Efficiency of Corporate Investment

by

Irwin Friend
Frank Husic

Working Paper No. 4-71

RODNEY L. WHITE CENTER
FOR FINANCIAL RESEARCH

University of Pennsylvania
The Wharton School
Philadelphia, Pa. 19174

A recent article by Baumol, Heim, Malkiel and Quandt in The Review of Economics and Statistics raises fundamental questions about the efficiency of the process of capital formation for large U.S. corporations and, in particular, about the propensity of management to retain earnings when it lacks profitable investment opportunities.[1] The authors (B-H-M-Q) find that in the period following World War II, the rate of return on investment financed by new equity, ranging from 14.5% to 20.8% per year in the set of comparisons they prefer, was substantially higher than the rate of return on debt-financed investment, ranging from 4.2% to 14%, which in turn was higher than that on internally-financed investment, ranging from 3.0% to 4.6%. The authors point out that the direction of these differences is consistent with the differentials in transactions costs, since these costs are highest for external equity and lowest for retained earnings. They question, however, the justification for the magnitude of the observed differences and especially the "uncomfortably" small rate of return to firms relying on ploughback for their new investment. Indeed, they state that their findings raise considerable doubt about any relationship between ploughback and growth in company earnings. They conclude by asking, "Are managements relatively careless in the use of funds that are not subject to the strictest test of market discipline? Do managements retain earnings first and then

look for something to do with them afterwards?"

The B-H-M-Q assumption that market discipline enforces a higher rate of return on externally financed investment can be questioned on the basis of a number of other studies of stock prices and rates of return. Thus, average rates of return on new stock issues, and particularly on unseasoned issues, have been shown in every study of the subject with which we are familiar to be considerably lower than on outstanding issues, except for short-run results in hot new issue markets.[2] This finding would appear to be in basic conflict with the B-H-M-Q results. Similarly, the apparent lack of any significant correlation between dividend payout and stock prices, once allowances are made for the obvious statistical biases, also casts some doubt on the B-H-M-Q analysis.[3]

However, while it is easy enough to find studies which raise questions about the B-H-M-Q findings, there are others which would appear to confirm them.[4] The findings themselves are startling, potentially important and badly in need of closer examination. This note indicates that the startling nature of the B-H-M-Q results may simply reflect a limitation of their statistical analysis. Once a correction for this deficiency is made, the results seem much more in accord with theoretical preconceptions.

The B-H-M-Q analysis regressed growth in earnings (E) on

ploughback (P), new common equity (N), new debt and preferred stock (D), and risk (R) over the period 1948-1964. An attempt was made, by experimenting with a number of different lag structures, to adjust for the fact that earnings in any year are dependent not only on that year's ploughback, debt and equity funds, but on those of previous years. A large number of regressions were fitted not only for different lag structures and for different base periods, but also for alternative measures of each of the variables in the regression. Thus, four earnings variables were tested, including and excluding interest and depreciation, though results are presented for only two, net income available for common plus interest (E_1') and net income plus interest and depreciation (E_2'). The two ploughback variables are both inclusive (P_1) and exclusive (P_2) of depreciation. Two estimates of new common equity were derived, but almost exclusive reliance was placed on the change in the total number of shares times price (N_1). Two estimates of new debt and preferred stock were used, one excluding (D_1) and one including (D_2) current liabilities. For only one of the two estimates of risk computed were results presented since this one, the mean annual market rate of return from common minus twice the standard deviation of returns (R_2), apparently gave somewhat better results.

