td>
</tr>
<tr>
<td>GI</td>
<td>-0.134x10^{-3} (-0.186)</td>
<td>.919 (11.9)</td>
<td>.921 (16.3)</td>
<td>.928 (8.28)</td>
<td>.991 (1.22)</td>
<td>.677 (7.21)</td>
<td>.904</td>
<td>.138x10^{-1}</td>
</tr>
<tr>
<td>G</td>
<td>-0.194x10^{-3} (-0.211)</td>
<td>.907 (8.03)</td>
<td>1.04 (13.3)</td>
<td>1.25 (7.26)</td>
<td>.833 (1.05)</td>
<td>.648 (4.89)</td>
<td>.832</td>
<td>.215x10^{-1}</td>
</tr>
<tr>
<td>MCG</td>
<td>-0.124x10^{-2} (-0.767)</td>
<td>.979 (5.25)</td>
<td>1.27 (10.4)</td>
<td>1.44 (5.44)</td>
<td>-0.204 (-0.203)</td>
<td>.444 (2.33)</td>
<td>.807</td>
<td>.275x10^{-1}</td>
</tr>
</tbody>
</table>

Table 3b summarizes the time series regressions of individual mutual fund excess return on five macrofactors. The table is analogous to Table 3a.
Table 4a
CAPM Alpha and Beta Estimates for Portfolios of Mutual Funds
1968,1 - 1982,12

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>EVW</th>
<th>$R^2$</th>
<th>DW</th>
<th>SEE</th>
<th></th>
<th>Intercept</th>
<th>EEW</th>
<th>$R^2$</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>$-0.128 \times 10^{-3}$</td>
<td>0.661</td>
<td>0.899</td>
<td>1.55</td>
<td>$0.106 \times 10^{-1}$</td>
<td></td>
<td>$-0.186 \times 10^{-2}$</td>
<td>0.504</td>
<td>0.881</td>
<td>1.82</td>
<td>$0.115 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(-0.162)</td>
<td>(39.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-2.17)</td>
<td>(35.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SGI</td>
<td>$0.608 \times 10^{-4}$</td>
<td>0.780</td>
<td>0.949</td>
<td>1.64</td>
<td>$0.862 \times 10^{-2}$</td>
<td></td>
<td>$-0.188 \times 10^{-2}$</td>
<td>0.574</td>
<td>0.863</td>
<td>2.30</td>
<td>$0.142 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(0.946 $\times 10^{-1}$)</td>
<td>(57.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-1.78)</td>
<td>(33.5)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>GI</td>
<td>$-0.776 \times 10^{-3}$</td>
<td>0.763</td>
<td>0.982</td>
<td>1.77</td>
<td>$0.488 \times 10^{-2}$</td>
<td></td>
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<td>0.544</td>
<td>0.839</td>
<td>2.37</td>
<td>$0.148 \times 10^{-1}$</td>
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<tr>
<td></td>
<td>(-2.13)</td>
<td>(99.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-2.35)</td>
<td>(30.49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>$0.123 \times 10^{-2}$</td>
<td>1.23</td>
<td>0.961</td>
<td>1.57</td>
<td>$0.119 \times 10^{-1}$</td>
<td></td>
<td>$-0.174$</td>
<td>0.884</td>
<td>0.838</td>
<td>2.22</td>
<td>$0.241 \times 10^{-1}$</td>
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<tr>
<td></td>
<td>(1.39)</td>
<td>(65.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-0.967)</td>
<td>(30.3)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MCG</td>
<td>$0.115 \times 10^{-4}$</td>
<td>1.08</td>
<td>0.903</td>
<td>1.63</td>
<td>$0.169 \times 10^{-1}$</td>
<td></td>
<td>$-0.264 \times 10^{-2}$</td>
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<td>0.806</td>
<td>2.14</td>
<td>$0.239 \times 10^{-1}$</td>
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<tr>
<td></td>
<td>(0.908 $\times 10^{-2}$)</td>
<td>(40.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-1.48)</td>
<td>(27.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4a describes the regressions of the excess return of portfolios of mutual funds on the equally-weighted and value-weighted market index excess return and an intercept. The mutual funds are sorted into equally-weighted portfolios based on the five mutual fund risk classes (see the notes to Table 3 for the five risk classes).
Table 4b
APT Alpha and Beta Estimates for Portfolios of Mutual Funds
1968, 1 - 1982, 12

