Corporate Capital Investment, Accounting Methods and Earnings: A Test of the Control Hypothesis

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THE PURPOSE OF THIS paper is twofold: first, I measure the effect of corporate capital investment decisions on the firm's earnings in the years following the capital investment. This relationship between investment and earnings is determined largely by two factors controllable by management: (1) the accounting methods used by the firm to measure its earnings and (2) the investment projects selected. The second purpose of this paper is to test a joint hypothesis about the effect of the type of control (manager or owner) of the firm on the investment-earnings relationship. Briefly, I find that the capital expenditure significantly reduces the earnings reported in the following year. Whether the firm is under a significant ownership control, however, seems to make little difference to this relationship between investment and earnings. Thus the selection of accounting methods and investment projects does not seem to be affected by the type of control of the firm. Measurement of investment-earnings relationship is presented in the first section. The control hypothesis is tested in the second. Implications of these results and further work now in progress are discussed in the concluding section.

I. Investment, Accounting Methods and Earnings

Capital expenditures by industrial firms are incurred in expectation of future cash inflows, provided that such inflows are sufficiently large in relation to the outflows and in relation to the uncertainty associated with the future. While investment decisions are necessarily subjective, the financial accounting methods used for measuring and recording investments and their consequences tend to be selected with a view to minimize such subjectivity; thus the accounting definition of an asset as an acquired economic resource with future benefits that are measurable with a reasonable degree of certainty. This criterion for recognition of accounting assets tends to exclude certain important economic resources such as research, development and certain exploration outlays and long-term advertising efforts, etc., and these items are charged off to income at the time they are incurred. This transfer of income from current to future periods arising from immediate expensing of outlays with highly uncertain benefits is referred to as conservatism in accounting.

Accounting for capital expenditures is particularly affected by certain account-

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ing practices. In the initial recording of investment, all costs necessary for making the plant ready for intended use are supposed to be capitalized, but many firms use the practice of expensing individual items smaller than a specified amount. The administrative and factory costs of starting up a new plant and equipment may be substantial but have to be expensed frequently due to the difficulty of separating these costs from costs not related to the capital project. Until the issuance of *Financial Accounting Standard 34* in 1979, most industrial firms expensed the interest cost of self-constructed assets and many will continue to do so unless they have a sufficient amount of debt. Finally, the use of accelerated depreciation methods for reporting purposes may overstate the depreciation in the early years of the life of the plant. Thus, under the current accounting practice, the effect of investment on earnings in the short run (within a year or two), may be less positive than the longer run effect. It is even possible that the short-run effect may be negative. In this section of the paper, I measure the profile of the income effect of investment under an appropriate set of assumptions. This measurement lays the ground work for a test of the effect of the type of control on this profile presented in the second part of the paper.

Estimation of Investment-Income Relationship

The general form of the relationship between investment and earnings can be specified under the assumption that capital outlays do not start yielding income to the firm before they are actually incurred. Earnings in any accounting period t will be derived from investments made during the preceding and, perhaps, the current account periods. Thus

$$E_t = \alpha + \textstyle\sum_{i=0}^{T} \beta_i I_{t-i} + u_t \tag{1}$$

where

E_t = accounting earnings reported for period t.
I_t = capital expenditures reported for period t
β_i = marginal contribution of capital expenditures in period t to the reported earnings i periods later.
u_t = disturbance term.
T = life of the investment projects measured in accounting periods.

While equation (1) allows flexibility in estimating the time profile of the marginal effects (β_i, $i = 0, 1, 2, \ldots, T$) of investment on income, direct estimation of this equation from time-series data is difficult for two reasons. For manufacturing industries, T may be sufficiently large, and the length of the available time series sufficiently small to drastically reduce the degrees of freedom in estimation. Second, lagged independent variables I_t, I_{t-1}, ..., etc., are highly correlated and present a serious multicollinearity problem.

