AGENCY AND ASSET PRICING

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This paper is concerned with the asset pricing implications of the substantial proportion of equity portfolios that are managed on an agency basis. Portfolio managers who act as agents are assumed to be concerned with the mean and variance of their return measured relative to a benchmark portfolio. Depending on how the benchmark portfolios are chosen, this will affect the equilibrium structure of expected returns. The empirical analysis, which assumes that the benchmark can be identified with the S&P500 portfolio, finds evidence of the pricing effects predicted by the agency model.

I

INTRODUCTION

The growth in institutionalization of private savings means that a substantial fraction of primary securities are now managed on an agency basis by professional portfolio managers for the benefit of the ultimate owners, who may be the shareholders of the intermediaries, mutual fund investors, insurance company policyholders, pension fund beneficiaries and so on. In 1955 institutions owned 23% of US equities while individuals owned 77%; by 1990 the institutional share had grown to 53% and the share of individual investors had fallen to only 47%[1]. If there were no agency problem in the management of institutional portfolios, this shift in asset ownership would have no effect on the structure of asset prices, since the institutions would simply hold the securities that individuals would have desired to hold on their own account. However, it seems likely that agency problems exist in the management of security portfolios, just as they do in the management of corporate assets, since portfolio managers are self-interested agents and their abilities and effort levels are only imperfectly

[1] Source: Lakonishok et al. (1991). In 1989 direct equity ownership by domestic individuals accounted for only 21.3% of the value of UK equity shares according to the Stock Exchange Quarterly (1991).

observable.[2]

Since the return on a managed portfolio depends upon both the random state of nature and the action of the portfolio manager, the analysis of Holmstrom (1979) suggests that it will in general be optimal for the portfolio manager's reward to depend not only on the realized return on the portfolio, but also on any signal that is informative about the manager's action. One such signal is the return on an unmanaged portfolio such as a market index, and the now extensive literature on the measurement of portfolio management performance[3] suggests that the returns on the managed portfolio be compared with those of a passive investment strategy[4]; this accords well with observed incentive schemes which reward the manager on the basis of the difference between the returns earned on the managed portfolio and the returns on a benchmark or index portfolio[5]. Even when managers do not have an explicit incentive contract, their ability to attract new funds with their attendant management fees will generally depend on how

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[2] See Ross (1973). Starks (1987) and Golec (1992) have previously drawn attention to the agency problem in portfolio management.

[3] See for example Grinblatt and Titman (1989)

[4] See Dybvig and Ross (1985) for some for the difficulties for traditional mean variance analysis when the manager follows a dynamic portfolio strategy.

[5] Or portfolio managers may be rewarded on their performance relative to each other. "Most managers regard the performance of the median manager as their benchmark, and indeed this is often part of their contract with the trustees...For most external managers, however, to diverge very far from the consensus asset allocation would constitute a severe business risk, more important in practice than the investment risk being borne by the client." Financial Times, May 7, 1992.

well they perform relative to generally accepted benchmarks[6]. Thus Lakonishok et al. (1991) report that most equity managers promise to beat the Standard and Poor's 500 (S&P500) index by 200 to 400 basis points, and that pension fund sponsors allocate money among money managers based on their evaluations of these money managers' ability to beat the S&P500. Therefore it is reasonable to assume that portfolio managers who are acting as agents will be concerned with the return on their portfolio relative to some unmanaged benchmark, rather than with the absolute return on the portfolio.

Classical asset pricing theory assumes that all portfolios are managed by expected utility maximizing principals. In this paper we consider the effect of the agency problem inherent in money management on asset pricing and equilibrium portfolios. In Section II we develop a simple mean-variance asset pricing model which assumes that there are two types of investor. The first type of investor, whom we refer to as an individual, is assumed to be concerned with the mean and variance of his portfolio return, as in the classical setup. The second type of investor, whom we refer to as an agent, is assumed to be concerned with the mean and variance of his return relative to that of a given benchmark portfolio. In the empirical analysis of Section III we identify the benchmark portfolio with the S&P500, since this is the most widely accepted measure of the return on equities. Thus, most index funds are constructed to mimic the return on the

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[6] Scharfstein and Stein (1990) show that reputational considerations can lead managers to herd on the same investment policies.

S&P500, and most pension fund equity portfolios appear to track the S&P500 closely[7].

II

THE MODEL

Consider a single period exchange economy with two types of investor: individual investors who are standard mean variance optimizers, and agency investors whose reward is proportional to the difference between the return on their portfolio and the return on an equity benchmark portfolio. We denote the benchmark portfolio for agent i (i = 1,..I) by the vector $\underline{x}_{0i}$, where $\underline{j}'\underline{x}_{0i} = 1$, and $\underline{j}$ is a vector of units. Assume that asset returns are multivariate normal with parameters (μ, Ω). Agents, who are assumed to be constrained to hold all of the wealth under their control in equities, in choosing their optimal portfolio, $\underline{x}_i$, face a mean-variance problem of the form:

$$\max_{\underline{x}} \; (\underline{x} - \underline{x}_{0i})'\mu - \lambda_i(\underline{x}'\underline{j} - 1) - \frac{a_i}{2}(\underline{x} - \underline{x}_{0i})'\,\Omega\,(\underline{x} - \underline{x}_{0i}) \qquad (1)$$

where a_i is the coefficient of absolute risk aversion, λ_i is a Lagrange multiplier

[7] Lakonishok et all (1991) report that the median beta with respect to the S&P500 for the pension funds in their data base was 1.0, with 50% of the fund betas falling between 0.96 and 1.04.

and $\underline{j}$ is a vector of units[8]. The vector of optimal portfolio proportions, $\underline{x}_i$, is given by

$$\underline{x}_i = \underline{x}_{0i} + \frac{1}{a_i}\Omega^{-1}(\mu - \lambda_i \underline{j}) \tag{2}$$

Imposing the constraint that the managed portfolio is entirely invested in equities, $x_i'\underline{j} = 1$. Then, substituting for $\underline{x}_i$ from equation (2), it is seen that $\lambda_i = \mu'\Omega^{-1}\underline{j}/\underline{j}'\Omega^{-1}\underline{j} \equiv R_v$, the return on the global minimum variance portfolio of risky assets.

