PART V

Anticipations

Anticipations and Investment Behavior: An Econometric Study of Quarterly Time Series for Large Firms in Durable Goods Manufacturing

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Investment behavior, in theoretical terms, seems very directly a matter of anticipations: present investment decisions can bear fruit in the form of new facilities only after a gestation lag of several calendar quarters, and in the form of added output and cost savings only over a period of several years after facilities are completed; hence rational decisions must relate to results to be expected in the fairly distant future. Empirically also, it may be taken as established that, when we organize the relevant data with time units of one year, an anticipations approach

NOTE: This paper is to be taken as an interim report on the Columbia University project in Expectational Economics supported by the National Science Foundation. Earlier reports (with more stress on capital appropriations and less on expenditures as objects of explanation) appear in A. G. Hart's article "Capital Appropriations and the Accelerator" (*Review of Economics and Statistics,* May 1965) and in R. Sachs' dissertation presented in May 1965 under the title "Manufacturers' Capital Appropriations as a Measure of Investment Decisions: An Econometric Study of Quarterly Time Series."

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has been validated by the proved usefulness of the various investment-intentions surveys. Data from such surveys are fairly useful as direct forecasts and highly useful as ingredients in predictive models. But for good reasons, econometric studies of investment behavior are shifting more and more to the analysis of quarterly data. Here studies which work only with *ex post* data have done at least fairly well. It must be considered questionable whether *ex ante* data can be made fruitful in a study which uses a quarterly time unit.

The discouragement of many investigators with *ex ante* investment data on a quarterly basis reflects a serious defect of the quarterly investment-intentions figures available from the Commerce-SEC survey. The time horizon of these figures is so short that they must measure primarily the *forecasts* of firms acquiring facilities for deliveries and the progress of work by their suppliers, rather than the *decisions* of the firms acquiring facilities. Only recently has the horizon of these inquiries been extended from one to two quarters in advance of the quarter when the data are collected. The present study, however, seeks to extend the horizon by using data for *capital appropriations*, exploiting systematically the quarterly survey by the National Industrial Conference Board.[1]

Appropriations Data in Relation to Investment Behavior

It is at first sight intuitively appealing to assert that to explain investment we must view it in terms of *investment decisions* and that the capital appropriations reported in the NICB survey constitute direct observation of such decisions. But the application of this assertion is not entirely straightforward and the simplifications involved in the second part of the assertion may be dangerous. In the first place, a decision on an investment project is not an event but a process; appropriation is clearly an interesting stage in that process, but cannot be certified in advance as an all-sufficient expression of the process as a whole. Both earlier and later stages may be important as objects of study as well as for policy formulation. In the second place, the investment decision as registered in an appropriation has dimensions which are not fully covered by a report only of the amount appropriated. Besides setting this amount, the investment decision must also embody a provisional distribution through time of expenditures to be made out

[1] Survey results, with some interpretation, are published regularly in *Newsweek* and the *Conference Board Business Record*. The data used in the present paper, however, incorporate unpublished revisions by the Department of Investment Economics at the NICB under the direction of Fred Stevenson, for which we wish to express our appreciation.

of the given capital appropriation. To actually apply the insight that appropriations may be taken to represent investment decisions, we need somehow to get past the difficulty that the appropriations survey tells us quarter by quarter about amounts appropriated,[2] but does not explicitly include any information about the distribution of resulting expenditures over time.

Other survey evidence suggests that respondent firms can furnish useful information about this time distribution of investment expenditures. The McGraw-Hill survey annually obtains an array of information about the prospective distribution over the oncoming three budget years of capital outlays under projects already budgeted for. If this information could somehow be crossed with that offered by the appropriations survey, we would be much closer to being able to measure both the size and timing dimensions of the investment decision. But for the present we are confronted with a situation where the appropriations survey is silent about future time distribution, while the investment-intentions surveys are silent about the dates at which decisions about investment projects crystallized.

Lacking actual survey data which cross appropriation dates and prospective expenditure dates, we can exploit the *ex ante* information offered by the appropriations survey only by trying to find in the record of appropriations an *implicit* pattern for inferring later expenditures. Having done so, we can compare this resulting *ex ante* model and a model that tries to explain investment expenditures from *ex post* data, and then match both against an eclectic model using elements of both.

Procedure of the Paper

The present study deals exclusively with the capital appropriations and expenditures of the durable goods producers among the 1,000 largest manufacturing corporations in the United States.[3] We prefer durable

[2] In fact, the survey yields information about these "amounts" both in flow and stock dimensions. The full array of NICB survey data for manufacturing industries (also, for a shorter period of observation, for public utilities) includes the *flow* of new appropriations by respondent firms during each quarter-year; the *backlog* (at the opening and close of the quarter) of funds appropriated and unspent; and *cancellations* during the quarter of funds appropriated but unspent. In addition, the survey collects data on actual capital expenditures by the firms which report appropriations.

[3] The Hart article cited in the beginning of the paper works entirely with aggregates for total manufacturing; the Sachs dissertation works separately with durables, nondurables (excluding petroleum because of its unique degree of concentration of appropriations in a single quarter), and their total. In addition, the Sachs dissertation complements the study of *levels* of appropriations, expenditures, and other variables with a study of their *changes*—measured by increments of logarithms.

goods to nondurable goods producers or to a combination of both because the former presumably do more advance planning and because the new orders variable, which in our preliminary studies has shown up as of crucial importance, has a more clear-cut meaning for durables than for nondurables manufacturers. We prefer working with the durable goods subaggregate data to working with available two-digit industry data, partly for lack of time to handle the problems of disaggregation and partly because the unavoidable complications of our report are already great enough without introducing additional dimensions through disaggregation. In view of the extent to which we have worked over the present data in the course of this study, the results are perhaps best viewed as hypotheses which should stand confrontation with the corresponding data for the two-digit durable goods manufacturing industries. Time lags and relative weights of variables should vary from industry to industry. But if our results are meaningful, the two-digit industries stage of the analysis should yield functions with a strong family resemblance to those presented in this study.

Our analysis passes through the following stages:

A. We first undertake to derive an explanation of capital expenditures in quarter (t) from appropriations data in antecedent quarters; the best model turns out to be one where the explanatory variables represent flows of appropriations in a series of successive quarters from $(t-6)$ through $(t-2)$.

B. We next compare the results of stage A with those of naive models based on autoregressions of expenditures. Here it is evident that the *ex ante* model incorporating appropriations is enormously superior to the autoregressive naive model, though there is an interesting partial correlation of expenditures with previous-quarter expenditures (after appropriations are taken into account) which suggests that random influences on expenditures probably tend to persist through two or three quarters rather than to exhaust themselves within one quarter.

C. We then take appropriations of quarter (t) as the object of explanation, considering an autoregressive naive model, a "pure-finance" model based upon cash flow and interest rates, an "accelerator" model based on the ratio of new orders to capacity, and an eclectic model. (The selection of these particular explanatory variables reflects extensive experimentation in the Sachs dissertation.) It turns out that the eclectic model is an enormous improvement over the naive model, a substantial improvement over the pure-finance model, and a moderate improvement over the accelerator model. The interest-rate variable appears highly significant in the pure-finance model, but very doubtful in the eclectic model where the ratio of orders to capacity as well as cash flow are also taken into account.

D. We then consider the possibilities of a "direct explanation" of capital expenditures from the accelerator and financial variables which in stage C were used to explain appropriations. The results are somewhat disconcerting; while the direct explanations of expenditures do not outperform the best appropriations model from stage A, they are considerably more powerful than one would expect from the results from stages B and C. We must infer that not all of the information relevant to expenditures which is carried by the financial and accelerator variables is incorporated in appropriations, but that some of the influences these variables represent somehow bypass the appropriations.

E. Next, we consider still more eclectic models which make use jointly of appropriations and of the financial and accelerator variables. These models considerably outperform either the pure appropriations models of stage A or the direct-explanation models of stage D. We must infer that capital appropriations embody a good deal of information relevant to expenditures which is not embodied in the several explanatory variables introduced at stage C. It should be noted, however, that to incorporate more such explanatory variables should reduce the apparent net contribution of appropriations data. It is conceivable that an optimum list of explanatory variables might pull this net contribution down until it became nonsignificant.

F. In stage F, we take up some indications on the behavior of Modigliani's *realization function*—working with *plan-image functions* and *indicators of surprise*. While an exhaustive exploration of this side of the problem would call for an enormously complex analysis, the results suggest that plans formulated as of the end of the third quarter before the expenditure may be taken as fairly firm, but that reactions to surprises of later dates are appropriate and significant.

