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PART IV

Capital Expenditures Forecasts by Individual Firms

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The initiation and development over the last decade of statistical series on capital expenditures anticipations of business came about largely because government and business urgently needed accurate short-run investment predictions. In spite of efforts by Clark, Klein, and others, existing series could not be adapted to this purpose.[1] Since there was little evidence that economists could make predictions on a behavioral basis, reasoning from economic magnitudes affecting investment to estimates of investment, recourse was had to businessmen themselves. In its purest form, the investment anticipations survey approach assumes that the businessman takes account of all relevant factors in making his prediction, and that the only task of the economist is to make correct use of sampling theory in deriving aggregate expenditure predictions from individual questionnaire answers. This is the general approach used by the Commerce Department–Securities and Exchange Commission survey, the McGraw–Hill survey, and the Canadian survey of capital expenditures.

Thus far the surveys have produced aggregate forecasts for a year in advance which have been, on the whole, very accurate. There have been many large errors, however, in the constituent company forecasts. These errors may be random in nature, or they may be caused systematically by outside economic factors, in which case they constitute a potential source of bias. The effects of a factor such as deviation of sales from expectations may have balanced out over the last decade, but this cancellation cannot necessarily be projected into the future.

NOTE: The author is indebted to William Fellner, James Tobin, Thomas Schelling, and Harold Watts of Yale University, who saw him through many earlier versions of this paper, and to Bernard Marks and Ralph Bristol of The RAND Corporation, who contributed many suggestions which aided in the preparation of the present version. Thanks are also due to Dexter Keezer of McGraw–Hill who made available the data on which the paper is based.

[1] Colin Clark, "A System of Equations Explaining the United States Trade Cycle, 1921-1941," *Econometrica*, April 1949, p. 93. Lawrence R. Klein, *Economic Fluctuations in the United States, 1921-1941*, Wiley, 1950.

The purpose of my paper is to investigate various possible systematic causes of errors in companies' investment predictions, and to suggest some methods whereby the analyst can correct for them, in order to avoid possible gross error in the aggregates. The adjustment of the individual firm's predictions might be carried out within a partially endogenous gross national product model so that at least some of the corrective factors used are estimates, based on the other equations of the model. The objective in this case would be to explain the deviations of actual from predicted investment, regardless of whether the factors causing these deviations occurred before or after the prediction. While this effort would certainly be an important step in the advancement of the science, it seems more urgent and useful at present to develop an adjustment procedure which can serve as a forecasting aid. Consequently the methods evolved here will use only the information available when the forecast is made.

Review of Survey Results

As indicated in Table 1, annual aggregate plant and equipment expenditures predicted by the Commerce–SEC and the McGraw–Hill surveys in the United States, and by the Department of Trade and Commerce survey in Canada, have come close to actual expenditures for 1947-54. The two United States surveys erred badly in 1947, and again in 1950 when business' plans were changed radically by the onset of the Korean war, but they have missed no cyclical turning points and have shown no systematic bias in either direction. Friend and Bronfenbrenner pointed out that the Commerce–SEC surveys have been giving better results than either a projection of actual capital expenditures for the previous year or a seasonally adjusted projection of actual expenditures for the first quarter of the year in question.[2] The Canadian survey tends to underpredict, and it missed the downturn in 1954, but the Canadian effort is more ambitious than ours. Questionnaire answers are gathered in December rather than in March, and cover not only nonfarm business but all public and private investment.

If the accuracy which has characterized the aggregate forecasts were based on accurate company forecasts, the surveys would probably continue to yield reliable results. Table 2 indicates that this is not the case. In the Commerce–SEC and the Canadian surveys close to half of the responding firms missed their predictions by 40 per cent or more. In the McGraw–Hill survey, where the better-predicting large companies are more strongly represented, not quite half of the respondents missed by 30 per cent or more. This individual company inaccuracy is the root of

[2] Irwin Friend and Jean Bronfenbrenner, "Plant and Equipment Programs and Their Realization," *Short-Term Economic Forecasting*, Studies in Income and Wealth, Vol. 17, Princeton University Press for National Bureau of Economic Research, 1955, p. 60.

TABLE 1

Comparison of Actual and Forecast Investment, 1947-1954
(U.S. and Canadian dollar figures in billions)

	ACTUAL U.S. INVEST-MENT	COMMERCE–SEC		MCGRAW–HILL		ACTUAL CANADIAN INVEST-MENT	CANADA	
		Fore-cast	*Error*[a]	*Fore-cast*	*Error*[a]		*Fore-cast*	*Error*[a]
YEAR	*(1)*	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1947	$20.6	$17.6	+16%			$2.5	$2.6	−3%
1948	22.1	21.4	+3			3.2	3.1	+4
1949	19.3	19.5	−1	$20.1	−4%	3.5	3.4	+2
1950	20.6	17.5	+15	18.5	+10	3.8	3.6	+5
1951	25.6	26.2	−2	24.4	+4	4.6	4.3	+7
1952	26.5	26.2	+1	26.2	+1	5.3	5.2	+2
1953	28.4	27.0	+5	29.0	−2	5.8	5.6	+4
1954	26.7	27.2	−2	27.2	−2	5.5	5.9	−8

[a] Departure of actual investment from forecast.

