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ECONOMIC DETERMINANTS OF BETA COEFFICIENTS

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INTRODUCTION

Empirical testing of the capital asset pricing model has demonstrated its inadequacy while also underlining the fact that it does have some predictive capability. Black, Jensen, and Scholes [6] disclosed that the excess returns, i.e., the returns in excess of the risk-free rate, predicted by the capital asset pricing model are too large for high beta securities and too small for low beta securities. As an outgrowth of this finding, Black [5] developed a model in which the role of the risk-free asset was taken over by the minimum variance, zero beta portfolio. In their second article on testing, Blume and Friend [8] note that whereas their results "cast serious doubt on the validity of the market line theory in either its original form or as recently modified [by Black]... [the] results do confirm the linearity of the relationship for [New York Stock Exchange] stocks."[1] Though the capital asset pricing model is not all it was hoped to be, it obviously carries some predictive capability and that capability clearly resides in beta.

It seems appropriate to note at the outset the distinction between beta, the empirically determined slope of the characteristic line, and systematic risk, the ratio of the covariance of expected returns with the market portfolio to the variance of expected returns with the market portfolio.

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[1] Marshall E. Blume and Irwin Friend, "A New Look at the Capital Asset Pricing Model," Journal of Finance (March 1973): 19.

Systematic risk is a concept which derives from the capital asset pricing model and is not directly measurable, since it is a function of ex-ante expectations. Beta, which is commonly used as a proxy for systematic risk, actually derives from the market model relating ex-post returns on an individual security to ex-post returns on some market index. Arguments supporting the use of beta as a proxy for systematic risk generally cite Blume [7], who showed that beta is (1) reasonably stable over time, (2) generally tends to unity over an extended period and, (3) can be accurately measured. Studies by Sharpe and Cooper [25] and Breen and Lerner [9] show that betas estimated (1) from different samples, (2) over different time periods, (3) using different market indices, are not stationary. The question of whether beta is an adequate proxy for systematic risk remains open.

A number of individuals have studied the relationship between systematic risk and certain accounting and macroeconomic variables on the assumption that beta was an adequate proxy for systematic risk. We shall view these results from a slightly different perspective. Leaving open the question of the relation between beta and systematic risk, we shall interpret their results as research into the relation between beta and certain accounting and macroeconomic variables.

Beaver, Kettler, and Scholes [4], Logue and Merville [9], and Breen and Lerner [10] regressed a number of accounting relationships on beta for different samples and varying time periods. Individually and/ or collectively they found that financial leverage, profit margin, return on assets, dividend payout, variability and covariability of earnings with the market index, growth of firm, and size of firm were (along with yet others) variables which influenced beta. Commendably, in view of the number of identified relationships, Melicher [20] took a factor-analytic approach and narrowed the list to size, leverage, return on equity, and dividend payout policy. Hamada [16], in studying what must have been the most significant relationship noted by all of the aforementioned, concluded that a sizeable portion of inter-firm differences in beta "can be explained merely by the added financial risk taken by the underlying firm with its use of debt and preferred stock."[2] Robichek and Cohen [24] explored the connection between changes in two macroeconomic variables, the rate of real growth and the rate of inflation, and beta. They concluded that in a small number of cases a significant relationship existed.

We shall not take issue with any of the above results as they relate to beta but rather address ourselves to the connection between beta and systematic risk. Since beta is measured on an ex-post basis, the possibility remains open that the predicitive capability of beta is the result of unanticipated events affecting both the security and the market in such a manner as to produce an apparent, but not real, relationship. If this is the case, as in fact it appears to be, we must ask

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[2] Robert S. Hamada, "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks," Journal of Finance (May 1972): 451.

ourselves whether the limited predictablity of the capital asset pricing model might derive from the ex-post nature of beta rather than the assumed ex-ante nature of systmatic risk.

The purpose of this article is to identify three variables capable of producing such correlation between ex-post returns to an individual security and ex-post returns to the market portfolio, and provide statistical evidence that published beta coefficients are, indeed, related to unanticipated changes in two of these variables.