G. A concluding section considers some basic limitations of this study and an agenda for further research.

A. Explanation of Capital Expenditures from Antecedent Appropriations

A series of regression equations for the explanation of capital expenditures from antecedent appropriations appears in Table 1. It will be immediately apparent that fairly handsome coefficients of determination result from extremely simple formulations, with an adjusted R^2 of 0.809, when we take account of appropriations in quarter $(t - 4)$ or of

TABLE 1

Regression Coefficients of Equations to Explain Capital Expenditures from Flow and Backlog of Appropriations

(million 1954 dollars per calendar quarter per unit of explanatory variable)

	Noncausal	Single Explanatory Term		Multiple Explanatory Terms		Plan Image,
	Explanation, Pure Seasonal,[a] Eq. A-1	Single Flow, Eq. A-2	Single Backlog, Eq. A-3	Single Flow with Preceding Backlog, Eq. A-4	Consecutive Series of Flows, Eq. A-5	Consecutive Series of Flow of Dates (t-3) and Earlier, Eq. A-6
Adjusted R^2	0.1208	0.8085	0.8753	0.9028	0.9344	0.9040
Intercept[b]	1037 ± 87	482 ± 69	214 ± 64	170 ± 63	284 ± 54	363 ± 62
Backlog of appropriations unspent:						
$B_{t\text{-}1}$			0.186 ± 0.013			
$B_{t\text{-}2}$				0.124 ± 0.013		
Flow of (gross) new appropriations:						
$A_{t\text{-}2}$				0.291 ± 0.037	0.193 ± 0.052	
$A_{t\text{-}3}$					0.150 ± 0.064	0.310 ± 0.058
$A_{t\text{-}4}$		0.498 ± 0.046			0.136 ± 0.066	0.125 ± 0.080
$A_{t\text{-}5}$					0.042 ± 0.075	0.102 ± 0.088
$A_{t\text{-}6}$					0.154 ± 0.057	0.069 ± 0.063
Adjusted R^2 with $C_{t\text{-}3}$ in eq.	0.1372	0.8212	0.9039	0.9244		

[a]Regression coefficients of seasonal dummy variables (which are included in all regression equations) are reported separately in Table A-2.

[b]Intercepts in all tables represent the *mean* level for all four quarters of the year (as opposed to direct results of the regression program, which used three seasonal dummies leaving the fourth seasonal regression implicit).

0.875 when we take account only of the backlog appropriated unspent at the opening of quarter $(t-1)$. These relations account, respectively, for 78 and 86 per cent of the variance left unexplained by a set of seasonal dummy variables.[4] The force of the explanation increases considerably if we extend these simple relations very slightly and use the most powerful combination of an appropriations-flow term with the backlog appropriated unspent just before the quarter of the appropriations (quarter $t-2$).[5] The most powerful explanatory equation of reasonably simple structure based on appropriations (equation A–5) yields an adjusted R^2 of 0.934 when we take account of appropriations in each quarter from $(t-6)$ up to $(t-2)$.[6]

An oddity of the data, for which we have no satisfactory explanation, is the consistency with which cancellations of unspent appropriations, taking place several quarters in advance of the expenditures to be explained, show a significant negative relation to the expenditures even after appropriations are taken into account. As may be seen from the last line in Table 1 (and from the repetition of the same phenomenon in the more complex situation reported in Table 2), adjusted multiple R^2's rise appreciably if this cancellations variable is included. The fact that the relationship is negative is scarcely surprising, since cancellations must above all register the unfavorable aspects of the news affecting investment decisions. But one might reasonably expect that this adverse news would register itself equally through holding down new

[4] These dummy variables are incorporated without exception in all our regression equations. We have avoided cluttering up the text tables with regression coefficients for the seasonal dummies; the variation of these coefficients from equation to equation can be traced in Table A-2 in the Appendix.

Note that the intercept values shown in each column are not those yielded directly by regression equations with three seasonal dummies, but implicit values which are obtained by adjusting the sum of these coefficients for the three dummies and the implicit fourth-quarter seasonal coefficient to equal zero.

[5] It would be inappropriate to combine appropriations-flow data for quarter $(t-2)$ with the backlog at the opening of quarter $(t-1)$ because the backlog at this date must be taken to include all funds appropriated in quarter $(t-2)$ with a very modest deduction for expenditures in the very quarter of the appropriation. But the backlog at the opening of quarter $(t-2)$ and the appropriations made during that quarter must be seen as clearly distinct pieces of information.

[6] The parameter of A_{t-5} is obviously nonsignificant; but it seems clearer at this stage to include it. The adjusted R^2 would rise to 0.936 if we economized one degree of freedom by omitting it.

The fact that the two highest parameters (0.193 and 0.154) appear for the most recent and most remote quarters suggests that appropriations of these quarters may be functioning to some extent as proxies for very recent and very remote quarters not included. However, in a similar equation both A_t and A_{t-1} were included but turned out to have regression coefficients far smaller than their standard errors and these terms were therefore rejected on the basis of statistical significance.

TABLE 2

Regression Coefficients of Equations to Explain Capital Expenditures (Using Autoregression) from Antecedent Expenditures and from Synthetic Combinations of Antecedent Expenditures with Appropriations Data

(million 1954 dollars per calendar quarter per unit of explanatory variable)

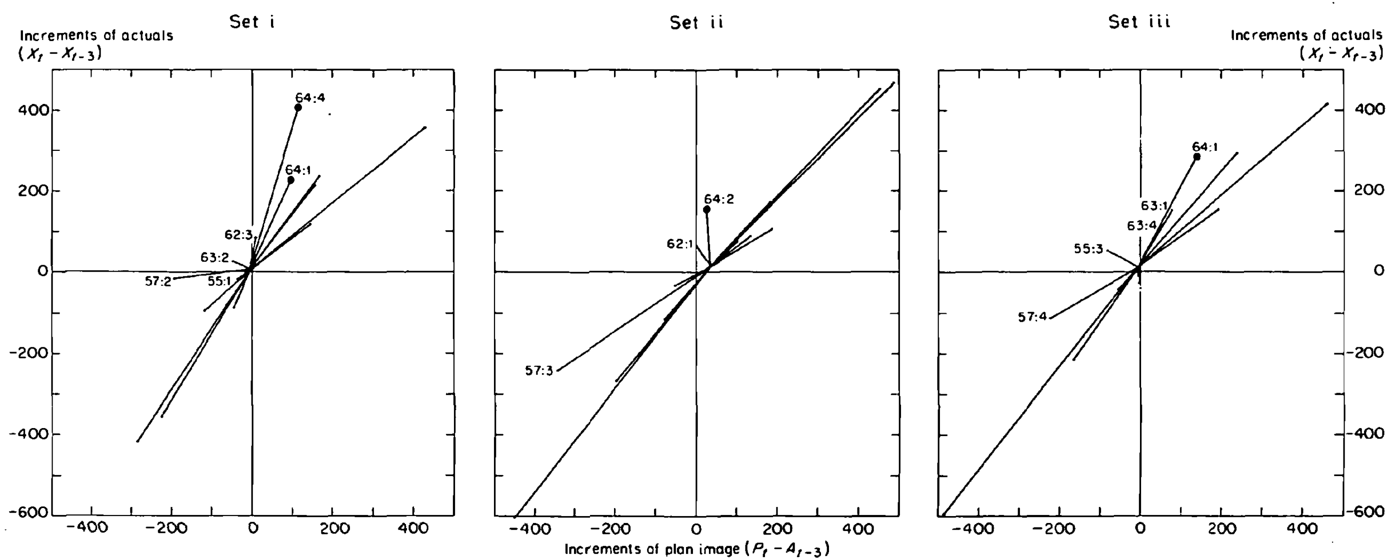
	Noncausal Explanation: Autoregression			Synthetic Explanation: One Autoregressive Term with Appropriations Terms Specified		
	Latest Expenditure, Eq. B-1	Three-Term Practical,[a] Eq. B-2	Four-Term Optimal,[a] Eq. B-3	Single Backlog, Eq. B-4	Single Flow Term,[b] Eq. B-5	Consecutive Series of Five Flow Terms,[a] Eq. B-6
Adjusted R^2	0.8408	0.7932	0.8990	0.9265	0.9390	0.9441
Intercept	105 ± 85	462 ± 111	253 ± 82		64 ± 53	140 ± 68
Autoregressive terms:						
X_{t-1}	0.903 ± 0.075		1.055 ± 0.069		0.698 ± 0.055	0.494 ± 0.125
X_{t-2}		1.264 ± 0.127				
X_{t-4}		−0.706 ± 0.127	−0.298 ± 0.069			
Flow of new appropriations:						
A_{t-2}					0.224 ± 0.031	0.163 ± 0.044
A_{t-3}						0.119 ± 0.048
A_{t-4}						0.064 ± 0.058
Adjusted R^2 with C_{t-3} in eq.	0.8675	(0.7875)	0.8984		0.9504	0.9561

[a]To avoid understating the contribution of autoregressive terms, we started the derivation of each equation with a continuous series of three, four, or five terms, but eliminated those terms whose inclusion *reduces* the adjusted R^2. Hence the absence from eq. B-2 of X_{t-3}, from eq. B-3 of X_{t-2} and X_{t-3}, and from eq. B-6 of A_{t-4} and A_{t-6}.

