Test of a Stock Valuation Model

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A MODEL DESIGNED to explain price differences among common stocks must build upon the working rules of professional investors and the theories of academic analysts and cannot avoid a troublesome dependence on expectations. Our stock valuation model is no exception. And so our tests of it are also tests of working rules and theories and of how well expectations can be estimated.

Though the current study has its origin in earlier work [2], the tests we plan have only begun. Therefore, this paper is a discussion of the model and an indication of plans for testing rather than a full report of results. The first section deals with the model and its use in testing a theory of risk. To avoid the disdainful criticism that we offer only promises, some results are included in the second section of the paper. The third section discusses the variables. Our plans are described in the final section.

I. MODEL

The model is put together with familiar parts and conventional assumptions. The observed price of a share of common stock at a moment in time, P_o, is taken to be the sum of the share's normal price, $\overline{P}_o$, and an error element, μ_o:

$$P_o = \overline{P}_o + \mu_o. \tag{1}$$

Normal price is viewed as the present value of dividends expected in each period, D_t, to some horizon, n, plus the present value of the share price expected at the horizon, $\overline{P}_n$. The discount rate, r, is assumed to be constant and to include an appropriate premium for risk. The basic model is the same as that suggested by Williams [7] and used by so many others:

$$\overline{P}_o = \frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2} + \dots + \frac{D_t}{(1+r)^t} + \dots + \frac{D_n + \overline{P}_n}{(1+r)^n}. \tag{2}$$

This model provides the variables to be estimated and the ideas to be tested.

Dividends depend on earnings and on payout policies. If investors consider that earnings will grow at a constant rate to the horizon and look upon the corporation's dividend payout decision as Lintner [4] did, then their dividend expectations will depend (1) on their estimates of normal or noiseless earnings in the period just past, E_o, (2) on earnings growth rate to the horizon, g, (3) on

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target payout rate on earnings, PAYE , and (4) on payout adjustment rate, ADJE. The dividend relation is

$$D_t = ADJE(PAYE \cdot E_t - D_{t-1}) + D_{t-1}. \quad (3)$$

With earnings growth constant,

$$E_t = E_o(1+g)^t \quad \text{and} \quad (4)$$

$$D_t = (1+g)D_{t-1}, \quad (5)$$

so that, substituting equation (4) and (5) in equation (3),

$$D_t \simeq \frac{ADJE \cdot PAYE \cdot E_o(1+g)^t}{ADJE + g} \quad (6)$$

expresses the dividend expectation in terms of its components.

The horizon can be taken as the time when a stock is expected to lose its distinctive qualities and display average growth, payout and risk characteristics. The horizon price should be consistent with this, and so investors' expectations for that price would be

$$\overline{P}_n \simeq \frac{D_{n+1}}{r^* - g^*}, \quad (7)$$

where r^* and g^* are average rates of discount and growth that apply in the years after the horizon and D_{n+1} is the expected dividend in the first post-horizon period. This first post-horizon dividend will depend principally on post-horizon rates of growth, g^*, payout, PAYE*, an adjustment, ADJE*.[1]

Just two elements of the basic model, dividends, D_t, and expected price at the horizon, $\overline{P}_n$, have provided a fairly long list of explanatory variables. However, the list is not complete. The discount rate, r, must be considered. This rate—the rate investors feel they must have if shares of stock are to be held in their portfolios—depends on both the systematic or market related risk of the stock and its unsystematic or residual risk. These two elements of risk are separated clearly when the return for a single stock, RR, is related to the return on the market portfolio of all stocks, RR_m. In this relationship or stock characteristic line

$$RR = \alpha + \beta \cdot RR_m + \varepsilon. \quad (8)$$

β, the slope coefficient, indicates systematic risk or how much the stock's return will vary with a change in market return. The variance of the random variable ε, σ_ϵ^2, is the variation unrelated to the market—the unsystematic or residual risk. When securities markets are in equilibrium, as Fama [3] has shown in reconciling the work of Sharpe and Lintner, [5, 6]

$$r = \overline{RR} = I + (\overline{RR}_m - I)\,\beta + \left(\frac{\overline{RR}_m - I}{\sigma_m^2}\right) X \cdot \sigma_\epsilon^2. \quad (9)$$

