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Plant and Equipment Expenditures Surveys: Intentions and Fulfillment

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Plant and Equipment Expenditures Surveys:
Intentions and Fulfillments.

Chapter I

INTRODUCTION

1

The weakest link in generalized descriptive models of national

income determination as well as their quantified counterparts used for

forecasting is and has been the relationship determining business

investment in plant and equipment. A great deal of empirical research

such as that of the Survey Research Center and the Cowles Foundation

has improved the formulation of the consumption-savings function.

Although this research has led to many qualifications on simple con-

sumption theory, there is a fair amount of agreement as to broad out-

lines. Similarly, although there have been many sophistications to

interest and liquidity preference theory, the major controversies have

involved the shape of the function rather than its existence.

When we come to the theory of fixed investment and change of

investment, there is some agreement that profitability, under the guise

of the Keynsian marginal efficiency of investment, the marginal pro-

ductivity of capital or some such thing is basic, but harmony ceases

here. The question of what measurable economic magnitudes determine

the marginal efficiency and therefore the investment is still open.

There have been two difficulties in the formulation of a theory of

investment. There has been no agreement by theorists as to what factors

affect investment and there has been a lack of data to test any of the

theories. Probably the most fundamental difference on the first issue, the factors affecting investment, is that between the "real" and the "monetary" theorists. For example, there is the cyclical investment model of Goodwin,* determining investment by a real value accelerator-

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* Goodwin, Richard M., "Econometrics in Business Cycle Analysis," Chapter 22 in Hansen, Alvin, Business Cycles and National Income, (New York, 1951).

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saturation-feedback system. This differs essentially from the Modigliani formulation of the Keynsian system,** where monetary values loom large,

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** Modigliani, France, "Liquidity Preference and the Theory of Interest and Money," Chapter 11 in Readings in Monetary Theory, (New York, 1951).

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Investment is a function of national income and the interest rate, and the accelerator is not used. It can be argued that the accelerator does not fit into static systems such as those of Keynes and Modigliani, but if it were desirable, a static formulation similar to the static multiplier could be worked out. Probably the money-real controversy is the major one among today's theorists, but it is by no means the only basic difference. Hansen*** spends seventy pages in summarizing the

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*** Hansen, Alvin, Business Cycles and National Income, (New York, 1951), pages 277-346.

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differences among business-cycle investment theorists.

The differences among theorists could probably be narrowed, if not resolved, if it were possible to refer to observed facts. So far, however, it has not been so possible. Most of the past attempts to quantify investment theories have been by use of time series data. This has added all the difficulties of statistical analysis of time series to the original difficulties of formulating satisfactory theoretical hypotheses on which to base regression computations. The passage of time alone may eliminate the lack of data which plagues time series analysis. It is possible that some day the other difficulties, such as the serial correlation of data with lagged data on the same variable; and the tendency of all economic time series to move together, making discovery of true causality nearly impossible, will be eliminated. They have not yet been. The result has been that statistical investment functions based on similar theoretical hypotheses differ rather widely. For example, the investment equations of Klein* and Clark** for economic

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* Klein, Lawrence R., Economic Fluctuations in the United States, 1921-1941, Cowles Commission Monograph No. 11 (New York, 1950), page 109 has I = Investment in private plant and equipment, p = the index of all prices, X = private production, E = excise taxes, q = the investment goods price index and K = the stock of capital. Then:

$$I = .259 + 0.12 \ (pX - E)/q + 0.04 \Big[(pX - E)/q \Big]_{t-1} - .10 \ K_{t-1}.$$

** Clark, Colin, "A System of Equations Explaining the United States Trade Cycle," 1921-41, in Econometrica, Volume 17, page 108 has G = investment in private equipment, Y = national income, $\overline{G}$ = a 10 year cumulation of G, H = investment in private plant and $\overline{H}$ = a 40 year cumulation of H. Then:

$$G = .120 \ Y - .0061 \ \overline{G} - 2.32$$
$$H = .255 \ Y - .0142 \ \overline{H} - 3.57.$$

fluctuations in the United States, 1921-1941, are based on similar real

factor causality hypotheses, but they show little similarity of para-

meters. As a consequence of these and similar difficulties, Bassie

concludes, referring mainly to time series:

> "In short, none of the conditions needed for a satisfac-
> tory utilization of the econometric approach is sufficiently
> fulfilled to make it a satisfactory working tool. The attempt
> to use mathematical procedures rigorously introduces too many
> flexibilities into the forecasting process; and these rigidi-
> ties enhence the possibility that the model will misbehave
> and produce wholly unrealistic forecasting results, at least
> in some of the significant variables. The procedure is for
> the time being, and perhaps will remain indefinitely, an
> impractical approach to the forecasting problem."*

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* Bassie, V. Lewis, "Introduction"to National Bureau of Economic
Research," Short-Term Economic Forecasting (Princeton, 1955), page 33.

Because of the difficulties of time series work there has been a

tendency toward abandonment of the approach, not only with investment

data, but also with other national income material.

The immediate need for investment predictions to be used by

government and business in national income and other projections has

nevertheless continued. In part, the functional approach--investment

dependent upon other economic magnitudes--has been continued on an

intuitive rather than a mathematical basis. It is not a difficult

economic calculation to guess that the heavy pressure on steel capacity

in 1955-56 means investment by the steel industry. In part a National

Bureau approach, using leads and lags, has been used. The great

development of the post-war period, however, has been the attempt to

predict investment directly by the survey method; asking the sellers

and/or the buyers of capital goods. Fortune Magazine had and Dun and

Bradstreet has surveys of business expectations including questions on

investment expenditure plans. According to Modigliani and Sauerlander,*

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* Modigliani, Franco and Sauerlander, Gwen H., "Economic Expectations and Plans of Firms in Relation to Short-Term Forecasting," in National Bureau of Economic Research, op. cit., page 263.

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the Fortune survey was at least a better predictor than straight

extrapolation.

Much more widely used than any of the above-mentioned have been

the three major surveys of plans of purchasers of plant and equipment.

The Department of Commerce together with the Securities and Exchange

Commission conducts both annual and quarterly surveys of investment

intentions of non-farm business in the United States. The McGraw-Hill

company has a similar survey on an annual basis only. The Canadian

Department of Trade and Commerce surveys annual investment expectations

of business and government twice a year and publishes the resulting

forecasts on a regional as well as a national basis.

The detailed record of and differences among these three surveys

will be discussed in chapter II below. What is important here is the

fact that they have, in general, provided very good predictions of

aggregate investment. Except for the forecast for 1950 when an unfore-

seeable event, the Korean War, changed all expectations and programs

in midyear, the surveys have provided aggregate investment predictions

which were not only correct as to direction but also very close as to

magnitude of investment and investment change. There have been very

wide discrepancies in the predictions by individual firms of their own

investment,* but these have cancelled out in the process of aggregation

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* See for example, the table on page 65, Friend, Irwin and Bronfen-
brenner, Jean, "Plant and Equipment Programs and their Realization,"
National Bureau of Economic Research, op. cit.

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thus far, although their unexplained existence poses a Damoclean threat

for the future. The excellent record of these surveys has led to their

wide use by both government and business in predicting the aggregate

investment component of national income.** It may not be scientific

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** For example, Aldis, Owen, A Framework for Forecasting GNP (Chase-
Manhattan Bank; unpublished).

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to abandon hope for a functional prediction of investment and to

substitute a survey prediction which avoids going into the reasons for

investment. Furthermore, until we know the conditions under which

business invests, there is always the possibility that these unknown

conditions will change between prediction and fulfillment and the

forecast will be far off. Nevertheless, until there exists an operation-

al quantifiable investment-function, surveys are the best tool available

for the immediate problem of predicting next year's investment.

While the immediate and indispensable use of the anticipations

surveys is to substitute for functional investment equations in national

income forecasting models, they have provided wholesale quantities of
cross-sectional raw data which can be used in formulating, testing,
and quantifying functional investment models. The Commerce Department's
large sample of firms' investment anticipations and fulfillments,
together with their follow-up surveys of reasons for erring predictions
can shed much light on the causes of investment. The McGraw-Hill
survey which asks companies a battery of questions about other economic
variables as well as investment is valuable now and should be invaluable
when the number of annual surveys taken has increased (it was begun on
the present basis in 1949) and the questions asked are broadened some-
what. Unless some radically new method of working with time-series
data is uncovered, these mines of raw cross-sectional statistics are
the most likely source of an investment-function comparable to the
modern consumption-function.

2

The purpose of this dissertation is to explore both of the uses
of the capital-goods buyers' anticipation surveys: the immediate pre-
diction of investment and the formulation of a testable theory of
investment. The core around which the paper is built is a sample of
the data gathered by the McGraw-Hill annual survey from 1949- 1954 made
available through the kind cooperation of Dr. Dexter Keezer of McGraw-
Hill. With the aid of this data the two problems to be discussed
(but by no means finally solved) are: (1) What are the factors affecting
the accuracy of survey-derived investment forecasts; under what conditions

will they continue to be as successful as they have been; how can the forecasts be improved; and (2) which of the hypothesized basic causes affecting investment can be isolated and tested, and how much of an effect, if any, do they have?

The chapter plan for the paper is: following this introductory chapter, a general look at the differences among and results of the three major surveys mentioned above; a chapter describing the material obtained from McGraw-Hill, the deficiencies in this material and the statistical methodology used in approaching it; a chapter describing the results and conclusions relating to the causes of investment; a chapter describing the results and conclusions relating to the predictive value of the surveys; and a concluding chapter.

3

Although the data used had severe limitations, discussed in chapter III below, a surprising quantity of information beyond the general ideas derived from earlier studies by Friend and Bronfenbrenner,* Eisner,** and Firestone*** was elicited from an intensive analysis of

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* op. cit., first footnote on p. 6.

** Eisner, Robert, Expectations, Plans and Capital Expenditures, a Synthesis of Ex Post and Ex Ante Data, unpublished paper presented to the Conference on Expectations, Uncertainty and Consumer Behavior, October 27-29, 1955, Pittsburg. (preliminary copy)

_____, Determinants of Capital Expenditure, an Interview Study (Urbana, 1956)

*** Firestone, O. J., Investment Forecasting in Canada, in National Bureau of Economic Research, op. cit.

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the available statistics. Thus, the major conclusion of this paper is
that a similar analysis on a body of data covering a longer and more
varied time period and free of omissions due to the confidential nature
of source material would be well worth the trouble. It would be at
least a first step toward eliminating the possibility of error in
survey investment forecasts and toward a theory of investment which
could ultimately be used in place of or together with the survey
forecasts.

The other major conclusions from the work done are:

A. Conclusions relating to the theory of investment:

1. There is definite evidence for the existence of an
accelerator relationship, but it does not explain all of
investment and it is a complex relationship with various
sales changes and expectations of sales changes. This
relationship conforms to the theoretical accelerator in the
fact that it works best on the investment of firms experi-
encing or expecting sales pressure on capacity. The relation-
ship seems to be more certain the more surely-held are the
firm's beliefs about future sales changes.

2. The truest formulation of the accelerator is almost
a tautology. This is the statement that as sales exert
pressure on capacity the company will increase capacity. To
get a meaningful accelerator, one relating sales change and
dollars invested, a logical move must be made from sales
change through capacity change to investment.

3. There is some evidence for distress or "last-gasp" investment by firms whose sales are declining although those of their competitors are not. This would mean, for these firms, a tendency exactly opposite to the accelerator.

4. Investment programs are not usually on a one calendar year basis and the annual character of most statistics tends to distort the theoretical bases of investment.

B. Conclusions relating to the value and use of the surveys for the task of investment prediction:

1. The surveys have provided a good basis for prediction of aggregate investment, and so far as could be determined, a change of business conditions from those of the last six years probably would not affect their predictive value.

2. However, there are factors which affect the realization of predicted investment by the predicting firm. Taking account of these should increase the value of the surveys. Among them are size and rate of growth of firm, annual change of Gross National Product and change of prices of investment goods. Not among the factors is realization of predicted sales change.

3. It follows that, although the best available methods are used by most of the surveying organizations to make the jump from individual firm investment predictions to aggregate investment predictions, it is possible for the investigator to improve the firm's forecast of its own investment by making use of some of these factors.

4. The recommendations of the Federal Reserve Consultant

Committee on Business Plant and Equipment Expenditure Expecta-

tions,* particularly those recommendations relating to altering

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* Reports of Federal Reserve Consultant Committees on Economic
Statistics, Hearings before the Subcommittee on Economic Statistics of
the Joint Committee on the Economic Report, Eighty-Fourth Congress
(Washington, 1955), page 15.

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the timing of collection of the Commerce-SEC annual survey

data and to investigating the feasibility of covering greater-

than-one-year investment programs, are very useful.

Chapter II

THE SURVEYS

1

There are, in North America, three organizations which carry on

sampling surveys designed to forecast aggregate capital expenditures

by asking the buyers of capital goods their plans. The Department of

Commerce Office of Business Economics in cooperation with the Securities

and Exchange Commission carries on annual and quarterly surveys of

capital expenditures intentions of non-farm business in the United

States.* The Department of Economics of the McGraw-Hill Publishing

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* Results of annual surveys published in March issue of Survey of
Current Business. Quarterly results published in the same journal.

Company publishes the results of annual surveys of U.S. non-farm

investment.** The Canadian Department of Trade and Commerce surveys

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** Results published in McGraw-Hill, Business Plans for New Plants
and Equipment (New York), annual series.

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annually both public and private capital investment in Canada.***

*** Results published in Department of Trade and Commerce, Private and
Public Investment in Canada, Outlook (Ottawa), annual series.

The results of the surveys in predicting investment are shown in Table 1. The McGraw-Hill survey was started on its present basis in 1949. It should be remembered that although the figures for the two United States surveys concern non-farm private business capital investment, the Canadian figures include all fixed investment, business, government and private housing. Only the annual Commerce-SEC surveys are included in the table, and discussed below. The quarterly forecasts will be mentioned as a supplement to the annual, their major function.

Although various differences in the way the surveys are taken and compiled are discussed below, there are not yet enough data to be able to tell whether the differences in results are due to the differences in methodology. The outstanding characteristics of the three series seem to be the similarity of results among them (particularly, of course, between the two United States surveys); the small size of the errors made, except for the beginning experimental period and for 1950; and the fact that the two United States surveys foretold accurately cyclical turning points, except, again, for 1950.

That the Commerce-SEC and McGraw-Hill surveys are similar is not too surprising in view of the fact that they make their predictions on the basis of similar questions asked of samples from the same population. Although there are some differences in methodology between the two, the results should be expected to be similar.

The smallness of errors in forecasts of aggregate investment appears from a cursory examination of Table 1. Except for 1947, the first year, and for 1950, when investment plans changed radically at

TABLE I
Results of Capital Expenditures Surveys

YEAR	1 U.S. INVESTMENT BILLIONS[1]	2 COMMERCE DEPARTMENT FORECAST BILLIONS[2]	3 DEPARTURE OF ACTUAL FROM COMMERCE PER CENT[3]	4 McGRAW-HILL FORECAST BILLIONS[4]	5 DEPARTURE OF ACTUAL FROM McGRAW-HILL PERCENT[5]	6 CANADIAN INVESTMENT CANADIAN BILLIONS[6]	7 CANADIAN FORECAST CANADIAN BILLIONS[7]	8 DEPARTURE OF ACTUAL FROM CANADIAN PERCENT[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

1.   From Economic Reports of the President 1956

2.   Computed from Columns 1 and 3, since published forecasts are not applicable in dollar terms to published fulfillments, due to annual change of base.

3.   1947-1952 from Friend and Bronfenbrenner, Plant and Equipment Programs and their Realization, in National Bureau of Economic Research, Short Term Economic Forecasting (Princeton, 1955), page 59. 1953 and 1954 from mineographed report of Louis J. Paradiso of Department of Commerce, to George Terborgh, Chairman of Federal Reserve Committee on Plant and Equipment Experditures, Table 1.

4.   Computed from Columns 1 and 5.

5.   1949-1953 from Planned versus Actual, unpublished McGraw-Hill Department of Economics paper. 1954 from change of actual investment in Column 1 and predicted change of investment in McGraw-Hill, Business' Plans for New Plants and Equipment, 1954-57 (New York, 1954).

6.   From Department of Trade and Commerce, Public and Private Investment in Canada, Outlook annual series (Ottawa).

7.   Computed from Columns 6 and 8.

8.   1947-1951 from Firestone, O. J., Investment Forecasting in Canada, in National Bureau of Economic Research, op. cit., p. 231. 1952-1954 computed from Column 6 and from forecast data in Department of Trade and Commerce, op. cit.

midyear due to the onset of the Korean conflict, the errors of both the
Commerce-SEC and McGraw-Hill surveys have been on the order of one to
five per cent and of less than a billion dollars in absolute magnitude.
The percentage error of the Canadian forecast seems slightly bigger
although in dollar terms it is of course much smaller. The direction
of error in both the United States surveys seems to bear out a hypothesis
of randomness of error, although the Canadian forecast seems to have a
systematic underprediction bias except for the missed cyclical turning
point in 1954. Similarly, both United States surveys accurately fore-
cast the turning points of 1949 and 1954, missing only the 1950 turn,
again because of the Korean War.*

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* The fact that both surveys predicted a continued downtrend for
1950 has interesting implications for the "might-have-beens" of post-
World War II cyclical history.

Bearing out the thesis of the small degree of error in the Commerce-
SEC forecasts, Friend and Bronfenbrenner point out that for the years
1947-1952, excluding 1950, the survey gave better results than either
a projection of the actual capital expenditures of the previous year
or a seasonally-adjusted projection of the actual expenditures of the
first quarter of the year in question.** This would also be the case

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** Friend, Irwin and Bronfenbrenner, Jean, "Plant and Equipment
Programs and Their Realization," in National Bureau of Economic Research,
Short Term Economic Forecasting (Princeton, 1955), p. 60.

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for the McGraw-Hill survey for 1949-1952, and is true for both of these surveys for 1953 and 1954.

The Canadian survey seems to have performed a little more poorly than the other two, both as to size and randomness of percentage error and to correct forecasting of turning points. Firestone discusses differences between the Canadian and Commerce-SEC surveys based on an analysis of methods and results from 1947-1952.* The greater accuracy

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* Firestone, O. J., "Investment Forecasting in Canada," in National Bureau of Economic Research, op. cit., pp. 229 et seq.

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of the United States results is not very obvious now and was less so then, so that Firestone's comments are not directed precisely at the possibility of consistently better United States performance. His major points are:

1. There is a greater preponderance of large firms in the United States and large firms tend to forecast better. United States reaction to investment opportunities may be faster than Canadian.

2. Canadian construction forecasts are more accurate than machinery and equipment forecasts, exactly the reverse of the United States situation. In Canada the short construction season requires considerable advance planning, while the dependence on foreign sources for much of the machinery means less accuracy.

3. In times of changing prices, Canadian estimates reflect expected changes. United States estimates reflect projected volume in current prices.

None of these except for the first point helps to answer directly the question of the seemingly better United States results. Probably two of the major reasons for differences in performance lie in the timing and coverage. The United States figures (both Commerce-SEC and McGraw-Hill) are compiled in March while the Canadian survey is in December. Greater accuracy three months later is almost certain. The United States surveys cover only business non-farm investment while the Canadian much more ambitiously covers private farm and non-farm investment, individual housing investment, and Dominion, provincial and local government capital expenditure. Both of these differences help to explain the fact that the size of percentage differences is greater for the Canadian figures. The earlier timing of the Canadian survey may explain the underestimate for six consecutive years since, as Friend and Bronfenbrenner point out, there is a consistent tendency for firms to underestimate expenditures* and it seems reasonable to

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* Friend and Bronfenbrenner, op. cit., p. 69.