[b]Eq. B-5 may be taken to represent also the combination of a single flow term with the appropriate backlog, since term B_{t-2} has no adjusted partial correlation when added to eq. B-5. Note that the single-appropriations term which is most useful is A_{t-2}. The inclusion of X_{t-1} has a strong effect on the relative explanatory value of the appropriations flow terms. To use A_{t-2} in place of A_{t-4} in eq. A-2 lowers the adjusted R^2 from 0.8085 to 0.6179; to use A_{t-4} instead of A_{t-2} in eq. B-5 lowers the adjusted R^2 from 0.9390 to 0.8638.

CHART 1

Capital Expenditures, Appropriation, and Explanatory Variables, Quarterly, Seasonally Adjusted, 1953-63 (monetary figures in billion 1954 dollars)



appropriations. This oddity would suggest that some pieces of information which register real influences on expenditures somehow bypass the stage of new appropriation and yet are registered in cancellations.

B. Explanation of Expenditures from Autoregressive Terms

A second set of regression equations, using autoregressive terms, appears in Table 2. Since capital expenditures are a very smooth series (as may be seen from the graph of seasonally adjusted data in Chart 1), it is not surprising that the coefficient of determination is as high as 0.841 using the directly antecedent level of expenditures (X_{t-1}) alone (equation B–1), or is 0.899 using the two autoregressive terms (X_{t-1}) and (X_{t-4}).[7] But it is clear from the outset that such noncausal "explanations" cannot dominate the explanation from appropriations data, since equation B–3 leaves 10.1 per cent of the variance unexplained compared with 6.6 per cent left unexplained by equation A–5 with its series of appropriations-flow terms. We should note further that the contrast would be still sharper if we were searching for "practical" relations which could be used to forecast expenditures (X_t) from data actually available before the opening of quarter (t). In this case, with data of quarter ($t - 1$) not being available, the best we could do with an autoregression would be to use (X_{t-2}) and (X_{t-4}) with an adjusted R^2 of 0.793 (equation B–2). But since the unavailable data in the appropriations-expenditure relation (A_{t-1}) made no net contribution, equation A–5 is already a practical forecasting relation. On this footing, the unexplained variance after the autoregression has been used to its limit is 20.7 per cent compared with 6.1 per cent from the appropriations-expenditure relation.

In any clear-cut choice between an explanation of expenditures from antecedent capital appropriations and a pseudo-explanation from autoregression, therefore, we can cheerfully choose the appropriations. But there is still an interesting question to consider: taking account of appropriations, do autoregressive expenditure terms make any *partial* explanatory contribution? This may be answered by comparing the synthetic equations in Table 2 with their corresponding numbers in Table 1: B–4 with A–3; B–5 with A–2 and A–4; B–6 with A–5. It

[7] Since we want to be sure not to set too low a baseline with our autoregressive "explanation," we present in Table 2 the combination of autoregressive terms ranging all the way to (X_{t-6}), which gives the highest adjusted R^2. To include the strongest of the omitted autoregressive terms (namely X_{t-3}) would raise the *unadjusted* R^2 only from 0.914 to 0.915 and would lower the adjusted R^2 from 0.899 to 0.897.

turns out that the autoregressive term (X_{t-1}) enables us to scale down the residual variance by 61.6 per cent when we take account only of a single appropriations-backlog term; by 50.7 per cent when we take account only of a single appropriation-flow term; by 37.2 per cent when we take account of a single appropriation-flow term and the antecedent backlog; and by 14.8 per cent when we take account of a series of successive appropriations-flow terms.[8]

While the apparent net explanatory contribution of the autoregressive term (X_{t-1}) diminishes sharply as we use more sophisticated appropriations patterns, it does not appear to converge upon zero: the regression coefficient for (X_{t-1}) in equation B–6 is significantly different from zero, with a t-value of 3.95. Our interpretation of this result is that there is probably considerable persistence from quarter to quarter in the economically "random" elements of capital expenditure. Since a large proportion of capital expenditures must be for projects in which spending goes on over two or more successive quarters, any random forces which affect the list of *active projects* in a given quarter should affect *expenditures* in two or more successive quarters. This rationalization obviously calls for testing in later work.

C. Explanation of Capital Appropriations from Financial and Accelerator Variables

The next stage of analysis brings us to a set of equations (Table 3) which for the first time in the paper offer analytical content of the sort that is ordinarily presented in analyses of investment behavior. The analysis may be characterized as a competition between financial and accelerator-type explanations, resulting in a merger. The variables selected for this paper represent the outcome of an extended screening process in the Sachs dissertation. While the resulting correlations are highly respectable (and are supported by substantial confirmation in the results obtained in the dissertation from a study of increments of logarithms of the variables), it should be remembered that the data have been all too thoroughly searched for handsome statistical relations. Hence, as was mentioned above, the empirical results should

[8] These terms cannot quite be reduced to conventional partial correlations since the presence of term X_{t-1} slightly shifts the choice of appropriations terms that yield the most efficient representatives of each approach.

Note that in the right-hand half of Table 2, we have simplified by using only (X_{t-1}) to represent autoregression. Using (X_{t-4}) as well would have raised the adjusted R^2 from 0.939 to 0.944 in equation B–6 and from 0.944 to 0.946 in equation B–6.

TABLE 3

Regression Coefficients from Equations to Explain Capital Appropriations from Financial and Accelerator Variables and Combinations Thereof

(million 1954 dollars per calendar quarter per unit of explanatory variable)

	Noncausal Explanation		Financial Explanation	
	Pure Seasonal, Eq. C-1	Auto-regression, Eq. C-2	Cash Flow Only, Eq. C-3	Bond Yield Only, Eq. C-4
Adjusted R^2	0.0321	0.6724	0.2908	0.4788
Intercept	1169 ± 153	404 ± 158	-228 ± 398	3187 ± 403
Autoregressive terms:				
A_{t-1}		0.897±0.113		
A_{t-4}		-0.234±0.111		
Bond-yield terms:				
R_t				
R_{t-1}				
R_{t-4}				-543 ± 102
Cash-flow terms:				
F_t			0.738±0.207	
F_{t-1}				
F_{t-4}				
Stock-price increment terms:				
ΔS_t				
ΔS_{t-4}				
Orders-capacity terms:				
O_t				
O_{t-1}				
O_{t-2}				
O_{t-7}				
O_{t-9}				
Adjusted R^2 with C_t in eq.	0.0811	0.6859	0.	0.6232

(continued)

TABLE 3 *(concluded)*

Financial Explanation, Bond Yield with: Cash Flow Only, Eq. C-5	Financial Explanation, Bond Yield with: Cash Flow & Stock-Price Increment, Eq. C-6	Accelerator Explanation, Ratio of Orders to Capacity, Eq. C-7	Eclectic Explanation, Orders – Capacity Ratio with Financial Variables: Bond Yield Only, Eq. C-8	Eclectic Explanation, Orders – Capacity Ratio with Financial Variables: Cash Flow with Bond Yield, Eq. C-9
0.6882	0.7939	0.8233	0.8563	0.8678
2103 ± 455	1460 ± 384	-2286 ± 327	-2357 ± 421	1967 ± 735
-340 ± 175	-532 ± 79			
				-494 ± 82
-248 ± 147				
0.689 ± 0.145	0.640 ± 0.149			0.411 ± 0.098
	0.261 ± 0.149			
			0.332 ± 0.116	
11.2 ± 5.7				
22.9 ± 6.0				
		453 ± 173	506 ± 161	
		267 ± 265	437 ± 154	
		238 ± 170		387 ± 85
			-290 ± 125	300 ± 72
			187 ± 113	
0.7043	0.8209	0.8300	(0.8563)	0.8828

probably be viewed not as reports on tests of hypotheses but rather as formulations of hypotheses to be tested on two-digit industries and on data more recent than the period of observation.