Here r is the discount rate that interests us; it is the required and the expected

1. The shift between growth rates makes it necessary to describe values of D_t and $\overline{P}_n$ as approaching or approximating rather than equalling the expressions on the right hand side of equations (5), (6) and (7).

return on the stock.[2] I is the pure rate of interest, RR_m and σ_m^2 are the expected return and variance of the market portfolio and X is the market value of all outstanding shares of the stock as a fraction of the value of all stocks in the market.

The intercept of the characteristic line, α, does not appear as a determinant of r. Since in equilibrium

$$r = \overline{RR} = \alpha + \beta \cdot \overline{RR}_m \qquad (10)$$

it follows from equation (9) that

$$\alpha = I - \beta \cdot I + \left(\frac{\overline{RR}_m - I}{\sigma_m^2}\right) X \cdot \sigma_\epsilon^2 \qquad (11)$$

or that, in the adjustment to equilibrium, the price of a stock will change so that the intercept of the stock's characteristic line and, therefore, its expected return are consistent with its systematic and residual risk. However, for markets in process of adjustment, a stock with given risk characteristics should have a higher price the higher its intercept, α.

Disassembling the model indicates that for a particular stock a share's normal price, $\overline{P}_o$, will be some multiple of normal or noiseless earnings, E_o, and that this price-earnings multiple should depend on a long list of variables including

g, the expected earnings growth rate to the horizon,
PAYE, the estimated target payout rate on earnings to the horizon,
ADJE, the estimated payout adjustment rate to the horizon,
n, the horizon,
α, the expected return on the stock when market return is 0,
β, the systematic risk of the stock,
$X\sigma_\epsilon^2$, the residual risk of the stock and
g*, PAYE*, ADJE* and r*, the expected post-horizon values for variables noted above and for the discount rate.

Disassembling the model also indicates that the relationship involved is too complicated to be estimated in its proper functional form. A linear or logarithmic approximation will have to do.

If the approximation is not a significant source of distortion and if usable estimates of the variables can be made, then testing this model may be of some help in testing the ideas on pricing of risky assets suggested by Fama, Lintner and Sharpe. As we have already noted in describing our model, these authors stress that some of the variation in return on common stock is related to the market or is systematic and can not be diversified. The remaining, residual variations can be diversified. Though the equilibrium analysis they develop indicates that the required return or discount rate on a stock varies directly, and the price of a share inversely, with either element of risk, it also

2. Fama points out that the relationship used here is developed assuming "the market for capital assets is composed of risk averting investors, all of whom are one-period expected-utility-of-terminal-wealth maximizers. . . ." We use it here in a multi-period model but feel this is not too abusive since the thrust of the Fama, Sharpe and Lintner work is to provide proposition that can be applied to the capital markets investors actually deal in.

makes clear that the impact of residual risk, because it can be diversified, will be very small. As a result, systematic risk will be the dominant determinant unless residual variation is very, very large relative to market variation, a fact which hasn't yet found empirical support. The propositions that one element of risk has a more important effect on stock price than the other and that a better explanation of stock prices can be had by separating risk into its elements are two propositions we can try to test.

II. Results

Of the variables listed above we made estimates for expected earnings growth, g, target payout, PAYE, adjustment rate, ADJE, expected return when market return is 0, α, systematic risk, β, and residual risk, σ_ϵ for each of 99 stocks for each year 1960 through 1966. We also estimated a number of other variables, including the total risk or standard deviation of return, σ_{RR}, intra year price variability, VAR, marketability, MKT, and residual firm effects, FIR, for each of these stocks in each year. We did not estimate the horizon, n, or the post-horizon rates, g*, PAYE*, ADJE* and r*, assuming that these would not vary among firms in a year even though they might vary among years. The data were drawn from a Standard Statistics Corporation COMPUSTAT tape received in March 1967 and the estimates were used in cross-sectional linear regressions. The most interesting and relevant results are shown in Tables 1 through 4.