<table>
<thead>
<tr>
<th></th>
<th>alpha</th>
<th>UTSF</th>
<th>UPRF</th>
<th>UIFF</th>
<th>UDUNF</th>
<th>MKTRES</th>
<th>R²</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>-1.14x10⁻² (-1.88)</td>
<td>.510 (12.2)</td>
<td>.520 (17.5)</td>
<td>.826 (12.6)</td>
<td>-1.77 (-5.44)</td>
<td>.163 (2.75)</td>
<td>.941</td>
<td>1.44</td>
<td>8.06x10⁻²</td>
</tr>
<tr>
<td>SGI</td>
<td>-6.85x10⁻³ (-1.31)</td>
<td>.676 (19.4)</td>
<td>.664 (25.6)</td>
<td>.941 (17.2)</td>
<td>-5.22 (-1.92)</td>
<td>.352 (7.10)</td>
<td>.969</td>
<td>1.78</td>
<td>6.74x10⁻²</td>
</tr>
<tr>
<td>GI</td>
<td>-9.13x10⁻³ (-2.67)</td>
<td>.750 (32.0)</td>
<td>.772 (46.2)</td>
<td>.790 (21.5)</td>
<td>.563 (3.08)</td>
<td>.585 (17.6)</td>
<td>.985</td>
<td>1.90</td>
<td>4.52x10⁻²</td>
</tr>
<tr>
<td>G</td>
<td>1.01x10⁻² (1.24)</td>
<td>1.10 (19.7)</td>
<td>1.25 (31.3)</td>
<td>1.49 (17.0)</td>
<td>1.24 (2.84)</td>
<td>.812 (10.2)</td>
<td>.967</td>
<td>1.64</td>
<td>1.08x10⁻¹</td>
</tr>
<tr>
<td>MCG</td>
<td>-239x10⁻³ (-2.02)</td>
<td>1.00 (12.4)</td>
<td>1.17 (20.2)</td>
<td>1.24 (9.79)</td>
<td>.822 (1.30)</td>
<td>.518 (4.51)</td>
<td>.917</td>
<td>1.80</td>
<td>1.56x10⁻¹</td>
</tr>
</tbody>
</table>

Table 4b describes the regressions of the excess return of these portfolios of mutual funds on the five macrofactors and an intercept.
Table 5a

CAPM Alpha and Beta Estimates for Size-Decile Portfolios
1968,1 - 1982,12

| Decile | Intercept | E_VW | Rsq | DW | SEE | Intercept | E_VW | Rsq | DW | SEE |
|--------|-----------|------|-----|----|-----|-----------|------|-----|----|-----|-----|
| 1      | .747 x 10^-2 (2.09) | 1.22 (16.2) | .596 | 2.13 | .479 x 10^-1 | .325 x 10^-2 (1.76) | 1.15 (38.6) | .893 | 2.03 | .246 x 10^-1 |
| 2      | .555 x 10^-2 (2.07) | 1.17 (20.7) | .708 | 2.11 | .360 x 10^-1 | .178 x 10^-2 (1.49) | 1.04 (35.9) | .942 | 2.10 | .160 x 10^-1 |
| 3      | .564 x 10^-2 (2.59) | 1.15 (25.2) | .781 | 2.08 | .292 x 10^-1 | .209 x 10^-2 (2.61) | .993 (77.0) | .971 | 2.04 | .107 x 10^-1 |
| 4      | .500 x 10^-2 (2.71) | 1.07 (27.7) | .811 | 1.87 | .248 x 10^-1 | .179 x 10^-2 (2.29) | .904 (71.8) | .967 | 1.96 | .104 x 10^-1 |
| 5      | .249 x 10^-2 (1.44) | 1.08 (29.8) | .833 | 2.04 | .233 x 10^-1 | -.682 x 10^-3 (-.792) | .898 (64.5) | .959 | 2.13 | .115 x 10^-1 |
| 6      | .197 x 10^-2 (1.22) | 1.13 (33.3) | .861 | 2.04 | .217 x 10^-1 | -.126 x 10^-2 (-1.31) | .918 (59.3) | .952 | 2.12 | .128 x 10^-1 |
| 7      | .305 x 10^-2 (2.26) | 1.07 (37.5) | .888 | 1.81 | .181 x 10^-1 | .150 x 10^-3 (.131) | .836 (45.1) | .920 | 2.19 | .153 x 10^-1 |
| 8      | .132 x 10^-2 (1.14) | 1.04 (42.9) | .912 | 2.08 | .154 x 10^-1 | -.143 x 10^-2 (-1.18) | .797 (40.6) | .903 | 2.28 | .162 x 10^-1 |
| 9      | .370 x 10^-3 (.448) | 1.01 (58.1) | .950 | 2.15 | .111 x 10^-1 | -.210 x 10^-2 (-1.43) | .732 (30.9) | .843 | 2.33 | .196 x 10^-1 |
| 10     | -.187 x 10^-2 (-2.31) | 1.00 (58.9) | .951 | 2.07 | .109 x 10^-1 | -.400 x 10^-2 (-1.93) | .658 (19.7) | .686 | 2.33 | .276 x 10^-1 |