To set a baseline, we begin with a purely seasonal explanation (equation C–1) and a naive autoregressive one (equation C–2). It is evident that capital appropriations show even less pronounced seasonal fluctuations than expenditures do, and that the autoregressive relation is also much weaker. The rationalization offered above for the autoregressive tendency of expenditures—that a given project is likely to enter the figures in two or more successive quarters—is probably inapplicable to appropriations, since from our knowledge of the capital-budgeting process, it seems likely that each project will generate only one main appropriation. But we should mention that, if we *had* found a strong autocorrelation, it might have been explained by a possible "bandwagon effect," by which one company's go-ahead decision on a major project may set off a cluster of parallel appropriations by competing or complementary companies, spread over two or three quarters.

We begin the substantive analysis of appropriations (equation C–3) by considering cash flow alone. The resulting coefficient of determination (0.291) is significant, yet so low as to indicate that the model is grossly incomplete and hence uninteresting since other reasonably simple models can do so much better. In fact, as will be seen from equation C–4, using the yield on high grade long-term industrial bonds results in an adjusted R^2 substantially higher than with cash flow alone.

Combining the bond yield with cash flow results in a coefficient of determination of 0.688 (equation C–5); taking the current state of bond yield and cash flow along with the increment of stock prices four quarters previous (equation C–6) yields a coefficient of 0.794. This seems to be the best the data will yield with a purely financial equation.[9]

On the accelerator side, experimentation in the Sachs dissertation indicated that the forces at work can be well represented by a ratio of the inflow of new orders to current productive capacity. This device was introduced in the Hart article as a substitute for the more conventional

[9] The exploration of these relationships broke off at several points because the equation just obtained was "reasonable," while the next variable to enter was about to do so with a regression coefficient of unacceptable sign. To illustrate, consider equation C–9. The experiment which generated this equation with its adjusted multiple R^2 of 0.868 went on to generate adjusted R^2's of 0.881 and 0.897 by adding to the list of included variables first the stock-price increment (ΔS_{t-5}) and then further (ΔS_{t-4}). But we rejected these results because in both cases the partial regression coefficient for (ΔS_{t-5}) had an unacceptable (negative) sign, and in the final form the positive coefficient for (ΔS_{t-4}) fell short in size of the negative coefficient for (ΔS_{t-5}).

utilization ratio of output to capacity which has proved useful in a number of recent investment studies as a measure of pressure on facilities. Because of gestation lags and the durability of capital goods, it is *future* pressure that should—in theory—be relevant. Since new orders manifestly have more *ex ante* content than output of the same date, the flow of new orders was substituted for output in the numerator of the utilization ratio.[10] Even orders, of course, do not in general have enough futurity to represent activity during more than the very earliest part of the period when new facilities now decided upon will be in use. But it is reasonable to suppose that orders come much closer than output of the same date does to expressing the information by which decision-makers learn about prospective future activity. For these reasons, the orders-capacity variable would seem well adapted to express acceleration forces.

The result of a preliminary experiment, in which all time signatures of the orders-capacity ratio were considered from (t) to $(t-8)$, was that the explanatory value of the ratio with respect to capital appropriations could be exhausted by the relation shown as equation C–7 in

[10] In the Hart article this substitution was managed by multiplying the output-capacity ratio by a second ratio (derived from the new Census series, which happens to carry its revisions back to the beginning of 1953 in suitable detail) of the value of flow of new orders to the value of output; the denominator was obtained by adding to shipments the increment of inventory of goods in process and finished products. Since the article dealt with total manufacturing this procedure was preferred to an attempt to directly deflate orders with a price index into "physical" dimensions. It turns out that the implicit price index obtained by dividing the FRB production index into the value of shipments has an unreasonable look for total manufacturing: in particular, it shows a decline from year to year in every year since 1958. The difficulty would seem to lie in the elements of duplication which exist in orders and shipments but which are netted out in deriving a production index; since these elements of duplication as well as price elements should be expected to alter numerator and denominator of the orders-output ratio proportionally, this procedure seemed preferable to price deflation.

Because the Sachs dissertation aims to provide the foundation for a study disaggregated to the two-digit industry level (for which disaggregation of inventory figures is insufficient and the problem of duplication—because one firm's products are bought by another firm—should recede), Sachs preferred to use a price deflator and his data for durables manufacturers have been carried over into this paper. This procedure enabled Sachs to experiment with orders and capacity as separate explanatory variables (measured, respectively, in 1954 dollars and in points of FRB index of production)—with the result that the ratio designated in the present paper as Ot seems to work in combination with financial variables much the same as do the separate variables orders-flow and capacity. To permit consideration of a rich variety of time lags of the different variables without surpassing the sixty-variable limit of the regression program being used, we preferred to simplify in this paper by using the orders-capacity ratio only.

Table 3 with an adjusted R^2 of 0.823—resting entirely on orders contemporaneous with the appropriation and in the two antecedent quarters. If we had to choose between explanations of the accelerator family and of the financial family, the margin of superiority of equation C–7 over equation C–6 would seem decisive.

Neither the financial-determination model nor the acceleration model of investment decisions, however, can properly be interpreted to exclude all elements of the other, either as a theoretical necessity or in fact. While it would be a convenient simplification if a pure accelerator model left all financial variables without significant partial correlations, or if a reasonably simple financial model left such accelerator variables as the orders-capacity ratio without a partial correlation, the empirical work very definitely shows that eclectic combinations using both financial and accelerator variables are considerably stronger than pure models. Two such eclectic combinations appear as equations C–8 and C–9 in this study. Like the financial and eclectic equations of the Sachs dissertation, these equations suggest that so long as cash flow is included, there is scope for obtaining rather high correlations with widely divergent patterns of the other financial variables. This outcome is somewhat disconcerting in view of the special importance for monetary analysis of the bond-yield variable. It is to be hoped that better research design will yield a more stable pattern of explanation with respect to the financial variables. One more peculiarity of the eclectic equations C–8 and C–9 should be mentioned: with the inclusion of financial variables, it appears uniformly that the rather remote orders-capacity ratio (O_{t-7}) has fairly substantial statistical significance whereas in the pure accelerator equation C–7 only very recent ratios appeared to be significant determinants of capital appropriations. The negative sign of the regression coefficient for (O_{t-7}) in the eclectic formulations presumably implies that decision-makers take into account the *rise* of the orders-capacity ratio over recent quarters as well as its very recent level.[11]

[11] In early drafts of the Hart article, there was a good deal of stress on the backlog appropriated but unspent as a *negative* element in the explanation of appropriations, representing the extent to which the needs shown by the orders-capacity ratio have already been provided for. In the present study, both the backlog at the opening of the quarter of appropriation (B_t) and that at the opening of the preceding quarter (B_{t-1}) uniformly have negative partial correlations if incorporated in the equations reported in Table C; but in no equation is either of these variables of statistical significance.

TABLE 4

Regression Coefficients from Equations to Explain Capital Expenditures (Bypassing Appropriations) Directly from Explanatory Variables

(million 1954 dollars per calendar quarter per unit of explanatory variable)

	Financial Explanation				Accelerator Explanation, Ratio of Orders to Capacity, Eq. D-5	Eclectic Explanation, Orders-Capacity with Cash Flow, Eq. D-6
			Bond Yield with			
	Cash Flow Only, Eq. D-1	Bond Yield Only, Eq. D-2	Cash Flow Only, Eq. D-3	Cash Flow with Stock-Price Increment, Eq. D-4		
Adjusted R^2	0.4224	0.4743	0.7515	0.7561	0.9108	0.9305
Intercept	−398 ± 364	2085 ± 236	638 ± 294	736 ± 302	−1137 ± 142	−1280 ± 140
Cash-flow terms:						
F_{t-1}	0.123 ± 0.121		0.203 ± 0.080	0.204 ± 0.080		0.141 ± 0.046
F_{t-3}	0.330 ± 0.134		0.257 ± 0.089	0.252 ± 0.088		
F_{t-4}						−0.077 ± 0.057
F_{t-5}	0.174 ± 0.158		0.111 ± 0.104	0.045 ± 0.116		
F_{t-6}	0.171 ± 0.150		0.184 ± 0.098	0.170 ± 0.098		
Bond-yield term:						
R_{t-8}		−291 ± 61	−268 ± 43	−259 ± 44		
Stock-price increment term:						
ΔS_{t-7}				7.2 ± 5.9		
Orders-capacity terms:						
O_{t-3}					216 ± 72	101 ± 76
O_{t-4}					161 ± 87	271 ± 95
O_{t-6}					230 ± 46	240 ± 42
Adjusted R^2 with B_{t-1} in eq.	0.9306	0.8766	0.9287	0.9341	0.9260	0.9508

D. Direct Explanations of Expenditures

The implication of introducing appropriations as an intervening variable between capital expenditures and explanatory variables of the financial or accelerator type is that the explanatory variables in some sense act on expenditures *through* appropriations. Pushed to extremes, this view would suggest a hypothesis that any attempt to bypass appropriations and explain expenditures directly from the variables used to explain investment decisions would in general yield relations weaker than those obtained from using appropriations. A number of regression equations which are useful to test this hypothesis are presented in Table 4.