METHODOLOGY

In order to establish a basis upon which to consider the effects of unanticipated changes in stockholder expectations, let us begin by developing the requisite valuation model.

Valuation of security j

We shall assume that the net operating income (NOI) valuation method is adequate for our purposes. This model implicitly assumes that the total value of the firm depends entirely on its net operating income and is unaffected by the effects of leverage.[3] Clearly, as Modigliani and Miller (M and M) [23] point out in their correction, the deductibility of interest for income tax purposes alters the equilibrium pricing structure so that leverage can increase the value of the firm.

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[3] David Durand, "Cost of Debt and Equity Funds for Business Trends and Problems of Measurement," Conference on Research on Business Finance (New York: National Bureau of Economic Research, 1952), p. 229.

The inclusion of this tax effect in our basic valuation model generates certain difficulties of aggregation and interpretation which outweigh the benefits, particularly in view of our intended use of the model.

According to the NOI method, the value of any equity interest, e.g., security j, will be equal to the value of the real assets of the organization less its net indebtedness. Since the value of the assets is, according to our assumption, equal to the present value of the stream of expected net operating income, and the net indebtedness of the organization is equal to the present value of its net contractual future cashflows, we may write P_j, the value of the equity interest in the j^{th} firm, as

$$P_j = A_j - D_j \tag{1}$$

$$= \sum_{t=1}^{\infty} \alpha \, NOI_t^j \, e^{-(i+S_j^A)t} - \sum_{t=1}^{\infty} C_t^j \, e^{-(i+S_j^D)t} \tag{2}$$

where NOI_t^j is the net operating income of firm j at time t, C_t^j is the net contractual debt service payment for firm j due at time t; i is the risk-free rate of interest, S_j^a the risk premium over the pure rate on the assets of firm j, S_j^d the risk premium on the net debt of firm j, and α is a factor which allows for general price level changes which are presumed to affect net operating income but not contractual debt service payments.

Expected return to security j

We are now in a position to compute the expected return to security j. If we assume that all of the variables in (2) remain constant except time, i.e., expectations remain unchanged as well as interest rates, we may compute the expected return to security j as

$$R_j = \frac{1}{P_j} \frac{\partial P_j}{\partial t} = -\left\{ i + S_j^A + (S_j^A - S_j^D) \frac{D_j}{P_j} \right\} \qquad (3)$$

where the negative sign preceding the brackets is simply a manifestation of the fact that as we move forward in time, the time remaining between the present and any expected future cashflows is reduced. A careful examination of the term within the brackets should convince the reader that (3) is merely Modigliani and Miller's expected return to a levered firm in the tax-free case.[4]

Our purpose in the preceding paragraph was not to prove once more that M and M's irrelevance conclusion follows directly from their valuation model, but rather to bring out an important characteristic of expected return in the traditional sense of anticipated return. It is that rate of return which will be experienced, given constancy of expectations, interest rates, and price level. We shall have more to say of this shortly.

Expected return to the market portfolio

We may now obtain the price of the market portfolio by summing (2) over all securities, j = 1, n, to obtain

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[4]The reader should compare (3) with Modigliani and Miller's proposition II, which is expressed symbolically in equation (8) in [22].

$$P_m = \sum_{j=1}^{n} A_j - \sum_{j=1}^{n} D_j \tag{4}$$

$$= \sum_{j=1}^{n} \sum_{t=1}^{\infty} \alpha \, NOI_t^j \, e^{-(i+S_j^A)t}. \tag{5}$$

Note that in the process of consolidation all debt servicing cashflows cancel between organizations, so the price of the market portfolio reflects only the value of society's real assets.