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believe that this underestiimate will be more serious the earlier the time of estimate.

The fact that the Canadian survey missed the 1954 downturn, while the United States forecasts did not cannot so easily be explained away. One possible reason for this is the fact that Canadian industry is to

some extent dependent upon United States and it was United States
factors, foreseen in this country but not foreseen in Canada, which
pushed 1954 investment down. There is no particular evidence for this
hypothesis beyond the possible logic of the reasoning, but as yet no
other hypothesis has been proposed.

However, it still can be said that the outstanding features of the
aggregate forecasts of all three surveys have been their similarity and
their ability to anticipate actual capital expenditures better than do
other methods. This accuracy is not the case for individual company
forecasts of their own expenditure, and here lies an indication of
possible danger for the future success of the aggregate predictions.
Thus far, firm errors have cancelled neatly, but there is no guarantee
that they will do so in the future. The problem is illustrated by
Table II, which shows the differences of predicted and realized invest-
ment by firms for certain years for the three surveys.

Table II shows that although there does seem to be some control
tendency in each of the five sets of data tabulated, there is a very
wide spread of individual firm investment realization. Thus far this
fact has not harmed the accuracy of the forecasts of aggregate capital
expenditure derived from this data, but there is no a priori reason to
assume that it never will in the future. This problem is discussed
more thoroughly in Chapter V below, where it is tentatively concluded
on the basis of insufficient evidence that although there are some
factors systematically affecting the relationship of predicted and
actual investment for the firm, there is nothing now visible which is
too likely to throw off the aggregate forecasts.

TABLE II

Frequency Distribution of Per Cent Deviations of Actual from
Predicted Investment, by Percentage of Firms

Per Cent Change of Actual from Anticipated	Commerce-SEC, 1949	Canada 1949	Canada 1950	Per Cent Change of Actual from Anticipated	McGraw-Hill 1949	McGraw-Hill 1954
-100 to -80	3.0	9.6	9.8	less than -49.9	9.5	3.3
-79.9 to -60	3.5	6.5	5.4	-49.9 to -40	7.5	6.2
-59.9 to -40	7.5	7.2	7.4	-39.9 to -30	6.1	6.6
-39.9 to -20	12.5	6.9	6.4	-29.9 to -20	8.2	7.3
-19.9 to 0	14.7	5.9	3.6	-19.9 to -10	8.8	16.0
0 to 19.9	12.8*	20.8*	21.0*	-9.9 to -.1	6.8	12.4
20 to 39.9	11.6	5.6	4.8	0 to 9.9	15.6	16.4
40 to 59.9	6.8	4.2	4.3	10 to 19.9	7.5	6.2
60 to 79.9	3.7	3.3	2.6	20 to 29.9	6.8	5.9
80 to 99.9	2.9	2.2	1.7	30 to 39.9	2.7	2.6
100 to 119.9	3.6	3.3	2.8	40 to 49.9	4.1	4.8
120 to 139.9	1.5	1.6	1.7	more than 50	16.3	12.4
140 to 159.9	1.6	0.9	1.6			
160 to 179.9	1.6	1.5	1.4			
180 to 199.9	0.7	0.4	0.7			
200 and over	12.0	20.1	24.8			
TOTAL	100.0	100.0	100.0		100.0	100.0

Sources: Commerce-SEC from Bronfenbrenner and Friend, op. cit., p. 65
(Manufacturing Firms).
Canada from Firestone, op. cit., p. 208 (Manufacturing Firms)
McGraw-Hill computed by writer from raw data (Manufacturing and
non-Manufacturing Firms)

* The Bronfenbrenner and Friend table on the Commerce-SEC data does not
state whether firms with no change are in the -19.9 to 0 category or the
0 to 19.9 category. For the Canadian data these companies are in the
0 to 19.9 class.

The only non-agnostic conclusion possible here, therefore, is that throughout their brief existence the capital expenditure anticipations surveys have provided good aggregate forecasts, both as to amount and change of capital investment, and that these forecasts are more accurate than those provided by other devices.

2

There are certain methodological differences among the three surveys, some of which have been mentioned above insofar as they may cause differential results. The main differences come under the headings of coverage, timing, questions asked, and methods of aggregation.

Possibly the major difference between the two United States surveys on the one hand and the Canadian on the other, is that of the amount of ground covered. The Department of Commerce-SEC and McGraw-Hill both confine themselves to business non-farm investment in plant and equipment and publish industry breakdowns as well as aggregates for the country as a whole. Canada seeks information on all fixed capital formation including private farm and non-farm, individual housing investment and construction and equipment expenditures by all levels of government, breaking down the results by these groups and subgroups, and also regionally. So far as the sample size within the sectors included is concerned, Canada had 11,000 replies to questionnaires, representing 81.4 percent of investment by business groups covered by the largest of several direct surveys during 1951.* The Commerce-SEC

* Firestone, op. cit., p. 117 for number of responses, p. 245 for coverage.

annual surveys receive on the order of 3,000 responses, covering about

60 percent of United States non-farm business investment.* McGraw-Hill,

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*   Reports of Federal Reserve Consultant Committees on Economic
Statistics, Hearings before the Subcommittee on Economic Statistics of
the Joint Committee on the Economic Report, Eighty-Fourth Congress
(Washington, 1955), p. 29.

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although unwilling to make its sample size public, states that it is

smaller than that of Commerce-SEC, but nevertheless covers more than

half of manufacturing by employment.**

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**   Verbal information.

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Commerce-SEC carries on its regular annual surveys during the first

quarter, publishing the results in March, although it has also done two

special fall surveys, which were less accurate than the March ones.

The annual surveys are supplemented by quarterly intentions surveys

taken during the preceding quarters. These are thought of as a supple-

ment to the major effort, are taken from a smaller sample, and are

typically less accurate than the annual surveys. The McGraw-Hill

regular surveys are also published in March, but there is a regular

fall "preliminary" survey, which, like the Commerce-SEC fall surveys,

is typically less accurate than the March survey.*** Canada has two

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*** Federal Reserve Consultant Committee, op. cit., p. 38.

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regular annual expenditure intentions surveys, one taken during the fall, which is considered "the" survey, and one taken in the spring, considered a revision and based on a smaller sample. As has been noted above, the comparison of the results of the United States and Canadian surveys is between the U.S. March results and the Canadian fall results, which may account for a good part of the smaller Canadian accuracy.

One of the major differences among the three is in the number of questions asked and the quantity and variety of data gathered by the regular surveys. Canada asks only gross capital and repair expenditures and anticipations, broken down into plant and equipment. Commerce-SEC requests the same information plus data about present and next year's sales. It is to be noted that there is considerable information available to these two Canadian and United States governmental bodies which is not available to McGraw-Hill. McGraw-Hill, not being in the constrained position of a public body, asks a shifting variety of questions in addition to the basic ones asked by the others. These include questions about breakdown of investment into replacement and expansion (from which can be derived something approaching net investment, a magnitude otherwise ignored by the surveys), change of capacity, long-run investment plans, long-run as well as short-run sales anticipations for the industry as well as the particular firm and planning time on capital expenditures. The McGraw-Hill questions make possible a statistical seeking for causes of error in firm anticipations as well as basic forces behind investment--a search which is carried on in

chapters IV and V below. In order to carry out the same quest, both
Commerce-SEC and Canada have sent respondents on the anticipations
surveys special questionnaires concerning the reasons for deviations
of actual investment from predictions. The differences between the two
methods of approach to the causal questions are discussed in chapter III
below, while the results of the special questionnaires are mentioned in
chapter IV.

Finally, there are differences in method of moving from individual
firm reports to aggregate forecasts. In Canada, where the sample
represents a major part of all economic sectors surveyed directly,
there is little sampling or aggregation difficulty for these sectors.
The move from the sample to the aggregate is mainly on the basis of
gross value of production. The major problems come with the estimation
of investment in sectors not surveyed directly, since the Canadians try
to get the complete picture of capital formation, whether surveyable or
not. A variety of estimation techniques are used to fill in these gaps,
which only amount to about 15 percent of total investment.* The Commerce-

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*   Firestone, _op. cit._, p. 245.

SEC publishes forecasts only for sectors surveyed directly. For some
of these, such as "Commercial and Miscellaneous," coverage is low and
there are serious aggregation problems. This aggregation is done on
the basis of ratio of assets of the reporting   sample to assets of
the sector population as reported annually to the SEC. These ratios

change annually with the latest SEC reports so that aggregate investment
intentions reported in March of one year, and investment fulfillments
for the same year, reported in March of the next year, are never on the
same base, making for comparison difficulties. McGraw-Hill uses a much
less complex aggregation procedure, more suited to the smaller size of
the organization. It seems to have performed well, considering its
simplicity. The McGraw-Hill respondents are weighted against one
another on the basis of employment, and then the ratio of predicted
investment for next year to fulfilled investment for the current year
within the sample is applied to the Commerce-SEC aggregate figure on
fulfilled investment. Assuming that the McGraw-Hill and the Commerce-
SEC firms are randomly chosen from the same universe, the procedure is
logical, except that there seems no need to weight the sample. Weights
are necessary when expanding a sample statistic to a universe, but no
expansion is done here.

3

The good record of all three of the surveys does not mean that
improvements, toward either increasing accuracy or increasing useful-
ness cannot be made. The wide variation among accuracy of individual
company forecasts shows that room for improvement does exist. However,
any conclusions about possible changes in methodology depend on the
purpose of the particular survey in question.

It is shown in chapter V that there seem to be possible methods of
improving on the individual company forecasts, using other information

of a type which is now gathered only by the Mcᵁraw-Hill survey. This
is one reason for a recommendation that all the surveys might well
collect data on economic magnitudes not appearing on the questionnaires.
Beyond this, however, additional data might some day lead to the formula-
tion of a functional investment theory which would be valuable for pre-
diction in its own right.

The major purpose of both the Canadian and United States government
surveys is aid in the formulation of National Product and National Income
predictions for possible government actions. The Canadian survey is
well-designed toward this purpose. The fall timing of the major survey
should work well in a country with a parliamentary budget system and
the budgetary flexibility this system implies. The full coverage of
all investment factors which might affect Gross National Product is
similarly useful, although perhaps the Dominion should not survey the
Dominion government's own investment. In modern fiscal theory the
expenditures of the national government are not a datum but a balancing
factor to be used to compensate for variations in private investment
and other expenditures.

However, too full a coverage by the surveys is preferable to too
small. In the United States it might be very useful for the Commerce-
SEC poll to add not only farm investment as suggested by the Federal
Reserve Consultant Committee on Business Plant and Equipment Expenditure
Expectations,* but also to survey intentions of states and municipalities.

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* Federal Reserve Consultant Committee, op. cit., p. 15.

So far as the timing of the Commerce-SEC survey goes, the Federal
Reserve Committee suggests exploring the feasibility of making it
earlier than March.* Although we do not have Canada's fiscal flexi-

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*   Ibid.

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bility, a fall survey might be early enough to have some effect on the
final version of the President's budget and should in any case aid in
Congressional consideration of the budget insofar as such factors are
considered by the Congress.

Other of the Federal Reserve Committee recommendations for the
Commerce-SEC survey are enlargement of sample, further checks of pre-
dictive accuracy, further breakdowns of data and a study of longer-than-
one-year capital programs. These are unexceptionable. One recommenda-
tion not made by the Committee is an attempt at a regional breakdown
such as the Canadian. The major reason is that the United States
surveys are made on a company rather than a plant basis.

The whole question of improving the forecasts made by the surveys
will be discussed in chapter V. What this chapter has done has been to
discuss the aggregate results of the surveys, to discuss the methodolo-
gical differences in the light of these results and to discuss in a
tentative manner some methodological recommendations which have been or
may be made.

Chapter III

DATA AND METHODOLOGY

The major portion of the statistical work and the final conclusions
of this paper is based on responses to questionnaires on investment
anticipations, fulfillments and other economic variables. The responses
are by a sample of 411 firms participating in the annual McGraw-Hill
plant and equipment expenditures survey for one or more years between
1949 and 1954 inclusive. Like the Commerce-SEC poll, the survey is
taken during the first quarter of the calendar year and results are
published in March. The responses were tabulated by McGraw-Hill in a
manner such that, although the individual firms were not identified,
all of the six (or fewer) years of answers for each company were
gathered on one tabulating sheet. In addition to the answers to
questions, for each firm there was listed an employment class and an
asset class. The classification of the 411 firms is shown in Table 1.
The employment classes were taken directly from the questionnaires.
The asset classes were taken from the Fortune magazine survey of the
500 largest corporations, by sales.* The No Asset Data Class includes

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* The Fortune Directory of the 500 Largest U.S. Industrial Corpora-
tions, Supplement to Fortune magazine, July, 1955.

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all of the companies not among these 500.

The fact that the asset classes are very broad and that more than
half the companies are not included and the fact that there is no
industry identification for the companies are deficiencies in the data

which will be discussed below, as will be the very obvious bias of the

sample toward very large companies. According to Adelman,* there were

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* Adelman, M. A., "The Measurement of Industrial Concentration," in
Review of Economics and Statistics, November, 1951, Table on p. 275.

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in 1948, 260 companies in the United States employing more than 10,000

each, more than half of which are represented here.

Table I

Responding Companies by Assets and Employment

Assets	Employment					
	0-500	501-1000	1001-5000	5001-10000	More than 1000C	Total
No Data. Not among 500 largest by sales	31	31	112	13	28	215
0-250 million	0	2	32	53	40	127
250-750 million	0	0	1	4	41	46
More than 750 million	0	0	0	0	23	23
TOTAL	31	33	145	70	132	411

The questions asked and the number of answers received are listed

in Tables II through VI below. Data in each case are listed for the

year to which the answer applies, rather than the year in which it was

made. For example, investment predicted in 1953 for 1954 is listed

under 1954.

Question 1. How much did you invest in new plants and equipment in the Continental United States in ____?
(This includes all purchases charged to capital accounts, whether for replacement, expansion or other purposes.)

Question 2. How much do you now plan to invest in new plants and equipment in ____ (next year)?

Table II

Responses to Investment Questions

Year

	1949	1950	1951	1952	1953	1954	TOTAL
Answering 1 and 2	147	213	228	228	245	274	1335
Answering 1 only	101	65	64	53	56	45	384
Answering 2 only	28	28	43	61	36	27	223

Question 3. How much were your company sales in ____?

Question 4. What dollar volume of sales do you expect your company to have in ____ (next year)?

Table III

Responses to Short-Run Sales Questions

Year

	1949	1950	1951	1952	1953	1954	TOTAL
Answering 3 and 4						217	217
Answering 3 only				235	259	53	547
Answering 4 only						34	34

Question 5. How much do you think the physical volume of sales of your company will increase or decrease by the end of ____ (3 years ahead)?

Question 6. How much do you think the physical volume of sales of your industry will increase or decrease by the end of ____ (3 years ahead)?

Table IV

Responses to Long-Run Sales Expectations Questions

Year

	1949	1950	1951	1952	1953	1954	TOTAL
Answering 5 and 6				149	173	6	238
Answering 5 only				34	32	194	260
Answering 6 only						1	1

Question 7. At the end of ____ how did your capacity, measured in terms of physical volume compare with what it was at the end of ____ (previous year)?

Question 8. If you carry out this (investment) program, what will be the net increase of your company's physical capacity?

Table V

Responses to Capacity Change Questions

Year

	1949	1950	1951	1952	1953	1954	TOTAL
Answering 7 and 8		3	164	148	175	203	703
Answering 7 only		215	66	54	59	51	445
Answering 8 only		1	40	59	42	28	170

Question 9. Roughly, how was your investment divided between (1) expansion and (2) replacement and modernization?

Question 10. Roughly, how will this investment (for next year) be divided between (1) expansion and (2) replacement and modernization?

Table VI

Responses to Expansion-Replacement Questions

Year

	1949	1950	1951	1952	1953	1954	TOTAL
Answering 9 and 10		166	189	195	200	233	983
Answering 9 only		69	66	51	64	57	297
Answering 10 only		34	41	55	36	29	196

2. Data Deficiencies

No economic statistical data used anywhere yet have been completely free of differences from the ideal. The data used for a major part of this paper have five differences of varying importance:

1. The lack of several important variables;

2. The short period of time covered;

3. The lack of industry identification for the firms;

4. The use of gross, rather than net, investment concepts; and

5. The lack of a complete size breakdown by firm and the bias toward large companies.

These five will be discussed in order below. The belief of the writer is that although some of these are serious, none are crippling. It is further believed that the one major advantage of the data, the fact that the large-sample cross sections used avoid the so far insuperable difficulties of aggregated time series, discussed in chapter I above, outweighs the deficiencies.

1. The most serious deficiency in the data tabulated above is the lack thereof. There are good sales data for at least two years, and there is a good six-year sample of investment prediction and fulfillment. There are other variables such as capacity change and expansion which can supplement these two. There are, however, no data on profits, no data on liquidity, none on percentage of desirable capacity at which present operations are being carried on. To some extent, these deficiencies can be remedied by devices such as Eisner's assumption that the existence of expansionary investment is a qualitative indicator of

pressure on capacity.*

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*   Suggested by Eisner, Robert, <u>Expectations, Plans and Capital Expenditures: a Synthesis of Ex Post and Ex Ante Data</u>, a paper presented to the Conference on Expectations, Uncertainty and Consumer Behavior, October 27-29, 1955, Pittsburg; p. 41 of mimeographed preliminary copy.

To some extent, previous work in the field, by Eisner and by

Bronfenbrenner and Friend,** can be used as a supplement to my statis-

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**   Friend, Irwin and Bronfenbrenner, Jean, "Plant and Equipment Programs and their Realization," in National Bureau of Economic Research, Studies in Income and Wealth, Volume 17, <u>Short Term Economic Forecasting</u>, Princeton, 1955. For other work by these authors, see the bibliography.

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tical results. However, it would be statistically unjustifiable to

insert regression and correlation coefficients taken from other data in

the equations estimated from this body of statistics. Therefore, it

will be impossible to present anything approaching a complete theory of

investment or a complete theory of discrepancies of predicted from

actual investment. What can be done is to present suggestive and in

some cases very interesting relationships based on the data which are

present, and to supplement these verbally with other previously dis-

covered relationships.

In this manner, considerable information is elucidated concerning

both investment theory and the direct forecasting value of survey

investment estimates, but because of the data lack no final statements

can emerge.

2. The second deficiency is in the small number of years covered by the data. There are two aspects of this. The investment anticipations and fulfillment statistics, which provide a good sample for six years, are more complete than those in any previous study in this field, and the capacity and expansion figures, giving good coverage for five years, supplement them well. However, these years cover only mild recession periods, and extrapolation from these mild downturns to severe depressions, although it will be attempted, is on a shaky foundation. The recessions of 1949 and 1954 did not partake of the character of major depressions, particularly inasmuch as business' long-run expectations were, by and large, for continued prosperity. There is no valid reason to assume that the parameters associated with small downturns are even in the same direction as those associated with large. No complete test of investment survey methods can be made until there is a severe decrease in investment, at which time, of course, it may be too late.

The other difficulty with the period covered is the fact that sales and sales expectations data are available only for the three years from 1952 to 1954. One year sales volume and expected sales volume is given in dollar figures. Three year expected sales change is given in percentage. Since using gross sales as a variable with no idea of value added or of profit associated with these sales is meaningless, there are only two periods of one year sales change data useable—change from 1952 to 1953 and change from 1953 to 1954. There are three years of data on the longer-run sales expectations.

