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Capital Expenditures, Profits, and the Acceleration Principle

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The Problem

CAPITAL expenditures and their fluctuations have long been recognized as of critical economic importance. This importance is underscored today as our interest in investment as a support of high levels of employment is reinforced by our concern for a growth in capital that may contribute to increases in output.

An understanding of the determinants of capital expenditures has been troubled by inability to choose between two apparently competing hypotheses. One, for which support may be found in work of Tinbergen, Klein, Meyer and Kuh,[1] and others, argues that past or current profits are significant in determining capital expenditure. Another hypothesis, consistent with work of J. M. Clark, Manne, Chenery, Koyck, Modigliani and Kisselgoff, and

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[1] Jan Tinbergen, "Statistical Evidence on the Acceleration Principle," *Economica*, May 1938, pp. 164–176; Tinbergen, *Statistical Testing of Business Cycle Theories*, Vol. I, *A Method and Its Application to Investment Activity* and Vol. II, *Business Cycles in the United States of America, 1919–1932*, Geneva, 1939; Lawrence R. Klein, *Economic Fluctuations in the United States, 1929–1941*, Cowles Commission Monograph 11, New York, 1950; Klein, "Studies in Investment Behavior," *Conference on Business Cycles*, New York, NBER, 1951, pp. 233–277; Lawrence R. Klein and A. S. Goldberger, *An Econometric Model of the United States, 1929–1952*, Amsterdam, 1952; J. R. Meyer and Edwin Kuh, "Acceleration and Related Theories of Investment; an Empirical Inquiry," *Review of Economics and Statistics*, August, 1955, pp. 217–230; Meyer and Kuh, *The Investment Decision: An Empirical Study*, Cambridge, Mass., 1957.

Eisner,[2] points to more or less sophisticated versions of the acceleration principle and the pressure of demand on capacity as a fruitful way of explaining investment. At least some versions of this explanation have in turn been criticized by Kuznets and Hickman,[3] *inter alios.*

Since profits and demand or pressure on capacity have tended to move in rough synchronization over time one may wonder whether we do have two meaningfully separate hypotheses. It is important, however, both for understanding and for possible policy purposes, to ascertain parameters of correctly specified structural relations. For one thing, the implications of a profits explanation as against those of an acceleration explanation would be quite different for various proposals for the stimulation of business investment. A profits explanation might imply that a reduction in the corporate profits tax rate, with total expected tax revenues maintained by increases in other rates, would bring about an increase in investment spending. The acceleration explanation would suggest that unless the reduction in the corporate tax rate increased demand, no additional investment would be forthcoming. To greater or lesser degrees, other proposals for reducing corporate tax incidence and increasing business after-tax profits, such as accelerated depreciation or investment tax credits, may also receive differing evaluations depending upon one's underlying explanation of investment.

The historical correlations are indeed indisputable; periods of high

[2] J. M. Clark, "Business Acceleration and the Law of Demand: A Technical Factor in Economic Cycles," *Journal of Political Economy*, March 1917, pp. 217–235, reprinted in American Economic Association, *Readings in Business Cycle Theory*, Philadelphia, 1951, pp. 235–254; A. S. Manne, "Some Notes on the Acceleration Principle," *Review of Economics and Statistics*, May 1945, pp. 93–99; Hollis B. Chenery, "Overcapacity and the Acceleration Principle," *Econometrica*, January 1952, pp. 1–28. L. M. Koyck, *Distributed Lags and Investment Analysis*, Amsterdam, 1954; Avram Kisselgoff and Franco Modigliani, "Private Investment in the Electric Power Industry and the Acceleration Principle," *Review of Economics and Statistics*, November 1957, pp. 363–380; Robert Eisner, "Expectations, Plans and Capital Expenditures, A Synthesis of *Ex Post* and *Ex Ante* Data," *Expectations, Uncertainty and Business Behavior*, ed. M. J. Bowman, New York, 1958, pp. 165–188; Eisner, "A Distributed Lag Investment Function," *Econometrica*, January 1960, pp. 1–29; Eisner, "Investment: Fact and Fancy," *American Economic Review*, May 1963, pp. 237–246.

[3] Simon Kuznets, "Relation Between Capital Goods and Finished Products in the Business Cycle," *Economic Essays in Honor of Wesley Clair Mitchell*, New York, 1935, pp. 248–267; Bert G. Hickman, "Capacity, Capacity Utilization, and the Acceleration Principle," *Problems of Capital Formation: Concepts, Measurement, and Controlling Factors*, Princeton for NBER, 1957, pp. 419–449; Hickman, "Diffusion, Acceleration and Business Cycles," *American Economic Review*, September 1959, pp. 535–565.

capital expenditures have been periods of high profits and periods of low capital expenditures have been periods of low profits. The workings of the acceleration principle have been far less obvious, and attempts to observe it empirically have had mixed success. For my part—and I do have some company—I prefer economic explanations that fit into the main body of the maximization principle in economic theory. In accord with this theory, I would suggest that capital expenditures are undertaken in the pursuit of profits, or perhaps in order to reduce the risk associated with expectations of profits. Setting aside the second aspect of the explanation, I would view the rate of investment demand as related to the expected profitability of investment, something which is quite different from past or current profits. A firm or economy may be enjoying high profits and yet find little profitability in adding additional plant, equipment, or inventories. Similarly, a firm or economy may be enjoying low profits and may have expectations of future demand in relation to current capacity such that substantial increases in capital stock seem profitable. The fairly good association over time between capital expenditures and profits would then be explained in large part, if not entirely, by the fact that profits have served as a "proxy variable." Periods of high profits have tended to be periods when demand was high relative to capacity; and, since there is some tendency, well observed in the past, for entrepreneurs to expect tomorrow to be like today, high-profit periods have also tended to be periods where expected demand was high relative to current capacity. Periods of high profit have, hence, frequently, but not necessarily always, been periods when the expected profitability of investment was high. If, however, profits have served as a proxy variable for demand (and perhaps other) factors, it may be possible by a multivariate analysis to isolate the roles of profits and the other factors for which it has been serving as a proxy in many previous studies.

In undertaking this task of distinguishing between the role of profits and demand factors it will be important to recognize that the response of capital stock to changes in demand cannot be expected to be immediate. The business decision-maker must judge first the extent to which any experienced change in demand is likely to be permanent or long run and, hence, influence his expectation of future demand. He may then be expected to react gradually over time to the changed expectation of future demand brought about by the experienced change in past demand. It should be appropriate, therefore, to attempt to explain investment in terms of a sufficient number of lagged sales variables.

This indeed will be critical to my approach. Previous published studies have frequently "tested" the acceleration principle by the use of variables measuring change in demand over merely one or two relatively short intervals of time. But if my view is correct, such tests would provide no direct measure of those major effects of changes in demand which could only be realized after sufficient time had elapsed for business decision-makers to become confident that the changes had been permanent and, also, for them to effectuate the consequent decisions to alter the amount of capital stock. Hence, in such tests a proxy variable that might capture some of these otherwise unmeasured forces of demand would be left considerable scope. To the extent that all of the role of demand factors can be included in the analysis, the effect of past or current profits should be expected to be sharply reduced, if not entirely eliminated.

The last hedge as to whether we should expect the apparent effect of past profits to be eliminated *entirely* should be explained. For one thing, if capital markets are imperfect, firms with low profits may find it more difficult to raise funds required for desired capital expenditures. Where this is so, it might be manifest most among relatively smaller firms which, it should be noted, would account for only a minor portion of aggregate investment. It might also be argued that this effect, to the extent that it does operate, might loom larger in the cross section than in movements over time or in the underlying structural relation we seek to estimate. Imperfect capital markets might induce allocation of a given amount of funds to firms enjoying high profits at the expense of those enjoying low profits, without seriously affecting the total amount of funds individuals are willing to invest.[4] A second reason why the apparent role of profits may not be entirely eliminated is that our past sales change variables may not "capture" entirely the expected demand-capacity relation, and some of this "uncaptured" element may be picked up in profits. Finally, we must note that factors other than those of aggregate demand must be included in any complete state-

[4] This point is discussed further in Robert Eisner and Robert H. Strotz, *Determinants of Business Investment*, Research Study Two in *Impacts of Monetary Policy*, prepared for the Commission on Money and Credit, Englewood Cliffs, N.J., 1963, Part II, section 3.

ment of the determinants of capital expenditures. Alterations in the composition of demand and in locations and methods of production, for example, account for a substantial portion of capital expenditures. Past or current profits might serve as a proxy for these factors as well. If they do, the relation, in including a fuller measure of total demand factors, will indicate a reduced, but not nonexistent, proxy role for profits.

The Data

This paper will offer a preliminary report of analysis of a very substantial and, in many ways, unique body of data collected in relation to the McGraw-Hill Publishing Company capital expenditure surveys. Raw material for the present study comes from surveys of 1954, 1955, 1956, 1957, and 1958, as well as related quantitative data collected from company financial statements. The McGraw-Hill data have been made available to me on an individual firm basis by code number in order to preserve the confidential character of the survey responses. The financial and accounting information has been tied to the individual (coded) firms participating in the surveys. I have data for over 700 firms, only a subset—although a large subset—of the entire McGraw-Hill sample. They tend to include the largest firms, which account for the bulk of capital expenditures, as indicated by the fact that their aggregated gross fixed assets in 1953 were over $160 billion. Data utilized in the analysis underlying the present report include responses to only a portion of the McGraw-Hill questions as well as only some of the separate financial information. These are: capital expenditures, capital expenditure anticipations, depreciation charges, gross fixed assets, sales, expected percentage sales change, profits, and actual and desired rates of utilization of capacity.

While some work has been done with undeflated data, the current analysis involves regressions of price-deflated variables wherever such price deflation was appropriate. In particular, sales have been deflated by one of eight sets of price indexes constructed from Bureau of Labor Statistics indexes and relatives on the basis of the broad product or industry classes into which I was informed the McGraw-Hill firms could be categorized. Capital expenditures and profits were deflated by a capital expenditures price index constructed from an average of the implicit GNP price deflators for "other new [nonresidential] construction" and "producers' durable equipment" weighted by the constant dollar volumes of these aggregates. Capital expenditure anticipations were deflated by the capital expenditures price index for the point of time, presumed to be the fourth quarter, at which the anticipations were indicated. Thus, for example, anticipations of 1957 capital expenditures made known at the end of 1956 were deflated by the capital expenditures price index for the fourth quarter of 1956. This may be rationalized by the assumption that businessmen during this period, in anticipating future capital expenditures, made their calculations on the basis of current prices.