Similarly, the portfolio problem faced by individual investor j (j = 1, J), with coefficient of absolute risk aversion b_j, may be written as:

$$\underset{\underline{x}}{\text{Max}}\ \underline{x}'(\mu - R_F \underline{j}) - \frac{b_j}{2}\underline{x}'\Omega\,\underline{x} \tag{3}$$

where R_F is the riskless interest rate: the optimal portfolio of risky assets for an individual investor may be written

$$\underline{x}_j = \frac{1}{b_j}\Omega^{-1}(\mu - R_F \underline{j}) \tag{4}$$

Market equilibrium requires that the sum of the portfolios of agent and individual investors be equal to the vector of aggregate asset supplies:

[8] Roll (1991) provides a detailed characterization of the portfolios implied by this type of objective function.

$$W_A \underline{x}_0 = \sum_{i=1}^{I} W_i \underline{x}_{0i}, \qquad \underline{x}_0' j = 1 \tag{5}$$

where W_i, and W_j are the values of the portfolios controlled by agents and individual investors respectively, and W_M is the value of the aggregate market portfolio of risky assets; $\underline{x}_M$ is the vector of asset proportions in the market portfolio. Then, substituting for $\underline{x}_i$ and $\underline{x}_j$ from equations (2) and (4), the vector of equilibrium expected asset returns may be written as:

$$\mu = R^*_F j + H(W_M \Omega \underline{x}_M - W_A \Omega \underline{x}_0) \tag{6}$$

where:

$$R^*_F = \frac{R_v \sum_{i=1}^{I} \frac{W_i}{a_i} + R_F \sum_{j=1}^{J} \frac{W_j}{b_j}}{\sum_{i=1}^{I} \frac{W_i}{a_i} + \sum_{j=1}^{J} \frac{W_j}{b_j}}$$

$$H = \left[\sum_{i=1}^{I} \frac{W_i}{a_i} + \sum_{j=1}^{J} \frac{W_j}{b_j} \right]^{-1}$$

and

$$W_A \underline{x}_0 = \sum_{i=1}^{I} W_i \underline{x}_{0i}, \qquad \underline{x}_0' j = 1$$

Equation (6) is the counterpart of the traditional Capital Asset Pricing Model and expresses the equilibrium expected return on a security as a linear function of the riskless interest rate, the covariance with the market portfolio, $\underline{x}_M$, and the covariance with the aggregate benchmark portfolio, $\underline{x}_0$. If the 'residual' portfolio $\underline{x}_R$ is defined as that part of the market portfolio which is not part of the aggregate benchmark portfolio, $W_R\underline{x}_R \equiv W_M\underline{x}_M - W_A\underline{x}_0$, where $\underline{x}_R'j = 1$, then the vector of expected returns may be expressed in terms of covariances with the residual portfolio:

$$\mu = R^*_F j + HW_R \Omega \underline{x}_R \tag{7}$$

This pricing expression reflects the fact that from the viewpoint of agent investors the benchmark portfolios are riskless so that, insofar as agents hold the benchmark portfolios, the assets in these benchmark portfolios are removed from the universe of assets whose risk must be borne and reflected in security prices - as a result, only covariance with the residual portfolio is priced in this model. An extreme example of this is provided by portfolio 'indexing' in which the agent is instructed to mimic the performance of some benchmark portfolio - indexing corresponds to the agent having an infinite risk aversion coefficient and therefore holding only the benchmark portfolio. It is interesting to note that indexing and the measurement of portfolio performance relative to a pre-determined benchmark have a qualitatively similar effect on equilibrium asset pricing - only the intercept and the slope of the asset pricing equation are affected by the risk aversion of agents.

It follows from equation (7) and standard portfolio efficiency results[9] that

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[9] See for example Merton (1972) or Roll (1977).

the market portfolio $\underline{x}_M$ will not be mean variance efficient unless the vector of market proportions is proportional to the residual portfolio vector, and this can only occur if the aggregate benchmark portfolio is the market portfolio.

The Choice of Benchmark Portfolios

A. Exogenous Benchmark Portfolios

Substituting for λ_i in equation (2), the equilibrium portfolio of agent i may be written as:

$$\underline{x}^e_i = \underline{x}_{0i} + \frac{1}{a_i}\Omega^{-1}(\mu - R_v j) \qquad (8)$$

Thus, in equilibrium, each agent combines his benchmark portfolio with an arbitrage portfolio[10] that is a linear combination of the minimum variance portfolio, $\Omega^{-1}j/j'\Omega^{-1}j$, and the portfolio that is at the point of tangency to the efficient set of a ray from the origin, $\Omega^{-1}\mu/j'\Omega\mu$[11]. Substituting for μ from the pricing relation (7), the vector of equilibrium asset holdings may also be written as

$$\underline{x}^e_i = \underline{x}_{0i} + \frac{1}{a_i}\left[\Omega^{-1}(R^*_F - R_v)j + HW_R\underline{x}_R\right] \qquad (9)$$

Equation (9) expresses the equilibrium asset holdings as the sum of the benchmark portfolio and an arbitrage portfolio which combines a long position in the residual portfolio $\underline{x}_R$ with a short position in the minimum variance portfolio $\Omega^{-1}j/j'\Omega^{-1}j$.

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[10] i.e. a zero net investment portfolio.

[11] Compare equation (8) with equation (4).

Equation (4) shows that the optimal risky portfolio of an individual investor is the tangency portfolio obtained by drawing a tangent from the riskless interest rate to the efficient frontier. Substituting for μ in this expression, the equilibrium holdings of an individual investor may also be expressed as:

$$x^e_j = \frac{1}{b_j}\left[(R_v - R^*_F)\Omega^{-1}j + HW_R x_R\right] \qquad (10)$$

Thus, individual investors in equilibrium combine a long position in the minimum variance portfolio (which offsets the short position of the agents) with a long position in the residual portfolio.