TABLE 1
Results from Cross-Sectional Estimates*

$$P_0/E_0 = a + b\,VAR + b_2 PAYE + b_3 ADJE + b_4 \sigma_{RR} + b_5\,MKT$$

	1960	1961	1962	1963	1964	1965	1966
a	12.24	11.12	9.05	7.97	5.04	−1.93	−.90
	(2.93)	(2.61)	(3.05)	(2.41)	(1.39)	(.49)	(.25)
b_1	41.35	48.54	35.81	33.67	23.66	32.53	33.37
VAR	(3.37)	(3.98)	(3.99)	(4.10)	(2.50)	(3.10)	(3.80)
b_2	−1.66	−1.14	−.77	−.12	4.23	4.50	7.37
PAYE	(.52)	(.35	(.34)	(.05)	(1.49)	(1.44)	(2.35)
b_3	2.21	4.59	2.01	2.89	6.81	11.80	8.49
ADJE	(.62)	(1.26)	(.80)	(1.01)	(2.12)	(3.26)	(2.48)
b_4	−35.63	−34.95	−25.53	−21.20	−8.45	−2.69	−16.55
σ_{RR}	(3.49)	(3.48)	(3.71)	(2.78)	(.99)	(.28)	(1.88)
b_5	.004	.011	.026	.030	.030	.046	.027
MKT	(.26)	(.70)	(2.46)	(2.83)	(2.77)	(4.50)	(3.32)
$\bar{R}^2$	.092	.137	.162	.182	.133	.304	.265

* The numbers in parentheses are t ratios; the numbers above are regression coefficients.

Each table shows regression coefficients, t-ratios and a coefficient of determination adjusted for degrees of freedom for each cross-sectional year for a different estimating equation. Four variables are common to all equations. These are intra year price variability of the stock, VAR, which we are apologetically using as a proxy for growth expectations, marketability or size of the market for the stock, MKT, dividend payout rate, PAYE, and payout adjustment rate, ADJE. The results for these variables do not differ much with the estimating equation used. Price variability, VAR, has a positive coefficient in each case and a t ratio below 2 and a beta weight below .2 only once. Marketability, MKT, has a positive coefficient in 26 of the 27 cases. Its beta weight and t ratio are low in 1960 and 1961 estimates, but in the 5 later years the former is never below .1 and the latter falls below 2 only 4 times. The payout rate, PAYE, and adjustment rate, ADJE, are somewhat more erratic, but each has the expected positive coefficient in every case in which the regression coefficient exceeds its standard error.

Not common to all equations are the variables relevant to a test of the risk propositions drawn from the Fama-Lintner-Sharpe writings. The first equation contains a variable representing total risk, the standard deviation of return σ_{RR}. Its coefficient is negative in each year, as expected, and it is more than 1.8 times its standard error in 5 of the 7 years. However, when this total risk variable is replaced by two variables representing systematic risk, β, and residual risk, σ_ϵ, in the equation reported in Table 2, the adjusted coefficient

TABLE 2
RESULTS FROM CROSS-SECTIONAL ESTIMATES*

$$P_o/E_o = a + b_1VAR + b_2PAYE + b_3ADJE + b_4\beta + b_5\sigma_\epsilon + b_6MKT$$