Depreciation charges and gross fixed assets were taken at their accounting values without price deflation. It should be pointed out in this regard that depreciation charges have only been introduced into the present analysis as a ratio of gross fixed assets. Inasmuch as the complicated weighting factors that it would have been necessary to introduce for appropriate price deflation of each of these two variables would have been virtually the same, the value of the ratio of depreciation charges to gross fixed assets would have been little affected by price deflation. Since the capacity and expected sales change variables were, implicitly or explicitly, in physical terms they were not deflated for price changes.

In addition to price deflation, a number of transformations were performed on the basic variables to put them in forms with desirable statistical and economic properties. In particular, since the main focus of this study has been cross-section analysis, it was desirable to transform the variables in such a way as to eliminate the extreme heteroscedasticity that might have been expected because of variance in the size of firms. Without appropriate transformation of data from firms of vastly different sizes, of course, the absolute size of error terms or the scatter around the regression line would be positively related to the values of the independent variables. Firms with high sales, high profits, and high capital expenditures, that is, large firms, would be firms with high absolute values (or squares) of error terms.

Both to meet this problem and to fit the underlying economic relation which I believe to be operative, capital expenditures and capital expenditure anticipations were expressed as ratios of gross fixed assets, and sales changes were expressed as ratios of sales. Capital expenditures divided by gross fixed assets, a measure of capital stock, may be taken, after subtraction of a term to reflect depreciation or scrapping of capital equipment, as a measure of the relative change in capital stock. The change in sales divided by sales is a measure of the relative change in output. With variables in this form, a capital stock adjustment or acceleration relation, implying that capital stock would be kept more or less proportionate to output at least in the long run, can be estimated efficiently without disturbances introduced directly by differences in firm size or in capital-output ratios.

Profits have been measured gross of taxes and deflated by gross fixed assets and, also, net of taxes and deflated by net worth. Either procedure gives a measure, however crude, of the rate of profit on existing capital. Depreciation, taken as a ratio of gross fixed assets, constitutes essentially a measure (in inverse form) of the durability of capital.

Last, it should be reported that some effort has been made to eliminate observations with extreme values. Thus, observations were included in regressions only if all of the sales change (or capacity) and gross profit variables had absolute values less than unity (less than 0.4 for net profits, where they were used) and if the variables measuring depreciation, capital expenditure anticipations, and capital expenditures were less than 0.4. Earlier work with a similar body of data indicated that only a small number of observations are likely to be eliminated by these bounds.

The Model

Our underlying hypotheses have perhaps by now been made clear. Capital expenditures are seen as stemming from the demand to replace worn-out or depreciating plant and equipment and from the adjustment of capital stock to changed expectations of demand. The adjustment, as well as the development of the demand expectations, is seen as occupying substantial periods of time. Thus, an increase in the rate of sales from period $t - 1$ to period t will, if sales are maintained at the new level of period t, develop gradually over, say, m periods, the view that this higher level of sales is permanent. Capital stock may be expected to adjust, with the additional lags introduced by the nature of the decision-making and expenditure process, to the gradually changing view of expected demand resulting from the initial change in sales. Reverting to a formulation I have used earlier,[5] and denoting output by Y and capital stock by F (gross fixed assets), this may be written

[5] "A Distributed Lag Investment Function," *Econometrica*, January 1960, p. 6.

$$\Delta Y \rightarrow \Delta F$$

However, noting again that investment is likely to be induced over a number of periods, this may better be written

$$\Delta Y_t \rightarrow \Delta F_t^t + \Delta F_{t+1}^t + \ldots + \Delta F_{t+m-1}^t,$$

where the subscripts indicate the period in which the indicated changes occur. And then the change in capital stock in any one period, ΔF_t, may be thought of as gross capital expenditures, I_t, minus replacement requirements; and these would equal the sum of the increments of capital stock ascribable to changes in output in a number of past periods, or

$$\Delta F_t^t + \Delta F_t^{t-1} + \ldots + \Delta F_t^{t-m+1}.$$

After some manipulation and utilizing the assumption of a constant ratio of sales to output, we derive finally,

$$\frac{I_t}{F_{t-\tau}} = b_0 + \sum_{n=1}^{m} b_n \left(\frac{S_{t-n+1} - S_{t-n}}{S_{t-\tau}}\right).$$

With a number of further assumptions, such as constancy and linear homogeneity of the production function, constant factor proportions, full (or constant) utilization of capacity, lack of "curbs" to the operation of the accelerator due to bottlenecks or inability to disinvest as rapidly as falls in demand would require, and lack of bias due to transitory elements in sales changes, the sum of the sales change coefficients, that is, the sum of b_n in the last equation, should equal unity. If, in fact, they do not equal unity, part of the explanation may be in the inaccuracy of one or more of the assumptions indicated.

Previous experimentation has shown that profits, measured as a ratio of gross fixed assets, show fairly high collinearity with their lagged values in cross sections. It has, hence, seemed best, by way of testing the role of past or current profits, to include only one profits variable in the linear regressions. On the basis of a priori considerations and results of previous empirical investigations, profits lagged one year were used in the various regressions involving capital expenditures.

The proportion of capital stock which firms might be replacing in any year would relate very largely to the average durability of their capital stock. Also, under current United States accounting rules, depreciation still reflects in large part expected lives of plant and equipment. Therefore, the ratio of depreciation charges to fixed assets has been introduced into the model to account for the interfirm variance in capital expenditures that may relate to the interfirm variance in durability and replacement requirements.

The basic relation estimated may hence be written,

$$\frac{I_t}{F_{53}} = b_0 + \sum_{j=1}^{7} b_j \left[\frac{S_{t+1-j} - S_{t-j}}{\frac{1}{3}(S_{52} + S_{53} + S_{54})}\right] + b_8 \frac{P_{t-1}}{F_{53}} + b_9 \frac{D_{53}}{F_{53}} + u,$$

where I = gross capital expenditures
F = gross fixed assets
S = sales
P = profits
D = depreciation charges, and
t = year of the dependent variable, capital expenditures.

In the abbreviated symbols used in the tables presenting the estimates of parameters, the preceding equation is

$$(1) \qquad i_t = b_0 + \sum_{j=1}^{7} b_i \Delta s_{t+1-i} + b_8 p_{t-1} + b_9 d_{53} + u.$$

It was found convenient, in collecting the underlying data and in the computation and analysis, to keep a constant deflator for sales, capital expenditures, and profits variables of different years. The year 1953 was selected in part because it was roughly centered in the period to which the variables related and in part because it offered a desirable deflator of depreciation charges of 1953, the last year before accounting depreciation began to reflect the changed practices encouraged by the 1954 revisions of the tax law. In deflating sales changes it was felt advisable to use an arithmetic mean of sales of three years, 1952, 1953, and 1954, so that the distribution of 1953 and 1954 sales change variables in particular, and others in general, would not be distorted unduly by low values of sales of 1953 alone. This first or "basic" relation was also used with coefficients of various of the lagged sales changes constrained to be zero.

A second relation estimated includes two sales expectations variables. One is the expected percentage change in the physical volume of sales in 1959 indicated by McGraw-Hill respondents at the end of 1958. The other is the expected percentage change per annum in the physical volume of sales from 1959 to 1962, also indicated by respondents at the end of 1958. I have presented this latter variable, however, in a transformation from its original form on the questionnaires, where the response ostensibly indicated the percentage change in the physical volume of sales expected from 1959 to 1962. This variable actually was used in the regressions; but to put it in a form consistent with the other annual rate of sales change variables, it has been redefined as one-third of the indicated figure, and the regression statistics have been rewritten accordingly.[6] In this second relation, which involves only 1958 capital expenditures, capital expenditures and depreciation were deflated by 1957 gross fixed assets. I deflated sales changes by the arithmetic mean of 1956, 1957, and 1958 sales; measured profits after taxes, designated P^*; deflated profits by net worth, denoted by W; and used 1957 depreciation charges. The relation estimated may hence be written,

$$\frac{I_{58}}{F_{57}} = b_0 + b_1\left[\frac{\frac{1}{3}(S_{62}^{58} - S_{59}^{58})}{S_{59}^{58}}\right] + b_2\frac{S_{59}^{58} - S_{58}}{S_{58}} + \sum_{j=3}^{9} b_j\left[\frac{S_{58+3-j} - S_{57+3-j}}{\frac{1}{3}(S_{56} + S_{57} + S_{58})}\right] + b_{10}\frac{P_{57}^*}{W_{57}} + b_{11}\frac{D_{57}}{F_{57}} + u,$$

or, again in abbreviated notation,

$$(2)\quad i_{58}^* = b_0 + b_1\Delta s_{59\text{-}62}^{58} + b_2\Delta s_{59}^{58} + \sum_{j=3}^{9}\Delta s_{t+3-j}^* + b_{10}p_{57}^* + b_{11}d_{57} + u.$$

A third relation estimated, involving 1957 capital expenditures only, used responses to questions on utilization of capacity as well as expected sales changes, which appeared in the 1956 McGraw-Hill questionnaires. My capacity variable in this relation was a combination of responses to two McGraw-Hill questions. The first was, "At the end of 1956, how much of your capacity were you operating? ______%." The second question was, "What do you consider a desirable operating rate at the end of the year in your industry? ______%." We therefore defined

$$\Delta c = \frac{\frac{S}{C} - \left(\frac{S}{C}\right)_d}{\frac{S}{C_d}} = \frac{\text{actual minus desired utilization of capacity}}{\text{desired utilization of capacity}}.$$

[6] Such a transformation of the parameter estimates is, of course, permissible with linear transformations of the variables. It would not have been possible had I executed the more precise transformation involved in translating the expected three-year percentage change into annual rates which, when compounded, would give the original total.

This variable, taken from 1956 responses, hence, at the time 1957 capital expenditures were undertaken, described the relative amounts by which firms had felt recently existing demand (sales) left them short of desired capacity.