Source: Col. 1—*Economic Reports of the President*, 1947-1954. Col. 2—Computed from cols. 1 and 3, since published forecasts are not comparable in dollar terms to published fulfillments, due to annual change of base. Col. 3—1947-52 from Irwin Friend and Jean Bronfenbrenner, "Plant and Equipment Programs and Their Realization," in *Short-Term Economic Forecasting*, Studies in Income and Wealth, Vol. 17, Princeton University Press for National Bureau of Economic Research, 1955, p. 59. 1953-54 from mimeographed report of Louis J. Paradiso, Dept. of Commerce, to George Terborgh, Chairman of Federal Reserve Committee on Plant and Equipment Expenditures, 1955, Table 1. Col. 4—computed from cols. 1 and 5. Col. 5—1949-53 from "Planned versus Actual," unpublished McGraw–Hill Dept. of Economics paper. 1954 from change of actual investment in col. 1 and predicted change of investment in *Business' Plans for New Plant and Equipment, 1954-57*, McGraw–Hill, 1954. Col. 6—from *Public and Private Investment in Canada, Outlook*, Dept. of Trade and Commerce, Ottawa, annual series, 1946-54. Col. 7—computed from cols. 6 and 8. Col. 8—1947-51 from O. J. Firestone, "Investment Forecasting in Canada," in *Short-Term Economic Forecasting*, p. 231. 1952-54 computed from col. 6 and from forecast data in *Public and Private Investment in Canada, Outlook*.

the problem. If null hypotheses denying the relationship of individual company predictive errors to other economic factors cannot be rejected, the predictive errors probably represent random drawings from a population with a mean at zero error. If the individuals filling out the questionnaire are careless or too low in the hierarchies of their firms to have full knowledge, this might occur. With the large number of random drawings represented by a sample in the thousands, there would be little chance of aggregate error. If, however, some null hypotheses are rejected, then corrections should be made for the systematic effects of the economic magnitudes represented by these hypotheses.

Data Employed

The method illustrated in the section below entitled "Statistical Findings" is just that—an illustration of a method. The data used had too

TABLE 2

Frequency Distribution of Percentage Deviations of Actual from Forecast Investment, by Percentage of Firms, Selected Years

PERCENTAGE ERROR[a]	MCGRAW–HILL *1949*	MCGRAW–HILL *1954*	COMMERCE–SEC *1949*	CANADA *1949*	CANADA *1950*
More than −100			0	0	0
−100 to −80	9.5	3.3	3.0	9.6	9.8
−79.9 to −60			3.5	6.5	5.4
−59.9 to −50			7.5	7.2	7.4
−49.9 to −40	7.5	6.2			
−39.9 to −30	6.1	6.6	12.5	6.9	6.4
−29.9 to −20	8.2	7.3			
−19.9 to −10	8.8	16.0	14.7	5.9	3.6
−9.9 to 0	6.8	12.4			
0 to 9.9	15.6	16.4	12.8[b]	20.8[b]	21.0[b]
10 to 19.9	7.5	6.2			
20 to 29.9	6.8	5.9	11.6	5.6	4.8
30 to 39.9	2.7	2.6			
40 to 49.9	4.1	4.8	6.8	4.2	4.3
50 to 59.9					
60 to 79.9			3.7	3.3	2.6
80 to 99.9	16.3	12.4	2.9	2.2	1.7
100 to 199.9			9.0	7.7	8.2
200 and over			12.0	20.1	24.8
Total	100.0	100.0	100.0	100.0	100.0

[a] Departure of actual investment from forecast.

[b] It is not known whether the Commerce–SEC firms with no change are in the −19.9 to 0 or the 0 to 19.9 category. For the Canadian data these companies are in the latter category. For the McGraw–Hill data they are in 0 to 9.9.

Source: Commerce–SEC data from Irwin Friend and Jean Bronfenbrenner, "Plant and Equipment Programs and Their Realization," *Short-Term Economic Forecasting*, Studies in Income and Wealth, Vol. 17, Princeton University Press for National Bureau of Economic Research, 1955, p. 65. Canadian data from O. J. Firestone, "Investment Forecasting in Canada," *Short-Term Economic Forecasting*, p. 208. McGraw–Hill data computed by the author from raw data. The latter refer to manufacturing and non-manufacturing firms; other data cover manufacturing only.

many deficiencies for it to be claimed that any definitive answers are given to either the question of what specific factors should be corrected for in improving the accuracy of the surveys or the question of what is the mathematical effect of these factors. What is suggested is that those, particularly the surveying organizations themselves, who have access to more and better data, might do well to try this method or a similar one to determine these specific factors and to improve the accuracy of their results.