The difficulties associated with the short time periods covered can be overcome to some extent by treating separately firms with atypical experience or expectations during the period. For example, it is shown in chapter IV that although the separation of 1953 and 1954 in studying the relation of one-year sales change and capacity change is significant, this significance disappears if companies are separated into those expecting and/or experiencing sales increases and those expecting and/or experiencing sales decreases. However, in spite of the aid given by these and similar techniques, it still cannot be said that the period 1949-1954 or the period 1952-1954 is necessarily a random sample of the second half of the twentieth century or even of the first two decades of this half-century. We can be sure of an adequate stratified, if not random, sample only when and if we again experience severe depression.

3. The third major deficiency in the data lies in the fact that, in order to preserve the confidential nature of the survey and avoid individual firm identification, McGraw-Hill could not disclose the industries to which the firms belong. There are two possible effects that industry classification might have upon the analysis. First, there might be an effect of industry upon realization of predicted investment--some industries might consistently predict too high while others might underpredict. Second, there might be an effect upon accuracy of prediction--some industries might consistently predict better than others, coming closer to perfect prediction regardless of any possible consistencies in the direction of deviations.

An attempt was made to discover the importance of inter-industry differences using published Department of Commerce-SEC annual survey data from the Survey of Current Business for the years 1948 through 1954. This attempt is discussed here, separately from the main body of statistical analysis in chapters IV and V, because whatever its conclusions as to the importance of industry differentiation, such differentiation cannot be made among the McGraw-Hill data used in the major work. In this analysis, each observation on actual and predicted investment represents one industry of the nineteen industry groups and manufacturing sub-groups into which the survey is broken down; and one year. For example, the actual and predicted investment of the Iron and Steel industry for the year 1950 would be an observation. The dependent variable is the fulfillment ratio, the ratio of predicted to actual investment, 1.00 being perfect prediction.

To test realization, the possibility of consistent under or over-prediction, a two-factor analysis of variance was made, using industry and year as the criteria of classification. An F test for the differences among the means then gave an F value significant at the .95 level for the explanation by the industry classification, showing that some industries predict consistently higher relative to their actual investment than do others. Some of the industries consistently predicting too high are textiles, mining, commercial and miscellaneous, "other durables" and "other non-durables." Consistently low industries are non-ferrous metal manufacturing, chemicals, petroleum and coal manufacturing, rubber and railroads. Thus there seems to be overprediction by the industries with smaller firm units and underprediction by at least some of the more concentrated industries.

In order to test the effect of industry on the accuracy of prediction, the closeness to perfect prediction regardless of sign of deviation, a chi-square difference of variance test was set up. If there are k industries and if s_i equals (fulfillment ratio - 1.00)$/\sqrt{n_i}$, the n_i being the number of degrees of freedom in each industry class, and if the overall number of degrees of freedom is n, then

$$\frac{-2 \log L}{1 + (n_i^{-1} - n^{-1})/(3K-3)} \text{, where}$$

$$L = \frac{s_1^{n_1} \cdots\cdots\cdots s_k^{n_k}}{(n_1 s_1^2 + \cdots\cdots\cdots + n_k s_k^2/n)^{n/2}}$$

is chi-square distributed. The chi-square value computed for this statistic for the nineteen industry groups and subgroups was not significant, indicating no important differences in predictive accuracy among industries.

Thus it can be seen that although there are significant differences among industries in that some consistently overpredict and others under-predict (realization), the differences in spread of predictions around the perfect prediction ratio of 1.00 (accuracy) are not significant.

An attempt was then made to explain the significant differences among the industry classifications not present in the McGraw-Hill data by using rough measures of variables which could be used in the analysis of the McGraw-Hill material. The first of these variables is average firm size within each industry. Measurement of this magnitude was attempted by using average employment per firm in each industry

but this was unsatisfactory because the average employment was forced down by the number of small units in all industries and was less than 100 in all cases, while the smallest employment class in the McGraw-Hill data is 0-500. A better measure, therefore, was believed to be the percentage of total number of workers in each industry employed by firms with total employment of 10,000 or more.* The second variable

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* From Adelman, op. cit.

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was assets of firms within the Commerce-SEC sample as a percentage of total assets within each industry.** Part of the variation from

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** From Survey of Current Business, December, 1951, Table on p. 21 and Survey of Current Business, August, 1952, Table on p. 23.

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perfect prediction for different industries by the Commerce-SEC survey may be explainable by the small percentage of the industry represented in the sample. If this is the case, it presents a difficulty in the published aggregated Commerce-SEC aggregates not present in the firm-by-firm McGraw-Hill data. Therefore, ratio of sample size to universe size was used as an explanatory variable. The final variable used as a substitute for industry was the arithmetic mean of the annual rate of change of investment, a growth measure which is available in both data sets.

Thus, the variables in the following analysis are:

P = predicted annual change of investment, relative to last year's investment,

A = actual annual change of investment, relative to last year's investment,

S = percentage of workers in an industry employed by units employing 10,000 or more,

R = ratio of assets of Commerce-SEC sample to total assets within industry

G = arithmetic mean of annual rate of change of investment, by industry.

In the analysis, the actual value of the regression coefficients, the βs, is unimportant since they depend very much on the direction of minimization of sums of squares of P and A. Although the computed regression coefficients are published, the important thing is the value of the F ratio for the addition of S, R and G to the equation.

A function of the type

(III 1) $\qquad P = \alpha + \beta A$

was set up. Any additional variable having an effect on P/A would also have an effect on this equation. Previous work had shown that constraining the function to

(III 2) $\qquad P = (1-\beta_0) + \beta_0 A$

would not detract significantly from the relationship and would save a valuable degree of freedom. To test the significance of S, R and G, they were tested as a linear influence on β_0, the relationship between A and P. Under this hypothesis

(III 3) $\qquad \beta_0 = \beta_1 + \beta_2 S + \beta_3 R + \beta_4 G.$

(III 2) and (III 3) solve to

(III 4) $\qquad P - 1 = \beta_1 (A-1) + \beta_2 (SA-S) + \beta_3 (RA-R) + \beta_4 (GA-G)$

which was estimated by least squares. The result was

(III 5) β_0 = .2711 - 1.4119 S + 2.3290 R - 3.8912 G.

The partial correlation coefficient of S, R and G on P is .375,

and the F ratio with 3 and 74 degrees of freedom for adding these

variables to the equation is 3.6066, significant at the .99 level. If,

instead of these three industry variables, 19 separate regressions are

used, one for each industry, the F ratio with 15 and 59 degrees of

freedom for the additional explanation is 1.3140, which is not signifi-

cant. Thus, for this particular purpose, at any rate, the significant

differences in the investment realization experiences among industries

can be explained away by variables which can be duplicated in the McGraw-

Hill data, for individual firms, even though the industry classifications

cannot. This is not to say that the lack of industry classifications is

a desirable characteristic of the data, but it can be claimed that in

some cases apparent industry differences are easily explainable on the

basis of other variables which can be identified for individual firms.

This all assumes, of course, that these variables mean the same thing

for industry aggregates on which they were tested and for firm data,

an assumption which may not be valid, particularly in the case of the

growth measure used. However, it is the only assumption we can make.

4. The fourth deficiency in my data, which is present in all

investment survey data, is more serious for testing the economic

meaning of the data than for testing the predictive value of the series.

This is the fact that in all cases the data received is on gross invest-

ment. McGraw-Hill asks for "all purchases charged to capital accounts";

Commerce-Sec asks for "all costs.....chargeable to fixed asset accounts and for which depreciation accounts are ordinarily maintained"; while Canada specifies "gross investment." The reason for this is the same reason that Gross National Product is used as a substitute for the economically more meaningful Net National Product in discussions of national product accounts. The movement from gross to net is still a very inexact one. The use of gross rather than net concepts should not affect the value of the surveys for forecasting, but it is unfortunate for testing certain aspects of economic theory. The simple accelerator theory in particular has net investment depending on sales change, and since there is no reason to assume that net and gross investment have a constant linear relationship, any test of the theoretical accelerator using this gross data is biassed against acceptance. To some extent, this difficulty can be avoided by using expansion investment rather than total investment as dependent variable, but it is unsafe to depend on the assumption that expansion investment means exactly the same thing as net investment. It may be that investment reported by companies as expansion investment is closer to the theoretical accelerator investment than is net investment, gross investment minus depreciation allowances, and the accelerator components of both expansion investment and capacity change will be tested and isolated. However, net and gross investment are the figures reported by the Commerce Department in the national accounts, rather than expansion investment.

5. Finally, there is the dual deficiency of broad asset classes and a sample biassed strongly toward very large companies. The fact that there are thirteen non-empty asset-employment classes is sufficient for most purposes, but there is one difficulty. This is the impossibility of transforming investment by dividing by fixed assets. Since the major effect on untransformed investment is size of firm leaving little room for anything else, some transformation must be used. It contributes nothing to our understanding to state that General Motors invested more dollars in 1954 than did Bridgeport Brass. In addition there is a very strong heteroscedasticity in the untransformed data. The economically meaningful deflator would be fixed assets, as used by Eisner.*

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* Eisner, op. cit., p. 4.

However, the asset data I have are obviously inadequate for the purpose, as are the employment data. Investment cannot be divided by an asset class $250 million wide or an employment class 5000 wide. The best remaining alternative for transformation seems to be the division of the actual and predicted investment figures for each year by the mean of the six years of actual investment for the firm. While this is by no means as satisfactory as using the ratio of investment to total fixed capital as the dependent variable in the analysis, at least it enables us to see what causes investment to vary from what might be called "ordinary" investment for the firm. In defense of this admittedly dubious transformation method, it might be stated that, as shown

in the next chapter, regressions on actual investment divided by mean investment had results similar to those on capacity change. The capacity change figures, since they are given in percentages, do not need transformation. The transformation question does not enter where we are testing predictive accuracy using the ratio of predicted to actual investment as the dependent variable, or using a regression of predicted on actual.

Beyond the transformation problem, there is the fact that, even if the best deflator could be used, it is possible that large companies have a larger (or smaller) investment in relation to fixed assets than do small. Since the sample is extremely biassed toward the large companies, there might be some question as to whether any effects discovered would apply to a universe of all companies. However, it is believed that here the thirteen asset-employment classes do suffice to remove this effect. It is not possible to argue that the sample is a random one from the population of all companies in the economy, but it is possible to argue that the sample within each of the classes is random in relation to the population of all companies in that class. In other words, we can convert a very poor random sample into at least a fair stratified sample. It was found, however, that in many cases this stratification was not necessary--that for many relationships, size of firm makes no difference. At any rate, although the sample may be biassed toward large firms, it may for that reason include the bulk of investment in the United States economy.

These then are the five major deficiencies in the data used: the
lack of **some** relevant variables; the short time period covered; the
lack of industry classification; the use of gross rather than net invest-
ment; and the undeflatability and large company bias of the data. As
discussed above, some of them are serious, but none of them are fatal,
and some characteristics of the data such as the six-year continuity of
investment prediction and fulfillment data are particularly good.

3. Methods of Assembling the Data

Four methods have been used by investigators studying data
gathered by plant and equipment expenditures surveys. They are:

1. The study of relationships between different answers to
    questionnaire questions.

2. The supplementing of the above by use of company accounting
    data.

3. The use of supplementary questionnaires asking reasons
    for erring predictions.

4. The use of data exogenous to the questionnaires.

1. The method used for the bulk of the statistical work in this
paper is that of relating some questionnaire answer data to other
answers on either the same questionnaire or on similar questionnaires
for different time periods. This is the method largely used by Eisner*

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*   Eisner, op. cit., for other work by Eisner, see the bibliography.

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in his work in this field and by Kuh and Meyer in their ex post study.*

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* Meyer, John and Kuh, Edwin, "Acceleration and Related Theories of Investment: An Empirical Inquiry," in Review of Economics and Statistics, August, 1955.

In the present paper, the dependent variables are accuracy of investment predictions; and investment and certain of its phases, such as capacity change. These are related to other variables from the same questionnaires or from other questionnaires answered by the same companies in other years. For example, 1954 investment is related to various combinations of actual and predicted sales changes from 1952 through 1954. The ratio of actual to predicted 1954 investment is treated as a function of other things, such as the ratio of actual and predicted sales for 1954. This method and the second one might be called "objective," in contrast with the third, in that the respondents report objective investment and other prediction and fulfillment statistics which are then investigated by the statistician for causal relationships.

2. The second method is used as a supplement to the first by Eisner and by Bronfenbrenner and Friend,** working with Commerce-SEC

** Friend and Bronfenbrenner, op. cit.

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data. This is the use of material obtained from balance sheets, tax returns and other accounting papers of the answering firms, in addition

to the questionnaire answers. Except for the material relating to firm
employment and assets mentioned above, I was unable to use this procedure.
Since my information did not bear firm identification I could not go else-
where to find information about the answering companies.

3. The third possibility is that of supplementing the investment
survey questionnaires with later surveys asking the firms for reasons
that the ex ante predictions varied from the ex post fulfillments.
This method, which might be called "subjective" was used by the Commerce
Department in 1950 and again in 1955, when forms were sent out listing
eight categories, including an open one, of reasons for deviation of
expected from actual investment. It has also been used by the Canadian
survey. Respondents were requested to check one major and all of the
relevant minor reasons for discrepancies. This method, although a
valuable supplement to the "objective" procedure, has the disadvantage
of channeling the results through the mind of the original predictor,
who will presumably find it much more difficult to answer than a
question concerning objective magnitudes such as size of sales, depre-
ciation allowances, etc. Another disadvantage is that it does not
easily lend itself to quantification. On the other hand, plumbing the
minds of the officials of the predicting firms may well bring out
causes of discrepancies which are not at all discoverable from objective
statistical data.

4. The final method by which the body of information may be
attacked is to relate the predictions and fulfillments and the connec-
tions between the two to outside events affecting the economy as a whole

or the industry as a whole. The best example of this is the virtual
exclusion of 1950 data from all studies of investment surveys, since
predictions for 1950 were made in 1949, before the advent of the Korean
War, while fulfillments took place during the six months after as well
as the six months before this event, which probably should be considered
exogenous to the economic system. I have made considerable use of this
method, using exogenous economy-wide data with reference to the McGraw-
Hill statistics, in which industry is not identified, and using
economy-wide and industry-wide data in trying to explain the course of
the industry aggregates of predicted and fulfilled investment published
quarterly in the Survey of Current Business.

These four methods of treating the investment survey data are, of
course, not mutually exclusive. They are complementary and a complete
study of the surveys should use all four. I shall use the first and
last only, since I do not have data useable for the second and third.
The second, the use of supplementary accounting document data, will
particularly be sorely missed, and to the lack of this procedure and
the lack of more varieties of questionnaire answers can, partially at
least, be attributed the fact that, although many statistically signi-
ficant relationships are discovered, in no case is as much as fifty
percent of the variation of the dependent variable explained. This
data deficiency is discussed in section 2, above.

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Given the data as outlined above, it was decided that the most

powerful method of studying relationships among the different variables

was the use of least-squares regression/analysis of variance, tested by
                                    and

F ratios. Although the data do not fulfill all of the assumptions

behind these methods (to be discussed below), least-squares regression

nevertheless provides an efficient method of estimating relationships.

The least-squares method as used here produces four types of

statistics for each equation or set of equations. They are:

    1. The index of correlation, R^2

    2. The F ratio

    3. The standard error of estimate, s_u^2

    4. The regression coefficients.

1. The index of correlation, R^2 is the ratio of the portion of

the variation of the dependent variable explained by the equation to

the total variance of this variable. In the past, much statistical

work has been done with the least-squares method using R^2 as the

sole or main statistic indicating the value of the independent variables

in explaining the dependent. R^2 is used throughout the statistical

sections of this paper, but it is not considered sufficient and is not

used alone for several reasons. First: although R^2 shows the pro-

portion of variation of the dependent variable explained by the inde-

pendent variables, it gives no indication of the likelihood that the

same explanation might be given by a random unrelated variable. The

addition of any new variable to a set of explanatory variables or the

breaking of a set of data into subsets for which separate computations are made will always increase the value of R^2. Without the computation of other statistics there is no way of discovering whether the addition to the value R^2 is significant. The second insufficiency of R^2 is that it gives no indication of how close the equation may come in estimating values of the dependent variable and no indication of how much the estimates may be improved by moving from a cross sectional individual firm basis to an aggregate basis. Therefore, R^2 is used herein as a statistic indicating the proportion of the dependent variable explained and making possible a comparison of the explained proportions of different dependent variables in different sets of equations, but it is not used as a measure of statistical significance or estimating error.

2. The F ratio is the ratio of the explained variance of the dependent variable divided by the number of degrees of freedom used in the explanation to the unexplained variance divided by the remaining degrees of freedom. After it is computed for a set of equations it can be compared to a table of F ratios derived from random numbers. If the computed F ratio is greater at the .95 significance level than the F table ratio with the same numbers of degrees of freedom, then it can be said that there are only five chances in one hundred that such a high ratio could arise from a set of explanatory variables bearing no systematic relationship to the explained variable. The .95 significance level is the one used throughout the paper. Thus the F

ratio tests whether the R^2 associated with a particular set of variables is significant or whether the same R^2 could be generated by a sample set of random variables from a population whose true R^2 is zero. Similarly, F ratios are used to test whether the addition of one variable to an existing set explains significantly more than would the addition of a random variable. All of the individual variables used in the following chapters have been so tested and found significant although only the F ratios for all the variables in a set of equations are published.

3. The standard error of estimate, s_u^2, is a measure of the reliability of the equation estimates for a dependent variable. It is the variance of the dependent variable around the regression plane at the mean of the dependent variable. It is the denominator of the F ratio, the variance left unexplained around the regression plane divided by the unused degrees of freedom. The square root of s_u^2 is an estimate of the standard deviation of the deviations of the observations from the regression estimates. Approximately 95 percent of the observations on the dependent variable at the mean will fall within a range of $\pm$ 1.96 standard deviations from the true regression plane if the deviations have a near-normal distribution. If the dependent variables in all the equations fell within the same numerical range and had roughly the same number of observations, the standard error of estimate could be used to compare to the goodness of forecast of the various equations. These conditions are not met in this paper and therefore this comparison is done with R^2. The characteristic of s_u^2

which is important for this paper is the fact that it will be reduced
by aggregation of data. The equations here all represent estimates of
investment or investment realization by individual firm and the standard
errors of estimate consequently are variances of estimates of investment
and investment realization by firm. To obtain the standard error of
estimate for aggregate investment or realization, the firm standard
error must be divided by the square root of the number of firms going
into the aggregation. For large samples, such as are used here, this
means a strong improvement of estimate. The standard error of estimate
for the aggregate is not published here because the aggregate of com-
panies in the sample is not economically meaningful and the companies
in the sample are not sufficiently representative of the aggregate of
all firms in the economy. However, the standard error of estimate for
the firm is given with each set of equations and the order of magnitude
of the standard error of estimate for the aggregates can easily be seen
by the reader.

4. Finally, regression coefficients are computed for all variables
used. These show the direction and indicate the magnitude of effect of
each of the independent variables on the dependent variable. Although
these coefficients are shown by the F ratios to be significantly non-
zero in all cases, it should be borne in mind that their absolute size
is indicative rather than exact.