If we take as baseline the adjusted R^2 of 0.934 obtained in equation A–5 for expenditures as a function of a consecutive series of antecedent appropriations flows, it is evident that we have been unable to find any combination of the explanatory variables used which would outperform appropriations: the best adjusted R^2 we have been able to obtain is 0.931 (equation D–6) for a combination of recent cash flows and somewhat more remote orders-capacity ratios. On the other hand, we might reasonably be suspected of a certain bias toward showing the superiority of the appropriations approach, and one might well be able to improve upon equation D–6 by taking account of variables which did not happen to figure among those used in section C to help explain appropriations. This admittedly limited test, therefore, is to be interpreted as indicating that appropriations are a highly efficient *summary* of the information bearing on the interpretation of capital expenditures rather than that direct explanations are weak in comparison.

Another formulation—a good deal less favorable to the appropriations data—deserves consideration. If in fact the forces represented by the explanatory variables act upon expenditures *only through appropriations,* we can link up the results of Tables 1, 3, and 4 to set ceilings for the correlations to be expected from direct explanations. From Table 1 we know that a consecutive series of appropriations terms together with seasonal dummies can clear up 93.44 per cent of the variance in expenditures (equation A–5) and that the seasonal dummies alone can clear up 12.08 per cent (equation A–1); hence appropriations account for 92.54 per cent of the nonseasonal variance. Multiplying 92.54 per cent by the adjusted R^2's of Table 3, we can infer the maximum percentage of nonseasonal variance which various combinations of explanatory variables ought to be able to clear up *if they acted on expenditures solely through appropriations.* This result can be com-

TABLE 5

Summary of the Relative Ability of Selected Variables to Explain the Nonseasonal Variance in Capital Expenditures

Combination of Explanatory Variables	Relevant Equations in		Adjusted R^2's of Equations in		Percentages of Nonseasonal Variance Explained		
	Table 3	Table 4	Table 3	Table 4	Expectation Based on Table 3[a]	Table 4 Table 4[b]	Excess
Bond yield	C-4	D-2	0.4788	0.4743	44.3	40.2	-4.1
Bond yield with cash flow	C-5	D-3	0.6882	0.7515	63.7	71.7	8.0
Bond yield with cash flow and Δ (stock price)	C-6	D-4	0.7939	0.7561	73.5	72.3	-1.2
Orders-capacity	C-7	D-5	0.8233	0.9108	76.2	89.8	13.6
Orders-capacity with cash flow	C-8	D-6	0.8563	0.9305	79.2	92.1	12.9

[a]92.54 per cent multiplied by adjusted R^2 from Table 3.

[b]$\frac{\text{Adjusted } R^2 \text{ from Table 4 minus } 0.1208}{(1.0000 - 0.1208)} \times 100$ per cent

pared to the percentage of nonseasonal variance in capital expenditures (that is, the partial contribution of the explanatory variables, taking into account that 12.08 per cent of the variance can be "explained" by seasonal dummies) accounted for by the various equations of Table 4. This test is summarized in Table 5.

The purely financial explanations of equations D–2 and D–4 fall short of the expectation so derived as to maximum explanatory power, so that they would leave open the hypothesis that financial variables acted only through appropriations. (The apparently superior explanatory power of equation D–3 does not change this finding, since equation D–3 is dominated by equation D–4, which in turn is dominated by C–6.) But explanations based on the orders-capacity ratio (alone or with cash flow) not only outperform the financial equations, but also exceed the maximum explanatory power consistent with action of the explanatory variables solely through appropriations. Whereas equation C–8 leaves unexplained 20.8 per cent of the nonseasonal variance, equation D–6 leaves unexplained only 7.9 per cent; thus the combination of orders-capacity and cash flow clears up three-fifths of what is left unexplained by equation C–8. It is interesting that a substantial part of the explanatory power of equation D–6 rests on cash flow one quarter before the expenditure.

E. Eclectic Explanation of Expenditures

It is interesting and at the same time somewhat disconcerting that the direct explanation of capital expenditures from the substantive explanatory variables is so powerful. Yet, the over-all results of the best direct explanation are still slightly inferior to those of an explanation of expenditures which takes appropriations as a datum. It follows that we must expect a further eclectic combination of substantive explanatory variables together with appropriations to do considerably better than the direct explanation. That this will be the case is shown by the memorandum at the foot of Table 4 which shows for each equation the effect of incorporating a single appropriations variable: the backlog appropriated but unspent at the opening of the quarter previous to the appropriation. Particularly for the financial equations, but also for the equations including orders-capacity as an explanatory variable, this single addition out of the appropriations data results in a substantial increase in explanatory power. But this is merely illustrative. If we admit more than one appropriations variable and allow the choice of this variable to vary with the content of the direct explanation of capital expenditures, we will be able to improve the relations still further.

Equations which present somewhat more flexible eclectic combinations of appropriations and substantive explanatory variables appear in Table 6.

TABLE 6

Regression Coefficients from Equations to Explain Capital Expenditures by Composite Functions of Appropriations with Explanatory Variables

(million 1954 dollars per calendar quarter per explanatory variable)

	Appropriations-Finance Explanation		Appropriations-Accelerator Explanation,
	Appropriations with Cash Flow Only, Eq. E-1	Appropriations with Cash Flow & Stock-Price Increment, Eq. E-2	Appropriations with Orders-Capacity, Eq. E-3
Adjusted R^2	0.9565	0.9630	0.9380
Intercept	32 ± 75	-57 ± 81	36 ± 207
Appropriations-flow terms:			
A_{t-2}	0.146 ± 0.044	0.131 ± 0.042	0.098 ± 0.071
A_{t-3}	0.168 ± 0.052	0.153 ± 0.051	0.113 ± 0.065
A_{t-4}	0.090 ± 0.055	0.062 ± 0.052	0.121 ± 0.065
A_{t-5}	0.084 ± 0.062	0.103 ± 0.058	0.028 ± 0.077
A_{t-6}	0.175 ± 0.047	0.187 ± 0.043	0.206 ± 0.071
Cash-flow terms:			
F_{t-1}	0.142 ± 0.037	0.163 ± 0.038	
F_{t-3}		0.041 ± 0.040	
Stock-price increment term:			
ΔS_{t-5}		3.4 ± 1.6	
Orders-capacity terms:			
O_{t-2}			123 ± 64
O_{t-7}			81 ± 79
O_{t-8}			-100 ± 58

Note: Without exception, all bond-yield terms have *positive* partial correlations if added to any of the equations in this table.

Of the composite eclectic equations shown in Table 6, the weakest (equation E–3) is more powerful than any of the direct-explanation equations of Table 4. This equation, however, is only a very small improvement over the original appropriations relationship (equation A–5, with its adjusted R^2 of 0.934). It appears, therefore, that virtually all the relevant information to be found in the orders-capacity ratio is well represented by capital appropriations. By comparison, the two financial equations of Table 6 show more additional information—chiefly by way of the cash-flow term F_{t-1}. This is not an altogether satisfactory outcome, since the cash flow of the quarter just before the actual capital expenditure would seem to come too late to have much scope to influence the expenditure. Our interpretation is that this variable (F_{t-1}) functions as a "surprise variable," influencing last-minute modifications of plans. One possibility is that the cash-flow situation has a strong effect on capital outlays made by division and plant managers under delegated authority, which are for relatively small items and may consist largely of outlays for items which suppliers have in stock and can ship on very short notice.

F. Plan-Image Analysis

If we had fuller information on the expectations of decision-makers about future sales, cash flow, etc., it would be interesting to undertake an adequate analysis of the "realization function"—that is, to treat actual capital expenditures as constituting overfulfillment or underfulfillment of plans—and to seek explanations of these deviations from plans in surprises, i.e., anticipations errors, experiences in sales, cash flow, etc. Unfortunately, we lack the background data on expectations about relevant surprise variables. Therefore, all we can do is to set up equations which represent plans as of a viewpoint date far enough from expenditure to leave scope for making revisions effective and then examine the partial correlations of surprise variables when added to these equations.