The data used to test the effect of certain factors on individual firm forecasts were answers to certain of the questions asked by the early winter surveys by 409 companies which were selected from the McGraw–Hill sample. The questions and the years when they were asked are:

1. Size of company by employment (1949-54). (To avoid individual company identification, they were grouped into five size classes in the data given the author.)
2. Actual capital expenditures in the previous year and planned capital expenditures in the current year (1949-54)
3. Actual sales in the previous year (1952-54) and expected sales in the current year (1954)
4. Expected percentage sales change for the company over the next three years (1952-54)
5. Expected percentage sales change for the industry over the next three years (1952-53)
6. Actual percentage capacity change in the previous year (1950-54) and expected percentage capacity change in the current year (1951-54)
7. Actual breakdown of investment into expansion and replacement in the previous year and expected breakdown of investment into expansion and replacement in the current year (1950-54).

From the McGraw–Hill sample 409 companies were selected, but not all of the companies answered all the questions in any one year.

McGraw–Hill could not identify the responding companies by name or industry without violating its pledge of secrecy to the respondents. Had identification been possible, the questionnaire data could have been supplemented with published balance sheets, stock market reports, and other information which would have given a better picture of the economic pressures affecting the firms. The deficiencies due to the lack of identification were threefold:

1. The lack of data on company assets posed a major problem since, in discussing investment by individual firms, it is necessary to express the dollar figures in terms of firm size. I was forced to divide each firm's annual investment by its mean investment for the six years covered. This gives variations from the six-year norm for individual firms, but company investment was probably high relative to fixed assets throughout this period. The deficiency does not affect the equations below which describe factors bearing on the fulfillment ratio of actual to predicted investment, since the ratio comes predeflated. It does affect the attempt to predict actual investment by use of predicted investment and other factors.
2. The questionnaires give no information about liquidity or profits, variables which could be expected to have an important effect on company behavior.
3. No differentiation could be made among respondents by industry.

The data are also deficient in the time period covered. The relatively prosperous years from 1949 to 1954 do not provide an adequate sample of the economic conditions under which companies may have to forecast.

Furthermore, while information on investment forecasts and fulfillments was gathered every year, information on factors which serve as explanatory variables in the analysis was gathered over even shorter time spans. For example, data on actual sales in the previous year were requested only from 1952 to 1954, and expected sales in the current year, only for 1954. Since sales change rather than level of sales is the relevant variable, there are only two usable years of actual sales change and only one of expected change. The data deficiencies obviously make it impossible to apply the equations and parameters developed below directly to the task of improving investment forecasts.

Method of Approach

DEFINITIONS

Strictly speaking, the "accuracy" of a firm's investment predictions defines the closeness of the predictions to actual investment. Accuracy is measured by the proximity of the ratio of actual investment to predicted investment, which I call the "fulfillment ratio," to unity. A 0.95 ratio represents the same degree of inaccuracy as a 1.05 ratio.

Since we are concerned with systematic causes which may bias predictions, we are interested in the direction as well as the size of error. To take account of this, we can define a company's "fulfillment" or "realization" of its anticipated investment as the degree to which it carries through the investment. Fulfillment is measured by the value of the fulfillment ratio, and a 0.95 ratio is, under this definition, of a different character from a 1.05 ratio. The differentiation between accuracy and fulfillment of company predictions is important because the two are not necessarily affected by the same variables. For example, in 1949, predictions of capital expenditures on new equipment were considerably more accurate than predictions of expenditures on new plant in the United States.[3] However, 41.7 per cent of the firms invested less in equipment than anticipated, while 41.8 per cent invested less in plant, indicating no difference between the two categories so far as fulfillment is concerned.

Of more importance is the distinction between "plans" and "anticipations." The two words are not interchangeable, but they are sometimes used interchangeably by the surveying organizations. The Commerce–SEC survey requests "anticipated" expenditures but goes on to explain, "For 'anticipated expenditures' show estimates of cost which according to present *planning* will be incurred during the specified period" (my italics). The definition of the verb, "plan" is "to devise or project a method or a course of action." The difficulty is that a company official may expect, when he fills out his questionnaire, an investment outlay which has not yet reached the status of a projected course of action, the more so because

[3] Friend and Bronfenbrenner, Table 6, p. 75.

planning in a large company may be a fairly formal procedure. The fact of this ambiguity is borne out by the statement of the Federal Reserve Committee on Plant and Equipment Expenditure Expectations that "there is a tendency toward systematic understatement in the plans reported by business, apparently as the result of the partial omission of small or uncertain items."[4] Since the omission of uncertain items is considered an understatement, evidently what is meant by "plans" is "best-guess anticipation." The McGraw-Hill survey asks, "How much do you now plan to invest?" In the past the published aggregate forecasts tended to treat the plans as if they were anticipations, but more recently, this misinterpretation has been corrected.[5]

The issue here is one of certainty, which may be the key to individual company realization of forecast investment. At the moment the investment questionnaire is filled out, the firm will have in mind for the period concerned various investment projects, to which are attached differing degrees of certainty. The firmest are those for which contracts have already been let. Those which have passed through the formal planning and budgeting process (which differs widely among companies) may also be considered relatively firm. However even for the next year there remains a residue of projects which, while nebulous, nevertheless have a probability greater than zero of being carried out. The difficulty with the wording of the investment questionnaires is that they fail to make clear to the respondents whether they call for answers about projects which have reached a particular stage in company planning or best guesses on total investment.