In order to obtain time-series estimates of the effect of investment on income, some restrictions on (1) seem necessary. Since the longer run effects are certain to be positive and are likely to be relatively smooth, we can impose a distributed lag structure on these coefficients. Since we are interested primarily in the form of the short-run effects of investment on earnings, we can allow the coefficients of I_t and I_{t-1} to remain free and start a geometric (Koyck) distributed lag structure[1] beginning I_{t-2}. Thus

$$E_t = \alpha + \beta_0 I_t + \beta_1 I_{t-1} + \beta(I_{t-2} + \lambda I_{t-3} + \lambda^2 I_{t-4} + \cdots \lambda^{T-2} I_{t-T}) + u_t \qquad (2)$$

where λ = rate of decay in marginal effect of investment on income beginning with lag 3. If λ is not too close to 1 and T is sufficiently large, (2) can be approximated by the structural equation:

$$E_t = \alpha + \beta_0 I_t + \beta_1 I_{t-1} + \beta(I_{t-2} + \lambda I_{t-3} + \lambda^2 I_{t-4} + \cdots) + u_t \qquad (3)$$

If we multiply (3) by λ and subtract from itself, reduced form equation (4) is obtained

$$E_t = \alpha(1-\lambda) + \beta_0 I_t + (\beta_1 - \lambda\beta_0)I_{t-1} + (\beta - \lambda\beta_1)I_{t-2} + \lambda E_{t-1} + u_t - \lambda u_{t-1}$$

or

$$E_t = a_0 + a_1 I_t + a_2 I_{t-1} + a_3 I_{t-2} + a_4 E_{t-1} + v_t \qquad (4)$$

where

$$\lambda = a_4$$

$$\alpha = a_0/(1 - a_4)$$

$$\beta_0 = a_1$$

$$\beta_1 = a_2 + a_4 \cdot a_1$$

$$\beta = a_3 + a_4 \cdot a_2 + a_4^2 \cdot a_1$$

$$u_t = v_t + \lambda v_{t-1} + \lambda^2 v_{t-2} + \cdots$$

If v_t is serially uncorrelated (i.e., u_t has serial correlation λ), we can obtain estimates of a_i, $i = 0, 1, \ldots, 4$ by ordinary least squares regression of (4) and use the relationship between the reduced form and the structural coefficients to estimate the structural coefficients. The data and the results obtained from the time-series regressions on aggregated data are described next.

The Data

The earnings and capital expenditures data were taken from the Merged Annual Compustat file at the University of Chicago. The file contains 60 data items from annual reports 1946–74 (29 years). Seven hundred and fifty-five firms for which data beginning 1947 or earlier and ending 1972 or later are available are included in the file. For the present study, I have used 273 manufacturing firms (industry codes 2000 to 3999) for which earnings and capital expenditures data are available for the entire 29-year period. This 100 percent data availability requirement has ensured reasonable uniformity in the sample with respect to

[1] See Maddala [1977], pp. 350–364, especially equation (16–17) for the use of this technique.

stable and well-established firms. Thus, the results presented here are not likely to have been affected by the special earnings patterns of new firms and firms about to go out of business.

The Compustat Manual gave the following definitions of the two data items used:

> "Net Income" represents income after all operating and nonoperating income and expense and minority interest, but before preferred and common dividends. It is stated after extraordinary items which are not net of applicable taxes, or where there is a question on this point. However, net income is before all extraordinary items that are listed in the company's public reports as being netted of taxes. In addition, net income is stated before appropriation for general contingencies. These items are treated as surplus adjustments.
>
> "Capital Expenditures" represent the amount spent for the construction or acquisition of facilities and equipment.
>
> The capital expenditure total is not on a pro forma basis where mergers have occurred, except in the year of the merger, in order to assume maximum comparability with the indicated balance sheet and income statement material.
>
> Expenditures on development, exploration and prepaid production expenses are included.

Since the accounting practices, especially with respect to direct adjustments of retained earnings, have changed considerably over the 29-year period, it does not seem worthwhile to make finer adjustments to the differences in treatment of extraordinary items mentioned above. I expect that the effect of investment on income will be sufficiently large to be robust to such variations.