There are several possible objections to the use of the least-
squares F ratio method. In addition to those associated with the
violation of certain of the multiple-regression assumptions, discussed.

below, Eisner has raised an objection peculiar to the use of expecta-

tional survey data.* His belief is that although businessmen can, with

* Eisner, Robert, Discussion of the Report of the Federal Reserve
Committee on Statistics, December, 1955 meeting of American Economic
Association.

some degree of accuracy, forecast the direction of change of sales and

the direction of change or the general magnitude of investment, they

cannot make any meaningful numerical predictions of these and similar

magnitudes. It therefore follows that the numbers used in these pre-

dictions are meaningless, and regressions using these cardinal numbers

are not very useful. To get around this difficulty, Eisner places

heavy dependence on the use of bivariate frequency tables ranging from

two by two to six by six, and on the use of the statistical methods

associated with such tables, rather than those, such as multiple

regression, associated with continuous variates.**

** Eisner, op. cit. in footnote 3.

Even if it were correct that businessmen do not predict more than

direction there is one immediate statistical reason for preferring mul-

tiple regression to contingency coefficients and other such methods.

This is the fact that multiple regression provides a simple method of

testing the value of simultaneous use of more than one independent

variable, a process which is very difficult by Eisner's methods, and in

which he does not frequently indulge. The simple testing of sets of
variables and of addition of new variables to sets is something which,
if not necessary, is at least highly desirable for any complete analysis.

Nevertheless, if Eisner were correct about the nature of the data,
it would make for serious difficulties in the interpretation of multiple
regression results. However, he qualifies his belief insofar as it
concerns investment anticipations, believing these plans to be more
susceptible to cardinal quantification than pure expectations such as
sales. Further, the fact that the Commerce-SEC and Mc Graw-Hill invest-
ment projections, taken from the surveys of business anticipations,
usually predict quite closely as to magnitude as well as direction of
change, seems to indicate that business anticipations are random around
some definite cardinal degree of change, rather than being completely
meaningless except for direction. In view of these factors, I felt
justified in using multiple regression and treating the data as cardinal
continuous variates. The combination of analysis of variance, an
Eisner-like ordinal technique, with multiple regression, as demonstrated
in the next chapter, seems to show both methods are useful.

There remain, however, the difficulties arising out of the non-
fulfillment of regression assumptions by the data. Two of these
assumptions can be easily disposed of. Since no complete system of
equations is being built up, there is no Cowles Commission identifica-
tion problem. Further, there is no reason to believe that the observa-
tions are not statistically independent among firms.

So far as the assumption of homoscedasticity of residuals is concerned, although no tests were made, there seem to be no systematic irregularities of variance once the data is deflated as described above, although of course there was extreme heteroscedasticity before the deflation.

Aside from statistical independence, the major prerequisite for use of multiple regression and F ratios is normality of residuals. The multiple regression method is still efficient even if this assumption is violated, but since an F ratio is a ratio of two chi-square distributed variables, and since the sum of the squares of variables is chi-square distributed only if the variables are normally distributed, normality is a requirement for the exact use of F ratios and tables. The residuals around several of the regression lines and planes derived in the next chapter were tested for normality and it was discovered that they were significantly non-normal in a chi-square test. The actual distribution of residuals in all four cases tested was roughly symmetrical and platykurtic (flat-topped). However, according to Kendall,[*] Pearson tested six non-normal populations,

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* Kendall, M. G., The Advanced Theory of Statistics, Volume II, (second edition, London, 1948) p. 205.

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including one which was symmetrical platykurtic, two which were symmetrical leptokurtic and three which were skew. Kendall states that the results indicated that the distribution of z $(z = 1/2 \log_e F)$ is

adequately represented by Fisher's distribution for a wide range of non-normal populations. If this is true of z, it is also true of F, and the use of F ratios and F tables in this paper should be viewed with some small degree of skepticism, but not with alarm.

Finally, there is a possible objection based on the philosophy of statistical research to the methods used in this paper. The techniques discussed above, particularly those associated with the F ratio, are applied to the body of data with the purpose of selecting variables and developing multiple hypotheses in which each of the variables used provides additional explanation significant at the .95 level. The sets of variables thus selected are then tested against the same body of data. This prejudices the case. The variables have been picked because each is significant for the particular sample body of data. Having been selected, they should then be tested as a group against another random sample from the same universe. This test will then show whether the researcher should reject or refuse to reject the group of explanatory variables. Instead, the set of variables is tested against the original data sample by use of which they were selected. Ideally the sample should have been randomly split in two and half should have been used for selection with the other half reserved for testing. The reason this procedure was not carried out, of course, was the paucity of data. In this, as in most work in economic statistics, the waste of data necessarily involved in sample-splitting is too costly to be considered. Therefore the common, not completely legitimate, procedure of selecting and testing with the same data was used here. This adds another element of weakness to the results but it is a necessary and probably minor element.

5

This chapter has attempted to describe thoroughly the data used, the deficiencies in the data, and the methods by which it was handled. Although the bulk of the chapter has been devoted to a discussion of the deficiencies of both data and methods, it is felt that what remains is a good large-sample body of virgin cross-sectional data; that those relationships brought out will be valid--perhaps not valid in an exact numerical sense, and perhaps not valid for the entire population of American non-farm business organizations--but valid in the sense that they indicate the existence of true relationships applying to a population heavily weighted by very large firms. The fact that the very large firms carry on the great bulk of all investment in the United States today adds to this validity for many purposes.

Chapter IV

SURVEY DATA AND INVESTMENT THEORY

As mentioned in Chapter I above, cross-sectional survey data in
this field can be used for two purposes. Surveys of investment in-
tentions can be used directly for prediction of aggregate investment.
The raw material from either ex ante prediction surveys or ex post
investment fulfillment surveys can be used to help in the formula-
tion of a theory of investment which may ultimately aid in the pre-
diction of aggregate investment. This chapter discusses survey data
and investment theory. Some of the hypotheses formulated and tested
here are then used in Chapter V in the discussion of investment pre-
dictions and their realization. The first part of this chapter
introduces the topic by viewing some of the previous work in the
field, while part 2 goes into the new analysis done with the McGraw
-Hill material.

1

Three of the most recent systematic attempts to study investment

theory using cross-sectional firm data have been by Meyer and Kuh*

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* Meyer, John and Kuh, Edwin, "Acceleration and Related Theories of Investment; An Empirical Inquiry," in The Review of Economics and Statistics, August 1955.

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and two by Eisner**. Meyer and Kuh used ex post data on gross

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** Eisner, Robert, Expectations, plans and Capital Expenditures: A Synthesis of Ex Post and Ex Ante Data, an unpublished paper given at the Conference on Expectations, Uncertainty and Business Behavior, Pittsburg, Oct. 27-29, 1955.

--------------------, Determinants of Capital Expenditures, An Interview Study, Studies in Business Expectations and Planning, Number 2 (Urbana, 1956).

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investment, sales, net profits, depreciation, fixed assets and current

assets and liabilities gathered from SEC form 10K for the years 1946-

1950. Eisner in his earlier study used ex post and ex ante data on

gross investment, fixed assets, sales and profits from the McGraw-Hill

survey for 1948-1950, together with balance sheet data from Moody's

and unpublished material from the Federal Reserve System. In the

second he used a small-sample interview technique rather than a large

sample of questionnaires.

Both the Meyer and Kuh and the Eisner papers devote most of their discussion to various phases of accelerator theory, with which the major part of my work in this chapter is concerned. Insofar as they worked with various "pure" accelerator models, using only various sales and capacity variables, their conclusions were similar to but not the same as those presented below in part 2 of this chapter. However, in both cases the writers had access to a class of material on which I have no data; the class of liquidity variables. For this reason it is worthwhile to discuss some of their conclusions as supplements to my own.

Meyer and Kuh come to the conclusion that:

"We noted that a sharp break in the observed behavior of the variables accompanied the economic transition of 1948 and 1949. In the immediate postwar years, 1946 and 1947, when demand was expanding rapidly and liquidity was plentiful, a capacity formulation of the accelerator had by far the closest relationship with investment. On the other hand, in 1948 and 1949, when economic conditions stabilized or declined in several lines of activity, the two liquidity flow variables, profits and depreciation expense, provided the best explanation of investment outlay. The liquidity stock variable and change in sales had, by contrast, little effective relationship with investment at any time during the 1946 to 1950 period.

"...........We therefore concluded that plentiful liquidity, of all the basic assumptions, seemed most essential to the accelerator's effectiveness and that, once liquidity became somewhat pinched, the availability of funds became a crucially important determinant of investment outlay in and of itself."[*]

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[*] Meyer and Kuh, op. cit., pp. 229-230.

The capacity formulation of the accelerator referred to here is the use of "total needed capacity," measured by the product of current sales times the minimum gross fixed assets to sales ratio reached between 1946 and 1949, as an explanatory variable for investment divided by fixed assets. This contrasts to a more ordinary accelerator with sales change as the major explanatory variable. The liquidity stock variable used was net current assets minus inventories and current liabilities.

Meyer and Kuh came to their conclusion regarding the preferability of the capacity accelerator after testing it in a model which also used a standard sales change accelerator. In my statistical work described below I was unable to test a similar capacity accelerator due to the lack of fixed asset data discussed in Chapter III. In contrast to, but not in direct opposition to Meyer and Kyh's conclusion, I found that a sales change accelerator did explain a significant portion of investment in 1953 and 1954. However, this explanation was significantly increased by the use of a measure of "pressure on capacity."

Similarly, although I did not have the data to test the liquidity variables mentioned above, I did find that in 1954, a year similar to 1948 and 1949 in that "economic conditions stabilized and declined in several areas," a sales change accelerator explained a significant portion of investment, not less significant than for 1953, particularly for those firms with increasing sales pressing on capacity. I cannot contradict the previous work on either the capacity accelerator or the liquidity variables since I was unable to test the variables used,

but I can say, very tentatively, that my work seemed to lead to differing, although possibly complementary, conclusions. One statement that can be made is that profits, used in the Meyer-Kuh model as a permissive liquidity variable, might almost as easily be used as a causative incentive variable. In general, however, the work of Meyer and Kuh, rather than being opposite in results to mine, complements my conclusions by showing that a complete model should use both accelerator and liquidity variables and reinforces them by showing that some consideration of pressure on capacity is necessary in any accelerator formulation. The specific theories about the "capacity formulation of the accelerator" and the major influence of liquidity in non-boom years I can neither confirm nor deny.

Eisner's work with a large questionnaire sample is not statistically as sophisticated as that of Meyer and Kuh. His aversion to multiple regression in particular makes it difficult to discover which independent variables can be used in combination with which others. Nevertheless he states that:

> "We have sought to focus data on certain recent economic theory which attributes importance to a multilagged and quantitatively limited version of the acceleration principle. In this effort, we have found evidence of an 'acceleration component' of investment. While investment of all firms revealed low correlations with both sales changes and expectations of sales changes, these correlations were generally found to be markedly higher among firms whose investment history or current plans warranted their inclusion in the acceleration category.

> "Investment was also found to be correlated with current profits. And sales expectations appeared to play a curious role of setting the stage for the effect upon investment of a number of other variables, such as capital supply and change in actual

sales. In view of the extremely low direct correlation between sales expectation and investment, one may infer that in a number of instances favorable sales expectations were a necessary but not **sufficient** condition for capital expenditures."*

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* Eisner, Expectations, Plans, etc., p. 64 of preliminary copy.

My findings, particularly as to actual sales change, generally agreed with those of Eisner. Using Eisner's suggestion of dividing firms into those whose history and expectations warranted inclusion in the acceleration category, and those which did not fit, I found accelerator relationships, both multi-lagged and simply-lagged which explained up to 35 per cent of investment and similar variables. I also found that longer-run sales expectations, on which I had data of a type not available to Eisner, played a major role in the accelerator equations. Because of the greater use of the powerful multiple regression tool, I found that my (multiple) correlation coefficients were in general considerably higher than those Eisner describes, although still fairly low. Since I had no data on profits or depreciation allowances, which both Eisner and Meyer and Kuh found to be significant, I can offer little comment on these findings. Meyer and Kuh found these two liquidity variables not to be significant at the same time as the accelerator variables. Eisner did not test the two sorts of variables together. It therefore cannot be said whether inclusion of liquidity variables would have significantly improved my correlations.

Eisner in the same paper also discusses a hypothesis that companies have a concept of "normal sales" and that any downward departure from normal generates an expectation of a rapid return. This provides one possible explanation for some curious results presented below, suggesting that firms with declining sales tend to invest in direct proportion to the amount of the decline. These findings will be discussed more fully below.

For his interview study, Eisner went to a much smaller group of fourteen companies which he studied in much more detail than would be possible merely by tabulating questionnaire answers. Statistical methods do not present the same problem here because the sample is so small as to preclude the use of statistical techniques and because the discussions with the corporation executives were not quantifiable. Eisner's major tentative conclusions concerning consistencies in factors affecting company investment are:*

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*   Eisner, <u>Determinants, etc.</u>, pp. 15-37.

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    1.   Capital expenditure plans are related to long-run demand factors but are themselves usually short-run. The high rate of discount businessmen put on risk tends to preclude too many long-run capital expenditure programs.

    2.   Investment for expansion, in particular, seems related to long-run changes of demand when these changes put pressure on productive capacity. However, it is not easy to draw a borderline between expansion investment and other investment, particularly between expansion investment and cost-reducing investment.

    3.   It is not necessarily the case that replacement and modernization investment can be depended upon to support investment expenditure aggregates in case expansion investment is low or

that replacement and modernization investment depends mostly on depreciation allowances. Replacement and modernization investment seems to depend on about the same things and follow about the same laws as expansion investment.

4. The supply of money capital did not seem to be a vital consideration in investment decisions but "there was repeated evidence that the problem of obtaining funds was an important one at least in the financial departments of the firm."*

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*   Ibid., p. 27.

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5. Given that somewhat the same factors seem to affect the investment decisions of many firms, the calculations which lead from the causative factors to the quantitative investment decisions seem to differ considerably among firms, and seem very difficult for the investigator to uncover.

Conclusion two is generally borne out by my computations. I did not have the data to test conclusion four or to test completely conclusion one. My findings relative to one seem to agree that long-run demand factors play an important role in investment decisions, and some of the data seem to indicate that two-year investment by the firm is more closely related to these factors than one year, but two-year investment is by no means a long-run investment program. So far as conclusion three is concerned, my data seems to show that modernization and replacement investment depend somewhat on distress investment factors. However, I would agree that such investment cannot be counted on when expansion investment is low.

However, possibly the most interesting of the conclusions is five, concerning the differences among and difficulties in discovering the firm calculations leading from causation to investment. It

would seem to be here that we might fruitfully look to discover
the cause of the low but significant correlation coefficients
which seem to plague past and present statistical cross-sectional
investment work. The hypothesis that there is a definite relation-
ship between accelerator-type change of sales or sales expectations
and investment seems to be confirmed by previous work as well as
by my own. However, it is difficult for the investigator not to
be disappointed by the lowness of the accelerator correlation
coefficients and indices. It may be that there is actually a
strong but differing relationship between sales change and invest-
ment for different firms, in which case the relationship would
appear smaller when estimated for a cross-section of the differing
firms. If this were the case it should be possible to estimate
these relationships by combining cross-sectional and time series
analysis and deriving separate equations (or equations with the
same slope but differing constant terms) for different companies.
I attempted, completely unsuccessfully, to do this using 1952-3
and 1953-4 sales change data, all that were available. Some future
investigator might well do better when there are more years of
useable data for each firm. At any rate, on the basis of Eisner's
findings it would be worth a try.

2

In the equations and sets of equations in Table IV-1 below, the
statement that a certain equation refers to the set of firms having

"capacity pressure" means that this particular equation is derived from data for firms which have indulged in expansion investment either during the year to which the equation's dependent variable belongs or the previous year. It was felt that this measure, following Eisner, would present a fairly good, if rough, idea of which firms actually felt sales pressing on capacity. A possible alternative, dividing firms into those which experienced actual capacity increases and those which did not, was rejected because a firm carrying on replacement investment merely in order to maintain its position would probably replace old equipment with more modern equipment which could well bring about a capacity increase even in the absence of any particular pressure on capacity.

The symbols used in the equations below are:

subscript a; meaning that the magnitude in question is an actual or fulfilled magnitude,

subscript p; meaning that the magnitude is a predicted one,

superscript numeral $9,0,1,2,3,4$ meaning that the magnitude occured during or is predicted for the year 1949, 1950, 1951, 1952, 1953, 1954

subscript numeral $9,0,1,2,3,4$ on predicted magnitudes only, meaning that the prediction was made in 1949,1950,1951,1952,1953,1954

superscript m; meaning 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,

superscript t, t-1, etc.; meaning that the magnitude occurred

during or is predicted for several different years within this par-

ticular equation,

subscript t, t-1, etc.; meaning that the magnitude was predicted

during several years for this particular equation,

An example using the above would be a variable I_{p3}^{4}/I_{a}^{m} , which

would be Investment predicted in 1953 for 1954 divided by the mean

of actual investment.

Other symbols are:

I = gross investment for the firm (reported on questionnaires),

S = sales for the firm (reported on questionnaires),

C = capacity for the firm (Used in ratio with previous or

subsequent capacity only. Capacity change is reported on questionnaires),

E = expansion investment for the firm (gross investment mul-

tiplied by percentage devoted to expansion, which is reported on

questionnaires.),

Co = company's expectation of three year percentage change

in its own sales (reported on questionnaires),

Ind = company's expectation of three year percentage change

in sales of its industry (reported on questionnaires).

For the convenience of the reader, Table IV-2 presents a

schematic diagram of Table IV-1.

TABLE IV-2
Schematic Diagram of Table IV-1

The numbers in the boxes below indicate the numbers of the relevant sets of equations in Table IV-1. The Notation "NS" means that no explanatory variables or breakdowns proved significant in the particular category.

	Equation Set (1) Capacity Change and Expansion Investment					
	DEPENDENT VARIABLES					
	Actual Investment	Predicted Investment	Actual Capacity Change	Predicted Capacity Change	Actual Expansion Investment	Predicted Expansion Investment
Equations using two-year value of dependent variable	NS	NS	(2)	NS	NS	NS
Equations using one-year value of dependent variable and both short- and long-run sales change and sales expectations as independent variables	(3)	NS	(4)	NS	(5)	NS
Equations using one-year value of dependent variable and one and two-year lagged short-run sales changes and sales expectations as independent variables	(6)	(7)	(8)	NS	(9)	(10)
Equations using one-year value of dependent variable and one-year lagged sales and sales expectations as independent variables	(11)	(12)	(13)	(14)	(15)	(16)
Equations using predicted sales change as independent variable in explaining actual Investment	(17)	NS	NS	NS	NS	NS

The equations and sets of equations tabulated above are logically divisible into three groups. Equation set (1) is unlagged and is intended to show no causation, but merely a relationship between two investment-type magnitudes, capacity change and net investment. Equation sets (2) through (5) covering the remainder of the top half of the sheet are each relatively "complete" or "final" equations expressing various aspects of investment as functions of various sorts of sales changes. Their completeness lies in the fact that they are the results of testing all of the available sales change and sales expectation variables, and they use all such variables which proved statistically significant at the .95 level. Equation sets (6) through (17) are not complete in the same sense, inasmuch as they exclude the long-run (three year) sales expectation variables, but they are nevertheless instructive and are therefore included in the presentation. It is to be noted that the dependent variables are classified as to type (actual investment, predicted capacity change, etc.) in the columns, and that dependent and independent variables are classified as to duration and lags in the rows.