B. Informed Principals

We have seen that when the composition of the benchmark portfolios is exogenously given, the market portfolio will not in general be mean-variance efficient. It is natural to ask whether the distortions in asset prices and portfolio holdings described above would persist if the principals on whose behalf the portfolios were managed were informed - i.e. knew the parameters of the return generating process (μ, Ω), and were mean-variance optimizers. An informed principal will wish to select the benchmark portfolio so that the agent will choose to select the "tangency portfolio": $\Omega^{-1}(\mu - R_F j)/j'\Omega^{-1}(\mu - R_F j)$. This implies from equation (2) that the optimal benchmark portfolio for the principal of agent i is:

$$x_{0i}^* = \Omega^{-1}(\mu - R_F j)/j'\Omega^{-1}(\mu - R_F j) - \frac{1}{a_i}\Omega^{-1}(\mu - R_v j) \qquad (11)$$

Substituting for $\underline{x}_{0i}^*$ in equation (6), it may be verified that the vector of equilibrium expected returns satisfies:

$$\mu = R_F^{**} j + H^* \Omega \underline{x}_M \tag{12}$$

for constants R_F^{**} and H^*. But (12) is the (zero-beta) form of the capital asset pricing model, which is therefore consistent with some portfolios being managed by agents, provided that the principals are informed.

However, the requirement that the principals be informed about the mean vector and covariance matrix, which is necessary if the benchmark portfolio is to be chosen according to (11), is a strong one; if the principal is that well informed then it would be possible to dispense with the agent. An alternative assumption is that principals, as well being informed directly about the covariance matrix of returns, know the expected return on the market portfolio and understand the nature of the market equilibrium and take this into account in selecting their benchmark portfolios - we term this a rational expectations equilibrium.

C. A Rational Expectations Equilibrium

Suppose that the principals of the agents know the covariance matrix of returns and the expected return on the market portfolio and conjecture that in equilibrium the market portfolio will be the mean variance efficient portfolio of risky assets - the "tangency portfolio", $\Omega^{-1}(\mu - RF_j)/j'\Omega^{-1}(\mu - R_F j)$. This conjecture allows them to infer the expected returns on all securities and then the principal of agent i will choose the benchmark portfolio:

$$\underline{x}_{0i} = \underline{x}_M - \frac{1}{a_i}\Omega^{-1}(\mu - R_F j) \tag{13}$$

Then, substituting for $\underline{x}_{0i}$ in equation (6) we obtain:

$$\mu = R_F j + \left(\sum_{j=1}^{j=m} \frac{W_j}{b_j}\right)^{-1} W_I \Omega \underline{x}_M \tag{14}$$

where W_I is the aggregate wealth of individual investors. But equation (14) implies that the market portfolio is the tangency portfolio as conjectured, and that therefore the simple Sharpe-Lintner version of the Capital Asset Pricing Model holds, despite the existence of investors who are agents. Note that now expected excess returns are proportional to the covariance with the portfolio held by individual investors, and the market price of risk depends only on the weighted average risk tolerance of the individual investors - in short, the equilibrium is as if there were only individual investors and the market portfolio were reduced by the share held by agent investors. In this equilibrium both agents and individuals hold the same portfolio of risky assets - the market portfolio. Note however, that this rational expectations equilibrium also implies that principals are informed about the parameters of the joint distribution of returns (as well as the risk aversion of their agent) in selecting their benchmark portfolio $\underline{x}_{0i}^{*}$, and in this setting the principals would have no incentive to employ a manager.

Thus the presence of agent investors in the capital market may give rise to one of three types of equilibrium. If the benchmark portfolios are exogenous, then expected returns are given by equation (6) which is equivalent to equation (7) - the risk premium depends on the covariance of asset return with the return on the "residual portfolio", which is the difference between the aggregate market portfolio and the aggregate benchmark portfolio. If the principals of the agents are informed and choose the benchmark portfolios in such a way that their agents will select the tangency portfolio in equilibrium, then the equilibrium is given by equation (12); the market portfolio is efficient but is no longer the tangency portfolio - that is to say, the Black (1972) version of the capital asset pricing model holds. Finally, if principals conjecture that in equilibrium the market portfolio will be mean-variance efficient, the resulting equilibrium expressed in equation (14) is such that the simple Sharpe-Lintner model holds.

It is at least doubtful if the conditions necessary for the agency equilibrium to be identical to the capital asset pricing model equilibrium are satisfied in practice. First, it is unlikely that the individual investors who purchase mutual funds, or the trustees of pension funds and other institutional portfolios, have the knowledge about individual returns assumed for informed principals. The assumption that all principals use the aggregate market portfolio as a benchmark also seems to be counterfactual in view of the widespread practice of indexing to the S&P500 portfolio, and the more general use of this portfolio as a benchmark.

In the following sections we shall test the capital asset pricing model equilibrium against the alternative of the specific form of the agency pricing model expressed in equations (6) or (7), in which the S&P500 is the aggregate benchmark portfolio; in order to emphasize the critical auxiliary assumption in our tests that the aggregate benchmark portfolio is the S&P500 we shall refer to this variant of the agency pricing model as the **S&P500 Model**[12]. Identifying the aggregate benchmark portfolio $\underline{x}_0$ with the S&P500 portfolio, the agency equilibrium model (6) implies that expected returns can be written as a linear function of the beta with respect to the value weighted market index, $\beta_{VWI,j}$, and the beta with respect to the benchmark portfolio, $\beta_{S\&P,j}$:

$$E[R_j] = a + b\beta_{VWI,j} + c\beta_{S\&P,j} \tag{15}$$

where $b > 0$ and $c < 0$. Define the S&P residual, e, as the residual from the regression of the return on the S&P index on the value weighted index:

$$R_{S\&P} = h_0 + h_1 R_{VWI} + e \tag{16}$$

Then it is easy to show that equation (16) implies that expected returns can be written as:

$$E[R_j] = a_0 + a_1\beta_{VWI,j} + a_2\beta_{e,j} \tag{17}$$

where $a_1 > 0$, $a_2 < 0$, and $\beta_{e,j}$ is the beta with respect to the S&P residual, that component of the S&P500 portfolio return that is orthogonal to the return on the value weighted index. Equation (17) is the focus of our empirical analysis.