An examination of all of the 32 regressions presented by B-H-M-Q raises substantial doubts about their conclusion that

the rate of return on debt-financed investment was in excess of that on internally-financed investment. It is not at all clear either from economic or statistical considerations why they seem to place most of their emphasis on the three equations (out of a total of 32) which do lend some support to their thesis on the comparative returns associated with debt and ploughback. Actually, the average rate of return on investment was 4.7% for ploughback, - 0.2% for debt, and 20.2% for external equity if all of the 32 regressions presented are given equal weight. The rate of return on ploughback exceeded that on debt in 23 out of the 32 cases but was below that on external equity in 28 cases. If attention is confined to those 19 regressions in which the earnings variable is the one (E_2') which B-H-M-Q seem to prefer, the average rate of return on investment becomes 6.4% for ploughback, 3.0% for debt, and 22.1% for external equity. The rate of return on ploughback was higher than that on debt in 13 out of the 19 cases and below external equity in 16 cases. The B-H-M-Q results seem to imply that the rate of return on ploughback is somewhat in excess of that on debt but still substantially below that on external equity. They also point to low rates of return on both ploughback and debt and exceedingly high rates on external equity.

Even this revised interpretation of the B-H-M-Q analysis

does not change the most peculiar finding of their original results -- viz., the inordinate comparative advantage of investment financed by external equity. However, a further examination of their regression analysis indicates an obvious deficiency which may help to explain this strange finding. The variables which they employ are not adjusted for differences in size of firm so that their regressions, which are uniformly based on cross-section data for different corporations over a specified period of time, are dominated by scale effects. As a consequence, when the change in earnings is related to the financing variables, the regression attributes an earnings effect to differences in financing sources which may more properly be attributed to differences in firm size. Moreover, the very large scale differences among firms would be expected to lead to inefficient estimation of the regression coefficients (as a result of heteroschedasticity).[5] Parenthetically, it might be noted that the fairly impressive correlations which were obtained probably largely reflected the common scale effect of dependent and independent variables (except for risk).

To test our hypothesis, we simply recalculated their regressions correcting them for scale effects. However, before doing so we recomputed a number of their original regressions to test that our computer programs would reasonably duplicate their results. The Compustat file we used was a later version than

that used by B-H-M-Q, resulting in a somewhat smaller number of observations as a result of the Compustat treatment of merged firms. When we attempted to duplicate their results, we found minor differences in the coefficients of the independent variables except for the constant term and the risk variable, whose coefficient was generally insignificant in both analyses.[6]

To correct the regressions for scale effects, we selected ten of the B-H-M-Q regressions and divided both sides of the equation (except for risk) by an assets variable. We experimented with four different asset variables all of which gave similar results. Table 1 presents the new results in which the asset variable used is average firm assets for the period over which the independent variables are measured (A).[7]

These results are more in accord with theoretical expectations than those obtained by B-H-M-Q. The average marginal rates of return for all 10 regressions were 8.1% for ploughback, 8.0% for debt and 14.0% for external equity. (The average rates were 4.9%, 3.0% and 14.3% for the corresponding B-H-M-Q regressions.) If attention is confined to the 8 regressions in which the earnings variable is that apparently preferred by B-H-M-Q, the corresponding rates of return are 9.3%, 9.1% and 14.5%, respectively. (The B-H-M-Q averages were 5.5%, 3.6%, and 22.3%.) The after-corporate-tax rates of return on ploughback and debt are no longer uncomfortably small and the discrepancy between

Table 1

Results for the Equation $\frac{E}{A} = a + b\frac{P_1}{A} + c\frac{N_1}{A} + d\frac{D_1}{A} + eR_2 + f(\frac{1}{A})$