	1960	1961	1962	1963	1964	1965	1966
a	8.19	9.62	9.11	7.80	5.06	−1.89	−.30
	(2.13)	(2.42)	(3.17)	(2.38)	(1.42)	(.50)	(.09)
b_1	55.51	47.97	32.02	32.16	20.74	27.80	26.77
VAR	(4.78)	(4.32)	(3.70)	(3.98)	(2.21)	(2.71)	(3.10)
b_2	−1.69	−.81	−.28	.04	4.53	5.11	7.36
PAYE	(.59)	(.27)	(.1)	(.02)	(1.62)	(1.69)	(2.48)
b_3	−.60	2.22	1.11	2.21	5.96	10.65	7.59
ADJE	(.18)	(.64)	(.45)	(.77)	(1.87)	(3.03)	(2.33)
b_4	−9.55	−7.72	−4.84	−3.51	−2.67	−2.92	−4.96
β	(6.02)	(5.39)	(4.55)	(2.93)	(2.11)	(2.22)	(3.73)
b_5	−.30	3.67	−2.81	−5.70	8.34	19.37	11.74
σ_ϵ	(.03)	(.37)	(.37)	(.65)	(.83)	(1.81)	(1.16)
b_6	.013	.016	.025	.031	.031	.045	.027
MKT	(.87)	(1.07)	(2.51)	(2.88)	(2.82)	(4.61)	(3.53)
$\bar{R}^2$	.256	.251	.214	.192	.158	.348	.332

* The numbers in parentheses are t ratios; the numbers above are regression coefficients.

of determination rises for each year's cross-section. In 6 of these years the contribution of the added variable is significant at the 5% level, and in 5 it is significant at the 1% level. This finding is consistent with the proposition that a better explanation of stock prices can be had by separating risk into its systematic and residual elements.

The results reported in Table 2 also are consistent with the proposition that systematic risk has a more important impact on discount rate and on stock price than residual risk. The residual risk variable has a coefficient that differs little from 0 and has a positive sign, the wrong sign, in 4 of 7 years. The systematic risk variable has a negative sign in each year and its t ratio is never less than 2. This result is satisfying but incomplete.

In Table 3 results are reported for an equation which includes the intercept of each stock's characteristic line, its expected return when market return is 0, α, as well as the slope, β, and standard error of estimate, σ_ϵ, of that line. With

TABLE 3

RESULTS FROM CROSS-SECTIONAL ESTIMATES*

$$P_0/E_0 = a + b_1 VAR + b_2 PAYE + b_3 ADJE + b_4 \alpha + b_5 \beta + b_6 \sigma_\epsilon + b_7 MKT$$

	1960	1961	1962	1963	1964	1965	1966
a	6.11	7.16	8.01	5.93	3.13	−5.40	−4.23
	(1.68)	(1.87)	(2.77)	(1.79)	(.6)	(1.43)	(1.33)
b_1	38.99	37.31	28.89	31.10	20.34	31.09	27.69
VAR	(3.34)	(3.39)	(3.33)	(3.93)	(2.20)	(3.16)	(3.55)
b_2	−1.12	−.97	−.09	−.27	4.21	4.71	7.28
PAYE	(.42)	(.33)	(.04)	(.11)	(1.52)	(1.63)	(2.71)
b_3	.81	2.82	1.33	1.99	5.56	9.44	6.72
ADJE	(.26)	(.86)	(.55)	(.70)	(1.77)	(2.79)	(2.27)
b_4	45.49	45.47	20.71	28.17	27.59	43.34	53.15
α	(3.81)	(3.34)	(1.95)	(2.26)	(1.99)	(3.13)	(4.66)
b_5	−1.62	−.27	−2.05	.11	.90	2.60	1.45
β	(.64)	(.11)	(1.16)	(.06)	(.41)	(1.20)	(.79)
b_6	−4.75	−3.25	−5.87	−10.33	3.11	7.09	−2.19
σ_ϵ	(.55)	(.33)	(.77)	(1.17)	(.30)	(.65)	(.23)
b_7	.004	.007	.019	.024	.024	.039	.021
MKT	(.31)	(.49)	(1.88)	(2.18)	(2.19)	(4.06)	(2.93)
$\bar{R}_2$	.351	.325	.237	.226	.184	.405	.454

* The numbers in parentheses are t ratios; the numbers above are regression coefficients.

this addition the case for systematic risk as a main determinant of discount rate and stock price becomes clouded. The coefficient for systematic risk now shows erratic sign changes and little indication that it is significantly different from 0. The intercept, α, takes its place as an important determinant. And, in each year the addition of α raises the corrected coefficient of determination and, at the 5% level, adds significantly to the equations' explanatory power.