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[12] For consistency we should also refer to the specific variant of the capital asset pricing model as the CRSP Value Weighted Model (see Roll(1977)); however, consistent with current usage, we shall eschew this nicety.

III

DATA AND EMPIRICAL TESTS

Monthly security returns were drawn from the CRSP data for the period 1926-91. Each year from 1931 to 1991 all securities listed for the previous 5 years that had at least 24 non-missing returns were allocated to one of 25 portfolios according to the following procedure. For security j $\beta_{VWI,j}$ and $\beta_{e,j}$ were estimated by a multiple regression of the security return for the previous months on the return on the CRSP value weighted index, $R_{VWI,t}$ and the return (excluding dividends) on the S&P index[13], $R_{S\&P,t}$:

$$R_{j,t} = \alpha_j + \beta_{VWI,j} R_{VWI,t} + \beta_{S\&P,j} R_{S\&P,t} + e_{j,t} \qquad (18)$$

The securities were then assigned to 5 equal size groups according to the estimated value of $\beta_{VWI,j}$; each of these groups was then further subdivided into 5 subgroups according to the estimated value of $\beta_{e,j}$. The result of this procedure is a set of 25 portfolios for the 61 year period 1931-91 chosen so as to maximize the dispersion of portfolio VWI betas and S&P residual betas.

Then, for each portfolio, the value weighted market beta (β_{VWI}) and the S&P residual beta (β_e) were estimated by simple ordinary least squares regressions of the portfolio returns on the corresponding index for the whole sample period. The betas and the mean monthly returns on the 25 portfolios are given in Table 1, together with a measure of the average size of the firms in the portfolio,

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[13] Until 1952 the S&P Index consisted of 40 securities; thereafter it includes 500 securities.

denoted SIZE. For each portfolio, SIZE is measured each month as the equally weighted average of the logarithms of the market values (in thousands of dollars) of the firms in the portfolio. The value reported in the table is the time series average for each portfolio. The values of β_e are negative for all of the portfolios, and range from -0.334 to -2.770. Table 2 reports the correlation matrix of the portfolio characteristics shown in Table 1. $\beta_{VWI,j}$ has a correlation with $\beta_{e,j}$ of only -0.38, and the SIZE variable is virtually orthogonal to the two estimated betas.

Table 3 reports the results of estimating equation (17) by generalized least squares for the whole sample period and different subperiods, with and without the addition of the SIZE variable. The results for the whole sample period are generally consistent with the predictions of the S&P500 model. The estimated coefficients of β_{VWI} are positive while those of β_e are negative and significant as predicted, and the size variable is not significant. The F-test of the linearity of the pricing relation is not significant. However, the subperiod results show that the good performance of the model is entirely due to the first half of the sample period when the influence of institutional investors could be expected to be least.

In order to investigate more closely the time series behavior of the coefficients we followed the standard Fama-Macbeth procedure of estimating a cross-section regression each month, and then averaging the coefficients over the sample period. The independent variables for these regressions are the betas estimated over the corresponding sample period. Table 4 reports the results of these regressions. The results for the whole period (with or without the SIZE variable) support the S&P500 model in that the coefficient of $\beta_{e,j}$ is negative and significant, while that of $\beta_{vwi,j}$ is also positive, although not significant. Again however the results are driven by the first half of the sample. For the second half, the coefficient of $\beta_{e,j}$ is either insignificant or significant and of the wrong sign when the SIZE variable is included in the regressions. The four quarter regressions yield indeterminate results.

Figures 1 and 2 plot the cumulative sums of the monthly coefficients of the $\beta_{e,j}$ variable from the Fama-Macbeth regressions when the portfolio betas are estimated over the whole sample period. Figure 1 is derived from the regressions in which the independent variables are β_{vwi} and β_e, while Figure 2 allows for effect of the SIZE variable in the regressions. When no size effect is included, the cumulative reward drops sharply in the 1930's, is then roughly constant until the mid-1970's when it drops sharply again, only to recover somewhat from the mid 1980's. When the SIZE variable is included, the cumulative reward declines irregularly throughout the sample period which is consistent with the model predictions.

Overall, the results thus far provide at best limited support for the predictions of the S&P500 model. However, an implicit assumption in the foregoing analysis is that the Value Weighted CRSP Index is an adequate proxy for the market portfolio. As Roll (1977) particularly has pointed out, this is a strong assumption. A weaker assumption is that the return on the aggregate market portfolio, $R_{M,t}$, can be written as a weighted sum of returns on a small number of factor portfolios:

$$R_{m,t} = \sum_{k=1}^{K} w_{mk} F_{k,t} \tag{19}$$

Now define the S&P residual as the residual from the regression of the S&P return on the returns on the factor portfolios. Then it may be shown that, corresponding to equations (15)-(17), equation (6) implies that expected returns are linear functions of the portfolio factor betas and the S&P residual beta:

$$E[R_j] = a_0 + a_1 \beta_{e,j} + a_2 \beta_{1,j} +..+ +a_{K+1} \beta_{K,j} \tag{20}$$

and that $a_1 < 0$.

In order to estimate equation (20), 10 factors were estimated for successive five year periods from 1931 to 1990 using the method of asymptotic principal components described by Connor and Korajczyk (1988). For each five year period the monthly returns of all of the N firms listed continuously on the CRSP tape for that period were assigned to a (Nx60) matrix **R**; the (60x60) matrix **R'R** was formed and the first ten eigenvectors computed. The scaled eigenvectors can be shown to be proportional to the factors of an approximate factor model[14].

Given these factor estimates, factor loadings, $\beta_{k,j}$ (k = 1, 10) were estimated for each of the 25 portfolios for the corresponding 60 month period. Finally, the following cross-section regression was estimated for each month:

$$R_{j,t} = a_{0,t} + a_{1,t}\beta_{e,j} + a_{2,t}\beta_{1,j} +\ldots + a_{6,t}\beta_{5,j} + u_{j,t} \tag{21}$$

[14] See Connor and Korajczyk (1988).