We may now compute an expected return to the market under the same conditions which applied to our expected return to security j in (3). The expected return to the market portfolio is

$$R_m = \frac{1}{P_m} \frac{\partial P_m}{\partial t} = - \sum_{j=1}^{n} \frac{A_j}{P_m} (i+S_j^A) \tag{6}$$

$$= - \left\{ i + \sum_{j=1}^{n} \frac{A_j}{P_m} S_j^A \right\}. \tag{7}$$

Expectations, anticipations, and unanticipated changes

So long as we continue to interpret expected return as the anticipated return, given no change in expectations, once expected returns are determined for each of the n securities, the expected return to the market is determined as well. Thus, if we were to plot the ex-ante expected return to security j against the ex-ante expected return to the market, as in Figure 1, we would have a single point. In fact, as long as expectations are fulfilled and remain unchanged, and interest rates and price level remain constant, any number of observations over varying time intervals would always fall on that one point in Figure 1.

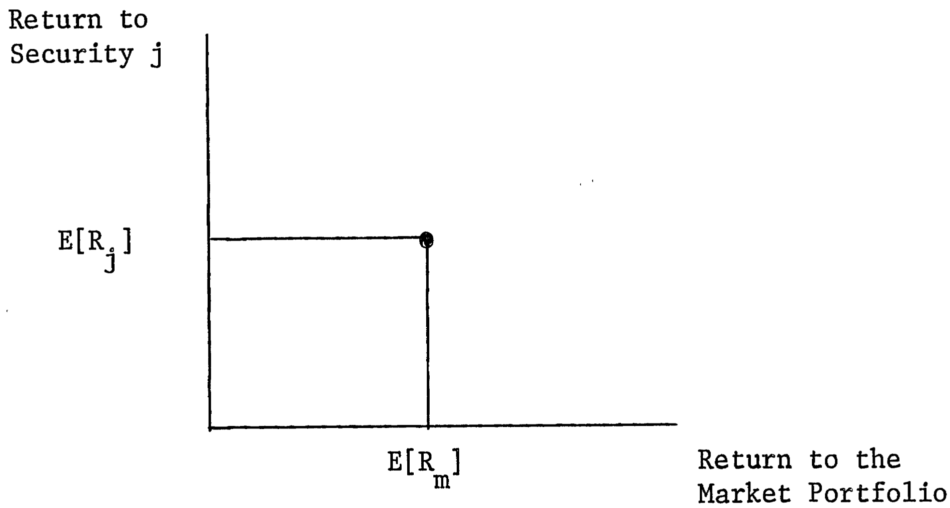

Fig. 1. Relationship of Ex-Ante Returns to Security j to Ex-Ante Returns to the Market Portfolio

The thought of a series of expected returns plotting as a single point seems, at first, abnormal. We generally expect these points to plot along a line--the so-called characteristic line--on an ex-post basis. Here lies the source of misunderstanding wrought by the transition from deterministic formulations to probabilistic formulations.

In traditional, deterministic formulations, expectations, in the sense of anticipations, played a key role in the determination of asset pricing. We are all familiar with the notion that ex-ante expectations, and not ex-post results, determine long-term asset pricing and that the difference between expectations and results constitutes unanticipated changes. These unanticipated changes, though capable of causing wealth transfers, upsetting equilibrium, and otherwise wreaking havoc on the economic system, were not considered to be determinants of asset pricing.

In probabilistic formulations of asset pricing, unanticipated changes are now docile points in probability space. We tend to overlook the modern role of these gremlins of traditional economic theory. Statistics now measure the expected deviation of ex-post returns from the expected return. These statistics are based on the second moment of the distribution of expected returns and include both variance and standard deviation. Indeed, we no longer ignore the role of unanticipated changes in our variables and grumble at their mischievousness; we now explicitly include them as risk. Or, perhaps we should say, we include expectations of unanticipated changes, for, on an ex-post basis, knowledge of unanticipated changes is of as little value in determining asset pricing as are ex-post observations of asset returns.

We must now ask what gives rise to unanticipated changes, i.e., deviations from the expected on an ex-post basis. Expected returns to both security j and the market portfolio were derived on the basis of assumed constancy of expectations, e.g., of cashflows, interest rates, and the price level. Lack of constancy in any of these variables would produce deviations from the expected on an ex-post basis.