Base Period	Lag (Yrs.)	$E' = \frac{E}{A}$	a	b	c	d	e	f	$\bar{R}^2$ [# Obs.]
1951-1955	4	E_2'	-0.006 (-0.14)	0.140 (4.54)	0.151 (3.47)	0.089 (2.72)	-0.145 (-2.79)	1.394 (5.38)	.15 [458]
1951-1955	5	E_2'	-0.009 (-0.18)	0.138 (3.58)	0.192 (3.54)	0.110 (2.68)	-0.023 (-0.30)	2.404 (7.37)	.16 [464]
1952-1955	3	E_2'	0.014 (0.58)	0.126 (4.78)	0.183 (5.00)	0.043 (1.68)	-0.115 (-3.73)	0.342 (3.61)	.14 [468]
1952-1955	4	E_2'	0.014 (0.45)	0.134 (3.87)	0.218 (4.53)	0.059 (1.76)	-0.023 (-0.48)	1.208 (6.04)	.13 [472]
1952-1955	4	E_1'	0.047 (1.97)	0.056 (2.08)	0.120 (3.24)	0.011 (0.41)	0.033 (0.91)	0.913 (5.92)	.09 [472]
1953-1959	2	E_2'	0.005 (0.15)	0.096 (6.21)	0.159 (7.83)	0.087 (4.64)	-0.049 (-1.15)	0.960 (3.10)	.26 [436]
1953-1959	4	E_2'	0.014 (0.24)	0.047 (1.91)	0.193 (6.04)	0.153 (5.11)	0.045 (0.55)	3.028 (6.15)	.20 [456]
1953-1959	4	E_1'	0.055 (1.23)	0.009 (0.51)	0.112 (4.65)	0.062 (2.78)	0.112 (1.81)	2.298 (6.21)	.13 [456]
1956-1959	4	E_2'	-0.016 (-0.52)	0.034 (1.06)	0.018 (0.58)	0.095 (3.41)	-0.029 (-0.81)	2.264 (7.82)	.13 [507]
1957-1959	3	E_2'	-0.014 (-0.84)	0.025 (0.84)	0.049 (1.91)	0.095 (3.75)	-0.016 (-0.80)	1.263 (7.19)	.13 [516]

rates of return on external equity and the other forms of financing has been substantially reduced. There is no case in which estimated returns are negative as compared with four out of the corresponding B-H-M-Q equations (and 20 out of the original set of 32 B-H-M-Q equations). The coefficient of the **risk** variable (which is inversely correlated with return) does not always have the correct sign, but even here the situation is somewhat improved as compared with the B-H-M-Q findings. The constant terms it may be noted are generally insignificant. The new results are more satisfactory for the 1951-55 base period than for 1953-59, but even for the latter period the best regression in terms of goodness of fit is reasonably satisfactory and the results as a whole for this period represent a considerable improvement over the corresponding B-H-M-Q regressions.

It is true that the B-H-M-Q correlations are substantially higher than those presented in Table 1, but as noted earlier the former are inflated by the common scale effect of dependent and independent variables. The division of the dependent and independent variables in our equations by the same assets variable which may be subject to measurement error may introduce some bias in the coefficients of the financing variables, but the measurement error and resulting bias would be expected to be small (since the measurement error is probably quite small relative to the level of assets).[8] In general, we feel both on eco-

nomic and statistical grounds that the results in Table 1 are more tenable than those presented by B-H-M-Q in their earlier paper.

If the results in Table 1 are taken as more satisfactory than those derived by B-H-M-Q, we have explained the most troublesome of their findings -- i.e., the extremely small rate of return they obtain for ploughback; but we have only reduced rather than eliminated the sizable discrepancy between rates of return on external and other forms of financing. It is worth reiterating, therefore, a point touched on by B-H-M-Q, viz. that in equations like those they used or those contained in Table 1 it is not clear which way the causation goes. In other words, it is quite possible that firms with high earnings potential are those which are most likely to use external equity (after exhausting other sources of funds necessary to finance rapid growth), and that B-H-M-Q and our modifications of their analysis are attributing a higher rate of return to investment financed by new equity whereas (since firm effects are not held constant) the causation really goes the other way.