ADJUSTMENT PROCEDURE

The character of the estimates received by a survey determines the approach used in adjusting the forecast. If the plans concept is used and is well-enough defined so that both questioner and respondent know what sort of plans should be reported (e.g. plans on which contracts have been let or plans provided for in the budget), then the investigator may correct the plans for systematic factors causing deviations from expected expenditures on planned projects, and add his own estimate of investment projects which will take place but have not yet reached the stage of hard plans. If anticipations are requested and it is made clear that what is desired is the best guess at total investment expenditures, no matter what projects have reached what stage in present budgeting and planning, then the

[4] *Hearings before the Subcommittee on Economic Statistics*, Joint Committee on the Economic Report, 84th Cong., 1st sess., 1955, p. 33.

[5] Compare the statement accompanying the 1954 forecasts that "Manufacturing industries expect to spend $12.3 billion" (*Business Plans for Plants and Equipment*, McGraw-Hill, 1953, p. 3) with the statement in 1956 that "This new McGraw-Hill survey . . . isn't a forecast but an objective report on what companies say they're now planning for the future" (*Business Week*, May 19, 1956, p. 23).

investigator will correct for factors he may think will affect fulfillment, but he will not add any estimates of other projects. Either concept can be used as a basis for forecasts of aggregate investment.

Since McGraw–Hill uses the plans rather than the anticipations concept, the procedure below both corrects and adds estimates of unplanned investment. I do this, however, with trepidation, since it is by no means clear that the respondents understood what sort of plans they were to report. The statistical results indicate that the division between the planned and unplanned portions of investment is by no means sharp.

MATHEMATICAL RELATIONSHIPS

In my discussion, the following symbols are used:

I = one year gross dollar investment by one firm.

γ = proportion of investment projects planned comparatively firmly.

Subscripts:

- a means that the investment in question is the actual investment for the year in question.
- p means that the investment is the business firm's prediction for the year in question, the prediction appearing on the survey questionnaire at the beginning of the same year.
- π means that the investment is that which the firm has planned.
- i means that the planning referred to by the use of π has taken place before the questionnaire is filled out. This is the portion of investment which is comparatively certain at questionnaire time.
- ii means that the planning in question has not occurred until after the questionnaire.

  i and ii are used only in conjunction with π.

Superscripts:

- t is the year in which the investment actually takes place, is predicted to take place, or is planned to take place.

Then

$$I_a^t = \gamma I_{\pi i}^t + I_{\pi ii}^t \qquad \text{(1-A)}$$

$$I_p^t = I_{\pi i}^t \qquad \text{(1-B)}$$

Equation 1-A states that the actual investment taking place during a year is the sum of some proportion, γ, of the investment projects planned comparatively firmly for that year up to the time of the survey questionnaire; plus the investment which has entered into plans after the questionnaire. Since investment "projects" may be thought of in terms of physical capital rather than money expenditures, p may be less than unity if the previously planned projects turn out to be less elaborate than had been thought. It may be greater if the reverse is true. The coefficient of investment planned after the questionnaire is assumed to be one because the lag time between planning and execution is short enough to preclude changes from plans during the period. Equation 1-B is an identity stating that under the conditions of the McGraw–Hill survey, the business firm records as its prediction the investment which has been planned at the time of the questionnaire.

Substituting (B) into (A), we get:

$$I_a^t = \gamma I_p^t + I_{\pi ii}^t \tag{2}$$

which states that actual investment during the year t will be some number, γ, times the investment predicted by the company on the questionnaire, plus investment "planned" after the questionnaire.

In the past the surveys have either not attempted to predict I_a^t or have used I_p^t as the best approximation. In the following sections, an attempt is made to discover variables which may affect γ and $I_{\pi ii}^t$. Versions of these variables, which will be available to the investigator at the time that he receives his filled-out questionnaires, are then used together with I_p^t to obtain an improved estimate of I_a^t, by a multiple regression technique.

Statistical Findings

In the statistical work below, each observation is on one company for one year. The symbols used in the equations in this section are as follows:

- I = one year gross dollar investment by one firm.
- S = one year dollar sales for one firm.
- ΔC = one year per cent capacity change for one firm.
- Co = one firm's expectation of three year per cent change in its own sales.
- Ind = one firm's expectation of three year per cent change in its industry's sales.
- ΔGNP = one year per cent change in money gross national product (computed from *Economic Reports of the President*, 1956).

Superscripts:

- *3, 4, 5, 6* mean that the magnitude in question occurred during or was predicted for 1953, 1954, 1955, 1956.
- t means that the magnitude in question occurred during or was predicted for several different years within this particular equation.
- m means that the value is the arithmetic mean of the magnitude for the individual firm for as many years out of six as the magnitude was reported.