Equation (4) was estimated at two different levels of aggregation. First, aggregated earnings for all 273 firms were regressed on contemporaneous and lagged aggregate investment and lagged aggregate earnings. Second, equation (4) was estimated separately for each of the 20 2-digit manufacturing industries (20 through 39). Income and capital expenditure for each industry for any given year were the sum of income and capital expenditure respectively across all firms in the industry for that year.

Aggregate Results

Estimates of the reduced form equation (4) from the aggregate data are given in the top portion of Table 1. The regression equation fits reasonably well; the adjusted R^2 is 0.967, all coefficients except the intercept are significant, and the serial correlation among the residuals is 0.063 (Durbin-Watson Statistic = 1.85).[2] Structrual equation derived from the reduced form estimates is given at the top of Table 2:

$$E_t = 2955 + 0.615 I_t - 0.516 I_{t-1} + 0.243(I_{t-2} + 0.641 I_{t-3} + 0.641^2 I_{t-4} + \cdots) \qquad (5)$$

[2] Due to bias in D-W Statistics when lagged dependent variables are used, an alternative test suggested by Durbin [1970] was conducted. The null hypothesis of zero serial correlation could not be rejected. The z-value (standard normal deviate) for the test was 0.25.

Table 1

Effects of Capital Expenditures on Income: Estimates of Reduced Form Equation (4)

$$E_t = a_0 + a_1 I_t + a_2 I_{t-1} + a_3 I_{t-2} + a_4 E_{t-1} + v_t$$

Code	Industry	No. of Firms	$\hat{a}_0$	$t(\hat{a}_0)$	$\hat{a}_1$	$t(\hat{a}_1)$	$\hat{a}_2$	$t(\hat{a}_2)$	$\hat{a}_3$	$t(\hat{a}_3)$	$\hat{a}_4$	$t(\hat{a}_4)$	Adjusted R^2	Durbin-Watson	1st Order Autocorr.
	Aggregate Data	273	1061	(0.94)	0.6151	(2.76)	−0.9102	(−3.94)	0.5738	(3.42)	0.6409	(1.82)	0.967	1.85	0.063
20	Food	35	−5.699	(−0.263)	0.098	(0.772)	0.031	(0.204)	0.098	(0.781)	0.852	(5.926)	0.990	1.468	0.227
21	Tobacco	7	5.298	(0.522)	0.012	(0.241)	0.156	(2.127)	−0.057	(−0.591)	1.007	(14.871)	0.991	1.416	0.261
22	Textile	6	16.626	(1.848)	0.593	(2.846)	−0.466	(−2.164)	0.221	(1.161)	0.359	(1.080)	0.835	2.123	−0.119
23	Apparel	2	0.292	(0.571)	0.238	(1.073)	−1.142	(−4.866)	0.435	(2.806)	1.343	(5.175)	0.939	2.131	−0.137
24	Lumber	2	14.059	(2.060)	0.413	(2.838)	−0.738	(−5.167)	1.045	(9.490)	0.064	(0.312)	0.944	1.880	0.042
25	Furniture	3	2.989	(1.705)	0.141	(0.985)	−0.164	(−1.085)	0.217	(1.552)	0.583	(2.956)	0.490	2.069	−0.096
26	Paper	11	40.233	(0.768)	0.617	(3.712)	−0.603	(−3.673)	0.264	(2.150)	0.489	(1.079)	0.893	1.811	0.062
27	Printing and Publishing	2	0.628	(0.873)	−0.082	(−0.414)	−0.487	(−2.336)	0.339	(1.827)	1.162	(7.311)	0.914	1.983	−0.087
28	Chemical	38	−23.074	(−0.188)	0.373	(2.101)	−0.645	(−3.374)	0.410	(2.556)	0.957	(3.349)	0.968	1.557	0.196
29	Petroleum	20	357.220	(1.290)	0.863	(4.565)	−0.442	(−1.792)	0.214	(1.080)	−0.012	(−0.027)	0.963	2.139	−0.070
30	Rubber	10	100.940	(4.031)	0.653	(6.259)	−0.508	(−3.997)	0.306	(3.402)	0.007	(0.031)	0.952	2.102	−0.059
31	Leather	2	−0.620	(−0.423)	0.488	(2.127)	−0.200	(−0.782)	0.296	(1.314)	0.770	(4.409)	0.955	2.360	−0.215
32	Stone, Clay, Glass	15	28.254	(0.893)	0.180	(1.544)	−0.223	(−2.358)	0.172	(2.352)	0.800	(2.863)	0.942	1.725	0.123
33	Primary Metals	27	298.950	(1.258)	0.678	(3.783)	−0.670	(−2.727)	0.201	(1.161)	0.465	(1.431)	0.605	1.485	0.086
34	Fabricated Metals	10	2.805	(0.673)	0.345	(2.567)	−0.259	(−1.565)	0.267	(1.778)	0.681	(3.726)	0.950	1.895	0.038
35	Machinery Excl. Electrical	34	−4.359	(−0.053)	0.163	(0.788)	−0.416	(−4.495)	0.305	(3.415)	1.074	(1.971)	0.990	1.807	0.088
36	Electrical Machinery	19	64.021	(1.063)	0.077	(0.353)	−0.197	(−0.734)	0.249	(1.473)	0.836	(3.613)	0.926	1.784	0.077
37	Transportation Equipment	23	580.210	(2.376)	0.996	(1.891)	−1.134	(−2.114)	0.843	(2.295)	0.153	(0.452)	0.612	1.740	0.062
38	Instruments	5	−11.142	(−1.105)	−0.483	(−2.799)	−0.401	(−2.118)	0.253	(1.291)	1.630	(7.889)	0.989	1.405	0.286
39	Miscellaneous Manufacturing	2	0.407	(0.339)	0.124	(0.857)	0.235	(1.724)	−0.036	(−0.248)	0.683	(3.623)	0.673	2.005	−0.037
	Average for 20 Industries		73.40	(0.91)	0.3247	(1.80)	−0.4140	(−2.06)	0.3025	(2.05)	0.6956	(3.60)	0.876	1.84	0.036
	Standard Deviation for 20 Industries		156.2	(1.15)	0.350	(1.96)	0.3620	(1.97)	0.2532	(2.03)	0.4455	(3.52)	0.152	1.28	0.14