This third relation also includes the expected percentage change in the 1957 physical volume of sales indicated at the end of 1956 and actual sales changes of 1957, 1956, and 1955, measured as percentages of previous sales. (These sales change variables, unlike those used in the other relations, were taken from reports of sales made in McGraw-Hill responses. The other sales change variables were derived from sales data taken independently from financial statements.) The third relation may hence be written,

$$\frac{I_{57}}{F_{53}} = b_0 + b_1 \frac{\left[\left(\frac{S}{C}\right)_{56} - \left(\frac{S}{C}\right)_d\right]}{\left(\frac{S}{C}\right)_d} + b_2 \frac{S_{57}^{56} - S_{56}}{S_{56}} + \sum_{j=3}^{5} b_i \frac{S_{57+3-j} - S_{56+3-j}}{S_{56+3-j}} + b_6 \frac{P_{56}}{F_{53}} + b_7 \frac{D_{53}}{F_{53}} + u,$$

or

$$(3) \qquad i_{57} = b_0 + b_1 \Delta c + b_2 \Delta s_{57}^{56} + \sum_{j=3}^{5} b_j \Delta s_{57+3-j}^{**} + b_6 p_{56} + b_7 d_{53} + u.$$

Finally, I have examined briefly the role of capital expenditure anticipations. For this purpose I have estimated parameters of a relation expressing capital expenditure anticipations as a function of six current and previous sales changes, previous profits, and depreciation charges. I have then compared this relation with an analogous one for actual capital expenditures, and I have also expressed capital expenditures as a function of capital expenditure expectations and the sales change, profits, and depreciation variables previously used. Employing i_t^{t-1} to denote anticipations at the end of the year $t - 1$ of capital expenditures of the year t, divided by 1953 gross fixed assets, these relations may be written,

$$(4) \qquad i_t^{t-1} = b_0 + \sum_{j=2}^{7} b_j \Delta s_{t+1-j} + b_8 p_{t-1} + b_9 d_{53} + u,$$

$$(5) \qquad i_t = b_0 + \sum_{j=2}^{7} b_j \Delta s_{t+1-j} + b_8 p_{t-1} + b_9 d_{53} + u,$$

and

$$(6) \qquad i_t = b_0 + b_1 i_t^{t-1} + \sum_{j=2}^{8} b_j \Delta s_{t+2-j} + b_9 p_{t-1} + b_{10} d_{53} + u.$$

Findings

Parameters of the "basic" relation, (1), were estimated for equations involving capital expenditures of 1955, 1956, 1957, and 1958. The computation procedure involved the inclusion of capital expenditure anticipations in constructing the underlying moment matrices. Complete observations hence required that a firm had reported its capital expenditures in a given survey and had also reported its anticipations of capital expenditures for that year in the survey of the previous year. They also required complete accounting data with regard to 1953 depreciation charges and fixed assets; profits of the preceding year; and sales of the year of capital expenditures and seven preceding years. Since incomplete observations were rejected, this reduced the number of firms included in the regressions in each year to more or less than half of the 700-odd for which data had been received. Some of the detailed results, presented in Tables 1 and 3, may repay careful study. I shall only call attention now to some of the highlights.

First, sales change coefficients of all years in all regressions are positive. In most cases, the coefficients, particularly those of the current and first three lagged sales changes, are significantly different from zero (in a statistical sense) by reasonable tests, usually at the 0.01 probability level. The sums of sales change coefficients for the regressions for the four years were, respectively, beginning with 1955, 0.470, 0.587, 0.525, and 0.564. It would thus appear that one or more of the conditions I have suggested as necessary for the sum of these coefficients to equal unity were not being met.

Coefficients of the profits variable were also positive in all four regressions, but were small. In the case of 1957 and 1958 capital expenditures, these coefficients did not differ significantly from zero. Of more direct bearing on my hypothesis with respect to the proxy role of profits are the relative sizes of the simple and partial correlation coefficients of capital expenditures with profits. It is to be noted that the simple correlations of capital expenditures with profits varied from 0.381 to 0.189, thus accounting for between 14.5 per cent and 3.5 per cent of the variance of the capital expenditure variable. The low partial correlation coefficients, ranging from 0.202

TABLE 1

CAPITAL EXPENDITURES AS FUNCTION OF SEVEN LAGGED SALES CHANGES, PREVIOUS PROFITS, AND DEPRECIATION CHARGES, 1955–58

	REGRESSION COEFFICIENTS AND STANDARD ERRORS *Capital Expenditures, i_t, of*				SIMPLE AND PARTIAL CORRELATION COEFFICIENTS *Capital Expenditures, i_t, of*			
	1955	1956	1957	1958	1955	1956	1957	1958
Constant term	.025	.030	.047	.039				
	(.008)	(.008)	(.008)	(.007)				
Δs_t	.105	.116	.058	.063	.209[a]	.277[a]	.199[a]	.230[a]
	(.022)	(.025)	(.024)	(.025)	.274[a]	.236[a]	.122[b]	.142[b]
Δs_{t-1}	.058	.106	.104	.108	.221[a]	.273[a]	.233[a]	.283[a]
	(.023)	(.022)	(.025)	(.025)	.156[a]	.237[a]	.204[a]	.237[a]
Δs_{t-2}	.074	.101	.096	.108	.242[a]	.182[a]	.196[a]	.254[a]
	(.025)	(.022)	(.022)	(.024)	.179[a]	.230[a]	.216[a]	.244[a]
Δs_{t-3}	.104	.100	.106	.038	.308[a]	.169[a]	.203[a]	.066
	(.027)	(.026)	(.021)	(.023)	.225[a]	.195[a]	.245[a]	.095
Δs_{t-4}	.035	.086	.120	.117	.033	.151[a]	.244[a]	.294[a]
	(.026)	(.027)	(.025)	(.025)	.082	.160[a]	.233[a]	.254[a]
Δs_{t-5}	.020	.050	.020	.082	.027	.095	.068	.220[a]
	(.028)	(.027)	(.027)	(.027)	.043	.093	.038	.169[a]
Δs_{t-6}	.074	.029	.021	.048	.307[a]	.081	.034	.246[a]
	(.027)	(.027)	(.026)	(.030)	.166[a]	.054	.041	.090
p_{t-1}	.052	.073	.009	.011	.381[a]	.373[a]	.189[a]	.243[a]
	(.019)	(.018)	(.017)	(.018)	.162[a]	.202[a]	.027	.034
d_{53}	.803	.792	.777	.758	.509[a]	.379[a]	.344[a]	.376[a]
	(.122)	(.144)	(.132)	(.134)	.374[a]	.274[a]	.285[a]	.306[a]
$\Sigma\Delta s$ coefficients	.470	.587	.525	.564				
n	278	386	402	322				
$\hat{R}^2$	.428	.361	.284	.363				

NOTE: In first four columns, regression coefficients are in upper line of each cell; standard errors, in lower line. In last four columns, simple correlation coefficients are in upper line; partial, in lower line.

[a] Significant at 0.01 probability level.

[b] Significant at 0.05 probability level.

to 0.027, indicate, however, that the proportions of variance of the capital expenditure variables accounted for by profits after inclusion of the seven sales change variables and depreciation range only from 4.1 per cent to less than 0.1 per cent of the total. It is further to be noted that while the partial correlation coefficients generally tend to be less than the simple correlation coefficients, the sharp discrepancies noted in the case of profits are not nearly so apparent in the case of the sales change variables. It is clear that the sales change variables account in the aggregate for a substantial portion of the variance in capital expenditures. And earlier work bringing out collinearity among successively lagged profits variables indicates that little would have been gained by including additional lagged profits variables in the regressions.

The depreciation ratios, as expected, did account for substantial portions of the variance in the capital expenditure ratio variables. The total variance accounted for by all variables, as indicated in the unbiased estimates of the square of the multiple correlation coefficients, were 0.428, 0.361, 0.284, and 0.363 for the successive regressions. These, it may be suggested, are relatively high for cross sections of this kind, where a lot of "noise" may be expected to surround the relation we are trying to estimate.

The data used in all four regressions have been pooled in such a way as to average the estimates of coefficients for each year's regression and to add, to some unspecified extent, the effects of changes in variables over time. To accomplish this I have summed the matrices of raw products and cross products over all of the regressions. The regression coefficients calculated from the sum of these matrices hence reflect variance and covariance about the means of observations for four years (with the exception of depreciation charges, which, as noted, were identically defined in all regressions as 1953 depreciation charges divided by 1953 gross fixed assets). Results, shown in Tables 2 and 3, tend to sharpen the picture already delineated. With a total of 1,388 observations, even the smallest sales change coefficients are more than three times their standard errors. The sum of sales change coefficients, 0.572, is somewhat high relative to the corresponding sums in the individual regressions. This suggests that we are picking up some element in the variance and covariance over time which adds to the role of variance in changes in sales, a matter to which we will return both in this paper and other work. It may also be noted that sales change coefficients show a decided tendency to fall off when lags are extended to five and six years, but that the Koyck-type geometric distribution of coefficients, with a hump for the first lag term, is somewhat marred by the relatively high value of the coefficient of the Δs_{t-4} variable.

TABLE 2

POOLED REGRESSIONS OF 1955–58 CAPITAL EXPENDITURES AS DETERMINED BY RELATION (1) AND REGRESSIONS ON INDUSTRY-YEAR MEANS

	Regression Coefficients and Standard Errors		*Simple and Partial Correlation Coefficients*	
	Pooled Data, All Years	Industry-Year Means	Pooled Data, All Years	Industry-Year Means
Constant term	.035 (.004)	.021 (.018)		
Δs_t	.085 (.011)	.094 (.069)	.233[a] .199[a]	.217 .287
Δs_{t-1}	.116 (.011)	.230 (.095)	.272[a] .269[a]	.394[b] .465[b]
Δs_{t-2}	.092 (.011)	.133 (.055)	.168[a] .228[a]	.050 .465[b]
Δs_{t-3}	.085 (.011)	.139 (.054)	.147[a] .206[a]	.078 .493[b]
Δs_{t-4}	.101 (.012)	.144 (.082)	.201[a] .216[a]	.288 .356
Δs_{t-5}	.043 (.013)	−.024 (.078)	.097[a] .088[a]	−.203 −.067
Δs_{t-6}	.052 (.013)	.046 (.084)	.168[a] .109[a]	.403[b] .118
p_{t-1}	.033 (.009)	.015 (.070)	.290[a] .098[a]	.535[a] .047
d_{53}	.771 (.066)	1.056 (.491)	.383[a] .298[a]	.452[b] .425[b]
$\Sigma\Delta s$ coefficients	.572	.761		
n	1,388	31		
$\hat{R}^2$	.351	.605		

NOTE: In first two columns, regression coefficients are in upper line of each cell; standard errors, in lower line. In last two columns, simple correlation coefficients are in upper line; partial, in lower line.

[a] Significant at 0.01 probability level.

[b] Significant at 0.05 probability level.