1. The first substantive points to be made concern the differences among the dependent variables. The six dependent variables are the actual and predicted magnitudes of Investment, of Capacity Change, and of Expansion Investment. The capacity change variables differ in two ways from the others. As discussed in Chapter III

above, it was felt necessary to transform the reported annual dollar investment and expansion investment expenditures for each firm by dividing by some base magnitude. The best available base magnitude was the six-year mean of investment for the firm, a device which is admittedly imperfect but was used nevertheless because of lack of alternatives. The capacity change figures, however, were reported by each company in percentage terms and therefore, need no transformation or "deflation." They are in a sense, therefore, more exact than either the investment or the expansion investment figures.

However, there is a more basic difference between capacity change on the one hand and investment and expansion investment on the other. Accelerator theory uses sales changes to explain investment expenditures, hypothesizing that if a company experiences an increase in product demand which it cannot fill at its present capacity, it will invest to increase the capacity and take advantage of the profits on the increased sales (provided of course that the returns on the sales are greater than the cost of the investment).*

* See for example, Meyer and Kuh, op. cit., page 217, or Hansen, Alvin, Business Cycles and National Income (New York, 1951), page 357

However, it might be more reasonable to say merely that in the case of sales pressing on capacity the company will increase its capacity. This second step may be probable but it is not necessary. Capacity could be expanded without expenditure of investment funds, in the course of repair and maintenance. More likely, capacity

could be and frequently is expanded without the use of funds
beyond replacement investment funds, as obsolescent machines are
replaced with modern ones. Therefore, the accelerator relationship
might be stated as being between sales change and capacity change
and only at second remove between sales change and the funds spent
on changing capacity. Actually, the capacity change accelerator
is in a sense tautological, since it merely states that if increased
capacity is needed, capacity will be increased. It is nevertheless
a necessary step on the road to a more meaningful theory relating
sales pressure on capacity and investment expenditure.

Just as capacity can be increased without spending investment
funds, investment funds can be spent without increasing capacity.
The replacement investment funds more often than not bear little
relation to capacity change, as indicated by the fact that total
investment could not be used as a significant variable in addition
to expansion investment in equation (1) relating capacity change
and investment. It may be that not even all expansion investment
expenditures increase capacity. There seems to be some evidence,
discussed below, for "distress investment" by declining sales firms.
If this is the case, it may be that it is the modernization and
cost-reduction effects of investment which attract these companies,
rather than the expansion of capacity to meet a contracting demand.
Indeed, in some cases it may even be that the publicity value and
the ability to appear optimistic which are consequent upon the
actual fund expenditures are of more importance to the firm than

the physical results of the spending.

Total investment and expansion investment also differ in
meaning, total investment being the sum of expansion investment and
replacement and modernization investment. The McGraw-Hill firms
report a dollar investment total and expansion and replacement
percentages, the sum of which should be 100 per cent. The expansion
investment figure used here is the product of total investment and
the expansion percentage. The difference in definition between
the total and the expansion magnitudes is obvious and need not
be labored.

Turning to a comparison of the three variables in the equations,
equation set (1) expresses capacity change as a function of expansion
investment. The fact that the regression coefficient declines
monotonically as time passes is the result of price changes and of
the fact that the capacity change figures are expressed as per-
centages of bases which grow from year to year. As such, this
decline is of little interest. What is of interest is: first, the
fact that the R^2 of the set of equations is fairly high compared to
other cross-sectional R^2s (30 per cent of the variance of capacity
change is explained) and the standard error of estimate is very
low (.0081 for a variable whose mean is about 1.02); and second,
the fact that whereas expansion investment was a significant explanatory
variable, total investment was tested and found not to be. This
seems to confirm the weakness of the link between capacity change
and gross investment and, if the theory that the sales-change

accelerator relates first to capacity change is accepted, may cast

some doubt upon any gross investment accelerators. At the same

time, the definite link between capacity change and expansion

investment would indicate a theoretical basis for a sales-change

expansion investment accelerator.

Leaving aside the computations using two-year values of the

dependent variable (equation 2) because these computations were

made for capacity change only,* the next group of equation sets

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* The reason for this was that the "deflation" of the money
investment variables by the firm's six-year mean of money in-
vestment made the use of two year investment or expansion invest-
ment fairly meaningless. For one year investment the deflator
was a number of which the numerator comprised only one sixth.
For two year investment the numerator already makes up a third
of the denominator and there is an increasing tendency for the
ratio to approach a useless 1. An attempt made to use two year
investment was not very successful, confirming this belief.

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contains those called "complete" (equations (3) through (5)),

because they include all the significant sales change and sales

expectation variables. Looking at the three equations, although

they all show accelerator-type sales-change effects, two interesting

differences appear upon comparison. The expansion investment equation

(5) uses a two-year actual sales change variable not significant in

total investment equation (3), and is also a better explanatory equation

than (3), showing a higher R^2 (.2236 compared to .1992). Second,

comparing the capacity change equation set (4) to the investment

equations (3) and (5), the capacity change set seems to be

the only one that conforms fully to the theoretical

formulation of the operation of the accelerator. This formulation
states that sales-change or expected sales-change has a positive
effect on investment when the sales-change produces an upward pressure
on capacity. Equation set (4) conforms by showing accelerator
relationships only for those firms having pressure on capacity
and showing these relationships to be only with increasing sales
or sales expectations. Equations (3) and (5) show that a similar
division of firms into theoretical accelerator and non-accelerator
cases does not significantly aid the sales-change explanation of
total investment or of expansion investment. Whatever sales-change
relationship is present in the investment expenditure equations (3)
and (5) seems to apply equally to all firms whether or not they
conform to the theoretical accelerator preconditions.
The more exact formulation of the accelerator probably does apply
to all of the dependent variables, as discussed in subsection 3
below, but the fact that it applies directly to capacity change
only indicates the greater conformity to theory of the capacity
change accelerator.

Thus the interpretation of equation (1) and the interpretation
of the comparison of equations (3) through (5) seem to agree.*

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* Since equations (6) through (17) are constrained to exclude
certain variables it did not seem too meaningful to make a similar
comparison for them.

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(1) indicates that capacity change can be expressed as a function,
although an inexact one, of expansion investment, but not as a
function of total investment. The comparison of (4) to (3) and (5)

indicates that capacity change as a dependent variable conforms

most closely to the theoretical sales-pressure-on-capacity

accelerator. The comparison of (3) to (5) indicates that there

is a stronger accelerator-type relationship between sales change

and expansion investment than between sales change and gross

investment. The progression of accelerator effects therefore seems

to be from the strongest, capacity change, through expansion

investment to the weakest, total or gross investment.

2.   In the foregoing paragraphs on dependent variable comparison,

I have been tacitly assuming, without explicitly discussing, the

correctness of accelerator theory. The results of my computations

seem to agree in general with the theory that investment in its

various aspects has a relationship to sales change. Equation (2)

on two-year change of capacity shows the strongest relationship

(R^2 = .3592) because the summing of two years eliminates the problem

caused by the fact that investment and capacity change programs

do not typically end on December 31. This equation shows ? multi-

lagged effect of various long-run sales expectations and shorter-

run actual sales changes on change of capacity. It is interesting

to note that this equation as well as most of the others using

multiple regression show considerably higher indices of correlation

than the highest obtained by Eisner, approximately .15.*

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* Eisner, Expectations, Plans, etc., page 52 of preliminary copy.
The author states that the figure is correct although the inter-
pretation thereof has changed since preliminary publication.

Equations (3) through (5), using one-year values of the dependent

variable and all of the possible significant lagged values of

sales change and expected sales change have been discussed above.

They all have accelerator relationships which are either multi-

lagged or singly·lagged with a multiple breakdown of firms.

Equation sets (6), (8), (9), (11), (13) and (15) are all

estimates of relationships between the actual values of the three

dependent variables and various short-run (one and two year) actual

sales change variables. Sets (8) and (13) on capacity change and

(9) on expansion investment all unambiguously indicate various

lagged accelerators. (6) and (11) on total investment and (15)

on expansion investment at first glance seem not to conform

to the accelerator hypothesis because equations (6.1), (11.1)

and (15.1) for firms with sales increasing over all periods of

time tested and with pressures on capacity show no significant

relationship between the dependent variables and changes of sales.

In all of these cases, however, equations estimated for all firms

pooled did indicate the existence of significant linear accelerator

relationships. The breaking down of the data into increasing

sales and decreasing sales groups provided better explanations than

the linear accelerators with use of the same number of parameters

and the loss of the same number of degrees of freedom. Although

there is no significant within-group linear relationship between

investment and sales change, there is an overall relationship

between the two variables indicated by the large difference

between investment means of the increasing sales and decreasing sales groups. Since the theoretical accelerator is not necessarily linear, these equation sets do not contradict accelerator theory.

The remaining sets of equations, (7), (10), (12), (14) and (16) for predicted values of the dependent variables and predicted sales changes and (17) for actual total investment and predicted sales changes all contain linear accelerators. Thus, all of the attempts at regression between the three dependent variables and various sales change variables seem to produce some sort of linear or non-linear effect of sales change upon capacity change, expansion investment and total investment. Taken individually, the R^2s seem low, if significant, but the fact that no attempt has been able to accept at the .95 level the hypothesis that there is no relationship between sales change and the other variables seems fairly impressive.

3. In the above, I have suggested that the data in my sample conform to the general outline of accelerator theory--that sales change does affect both capacity change and investment expenditure. However, a more complete statement of the theory includes the qualification that this effect comes only when upward sales change is pressing on the productive capacity of the firm. The data seem to conform to this qualification but not as unambiguously as they do to the more general statement.

In equation sets (6) and (17) on actual total investment, (4) and (13) on actual capacity change, (14) on predicted capacity

change and (9) and (15) on actual expansion investment, breakdowns

of cases into firms with and without pressure on capacity (pressure

on capacity being defined as the existence of expansion investment)

and into firms with increasing and decreasing sales both added

significantly to the explanation of the dependent variables.

Sets (11) on actual total investment, (7) and (12) on

predicted total investment, and (10) and (16) on predicted

expansion investment have incomplete breakdowns.* In each case

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* In equations (10.2), (15.3) and (16.2) for expansion investment, investment for companies without capacity pressure is zero by definition. Since, by the definition used for capacity pressure, a company without capacity pressure must have had 0 expansion investment in year t, this must be the case in the equations mentioned.

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some differentiation between capacity pressure and non-capacity

pressure or between increasing sales and decreasing sales firms

does help the explanation, but in (7), (12), (10) and (16) both

increasing and decreasing sales firms are included in the accel-

erator category so long as they have pressure on capacity, while

in (11) both firms with and without pressure on capacity are in-

cluded so long as they have increasing sales.

In equations (3) on actual total investment, (2) and (8) on

actual capacity change and (5) on actual expansion investment, no

grouping of companies aided the explanation.

Bearing in mind the fact that the .95 confidence level is used

throughout, the evidence seems to indicate that the sales-pressure-

on-capacity qualification to the accelerator is a helpful degree

of sophistication. The fact that a division of firms according
to sales direction or capacity pressure is not significant at
the .95 level merely means that in more than 5 cases out of 100
a division of firms according to some random unrelated criterion
could produce the same additional explanation as the breakdown
being tested. The rejected breakdowns might provide additional
explanation which is useful even though not significant at .95.
In several of the cases I have called "incomplete breakdown"
in which some theoretical non-accelerator firms are included in
the accelerator category, a further division excluding these firms
from the category was significant at the .90 level. It therefore
seems reasonable to say that all eleven of the complete or in-
complete breakdown equation sets tend to confirm the theoretical
qualification on the accelerator. Further confirmation is added
by an inspection of the equations in the eleven sets. In sets
(6), (11) and (15) where, as has been pointed out, there exists
an overall accelerator relationship even though there is no
within-group linear accelerator, the mean of investment within
the increasing-sales capacity-pressure group is substantially
higher than the means of other groups. In the other eight sets
the regression coefficients on the sales change variables in
the theoretical accelerator groups are invariably of positive
sign* while in the non-accelerator groups either there is no

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* In equation (2.1), S_a^4/S_a^2 has a positive coefficient,
while S_a^3/S_a^2 has a smaller negative coefficient. The latter
variable is part of the former and the net effect is positive.

relationship between sales change and investment or the relation-
ship is a significantly negative one. The meaning of the negative
coefficients within the non-accelerator groups will be discussed
below. What is of importance here is the fact that wherever
the breakdown into theoretical accelerator and theoretical non-
accelerator groups can be made, the cases which should conform
to the accelerator theory do, while those which should not do not.

Thus far, the data do seem to confirm the qualification to
the accelerator. However, equations (2), (3), and (5) where
no breakdown helps, have been deliberately left out of the
discussion. These equations, which are three of the four
in which all available sales-change variables have been tested,
cast doubt upon the qualification. Aside from the lack of
significant explanation from divisions by capacity pressure
or direction of sales change, these equations have on interesting
similarity. They are all multilagged equations in which the
dominant independent variables are long-run (three year) sales
expectations for the company as predicted the year before the
start of the investment or capacity change program. The other
variables in each equation seem to qualify the major variable
in a manner to be discussed below. What is relevant here is
that, in the other equation sets, where investment is considered
a function of short-run sales change then the qualification to
the accelerator seems to hold; that is, only in the companies
for which sales change exerts an upward pressure on capacity is

the accelerator relationship clear. For these sets in which

investment is considered a function mainly of longer--run ex

ante expectations of sales change the qualification does not

seem to hold; pressure on capacity seems to play no important

role. One possible explanation lies in the limitations of the

criterion used for pressure on capacity. Regardless of whether

it shows expansion investment this year or last, a company expecting

a long-run sales increase presumably also expects eventual capacity

pressure. This should be the case unless the company is now oper-

ating at a very low percent of capacity, which is unlikely in the

comparatively prosperous years covered by the data. The expansion

investment criterion may be sufficient in the shorter-run case when

the question is of the effect of one or two-year sales change on

investment. It seems not to be sufficient when we consider the

longer-run expectations.

This hypothesis, however, does not explain equation (8) in

which no breakdown helped even though there were no long-run ex-

pectational variables. Number (8) is a single equation, rather

than a set, and uses three explanatory variables--a loss of four

degrees of freedom. It was discovered that a possible alternative

to (8) existed; a set of three equations broken down according to

the sales-pressure-on-capacity classification and using in each

equation only the s_a^4/s_a^2 variable. This set explained more than

(8), using up six degrees of freedom. The additional explanation

given by the two additional degrees of freedom, however, was

significant at only the .90 level and the alternative could

therefore not be accepted. There does nevertheless seem to be

a partial interchangeability between the one equation with several
independent variables and several equations with one independent
variable each. Indeed this interchangeability was apparent in
other cases. This "either-or" phenomenon may have an explanation
lying in the statistical method of acceptance or rejection by
comparison with random sample correlations from non-related
populations. There seems to be no more than 20 to 35 percent
of the variance of investment or capacity change explainable
by any of the sets of sales change variables. The undiscovered
remainder of the variance presumably stems from either classes
of variables such as liquidity, not tested, or from a hard core
of idiosyncracies of individual firms. With only 20 to 35 percent
of the variance explained and with samples typically of size 100 to
200, there is a limit to the number of degrees of freedom which can
be lost in explanation before the additional explanation of any next
variable becomes insignificant. Thus we can use a set of three equations
with six lost degrees of freedom or we can use one many-parametered
equation with four lost degrees, but if we were to try to use a set of
three equations with four parameters each we would lose twelve degrees
which is too much for samples of this size. With larger samples it
might be the case that although still 20 to 35 percent was explained,
this explanation could successfully be divided among a larger number
of parameters with the loss of a larger number of degrees of freedom.

In general the weight of the data seems to bear out the sales-pressure-on-capacity qualification to the accelerator. In the case of the eleven "breakdown" sets of equations the evidence seems to be fairly definite. As for the four where no breakdown helped, either the argument that the measure of capacity pressure used is insufficient for the long-run expectational variables or the argument that the sample size is too small to support the loss of too many degrees of freedom might be used to explain away the divergence from the theoretical qualification. It is easier to explain away this four equation divergence than to explain away the conformance of the eleven equation sets. The evidence that the accelerator works only when upward sales change exerts pressure on capacity is not unambiguous, but at least such evidence does seem to exist.

4. A thread (sometimes tenuous) of data and reasoning has led to the statements that an accelerator relationship seems to exist and that it may well conform to the theoretical sales-pressure-on-capacity accelerator. The next question is that of which particular sales change variables are involved in this accelerator relationship. For this purpose we can inspect only equation sets (2) through (5) since the other equations were constrained to exclude certain variables.

The most obvious thing about these equations is that they all include as an independent variable company prediction of own three year sales change. In each equation company predictions

made at different times were tested and in each equation the only prediction to be significant was the one made in March of the year before the investment or capacity change program in question was commenced. From this it is an easy conclusion that one major component of an accelerator explanation of investment is a comparatively long-run sales expectation variable and that there is some lag of about a year between the expectations and the action. The statement of the lag is not definite because of the annual nature of the data but variables that have been tested and rejected indicate that the lag is neither zero nor two years.

Equations (2) and (5) also include actual past change of sales variables. Equation (4.3) uses a one year actual sales change variable for the cases where this variable is increasing even though long run sales expectations are downward. A similar additional variable was rejected at the .95 level for equation (3) on total investment, but it was significant at the .90 level, so that we can probably generalize the effect of such explanatory variables to all of the dependent **variables**.

It is very difficult to draw any overall conclusions from the significance of the past change of sales variables in the equations. In equation (2)(and in equation (8) excluding the long-run expectational variables) the net result of the use of the three short run variables is a negative effect on capacity change. In equation (4.3) and equation (5) the relationship is positive. One explanation for the negative effect is that the

investment from past sales increases has already taken place due to the previous expectations of these increases. Those companies which had a previous high rate of investment and large change of capacity in this way are then less likely, either for liquidity and lack of funds reasons, or because they have increased capacity ahead of demand, to continue this rapid expansion, even though they still have high hopes for the future. However, this does not mean that these companies will not increase capacity at all. If their long-run expectations are still upward they probably will, but less than those companies which have high expectations after a dry spell. Equation (4.3) does not particularly conflict with this theory since the group of companies with past sales increasing and expectations decreasing is too small to have much of an effect on equation (2) for all companies. This group may have its own reason for increasing capacity. Since these companies still have present pressure on capacity, their investment programs may be lagging behind the others and their investment in year "t" is probably still in response to past sales changes.

Equation (5) however, contains roughly the same group of companies as contained in equation (2) and seems to show that the same 1953 and 1954 sales change which slowed down capacity change in 1953-4 increases the 1954 expansion investment. It may be that three-year sales expectations have changed completely from the 1952 prediction used in equation (2) to the 1953 prediction used in (5) but this effect did not show up in the data and to

use this as an explanation smacks of sheer statistical sophistry.
It is probably better to say in the case of the net additional
effect of the past sales change variables that these variables
seem to have a negative effect but that the evidence is very
ambiguous and the result not at all clear. This is not very
satisfactory, but no clear-cut result emerges.

There are two further points in these four equations which
need explanation. The first is the fact that in equation (2),
although the net effect of the past actual sales change variables
is negative, there are two negative one-year and one positive
two-year variables rather than one overall negative variable.
The second is that in equations (3) and (5) the positive effect
of sales expectations for the firm is qualified by a negative
effect of the firm's sales expectations for the industry. These
facts can probably be best explained by a hypothesis which states
that the effect of the sales change variables on the firm's
investment or capacity change is stronger the more certain it is
of its expectations and of the lessons taught by its experience.
In equation (2),(and in incomplete equation (8)) the result of
having three past sales change variables rather than one is that
the net negative effect of variables is weaker where the change
has been steady from year to year rather than up strongly one
year and down the next or up strongly one year and up slightly
the next. For example, a firm with sales of 1.0 in 1952, 1.2
in 1953 and 1.5 in 1954 will have a net effect of -1.41. One
with 1.0 in 1952, 1.5 in 1953 and 1.5 in 1954 will have -1.45.