Returning to the characteristic line, which must be plotted on an ex-post basis as in Figure 2, we shall find it useful to think of any horizontal deviation from $E[R_m]$ as an unanticipated return to the market and any vertical deviation from $E[R_j]$ as an unanticipated return to security j. Of the myriad of variables capable of causing unanticipated returns to security j and the market portfolio, we can disregard all those variables which would be incapable of causing unanticipated returns

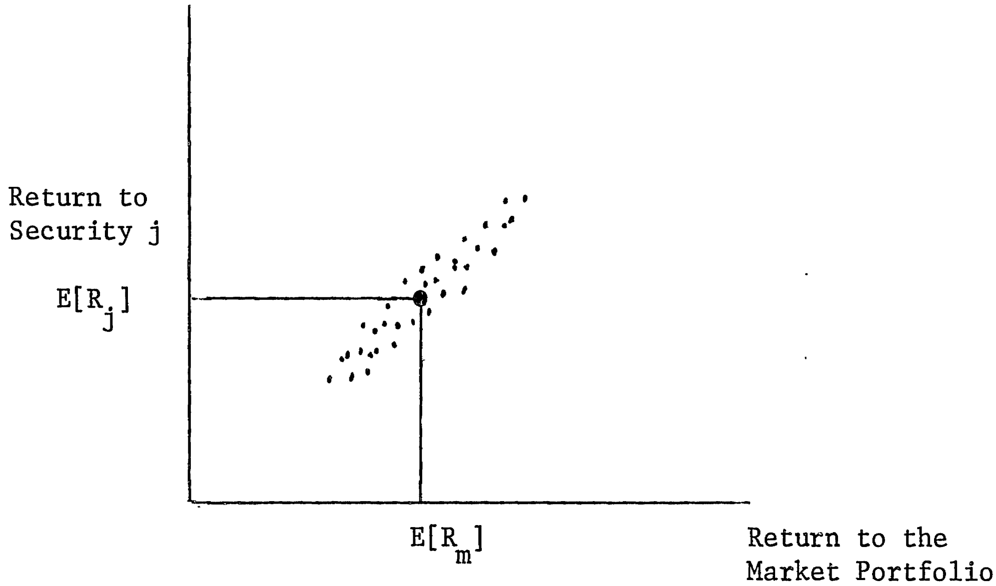

Fig. 2. Relationship of Ex-Post Returns to Security j to Ex-Post Returns to The Market Portfolio

in both security j and the market portfolio. After all, the characteristic line portrays the correlation between unanticipated returns to security j and unanticipated returns to the market portfolio. To explain this correlation we need examine only those variables capable of producing it.

Beta and unanticipated changes in key economic variables

If the above is correct reasoning, the characteristic line, and hence its slope β, must be the result of unanticipated changes in key economic variables during the period over which β was measured. We say key economic variables because in order to generate a characteristic line having a slope which is neither zero nor infinite, this variable must be capable of affecting returns to both security j and the market portfolio.

Unanticipated price level changes, unexpected shifts in the pure rate of interest, and changes in the risk premium on real assets have been selected as three such key variables. Using the point in Figure 1 as a reference, we can determine the slope of the characteristic line which would theoretically be generated by an unanticipated change in the level of each of these key economic variables using these models of security pricing.

We may compute the unanticipated return to security j, which would be caused by an unanticipated change in any of the key variables, by noting that the return to security j can be written

$$R_j = \frac{1}{P_j}\, dP_j = \frac{1}{P_j}\left\{\frac{\partial P_j}{\partial t}\Delta t + \frac{\partial P_j}{\partial \alpha}\Delta\alpha + \frac{\partial P_j}{\partial i}\Delta i + \frac{\partial P_j}{\partial S_j^A}\Delta S_j^A\right\}. \quad (8)$$