The coefficient of the profits variable is again significantly positive but clearly small. What is more, the simple correlation coefficient of 0.290 reveals that the profits variable alone accounted for 8.4 per

TABLE 3

MEANS AND STANDARD DEVIATIONS RELATING TO REGRESSIONS FOR INDIVIDUAL YEARS, POOLED DATA, AND INDUSTRY-YEAR MEANS

	Means and Standard Deviations					
	t = 1955	t = 1956	t = 1957	t = 1958	Pooled Data	Industry-Year Means
Δs_t	.097 .157	.078 .138	.030 .140	−.047 .152	.039 .155	.037 .070
Δs_{t-1}	−.058 .161	.098 .164	.073 .135	.036 .135	.045 .159	.045 .066
Δs_{t-2}	.074 .138	−.043 .158	.103 .156	.075 .139	.050 .160	.053 .072
Δs_{t-3}	.051 .137	.069 .128	−.035 .158	.104 .154	.043 .155	.043 .076
Δs_{t-4}	.069 .141	.052 .130	.063 .133	−.033 .150	.039 .143	.028 .066
Δs_{t-5}	.071 .131	.071 .133	.044 .128	.068 .128	.062 .130	.057 .053
Δs_{t-6}	−.055 .134	.076 .127	.067 .135	.038 .120	.038 .138	.033 .073
p_{t-1}	.239 .189	.251 .200	.263 .210	.239 .203	.249 .202	.221 .098
d_{53}	.055 .029	.050 .025	.050 .027	.051 .027	.051 .027	.049 .014
i_t	.098 .070	.120 .079	.114 .076	.096 .073	.108 .076	.108 .028
n	278	386	402	322	1,388	31

NOTE: Means are in upper line of each cell; standard deviations, lower line.

cent of variance in the capital expenditure variable; but the partial coefficient of 0.098 shows that when other variables are included in the regression, the remaining explanatory power of the profits variable is reduced to less than 1 per cent of the variance not otherwise accounted for.

The means and standard deviations presented in Table 3 offer some light on the relative magnitudes of interfirm, intrayear variance and interyear, intrafirm variance. The successive means in the columns headed "t = 1955," "t = 1956," "t = 1957," and "t = 1958" indicate how sales moved over time. Thus, for firms included in the 1955 capital expenditure regression the means of sales changes from the preceding year, measured as ratios of average sales of 1952, 1953, and 1954, were (in percentages): 1949, −5.5; 1950, +7.1; 1951, +6.9; 1952, +5.1; 1953, +7.4; 1954, −5.8; and 1955, +9.7. The corresponding mean percentage changes in sales from 1956 through 1958, taken from the observations included in the 1958 capital expenditure regression, were +7.5, +3.6, and −4.7. (The means of sales changes for the same year in different regressions were not identical, because of somewhat differing compositions of the sets of firms included in each regression.) These differences in the mean sales change from year to year are reflected in the tendency for standard deviations of sales changes about the means of all sales changes to be somewhat higher in the pooled data than in the data for individual years. For example, the standard deviations of sales changes lagged two years were, for the successive individual-year regressions, 0.138, 0.158, 0.156, and 0.139. These standard deviations were taken about the means of sales changes for each single year from 1953 to 1956. The standard deviation of sales changes lagged two years in the pooled data was 0.160. This standard deviation stemmed from the variance around the mean of sales changes of all four years. However, the standard deviation for the pooled data was even in this instance not markedly higher than the standard deviations for each of the single years; nor was it, observing as well the statistics for other years, in general larger than the standard deviations in all of the individual-year regressions. Apparently, the major part of variance in all variables was the interfirm cross-section variance rather than intrayear variance.

The pooled data for the regressions of four years, hence, reflect largely the average of the regressions of individual years. It should of course be possible to ascertain this more precisely in a formal analysis of variance and covariance to which we intend to turn in subsequent work.

It may be argued, however, that individual firms, particularly smaller firms, would tend to view their own sales experience as unlikely in the long run to differ markedly from that of the industry or, perhaps, the economy as a whole. In deciding the extent to which to consider changes in their own sales as likely to be lasting or "permanent" rather than temporary or "transitory," they might well be influenced by the degree to which these changes in their own sales were similar to changes in the industry or in the economy. Fluctuations in their own individual firm sales might then be viewed as consisting of two components, industry (or economy) sales fluctuations and fluctuations of individual firm sales about the industry (or economy) levels. In terms of the transitory-permanent dichotomy made familiar in the study of the consumption function, the variance of the firms about the industry (or economy) levels, constituting in considerable part essentially random fluctuations in their own relatively small sample of experience, would be viewed as in smaller proportion permanent than the variance of sales of the industry (or economy). And since transitory fluctuations in sales should be expected to contribute relatively little, if anything, to the explanation of capital expenditures, one should expect higher sales change coefficients and higher coefficients of determination in capital expenditure regressions with observations having a larger "permanent" content.[7]

It has been possible to accomplish a preliminary test of this related set of propositions. This has been done by dividing firms into the "industries" or product classes which were identified for purposes of price deflation. Complete observation vectors were available for eight industries for capital expenditures of 1958, 1957, and 1956, and for seven industries (all of the eight except utilities) for 1955. From these were constructed thirty-one sets of "industry-year" means. Variance and covariance among these observations would therefore reflect a combination of interindustry differences and movements of the economy as a whole over the four years encompassed.

Results, presented in Tables 2 and 3, suggest that this approach may prove fruitful. My estimates of the parameters of (1) with these thirty-one industry-year means as observations include substantially positive coefficients for the first five sales change variables. Even taking the number of independent observations as only thirty-one, rather than the 1,388 from which the means are derived, three of these coefficients differ from zero by more than twice their standard errors. The sum of sales change coefficients, 0.761, is markedly higher than the corresponding sum, 0.572, for the pooled data of individual firms. And standard deviations, as seen in Table 3, are much smaller

[7] Cf. Milton Friedman, *A Theory of the Consumption Function*, Princeton for NBER, 1957; and Robert Eisner, "The Permanent Income Hypothesis: Comment," *American Economic Review*, December 1958, pp. 972–990.

for the means than for the original data. These statistics are consistent with my hypothesis that the permanent variance in sales change is relatively more concentrated between industry-years than between firms and that it is this permanent variance which is more closely (if not exclusively) related to the variance in capital expenditures.

The industry-year-mean regression offers, further, even more striking evidence of the proxy role of profits. The regression coefficient of the profits variable is 0.015, differing from zero in no significant fashion, either statistically or economically. While the simple correlation coefficient of the capital expenditure variable with the profits variable is a significant 0.535, the corresponding partial correlation coefficient is only 0.047. It may be noted, finally, that the adjusted coefficient of multiple determination is 0.605, suggesting that we have indeed washed out a relatively large proportion of transitory "noise" with the intraindustry variances and covariances.

We have also estimated relation (1) for individual industries, again pooling the observations of all four years (except in the case of utilities, for which only three years were available). Results of these pooled industry regressions, presented in Table 4, seem generally consistent with what we have argued thus far. Sums of sales change coefficients vary between 0.387 and 1.056. Their simple average is indeed somewhat higher (0.630) than the sums of sales change coefficients for the entire cross sections of each year or for all of the pooled data of all years. But this fact may perhaps be better passed over until appropriately weighted within-industry coefficients are obtained from the analysis of variance and covariance, which remains to be undertaken.

Finally, in regard to relation (1), the effects may be noted of eliminating various of the sales change variables or, put in other terms, restricting the coefficients of various of the sales change variables to be zero. Comparing Table 5 and Table 2 it is seen that estimated parameters remain fairly invariant with respect to inclusion or exclusion of a number of sales change variables. The effect of sales changes does, however, seem to be largely additive. Thus, the sum of sales change coefficients is only 0.257 for the pooled individual firm data and 0.380 for the industry-year means when only three lagged sales changes are included, as against 0.572 and 0.761, respectively, when seven sales change variables are included in the regressions. Further, the adjusted multiple coefficients of determination were only 0.264

TABLE 4

POOLED REGRESSIONS OF 1955–58 CAPITAL EXPENDITURES AS DETERMINED BY RELATION 1, BY INDUSTRY

	Primary Metals	Metal Working	Chemical Processing	All Other Manufacturing	Mining and Petroleum	Utilities	Transportation	Commercial
REGRESSION COEFFICIENTS AND STANDARD ERRORS								
Constant term	.034 (.019)	.028 (.010)	.067 (.015)	.023 (.009)	.056 (.015)	0.012 (0.034)	0.021 (0.009)	0.046 (0.018)
Δs_t	.064 (.044)	.091 (.017)	.048 (.034)	.096 (.025)	.055 (.037)	−0.009 (0.041)	0.136 (0.045)	0.194 (0.079)
Δs_{t-1}	.191 (.044)	.091 (.020)	.163 (.033)	.104 (.023)	.082 (.033)	0.300 (0.083)	0.068 (0.049)	0.072 (0.075)
Δs_{t-2}	.154 (.050)	.089 (.018)	.076 (.032)	.040 (.022)	.060 (.032)	0.186 (0.047)	0.179 (0.057)	0.059 (0.074)
Δs_{t-3}	.075 (.045)	.115 (.018)	.033 (.033)	.057 (.023)	−.0001 (.042)	0.099 (0.047)	0.110 (0.057)	0.051 (0.071)
Δs_{t-4}	.068 (.053)	.108 (.020)	.105 (.037)	.053 (.025)	.116 (.042)	0.133 (0.054)	−0.030 (0.066)	0.285 (0.132)
Δs_{t-5}	−.023 (.055)	.048 (.022)	.027 (.047)	.055 (.022)	.050 (.043)	0.125 (0.145)	0.126 (0.070)	0.246 (0.115)
Δs_{t-6}	.003 (.049)	.064 (.022)	.042 (.044)	.024 (.021)	.023 (.042)	0.052 (0.084)	0.149 (0.050)	0.150 (0.126)
p_{t-1}	.155 (.052)	.066 (.017)	.075 (.029)	.031 (.015)	−.065 (.047)	0.046 (0.051)	−0.153 (0.081)	0.054 (0.044)
d_{53}	.477 (.328)	.599 (.140)	.233 (.285)	.762 (.163)	.916 (.232)	1.021 (1.187)	1.354 (0.193)	0.714 (0.234)
$\Sigma\Delta s$ coefficients	.578	.608	.492	.428	.387	0.886	0.603	1.056
n	81	343	231	273	104	115	122	119
$\hat{R}^2$	.328	.380	.195	.347	.230	0.324	0.718	0.305
SIMPLE AND PARTIAL CORRELATION COEFFICIENTS (WITH i_t):								
Δs_t	.105 .171	.245[a] .284[a]	.098 .094	.311[a] .231[a]	.138 .151	.166 −.021	.399[a] .273[a]	.339[a] .229
Δs_{t-1}	.356[a] .457[a]	.210[a] .244[a]	.330[a] .311[a]	.363[a] .267[a]	.136 .250[b]	.456[a] .334[a]	.409[a] −.128	.301[a] .091
Δs_{t-2}	.145 .346[a]	.097 .257[a]	.101 .156[b]	.221[a] .109	.117 .191	.402[a] .362[a]	.385[a] .287[a]	.207[b] .076