Table 5a shows the regressions of the excess return to ten size-sorted portfolios on the excess return to the equally weighted and value weighted market indices and an intercept. The size-sorted portfolios are formed each year based on all NYSE firms with no missing monthly return observations during the year. The portfolios are ordered from the smallest firms (1) to the largest firms (10).
<table>
<thead>
<tr>
<th></th>
<th>alpha</th>
<th>UTSF</th>
<th>UPRF</th>
<th>UIFF</th>
<th>UDUNF</th>
<th>MKTRES</th>
<th>$\hat{R}^2$</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$0.195 \times 10^{-2}$ (1.30)</td>
<td>0.566 (5.52)</td>
<td>0.494 (6.74)</td>
<td>3.00 (18.6)</td>
<td>-18.9 (-23.6)</td>
<td>-0.296 $\times 10^{-1}$ (-0.203)</td>
<td>0.931</td>
<td>2.15</td>
<td>0.198 $\times 10^{-1}$</td>
</tr>
<tr>
<td>2</td>
<td>$0.145 \times 10^{-2}$ (1.35)</td>
<td>-0.554 $\times 10^{-1}$ (-0.745)</td>
<td>0.731 (13.8)</td>
<td>2.40 (20.5)</td>
<td>-13.3 (-22.8)</td>
<td>-0.105 (-0.995)</td>
<td>0.953</td>
<td>2.34</td>
<td>0.144 $\times 10^{-1}$</td>
</tr>
<tr>
<td>3</td>
<td>$0.207 \times 10^{-2}$ (2.43)</td>
<td>0.317 $\times 10^{-1}$ (0.544)</td>
<td>0.675 (16.2)</td>
<td>2.44 (26.7)</td>
<td>-10.2 (-22.4)</td>
<td>-0.350 $\times 10^{-1}$ (-0.423)</td>
<td>0.967</td>
<td>2.29</td>
<td>0.113 $\times 10^{-1}$</td>
</tr>
<tr>
<td>4</td>
<td>$0.206 \times 10^{-2}$ (2.71)</td>
<td>0.878 $\times 10^{-1}$ (1.68)</td>
<td>0.671 (18.0)</td>
<td>2.25 (27.5)</td>
<td>-8.14 (-20.0)</td>
<td>0.766 $\times 10^{-1}$ (1.03)</td>
<td>0.969</td>
<td>1.92</td>
<td>0.101 $\times 10^{-1}$</td>
</tr>
<tr>
<td>5</td>
<td>$-0.359 \times 10^{-3}$ (-0.472)</td>
<td>0.253 (4.86)</td>
<td>0.692 (18.6)</td>
<td>2.10 (25.7)</td>
<td>-7.08 (-17.4)</td>
<td>-0.603 $\times 10^{-1}$ (-0.814)</td>
<td>0.968</td>
<td>2.17</td>
<td>0.101 $\times 10^{-1}$</td>
</tr>
<tr>
<td>6</td>
<td>$-0.660 \times 10^{-3}$ (-0.919)</td>
<td>0.389 (7.91)</td>
<td>0.756 (21.5)</td>
<td>2.14 (27.7)</td>
<td>-5.43 (-14.1)</td>
<td>-0.123 (-1.85)</td>
<td>0.973</td>
<td>2.06</td>
<td>0.950 $\times 10^{-2}$</td>
</tr>
<tr>
<td>7</td>
<td>$0.843 \times 10^{-3}$ (1.06)</td>
<td>0.543 (10.0)</td>
<td>0.678 (17.5)</td>
<td>1.75 (20.6)</td>
<td>-4.20 (-9.91)</td>
<td>0.146 (1.89)</td>
<td>0.962</td>
<td>1.95</td>
<td>0.105 $\times 10^{-1}$</td>
</tr>
<tr>
<td>8</td>
<td>$-0.482 \times 10^{-3}$ (-0.713)</td>
<td>0.824 (17.8)</td>
<td>0.789 (23.8)</td>
<td>1.27 (17.5)</td>
<td>-3.07 (-8.50)</td>
<td>0.110 (1.67)</td>
<td>0.970</td>
<td>2.18</td>
<td>0.895 $\times 10^{-2}$</td>
</tr>
<tr>
<td>9</td>
<td>$-0.269 \times 10^{-3}$ (-0.404)</td>
<td>1.01 (22.2)</td>
<td>0.960 (29.5)</td>
<td>1.04 (14.6)</td>
<td>0.327 (0.919)</td>
<td>0.380 (5.87)</td>
<td>0.968</td>
<td>2.04</td>
<td>0.881 $\times 10^{-2}$</td>
</tr>
<tr>
<td>10</td>
<td>$-0.783 \times 10^{-3}$ (-1.38)</td>
<td>1.36 (34.8)</td>
<td>1.20 (42.9)</td>
<td>0.649 (10.6)</td>
<td>4.92 (16.2)</td>
<td>1.13 (20.4)</td>
<td>0.977</td>
<td>2.07</td>
<td>0.753 $\times 10^{-2}$</td>
</tr>
</tbody>
</table>