Subscripts:

- *a* means that the magnitude in question is an actual or fulfilled one.
- *p* means that the magnitude in question is a predicted one.
- *3, 4* for predicted magnitudes means that the prediction was made at the beginning of 1953, 1954.
- *t* for predicted magnitudes means that predictions made in several years were considered within this particular equation.

Thus, I_a^t refers to actual annual investment in several years, not distinguishing among observations on different years, while $Co_{p4}^{4\text{-}6}$ refers to the company's early 1954 prediction of its own sales change from 1954 to 1956.

FACTORS AFFECTING PLANNED INVESTMENT

To avoid as much as possible the problem of having to deflate investment figures by dividing by the six-year mean of investment for the firm, the investigation of the factors which might affect γ was carried on by using regressions of hypothesized explanatory variables against the fulfillment ratio, I_a^t/I_p^t, rather than by using these same variables in regressions of I_a^t/I_a^m against I_p^t/I_a^m. If κ is significant in the relationship $I_a^t/I_p^t = \kappa x_1$, there is at least a presumption that it will be significant in a relationship $I_a^t/I_a^m = \kappa(I_p^t/I_a^m)(x_1)$. Since we are now looking for factors which might be useful in the ultimate predicting equation, this presumption suffices. The very low coefficients of multiple determination in some of the equations below also suffice since they are significant by an F test for the large samples used, and no conclusions are drawn on the basis of these equations alone. The coefficient of the final predicting equation is considerably higher.

That errors in investment predictions should be related to errors in sales anticipations seems a reasonable hypothesis. However, the hypothesis could not be confirmed on the basis of the available data. Only 1954 data were available on predicted sales. No significant connection could be discovered between the variables I_a^4/I_{p4}^4 and S_a^4/S_{p4}^4 either in simple or multiple relationships. However, a significant relationship was discovered between accuracy of sales prediction and the fulfillment ratio for change of capacity, a magnitude closely related to the investment fulfillment ratio. The equation is:

(3) $$\Delta C_a^4/\Delta C_{p4}^4 = -0.4074 + 1.6083\, S_a^4/S_{p4}^4$$

F ratio for equation with 1 and 160 degrees of freedom = 5.7295

R^2 for equation = 0.0358

The relationship, although not strong, is statistically significant. While it is of little use in formulating predictions of investment expenditures, it suggests that with large and better bodies of data, the null hypothesis that S_a^t/S_p^t has no effect on I_a^t/I_p^t might be rejected.

Other studies, as well as a previous investigation of mine, suggested that size of company had an effect on the company's fulfillment of planned investment, the smaller firms tending to underpredict and the larger coming closer to perfect prediction.[6] Therefore, another independent variable investigated was company size as measured by number of employees. Data were available in five employment size classes rather than as a continuous variate. I therefore included it in the regression by computing a separate constant term for each of the five classes. The explanation of the variance of the dependent variable, I_a^t/I_p^t, stemming from this technique was tested and found to be significant.

Annual change in sales might also affect the fulfillment ratio and the γ of equation 2 if, as hypothesized above, γ measures in some sense the manner in which a more firmly planned project is carried out. New plant and equipment may be currently planned for next year, but may be more or less elaborate depending on the movement of sales. To put this concept into the terminology of economic theory, it may be certain that a company is operating too far to the right on its short-run average and marginal cost curves, and that therefore some move to a new point on the long-run average cost curve is necessary. The particular point on the long-run curve may be determined on the basis of next year's sales or the trend indicated by next year's sales. Provisions for adaptability and flexibility may depend on the sales change or its trend.[7] Unfortunately, annual sales change data were available only for 1952-53 and 1953-54, and their use would have entailed discarding the statistics on investment fulfillment ratios for 1949-52. Therefore I assumed that change in GNP measures to some extent sales change for all firms. This assumption is not used in the final predicting equation but in the preliminary equation 4, annual change of GNP is used as a variable applied equally to the observations on all firms for a given year.

Finally, it seems reasonable to hypothesize that firms which are growing rapidly will over-fulfill their investment predictions more often than those expanding more slowly. Companies anxious to expand predict investment on the basis of expected constraints and then put more money in if the constraints are less oppressive than anticipated. The inclusion of some measure of company growth may substitute for the liquidity variables excluded from the analysis, since liquidity is an important constraint of the type mentioned. Mean capacity change over the six years was used to

[6] See, for example, Friend and Bronfenbrenner, Table 4, p. 70, and Robert A. Levine, "Plant and Equipment Expenditures Surveys, Intentions and Fulfillments," Cowles Foundation Discussion Paper 17, mimeographed, October 26, 1956, Table 1, p. 105.

[7] George Stigler, "Production and Distribution in the Short Run," *Journal of Political Economy*, June 1939, p. 305.

estimate this growth pressure. The major reason for using mean rather than annual capacity change was statistical. Change in capacity in a given year is closely related to actual investment in the same year, but the investment is the numerator of the dependent variable in the regression. Therefore the use of the annual capacity change figure would probably lead to some spurious correlation.