(continued)

TABLE 4 (concluded)

	Primary Metals	Metal Work-ing	Chemical Process-ing	All Other Manu-facturing	Mining and Petro-leum	Utilities	Trans-porta-tion	Com-mercial
Δs_{t-3}	−.134	.155[a]	.008	.246[a]	.026	.203[b]	.317[a]	.176
	.195	.327[a]	.066	.150[b]	−.0003	.201[b]	.180	.069
Δs_{t-4}	.247[b]	.140[a]	.217[a]	.228[a]	.254[a]	.264[a]	.346[a]	.201[b]
	.152	.282[a]	.185[a]	.130[b]	.272[a]	.235[b]	−.043	.203[b]
Δs_{t-5}	−.192	.049	−.010	.140[b]	.193	.206[b]	.284[a]	.252[a]
	−.049	.119[b]	.038	.149[b]	.120	.084	.167	.200[b]
Δs_{t-6}	.239[b]	.141[a]	.165[b]	.100	.078	.022	.351[a]	.242[a]
	.007	.157[a]	.064	.070	.058	.061	.271[a]	.114
p_{t-1}	.365[a]	.394[a]	.267[a]	.296[a]	−.051	.084	.192[b]	.269[a]
	.332	.209[a]	.170[b]	.130[b]	−.140	.089	−.176	.117
d_{53}	.109	.324[a]	.174[a]	.379[a]	.375[a]	−.213[b]	.824[a]	.385[a]
	.170	.228[a]	.055	.277[a]	.376[a]	.084	.553[a]	.280[a]
				MEANS AND STANDARD DEVIATIONS				
Δs_t	.013	.040	.049	.030	.052	.064	.014	.044
	.165	.207	.136	.128	.169	.103	.131	.110
Δs_{t-1}	.031	.024	.046	.044	.068	.105	.025	.055
	.167	.204	.142	.141	.193	.056	.123	.121
Δs_{t-2}	.049	.033	.057	.043	.069	.102	.018	.068
	.169	.207	.143	.145	.194	.093	.102	.115
Δs_{t-3}	.020	.036	.062	.041	.052	.085	−.007	.053
	.193	.201	.138	.141	.149	.088	.100	.113
Δs_{t-4}	−.0002	.069	.037	.035	.025	.064	−.0001	.021
	.167	.192	.124	.133	.145	.077	.099	.064
Δs_{t-5}	.075	.106	.062	.039	.034	.071	.035	.029
	.145	.162	.100	.144	.146	.030	.085	.072
Δs_{t-6}	.027	.055	.039	.021	.050	.081	.0004	.021
	.164	.167	.110	.153	.144	.050	.125	.070
p_{t-1}	.208	.330	.259	.295	.157	.101	.070	.328
	.116	.217	.163	.229	.135	.079	.054	.201
d_{53}	.045	.062	.052	.052	.051	.022	.034	.066
	.018	.024	.017	.020	.027	.004	.037	.037
i_t	.102	.116	.122	.088	.111	.119	.064	.146
	.063	.073	.074	.063	.068	.051	.084	.101

NOTE: Regression coefficients, simple correlation coefficients, and means are in upper lines of cells; standard errors, partial correlation coefficients, and standard deviations are in lower lines.

[a] Significant at 0.01 probability level.

[b] Significant at 0.05 probability level.

TABLE 5

CAPITAL EXPENDITURES AS FUNCTION OF SELECTED RELATION (1) VARIABLES, POOLED REGRESSIONS OF 1955–58 AND REGRESSIONS ON INDUSTRY-YEAR MEANS

	Regression Coefficients[a] *and Standard Errors*[b]									
	Pooled Data, All Years					Industry-Year Means				
Constant term	.036 (.004)	.036 (.004)	.037 (.004)	.038 (.004)	.040 (.004)	.018 (.018)	0.021 (0.017)	0.018 (0.015)	.026 (.016)	.039 (.018)
Δs_t				.085 (.011)	.090 (.011)	.112 (.011)	0.094 (0.067)	0.086 (0.062)	.164 (.052)	
Δs_{t-1}	.122 (.011)	.129 (.011)	.129 (.011)	.116 (.011)	.120 (.011)	.233 (.097)	0.269 (0.061)	0.277 (0.054)	.269 (.058)	.229 (.066)
Δs_{t-2}	.086 (.011)	.090 (.011)	.085 (.010)	.085 (.011)	.074 (.011)	.114 (.055)	0.133 (0.054)	0.137 (0.052)	.159 (.055)	.108 (.061)
Δs_{t-3}	.079 (.011)	.081 (.011)	.080 (.011)	.075 (.011)	.063 (.011)	.135 (.055)	0.132 (0.051)	0.130 (0.050)	.092 (.049)	.043 (.054)
Δs_{t-4}	.126 (.012)	.096 (.012)	.091 (.012)			.219 (.063)	0.142 (0.081)	0.151 (0.073)		
Δs_{t-5}	.060 (.013)	.037 (.013)				.014 (.074)	−0.023 (0.076)			
Δs_{t-6}	.052 (.013)					.045 (.085)				
p_{t-1}	.030 (.009)	.035 (.009)	.037 (.009)	.040 (.009)	.038 (.009)	−.014 (.069)	0.025 (0.067)	0.020 (0.064)	.073 (.062)	.073 (.072)
d_{53}	.797 (.068)	.793 (.067)	.815 (.066)	.845 (.068)	.909 (.070)	1.259 (.477)	1.018 (0.478)	1.054 (0.454)	.696 (.447)	.709 (.522)
$\Sigma\Delta s$ coefficients	.524	.518	.474	.387	.257	.760	0.747	0.781	.684	.380
n	1,388	1,388	1,388	1,388	1,388	31	31	31	31	31
$\hat{R}^2$	.325	.344	.341	.314	.264	.589	0.617	0.633	.583	.432

[a] Top lines.
[b] Bottom lines.

and 0.432 for the regressions restricted to three sales changes as against 0.351 and 0.605 for the full regressions presented in Table 2. I take this as further evidence that the acceleration relation may in large part be missed in quantitative studies that do not involve functions which give sufficient time for the full impact of changes in demand to be realized in resultant changes in capital stock.

TABLE 6

CAPITAL EXPENDITURES AS DETERMINED BY RELATION (2), BY SIZE OF FIRMS, 1958

	Regression Coefficients and Standard Errors			*Simple and Partial Correlation Coefficients*			*Means and Standard Deviations*		
	Smaller Firms	Larger Firms	All Firms	Smaller Firms	Larger Firms	All Firms	Smaller Firms	Larger Firms	All Firms
Constant term	.004	0.004	.006						
	(.012)	(0.016)	(.009)						
Δs^{58}_{59-62}	.038	0.324	.125	0.080	0.363[a]	0.154[a]	.065	.065	.065
	(.087)	(0.131)	(.072)	0.032	0.263[b]	0.103	.048	.038	.045
Δs^{58}_{59}	.073	0.005	.059	0.078	−0.027	0.044	.112	.081	.102
	(.043)	(0.067)	(.036)	0.123	0.008	0.099	.096	.088	.095
Δs_{58}	.145	−0.017	.119	0.269[a]	0.212[b]	0.253[a]	−.040	−.034	−.038
	(.027)	(0.049)	(.023)	0.370[a]	−0.039	0.293[a]	.157	.122	.146
Δs_{57}	.102	0.054	.093	0.209[a]	0.279[a]	0.227[a]	.020	.037	.025
	(.032)	(0.060)	(.028)	0.229[a]	0.098	0.199[a]	.119	.095	.112
Δs_{56}	.024	0.090	.032	0.094	0.212[b]	0.114	.074	.054	.067
	(.032)	(0.070)	(.029)	0.054	0.141	0.066	.129	.073	.114
Δs_{55}	.007	0.022	.024	0.044	−0.141	0.008	.090	.088	.089
	(.026)	(0.074)	(.024)	0.019	0.033	0.060	.171	.090	.150
Δs^{*}_{54}	−.018	0.163	.015	0.047	0.313[a]	0.105	−.041	−.021	−.035
	(.028)	(0.058)	(.025)	−0.048	0.297[a]	0.036	.166	.103	.148
Δs_{53}	.024	0.077	.031	0.119	0.298[a]	0.153[a]	.059	.063	.061
	(.029)	(0.068)	(.027)	0.061	0.123	0.071	.143	.083	.127
Δs_{52}	.033	0.006	.034	0.095	0.343[a]	0.154[a]	.037	.030	.035
	(.030)	(0.081)	(.027)	0.082	0.008	0.076	.135	.095	.123
p_{57}	.288	−0.035	.220	0.309[a]	0.216[b]	0.284[a]	.087	.085	.086
	(.077)	(0.140)	(.067)	0.267[a]	−0.027	0.193[a]	.054	.039	.049
d_{57}	.603	1.008	.619	0.293[a]	0.524[a]	0.352[a]	.055	.042	.051
	(.181)	(0.242)	(.140)	0.240[a]	0.417[a]	0.257[a]	.022	.023	.023
i_{58}				1.000	1.000	1.000	.074	.076	.075
				0.559[c]	0.671[c]	0.548[c]	.061	.057	.060
$\Sigma\Delta s$ coefficients	.427	0.723	.532						
n	194	94	288						
$\hat{R}^2$	.271	0.376	.273						

NOTE: Regression coefficients, simple correlation coefficients, and means are in upper lines of cells; standard errors, partial correlation coefficients, and standard deviations are in lower lines.

[a] Significant at 0.01 probability level.

[b] Significant at 0.05 probability level.

[c] Multiple correlation coefficient (unadjusted).