In an attempt to hold earnings potential and other firm characteristics more nearly constant, the ten equations of Table 1 were recomputed including only those firms which used some new equity during the base period. The number of firms included is reduced only moderately.[9] The results shown in Table 2 are

Table 2

Results for the Equation $\frac{E}{A} = a + b\frac{P_1}{A} + c\frac{N_1}{A} + d\frac{D_1}{A} + eR_2 + f(\frac{1}{A})$;

Excluding Cases Where New Equity Financing Was Not Used During the Base Period

Base Period	Lag (Yrs.)	$E' = \frac{E}{A}$	a	b	c	d	e	f	$\bar{R}^2$ [# Obs.]
1951-1955	4	E_2'	-0.032 (-0.65)	0.157 (4.15)	0.119 (2.65)	0.101 (2.86)	-0.103 (-1.82)	3.225 (7.18)	.20 [367]
1951-1955	5	E_2'	-0.067 (-1.07)	0.168 (3.55)	0.151 (2.68)	0.126 (2.84)	0.038 (0.47)	5.237 (9.24)	.23 [372]
1952-1955	3	E_2'	0.004 (0.14)	0.144 (4.43)	0.157 (4.14)	0.051 (1.88)	-0.077 (-2.25)	1.324 (4.59)	.16 [359]
1952-1955	4	E_2'	-0.012 (-0.30)	0.172 (3.89)	0.175 (3.43)	0.067 (1.84)	0.026 (0.50)	2.708 (6.95)	.18 [364]
1952-1955	4	E_1'	0.042 (1.36)	0.075 (2.23)	0.089 (2.27)	0.014 (0.49)	0.080 (1.97)	1.903 (6.38)	.12 [364]
1953-1959	2	E_2'	0.010 (0.24)	0.097 (5.95)	0.150 (7.09)	0.088 (4.54)	-0.040 (-0.88)	1.339 (3.86)	.26 [391]
1953-1959	4	E_2'	0.008 (0.11)	0.058 (2.23)	0.173 (5.24)	0.149 (4.88)	0.021 (0.24)	3.200 (5.79)	.20 [406]
1953-1959	4	E_1'	0.079 (1.64)	0.010 (0.54)	0.097 (4.04)	0.058 (2.58)	0.108 (1.71)	2.228 (5.53)	.12 [406]
1956-1959	4	E_2'	-0.032 (-0.90)	0.059 (1.62)	0.011 (0.33)	0.099 (3.31)	-0.043 (-1.11)	2.077 (6.10)	.11 [439]
1957-1959	3	E_2'	-0.022 (-1.10)	0.042 (1.23)	0.049 (1.84)	0.100 (3.62)	-0.025 (-1.12)	1.098 (5.24)	.11 [431]

now much more consistent with theoretical expectations. The average coefficients of ploughback, equity and debt for all ten regressions are 9.8%, 11.7% and 8.5% respectively. Further, if one considers only the eight cases where the B-H-M-Q favored earnings variable (E_2') is used, the results are further improved. The averages are 11.2% for ploughback, 12.3% for equity and 9.8% for debt. These remaining discrepancies might be reduced even more if firms issuing negligible amounts of stock were eliminated.

These last results do not indicate any major difference between marginal rates of return earned on investment financed by external and internal equity. The smaller rate of return on investment financed by debt (including preferred stock) than on external equity may be explainable in large part neither by the difference in transactions costs nor by management carelessness in the use of funds referred to by B-H-M-Q but rather by profit maximization considerations. Rational behavior by management who are attempting to maximize common shareholder wealth would suggest use of corporate debt so long as, for given risk to common stockholders[10], the associated growth in earnings and interest is in excess of the interest which has to be paid to the holders of debt. Presumably a 9.8% rate of return on debt-financed investment in the 1951-59 period would be well in excess of interest rates paid by corporations.

To summarize, there is little reason for concluding, as B-H-M-Q do, that the rate of return on new investment financed by new common equity (i.e., external equity) is much higher than on investment financed by retained earnings (to say nothing of nearly 5 times as high). Their conclusion that the rate of return on new investment financed by debt is higher than on investment financed by retained earnings also seems incorrect. However, there is some though not very strong evidence that the rate of return on investment financed by either external or internal equity is significantly higher than on investment financed by debt. The empirical evidence for all of these conclusions is relatively weak but it is at least in reasonable accord with theoretical expectations. More definitive results might be obtained from a continuous cross-section or panel analysis of the firms covered so that the time response of earnings in individual firms to investment financed by different sources could be studied to supplement the purely cross-section analysis, and in the process to largely eliminate the problem of reverse causation and other difficulties associated with firm effects.