Table $5b$ shows the same independent variables regressed against the five macrofactors and an intercept.
Table 6a
CAPM Henriksson-Merton Estimates for Portfolios of Mutual Funds
1968,1 - 1982,12

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>EVW</th>
<th>PUT</th>
<th>R²</th>
<th>DW</th>
<th>SEE</th>
<th>Intercept</th>
<th>EEW</th>
<th>PUT</th>
<th>R²</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>-.471x10⁻³</td>
<td>.669 (21.8)</td>
<td>.184x10⁻¹</td>
<td>.343 (1.56)</td>
<td>.106x10⁻¹</td>
<td>.713x10⁻³</td>
<td>.457 (19.6)</td>
<td>-.110 (-2.55)</td>
<td>.885</td>
<td>1.74</td>
<td>.113x10⁻¹</td>
<td></td>
</tr>
<tr>
<td>SGI</td>
<td>.175x10⁻³</td>
<td>.777 (31.2)</td>
<td>-.612x10⁻²</td>
<td>-.140 (.949)</td>
<td>.865x10⁻²</td>
<td>.158x10⁻²</td>
<td>.509 (17.8)</td>
<td>-.148 (-2.79)</td>
<td>.869</td>
<td>2.25</td>
<td>.139x10⁻¹</td>
<td></td>
</tr>
<tr>
<td>GI</td>
<td>-.480x10⁻³</td>
<td>.755 (53.7)</td>
<td>-.159x10⁻¹</td>
<td>-.644 (.982)</td>
<td>.488x10⁻²</td>
<td>.683x10⁻³</td>
<td>.483 (16.1)</td>
<td>-.140 (-2.52)</td>
<td>.845</td>
<td>2.32</td>
<td>.145x10⁻¹</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>.342x10⁻²</td>
<td>1.17 (34.5)</td>
<td>-.118 (-1.97)</td>
<td>.961 (1.53)</td>
<td>.118x10⁻¹</td>
<td>.480x10⁻²</td>
<td>.762 (15.8)</td>
<td>-.280 (-3.11)</td>
<td>.980</td>
<td>2.16</td>
<td>.235x10⁻¹</td>
<td></td>
</tr>
<tr>
<td>MCG</td>
<td>.405x10⁻²</td>
<td>.975 (20.3)</td>
<td>-.217 (-2.58)</td>
<td>.907 (1.52)</td>
<td>.167x10⁻¹</td>
<td>.600x10⁻²</td>
<td>.626 (13.3)</td>
<td>-.369 (-4.22)</td>
<td>.824</td>
<td>2.01</td>
<td>.229x10⁻¹</td>
<td></td>
</tr>
</tbody>
</table>