We may now turn to brief consideration of estimates of the other relations presented earlier in this paper. Estimates of parameters of (2), involving 1958 capital expenditures and two expected sales change variables as well as the other variables already considered, may be seen in Table 6. In this case I have divided firms into "smaller" and "larger" sets, the line of division being 1953 gross fixed assets of $100 million. First, it may be observed that the coefficients of expected sales changes were generally positive but tended to pick up, apparently, some of the role of past sales changes seen in (1). This is, of course, consistent with the model, which suggests that capital expenditures should depend upon the relation between current capacity and expected demand, with past changes in sales relevant because of their effects on expected demand. The sum of the sales change coefficients in (2), including the coefficient of the expected sales change term, is not more (and is even somewhat less) than the sum of sales change coefficients (for a slightly larger sample) observed in the regression coefficients of 1958 capital expenditures for (1) shown in Table 1. It may also be noted that the coefficient of expected long-run sales change, from 1959 to 1962, was markedly higher (0.324 as against 0.038) for larger firms, whose anticipations of the future might be expected to be more precisely formulated, than for smaller firms. However, it is probably unwise to make too much of this difference in view of the relatively small number of firms and high standard errors attached to the coefficients. It may also be observed, with a similar caution even though the finding fits our theory, that there is a significantly positive coefficient of 0.288 for the profits variable for smaller firms and a significantly positive coefficient of 0.220 for the cross section of all firms; but in the case of larger firms the profits coefficient is −0.035. This is consistent with my earlier suggestion that whatever role might be found for past profits in the determination of capital expenditures would be more likely among smaller firms, where imperfections of the capital market might be relatively more operative. It should, of course, be realized that the coefficient of the profits variable in the all-firms estimate of (2) is higher than the corresponding estimate of the profits coefficient for 1958 capital expenditures in (1) partly because of the different definition of the profits variable: profits *after* taxes divided by *net worth* in (2), as against profits *before* taxes divided by *gross fixed assets* in (1).

However, differences in the two sets of estimates remain somewhat puzzling. They may reflect the tendency of firms to have a view of normal demand from which deviations in current experience are treated as in large part transitory. Hence, those firms which experienced low profits in 1957 or low sales in 1958 relative to other firms tended to expect greater gains relative to other firms in later years in order to get back to the normal line which they had accepted. The inclusion of expected sales change variables in the regression would, hence, pick up this effect that otherwise would contribute to negative relations between capital expenditures and current and recent experience in both sales and profits, which of course are not unrelated to each other. This hypothesis, for what it is worth, gets some support from the estimate of the coefficient of 1958 sales change: the figure is higher in the Table 6 estimate of (2) than in the corresponding estimate of (1) in Table 1, i.e., 0.119 compared to 0.063.[8]

It was possible to estimate parameters of (3), involving the variable for actual minus desired rate of utilization of capacity, with only 138 firms for which responses on this and the other variables in the relation were jointly available (Table 7). The coefficient of the capacity variable was 0.112, just over twice its standard error, in the estimate for all firms. However, the separate estimates for the regressions involving firms manufacturing durables and firms manufacturing nondurables, which comprised almost all of the set of firms for which data were available, differed markedly; the coefficient of the capacity variable for the nondurable firms was −0.116. On the other hand, the coefficient of 1956 sales changes was 0.245 in the case of nondurables manufacturers, a low 0.058 for all firms, and −0.046 for firms manufacturing durables. A possible explanation for the uncertain character of these results may be the negative values for the means of the capacity variable in 1956. One would not expect a clear relation between capital expenditures and the rate of utilization of capacity for those firms whose rates of utilization are substantially below desired utilization. The role of such a capacity variable might better be examined separately for firms operating at or above desired rates of utilization and those operating below such rates. This analysis has, however, not been undertaken and would prob-

[8] These coefficients are roughly comparable in spite of different definitions of the variables. While denominators of the sales change variables are centered around 1957 in (2) instead of around 1953 as in (1), capital expenditures in (2) are divided by 1957 fixed assets instead of by 1953 fixed assets, as in (1).

TABLE 7

CAPITAL EXPENDITURES AS DETERMINED BY RELATION (3), FOR DURABLE- AND NONDURABLE-GOODS MANUFACTURERS, 1957

	Regression Coefficients and Standard Errors			*Means and Standard Deviations*		
	Durables	Non-durables	All Firms[a]	Durables	Non-durables	All Firms[a]
Constant term	.083 (.032)	0.005 (0.028)	0.050 (0.020)			
Δc_{56}	.130 (.075)	−0.116 (0.089)	0.112 (0.054)	−.036 .138	−.054 .098	−.039 .124
Δs_{57}^{56}	.085 (.110)	−0.047 (0.088)	0.027 (0.072)	.067 .101	.070 .099	.068 .098
Δs_{57}^{**}	.021 (.080)	0.092 (0.086)	0.039 (0.057)	.016 .144	.001 .109	.009 .129
Δs	−.046 (.068)	0.245 (0.066)	0.058 (0.047)	.074 .153	.019 .128	.051 .143
Δs_{55}	.072 (.053)	0.130 (0.070)	0.111 (0.039)	.126 .185	.093 .128	.108 .163
p_{56}	.039 (.044)	0.003 (0.051)	0.016 (0.032)	.349 .232	.257 .169	.304 .213
d_{53}	.452 (.503)	1.705 (0.545)	1.029 (0.332)	.055 .020	.051 .016	.054 .020
i_{57}				.129 .082	.112 .071	.123 .078
$\Sigma\Delta c$ and Δs coefficients	.263	0.304	.347			
n	79	54	138			
$\hat{R}^2$	.043	0.365	0.132			

NOTE: Regression coefficients and means are in upper lines of cells; standard errors and standard deviations, in lower.

[a] Including five nonmanufacturing firms.

ably, in any event, not be successful with the current small number of observations.

Finally, the role of capital expenditure anticipations is examined by considering estimates of parameters of (4), (5), and (6). The underlying hypothesis, it may be recalled, is that except for data or information which become available after the time anticipations are

TABLE 8

CAPITAL EXPENDITURE ANTICIPATIONS AND CAPITAL EXPENDITURES AS DETERMINED BY RELATIONS (4)–(6): POOLED REGRESSIONS 1955–58 AND REGRESSIONS ON INDUSTRY-YEAR MEANS

	REGRESSION COEFFICIENTS AND STANDARD ERRORS						CORRELATION COEFFICIENTS: SIMPLE (RELATION 4) AND PARTIAL (RELATION 6)	
	Pooled Data, All Years			*Industry-Year Means*				
	Anticipations (Relation 4)	Expenditures (Relation 5)	Expenditures (Relation 6)	Anticipations (Relation 4)	Expenditures (Relation 5)	Expenditures (Relation 6)	*Pooled Data, All Years*	*Industry-Year Means*
Constant term	.036	.036	.010	.031	0.018	−0.010		
	(.004)	(.004)	(.002)	(.016)	(0.018)	(0.008)		
Δs_t			.048			0.081	0.167[a]	0.057
			(.007)			(0.030)	0.180[a]	0.521[b]
Δs_{t-1}	.143	.122	.015	.243	0.233	−0.013	0.294[a]	0.539[a]
	(.012)	(.011)	(.007)	(.085)	(0.097)	(0.048)	0.055[b]	−0.059
Δs_{t-2}	.097	.086	.019	.142	0.114	−0.012	0.174[a]	0.066
	(.011)	(.011)	(.007)	(.048)	(0.055)	(0.028)	0.076[a]	−0.093
Δs_{t-3}	.081	.079	.024	.141	0.135	−0.003	0.137[a]	0.103
	(.012)	(.011)	(.007)	(.047)	(0.055)	(0.027)	0.092[a]	−0.021
Δs_{t-4}	.134	.126	.015	.191	0.219	−0.037	0.196[a]	0.233
	(.013)	(.012)	(.008)	(.055)	(0.063)	(0.040)	0.049	−0.203
Δs_{t-5}	.063	.060	.004	.035	0.014	−0.053	0.095[a]	−0.211
	(.014)	(.013)	(.008)	(.064)	(0.074)	(0.034)	0.014	−0.335
Δs_{t-6}	.062	.052	.007	.093	0.045	−0.048	0.183[a]	0.554[a]
	(.014)	(.013)	(.008)	(.074)	(0.085)	(0.037)	0.024	−0.276
p_{t-1}	.017	.030	.019	−.007	−0.014	0.018	0.264[a]	0.464[a]
	(.010)	(.009)	(.006)	(.060)	(0.069)	(0.030)	0.092[a]	0.133
d_{53}	.902	.797	.130	.956	1.259	0.129	0.388[a]	0.323
	(.072)	(.068)	(.044)	(.415)	(0.477)	(0.232)	0.079[a]	0.123
i_t^{t-1}	[d]		.723	[d]		1.000	1.000[a]	1.000[a]
			(.016)			(0.103)	0.776[a]	0.908[a]
i_t		[d]	[d]		[d]	[d]	0.851[a]	0.944[a]
							0.862[c]	0.975[c]
$\Sigma\Delta s$ coefficients	.579	.524	.133	.846	0.760	−0.085		
n	1,388	1,388	1,388	31	31	31		
$\hat{R}^2$	.336	.325	.742	.668	0.589	0.927		

NOTE: Regression coefficients and simple correlation coefficients are in upper lines of cells; standard errors and partial correlation coefficients, in lower.

[a] Significant at 0.01 probability level.

[b] Significant at 0.05 probability level.

[c] Multiple correlation coefficient (unadjusted).

[d] Dependent variable.

formed or plans are made, capital expenditures and capital expenditure anticipations are functions of the same variables. This seems amply confirmed in the findings presented in Table 8. Where capital expenditures and capital expenditure anticipations are both related to sales change variables current with or preceding the points of time at which anticipations were indicated, the estimates of parameters are found to be strikingly similar. This is true both for the pooled data of individual firms for all years and for the regressions on industry-year means.

In (6), capital expenditures are made a function of capital expenditure anticipations and sales changes current at the time of capital expenditures, but anticipations are postdated, as are the lagged sales changes, profits, and depreciation variables. Here, interestingly, the coefficients of sales change variables known at the time capital expenditure anticipations were indicated were close to zero, but were still significantly positive in a number of cases, in the regressions of pooled individual-firm data. Most, but apparently not all, of the variance of sales changes affecting capital expenditures was picked up in capital expenditure anticipations. The coefficient of the sales changes which were subsequent to capital expenditure anticipations is, however, a distinctly larger and significantly positive 0.048. Results in the case of industry-year means were similar with regard to the positive coefficient of Δs_t in the regression including capital expenditure anticipations as an independent variable. But coefficients of the lagged sales variables, while low in absolute amount, were persistently negative. These results would seem to suggest that capital expenditure anticipations, as a forecast of actual expenditures, rather underreflect the intra-industry variance in actual sales changes but somewhat overreflect the interindustry variance. Be that as it may, these sets of estimates seem essentially consistent with the concept of a realizations function that I have discussed at greater length elsewhere.[9]

Conclusion

While closer study of these and other data is in order and will be forthcoming, the preliminary report I have made here seems to confirm the operation of a distributed lag accelerator in the determination of capital expenditures. It similarly offers further evidence that the apparent role of past or current profits (as distinguished

[9] "Investment Plans and Realizations," *American Economic Review*, May 1962.

from the expected profitability of investment) is in large part if not entirely a proxy role which can be accounted for by introducing properly into the quantitative analysis variables more truly related structurally to capital expenditures. This is indicated both by the regression coefficients of sales change and profit variables for capital expenditures of four successive years and in the comparison of simple and partial correlation coefficients of capital expenditures with profits. These findings are given added support by examination of the role of sales change expectations. In this latter analysis, conducted separately for large and small firms, there is evidence that whatever role does exist for past profits is confined to smaller firms (where imperfections of capital markets may be more relevant). Some sketchy but uncertain further support of the operation of a demand-capacity relation is found in examination of the role of actual minus desired rates of utilization of capacity as indicated in 1956 McGraw-Hill survey responses. Regressions involving capital expenditure anticipations prove consistent with the underlying model of the determination of capital expenditures as well as with the role of anticipations suggested by the concept of a realizations function.