Table 2

Effects of Capital Expenditures on Income: Estimates of Structural Equation

$$(3)\ E_t = \alpha + \beta_0 I_t + \beta_1 I_{t-1} + \beta(I_{t-2} + \lambda I_{t-3} + \lambda^2 I_{t-4} + \ldots) + u_t$$

Code		No. of Firms	$\hat{\alpha}$	β_0	β_1	β	λ
	Aggregate Data	273	2955	0.615	−0.516	0.243	0.641
Code	Industry						
20	Food	35	−38.730	0.098	0.115	0.197	0.852
21	Tobacco	7	−706.467	0.012	0.168	0.113	1.007
22	Textile	6	25.962	0.593	−0.252	0.130	0.359
23	Apparel	2	−0.851	0.238	−0.822	−0.669	1.343
24	Lumber	2	15.027	0.413	−0.711	1.000	0.064
25	Furniture	3	7.174	0.141	−0.081	0.169	0.583
26	Paper	11	78.778	0.617	−0.300	0.117	0.489
27	Printing and Publishing	2	−3.863	−0.062	−0.583	−0.338	1.162
28	Chemical	38	−541.008	0.373	−0.288	0.134	0.957
29	Petroleum	20	352.903	0.863	−0.452	0.220	−0.012
30	Rubber	10	101.690	0.653	−0.504	0.303	0.007
31	Leather	2	−2.704	0.488	0.175	0.432	0.770
32	Stone, Clay, Glass	15	141.567	0.180	−0.078	0.109	0.800
33	Primary Metals	27	558.879	0.678	−0.354	0.036	0.465
34	Fabricated Metals	10	8.809	0.345	−0.024	0.250	0.681
35	Machinery Excl. Electrical	34	58.280	0.163	−0.240	0.046	1.074
36	Electrical Machinery	19	390.395	0.077	−0.132	0.138	0.836
37	Transportation Equipment	23	685.624	0.996	−0.981	0.692	0.153
38	Instruments	5	17.668	−0.483	−1.190	−1.687	1.630
39	Miscellaneous Manufacturing	2	1.288	0.124	0.320	0.182	0.683
Average for 20 Industries			57.52	0.3247	−0.3110	0.0789	0.6956
Standard Deviation for 20 Industries			310.2	0.3500	0.4010	0.5308	0.4455