Thus, the three variables tested and found significant are: company size as measured by employment; annual percentage change in money GNP, applied to all companies in a given year; and mean percentage change in capacity, applied to all years for a given company. It must be emphasized that many other variables might have proved useful, had they been available in the data.

The equation as estimated is:

$$I_a^t/I_{pt}^t = \begin{matrix} 1.0249 \\ 1.1690 \\ 1.1612 \\ 1.0154 \\ 0.8622 \end{matrix} \begin{pmatrix} \text{Firms employing 0–500} \\ \text{500–1,000} \\ \text{1,000–5,000} \\ \text{5,000–10,000} \\ \text{more than 10,000} \end{pmatrix} + 2.0350\Delta GNP^t + 0.0700\Delta C^m \tag{4}$$

F ratio for equation with 6 and 911 degrees of freedom = 8.8738

R^2 for equation = 0.0552

The constant term of 0.8622 for the largest companies would put them close to perfect prediction for years in which GNP increases by about 5 per cent. The smaller companies tend to underpredict (over-fulfill), probably because they engage in less detailed advance planning. There seems no good explanation for the better prediction on the part of the smallest firms. The signs on the coefficients of the other two variables are as postulated above.

FACTORS AFFECTING ADDITIONAL INVESTMENT

The McGraw-Hill data on actual investment did not differentiate between investment projects planned before and after the date of the predicting questionnaires. Therefore the investigation of variables which might estimate the less firmly expected investment, $I_{\pi ii}^t$, was carried on under the assumption that factors affecting total investment would also affect the specific portion in question. Since no conclusions are drawn from equation 5 alone, the complete validity of the assumption is not vital. The factors available for testing were limited to various accelerator-type sales change variables. I have elsewhere discussed the method of approach, the different variables tested, and some general conclusions relevant to investment theory.[8] I discovered that the equation which

[8] Levine, p. 121.

explains the greatest portion of the variance of one-year investment (divided by mean investment for the firm for reasons discussed above) is:

$$(5) \qquad I_a^4/I_a^m = 1.0384 + 1.2159 Co_{p\,4}^{4\text{-}6} - 1.5621 Ind_{p\,3}^{3\text{-}5}.$$

F ratio for equation with 2 and 97 degrees of freedom = 12.0655

R^2 for equation = 0.1992

Only 1954 data were available for the *Co* and *Ind* variables with the proper lags.

It is important to note that the company's expectations of its own three-year sales change was significant in a simple regression against investment as well as in the multiple relationship, while company expectations of industry sales change was valid only in the multiple computation. It would therefore appear that there is an accelerator relationship between investment and a firm's longer-run sales expectations, but the accelerator is qualified by the expected change of the company's position within its industry. As between two companies which expect the same change in industry sales, the one which expects the greater increase in its own sales will invest more heavily. This conforms to an accelerator hypothesis. However, as between two companies expecting the same change in their own sales, the one expecting to increase relative to its industry will invest more than the one expecting to increase only with its industry.

Here the certainty hypothesis again enters. If a firm is to invest on the basis of sales or other expectations, the investment plans will be firmer, the more certain are the expectations. In the case in point, the firm expecting its sales to increase relative to its industry probably has a better reason for the expectation—a new product or a new sales campaign, for example, than the firm expecting its sales to move up with its industry's. The accelerator component is still present, as evidenced by the positive coefficient of $Co_{p\,4}^{4\text{-}6}$, but the funds invested depend not only on the best guess at expected sales change, but also on the confidence the company has in this guess.

THE PREDICTING EQUATION

In the predicting equation certain changes were made in some of the variables which were found to affect the relationships between actual and planned investment; and in some of those which by affecting total investment indicated that they might also bear a relationship to that portion of investment not yet planned at questionnaire time. The equation was derived from 1954 investment data alone because several of the relevant variables were available only for this year. Since the number of available observations is 90, compared to the 918 in equation 4 for six years of investment, I had to group the data into three rather than five employment classes. In addition, the company growth variable of equation 4, ΔC^m, was found not to add significant explanation in this equation and was dropped out.

Finally, expected sales change for the individual firm for 1953-54 was substituted for the actual GNP change which was inserted into equation 4. Change in GNP could, of course, not be used in an equation using one year of data, since it would have the same value for each observation. I could have substituted actual 1953-54 sales change had I not decided to estimate the equation using only variables available to the analyst at the time of the survey.

It may seem strange that expected sales, a variable reported at the same time as the firm's investment forecast, could explain changes from predicted investment. A first guess might be that *deviations* from expected sales would be a more likely choice, but as shown above these deviations did not have a statistically significant effect. Expected sales is not meant here as a substitute for deviations, but rather the expected sales change variable may sort firms out according to how badly they want to invest in the year in question. A company, in recording its investment predictions, either assumes a certain ability to raise funds or ignores liquidity conditions and assumes that funds will be available as desired. When the question of actually obtaining the investment funds comes up, however, some firms may be unwilling to pay the price and will therefore revise their investment plans.