Most interesting and suggestive of fruitful work in the future is the comparison of findings from regressions of pooled individual firm data for regressions of all years and regressions of observations composed of industry-year means. In the latter case the sum of sales change coefficients was markedly higher than in the former; and the proportion of variance in the capital expenditures variable accounted for by the regression, decidedly large. It is suggested that this is strikingly consistent with application of a "permanent income hypothesis" to the theory of investment. For in any quantitative analysis one should expect the variance of capital expenditures around its mean to be related to variances of sales changes around those means which are viewed as relatively long run or "permanent" rather than those that are considered temporary or "transitory." And there is reason to believe that the variance of sales changes around industry-year means includes in larger proportion a permanent component than the variance of sales changes between firms. But definitive and rigorous evaluation of these findings, as suggested earlier, calls for a formal analysis of variance and covariance—and another paper.[10]

[10] Some of this formal analysis has now been reported upon in "Investment: Fact and Fancy," *American Economic Review*, May 1963, pp. 237–246.

COMMENT

BERT G. HICKMAN, Brookings Institution

I find myself in an enviable position for an invited discussant, since I have been asked to comment on a paper which is both important and impressive, but in which I nonetheless find considerable area for disagreement. The bulk of my discussion will be concerned with Robert Eisner's empirical work on the investment function, but first I want to comment briefly on certain aspects of his introductory statement which require qualification if misunderstanding is to be avoided over the points at issue between critics and defenders of the acceleration principle and over the implications of Eisner's empirical analysis.

To begin with, Eisner uses the terms "acceleration principle" and "pressure on capacity" interchangeably. It is clear from his own explicit formulation and from his citations to other authors that when he refers to the acceleration principle, he has in mind a model in which allowance is made for excess capacity and reaction lags when sales increases are translated into investment decisions, and in which curbs on the time-rate of disinvestment in response to sales declines are recognized. Now, for those who identify theories by their predictions, the acceleration principle as originally formulated and still widely understood means at least a strong tendency for net investment to vary with the rate of change of output and to lead fluctuations in the level of output, and for gross investment to fluctuate more widely than output. However, as Chenery emphasized, a capacity formulation of the capital stock adjustment process "has a more fundamental effect than merely making the accelerator flexible. It changes the simple dependence of investment on the rate of change in demand, it alters the phase relationship between investment and output over the cycle, and it does not require that the amplitude of fluctuations in gross investment be larger than those in output."[1] Thus, even if Eisner's results were accepted as providing

[1] Hollis B. Chenery, "Overcapacity and the Acceleration Principle," *Econometrica*, January 1952, p. 14. Chenery tests his "capacity principle" against the "acceleration principle." L. M. Koyck also takes the position that the acceleration principle posits a close short-run relationship between net investment and the *rate of change* of output (as in the models of Harrod, Samuelson, and Hicks), and contrasts that situation with one in which the adjustment of capacity to output is slow as a consequence of the distributed lag, making net investment a function of the *level* of output in the short run (as in the Kalecki and Kaldor models). Cf. L. M. Koyck, *Distributed Lags and Investment Analysis*, Amsterdam, 1954, pp. 72–73.

full verification of the operation of his version of the accelerator mechanism, it would be important to remember that this would not constitute verification of the predictions about investment-output relationships historically associated with the acceleration principle and embedded in much of cycle and growth theory.

On another point, Eisner's statement that he espouses the acceleration principle because it fits in with the main body of theory based on the maximization principle must have an ironical ring to those who were critical of the principle in the past precisely because of its disparagement of economic determinants in the investment decision. Eisner does not himself argue that the capital-output ratio is invariant in either the short or the long run for technological reasons, but many distinguished economists have done so. Moreover, even though he implicitly recognizes the relevance of product and factor prices, they do not enter his investment function as explanatory variables. In this sense, the acceleration principle has been abstracted from, rather than fitted into, a maximizing theory of investment.

Nor should Eisner's implication that profits from past or present operations cannot be fitted into the main body of a maximizing investment theory go unanswered. I turn now to a discussion of his empirical findings, in the course of which I will show how profits may enter the investment equation through rational structural relationships derived from maximizing premises.

First for some comments on Eisner's data and deflation procedures. It will be recalled that his basic regression includes as independent variables a set of lagged sales changes, a profits term, and a depreciation term. The dependent variable is gross capital expenditure. Each sales change is expressed as a ratio to average sales in 1952–54, and all other variables are divided by the 1953 value of gross fixed assets. Sales, capital expenditures, and profits are corrected for price changes, whereas depreciation allowances and gross assets are not.

The ratio of depreciation to gross fixed assets is intended to measure the average durability of capital. The data on depreciation and fixed assets are for 1953 and are gross of Korean War accelerated amortization. This means that the useful lives will be considerably distorted in defense-related firms but not in others, introducing a spurious source of variation in the durability measure. Similarly, the 1957 values of fixed assets are involved in his second regression, with distorting effects on apparent useful lives owing to the uneven incidence of methods of curvilinear depreciation under the 1954 tax code.

Another source of spurious variation is Eisner's decision to forego price deflation of fixed assets and depreciation allowances. Whereas it is true, as he states, that the ratio of depreciation to fixed assets would be little affected by price deflation, the same cannot be said of the ratios of capital expenditures and profits to fixed assets. Both capital expenditures and profits are deflated by an index of capital goods prices, but each is expressed as a ratio to fixed assets at original cost. If fixed assets were converted to constant dollars by a weighted average of capital goods prices over the useful life span of assets for each firm, the result would be to alter the capital stocks unevenly as among firms with differing lives and time patterns of past investment. Thus, price deflation of fixed assets would alter the distributions of both the investment-to-assets and profits-to-assets variables.

The foregoing problems concerning biases in the data are troublesome because they have unknown effects on the regression results, but my strongest reservations about the significance of the findings stem from another source. They relate to certain deficiencies in Eisner's formulation of the role of profits in the investment decision. Profits may affect investment by influencing either the cost of funds or the marginal efficiency of investment. Let us deal first with effects on the cost of funds.

Eisner concedes that profits may play an independent role if capital markets are imperfect, but suggests that capital rationing is apt to influence only a small portion of total investment because it is a problem primarily for small firms. However, Duesenberry has shown that the imputed cost of funds may rise abruptly for amounts of investment in excess of internal funds from current operations because of the increased risk associated with higher debt-earnings ratios.[2] Debt aversion is not confined to small firms: rather, it will be strongest for firms subject to high risks from cyclical or competitive factors. Similarly, the cost of equity funds will vary with the degree of risk of the business and its growth prospects. Thus, for many firms, the cost of external funds may be considerably higher than the opportunity cost of internal funds. These considerations suggest that the volume of internal funds may be a significant determi-

[2] James S. Duesenberry, *Business Cycles and Economic Growth*, New York, 1958, Chap. 5.

nant of investment expenditure within a profit-maximizing framework.

How could one test for the influence of internal funds in a multiple regression of the type used by Eisner? The relevant variable would be profits after taxes and dividends plus depreciation. It would be included for either the year preceding or the year concurrent with the investment expenditure to be explained, or for both years, since its principle a priori effect is to cause the firm to increase or decrease the current rate of adjustment of desired to actual capital stock. Depreciation allowances and retained earnings would be entered at their accounting values after deflation by an index of current prices of capital goods. Finally, their combined value would be deflated by gross fixed assets in the same units used to deflate capital expenditure.

Eisner's formulation differs in several respects from the foregoing suggestions. Thus, although profits are included with a one-year lag and are deflated by capital goods prices, they are entered before taxes and dividends. The inclusion of taxes probably makes little difference, since the correlation of before-tax and after-tax profits with investment would be virtually the same,[3] but the distribution of retained earnings may be substantially different from that of after-tax profits because of differing dividend policies. Depreciation allowances have also been included, but with a lag varying between two and six years and without deflation by capital goods prices.

I do not know how the regression results would be influenced by the changes I have suggested, and it may be dangerous to speculate on the meaning of the correlation for the present form of the profits and depreciation variables. It does seem likely, however, that the strong influence exerted by the depreciation variable in the present correlation would persist in the new one. In Eisner's view, of course, the depreciation variable is essentially a measure of replacement

[3] Neglecting small corporations and loss firms, profits after taxes should be about one-half of profits before taxes. Decreasing the profits of all firms by one-half would not alter the partial correlation coefficient between profits and investment, although it would double the size of the net regression coefficient. Incidentally, if comparisons are to be made among the regression coefficients of sales, profits, and depreciation, it would be preferable to use beta coefficients, since the variables are expressed in different units and differ in variability. Inspection of the standard deviations in Table 3 indicates that the size of the regression coefficient of depreciation would be substantially reduced if it were expressed as a beta coefficient. The coefficients of profits and the sales change variables would be increased, but would not change much relative to one other. The considerable disparity between the uncorrected coefficients of profits and depreciation, however, would be substantially reduced by the conversion to beta units.

demand. Admittedly, there is a serious identification problem involved in separating the effects of depreciation allowances as a source of investible funds from their role as an index of replacement demand, but until that is done, the interpretation of the results is largely a matter of taste.

There is yet another way by which current profits may enter the investment decision, this time through the investment demand schedule. The marginal efficiency of investment in additional capacity is that rate of discount which equates the present value of the prospective series of annual net yields from the new assets to their purchase cost. One way to estimate the average annual net yield is to multiply the expected physical volume of sales per year by the expected gross profit margin (profits after taxes plus depreciation) on each unit sold. In view of the uncertainties which confront the decision-maker with respect to the future path of product demand, factor prices, and technical progress, it would not be unnatural or irrational for him to extrapolate the current gross margin into the future, just as he might rationally extrapolate the current level or rate of change of sales.