The company experiencing a steady change of sales is more likely
to be sure of the trend indicated by the change than one exper-
iencing spurts and plateaus. The uncertain company is less likely
to invest heavily. Similarly, for equations (3) and (5), a company
which expects that its own sales will increase as a result of a
general movement of industry sales may not be certain of its share
of the general increase. A company, however, which expects its
own sales to increase a good deal more than those of its industry
will probably have good reason for this expectation. Again the
net effect of the company and industry sales expectations will
be stronger for the firm which is more certain of its own ex-
pectations.

Thus there are three conclusions from this detailed examination
of the variables used in the equations for which all variables
were tested. First--the variables representing long run sales
change expectations seem to have the major accelerator effects
on capacity change. Second--these variables are modified by
short-run past sales change variables and although the modifi-
cation seems to be that past sales change inhibits the investment
effect of expected sales change, this conclusion is not at all sure.
Third--whatever the accelerator effects of the sales change variables,
these effects are stronger the more certain are the lessons of
the past or the expectations of the future.

5. There is one interesting non-accelerator effect of sales
change on investment which appears from the equations. This is

the fact that there seems to be some evidence for a distress investment theory. In equations (6.3) and (17.2) on actual total investment, companies experiencing or expecting sales decreases invest in inverse proportion to the size of the decreases. In (12.2) on predicted total investment, companies without sales pressure on capacity show the same relationship. In equation set (7) on predicted total investment, among the companies without pressure on capacity those expecting sales decreases invest considerably more than those expecting increases. These companies are not investing for expansion nor are they increasing capacity, since the same effect does not show up in any of the equations using these other magnitudes as dependent variables.* The non-expansion investment on the McGraw-Hill

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* In equation (9.2) for expansion investment of firms with S_a^4/S_a^2 upward and S_a^3/S_a^2 downward, both variables have negative coefficients, but this was a very small number of companies and this fact plus the extremely large size of the coefficients leads me to believe that this was one of the 5 chances in 100 where equations which are significant at the .95 level are pure statistical accidents.

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questionnaire is for "Replacement and Modernization", and it seems likely that these declining firms are modernizing in an attempt to regain their position. Firms experiencing or expecting slight sales declines maintain their normal investment so that dollar investment for the year in question is close to the mean

of investment for the six years. Those firms with drastic sales

declines in equations (6.3), (7) and (17.2) seem to be going all

out to modernize before going under. Those firms with excess

capacity in (12.2) are acting similarly. It is dubious whether

the relationship appearing here has too much significance for the

accelerator in business cycle theory, since companies having sharp

sales decreases at a time when all other companies are undergoing

the same experience are more likely to retrench than to modernize

radically. The firms included here find themselves going under

when their competitors in the comparatively prosperous years of

1953 and 1954 are doing well and it is this comparison which

causes the increase in modernization expenditures. The same

statistical effects might be explained by Eisner's hypothesis

that companies have a concept of "normal" sales and if actual

sales are down sharply the expectation is for a future sharp

increase. However, the fact that the inverse sales-change

investment relationship extends to predicted sales change in

(7) and (12) weakens the applicability of his theory considerably.

6.   As mentioned above, Meyer and Kuh show that in their data

investment in years of business expansion seems to be affected

by a different class of variables than in years of business

contraction. Had I been able to obtain material on liquidity

I might have obtained the same result, but without such data the

evidence seems to point tentatively in the other direction. Equation

sets (4) and (11) through (16) include data for 1953, a year
characterized mostly by expansion and 1954, characterized
mostly by contraction. In none of the equations was the
relationship between investment and sales change significantly
affected by grouping the data by year. In (4), the year did
make a slight difference in the constant term of the equation
for firms with sales pressure on capacity, indicating that some
variables not included might have had a significant additional
effect, but in (11) through (16) similar differences in the
constant term were made insignificant by the division of the
companies according to capacity pressure and sales direction.
Because of the lack of liquidity data, because of the fact that
the recession of 1954 actually began in 1953 for many companies,
and because my "best" equations had data for 1954 only, not too
much weight should be placed upon my results in this case.

7.   A final word should be said about the comparison between
actual and predicted magnitudes of the same dependent variable.
In the "incomplete" equations (6) through (17) the main effect
of such a comparison seems to be that sales change had some-
what more of an effect on predicted than on actual investment.
Comparing (6) to (7), (11) to (12) and (15) to (16) it seems
to be the case that the predicted values of the dependent variables
had linear relationships with sales change within the sales-
pressure-on-capacity group, while the actual values did not.
Similarly, although there does not seem to be too much difference

between (13) and (14) so far as parameters are concerned, (14) on predicted capacity change has an R^2 of .2051 compared to (13)'s .0902. The evident explanation of this is that although companies try to invest on the basis of an accelerator relationship, other factors throw their investment off the planned path. Some of these factors may be liquidity, capital goods supply, prices and other things which could not be tested here.

Similar comparisons were not made for "complete" equations (2) through (5) because it was felt that computing separate equations for the predicted magnitudes of the dependent variables would serve no useful purpose. Once lags going back two or three years for the independent variables were introduced, any difference between actual investment and investment for the same year pre-dicted one year earlier should be purely random. An attempt made to compute such a regression for the predicted value of one of the dependent variables confirmed this feeling. The fact that strong accelerator relationships were discovered for the "complete" equations while they were much less strong for the actual values of the dependent variables in the "incomplete" adds further confirmation.

A systematic investigation of company fulfillment of invest-ment plans is made in Chapter V.

3

To summarize the results of the finding in this chapter:

1. Definite evidence was discovered for the accelerator, the relationship of sales change to capacity change or investment.

There was evidence that this relationship is strongest (if
tautological) on pure capacity change although it exists at
second remove on expansion investment and on total investment.
Future expectations of comparatively long-run sales change
are the major accelerator variables, but the accelerator is
modified in a confusing manner by past sales changes.

2. The accelerators derived in this chapter are sales change
rather than Meyer-Kuh capacity formulation accelerators. However,
it was not possible to test the Meyer-Kuh theory and it was dis-
covered that grouping the companies by pressure on capacity and
by direction of sales change did significantly improve the
accelerator relationships.

3. There was evidence to show that the accelerator relation-
ships are stronger the more strongly held are the expectations
for future sales change or the beliefs based on past sales change.

4. The evidence seemed in a very tentative manner not to
conform with the Meyer-Kuh theory that investment is affected by
differing factors in years experiencing different directions of
general business movement.

5. There was no data on and no tests of the relationship
of liquidity variables with investment.

6. There was evidence for the existence of distress modern-
ization investment among firms declining at a time when most
firms are improving their position.

Chapter V

INVESTMENT PREDICTIONS AND THEIR REALIZATION

1

As was pointed out in Chapter II above, the aggregate forecasts
derived from investment intentions surveys have performed very
well, predicting the magnitude of capital goods expenditures
to within a few per cent and accurately forecasting the cyclical
turning points of 1949, 1954 and 1955. As was also pointed out,
this success has been due to the cancelling out of very wide
errors in company forecasts of their investment. If this wide
variation in company fulfillment of investment plans is not
statistically random the danger always exists that errors will
not cancel and that aggregates will be far off. The purpose of
this chapter is to investigate the factors affecting accuracy
and realization of company investment plans and to discuss possible
methods of allowing for imperfect predictions. Except for a few
words on the comparison of fulfillment of total investment, expansion
investment and capacity change plans, the discussion will be
confined to total investment since this is the magnitude which
must be correctly forecast in the aggregate in order to obtain
accurate Gross National Product projections.

There are several matters of definition which should be
discussed before the substantive exposition. The first is that

of the difference between expectations and plans. In general, in

the previous work in this field, the term expectation or antic-

ipation is used for any belief about the future value of any

economic magnitude. A plan or intention is a particular expectation

over which the expector has control.* This chapter is specifically

* These are the definitions used by Irwin Friend in his paper
on Critical Evaluation of Surveys on Expectations, Plans and
Investment Behavior presented to the Conference on Expectations,
Uncertainties and Business Behavior, Pittsburg, October 27-29, 1955,
page 1 of the preliminary copy.

concerned with company plans for investment and with other non-

planned expectations only as they affect investment plans.

There is another semantic point of some importance involved

in the use of the word "plans". What the surveying organizations

hope to get is the firm's best guess expectation of its investment.

Canada asks for "estimated" expenditures, which seems unambiguous.

The Department of Commerce -SEC requests "anticipated" expenditures.

The relevant dictionary definition of the word "anticipate" is

"to expect; as, to anticipate disaster."** This also seems un-

** Webster's Collegiate Dictionary (Fifth Edition, Springfield,
Mass., 1936) page 46.

ambiguous, but the Commerce -SEC questionnaire goes on to explain,

"For 'anticipated expenditures' show estimates of costs which

according to present planning will be incurred during the specified

period". (My underlining.) McGraw-Hill asks "How much do you now plan to invest......" The dictionary definition of the verb "plan" is "to form a plan" and of the noun "plan", "Method or scheme of action, procedure, arrangement; project, program, outline or schedule."* The two definitions are not necessarily

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* Ibid., page 758.

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interchangeable. A company official may anticipate in March an investment outlay which has not yet reached the status of a plan. If this is the case, should he report it as an anticipation or leave it out as not belonging in "present planning"? Probably the official will be aware of the purposes of the survey and include the outlay, but this is not necessarily the case. As a result, the Federal Reserve Committee on Plant and Equipment Expenditure Expectations states 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."** Since the omission of uncertain items is

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** Reports of Federal Reserve Consultant Committees on Economic Statistics, Hearings before the Subcommittee on Economic Statistics of the Joint Committee on the Economic Report, Eighty-Fourth Congress (Washington, 1955), page 33.

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considered an understatment, evidently what is meant by "plans" is anticipations. It is possible that this systematic understate-

ment could be removed if the questionnaire wording were tightened up. At any rate, throughout this chapter the words "plans" and "anticipations" shall be used as they are by the surveying organizations, to mean "best guess", but it should be borne in mind that the people who answer the questionnaires may not define the words in the same way.

The above is not a mere quibble. It might be desireable to obtain "presently planned" outlays as a basis on which the investigator can make his own forecast of actual expenditure by adding an estimate of outlays not presently planned. If what are gathered are anticipations, the investigator may still improve the forecast by adjusting the anticipations on the basis of other knowledge, as I shall attempt to do below, but the procedure is different from one which adds planned and unplanned investment.

Another definitional difference is that between "accuracy" and "fulfillment" or "realization". The accuracy of a firm's anticipations is a question of how close the firm comes to perfect prediction -- how close the variable actual investment/predicted investment, which I call the fulfillment ratio, comes to the number 1.00. It is essentially a measure of the spread of this variable. A company's realization of its anticipated investment involves also the sign of the deviation from 1.00. A 20 percent under-fulfillment is a different animal from a 20 percent overfulfillment. There may be different factors affecting accuracy and realization. For example, as mentioned below, it has been found that investment programs are generally more accurately forecast by expanding firms

than by those not expanding. This does not mean, however, that
expanding companies have a systematically higher or lower ful-
fillment ratio than do others.

The question of what factors affect accuracy is an interesting
one and is discussed below in terms of previous findings and in
terms of frequency distributions and such measures as medians of
the data with which I worked. What is perhaps more important in
terms of using investment expenditures surveys for Gross National
Product projections is the question of factors affecting the
realization of investment anticipations. If such factors do exist,
their effect on different firms has thus far cancelled out, as
evidenced by the lack of systematic bias in the aggregates. However,
if they do exist and can be discovered and corrected or allowed
for, the aggregate investment forecasts can be saved from the
possibility of large error in case these factors ever affect all
companies in the same direction at the same time. Assuming that
we want to obtain the investment portion of a Gross National
Product forecasting model by using the anticipations surveys rather
than a functional relationship, we must correct the survey components
for possible systematic bias. Friend puts the question very well
when he says:*

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* Friend, Irwin, op. cit., page 4.

".......The basic problem in the determination of a function or
relation which explains as much of the variation

in investment as possible. If investment could be fully explained by past values of other non-expectational variables, data on expectations would have comparatively little utility for analyzing or projecting investment except insofar as these data served as convenient proxy variables for a large amount of non-expectational information, or insofar as the study of the structure of expectations was a convenientmeans for determining the non-expectational variables affecting investment via their influence on expectations. It seems plausible to suppose however, that expectations relating to the expected rate of return on new investment (particularly for new products or to cut costs) reflect information which is not completely depicted by past values of non-expectational variables, or reflect past values of these variables in ways which cannot be measured. If this is true -- and the validity of this hypothesis must be tested against the empirical evidence -- data on expectations may add significantly to the explanation and prediction of investment behavior.

"Under this assumption, investment would be a function both of non-expectational and expectational variables with the determination of the relevant variables, the form of the relationship and the values of the parameters as the fundamental research problem. Expectations, of course, are not static but are modified by economic developments as actual conditions vary from those anticipated, so that investment for any period will be a function both of initial and later expectations, the importance of initial expectations varying inversely with the length of the period. The rapidity of changes in expectations and the lag of actual investment behind these changes will determine the usefulness of data on expectations for forecasting investment. Such forecasts will be successful only if investment for a period can be adequately approximated by initial expectations, past values of non-expectational variables, and subsequent values of any variables (normally not including later expectations) which can be determined as part of the solution of a complete economic model. Totally apart from the empirical evidence, there is reason to believe that data on investment plans, particularly for a business firm, will provide some advance insight into the course of actual expenditures, because investment decisions normally involve various types of commitments in advance of expenditure and there is resistance to change once decisions are made."

I have attempted below, with statistical success at any rate,

to estimate actual investment with equations using initial ex-

pectations and past values of non-expectational variables, which

is to say the same thing as that I have attempted to correct

investment anticipations for the firm for some factors causing

systematic under-or over-fulfillment.

2

The most complete investigation of the reasons for dis-
crepancies between actual and predicted investment was done by
Friend and Bronfenbrenner in Short-Term Economic Forecasting,
a volume of the National Bureau's Income and Wealth Series.*

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*   Friend, Irwin and Bronfenbrenner, Jean, Plant and Equipment
Programs and their Realization, in National Bureau of Economic
Research, Short Term Economic Forecasting (Princeton, 1955).

This followed up an earlier article by the same authors in the
Survey of Current Business* and the findings were discussed

**   Friend, Irwin and Bronfenbrenner, Jean, "Business Investment
Programs and their Realization", Survey of Current Business,
December 1950.

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further in a later paper by Friend.*** The investigation was by

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*** Friend, Irwin, op. cit.

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two methods. A study was made of the relationships between the
actual-anticipated investment relationship and objectively deter-
mineable firm and investment characteristics. In addition a

detailed analysis was made of a special questionnaire sent out
by the Department of Commerce asking businessmen the reasons
for which their actual expenditures had deviated from the
anticipations. The latter part of the investigation was followed-
up by a statistical study of some of the factors pointed up by
the questionnaire. The data studied was for 1949 only.

The first company characteristic studied by Friend and
Bronfenbrenner was company size as measured by assets. They
found that larger companies tend to estimate more accurately in
terms of spread of deviations of actual from anticipated investment.
It was also the case that only the largest firms resist the
tendency to underpredict (or to overfulfill). My data on break-
down of companies by employment tend to confirm these findings.

Friend and Bronfenbrenner also note greater accuracy for
predictions of investment programs which were large relative to
the size of firm fixed assets. My data agree here too, but the
fact of greater accuracy for larger investment programs seems to
be a corollary of the dominant effect of this breakdown which is
that large investment programs are underpredicted while the small
are overpredicted. This is discussed below in section 3. Third,
so far as character of investment is concerned, they found that
equipment investment is more accurately predicted than is plant
investment. My data were not broken down so as to make possible
a testing of this result. Friend and Bronfenbrenner suggest that
the reason for this is the fact that the construction of new plants
is a much more discrete process than the purchase of machinery --

that a change of decision on the building of a new plant
automatically means a large predictive inaccuracy, whereas
decisions on equipment are less "yes or no" decisions and
more of the "how much" type. It is interesting to note,
however, that in Canada it is the plant investment which is
typically more accurately predicted. Firestone suggests that
the reason for the difference here is that in Canada the
short building season necessitates accurate advance planning.*

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* Firestone, O.J.,"Investment Forecasting in Canada", in
National Bureau of Economic Research, op. cit., page 237.

Both Friend's and Firestone's reasoning seems correct, and
there is little which can be added here. Finally, one
negative finding by Friend and Bronfenbrenner which has
been discussed above in Chapter III is the fact that industry
seems not to explain any predictive inaccuracies not ex-
plained by other company characteristics.

Friend and Bronfenbrenner's analysis of the data from
the special questionnaires is in terms of fulfillment rather
than spread of accuracy. They discovered that the largest
number of the firms giving reasons for downward deviation
of actual from anticipated investment (underfulfillment) used
change of sales outlook as the major explanation. Similarly,
a change in earnings outlook, which is closely related to
sales outlook, was used by many firms. However, they found

that in an attempt to relate deviations of actual investment from predicted to either deviations of actual sales from predicted or to various earnings variables the correlation coefficients were very low, although they were improved somewhat when the same computations were attempted for the group of firms with large investment deviations. Particularly in view of the analysis in Chapter III above, relating investment to sales change, it seems reasonable to expect that investment deviations and sales deviations should be related, although most of my statistical findings, discussed below, are similar to Friend and Bronfenbrenner's. Other important reasons given for underfulfillment were timing, working capital requirements, and availability of labor and materials, none of which either Friend or I had the data to test statistically.

Major reasons for overfulfillment of investment plans were: changes in plant and equipment supply situation, in plant and equipment costs, in competitive conditions, in new products, and routine underestimates. The last presumably includes those capital outlays which had not reached the status of plans at the time of the original anticipations survey. Again, these causes have not been statistically tested by either Friend or myself.

Friend and Bronfenbrenner found very little effect of any liquidity variables on predictive accuracy. Seven such

were statistically tested without significant results. On

the questionnaire concerning reasons of deviations of actual

from anticipated very few firms gave either avilability and

cost of debt financing or availability and cost of equity

financing as explanations. I had no data to test the re-

lationship of liquidity to investment and I have none to

test the relationship of liquidity to predictive accuracy.

Firestone, discussing the Canadian survey, has done an

analysis similar to that of Friend and Bronfenbrenner.*

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*   Ibid.

_____

Like them he found that size of firm and size of expenditure

had important effects on deviations of actual from predicted.

Unlike them, as mentioned above, he found greater accuracy

for predictions of plant investment than for predictions of

equipment investment. Firestone also includes some data

on the results of forecasts by different company officers.

He finds that owners and secretaries are the best forecasters,

that financial officers tend to underpredict, and that executive

officers and management tend to overpredict.