If our reference points are the expected return to security j, R_j, and the expected return to the market portfolio, R_m, which would result from a simple change in time, then we may compute the slope of the characteristic line which would result from unanticipated changes in, for example, price level. Assuming that all expectations, with the exception of price level, remain constant, the slope of the characteristic line must be

$$B_j^{\alpha} = \frac{\Delta R_j}{\Delta R_m} = \frac{\frac{1}{P_j}\left\{\frac{\partial P_j}{\partial t}\Delta t + \frac{\partial P_j}{\partial \alpha}\Delta\alpha\right\} - \frac{1}{P_j}\frac{\partial P_j}{\partial t}\Delta t}{\frac{1}{P_m}\left\{\frac{\partial P_m}{\partial t}\Delta t + \frac{\partial P_m}{\partial \alpha}\Delta\alpha\right\} - \frac{1}{P_m}\frac{\partial P_j}{\partial t}\Delta t} \quad (9)$$

$$= \frac{\frac{1}{P_j}\frac{\partial P_j}{\partial \alpha}}{\frac{1}{P_m}\frac{\partial P_m}{\partial \alpha}} . \tag{10}$$

Note that the slope is independent of the magnitude of the unanticipated change in price level, $\Delta\alpha$. Taking partial derivatives leads to the result

$$B_j^{\alpha} = \frac{A_j}{A_j - D_j} \tag{11}$$

where A_j is the value of the firm's real, physical assets, and D_j represents the firm's net debt. A positive D_j indicates that the value of the firm's monetary liabilities, both current and long term, exceed the value of the firm's monetary assets. A negative value of D_j would indicate that firm j is a net monetary creditor. Given this interpretation, and recognizing that $A_j - D_j$ must equal the equity invested in the firm, we may rewrite (11) as

$$B_j^{\alpha} = 1 + \frac{D_j}{A_j - D_j} . \tag{12}$$

Clearly, for net debtor firms, i.e., $D_j > o$, the slope of the characteristic line is greater than one, and the returns to such firms will be above returns to the market portfolio during periods of unanticipated inflation. The reverse holds for net monetary creditors whose returns, during periods of unanticipated inflation, would fall short of returns to the market as a whole. The transfer of wealth resulting from unanticipated changes in price level has been treated at length and our results, both theoretical and, as we shall see, empirical, are in agreement with that work.[5]

We now have an expression, (12), relating the slope of the characteristic line which would be generated by unexpected changes in price level to a measurable accounting relationship. Let us now attempt to derive another such relationship for unexpected changes in the pure rate of interest, i.

Once again we use the expected returns to security j and the market portfolio as a reference. The slope of the characteristic line generated by an unexpected change in the price rate of interest would be

$$B_j^i = \frac{\Delta R_i}{\Delta R_m} = \frac{\frac{1}{P_j}\left\{\frac{\partial P_j}{\partial t}\Delta t + \frac{\partial P_j}{\partial i}\Delta i\right\} - \frac{1}{P_j}\frac{\partial P_j}{\partial t}\Delta t}{\frac{1}{P_m}\left\{\frac{\partial P_m}{\partial t}\Delta t \quad \frac{\partial P_m}{\partial i}\Delta i\right\} \quad \frac{1}{P_m}\frac{\partial P_j}{\partial t}\Delta t} \tag{13}$$

$$= \frac{\frac{1}{P_j}\frac{\partial P_j}{\partial i}}{\frac{1}{P_m}\frac{\partial P_m}{\partial i}} \tag{14}$$

$$= \frac{-\frac{1}{P_j}\left[\sum_{t=1}^{\infty} t\alpha NOI_t^j \, e^{-(i+s_j^A)t} - \sum_{t=1}^{\infty} tC_t^j e^{-(i+s_j^D)t}\right]}{-\frac{1}{P_n}\left[\sum_{j=1}^{n}\sum_{t=1}^{\infty} t\alpha NOI_t^j \, e^{-(i+s_j^A)t}\right]} . \tag{15}$$

[5]See [1], [2], [3], [12], [13], [18], [26].