Table 6a shows the regressions of the excess return to the risk-sorted mutual fund portfolios on the excess return to the value-weighted and equally weighted market indices, an intercept, and a European put option on the market index (PUT). See the text for a fuller description of the put option.
Table 6b

APT Henriksson-Merton Estimates for Portfolios of Mutual Funds
1968,1 - 1982,12

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>UTSF</th>
<th>UPRF</th>
<th>UIFF</th>
<th>UDUNF</th>
<th>MKTRES</th>
<th>PUT</th>
<th>$R^2$</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>-.119×10^{-2} (-1.21)</td>
<td>.511 (11.2)</td>
<td>.522 (12.0)</td>
<td>.828 (14.4)</td>
<td>-1.77 (-5.42)</td>
<td>.164 (2.58)</td>
<td>.261×10^{-2} (0.064)</td>
<td>.941</td>
<td>1.45</td>
<td>.808×10^{-2}</td>
</tr>
<tr>
<td>SGI</td>
<td>-.150×10^{-3} (-.184)</td>
<td>.663 (17.4)</td>
<td>.650 (21.5)</td>
<td>.927 (16.1)</td>
<td>-.529 (-1.94)</td>
<td>.336 (6.33)</td>
<td>-.277×10^{-1} (-.807)</td>
<td>.969</td>
<td>1.76</td>
<td>.674×10^{-2}</td>
</tr>
<tr>
<td>GI</td>
<td>-.557×10^{-2} (-1.02)</td>
<td>.742 (29.1)</td>
<td>.763 (37.6)</td>
<td>.780 (20.2)</td>
<td>.558 (3.05)</td>
<td>.574 (16.1)</td>
<td>-.192×10^{-1} (-.833)</td>
<td>.985</td>
<td>1.87</td>
<td>.452×10^{-2}</td>
</tr>
<tr>
<td>G</td>
<td>.325×10^{-2} (2.52)</td>
<td>1.05 (17.4)</td>
<td>1.19 (24.8)</td>
<td>1.43 (15.7)</td>
<td>1.21 (2.80)</td>
<td>.745 (8.86)</td>
<td>-.121 (-2.22)</td>
<td>.968</td>
<td>1.60</td>
<td>.107×10^{-1}</td>
</tr>
<tr>
<td>MCG</td>
<td>.380×10^{-2} (2.05)</td>
<td>.907 (10.5)</td>
<td>1.06 (15.4)</td>
<td>1.13 (8.66)</td>
<td>.766 (1.24)</td>
<td>.397 (3.29)</td>
<td>-.217 (-2.79)</td>
<td>.920</td>
<td>1.70</td>
<td>.153×10^{-1}</td>
</tr>
</tbody>
</table>

Table 6b shows the same regressions using the five macrofactors, an intercept, and the put option against the value-weighted index. For both Tables 6a and 6b, the t-statistics are computed using the Hansen-White heteroskedasticity consistent standard errors.
\begin{center}
Table 7
CAPM Modified Henriksson-Merton Estimates
for Portfolios of Mutual Funds
1968,1 - 1982,12
\end{center}

\begin{tabular}{|l|c|c|c|c|c|}
\hline
 & Intercept & EVW & NPUT & R² & DW & SEE \\
\hline
I & -0.121 \times 10^{-3} & 0.669 & 0.185 \times 10^{-1} & 0.899 & 1.56 & 0.106 \times 10^{-1} \\
 & (-0.152) & (21.8) & (0.343) &  &  &  \\
\hline
SGI & 0.584 \times 10^{-4} & 0.777 & -0.595 \times 10^{-2} & 0.949 & 1.64 & 0.865 \times 10^{-2} \\
 & (0.091) & (31.2) & (-0.136) &  &  &  \\
\hline
GI & -0.782 \times 10^{-3} & 0.755 & -0.160 & 0.982 & 1.75 & 0.488 \times 10^{-2} \\
 & (-2.15) & (53.7) & (-0.647) &  &  &  \\
\hline
G & 0.118 \times 10^{-2} & 1.17 & -0.117 & 0.961 & 1.53 & 0.118 \times 10^{-1} \\
 & (1.35) & (34.5) & (-1.97) &  &  &  \\
\hline
MCG & -0.744 \times 10^{-4} & 0.975 & -0.216 & 0.906 & 1.52 & 0.167 \times 10^{-1} \\
 & (-0.060) & (20.3) & (-2.57) &  &  &  \\
\hline
\end{tabular}