A collection of such plan-image equations is presented in Table 7. In order to leave room for effective modifications of plans, we have worked with data in the plan-image function which has a time signature no closer than $(t - 3)$ to the date of expenditure. Consequently, there is room for experience which is too late to affect appropriations of date $(t - 3)$ and probably even of date $(t - 2)$, but long enough ahead of the date of expenditure to be registered and to permit scaling planned capital outlays up or down. We represent the surprise variables by proxies. Cancellations may be taken to be a proxy for adverse news about factors affecting investment. Cash flow of date $(t-1)$, in view of its apparent influence in the eclectic equations of Table 4, may be taken to be a proxy for favorable news. These variables can sensibly be combined, with the stipulation that the regression coefficients for (C_{t-2}) and (C_{t-1}) must both be negative and that for (F_{t-1}) must be positive. An alternative approach would be to suppose that the *partial* relation of the backlog of unspent appropriations at the opening of the current or preceding quarter is a composite proxy for factors leading to alterations of plans. Most of the variance of the appropriations backlog can, of course, be explained by the variables which make up the equations of Table 7 so that to add variable (B_{t-1}) is to add a *residue* of information of later date than the appropriations and other variables which appear in Table 7.

Three of the equations of Table 7 appeared in earlier tables (F–1 is identical to A–1; F–3 to D–3; and F–5 to A–6). They are included here for completeness and because the supplementary relations treated in the memorandum at the end of the table are different from those examined previously. The accelerator plan-image equation (F–3) and the appropriations plan-image equation (F–5) are fairly powerful. The financial variables, when deprived of recent cash flow (F_{t-1}), show a comparatively weak correlation in equation F–2. However, the same variables make a significant contribution when combined with the orders-capacity ratio (equation F–4). But when we combine appropriations with the orders-capacity ratio in equation F–6, none of the financial variables contribute significantly. It should be noted that in setting up these plan-image equations, we were not able to establish any significant contribution for long-term bond yields except in the purely financial variant (equation F–2).

The rather modest residual variance left by the plan-image equations can be appreciably reduced by taking account of our so-called surprise variables, as may be seen from the memorandum in the lowest lines of Table 7. The combined effect of taking account of the two cancellation terms (which have appropriate negative regression coefficients throughout) is clearly visible except for the pure-finance equation. Except in equation F–4, however, we would explain a larger proportion of the residual variance with the cash-flow surprise variable F_{t-1}. The combination of these three variables makes an appreciable improvement over the use of the two cancellation terms alone and a modest improvement over using F_{t-1} alone. The backlog term turns out to contribute considerably less (in several equations essentially zero),

TABLE 7

Regression Coefficients of Equations to Explain Capital Expenditures by Appropriations and Explanatory Variables of Dates (t-3) and Earlier

(million 1954 dollars per calendar quarter per unit of explanatory variable)

	Noncausal Explanation, Pure Seasonal, Eq. F-1 (=A-1)	Financial Explanation, Cash Flow with Bond Yield & Stock-Price Increment, Eq. F-2
Adjusted R^2	0.1208	0.7393
Intercept	1037 ± 87	735 ± 331
Cash-flow terms:		
F_{t-3}		0.352 ± 0.083
F_{t-6}		0.240 ± 0.097
F_{t-7}		
Bond-yield term:		
R_{t-8}		-221 ± 46
Stock-price increment terms:		
ΔS_{t-3}		8.2 ± 4.4
ΔS_{t-4}		
ΔS_{t-7}		9.3 ± 5.4
Orders-capacity terms:		
O_{t-3}		
O_{t-4}		
O_{t-6}		
Appropriations-flow terms:		
A_{t-3}		
A_{t-4}		
A_{t-5}		
A_{t-6}		
Adjusted R^2 with surprise variables in eq.		
C_{t-1} with C_{t-2}	(<0.1208)	(<0.7393)
F_{t-1}		0.7649
C_{t-1} and C_{t-2} with F_{t-1}		0.7513
B_{t-1}	0.8764	0.8978

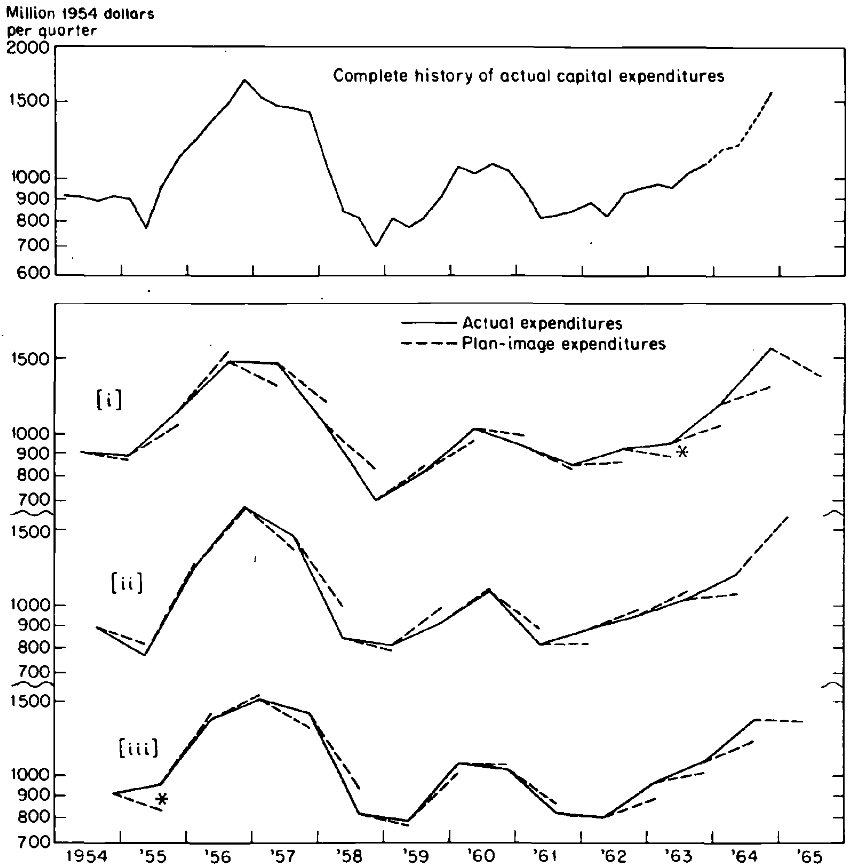
(continued)

TABLE 7 *(concluded)*

Accelerator Explanation, Orders-Capacity, Eq. F-3	Financial-Accelerator Explanation, Orders-Capacity with Cash Flow & Stock-Price Increment, Eq. F-4	Appropriations Explanation, Consecutive Series of Flows, Eq. F-5(=A-5)	Composite Explanation, Appropriations Flows with Orders-Capacity, Eq. F-6
0.9108	0.9238	0.9040	0.9249
−1037 ± 142	−1337 ± 156	363 ± 62	−116 ± 167
	0.172 ± 0.065		
	3.3 ± 2.7		
216 ± 72	229 ± 77		177 ± 60
161 ± 87	199 ± 85		
230 ± 46	149 ± 53		
		0.310 ± 0.058	0.165 ± 0.071
		0.125 ± 0.080	0.099 ± 0.071
		0.102 ± 0.088	0.091 ± 0.078
		0.069 ± 0.063	0.109 ± 0.057
0.9256	0.9432	0.9207	0.9385
0.9267	0.9382	0.9401	0.9501
0.9298	0.9459	0.9422	0.9526
0.9240	0.9278	0.9048	(<0.9249)

CHART 2

Levels of Actual and Plan-Image Capital Expenditures Using Plan-Image Based on Appropriations, Seasonally Adjusted, 1954-65



Source: Table A-1.

except that its inclusion clears up some three-fifths of the substantial residual variance left by the pure-finance equation (F–2).

We may reasonably conclude that if we were able to mobilize suitable data, the realization-function approach would probably offer a suitable framework for the analysis of capital appropriations and expenditures. But besides the lack of explicit information as to the time shape of expenditure plans, we suffer (for the present) from a dearth of data on sales forecasts, etc., so that the only available procedure would be to set up constructs to represent what respondents *could be reasonably expected to anticipate.* This is by no means a hopeless enterprise but it will invariably include several points where we can proceed only by making highly arbitrary assumptions.