If we now define

$$ {}^{t}A_{j} = \frac{\sum_{t=1}^{\infty} t\alpha NOI_{t}^{j} e^{-(i+s_{j}^{A})t}}{\sum_{t=1}^{\infty} \alpha NOI_{t}^{j} e^{-(i+s_{j}^{A})t}} \tag{16} $$

and

$$ {}^{t}D_{j} = \frac{\sum_{t=1}^{\infty} tc_{j}^{i} e^{-(i+S_{j}^{D})t}}{\sum_{t=1}^{\infty} c_{t}^{i} e^{-(i+S_{j}^{D})t}} \tag{17} $$

and finally,

$$ {}^{t}M = \frac{\sum_{j=1}^{n} \sum_{t=1}^{\infty} t\alpha NOI_{t}^{j} e^{-(i+s_{j}^{A})t}}{\sum_{j=1}^{n} \sum_{t=1}^{\infty} \alpha NOI_{t}^{j} e^{-(i+s_{j}^{A})t}}, \tag{18} $$

we may rewrite (15) as

$$ B_{j}^{i} = \frac{{}^{t}A_{j}}{t_{m}} + \frac{{}^{t}A_{j} - {}^{t}D_{j}}{t_{m}} \left(\frac{D_{j}}{A_{j} - D_{j}} \right) . \tag{19} $$

We now have an expression for the slope of the characteristic line which would result from unanticipated changes in the pure rate of interest. Whereas (12) involved only accounting variables, (19) involves three variables which are not reported in financial statements. Two of these variables can be approximated from data provided in financial statements and the third, t_m, need not concern us as it remains constant. Following Hicks, these three variables, defined by (15), (16), and (17), will be referred to as the average period of assets and average period of debt for firm j, and average period for the market portfolio.

According to Hicks, the average period represents the "average length of time for which the various payments are deferred from the present, when the times of deferment are weighted by the discounted values of the payments."[6] Hicks goes on to note that "if the average period of the stream of receipts is greater than the average period of the standard stream (in our case the stream associated with ownership of the market portfolio) with which we are comparing it, a fall in the rate of interest will raise the capital value of the receipts stream more than that of the standard stream."[7]

The intuitive application of Hick's explanation is hampered by the fact that returns to security j are the net result of returns on debt and equity. If we assume $D_j = 0$ then the second term on the right side of (19) drops out. Now, if $t_{a_j} > t_m$, the slope of the characteristic line generated by an unexpected change in the rate of interest exceeds unity, and rates of return to security j would exceed those to the market portfolio. If firm j is a net monetary debtor, i.e., $D_j > 0$, the slope of the characteristic line will be increased if the average period of debt is less than that of assets for firm j.

We are now ready to consider the third variable which might be capable of causing a correlation between ex-post returns to security j

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[6] J. R. Hicks, Value and Capital (Oxford: Clarendon Press, 1946), p. 186.

[7] Ibid., p. 187.

and to the market index. As the risk premium on real assets, S_j^A, shifts, it will have an effect on the price of each security as well as the market, assuming, of course, that the shift occurs for all real assets.

Once again we choose the expected return to security j and to the market portfolio as a reference, and compute the slope of the characteristic line which would be caused by unanticipated shifts in the risk premium on real assets as

$$B_j^{S^A} = \frac{\Delta R_j}{\Delta R_m} = \frac{\frac{1}{P_j}\left\{\frac{\partial P_j}{\partial t}\Delta t + \frac{\partial P_j}{\partial S_j}\Delta S_j^A\right\} - \frac{1}{P_j}\frac{\partial P_j}{\partial t}\Delta t}{\frac{1}{P_m}\left\{\frac{\partial P_m}{\partial t}\Delta t + \sum_{j=1}^{\infty}\frac{\partial P_m}{\partial S_j^A}\Delta S_j^A\right\} - \frac{1}{P_m}\frac{\partial P_m}{\partial t}\Delta t} \tag{20}$$

which simplifies to

$$B_j^{S^A} = \frac{t_{A_j}}{t_m}\left(1 + \frac{D_j}{A_j - D_j}\right). \tag{21}$$

For an unlevered security, the slope of the characteristic line will be greater or less than unity as the average period of that firm's real assets is greater or less than the average period of the market portfolio. The addition of debt would tend to increase the slope of the characteristic line.