That the inclusion of the intercept, α, should cause problems is not unexpected. If capital markets were in equilibrium, theory suggests α will depend upon, and correlate perfectly with, systematic and residual risk. In or out of equilibrium the method of fitting characteristic lines assures a large negative correlation of the intercept, α, and slope, β, in cross sections[3] and makes good estimates of the individual impact of these variables difficult. Still, the dominance of the intercept is a surprise since it seems more subject to error and to change than is the slope.

In Table 4, a variable, FIR, is added representing firm characteristics that show a persistent influence but that have not been specifically identified.[4]

3. For our 7 cross-sections the correlation coefficients of α and β were —.792, —.825, —.773, —.812, —.800 and —.717.

4. Firm effects were used in our earlier study with substantially the same results and are dis-

TABLE 4

RESULTS FROM CROSS-SECTIONAL ESTIMATES*

$P_o/E_o = a + b_1VAR + b_2PAYE + b_3ADJE + b_4\alpha + b_5\beta + b_6\sigma_\epsilon + b_7MKT + b_8FIR$

	1961	1962	1963	1964	1965	1966
a	9.28	9.38	8.29	5.44	−3.19	−1.83
	(4.72)	(7.18)	(4.22)	(1.96)	(1.26)	(1.00)
b_1	21.49	19.08	18.03	9.10	22.56	20.56
VAR	(3.76)	(4.83)	(3.77)	(1.28)	(3.41)	(4.59)
b_2	−.28	.41	.71	3.79	3.26	4.31
PAYE	(.19)	(.42)	(.49)	(1.81)	(1.69)	(2.78)
b_3	2.93	1.13	2.61	5.29	8.41	7.14
ADJE	(1.75)	(1.03)	(1.57)	(2.21)	(3.72)	(4.24)
b_4	58.32	37.58	42.56	43.51	58.59	61.45
α	(8.33)	(7.73)	(5.73)	(4.06)	(6.26)	(9.40)
b_5	2.66	−.13	2.22	3.24	4.69	2.72
β	(1.98)	(.16)	(1.88)	(1.92)	(3.21)	(2.60)
b_6	−1.26	−3.74	−9.34	3.39	7.54	−1.06
σ_ϵ	(.25)	(1.08)	(1.80)	(.44)	(1.03)	(.19)
b_7	−.003	.008	.012	.016	.032	.018
MKT	(.46)	(1.65)	(1.77)	(1.87)	(4.90)	(4.42)
b_8	5.77	4.50	4.69	4.16	5.01	4.80
FIR	(16.07)	(18.90)	(13.09)	(8.25)	(10.69)	(13.77)
$\bar{R}^2$	.824	.845	.730	.530	.735	.822

* The numbers in parentheses are t ratios; the numbers above are regression coefficients.

The addition reduces unexplained variance significantly but does nothing to alter earlier conclusions.

The explanation of why the impact of systematic risk, β, is obscured when the intercept, α, is included in the estimating equation is not obvious. One factor may be that the system is moving toward equilibrium. In moving, the price of a share of stock that has too high an intercept should be bid up to force the stock's characteristic line down to the proper level. More important, however, may be the possibility that statistical estimates using past data significantly understate residual risk. Some of this residual risk is liquidity risk and is reflected in the positive coefficient of our marketability, MKT, variable. But more may be in things that have some chance of happening but that don't happen to firms that survive; anti-trust dissolution in the case of IBM for example. This type of unrecorded but perceived risk may be much larger than research on past data can reveal and may have its effect on the intercept, α. It may make α, in part, a proxy for residual risk. This possibility, weak as it is, suggests that the proposition that systematic risk dominates