The negative marginal effect of investment of earnings of the following year is relatively large, 52 percent with a t-statistic[3] of approximately 2.42. The longer term marginal effect on annual earnings is, as expected, positive at 24 percent. The rate of decay, λ, as expected is between 0 and 100 percent. The coefficient of I_t is 62 percent, which needs further explanation.

Even though the capital expenditures are made in the anticipation of future earnings and, therefore, may be considered to have been caused by such expectations, it is clear that the earnings in subsequent periods would not materialize if capital investment were not made. Thus, in spite of the mutuality of relationship, we can conclude that the earnings of, say, period t will be lower by 24 cents if the capital investment in period $t - 2$ were reduced by a dollar. Similar interpretation of the coefficient of I_t is not possible. While the current earnings play a large role in determining the level of current capital expenditures, the capital expenditures in turn, due to accounting practices referred to earlier, and due to the effects of the firm's operations, affect the current earnings. The coefficient of I_t is simply indicative of the resultant correlation between I_t and E_t and it is difficult to assign further significance to it until data on the component of E_t that arises from investment I_t can be gathered.

Industry Results

Estimates of the reduced form equation (4) for the 20 2-digit manufacturing industries are summarized in the lower part of Table 1. The specification of the equation seems to hold up reasonably well. The average value of the adjusted R^2 for the 20 industries is 0.88 with a minimum of 0.49 for the furniture industry. The average value of the Durbin-Watson Statistic is 1.84 in a range of 1.4 to 2.4. The null hypothesis of zero serial correlation is *not rejected* at the 1% level of significance for 16 industries; the test is inconclusive for the other 4 at 1% as well as at the 5% level. Durbin's alternative tests gave similar results. The error terms in the reduced form equation are serially uncorrelated.

As with the aggregate data, the intercept term is generally not significant, while all other coefficients are generally significant with average t-values of 1.80 for a_1, -2.06 for a_2, 2.05 for a_3 and 3.60 for a_4.

Estimates of the structural parameters for the 20 industries are shown in the lower part of Table 2. For 16 out of 20 industries, $\hat{\beta}_1$, the marginal effect of investment on earnings of the following year is negative. The average value of $\hat{\beta}_1$ is -31 percent for the 20 industries. As we would have expected, the longer run marginal effect, $\hat{\beta}$, is positive for 17 industries and has an average value of 8 percent. The estimated rate of decay has an average of 0.70 with 6 industries out of the expected 0 to 1 range.[4]

[3] T-statistic of reduced form estimates is derived from linear approximation from the covariance of structural estimates. Thus, $\hat{\beta}_1 = \hat{a}_2 + \hat{a}_4 \cdot \hat{a}_1$ yields $\mathrm{Var}(\hat{\beta}_1) = \hat{a}_4^2 \mathrm{Var}(\hat{a}_1) + \mathrm{Var}(\hat{a}_2) + \hat{a}_1^2 \mathrm{Var}(\hat{a}_4) + 2\hat{a}_4 \mathrm{Cov}(\hat{a}_1, \hat{a}_2) + 2\hat{a}_1 \mathrm{Cov}(\hat{a}_2, \hat{a}_4) + 2\hat{a}_1\hat{a}_4 \mathrm{Cov}(\hat{a}_1, \hat{a}_4)$.

[4] The restricted least squares estimates of $\hat{\beta}_1$ with restriction $0 \leq \lambda \leq 1$ were essentially the same as the unrestricted estimates.