This table shows the regressions of the excess return to the risk-sorted mutual fund portfolios on the excess return to the value-weighted index, an intercept, and the excess return to a put option on the market index (NPUT). The t-statistics use the Hansen-White heteroskedasticity consistent standard errors.
<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>EVW</th>
<th>NPUT</th>
<th>$\hat{R}^2$</th>
<th>DW</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$0.743 \times 10^{-2}$</td>
<td>1.16</td>
<td>-0.111</td>
<td>0.596</td>
<td>2.13</td>
<td>$0.481 \times 10^{-1}$</td>
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<tr>
<td></td>
<td>(2.07)</td>
<td>(8.41)</td>
<td>(-4.57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$0.552 \times 10^{-2}$</td>
<td>1.13</td>
<td>-0.880</td>
<td>0.708</td>
<td>2.11</td>
<td>$0.361 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(2.05)</td>
<td>(10.9)</td>
<td>(-4.82)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$0.562 \times 10^{-2}$</td>
<td>1.13</td>
<td>0.572</td>
<td>0.782</td>
<td>2.08</td>
<td>$0.293 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(2.57)</td>
<td>(13.4)</td>
<td>(-3.87)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$0.496 \times 10^{-2}$</td>
<td>1.02</td>
<td>-0.108</td>
<td>0.812</td>
<td>1.87</td>
<td>$0.248 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(2.68)</td>
<td>(14.3)</td>
<td>(-0.862)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$0.249 \times 10^{-2}$</td>
<td>1.08</td>
<td>0.566</td>
<td>0.833</td>
<td>2.04</td>
<td>$0.233 \times 10^{-1}$</td>
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<tr>
<td></td>
<td>(1.43)</td>
<td>(16.2)</td>
<td>(-0.004)</td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>$0.195 \times 10^{-2}$</td>
<td>1.13</td>
<td>-0.161</td>
<td>0.861</td>
<td>2.04</td>
<td>$0.218 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(1.21)</td>
<td>(17.9)</td>
<td>(-1.146)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>$0.311 \times 10^{-2}$</td>
<td>1.14</td>
<td>0.152</td>
<td>0.889</td>
<td>1.84</td>
<td>$0.180 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(2.32)</td>
<td>(21.9)</td>
<td>(1.57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>$0.135 \times 10^{-2}$</td>
<td>1.08</td>
<td>0.879</td>
<td>0.913</td>
<td>2.08</td>
<td>$0.154 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(1.17)</td>
<td>(24.3)</td>
<td>(1.13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>$0.422 \times 10^{-3}$</td>
<td>1.07</td>
<td>0.130</td>
<td>0.951</td>
<td>2.12</td>
<td>$0.109 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(0.517)</td>
<td>(34.0)</td>
<td>(2.34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>$-0.185 \times 10^{-2}$</td>
<td>1.02</td>
<td>0.430</td>
<td>0.951</td>
<td>2.05</td>
<td>$0.109 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(-2.28)</td>
<td>(32.7)</td>
<td>(.781)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVW</td>
<td>0.0</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>--</td>
<td>0.00</td>
</tr>
<tr>
<td>EEW</td>
<td>$0.355 \times 10^{-2}$</td>
<td>1.18</td>
<td>-0.722</td>
<td>0.834</td>
<td>2.17</td>
<td>$0.253 \times 10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>(1.88)</td>
<td>(16.2)</td>
<td>(-0.056)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table shows the regressions of the excess return to the size-sorted portfolios on the excess return to the value-weighted index, an intercept, and the excess return to a put option on the market index. The t-statistics use the Hansen-White heteroskedasticity consistent standard errors.