Canada carried on a special survey of reasons for dev-

iations in 1950, which is discussed by Firestone. The

results are similar to those of the Commerce-SEC special

questionnaire. The major reason for underfulfillment in

Canada was the cancellation or deferment of projects. Defer-

ment is related to the timing reason for underfulfillment
mentioned by Friend and Bronfenbrenner, but its importance
is difficult to discover because of its inclusion with
cancellation, which is a statement of what happened to
investment projects rather than a reason why. Changed sales
outlook, which ranked first in the United States, was second
to this lumped category in Canada. The only other class
including more than 10 percent of the firms was miscellaneous.
Major reasons for overfulfillment were: projects added,
which again does not say why; unexpected inadequacy of
storage facilities, which was a temporary situation due to
postwar inventory changes and tight transportation because
of a boxcar shortage; and routine underestimate, similar to
the United States category.

Thus, the two studies of reasons for deviations of
fulfillments from anticipations agree on most major points
except the plant and equipment difference mentioned above.
It seems to be the case from this data that the major company
characteristic with an important effect is size; the major
characteristic of the type of investment is its size; the
most important reason given for underfulfillment is change
of sales outlook; one important reason for overfulfillment
is a routine underestimate due to lack of set plans; and
supply and cost conditions have some effect in both directions.

3.

As mentioned above, my work was divided into a study of
accuracy and a study of realization. To investigate predic-
tive accuracy, I made several frequency distributions of the
data from the McGraw-Hill survey. There are in each dis-
tribution (except where noted) a total of 1335 observations,
each of which represents the fulfillment ratio (actual invest-
ment divided by predicted investment) of one company for one
year. These distributions serve two purposes. They, to-
gether with some of their parameters, are the easiest method
of looking at the true accuracy (spread around 1.00) of the
data. They also can help in selecting variables for the
more important study -- the regression investigation of factors
affecting fulfillment. The frequency table method makes it
difficult to use more than one mode of classification at
once, but this is done in the regression study. In the first
four frequency tables below, the columns are classified by
size of fulfillment ratio while the rows are classified by
four characteristics of the data: company size by employment;
size of investment measured by the ratio of the year's in-
vestment to the six-year mean of investment for the company;
whether or not the company carried on any expansion in-
vestment during the year in question; and by year. The
distribution is by percentage of observations falling into
each fulfillment ratio column and the rows all sum to 100

per cent, plus or minus a rounding error up to .2 per cent.

Two parameters are given for each row: the percentage of

observations falling within a plus or minus .20 range of

the perfect fulfillment ratio of 1.00, a measure of true

accuracy spread; and the median, a measure of fulfillment.

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* The plus or minus .20 range was used rather than
standard deviation, interquartile range or some more common
parameter because what was desired was the spread around
the perfect prediction ratio, 1.00 rather than the spread
around the mean or median or some other parameter which is
dependent on the particular distribution. The median was
used rather than the mean because there are several ob-
servations where the predicted investment is zero and the
actual investment is some positive number making the ratio
infinite. Thus a mean cannot be computed but a median can
be, including such observations in the "Greater then 1.49"
class.

Table I breaks the data down according to company size.

TABLE I

FULFILLMENT RATIO BY COMPANY SIZE

Fulfillment Ratio

Co. Size by Employment	less than .50	.50 to .59	.60 to .69	.70 to .79	.80 to .89	.90 to .99	1.00 to 1.09	1.10 to 1.19	1.20 to 1.29	1.30 to 1.39	1.40 to 1.49	more than 1.49	median	per cent within ∗ .20
0-500	15.6	6.5	6.5	3.9	6.5	1.3	9.1	3.9	1.3	2.6	0	42.9	1.13	20.8
501-1000	10.0	5.0	2.5	5.0	10.0	3.8	12.5	3.8	8.8	2.5	2.5	33.7	1.13	30.1
1001-5000	6.1	5.9	4.7	4.9	10.8	10.1	10.6	6.1	5.7	5.2	5.2	24.8	1.08	36.6
5001-10000	3.5	3.9	4.3	8.3	9.8	8.3	17.7	6.3	8.7	4.3	4.7	20.1	1.07	42.1
more than 10000	2.5	3.5	7.0	8.9	13.7	17.8	16.4	7.0	6.8	3.9	2.7	9.9	.98	54.9
OVERALL	5.0	4.6	5.5	7.0	11.5	11.8	14.2	6.2	6.6	4.2	3.7	19.7	1.03	43.7

The agreement of my McGraw-Hill data for 1949-1954 with

Friend's and Bronfenbrenner's Commerce-SEC material for 1949

is obvious. Accuracy grows with size as evidenced by the

monotonic growth of the percentage of observations within

the plus or minus .20 of 1.00 range as company size increases.

Friend reported that only the largest companies avoided over-

fulfillment. Here it can be seen that the larger the company,

the less the fulfillment, although as shown below, when size

is used in multiple regression with certain other variables,

this effect changes. A discussion of the over- and under-

fulfillment characteristics will be saved for the section

in which these are attacked with the regression tool. So

far as the fact that accuracy seems an inverse function of

company size is concerned, Friend and Bronfenbrenner suggest

three reasons.* They say that: for a large company with

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* Friend, Irwin and Bronfenbrenner, Jean, in National
Bureau of Economic Research, op. cit.

---

many projects random routine over- and under-estimates have

more of a chance to cancel; that for a large company, unexpected

expenditures such as those consequent on the breaking down of

a piece of equipment loom less large as a part of the total;

and that large companies must have longer and more formal-

ized investment programs which lead to greater accuracy. This

reasoning seems to cover the case.

Table II divides the data by size of investment expenditure compared to mean size for the company.

TABLE II

FULFILLMENT RATIO BY SIZE OF INVESTMENT

Fulfillment Ratio

Investment divided by mean for company	less than .50	.50 to .59	.60 to .69	.70 to .79	.80 to .89	.90 to .99	1.00 to 1.09	1.10 to 1.19	1.20 to 1.29	1.30 to 1.39	1.40 to 1.49	more than 1.49	median	per cent within ±.20
below .50	21.8	9.1	7.9	4.8	9.7	12.1	12.7	1.8	4.2	1.8	1.8	12.1	.86	36.3
.50 to .59	7.6	9.1	15.2	4.5	12.1	10.6	13.6	4.5	0	3.0	1.5	18.2	.91	40.8
.60 to .69	4.4	8.9	5.6	10.0	15.6	8.9	13.3	2.2	6.7	2.2	5.6	16.7	.95	40.0
.70 to .79	2.4	8.9	5.7	8.1	9.8	14.6	14.6	4.9	7.3	3.3	1.6	18.7	1.00	43.9
.80 to .89	4.5	4.5	8.3	12.9	16.7	7.6	12.9	5.3	7.6	6.8	3.0	9.8	.94	42.5
.90 to .99	2.9	1.0	4.9	12.7	6.9	13.7	19.6	5.9	6.9	3.9	2.9	18.6	1.04	47.2
1.00 to 1.09	2.0	2.6	7.2	5.9	17.8	13.2	16.4	5.9	3.9	5.3	2.6	17.1	1.00	53.3
1.10 to 1.19	2.1	2.1	4.2	4.2	11.6	12.6	14.7	9.5	5.3	5.3	5.3	23.2	1.08	46.4
1.20 to 1.29	1.9	2.9	2.9	8.7	11.5	11.5	18.3	5.8	8.7	1.9	1.9	24.0	1.05	47.1
1.30 to 1.39	0	2.5	1.2	2.5	8.6	16.0	14.8	9.9	12.3	8.6	3.7	19.8	1.04	49.3
1.40 to 1.49	0	2.1	2.1	8.5	10.6	14.9	17.0	8.5	2.1	0	10.6	23.4	1.06	51.0
above 1.49	0.6	1.1	1.1	3.4	6.8	9.0	12.4	11.3	10.7	5.6	6.8	31.1	1.23	39.5
OVERALL	5.0	4.6	5.5	7.0	11.5	11.8	14.2	6.2	6.6	4.2	3.7	19.7	1.03	43.7

Friend and Bronfenbrenner report that companies with relatively larger investment programs seem to predict more accurately than those investing less and reason that this is because major investment programs are planned more carefully and further in advance. My factual findings agree with his. Of those companies with investment less than their mean investment, 41.3 percent are within the plus or minus .20 of perfect prediction range. Of those investing equal to or more than their mean, 47.3 per cent are in this range. However, I believe a better explanation can be offered on a non-economic basis.

The data is dominated by the fact that the relatively larger are the expenditures, the larger is the fulfillment. This is probably a purely mathematical result of the fact that the numerators of the fulfillment ration and of the investment-relative-to-mean ratio are the same and therefore the two ratios have some spurious correlation. From this spurious correlation there can also be derived e hypothesis for the greater accuracy of the larger investment programs. The distribution of the data is such that most of the data near the median is concentrated to the left of the median. This is true not only of the overall distribution but also of most of the classes. Since this is the case, those classes having low medians and small investment programs will have most of the data far from the 1.00 perfect prediction ratio. However, those classes in which the medians are above 1.00, even though these medians may be just as far from perfect prediction as the lower ones, will have the bulk of the data very close to 1.00 and within the .80 to 1.19 range. If this explanation is correct, then the fact that the large investment programs are more accurately predicted is not based on any inherent economic characteristics of the larger programs.

Table III divides the data into companies having expansion investment and those without. The sample here is smaller (1024) because of the lack of expansion data for some companies.

TABLE III

FULFILLMENT RATIO BY EXPANSION AND NONE

Fulfillment Ratio

	less than .50	.50 to .59	.60 to .69	.70 to .79	.80 to .89	.90 to .99	1.00 to 1.09	1.10 to 1.19	1.20 to 1.29	1.30 to 1.39	1.40 to 1.49	more than 1.49	median	percent within ± .20
Expansion	3.1	4.0	5.2	7.3	11.9	13.3	13.8	6.2	7.4	4.2	4.3	19.4	1.03	45.2
No Expans.	8.4	6.1	7.9	6.5	10.3	6.5	14.0	3.3	2.3	6.5	2.3	25.7	1.02	34.1

It can be seen here that, although there is virtually no difference between the expanding and the non-expanding companies so far as fulfillment is concerned (the medians of the two classes are almost the same as each other and as the overall median of the larger sample), the expanding companies predict much more accurately than those which are not expanding. Forty-five per cent of the former and only thirty-four per cent of the latter are in the forty-point range surrounding perfect prediction. This is in spite of the fact, discussed below, that prediction of dollar expansion investment is considerably less accurate than is prediction of dollar gross investment. This inaccuracy makes it difficult to explain the divergence of the two classes with the reasonable-sounding hypothesis that expansion investment requires longer advance planning and contains fewer unexpected items. A more consistent explanation can be derived by reverting to Chapter IV above, where companies carrying on expansion investment were defined as having pressure on capacity. To carry this definition on to the present case, companies with capacity pressure are under a strong pressure to invest and not revise their anticipations and therefore fulfillments cannot stray too far from plans. Those without pressure and with no expansion

investment have much more leeway in changing their plans, and so
have a very wide spread of fulfillment ratios.

The final grouping, in frequency table IV, divides the data
into years, from 1949 to 1954.

TABLE IV

FULFILLMENT RATIO BY YEAR

Fulfillment Ratio

Year	less than .50	.50 to .59	.60 to .69	.70 to .79	.80 to .89	.90 to .99	1.00 to 1.09	1.10 to 1.19	1.20 to 1.29	1.30 to 1.39	1.40 to 1.49	more than 1.49	median	percent within ± .20
1949	9.5	7.5	6.1	8.2	8.8	6.8	15.6	7.5	6.8	2.7	4.1	16.3	1.02	38.7
1950	7.0	1.4	3.3	4.7	7.0	8.5	13.6	3.3	5.2	7.0	1.9	37.1	1.23	32.4
1951	3.9	4.4	5.3	6.6	8.3	11.4	14.9	7.9	8.3	3.9	2.6	22.4	1.07	42.5
1952	3.5	7.0	6.1	7.0	15.4	11.4	11.4	4.8	7.9	4.8	3.5	17.1	1.00	43.0
1953	4.1	1.6	5.3	8.6	11.0	18.0	13.9	7.8	6.1	4.9	4.1	14.8	1.01	50.7
1954	3.3	6.2	6.6	7.3	16.0	12.4	16.4	6.2	5.8	2.6	4.7	12.4	.98	51.0
OVER-ALL	5.0	4.6	5.5	7.0	11.5	11.8	14.2	6.2	6.6	4.2	3.7	19.7	1.03	43.7

Excluding 1950 with its large overfulfillment due to the Korean War,
there seems to be no remarkable difference among the years. The
somewhat higher median for 1951 can probably be explained by the
price inflation which caused investment programs,to be fulfilled
in prices which were higher than those at the time of prediction.
Firestone points out that "Projected capital outlay as reported by
business in the United States is said to reflect largely volume
estimates, expressed in current prices,"* and this is confirmed

* Firestone, op. cit., page 237.

by my work in section 4 below. The only other noticeable difference among the medians is that the under-prediction seems to be concentrated mostly in 1950 and 1951. This may contradict previously mentioned statements of Friend and Bronfenbrenner and of the Federal Reserve Committee on plant and equipment statistics concerning the consistent tendency to underpredict. However, since the distributions show actual overprediction only in 1954, a recession year, no definite conclusion can be drawn.

Thus there seems to be no major effect of year on fulfillment and specifically there is no cyclical effect visible in this simple one-characteristic breakdown. In the later discussion of fulfillment using the multiple regression tool it will be shown that annual change of Gross National Product does significantly affect investment fulfillment, but this fact is not noticeable here. What is most visible about Table IV is the fact that there seems to be a secular improvement of accuracy over the years (excluding, again, 1950). As the company learns more about what information is desired by the surveying organizations, and as the necessity of answering survey questions may feed back by causing greater systemization and longer lead time in the company planning process, this may cause company predictive accuracy to increase and the percentage of firms within the plus or minus .20 range to grow larger. There is probably some asymptotic limit to this gradual improvement process as the time approaches when the random or accidental factors causing inaccuracy disappear and the systematic factors remain.

Finally, something should be said about the comparison of the fulfillment ratios of the three variables.-- total investment, capacity

change and expansion investment. Although the major analysis is of total investment because, as has been pointed out, total investment is the magnitude the prediction of which is necessary for Gross National Product projections, some mention should be made of the others. Table V gives frequency distributions of the fulfillment ratios of the three variables.

Table V

INVESTMENT CAPACITY CHANGE AND EXPANSION INVESTMENT,

Fulfillment Ratio

	less than .50	.50 to .59	.60 to .69	.70 to .79	.80 to .89	.90 to .99	1.00 to 1.09	1.10 to 1.19	1.20 to 1.29	1.30 to 1.39	1.40 to 1.49	more than 1.49	median	percent within ± .20
Total Investment	5.0	4.6	5.5	7.0	11.5	11.8	14.2	6.2	6.6	4.2	3.7	19.7	1.03	43.7
Capacity Change	16.7	6.0	4.7	2.0	3.9	1.4	33.8	1.3	2.6	1.1	1.4	25.0	1.04	40.4
Expansion Investment	14.0	5.0	5.6	4.6	5.3	4.0	21.7	3.6	4.2	2.5	2.6	27.0	1.04	34.6

Although the medians are almost the same and the variables therefore do not differ in their over- and under-fulfillment characteristics, there is a difference among them in the range of their accuracy. This difference is accentuated when it is realized that there are many more companies which predict no capacity change and report no capacity change or predict no expansion investment and report none, thus having perfect fulfillment ratios of 1.00, then there are either predicting or reporting no investment. The fact that total investment anticipations are much more accurate than those for expansion investment is easily explainable by the ambiguity of definition of expansion investment. The smaller difference between total investment and capacity change is not so easily explained. One possibility might be

the way the magnitudes are gathered on the McGraw-Hill questionnaire. The questions about predicted and fulfilled investment expenditures are asked in dollar terms, which probably induces the answering businessman to think and reply fairly specifically. The capacity questions are asked in terms of percentage change, which might induce more general thought and answers to the nearest five or ten per cent. This is borne out by the fact that the capacity change answers are largely concentrated at five per cent, ten per cent, etc. Thus the effect of the question wording, possibly plus the fact that the businessmen answering the questionnaires know that the investment questions are the major ones and concentrate on them probably account better for the lesser accuracy of the capacity change intentions than does any economic reasoning.

The major discussion of this section has been of accuracy of intentions predictions, defined as the spread of fulfillment ratios around 1.00. The more important question of over- and under-fulfillment will be taken up in the next section. The major conclusions on accuracy have been the fact that company size and company expansion do seem to have an effect; that there has been a steady growth of accuracy over time; that relative size of investment program has an effect but this may be purely statistical; and that predictions of total investment have been more accurate than either predictions of capacity change or predictions of expansion investment. These are points which should be borne in mind in assessing the surveys but, since accuracy as defined here is random in direction and company errors mostly cancel in the aggregate, those factors causing inaccuracy do not seriously affect the value of the surveys.

4

In this section, the symbols used in the equations are as follows:

subscript a; meaning that the magnitude in question is an actual or fulfilled one,

subscript p; meaning that the magnitude is a predicted or planned one,

superscript numeral $9,0,1,2,3,4$, meaning that the magnitude occurred during or is predicted for the year 1949, 1950, 1951, 1952, 1953, 1954,

subscript numeral $9,0,1,2,3,4$, for predicted magnitudes only, meaning that the prediction was made in 1949, 1950, 1951, 1952, 1953, 1954,

superscript m, meaning that the value is the airthmetic mean of the magnitude for the individual firm for as many years out of six as the magnitude was reported,

superscript t, t-1, etc.; meaning that the magnitude occurred during or is predicted for several different years within this particular equation,

subscript t, t-1, etc.; meaning that the magnitude was predicted during several years for this particular equation,

I = gross investment for the firm (reported on questionnaires)

S = sales for the firm (reported on questionnaires)

ΔC = Capacity change for the firm (reported on questionnaires)

Co = Company's expectation of three year percentage change in its own sales (reported on questionnaires),

Ind = Company's expectation of three year percentage change in sales of its industry (reported on questionnaires),

$\Delta GNPm$ = Annual percentage change in money Gross National Product computed(From Economic Reports of the President)

$\Delta GNPr$ = annual percentage change in real Gross National Product

(computed from Economic Reports of the President)

R = Cost index for investment goods, (computed by comparing real and

money investment statistics in Economic Reports of the President)

1.   The first attempt which was made to explain systematically differences

in fulfillment of investment anticipations among companies was by using

accuracy of sales expectations as an explanatory variable for the fulfillment

ratios of different investment magnitudes. Only 1954 data were available.

No significant relationship whatever could be discovered between the

variable S_a^t/S_p^t and either I_a^t/I_p^t or the same ratio for expansion

investment. However, a relationship was discovered with the fulfillment

ratio for change of capacity, a fact that fits in nicely with the

hypothesis in the last chapter that the accelerator effects of sales

change bear an immediate relationship to capacity change and only a

second remove relationship to either expansion investment or total invest-

ment. The equation for capacity change fulfillment was:

$$(V-1) \quad \Delta C_a^4/\Delta C_p{}_3^4 = -.4074 + 1.6083 \ S_a^4/S_p{}_3^4 \qquad F(1,160) = 5.7295$$

$$R^2 \qquad = .0350$$

$$S_u^2 \qquad = .9594$$

The relationship, although not strong, is significant. Its meaning is

fairly clear. Just as there was a strong capacity change accelerator,

there is a relationship, less strong, between sales accuracy and capacity

change accuracy. The investment and expansion investment accelerators

were weaker, weak enough to slack off into insignificance in this

formulation.