Summary

The above examination of the aggregate and industry earnings and capital investment data indicates that capital investment has a substantial short-run negative effect on earnings of firms. This finding forms the basis of formulating and testing a hypothesis about the effect of the nature of control on this relationship between earnings and investment.

II. Corporate Control, Selection of Investments and Accounting Methods

Managerial theories of the firm, developed since the seminal work of Berle and Means [1932] suggest that the decisions made by the firm are affected by whether the owners or hired managers make the decisions.[5] Most of the empirical tests of managerial theories have been concerned with comparing the profitability of the owner-controlled firms to that of the manager-controlled firms. The results of this work have been inconclusive. Monsen, Chiu and Cooley [1968] and Stano [1976] have found that the returns to shareholders of the owner-controlled firms have been higher than for the manager-controlled firms; Kamerschen [1968] and Larner [1970] could not find support for that conclusion. Palmer [1973] concluded that the type of control becomes a significant factor only in the presence of a high degree of monopoly power. The relationship between investment and income provides an interesting basis to the effect of the nature of control on firm's decisions.

Two types of decisions made by the top management determine the time-profile of the earnings consequences of investments of a firm. First, the management selects, within the broad limits of Generally Accepted Accounting Principles, a set of accounting methods. This choice, especially the options selected with respect to depreciation, investment tax credit, cost of leasing and exploration (in the oil and gas industry) and interest costs on self-constructed assets, has a particularly important effect on time-profile of earnings that result from a given investment. Second, under a given system of accounting, each investment project will have a different time-profile of earnings, and the management has the ability to affect this profile by appropriate selection of investment projects.

It may be argued that the type of control of the firm will have some effect on both the accounting and the investment decisions. Schiff [1966] and Gordon [1964] have argued that the role of external or financial accounting in owner-controlled firms is much narrower than its role in a manager-controlled firm. Owner-managers will produce financial statements for the use of their bankers and governmental bodies and generally may use for financial accounting the same methods as they use for tax reporting. Since the remuneration of owner-managers does not depend on the external accounting measures of performance, they may have more reason to select relatively conservative accounting methods than the hired managers do. Manager-run firms may choose accounting methods with a view to stabilize the earnings of the firm, and thus the compensation received by

[5] Also see Williamson [1964] and Jensen and Meckling [1976].

the managers. Since the financial reports of manager-controlled firms are a major source of information for the shareholders, such managers are not as immune to variations in income as the owner-managers are. Other things being equal, one may expect that the manager-run firms will choose accounting methods that will tend to lessen the short-run negative effect of investment on earnings than would be the case for the owner-run firms.

Smith [1976] and Salamon and Smith [1979] present evidence that accounting choices made by firms are indeed affected by the type of control the firm has. Smith [1976] found that the manager-controlled firms make more smoothing changes than the owner-controlled firms do. Salamon and Smith [1979] concluded that the accounting manager-controlled firms tend to make accounting changes that increase their earnings in years when their stock price decreases. Both Smith and Salamon and Smith studies are concerned with the relationship of the year-to-year changes in accounting methods with the year-to-year changes in earnings and stock prices of owner- and manager-controlled firms. In contrast, the present study examines the effect of the accounting and investment decisions selected by the owner- and manager-controlled firms of the functional form of the investment-earnings relationship.

Approximately similar arguments apply to the differences between earnings profiles of investment projects selected by the manager- and owner-run firms. Under a given set of accounting methods, managers may be expected to select projects that will have a smoother time-profile of earnings and for which the negative short-run effect of investment on earnings will be smaller than for the owner-run firms. Since return to the owners is not directly affected by the reported earnings of the firm, they may choose capital investment projects on the basis of wealth maximization criterion alone and without regard to the time profile of earnings.

From the above discussion, it would appear that the managerial theory of a firm can be tested by comparing the magnitude of the short-term negative effect of investment on earnings. If this effect is more negative for the owner-run firms than for the manager-run firms, the data would support the hypothesis that the decisions made by owner-managers and hired managers are not the same. If no significant differences are found between the earnings profile of manager- and owner-controlled firms, we will be led to doubt that the manager-controlled firms tend to select their capital projects by using an income constraint.