The means of the coefficients of the S&P residual beta and the size variable are reported in Table 5 along with their associated t-ratios[15]. a_1, the coefficient of $\beta_{e,j}$, is now positive in the first quarter of the sample period, but is negative, as the agency model predicts, in the three subsequent quarters and, moreover, is increasing in absolute value over time, which is consistent with the greater importance of insititutional investment in recent years.

Thus the factor model (with or without the size variable) reverses the results obtained using the value weighted CRSP index. Furthermore, the results for the last two quarters are highly statitically significant, as we should expect if institutional investment is important, the reward per unit of S&P residual beta being of the order of 0.4% per month. The SIZE effect is irregular and generally insignificant.

Figure 3 shows the cumulative sum of the coefficients of $\beta_{e,j}$ from regressions (21) with the addition of the size variable[16]. The cumulative reward function fluctuates sharply up till about 1952 when the coverage of the S&P index was extended; thereafter it declines almost monotonically up to the mid-1980's when it levels out.

A possible interpretation of the levelling out the reward series during the

[15] It is not possible to aggregate the coefficients of the factor betas across different 60 month intervals since there is no assurance that the identity of the factors remains constant across intervals.

[16] The corresponding figure when the SIZE variable is omitted from the regressions is virtually identical and is omitted.

1980's is related to the growth in indexing[17] during this period. Equation (6) shows that the expected reward to covariance with the benchmark portfolio is decreasing in the size of the aggregate benchmark portfolio. An unexpected increase in the size of this portfolio brought about, for example, by an increase in indexing, would imply an unanticipated capital gain on securities with a positive covariance with the benchmark. Chan and Lakonishok (1992) report that the fraction of the top 200 pension fund equity portfolios indexed to the S&P500 grew from about 2% in 1980 to about 20% by 1990, and argue that this growth in demand for stocks in the index pushed up the prices of stocks in the index by about 2% per year[18].

In summary, the factor portfolio based regression results of Table 4 are consistent with the predictions of the agency model, except for the first quarter of the sample period when instituional investors were of relatively little importance and the S&P index coverage was narrow. Moreover, these results are more robust than those which are based on the CRSP value weighted index since they do not rely on an a priori specification of the market portfolio. Whether or not SIZE is included, Figure 3 shows significant negative returns to the S&P500 residual beta during the 1970's and early 1980's, with close to zero returns in the late 1980's. The negative returns are consistent with the S&P 500 model. The

[17] By this we mean passive portfolio strategies that aim to track an index portfolio. Virtually all equity indexers track the S&P500 portfolio.

[18] See also the evidence of Harris and Gurel (1986) that the addition of a stock to the S&P500 index causes an immediate increase in its price.

recent zero to slightly positive returns could also be interpreted as consistent with the S&P500 model combined with an unanticipated increase in the value of indexed portfolios.

III

CONCLUSION

In this paper we have drawn attention to the market equilibrium implications of portfolios managed on an agency basis. We have suggested that the managers of such portfolios will be concerned only about their returns relative to those of a benchmark portfolio. Then we have derived an equilibrium model of asset pricing in a mean-variance setting. The nature of the equilibrium depends critically on the assumptions about the behavior of the principals on whose behalf the portfolios are managed. If the benchmark portfolios are chosen exogenously, then equilibrium expected returns are a linear function of covariances or betas with respect to the residual portfolio of assets not contained in the aggregate benchmark portfolio or, equivalently, a linear function of betas with respect to the market portfolio and betas with respect to that component of the return on aggregate benchmark portfolio that is orthogonal to the return on the market portfolio. If the principals know the structure of expected returns and choose the benchmarks optimally, then the equilibrium is identical to the zero-beta form of the classical capital asset pricing model. If the principals conjecture that the market portfolio will be the Sharpe-Lintner tangency portfolio and choose their benchmarks correspondingly, then the resulting equilibrium is identical to that of the Sharpe-Lintner form of the capital asset pricing model. In reality, principals are likely to be constrained in their choice of benchmarks to available published indices of passive portfolios such as the S&P500 index.

Thus the empirical analysis assumed that the aggregate benchmark portfolio was the S&P500 portfolio. Tests were conducted using both the CRSP Value Weighted Index and a linear combination of 10 factor portfolios as proxies for the market portfolio, and allowing for a size effect. When the 10 factor proxy is used, the results support the agency model in that the returns to the S&P500 residual beta are found to be negative in the post WWII period, and to be statistically significant in the whole sample period, the second half (1962-1991), and the final two quarters separately. Moreover, the absolute value of the S&P500 residual effect was found to be increasing over time, which is consistent with increasing institutional participation in equity markets. However, visual analysis reveals that the return to the S&P500 residual beta was close to zero in the latter part of the 1980's. It is suggested that this may be attributable to an unanticipated increase in the value of portfolios managed passively to mimic the index.

While we have taken the aggregate benchmark portfolio as exogenous and proxied it by the S&P500, it is to be expected that as knowledge of the inefficiency of the S&P500 portfolio becomes more widespread among principals, it will generate a demand on the part of principals for other benchmarks that are more efficient, or that approximate better either the whole available market portfolio of common stocks, or that part of it that is not represented by existing indices. This process appears to be visible in the recent proliferation of stock market indices and associated futures contracts.

The model of agency that we have proposed is an extremely simple one. In particular it is static, and we have attempted to model neither the behavior of principals with limited information about security returns trying to devise appropriate contracts for screening and rewarding portfolio managers[19], nor the optimal dynamic strategy of a manager given an incentive contract. Indeed, we have given no attention to the asymmetry of information between principals and agents about the distribution of asset returns which gives rise to the demand for portfolio management services. In view of the huge size of portfolios currently managed on an agency basis, it is an urgent task to develop more realistic models of the agency problem in this context, and the implications of agency for asset pricing and the allocation of capital.

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[19] See Bhattacharya and Pfleiderer (1985) and Allen (1990).