FOOTNOTES

*The authors are respectively Richard K. Mellon Professor

*The authors are respectively Richard K. Mellon Professor
of Finance at the University of Pennsylvania and Investment Manager at Donaldson, Lufkin and Jenrette. The authors wish to thank the Rodney L. White Center for Financial Research of the Wharton School for financial support.

William J. Baumol, Peggy Heim, Burton G. Malkiel, and Richard E. Quandt, "Earnings Retention, New Capital and the Growth of the Firm," The Review of Economics and Statistics, November 1970. The corporations covered include virtually all industrial firms listed on the New York Stock Exchange.

[2]E.g., see Irwin Friend and J. R. Longstreet, "Price Experience and Return on New Stock Issues," in Investment Banking and the New Issues Market, Cleveland, The World Publishing Company, 1967.

[3]Irwin Friend and Marshall Puckett, "Dividends and Stock Prices," The American Economic Review, September 1964.

[4]These are cited in the B-H-M-Q paper.

[5]The B-H-M-Q regressions also contain dimensional incomparabilities between the financing and risk variables.

[6]For example, for the 1957-59 base period with a three year lag, they obtained

$$E_2' = \underset{(-1.13)}{-3.189} + \underset{(4.27)}{.0297}\, P_1 + \underset{(8.71)}{.1449}\, N_1 + \underset{(10.74)}{.1434}\, D_1 + \underset{(.247)}{1.232}\, R_2$$

$$\bar{R}^2 = .701 \quad [582]$$

while we obtained

$$E_2' = \underset{(-.52)}{-1.845} + \underset{(4.25)}{.0267}\, P_1 + \underset{(8.79)}{.1523}\, N_1 + \underset{(11.47)}{.1519}\, D_1 + \underset{(.297)}{1.669}\, R_2$$

$$\bar{R}^2 = .715 \quad [529]$$

where $\bar{R}^2$ is the coefficient of determination adjusted for degrees

of freedom, the numbers in parentheses represent t-values, and the numbers in brackets are number of firms in the sample.

[7]Similar results were obtained when log A was substituted for (1/A) in the regressions in Tables 1 and 2.

[8]To verify this hypothesis, a simulation was run allowing for random error in the measurement of assets. The model used in the simulation was

$$\frac{\Delta E}{A(1+\epsilon)} = a + b\frac{P_1}{A(1+\epsilon)} + c\frac{N_1}{A(1+\epsilon)} + d\frac{D_1}{A(1+\epsilon)} + eR_2 + f\frac{1}{A(1+\epsilon)}$$

where ϵ is normally distributed with zero mean and standard deviation σ_ϵ and all other variables are as defined before. This simulation was computed for the period 1951-1955 with a four year lag and E_2 as the dependent variable. With 50 trials, assuming the observed A's are the true A's and setting $\sigma_\epsilon = .1$, the results exhibited a remarkable degree of stability. As compared to the original values of .140 for the ploughback coefficient (b), .151 for equity (c), and .089 for debt (d), shown in Table 1 for this regression, the mean values in the 50 simulations were .144 for (b) with $\sigma_P = .013$, .151 for (c) with $\sigma_N = .013$, and .090 for (d) with $\sigma_D = .009$. Moreover, the $\bar{R}^2$ of the 50 trials ranged from .14 to .18 with a mean of .16 as compared to the original value of .15. Clearly any bias due to measurement error here is quite small. Setting $\sigma_\epsilon = .3$, which seems unreasonably high, the mean values were not changed greatly (though now b>c) but both the standard deviation of the coefficients and in general the $\bar{R}^2$ were substantially increased.

[9]However, many of the remaining firms issued only negligible amounts of stock.

[10]At least in theory, B-H-M-Q hold this risk constant in their regressions.