Data for the Test of Control Hypothesis

I have used the data on control of firms gathered by Palmer [1973] and refined by Stano [1976].[6] Palmer started with the *Fortune 500* firms for 1965 and identified each firm as being manager-controlled, weakly owner-controlled and strongly owner-controlled depending on the fraction of total outstanding stock of the firm held by a single party being in the ranges 0–10, 10–30 and 30–100 percent. This definition of ownership control may be too strict since for the large publicly held corporations with widely held stock, even a 5 percent ownership may give an

[6] I am grateful to Miron Stano for providing me this data.

owner a substantial control of affairs of the firm. On the other hand, banks, insurance firms and pension funds who hold large blocks of stocks of a firm rarely take an active role in its management.[7]

Out of 273 firms in my sample, 204 were included in the Palmer-Stano sample of which 157, 35 and 12 were identified to be manager-, weakly owner- and strongly owner-controlled. The income and investment data for 1946–74 was aggregated across all firms in each group and reduced form equation (3) and the structural equation (4) were estimated. The results are shown in Tables 3 and 4 respectively.

Results of the Tests of Control Hypothesis

Estimates of the reduced form equation (4) in Table 3 indicate that specification of the model holds up very well for all groups with the possible exception of the group of 69 firms whose type of control could not be identified from the Palmer-Stano data base and for which the null hypothesis of zero serial correlation is rejected. Practically all coefficients are significant with the exception of the intercept term. For the group of weakly owner-controlled firms, estimates of $\hat{a}_4$ lies outside of the reduced range of 0–1 and the restricted least squares estimates of the reduced form equation for this group ($\hat{a}_4 = \lambda = 1$), given at the bottom of the table, are essentially the same as the unrestricted estimates.

The sign of the marginal effect of investment on earnings of the following year, $\hat{\beta}_1$, is uniformly negative for all groups (Table 4). This result is consistent with the findings for the aggregate and industry data reported in Table 2. In order to determine if the magnitudes of $\hat{\beta}_1$ are significantly different from zero, the t-statistic obtained from linear approximation are also shown in Table 4 (see footnote 2).

The estimated $\hat{\beta}_0$ and $\hat{\beta}$ are all positive with exception of weakly owner-controlled firms (for which $\hat{\beta}$ obtained from restricted least squares is positive) as expected.

The relationship between the $\hat{\beta}_1$ for manager- and owner-controlled firms is exactly opposite of what might have been expected under the managerial theory. While that theory would predict that the negative marginal effect of investment on income be smaller for manager-controlled firms than for all owner-controlled firms and even smaller than the coefficient for the firms controlled strongly by the owners, we find that the largest negative coefficient occurs for management-controlled firms and its magnitude declines for firms controlled weakly by the managers and declines further for the firms controlled strongly by the owners.

In order to determine if $\hat{\beta}_1$ for manager-controlled firms is significantly less than the $\hat{\beta}_1$ for owner-controlled firms, we conducted tests of significance. The t-statistic of the difference from $\hat{\beta}_1$ for manager- and all owner-controlled firms is −0.65. It seems that the null hypothesis that the relationship between investment and reported earnings of firms is not affected by the type of control cannot be rejected on the basis of these results. These data do not show that the manager-

[7] Smith [1976] and Salamon and Smith [1979] have used broader criteria to define ownership control and have used a smaller, industry-matched sample of owner- and manager-controlled firms.