The above relationship is interesting, but of little use in formulating an investment prediction for a Gross National Product projection, since the capacity relationship cannot be extended to any of the money aggregate figures. The accuracy-of-sales relationship to the fulfillment ratio of total investment was also found to be insignificant in a multiple regression equation (V-4) discussed below. These findings agree with Friend and Bronfenbrenner's statistical results mentioned above, but disagree with the results of both the United States and Canadian special surveys on discrepancy reasons. The special surveys reported changed sales outlook as a major reason for downward revision of investment plans. The reason for the discrepancy between the statistical results and the survey results is quite probably dependent on the question of what sales outlooks are changed. As reported in Chapter IV above, the major sales-change effect on investment was that of long-run sales expectations. Both Friend and Bronfenbrenner and myself analyzed the relationship of change of investment from plans to change of sales from short-run expectations only: they, because the Commerce-SEC survey does not gather long-run sales expectation data; myself because I did not have enough actual sales change data to compare these to the three year expectations. If businessmen answering the special surveys were referring in the main to changes of sales trend from long-run expectations then these effects would not necessarily show up in the statistical analyses. A change-of-long-run-sales-expectations variable should be tested when data becomes available.

2. As was pointed out above, the analysis of investment fulfillment and sales prediction accuracy had to be confined to 1954 because the data on

predicted sales was not available for other years. An attempt was made to
study fulfillment ratios using all of the available data from the years
1949-1954. Ideally, one variable to be tested in this relationship should
be annual change of sales, the magnitude which both the United States and
Canadian questionnaires have found to have an important effect on
fulfillment. However, change of sales data is only available for 1952-53
and 1953-54, so a substitute had to be found. Change in Gross National
Product, although it is by no means a perfect substitute for change of
sales for the individual company, was therefore used as the best thing
available. Thus the same change-of-GNP variable is used as an indication
of change of sales for all companies during the year in question. This
is of course not for individual firms, accurate, but it is a fair overall
approximation.

At least one variable then had to be found to distinguish between
the companies within the year. The major effect on fulfillment discovered
using the frequency distributions of the last section was the increase
of fulfillment ratio with the increase of the relative size of investment.
However, just as this seems to have been due largely to the fact that the
numerators of the fulfillment ratio and the investment mean investment
ratio were the same number, there might be some tendency toward spurious
correlation if any explanatory variable was used whose numerator was
functionally related to investment for a particular year. Therefore it
was decided to use an independent variable whose value was a mean of as
many years as possible. The variable used was five-year (1950-1954)

arithmetic mean of capacity change for the company. Companies with a high rate of capacity change may be presumed to have higher investment relative to fixed assets than other companies, and this variable is a measure of the size-of-investment-program effect which avoids the spurious correlation which would be obtained using annual figures. The change of capacity variable tests the effect on fulfillment of the rate of company growth, which is perhaps a better way of describing the size-of-investment-program effect.

Thus there are two variables; the change of Gross National Product, applied equally to all companies for a year; and the mean change of capacity, applied equally to all years for a company. Each observation on one firm for one year is uniquely identified. In addition, the frequency tables as well as the previous literature had shown size of firm to have an important effect on realization of investment program. Number of workers employed, the best available indicator of firm size, could not be used as a continuous variable since the data was grouped into five wide classes. Instead, within the equations using the two previously-mentioned variables, a separate constant term was computed for each employment class and the additional explanation stemming from this breakdown was tested. A test was also made of the effect of using completely separate equations for each size firm, but the additional explanation here was insignificant.

The equation estimated as described above was:

$$\text{(V-2)} \quad I_a^t/I_p{}^t{}_{t-1} = \begin{matrix} 1.0249 \\ 1.1690 \\ 1.1612 \\ 1.0154 \\ .8622 \end{matrix} \begin{matrix} \text{(Firms employing 0-500)} \\ \text{(} \qquad\qquad 500\text{-}1000\text{)} \\ \text{(} \qquad\qquad 1000\text{-}5000\text{)} \\ \text{(} \qquad\qquad 5000\text{-}10000\text{)} \\ \text{(} \qquad \text{more than } 10000\text{)} \end{matrix} + 2.0350 \ \Delta GNPm^t + .0700 \ \Delta C^m$$

$$F(6,911) = 8.8738$$

$$R^2 = .0552$$

$$S_u^2 = .5531$$

All of the variables as well as the size breakdown added significant additional explanation of the fulfillment ratio. The breakdown shows that the inverse relationship of fulfillment ratio to firm size shown in Table I above is changed once the breakdown is put into combination with other variables. The four classes of companies employing more than 500 workers still show this effect, but the very smallest companies, those with employment under 500, join the very largest in having near perfect ful-fillment rather than the large overfulfillment shown in the frequency distribution. Friend and Bronfenbrenner's reasoning, referred to above, concerning the greater accuracy of large companies applies in part to the smaller overfulfillment of larger companies shown here. With larger companies, unexpected expenditures due to breakdown of machinery, etc., loom less large relatively, and with larger companies longer and more formalized advance investment planning is usual and there are fewer items unexpected at questionnaire time. This reasoning would explain the monotonic change of fulfillment ratio with company size which appeared in Table I and appears for companies employing more than 500 in equation (V-2). Further explanation is needed however for the low overfulfillment of the smallest companies in the equation. One possible hypothesis for this change from the frequency table to the equation is to postulate that the explicit

variables, Gross National Product change and mean capacity change are the sole important variables affecting the fulfillment ratios of the smaller firms. Then if there is no large change of GNP and if the company is maintaining a stable size, it will have close to perfect prediction at its constant term of 1.0249. For the larger companies, particularly those employing between 500 and 5000, there are other factors which cause underprediction and overfulfillment no matter what the course of GNP and what the expansion rate of the firm. Such factors as availability of labor and materials for expansion, one significant reason given by business men in the Commerce-SEC special questionnaire on discrepancies, might well effect the middle-size company more than the very small one which presumably needs its supplies and labor in quantities so small as to be readily available. The very largest companies, those above 5000, have the same problems as the middle-sized but have better apparatus for anticipating and solving them and therefore return toward the perfect prediction fulfillment ratio of 1.00.

The other two variables in the equation need less explanation. It seems reasonable to accept the indicated fact that an increase in Gross National Product will cause some tendency to overfulfill. In Chapter IV, above, it was shown that investment seems to be based mostly on long-run sales change expectations and then revised somewhat on the basis of short-run actual sales changes. This revision of fulfilled investment from investment planned a year earlier on the basis of a change of Gross National Product in the intervening time can be easily explained in this light. Similarly, it is not too difficult to explain the higher fulfillment on the part of the more rapidly growing firms. The growing company will

make its best prediction and if it finds it has the funds or other
necessaries, overfulfill. The contracting company, of which several
existed and were included in the equation, will also make the best
prediction, but hopes to find ways to cut back where possible.

In an attempt to discover the effects of price changes on fulfillment
of investment, equation (V-2) was revised by dividing actual investment
by the investment goods cost index at the time of investment and predicted
investment by the index at the time of prediction and by using change
of real rather than money Gross National Product. The capacity change
variable remains as is. The reestimated equation is:

$$\text{(V-3)}\quad (I_a^t/R^t)/(I_p{}_{t-1}/R^{t-1}) = \begin{matrix} 1.0085 \\ 1.1595 \\ 1.1574 \\ 1.0121 \\ .8623 \end{matrix} \begin{matrix} \text{(Firms employing 0-500)} \\ \text{(}\qquad\quad 500\text{-}1000) \\ \text{(}\qquad\quad 1000\text{-}5000) \\ \text{(}\qquad\quad 5000\text{-}10000) \\ \text{(}\qquad\text{more than } 10000) \end{matrix} + 2.4221\ \Delta GNPr^t + .0689\ \Delta C^t$$

$F(6,911) = 9.0472$

$R^2 \quad = .0562 \quad R^2$ for additional explanation over money investment
equation $= .1272$

$S_u \quad = .5110$

The index of correlation, R^2, computed in terms of percentage explanation
of the dependent variable of the equation, is not significantly higher than
that of (V-2) for fulfillment of money investment. However, what is
significant is the fact that by adjusting for price changes, we have
12 per cent less unexplained variation than in the money equation. Thus
we can state than one important reason for overfulfillment in the six
years in question has been price change between time of prediction and
time of expenditure. Firestone's theory, mentioned above, that United

States businessmen state their anticipations in terms of physical

volume at current prices seems correct. If prices change, then ful-

filled investment becomes greater than anticipations. The additional

explanation is the only important effect of changing the relationship

from money to real terms. The relationship between the dependent and

the independent variables remains much the same as it was. The regression

parameters and the constant terms associated with the employment size

classes are virtually unchanged.

5

Thus far in this chapter there has been a discussion of the factors

affecting accuracy of prediction of investment and the factors affecting

fulfillment of investment plans. So far as inaccuracy, the routine

signless predictive error, is concerned, it is not of too much moment when

the investment intentions surveys are evaluated. The risk of a large

error in the aggregate investment forecast due to purely random firm

deviations is slight since, so long as the company errors are random in

size and sign, they will tend to cancel. What are of importance are factors

affecting fulfillment of investment plans. These are factors working

definitely in one direction or another on each company, which change the

actual investment from the anticipated. Thus far, since 1949, the good

performance of the aggregates has indicated that these factors have worked

in different directions on different companies and have therefore also

cancelled. If, some day, they affect all companies in the same direction,

sales change being downward for all companies for example, they will not

cancel and there will be a large error in the resulting aggregate. However,

these factors, if they can be discovered can be allowed for. This is what is attempted in this section. An equation is derived to obtain a prediction of actual investment for the company using three sorts of explanatory variables, all of which are available to the investigator at the time he must predict. The first is the company's anticipated investment. The second is the group of factors previously discovered to affect the fulfillment ratio, which is the relationship between actual investment and anticipated investment. These variables are estimated as having a linear effect not on the dependent variable, actual investment for the firm, but on the relationship. Thus if x is such a variable the relationship is estimated as $I_a = (\alpha + \beta x)I_p$. This estimate can be computed linearly by multiplying out and using least squares on $I_a = \alpha I_p + \beta x I_p$. The third group of variables tested was that discovered in Chapter IV above to have an effect on actual investment, the dependent variable in this equation. The equation thus obtained, using only the variables which proved significant at .95 was:

$$(V-4) \quad I_a^4/I_a^m = .2022 + \begin{bmatrix} +.0561 \text{ (Firms employing 0-5000)} \\ -.1118 \text{ (} \qquad\qquad 5000\text{-}10000\text{)} \\ -.1385 \text{ (} \qquad \text{more than } 10000\text{)} \end{bmatrix} + .8155 \; S_p \, {}^4/S_a^3 \; \Bigg] \; I_p \, {}^4/I_a^m$$

$$+.7962 \; Co_p \, {}^{4\text{-}6}_{\;3} - .5940 \; Ind_p \, {}^{3\text{-}5}_{\;2} \; .$$

$F(6,83) = 21.5647$
$F(5,83)$ compared to use of $I_p \, {}^4_{\;3}$ alone $= 4.3957$

$R^2 = .6087$

R^2 compared to use of $I_p \, {}^4_{\;3}$ alone $= .2094$

$S_u^2 = .1034$

The employment class breakdown was found significant in its effect
on fulfillment ratio and therefore is used to modify the relationship
between actual and anticipated investment. Three classes rather than
the previous five are used because the lowest classes did not have
sufficient observations with the requisite data to be separately useable.
Similarly the one-year predicted sales variable is used as a substitute
for the change of Gross National Product which significantly affected
the fulfillment ratio. There are several reasons for the substitution.
Since only 1954 data had all the variables it was desired to test, only
one GNP change figure was available to be applied to all of the observations.
Because the GNP change was originally used to make up for the lack of data
for all years on company sales change which is the specific effect of GNP
change on the individual firms, it seemed logical to substitute a sales
change variable for a year in which it was available. Predicted sales
change was used because a variable was desired which would be available to
the investigator from an exogenous source at the time he makes his overall
Gross National Product forecast. The third variable which significantly
affected the fulfillment ratic, mean capacity change for the firm for
five years, proved not significant at the .95 level in this context.
The variables concerning the firm's expectations for its own sales and
for its industry's sales were ones which were shown in Chapter IV above
to have a significant relationship to actual investment. The other variables
used in Chapter IV were not significant here.

The important thing about equation (V-4) is the fact that it
provides a substantially better forecast of the company's actual
investment than do the company's own anticipations alone. Twenty-one
per cent of the variance of actual investment left unexplained by predicted

investment is explained by the addition of the other variables. The

use of the size breakdown corrects for the fact discussed above that

the smaller companies tend to predict considerably higher relative to

their fulfilled investment than do the larger firms. The one-year

sales change variable, S_{p3}^4/S_a^3, makes a correction which could help avoid

an important source of possible bias in aggregates. Through 1954,

the sales change variables tended to cancel among firms and not show

up in the aggregate. However, in 1955, company data for which was not

available for inclusion in this paper, the Commerce-SEC survey and even

more so the McGraw-Hill survey seriously underestimated the extent of

investment revival, using uncorrected company anticipations. Had a

predicted sales-change variable been used, the results should have

been considerably better. The final two variables, expectations for

company sales and for industry sales, have a net positive linear effect

on actual investment and tend to correct the consistent underestimate

(overfulfillment) by companies, which has been discussed above. It

was suggested above that the major reason for this underestimate has been

the non-inclusion of expenditure items which are less certainly planned

at the time of the questionnaire. It seems reasonable to state that

if the answering companies cannot be induced to include such items

in their best guess predictions, then the investigator can estimate

them by using company and industry longer-run sales expectations which were

shown in Chapter IV to have an important effect on investment.

Thus by the use of these additional variables, all available at

time t-1, a better investment forecast for time t can be made than

by using anticipated investment expenditures alone. It is not claimed,

of course, that this equation or even this set of variables, which was selected largely on the criterion of availability to the writer, could be adopted and used by the Commerce Department or the McGraw-Hill company to improve their estimates. What is possible is that a similar equation could be obtained by these organizations from the much larger store of data available to them. It might include, among other things, a variable expressing the deviations of actual sales trend from long-run expectations, mentioned in section 4 above. Such an equation should have the immediate effect of improving the individual company forecasts and thereby improving the aggregates compiled from these forecasts. It might have the much more important effect in the future of avoiding severe aggregate error at a time when all of the correction variables act in the same direction on a large majority of the companies.

There is another possible method of approaching the problem of capital expenditure prediction using capital expenditure anticipations as a basis. The above analysis uses only variables which can be obtained independently by the investigator at the time of forecast. However, it is logically possible to use an investment equation based on investment anticipations as part of an overall endogenous Gross National Product model. In this case the model-builder could use estimated actual rather than company predicted values for the variables other than planned invest-ment, particularly for the short-run sales-change variable. The long-run expectational variables would probably remain in any case, since they have an effect on investment in their own right, independent of the actual change during the three years covered. The model could also include the investment goods price index shown to be significant. To

discuss this possible approach thoroughly would require a study of
the relationship between actual and predicted sales similar to the
discussion here of the relationship between actual and planned invest-
ment -- a study which I have not made. At any rate, at the present stage
of the game of model-building, it is probably preferable to predict Gross
National Product using as many determineable exogenous variables as
possible rather than using a nearly completely endogenous set of
equations.

<p style="text-align:center">6</p>

This chapter has attempted to focus on the factors affecting the
individual company anticipations which are the building stones of
the aggregate investment forecasts. After discussing some important
definitional questions, particularly those of the differences between
"anticipated" and "planned" and between "accuracy" and "fulfillment",
a general analysis was made of both accuracy and fulfillment in using
both previous work in the field and a frequency distribution analysis
of the available McGraw-Hill data. Finally a systematic analysis was
made of the factors affecting degree of fulfillment of investment
anticipations and a method was suggested by which a knowledge of these
factors could lead to an improvement of investment forecasts. The
last is the key point. Statements by those most familiar with the
surveys, such as the lengthy quotation from Friend in the beginning
of the chapter indicate a wariness about accepting fully the survey results.
This caution is due mostly to the wide errors in company forecasts which
have so far mostly cancelled out in the aggregate. I have suggested, not

as an answer but as an approach, a way by which these company forecasts can be improved: a method by which, when more of the relevant variables are uncovered and used, only random error would remain.

Chapter VI

CONCLUSION

Since its divorce from theology, economics has had a dual goal -- the search for a policy and the search for a theory. The distinguishing characteristic of the greatest works in economics, from The Wealth of Nations to The General Theory has been their combination of major contributions to theory and major contributions to political economy. Policy has been the motivation but theory has been the necessary tool.

In modern times, the trend toward specialization has tended to divide economists into two groups -- those interested mainly in economic theory and those interested mainly in economic policy. Among the followers of Keynes, the theoretical group includes Harrod and Hicks and the econometricians; the policy group, Hansen, Beveridge and the fiscal policy school. This divergence in fields of interest, however, has not prevented mutual aid. In the economics of consumption, for example, both the theoreticians and the political economists had the traumatic experience of vastly underestimating consumption potential in their post-World War II expectations. The search for ways to avoid future error of this type has greatly improved both consumption theory and the practical ability to forecast consumption trends, although there is still much to be learned.

In the field of investment, neither group has made too much headway. There has been a good deal of agreement among theorists as to the major magnitudes affecting fixed investment: liquidity, stock of capital

and the accelerator. There has been little agreement as to their
relative importance, not to speak of their exact quantitative effects.
Equation systems relating investment to other variables fail to predict
accurately from year to year.

The lack of theoretical agreement as the relative importance of the
factors affecting plant and equipment investment has led to considerable
disagreement among the political economists as to the uses of monetary
and fiscal policy. It has also led to the attempts discussed in previous
chapters to predict investment directly by asking investors their intentions.
The thesis of this paper is that these intentions surveys can aid in the
formulation of a theory of investment and also be combined with this
developing theory to improve the prediction of investment. As has been
shown, the aggregate investment predictions extrapolated statistically
from the samples of individual company predictions have been reasonably
accurate in the last ten years, even though no account was taken of other
economic factors which might have thrown the forecasts off. This happy
state will not necessarily continue indefinitely. In 1955, the surveys
underestimated considerably the extent of the plant and equipment invest-
ment revival. The 1956 McGraw-Hill preliminary survey*, published in

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*   McGraw-Hill, Business' Plans, 1956-1960 (New York, 1956)

June, shows investment plans through 1960 declining from the 1956 peak,
if the survey responses are to be taken at face value, but McGraw-Hill,
probably quite correctly, does not interpret this to mean a fall in actual

investment. To obtain a reasonable forecast of aggregate expenditures, a knowledge of factors affecting investment and a knowledge of factors affecting response to investment surveys must be added to the survey results themselves. The importance of using theory to interpret survey responses is emphasized by the fact that individual firms do not typically predict their own expenditures very closely, leading to the inference that systematic causes making for individual firm inaccuracies might well make for inaccuracies in forecasts of aggregate investment at such time as these causes affect most firms simultaneously.

In Chapter IV, it was shown that the responses to the investment surveys provide valuable data for the statistical study of investment theory. This statistical utility of the data for theory is not only in itself an important result of the surveys, but it also leads to the hope that eventually it may be possible to make an accurate functional prediction of investment. Such a prediction would, if nothing else, be intellectually more satisfying than one which admits the weaknesses of economic theory by using only survey results and leaving out causation. A red sky at night may be a sailor's delight, but it takes a meteorologist to predict the red sky a few days in advance. Predicting investment solely by the survey method leaves economics at the sailor stage and not until the investigator knows more about the decisions of the investor than does the investor himself, will economics be a science on a par with the least exact of the physical sciences.

For the political economists, however, the problem remains the accurate prediction of investment, by whatever method or combination of methods. In Chapter V, it was shown that economic theory can add a