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Portfolio	β_{VWI}	β_e	SIZE	Mean Monthly Return x 100
1	0.973	-2.175	10.54	1.466
2	0.782	-1.308	11.16	1.301
3	0.742	-0.766	11.39	1.104
4	0.727	-0.617	11.54	1.056
5	0.725	-0.700	11.67	1.125
6	1.192	-1.971	10.50	1.516
7	1.120	-1.240	11.06	1.410
8	1.047	-0.546	11.34	1.292
9	1.002	-0.334	11.64	1.153
10	1.007	-0.616	11.94	1.184
11	1.361	-2.770	10.34	1.775
12	1.365	-1.213	10.85	1.439
13	1.252	-0.913	11.18	1.502
14	1.230	-0.513	11.36	1.270
15	1.195	-0.314	11.69	1.401
16	1.522	-2.397	10.25	1.715
17	1.567	-1.441	10.73	1.713
18	1.497	-1.282	11.00	1.537
19	1.473	-0.656	11.20	1.471
20	1.432	-0.491	11.32	1.432
21	1.880	-2.449	9.90	1.706
22	1.845	-1.481	10.29	1.650
23	1.734	-1.686	10.48	1.498
24	1.700	-0.982	10.71	1.607
25	1.631	-0.786	10.77	1.571

Characteristics of Portfolios formed on value weighted market beta (β_{VWI}) and S&P residual beta (β_e)
Table 1

β_{VWI}	β_e	SIZE
1.00	-.38	-.03
-.38	1.00	0.04
-.03	0.04	1.00

Correlations of Portfolio Characteristics

Table 2

Independent Variables

	Intercept x 100	β_{VWI} x 100	β_e	SIZE	F-Statistic (d.f.)
Jan 1931- Dec 1991	0.761 (5.43)	0.401 (1.59)	-0.117 (2.06)		1.203 (22, 710)
Jan 1931- Dec 1991	0.963 (0.80)	0.394 (1.54)	-0.110 (1.56)	-0.117 (0.17)	1.26 (21,711)
Jan 1931- Jun 1961	0.661 (3.70)	0.475 (1.22)	-0.158 (1.72)		1.43 (22, 344)
Jan 1931- Jun 1961	-0.138 (0.06)	-0.514 (1.26)	-0.178 (1.62)	0.071 (0.38)	1.49 (21, 345)
Jul 1961- Dec 1991	1.244 (6.29)	-0.094 (0.30)	0.004 (0.12)		1.83 (22, 344)
Jul 1961- Dec 1991-	0.468 (0.35)	0.024 (0.07)	-0.016 (0.39)	0.152 (1.28)	1.85 (21, 345)

Generalized Least Squares Regressions of Mean Returns on 25 Portfolios ranked by value weighted market beta and residual market beta for the period 1931-1991 on the value weighted market beta (β_{VWI}), the S&P residual beta (β_e), and the average logarithm of equity value (SIZE).

(t-ratios in parentheses).

Table 3

	Constant × 100	β_{VWI} × 100	β_e × 100	SIZE × 100
Jan 1931 -	0.782	0.388	-0.132	
Dec 1991	(4.80)	(1.46)	(2.10)	
Jan 1931 -	0.436	0.722	-0.225	
Dec 1961	(1.74)	(1.73)	(2.03)	
Jan 1962-	1.226	-0.098	-0.023	
Dec 1991	(5.73)	(0.29)	(0.52)	
Jan 1931-	-0.331	1.479	-0.227	
Dec 1945	(0.71)	(1.91)	(1.67)	
Jan 1946-	1.115	-0.050	0.010	
Dec 1960	(6.68)	(0.15)	(0.05)	
Jan 1961 -	1.057	-0.180	-0.003	
Dec 1975	(2.81)	(0.35)	(0.05)	
Jan 1976 -	1.544	-0.124	-0.057	
Dec 1991	(6.20)	(0.29)	(1.00)	
Jan 1931 -	0.014	0.428	-0.165	0.062
Dec 1991	(0.01)	(1.59)	(2.14)	(0.59)
Jan 1931 -	3.772	0.477	-0.110	-0.291
Dec 1961	(1.41)	(1.14)	(0.79)	(1.22)
Jan 1962	7.667	0.520	0.256	-0.522
Dec 1991	(4.72)	(1.40)	(3.24)	(3.99)
Jan 1931 -	3.992	1.006	-0.126	-0.369
Dec 1945	(1.35)	(1.26)	(0.81)	(1.43)
Jan 1946 -	-0.029	0.012	-0.003	0.103
Dec 1960	(0.02)	(0.04)	(0.02)	(0.84)
Jan 1961 -	3.652	0.234	0.106	-0.234
Dec 1975	(2.10)	(0.45)	(1.54)	(1.63)
Jan 1976 -	6.276	0.184	0.151	-0.362
Dec 1991	(3.32)	(0.41)	(1.53)	(2.46)

Time Series Means of Cross Sectional Regression Coefficients from

$$R_{jt} = a_{0t} + a_{1t}\,\beta_{VWI,j} + a_{2t}\,\beta_{e,j} + a_{3t}\,SIZE_j + u_{jt}$$

(t-ratios in parentheses)

Table 4

	a_2 (× 100)	a_{13} (× 100)
January 1931 -	-0.139	
December 1990	(2.23)	
January 1931 -	0.193	
December 1961	(2.02)	
January 1962 -	-0.422	
December 1990	(5.16)	
January 1931 -	0.426	
December 1945	(3.58)	
January 1946 -	-0.114	
December 1960	(0.72)	
January 1961 -	-0.416	
December 1975	(3.56)	
January 1976 -	-0.428	
December 1990	(3.74)	
January 1931 -	-0.072	-1.225
December 1990	(1.07)	(0.38)
January 1931 -	0.297	-1.450
December 1961	(2.86)	(0.32)
January 1962 -	-0.386	-0.993
December 1990	(4.38)	(0.21)
January 1931 -	0.589	-1.360
December 1945	(4.30)	(0.13)
January 1946 -	-0.040	-1.49
December 1960	(0.25)	(0.32)
January 1961 -	-0.332	8.736
December 1975	(2.66)	(1.69)
January 1976 -	-0.439	-17.689
December 1990	(3.54)	(1.99)