Table 3

Effects of Capital Expenditures on Income: Estimates of Reduced Firm Equation for Groups of Firms Classified by the Type of Control

(4) $E_t = a_0 + a_1 I_t + a_2 I_{t-1} + a_3 I_{t-2} + a_4 E_{t-1} + v_t$

Group	No. of Firms	$\hat{a}_0$	$t(\hat{a}_0)$	$\hat{a}_1$	$t(\hat{a}_1)$	$\hat{a}_2$	$t(\hat{a}_2)$	$\hat{a}_3$	$t(\hat{a}_3)$	$\hat{a}_4$	$t(\hat{a}_4)$	Adjusted R_2	Durbin-Watson	Durbin's z-value
1. Manager-controlled	157	854.5	(0.94)	.607	(2.50)	−.916	(−3.58)	.584	(3.18)	.645	(1.80)	.964	1.97	−0.13
2. Weakly owner-controlled	35	−53.74	(−.75)	.327	(1.66)	−.592	(−3.52)	.208	(1.37)	1.198	(3.01)	.974	2.00	−0.21
3. Strongly owner-controlled	12	140.4	(2.18)	.210	(2.18)	−.240	(−1.59)	.267	(2.28)	.589	(3.34)	.90	2.11	−0.30
4. All owner-controlled (2 + 3)	47	132.2	(0.85)	.490	(3.38)	−.560	(−3.21)	.34	(2.54)	.675	(2.16)	.970	2.15	−0.67
5. Control not identified	69	−7.417	(−0.13)	.396	(2.15)	−.471	(−2.29)	.291	(1.92)	.810	(3.00)	.910	1.28	2.67
Restricted (λ = 1) least squares results for weakly owner-controlled firms		−31.34	(−0.57)	0.417	(5.68)	(−.584)	(−3.54)	.249	(1.98)	1.00	—	0.65	1.96	

Table 4

Effects of Capital Expenditures on Income: Estimates of Structural Equation for Groups of Firms Classified by the Type of Control

$$E_t = \alpha + \beta_0 I_t + \beta_1 I_{t-1} + \beta(I_{t-2} + \lambda I_{t-3} + \ldots) + u_t$$

Group	No. of Firms in the Group	$\hat{\alpha}_1$	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}$	$\hat{\lambda}$
1. Manager-controlled	157	2,407	.6073	−.525	.2454	.645
2. Weakly owner-controlled	35	272	.3270	−.201	−.032	1.200
3. Strongly owner-controlled	12	342	.2106	−.1168	.1982	.5893
4. All owner-controlled (2 + 3)	47	407	.4905	−.229	.1854	.6752
5. Control not identified	69	39.2	.3965	−.1498	.1701	.8108
Restricted least squares ($\lambda = 1$) estimates for weakly owner-controlled firms	35		0.417	−0.167 (−1.36)	.0827	1.00

controlled firms use income constraint in selecting their investment projects any more than the owner-controlled firms do.

Conclusion

This paper presents only preliminary analysis of the investment-earning data and the control hypothesis and further investigation seems necessary in several directions.

First, the tests have been conducted only for the aggregated data for industries, control groups, and all firms. Analysis of data for individual firms and the relationship of individual firms results to the aggregate results presented in this paper involves interesting problems of aggregation bias.[8] There is some indication in Tables 1 and 2, and 4 and 5 that some of the differences between all firm and industry groups on one hand and between the manager-controlled and owner-controlled firms on the other, may have been caused by the aggregation bias since they have very different sample sizes. Analysis of individual firm data should clear up some of these questions.

Second, this paper presents only the time-series analysis of data and the specification and estimation of the cross-sectional model remains to be carried out.

Third, the test of control hypothesis presented here is a joint test of the effect of control through all decisions of the firm on investment-earnings relationship. We have specified two types of decisions and, perhaps, other decisions that affect this relationship could be added to the list. It would be desirable to conduct separate tests of the effect of the type of control on various classes of decisions. It is possible to identify directly the accounting methods chosen by the firm, and even to make some estimates of these choices on the investment-earnings relationship. Having thus separated the effect of accounting choices, it might be possible to directly test the hypothesis about the effect of the type of control on the investment-earnings relationship.

[8] See Theil [1954].

Finally, it may be possible to integrate the model of ex post investment-earnings relationship with models of investment decisions in which current investment is a function of current and future expected earnings or cash flows.[9] Such integration would be particularly useful in interpreting the coefficient β_0 of I_t in equation (3).

[9] See, for example, Eisner and Strotz [1963] and Jorgenson [1963].

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