RESIDUAL ANALYSIS OF PLAN-IMAGE RELATIONS

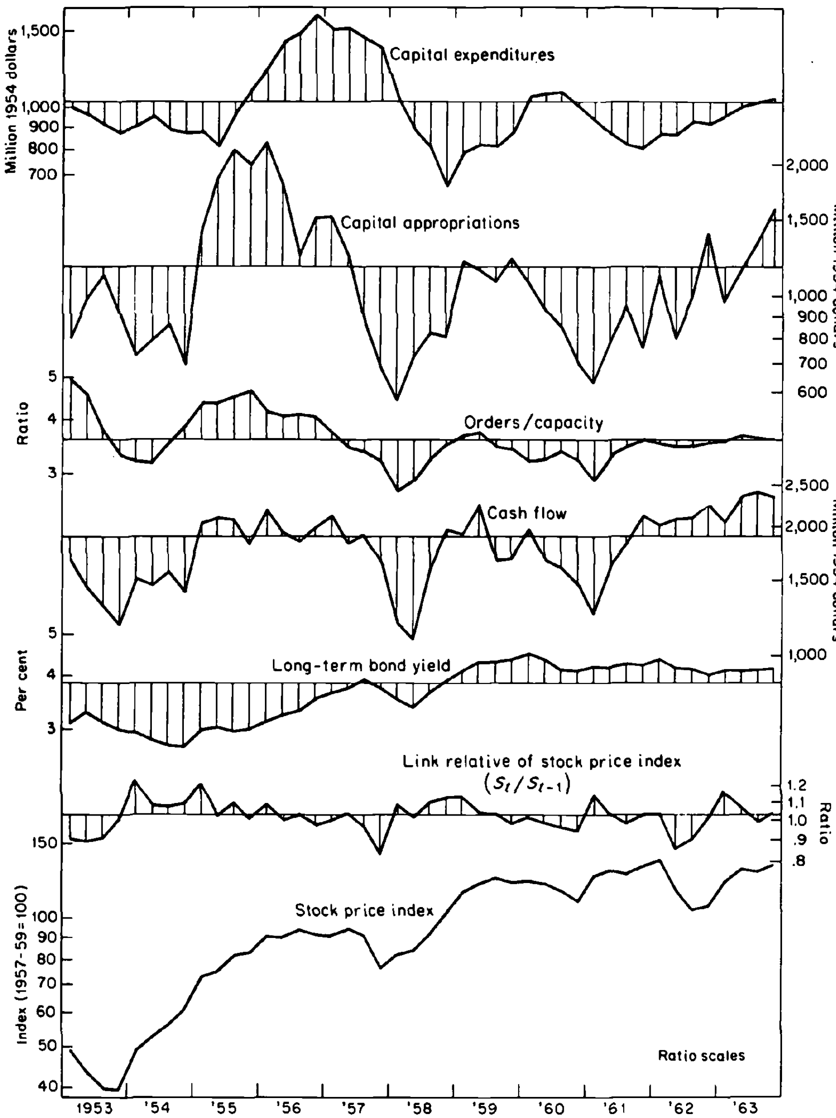
Starting from the most interesting of the plan-image equations (F–5, resting purely on appropriations flows), we can form an interesting impression of the time shape of investment planning from Chart 2. Since the time span from the viewpoint date to the date of expenditure is taken as three quarters, we have graphed the actual data (continuous solid curve) with a three-quarters interval between points. Thus we arrive at three curves—one starting with the first quarter of 1955, one with the second quarter of 1955, and one with the third quarter of 1955. The planned level of expenditure implicit in the previous appropriations flows (according to the regression formula F–5) is graphed for each date as a point off the curve. These points are then tied back by broken lines to the actual expenditure of the viewpoint quarter and so each broken line represents a hypothetical extension of the historical record to the left of it. To avoid putting undue emphasis on the ability of decision-makers to visualize seasonal movements, we have adjusted all the points by the seasonal formula yielded by the regression coefficients of the seasonal dummies in equation F–5.

It is visible immediately that the broken lines closely follow the curve of actual movements with a few interesting exceptions to be examined in a moment. That is, the plan image corresponds quite well to the actual course of events. This is as it should be if the plan image is a good proxy for actual plans; for while we have chosen the three-quarter time interval to leave scope for revision of plans, this scope is so narrow that major revisions can be expected only in emergencies.

At the points marked with asterisks on Chart 2, the plan image actually fails to agree in direction with the actual change: this happens only twice (in the changes from the fourth quarter of 1954 to the third quarter of 1955 in set iii and in the changes from the third quarter of 1962 to the second quarter of 1963 in set i). The first of these divergencies (which is much the larger) is readily explained by the dramatic triumph on the market of the 1955 automobile models, which seems to have been an agreeable surprise sharp enough to produce a major change in evaluations of the near future by manufacturers. Note that the presence of a few such divergencies is not pre-

CHART 3

Three-Quarter Increments of Actual and Plan-Image Capital Expenditures, Using Plan Image Based on Appropriations (million 1954 dollars)



cluded by the concept of plan image: on the contrary, they are required. The basic methodological principle here is that *the same figure can measure both what firms expect and what is actually going to happen only when management is in a position to foretell the course of events.* Even in a field like capital expenditures, where the object of the forecast is something the firm in question will itself participate in, rather than a strictly external phenomenon, some turns of events are so surprising that they must effect deviations from plans of this sort.

The same data may be examined in slightly different perspective in the scatter diagram presented in Chart 3. For the same three sets of dates, we obtain scatter charts whose basic tendency is clearly for roughly proportional variation of plan image and actual.[12] We have dated the points at which the actual change is conspicuously large compared with what the general shape of the scatter would suggest as normal.

The high concentration of recent dates with increments larger than the plan image must be taken to indicate serious shortcomings in the plan image.[13] It must be remembered that while our data book includes a considerable number of calendar quarters, it includes only two and a half business cycles. It is likely that when our experience includes a definite peak for the upswing that started in 1961, more significant results can be obtained by analyses of this type. Furthermore we suspect that somewhat more sophisticated seasonal-adjustment measures will also prove worthwhile.

G. Agenda for Further Research

We hope, with the benefit of criticism, to push this analysis considerably further. The data for two-digit manufacturing industries lend themselves to an analysis of the type undertaken here—though not without some difficulties in applying measures of capacity and the like.

[12] Combining all three sets of data into one calculation yields an adjusted R^2 of 0.886 between actual and plan image predicted three-quarter increments, from expenditure dates 1955:1 through 1963:4. The 1964 data (not used in the calculations) are shown with points marked by a dot. Since the high points in the period of observation 1955–63 cluster to the left of the center of gravity, the regression coefficient yielded by the relation (with actual change as dependent variable) is somewhat lower than would be indicated by the consistent tendency of the larger changes to follow closely a 45-degree line.

[13] Inclusion of time as a variable either in the correlation of levels of X with antecedent levels of A or in the correlation of $(X_t - X_{t-3})$ with $(P_t - X_{t-3})$ suggests that mere inclusion of a trend will not clear up the difficulty; for in both cases the regression coefficient for time is nonsignificant, taking a closing date of 1963:4.

Furthermore, it appears that data exist from which sales forecasts can be given a much more appropriate time-shape.[14] As was mentioned above, the present study should probably be viewed as a reconaissance: we have looked at so many relations that the degree to which we can claim to have genuinely tested hypotheses is doubtful. But at the very least, we are in a position to enter upon research at the two-digit industry level with fairly well-defined hypotheses. It may prove practical to experiment also with microdata.

One relatively important shortcoming of the present study should be mentioned at this point, since any further research undertaken in this area will probably face the same difficulty. On the basis of some further work done by one of the authors since the completion of the present paper, we have concluded that our technique of statistical estimation—single-stage least-squares done on the observed, deflated levels of variables—has introduced a systematic bias into our plan-image functions. The difficulty is that, in the plan-image functions based on one or more capital appropriations terms, there is consistently a large and positive intercept. The weights (regression coefficients) of the independent variables in these relations do not sum to unity, which they ought to in theory, but typically sum to approximately 0.65 or so.

The implications of this deficiency of the sum of weights in these plan-image relations became most apparent in some recent work we have done. In attempting to sketch statistically the time shape of the capital expenditure "forecasts" implicit in the antecedent capital appropriations, it became evident that these quasi *ex ante* capital expenditure figures did not perform very well as "forecasters" of the 1964 period. The available evidence suggests that, if we had gotten virtually zero intercepts in the relevant plan-image functions, they would probably have performed better as forecasting relations. As is, our plan-image equations now imply that, if capital appropriations double, capital expenditures will eventually stabilize at a level only approximately two-thirds greater than their previous level. In principle, a conservation of capital appropriations in expenditures is, of course, required.

It should also be noted that the period of observation (1953–63) for the plan-image regression equations exhibited a virtually horizontal time trend in capital appropriations and expenditures. Therefore, because of the bias introduced by our statistical estimation technique,

[14] S. Almon, in an unpublished paper, has made a very interesting attempt to reshape McGraw-Hill sales forecasts so as to simulate a moving eight-quarter horizon; we suspect that her approach can profitably be used to backstop alternative methods of estimation, but it contains too many arbitrary elements to be definitive.

although these plan-image functions proved to be highly successful in terms of their "predictive" (explanatory) value, the same relations essentially broke down in terms of their "forecasting" ability, since the forecast period, in distinction to the fit-period, exhibited a very pronounced upward trend.