The sales change variable used here implies that the companies with the most rapid expected sales increases will be the most willing to pay the necessary price for the funds and therefore the most likely to fulfill their plans. This variable may therefore take account of some of the liquidity factors otherwise ignored.

In equation 6 the value of the coefficient of this variable is fairly high (0.8155) and is quite significant (standard error of 0.0863) for 1954, a year of comparatively easy liquidity. The coefficient will not have the same value for all years, since it depends on a complex interaction of actual and expected liquidity. The use of this variable with its coefficient expected to shift from year to year does not conform completely to the objective of formulating an equation which can be used directly at the time for forecast without calling upon the analyst to estimate separately the values of the relevant variables, but it is a valuable forecasting aid.[9]

The predicting equation, estimated by multiplying the variables within the brackets by I_{p4}^{4}/I_{a}^{m}, and using multiple regression on the resulting linear function is:

[9] A variable of this sort (or, preferably, a better variable expressing the effects of liquidity), may, when estimated for a range of years, perform a valuable service by giving different investment forecasts for different levels of liquidity and therefore giving useful information to those who try to affect the level of investment by use of monetary policy.

$$(6)\quad I_a^4/I_a^m = \left[\begin{matrix}+0.0561\\-0.1118\\-0.1385\end{matrix}\begin{pmatrix}\text{Firms employing 0–5,000}\\ \text{5,000–10,000}\\ \text{more than 10,000}\end{pmatrix} \begin{matrix}+0.8155 S_{p4}^4/S_a^3\\ (0.0863)\end{matrix}\right] I_{p4}^4/I_a^m$$

$$\begin{matrix}+0.2022+0.7962 Co_{p4}^{4\text{-}6}-0.5940 Ind_{p3}^{3\text{-}5}\\ (0.2434) \qquad\qquad (0.2523)\end{matrix}$$

F ratio for equation (6 and 83 degrees of freedom) = 21.5647

R^2 for equation = 0.6087

F ratio for comparison of this equation with $I_a^4/I_a^m = I_{p4}^4/I_a^m$ (7 and 83 degrees of freedom) = 4.8656

R^2 for $I_a^4/I_a^m = I_{p4}^4/I_a^m = 0.4489$

Despite the imperfections of the data employed, this equation explains 15 per cent more of the variance of actual investment by individual firms than does the equation $I_a^4/I_a^m = I_{p4}^4/I_a^m$, which uses the firms' answers to the investment surveys without any adjustment.

The computations do not, however, confirm the certainty theory I outlined. Under the hypothesis of equation 2, the part of equation 6 within the brackets would represent γ, the relationship between predicted expenditures on the comparatively certain portion of investment planned by the time of the questionnaire, and actual expenditures on the same portion. The part of the equation beginning with the constant term, 0.2022, would then estimate $I_{\pi ii}^t$, the investment expenditures which were less certain at the time of the questionnaire. A simple example shows that these two portions of investment are not separable statistically as easily as they are conceptually. A company employing 5,000-10,000 persons, predicting investment 10 per cent greater than its mean, expecting annual sales increases of 5 per cent (implying a 15.76 per cent increase over the three-year period), and expecting a three-year industry sales increase of 10 per cent, will actually invest 8.2 per cent more than its mean.

This seems reasonable. However, the value of γ would be about 0.74, while $I_{\pi ii}^t$ would be about 25 per cent of total investment, indicating that the firm would reduce expenditures on the more certain projects by about a quarter, while a quarter of final total investment would be on the less certain portion. Not only for the particular example shown here, but also for most of the range of likely values for the independent variables, this interpretation of the two parts of equation 6 would have firms sharply reducing their money expenditures on the certain investment projects planned before the questionnaire and then planning a large portion of investment later on. The two portions of the equation evidently do not represent unambiguously the two hypothesized portions of fulfilled investment.

The hypothesis about planned and unplanned investment is not denied, but the difficulty or impossibility of testing it on the basis of data now available is indicated. The various surveys do not produce data which touch all of a company's investment. Because of the lack of precise definition of the information desired, they also do not produce data on a company's most certain plans alone. It would help us to understand what it is that we are receiving in the annual investment surveys if each firm were requested to answer two investment intentions questions, one on plans which had entered the budget at time of questionnaire and the other on additional expected investment.

Perhaps the major factor ignored in the investment anticipations surveys and in past analyses of them is the question of uncertainty. Some portions of investment are more certain at any given instant than are others, and there is no reason to believe that all portions are affected by the same factors in the same manner. Similarly, some companies' expectations of sales changes are more firmly grounded than others, and there is no reason to believe, in discussing accelerator-like sales-investment effects, that both certain and uncertain sales increases will affect investment in the same way. The consumer surveys of the Survey Research Center have for some time been inquiring not only what the consumer expects to buy, but how strong is the expectation. The investment anticipations surveys should at least try to do as much.