cussed in more detail there. In spite of changes of method in estimation and fitting other results are also similar. Two findings that are not similar involve the earnings growth rate, g, and the systematic risk variable, β. The growth variable had the right sign and reasonable t ratios in the earlier study. Here it did not have the right sign or significance and was discarded. The systematic risk variable, β, worked well in the earlier study in an equation similar to that in Table 2 but without the residual risk variable σ_ϵ. We pushed the risk analysis no further in the earlier work.

residual risk as a determinant of a stock's discount rate or required return needs additional empirical attention before it is accepted.

III. Variables

The variables used came from a larger set, some of which were discarded. All variables in the original set are noted here. They were calculated for a selected sample of firms.[5] The variables were used in linear and logarithmic equations. The logarithmic equations were consistently worse than the linear equations and were not reported above. However, experiments with form can not be considered complete. The variables used include:

Price to earnings ratio, P_o/E_o: The numerator is year-end price in the year of the cross section. The denominator is estimated by smoothing earnings from 1947 through the cross-section year using a smoothing model that assumes a percentage growth rate. Smoothing coefficients for the model were those that provided the best set of 3 year earnings forecasts for the Standard and Poor's industry group in which a company was included.

Intra-year price variability, VAR: The difference between the high and low price was divided by the average of the high and low price for each year 1947 to 1966. An exponentially weighted average of these values from 1947 through the year prior to the cross-section year was then used as the value of this variable for each stock. Prices in the cross-section year do not affect this variable.

We are very tentatively beginning to view this variable as a proxy for earnings growth expectations. This is in part an opportunistic response to the persistently positive sign in our work, and elsewhere, of this seeming risk variable. But it is also recognition that stock price appreciation rates which are reflected in this variable may better estimate investor's earnings growth expectations than anything we can do with actual earnings. We did use the smoothing model described in the price to earnings ratio section to estimate an earnings growth rate, g, for each company and we did limit ourselves to companies in the sample for which we had Theil inequality coefficients of less than one. Still, this variable did badly, had the wrong sign and was dropped. We also used actual growth in the three years following the cross-section year, g_{+3}, and found it of little help.

Dividend payout rate, PAYE and payout adjustment rate, ADJE: Using earnings and dividend data for a firm from 1947 through the cross-section year we estimated the equation:

$$D_t = a + bE_t + cD_{t-1}$$

and, in keeping with equation (3) above estimated ADJE for the years as 1-c and PAYE as b/(1-c). Where the results for PAYE were negative or much above one we dropped the company. We also used the same equation with cash flow, CF, in place of earnings, E_t, and estimated cash flow payout and adjustment rates, PAYCF,

5. To assemble the sample we went through the first 395 corporations on our COMPUSTAT tape. 206 of these were dropped because some item of information was not availbale and 36 were dropped because they were not reporting on a calendar year basis. Of the 153 corporations actually taken from the tape for use 36 were dropped because forecasts we developed of their earings growth did not predict as well as a naive assumption that earnings would remain the same for the next 3 years and 18 were dropped because their estimated dividend payout rates were negative or substantially greater than 1.

ADJCF. These cash flow estimates did a poorer job of predicting dividend payments and a poorer job in cross-sections and so were dropped.

Standard deviation of return, σ_{RR}: Return to an investor in a stock was calculated for each year from 1948 to 1966 by taking the sum of price appreciation over the year and dividends during the year and dividing it by price at the end of the previous year. Using return in each year from 1948 through the cross-section year, a standard deviation of return, σ_{RR}, was calculated for each stock for each cross-section year.