EMPIRICAL EVIDENCE

Three key economic variables emerge from the preceding section, unanticipated changes in any of which might be assumed to be capable of generating a characteristic line. We must now determine whether measured beta coefficients for a large sample of industrial corporations are related to the hypothesized slopes of characteristic lines which might be generated by unanticpated changes in our key variables.

Were we able to isolate a time period in which only one of the key variables changed, we could measure beta over that period for each of our securities and then regress the theoretical slopes against the observed beta values. Unfortunately, finding a time period in which only one of these key variables changed would be difficult enough, but measuring beta over such a necessarily short period would be impossible.

Consequently, we have chosen a period during which a series of unanticipated changes may be assumed to have occurred in the key economic variables. The five-year period ending October 1971, is doubtless such a period and measured beta coefficients were available for that period from "Security Risk Evaluation," a tabluation, issued monthly by Merrill Lynch, Pierce, Fenner, and Smith of beta coefficients measured over the preceding five-year period.

We then computed the theoretical slope, or a variable proportional to that slope, since we had no way of estimating t_m,[8] for as many industrial firms as (1) were included on the Compustat data base, <u>and</u> (2) were not missing essential data, <u>and</u> (3) were included in "Security Risk Evaluation." Data was obtained for more than fourteen hundred firms which met these requirements.

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[8] A description of the computation of proxy variables for the average periods of assets and debt is provided in the appendix.

We then fitted the following model to our observations

$$\beta_j = \gamma_1 + \gamma_2 \left(\frac{D_j}{E_j}\right) + \gamma_3 \left(1+\frac{D_j}{A_j-D_j}\right) + \gamma_4 \left(t_{A_j} + (t_{A_j} - t_{D_j})\cdot\frac{D_j}{A_j-D_j}\right) + \gamma_5 \left(t_{A_j} + t_{A_j}\frac{D_j}{A_j-D_j}\right) + e_j. \qquad (22)$$

In view of previous results mentioned in the introduction, the debt-to-equity ratio is included as the first independent variable to discourage the notion that our results might grow out of the relationship between expected return and capital structure. We should expect γ_2 to be positive and significantly different from zero if it measures a factor other than that measured by another of our variables.

If β_j is a function of unanticipated changes in price level, and unexpected changes in price level occurred during the five-year period ending October 1971, as indeed they must have, then γ_3 ought to be positive. Similiarly, a relationship between the measured value of the beta coefficient and unanticipated changes in the pure rate of interest should result in $\gamma_4 > 0$, provided unanticipated changes in the pure rate of interest occurred during the period. Finally, if unexpected changes occurred in the risk premium on real assets during the sample period and a relationship exists between these unexpected changes and the measured betas, we would expect $\gamma_5 > o$.

A summary of regression results is presented in Table 1.

Two of our estimated regression coefficients, γ_3 and γ_4, are significantly different from zero, on which basis we claim that beta is related to unanticipated changes in price level and the pure rate of

Table 1
REGRESSION STATISTICS OBTAINED FROM FITTING (22)
TO A SAMPLE OF 1401 INDUSTRIALS

i	γi	Standard Error of γi	t	Significance Level
1	1.254			
2	.0408	.0512	0.796	
3	.1902	.0702	2.708	.005
4	.0156	.0073	2.145	.02
5	-.0113	.0096	1.182	

interest. The values of γ_3 and γ_4 are both positive as expected. The fact that γ_2 is not significantly different from zero, in marked contrast to the findings of previous studies, indicates that the reported relation of leverage to beta may result from its high correlation with the ratio of net monetary debt to equity (R = .753 in our sample), unanticipated changes being the cause of the apparent correlation in price level and the pure rate of interest. In conclusion, there is no evidence that a relationship exists between measured betas and unexpected shifts in the risk premium on real assets.