Thus, one way to introduce price-cost influences explicitly into Eisner's regression would be to include the gross profit margin as a variable. That is, after-tax profits plus depreciation would be entered in the numerator of the variable; and deflated sales of the same year, in the denominator. In order to take into account the decision and gestation lags stressed by Eisner, the profit margin variable would be entered with the same sort of distributed lag as changes in deflated sales. Since the dependent variable is real capital expenditure, each lagged value of the margin variable would be divided by the capital goods price index for that year.

One may speculate tentatively about the possible statistical problems of a regression containing a series of lagged sales changes plus a series of lagged gross margins. Total profits are so highly autocorrelated that Eisner included only one profits variable in the regressions. Autocorrelation of gross margins on current sales should be much smaller. Unfortunately, however, the collinearity between the sales change and profit margin variables would probably be high. This is because there is a strong positive correlation between gross profits margins and levels of capacity utilization. Also, the correlation between sales changes and levels of capacity utilization will be high in periods such as that covered by Eisner, during which there are no deep contractions and full capacity utilization is closely approached at cyclical peaks.

The high simple correlation between sales changes and profit margins implies two things. First, in Eisner's regressions, the sales change variables may be "carrying" part of the influence of the omitted margin variables. Secondly, however, a regression containing both sales change and margin variables might be so strongly affected by collinearity as to provide inconclusive results about the separate influence of the two kinds of variable.

But how essential is it to separate the two variables? Eisner argues that the main task is to distinguish between the role of profits and demand factors. In my opinion, the problem should be defined instead as that of distinguishing between factors affecting the cost-of-funds schedule and those affecting the investment demand schedule, since there are a priori grounds for expecting profits to affect both sides of the investment decision. A step in this direction, given data such as Eisner's, might be made by formulating a regression with the following properties.

A demand variable would be defined which was the product of (1) the change in deflated sales between one year and the next and (2) the gross profit margin in the second year, after correction for changes in capital goods prices.[4] It would be included with a distributed lag. It may be observed in passing that this formulation would be akin to, though less complete than, those capital stock adjustment theories in which the desired level of capital stock is made a function not only of the level of output but also of product and factor prices and interest rates. The cost-of-funds variable would be the one previously suggested: retained earnings plus depreciation allowances at original cost, both deflated by capital goods prices of the same year and expressed as a ratio to gross fixed assets. Once again, however, even if this regression were as successful as the wildest optimist could expect, the "internal funds" variable could be identified as a supply variable only if some way were found

[4] This formulation depends on the assumption that the gross profit margin in the second year is a better approximation to the margin at an optimum rate of capacity utilization than would be the margin of the preceding year. This appears reasonable, given the prevailing view that marginal cost is virtually constant until the firm is operating at nearly its maximum short-run output, since the sum of variable costs per unit and overhead costs (excluding depreciation) per unit should then fall throughout most of the observed utilization range. Similarly, profit markups over variable cost are apt to be shaved when substantial excess capacity exists and increased when output is near full capacity.

to control for the relationship between depreciation allowances and replacement demand. Perhaps some discrimination between the two aspects of depreciation could be achieved by retaining Eisner's variable, in which depreciation at original cost is divided by gross fixed assets at original cost, along with the new variable—but this attempt, too, is likely to founder on intercorrelation between the two depreciation variables.

In conclusion, I do not believe that Eisner has proved that realized profits and internal funds are insignificant factors in investment decisions. This does not mean, however, that I am advocating the "profits principle" to the exclusion of the "sales principle" or urging that profits are necessarily more important than the capacity-output relationship in determining the volume of investment. What all of us want to know is the relative importance and elasticities of the various investment determinants; and this can only be established within the framework of a complete model in which all relationships are identified and collinearity is reduced to manageable proportions. We are all in debt to Eisner and other economists who are tackling this formidable task head-on.

REPLY by Robert Eisner

Bert Hickman's attempt to credit me with a novel, flexible formulation of the acceleration principle is all too flattering. J. M. Clark, many years ago, argued against confusing the complex relation between investment and changes in demand with the "mechanical law" which he has employed as an heuristic tool.[1] But since Hickman questions my view of the acceleration principle as an "abstraction from" the broad canvas of economic theory, it may be useful to rise to the issue.

In accordance with hypotheses of profit maximization, one should expect a business firm to incur capital expenditures, when such expenditures would increase the mathematical expectation of profits (or reduce the mathematical expectation of loss).[2] But it must be

[1] "Business Acceleration and the Law of Demand: A Technical Factor in Economic Cycles," *Journal of Political Economy*, March 1917, pp. 217–235, reprinted in American Economic Association, *Readings in Business Cycle Theory*, Philadelphia, 1951, pp. 235–254, with "Additional Note," written in 1936, pp. 254–260, especially pp. 256–257.

[2] I do not doubt that business behavior is influenced by more than the goal of maximization of the mathematical expectation of future profits. For one thing, one might certainly wish to take into account, for many purposes, other parameters than the mean of the probability distribution of expected profits, thus allowing, for example, for desires to reduce the risk of major loss or bankruptcy. But I doubt that Hickman really means to challenge the hypothesis of profit maximization suggested above.

clearly understood that this has nothing to do with incurring capital expenditures when profits are expected to be high, let alone incurring capital expenditures when profits have been high. Thus, in my model, a firm would wish to purchase additional plant and equipment when such purchase would add to its profits, whether it is currently making higher profits or not and whether it was expecting to make higher profits or not. Similarly, a firm earning high profits or expecting to earn high profits would not purchase additional plant and equipment unless the additional plant and equipment were expected to *add* to its future profits. This judgment, however, is subject to modification to the extent that imperfections of capital markets affect the ability of firms to finance their desired expenditures.

My theoretical model is thus based on profit maximization, but not on profits. In accordance with it, and with almost any reasonable production function, one should expect increases in demand sooner or later to generate capital expenditures, and profits to be associated with capital expenditures only to the extent that they themselves were associated with the pressure of demand on capacity. Capital expenditures would be associated with profits per se only where imperfections of capital markets were likely to be significant, and we might expect that this would normally be true with relatively smaller firms. And this is—remarkably, to anyone accustomed to the frustration of trying to fit treacherous data to a theoretical mold—what the data do reveal. I am confident of the wisdom of my theoretical formulation and happy to argue in theoretical terms on its merit. But I do regret that Hickman, commenting on an essentially empirical paper, does not note that the empirical data do indeed argue for the usefulness of the theory.

Hickman's only criticisms bearing on the empirical results relate to the possibility that depreciation will indeed measure other things than durability, and to my failure to deflate depreciation and gross fixed assets for price changes. With a better measure of durability presumably I would have gotten higher coefficients of determination. But there is no *apparent* reason—and Hickman has advanced none—why the failure of the depreciation variable to pick up all of the "noise" relating to interfirm differences in durability of capital should lead us to reject the estimated coefficients of the other variables with which we are concerned. Similarly, a better measure of the real value of gross fixed assets should have eliminated some of the "noise" or unexplained variance in the regression. But unless the imperfection of the measure of capital stock has contributed consistent bias, and again Hickman has not argued that it has, one cannot see why this imperfection should obscure any really significant role of profits.

Hickman's preference for beta coefficients to standard regression coefficients in comparing roles of profits and depreciation is surely not justified. According to his theoretical model, apparently, depreciation, like profits after taxes and dividends, should, by affecting the flow of funds, generate investment. A dollar of funds should then generate the same amount of investment, whether called by the accountant depreciation or profits. The decided difference between the coefficients of the depreciation variable and the profits variable is indeed very strong evidence that the element affecting the flow of funds, presumably common, by Hickman's argument, to both profits and depreciation, is not the factor affecting investment. Hickman is certainly cavalier in his comment, on my evidence on this point, that "interpretation of the results is largely a matter of taste."

The variables that Hickman would define and the relations that he would estimate are subject to serious reservations. First, he would take as a measure of the "flow of internal funds" profits after taxes, minus dividends plus depreciation charges. It should, of course, be pointed out that neither profits nor depreciation is a direct measure of funds. As any small businessman can testify, profits need not accrue in any liquid form. All too frequently they are tied up in accounts receivable, inventories, and plant and equipment. But further, whatever Hickman's reservations about the perfection with which depreciation charges measure durability and replacement requirements, it is surely improper to act as if they do not measure them at all and to use a variable involving depreciation charges to indicate the influence of internal funds. As suggested above, if depreciation charges and profits after taxes really do measure the role of internal funds, the coefficients of these two variables should not differ substantially when introduced independently in a multiple regression. Yet my own findings demonstrate that the regression coefficient of profits was small or not significantly different from zero when the depreciation coefficient was substantially positive and highly significant. Nor could I accept profits after taxes, less dividends, as a measure of the influence of internal funds on capital expenditures. If any positive relation were found between capital expenditures and profits after taxes minus dividends, one would be hard-pressed to identify the relation. It would appear at least as reasonable to argue that firms anticipating or incurring high capital expenditures would keep dividend payments low in order to retain funds, as it would be to infer that those firms with a record of low dividend payments decide to use their excess funds to incur capital expenditures, rather than increase dividend payments or use the funds in some other fashion.

One can hardly judge the variable

$$\frac{\text{profits after taxes, plus depreciation}}{\text{sales}}$$

as a measure of price-cost influences. A spurious (replacement factor) element in depreciation charges has already been made clear. But what is more, firms with high ratios of profits to sales would tend, to some extent, to be firms operating at high rates of capacity. It would therefore be quite unjustified to infer that any positive association between capital expenditures and the ratio of profits to sales relates to "price-cost influences" rather than to the pressure of demand upon capacity.

The demand variable defined by Hickman as a product of the change in deflated sales and the subsequent gross profit margin is a queer one, and I would be hard-pressed to interpret his estimated coefficients. (I fail to understand Hickman's argument that the gross profit margin "in the second year is a better approximation to the margin at an optimum rate of capacity utilization than would be the margin of the preceding year.")

That these issues are important and loaded with economic and policy significance is made clear currently (April 1962), when leaders of the United States steel industry argue that they should have higher prices for steel in order to enjoy higher profits, which are in turn necessary to bring about capital expenditures. These would then enable the American steel industry to produce more cheaply and "competitively."

If internal funds and profits really were critical, the steel industry leaders might be correct. If, however, it is the expected profitability of investment that determines its amount, and if this depends largely upon the relation between expected product demanded and the current capacity to produce, then the United States steel industry leaders are unfortunate victims of their own mythology. An increase in prices, far from bringing about higher capital expenditures, might be expected to have the effect of reducing the quantity of steel demanded, and hence lowering the amount of capital stock required. It would be particularly important that *economists*, not trapped in the business mythology regarding the role of profits, make no similar mistake in *their* analysis of the determinants of business capital expenditures.