Systematic risk, β, residual risk, σ_ϵ, and intercept, α: Using the returns for each stock described just above and the returns to an investor if he had held the Dow-Jones Industrial Index stocks for each year 1948 through the cross-section year, equation (8) was estimated. The regression coefficients of that equation and its standard error of estimate were used as the α, β and σ_ϵ for the stock in the cross-section year. The correlation coefficient, COR, was also calculated but was not used.[6]

Marketability, MKT: The number of shares traded was multiplied by the average of the year's high and low price for each year from 1947 to 1966. An exponentially weighted average of these values from 1947 through the year prior to the cross-section year was then used as the value of this variable for each stock in each cross-section year. Since an investor's liquidity should increase with the breadth of the market for the stocks he holds this variable should have a positive effect on price. Another variable, the value of shares outstanding, SIZ, was calculated in the same manner as marketability. It was highly correlated with marketability and was dropped. However, we plan to use it with σ_ϵ in constructing a more appropriate residual risk variable.

Firm effects, FIR: the difference between actual P_o/E_o for each stock and predicted P_o/E_o from the Table 3 equation was calculated for each cross-section year. In doing a Table 4 regression for a cross-section year, the arithmetic average of these differences for each stock in the years prior to the cross-section year were used to represent those characteristics of a stock which influence its price to earnings ratio, do not change over time and are not reflected in other variables.

IV. Plans

The results we've reported here, though not unambiguous, are interesting enough to make us want to carry out plans for testing this valuation model. Four types of activity will be involved.

First, there is more work to be done on explanatory variables using the current sample of corporations. The residual risk variable should be recalculated and rerun. Analysts' estimates of earnings growth deserve attention as an explanatory variable. Intra-year price variability needs much closer examination. Regressions pooling data for cross-section years should be used to test whether coefficients are consistent among years. And the firm effect must be broken into some useful set of components. A quick study of the residuals that form the firm effect indicates that for most firms these residuals are steady and that for some industry groups residuals are consistent among

6. Annual data is not ideal for estimating the characteristic line, however, our estimates do not seem to suffer too badly. Of our 99 stocks, 33 were studied by Marshall E. Blume II in his doctoral dissertation, [1]. The rank order correlation between our β values and his for the 33 stocks is .6. His estimates, pp. 106-112, are based on monthly observations 1927 to 1960. The .6 rank order correlation is not out of line with the .68 he gets for estimates of β made separately for the third and fourth quarters of his 1927-1960 period, p. 44.

firms. This holds out some promise of identifying explicitly firm and industry characteristics to replace the catchall firm effects variable.

Second, the matter of functional form requires explicit attention. As we noted earlier, the test of our model and of the theories and working rules it reflects is also a test of the estimates of expectational variables and of the functional form used in fitting the relationship. To explore various functional forms and to discover the extent of distortion in each, we've developed a computer simulation of our basic model. It will be used to generate data consistent with all our assumptions and inconsistent with some of them; data with error in observations of independent variables and data without it. In the first few of these simulations, with all assumptions satisfied and no error in observation, the estimated coefficients of regressions run in both linear and logarithmic form have shown no problems with signs or significance. But, contrary to our work with actual data, the logarithmic form has shown better results.

Third, the model will be used in selecting stocks and building portfolios. For this purpose closing prices in March 1967 will be used in place of 1966 year end prices. The other data will be historical, taken from the 1966 COMPUSTAT tape that was available before these prices were established. Using this data, stocks can be selected to provide premium returns on risk, and portfolios can be assembled to compete with randomly selected portfolios. Successful selection and assembly would not be expected according to stronger versions of the random walk hypothesis. So this work should serve as one test of that hypothesis.

Fourth and finally, we will repeat many of the things we plan with another sample of stocks from the 1966 COMPUSTAT tapes and with samples from the tapes for 1967, 1968 and 1969.

V. Conclusion

While this paper has been more a statement of intent than a report of accomplishment, some modest results were offered as an illustration of what might be expected as we continue tests of our stock valuation model. The tests promise some small increase in understanding of stock price determination. Unhappily, they don't seem to offer much hope of providing a golden rule for stock market success.

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