CONCLUSIONS

We have interpreted characteristic lines as portraying the relationship between unanticipated returns to an individual security and unanticipated returns to the market portfolio. We have hypothesized that these unanticipated returns, and hence the characteristic lines themselves, result from unanticipated changes in key economic variables. Statistical analyses of published beta coefficients for a large sample of industrial firms support our hypothesis for unanticipated changes in price level and the pure rate of interest.

If in fact, the slope of the characteristic line is a function of unanticipated changes in key economic variables, what implications does this have for financial theory and practice? The first, and most obvious, implication is that beta coefficients, at least in part, become historical accidents and their usefulness as a measure of risk should be called into question. Who is to say that the same mix of unanticipated changes will occur, yielding the same value of beta in a future time period?

Another implication is that the apparent predictive power of the capital-asset pricing model can be an entirely ex-post phenomenon. Unanticipated changes in price level or the pure rate of interest are capable of producing unanticipated returns both for the individual security and the market portfolio which would be correlated over time. This would tend to make sense of the Black, Jensen, and Scholes finding that the return to the "beta factor" is "significantly different from the average risk-free rate and indeed is roughly the same size as the average market return."[9] We could rewrite their estimating equation as

$$\tilde{r}_j = \tilde{r}_z + \beta_j \{\tilde{r}_m - \tilde{r}_z\} + \tilde{w}_j \tag{23}$$

where $\tilde{r}_j$ is the ex-post return to security j, and $\tilde{r}_m$ is the ex-post return to the beta factor. To the extent that $\tilde{r}_z$ approximates the

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[9]See p. 82 in [6].

expected excess return to the market, the term in brackets approximates the unexpected change from that expected return to the market. Multiplying this unexpected return by beta should, when added to the expected return to the market, provide an estimate of the ex-post return to security j which, aside from a constant representing the difference between E $[R_j]$ and $\tilde{r}_z$, ought to correlate nicely with experienced returns to security j over time.

Since the systematic risk of any asset has not yet been truly measured, we may be overlooking the real power of the capital-asset pricing model. Currently there is a strong temptation to allow other factors in addition to systematic risk to be considered as risk. Recent articles by Stone [27] and Chen and Boness [11] attempt to incorporate as risk what amounts fundamentally to unanticipated changes in interest rates and the price level. To the extent that complete diversification does not exist, investors may receive remuneration for bearing unsystematic risk, and yet it would seem that the portion of unsystematic risk accounted for by unanticipated changes in price level and interest rates would have been the first to be diversified away. Before we move too far away from covariance with the market as the sole source of rewarded risk, perhaps we should inquire more deeply into the nature of systematic risk.

<u>A closing note on methodology</u>

Any reader of Hicks must at times become frustrated by his insistence on continually reflecting upon just what is being done. Working in the realm of economic dynamics, we, as theorists in finance, might find it helpful to follow Hicks' example. The transition from deterministic to probabilistic models has created a series of misunderstandings, particularly as regards the distinction between ex-ante and ex-post formulations and their testing. Our major methodological handicap has long been, and remains today, our inability to measure expectations and hence to verify our ex-ante theories. Until we overcome this shortcoming, theories such as those set forth by Stone and Chen and Boness must remain untested, or, if tested with ex-post data, suffer from the knowledge that their predictability may result from a relationship which only holds ex-post.

APPENDIX

Each of the regression variables included the ratio of net monetary debt to equity. Net monetary debt was computed by subtracting the book value of equity accounts from the sum of inventories and net plant. The ratio of net monetary debt to equity was then computed using the average market value of equity. This ratio was averaged over the five-year period ending October 1971.

The average period of the real assets of the firm, t_{A_j}, was computed from the ratio of net plant to annual depreciation. This ratio, which provides a rough estimate of the number of years over which the currently owned assets are expected to provide service, was averaged over the five-year period. The average period of real assets was estimated to be thirty percent of this average number of years of service.

The average period of debt for firm j, t_{D_j}, depends on the relative amounts of current and long-term monetary debt held by the firm. The average period of current monetary debt was assumed to be roughly two months. The average period of long-term debt is assumed to be thirty percent of the ratio of total long term debt, including the current portion, to the current portion of long-term debt.

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