Time Series Means of Cross-Sectional Regression Coefficients from

$$R_{jt} = a_{0t} + a_{1t}\,\beta_{je} + a_{2t}\,\beta_{j1} + \ldots + a_{12t}\,\beta_{j10} + a_{13t}\,SIZE_j$$

(t-ratios in parentheses)

Table 5

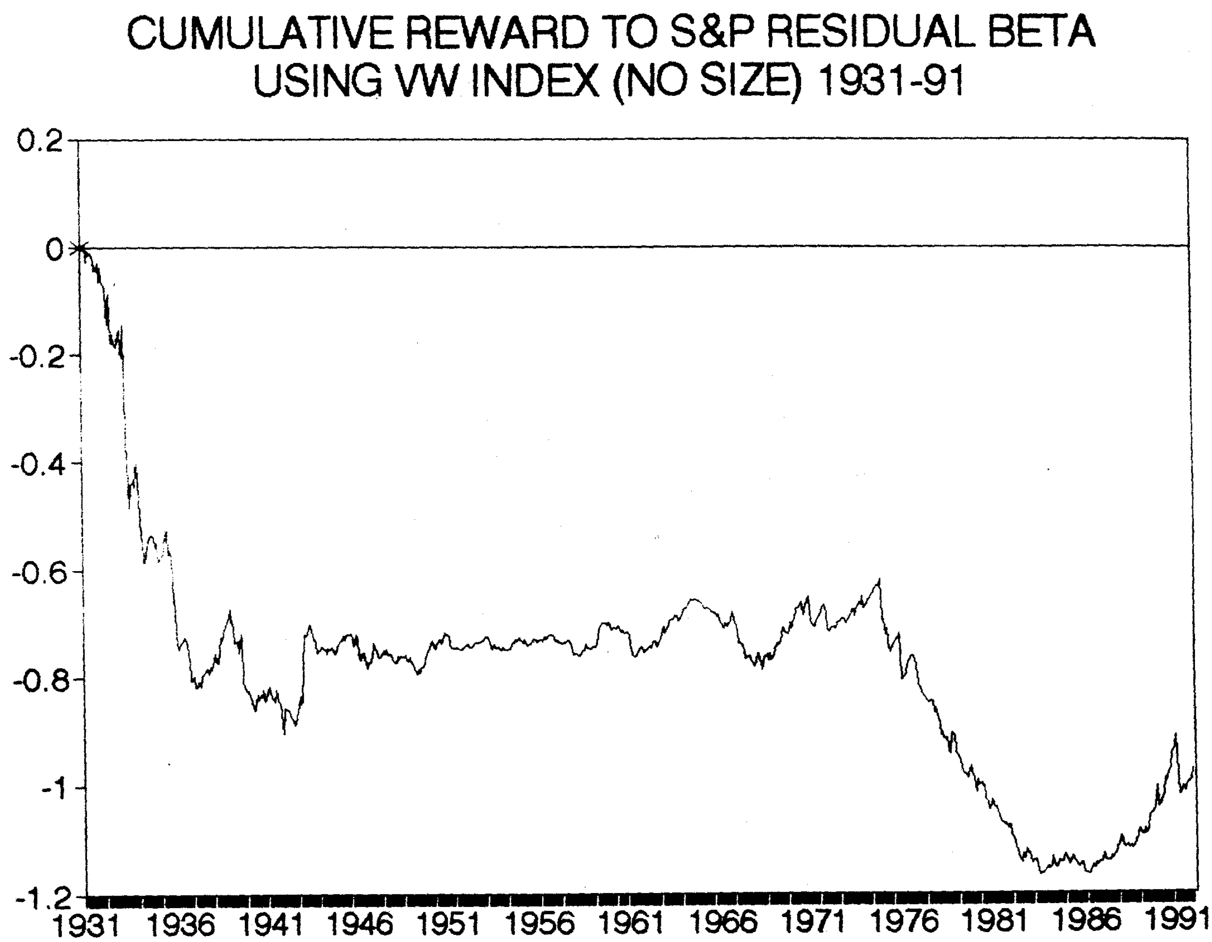
CUMULATIVE REWARD TO S&P RESIDUAL BETA
USING VW INDEX (NO SIZE) 1931-91
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
1931 1936 1941 1946 1951 1956 1961 1966 1971 1976 1981 1986 1991