Because of data deficiencies it cannot be claimed that equation 6 is a final predicting equation which can be used by surveying organizations for better prediction. Nevertheless the equation, with all of its imperfections, explained significantly more of the variance of actual investment by individual firms than did the individual firms' own answers to the surveying questionnaires. It clearly indicates that the factors causing the wide variation in company fulfillment ratios illustrated in Table 2 above are not random in nature. Certain of the variables isolated, particularly those representing various sales change expectations, are ones that could severely bias both the individual company forecasts and the aggregates at some crucial turning point in the business cycle. Therefore it would seem worthwhile for those who have access to better and larger bodies of data to undertake a similar study and to obtain a predicting equation which could be used directly for the improvement of forecasts.

COMMENT

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Investment anticipations, as reported on survey questionnaires, are based upon the conditions existing at the time the anticipations are formed and on expectations about future conditions. To the extent that new information becomes available to the respondents and that their plans are flexible, realizations (actual expenditures) may differ from anticipations. The mere confirmation by actual sales and profits of previously uncertain expectations may lead to an increase in expenditures. Thus, if we know the initial conditions and expectations embodied in reported plans or anticipations, we should be able to predict how the plans will be affected by developing information. We should be able to make similar adjustments on the basis of independent forecasts of how conditions and expectations are likely to change as a result, say, of new governmental policies not reflected in the business plans. Tentative confirmation of the usefulness of this approach may be found in data provided by the 1949-50 McGraw–Hill capital expenditure surveys and related financial statements.

From the 1949 surveys I took capital expenditure plans for 1950 and the expected percentage change in dollar volume of sales (for the firm), 1949-50. The 1950 survey told me how much the firm's capital expenditures in 1950 actually were. Income statements and balance sheets yielded 1949 gross fixed assets (used to relate expenditures to the size of firm), and actual sales in 1948, 1949, and 1950. I was thus able to define the following variables:

I = 1950 actual capital expenditures divided by 1949 gross fixed assets.
K = 1950 capital expenditures anticipated in 1949, divided by 1949 gross fixed assets.
A = Actual percentage change in sales, 1948-49.
B = Actual percentage change in sales, 1949-50.
C = Expected percentage change in sales, 1949-50, as indicated in the fall of 1949.

Since virtually no correlation was found between sales expectations and capital expenditure anticipations, as defined above, there remained a consideration of the effect upon capital expenditures of changes in sales which occurred after capital expenditure anticipations were indicated. The prime test here was the improvement of the correlation by adding actual sales changes after anticipations to the linear regression relating actual and anticipated expenditures. The results follow.

The simple or zero order correlation between capital expenditures and anticipations (as deflated by gross fixed assets) was $r_{IK}=0.685$; the value of r^2_{IK} was 0.469. But the first order partial correlation between actual capital expenditures and previous sales change, with capital expenditure anticipations in the regression, was $r_{IA.K}=0.370$. And the second order partial correlation between capital expenditures and current sale change, with anticipations and previous sales change in the regression, was $r_{IB.KA}=0.396$. Since r_{IC} was only slightly positive and r_{KC} was almost zero, current sales change (B) showed almost as high a partial correlation with actual capital expenditure (I) when prior expectations of that sales change (C) were included in the regression; $r_{IB.KCA}=0.360$. Thus the multiple correlation of capital expenditures with capital expenditure anticipations *and* current and previous sales changes was $R_{I.BKA}=0.783$ and the value of $R^2_{I.KBA}$ was 0.613. Since $r^2_{IK}=0.469$, the addition of these sales change variables explains some 27 per cent of the variance in capital expenditures left unaccounted for by the anticipatory data.[1]

From the standpoint of forecasting, several observations are appropriate. First, the information on 1948-49 sales changes became available after anticipated 1950 capital expenditures were reported, but before these expenditures were carried out. Therefore, the information could have been used to improve predictions of 1950 investment. Second, information on the 1949-50 change in sales began to accumulate early in 1950, at least to the extent of permitting comparisons between the first and second quarters of the two years. With the commencement of the Korean war in June 1950 the analyst might well have predicted that the total volume of sales would substantially exceed that of the previous year—the actual outcome. It should then have been possible to add estimates of sales changes to the regression (or regressions, for firms categorized by industry or other relevant characteristics), to improve further the forecasting value of the original anticipations.

Of course, ex post knowledge of correlation does not help us to forecast unless we have estimates of regression coefficients that can be used before actual expenditures are realized. However, the positive correlations and regression coefficients derived for the 1948-50 period, as relating to 1950 investment, are consistent with appropriate theoretical models and in particular a sophisticated version of the acceleration principle, involving distributed lags and the relation of output to capacity. It is therefore possible that reliable estimates of fairly stable parameters of an investment "realization" function can be obtained. I am engaged currently in an investigation of the McGraw-Hill capital expenditure surveys data of 1949 to 1957 and related collateral statistics on an individual firm basis, in the hope of discovering such parameters.

[1] I reported on this procedure more fully in "Expectations, Plans and Capital Expenditures," in *Expectations, Uncertainty and Business Behavior*, Mary Jean Bowman, ed., Social Science Research Council, 1958, pp. 165-188.