Figure 1

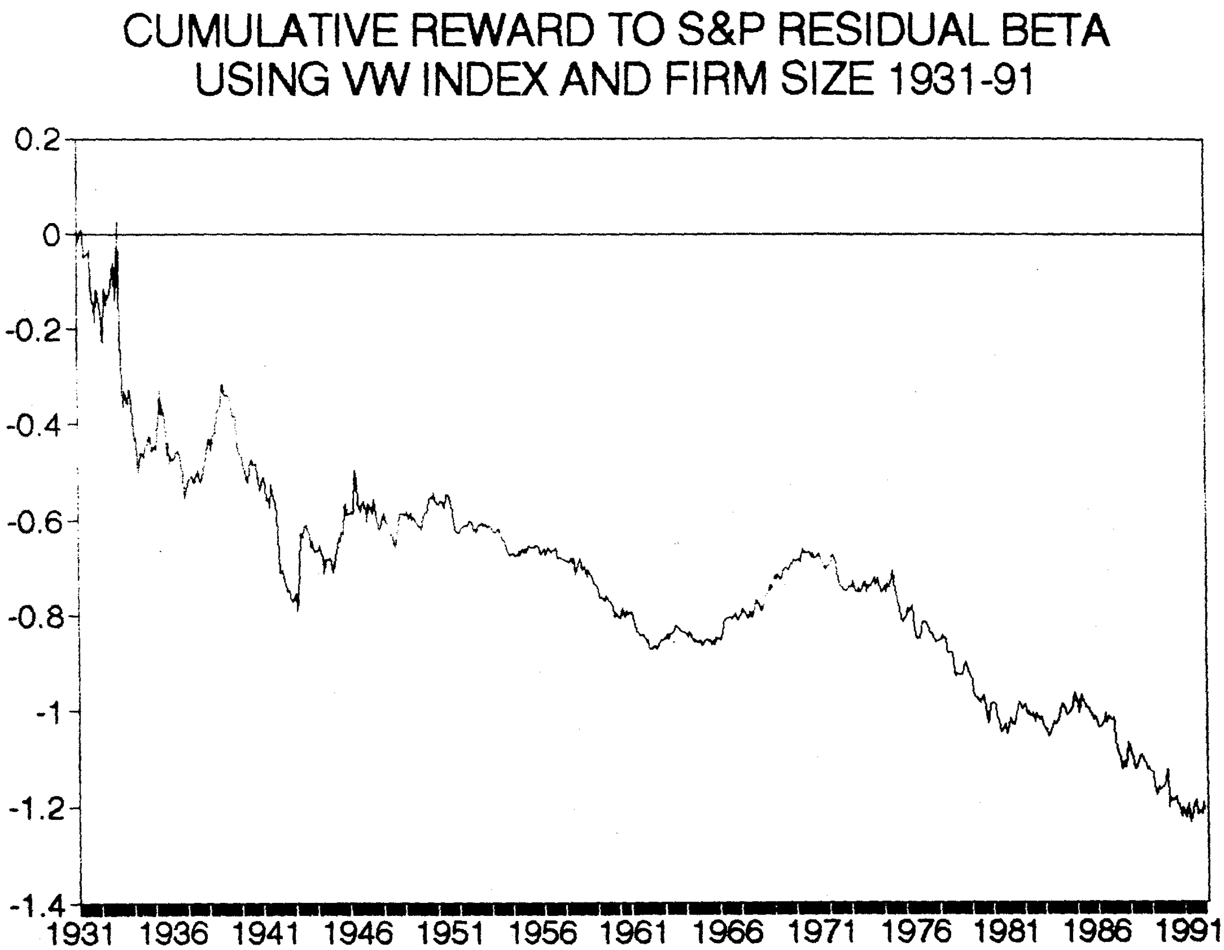
CUMULATIVE REWARD TO S&P RESIDUAL BETA
USING VW INDEX AND FIRM SIZE 1931-91
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
1931 1936 1941 1946 1951 1956 1961 1966 1971 1976 1981 1986 1991

Figure 2

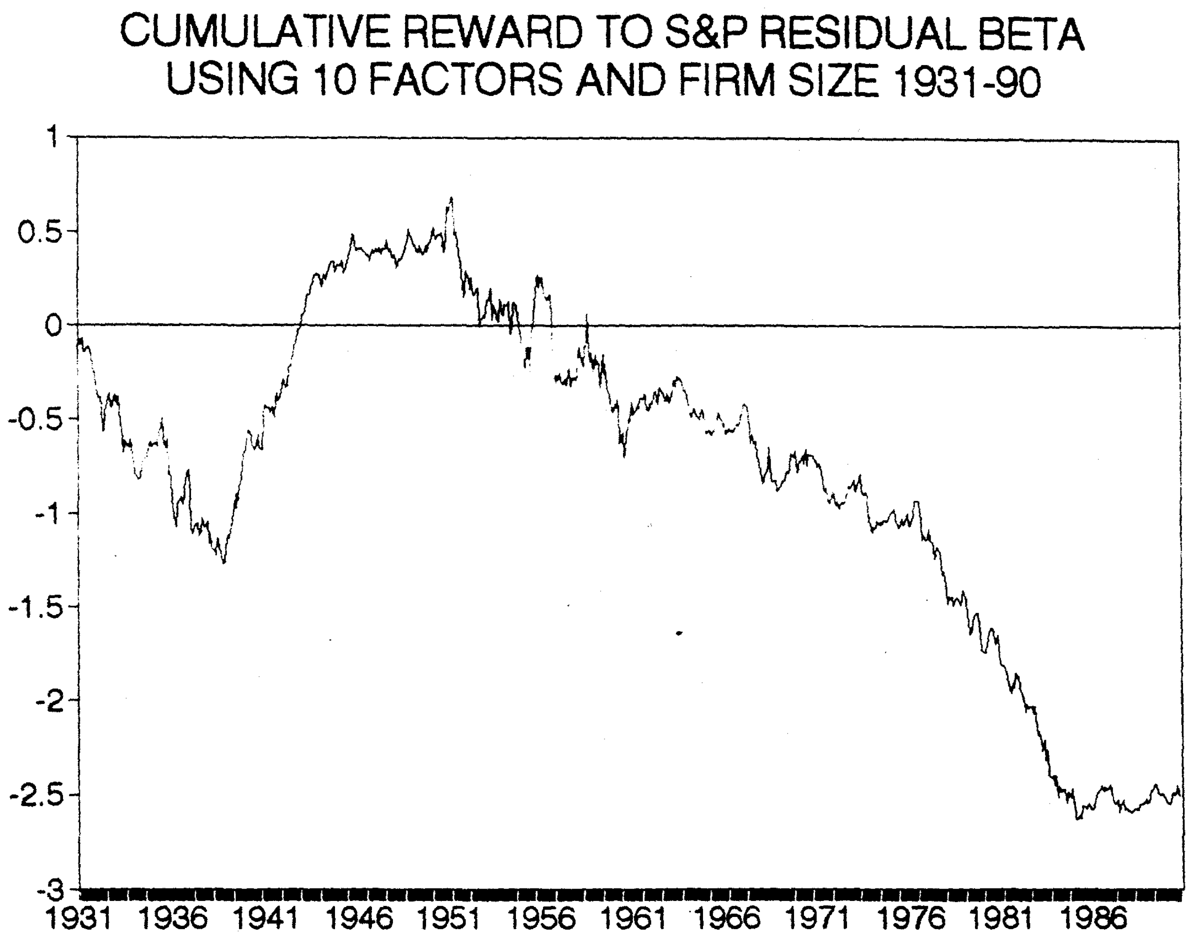
CUMULATIVE REWARD TO S&P RESIDUAL BETA
USING 10 FACTORS AND FIRM SIZE 1931-90
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
1931 1936 1941 1946 1951 1956 1961 1966 1971 1976 1981 1986

Figure 3