Two methods of correcting for this bias suggest themselves. One would be to specify an appropriate a priori distribution of lag weights and in this manner constrain the regression coefficients of the plan-image function based on capital appropriations. A conservation of capital expenditures would presumably be established if the intercept of the relation is forced through the origin. A very successful application of such a scheme is illustrated in the recent work of S. Almon, where the lag weights are distributed along a polynomial. A second alternative would be to fit the plan-image equations to variables transformed into some sort of incremental form, working with different increment spans. Our experiments along these latter lines have not yielded any conclusive results.

A crucial problem in this field is the study of the actual institutional content of the lags which students find econometrically in the investment process. It is highly probable that such a study can progress a long way by exploitation of press releases and company reports, which have a great deal to say about major investment projects. The likelihood is high, however, that a *special survey* to deal with the distribution of capital outlays in a current quarter by past quarters when the projects passed the appropriation stage will prove highly illuminating. We hope to promote such an exploratory survey and perhaps to frame recommendations for the more efficient exploitation of the mine of data which existing surveys have been high-grading. The results are sure to be of enough interest to businessmen that they will be willing to continue to generate useful data. With few adaptations, the field of *ex ante* data on investment can probably be restructured to put studies of business investment behavior on a much firmer footing.

Appendix on Data Sources

The several variables used in this study are quarterly, seasonally unadjusted, constant-dollar (except for bond yields and stock prices) series for the period 1953 through 1963. The National Industrial Conference Board (NICB) supplies us with the investment statistics used in the present study. These are generated by way of a survey questionnaire sent by the NICB to 570 of the 1,000 largest manufacturing corporations, including 337 of the largest 627 durable goods producers. The survey data are filed by respondents in the following form:

	Beginning-of-quarter backlog of funds appropriated but unspent
plus	Newly authorized appropriations during the quarter
minus	Cancellations of unspent appropriations during the quarter
minus	Capital expenditures during the quarter
equals	End-of-quarter backlog of funds appropriated but unspent.

Revisions occasionally make the new quarter's initial backlog diverge from the previous quarter's initial backlog.

A capital *appropriation* is defined in the survey as the authorization to management by the board of directors or investment committee of a company to incur charges on fixed capital account in order to carry out specific investment projects. Thus, the focus of the NICB capital appropriations survey is on *when* the capital-spending *decision* is actually made final at the company's top management level. The survey figures on investment *expenditures* are, for the panel of 570 companies, identical to those reported by the same firms to the Commerce-SEC survey of capital spending published in the *Survey of Current Business*.

The capital appropriations survey data from the first quarter of 1953 (53:1) to the fourth quarter of 1963 (63:4) was generated from three basic panels. From 53:1 to 54:4, there were 353 reporting companies (reporting retrospectively in 1955); from 55:1 to 57:4, there were 511; and from 58:1 to 63:4, there were 602 reporting companies. The current figure is 570. Splicing of the series to correct for sample changes was done in terms of industry assets. The regression results reported in the present study were all derived from estimating equations in which sampling universe data were used. That is to say, throughout, we worked with investment data estimated for the population of the 1,000 largest U.S. manufacturing corporations. The "blow-up" from reporting company data to estimates for the 1,000 largest firms in manufacturing is done by industry and is simply based on the relationship of the total assets of companies within each industry (universe) to the total assets of companies within each reporting or sample industry.

There are several advantages in using estimated population figures rather than reporting company, i.e., sample data. Significant sample changes have been incorporated into the universe estimates and corrections for changes in company ownership and in the pattern of survey response have been made. As of 64:2, all published NICB investment survey data are population estimates for the 1,000 largest manufacturing companies rather than panel data. The level and time shape of the durables manufacturing subaggregate investment series on a reporting company basis is in part determined by the (varying) representation of the component two-digit industries. On this basis, the component industry weights are essentially response weights and interpretation of the relevant NICB investment series is ambiguous. An industry basis for weighting is achieved and the interpretive problem is thereby lessened, when the panel values of each series for a given two-digit industry are adjusted to estimates of the population of the 1,000 largest firms. For these latter values, each industry contributes a more "realistic" proportion to the corresponding subaggregate series.

The NICB survey population or sampling universe consists of the 1,000 largest U.S. manufacturing corporations. Size is defined here in terms of total assets and the cut-off point is approximately $15 million. These 1,000 companies account for slightly over one-half (55 per cent) of total manufacturing employment, roughly three-quarters of all manufacturing capital outlays, estimated at $18 billion in 1964, and about two-thirds of total manufacturing assets. The individual firms included in the NICB survey universe correspond very closely to those listed in the Federal Trade Commission's *A List of 1,000 Large Manufacturing Companies.* In 1958, the ratio of the total assets of reporting companies in the NICB survey to the total assets of the top 1,000 manufacturing firms was 70 per cent. Reporting companies accounted for more than half of total investment spending in the manufacturing sector, as estimated by the Commerce-SEC survey of capital expenditures. In terms of sample coverage, the NICB and OBE-SEC investment surveys are very similar. For example, the proportion of total capital outlays accounted for by durables and nondurables in the NICB survey is 49.6 and 50.4 per cent, respectively, and the corresponding figures for the OBE-SEC survey are 50.3 and 49.7 per cent. A comparison of the OBE-SEC series on investment spending for the manufacturing aggregate with the corresponding NICB total shows no radical differences in their behavior over time.

The data source for the series on manufacturers' new orders is the U.S. Department of Commerce, Bureau of the Census Publication, *Manufacturers' Shipments, Inventories, and Orders: 1947–1963 (Revised).* A quarterly new orders series for durable goods manufacturing industries is obtained by simply cumulating the appropriate figures for successive three-month periods. The most recent orders figures were taken from the relevant issues of the *Survey of Current Business*. The sample upon which the Census Bureau's estimates of new orders in durables manufacturing is based has a very strong large-company bias, a helpful distortion for the present study. The number of reporting firms with more than 1,000 employees has been increased from 1,100 in mid-1957 to 1,850 in mid-1962 and such firms are included in the sample with a (probability) weight of 1.0. Moreover, the response rate of small companies is relatively poor. For these and other reasons, the month-to-month changes of the universe estimates reflect primarily the new orders behavior of the larger manufacturing enterprises.

Survey coverage is best in those industries which are characterized by a large scale of production and a correspondingly small number of large firms. Most of the two-digit durable goods manufacturing industries fall into this category. Although this manufacturing sector typically produces to order rather than to stock, in some cases, new orders data is not available and shipments figures are substituted for them. Among the durable goods manufacturing industries at the two-digit level, the percentage of total reported shipments accounted for by companies also reporting unfilled orders backlogs, i.e., really producing to order, ranges from 28 per cent for "stone, clay and glass" to 75 per cent for "total transportation equipment."

The estimates of manufacturing capacity for the durable goods sector used in this study and combined in ratio form with new orders were developed by F. de Leeuw of the Federal Reserve Board (FRB). This capacity index combines three sets of figures: (1) business records on gross investment spending and depreciation, which are used by the Commerce Department to estimate manufacturers' fixed capital stock; (2) the McGraw-Hill manufacturing capacity index which is based on survey questionnaire reports from businesses on the percentage increase in the physical volume of capacity during the year; and (3) the ratio of the seasonally unadjusted December-January average FRB index of the durables manufacturing sector output (1957–59 = 100) to the McGraw-Hill end-of-year estimate of capacity utilization, which is based on survey questionnaire reports from businesses in response to the question: "How much of your capacity were you operating at the end of 19__?"

Both the Commerce Department and McGraw-Hill series exhibit a distinct upward time trend, with the latter series growing at a rate 1.8 per cent faster than the capital stock series for the period 1947–59.

The third component series was assumed to have no drift over time since it is directly linked to actual manufacturing production. However, due to varying response rates, ambiguity in the definition of "end of year," and the alternative use of a seasonally adjusted or unadjusted FRB manufacturing output index, this third series exhibited much sharper short-run fluctuations than did either of the other two. Since the first two component series drifted from the desired capacity measure as a result of the passage of time whereas the third series exhibited fairly random fluctuations with no very pronounced time trend, de Leeuw regressed the ratio of the third series to each of the other two on time and a random disturbance term.

From the estimates of the two regression coefficients, two values of the capacity utilization rate were calculated, one from each regression equation, and the simple average of these was used to derive the final capacity figures. The estimating equations were fitted by de Leeuw on annual time series (converted to logarithms), and the quarterly capacity estimates for durables manufacturers used in the present study represent interpolations which minimize the quarter-to-quarter fluctuations of the index, subject to an annual data constraint.

The source of the cash flow variable, defined as equal to net profits after taxes less dividends plus depreciation allowances, is the *Quarterly Financial Report for Manufacturing Corporations (QFR)* issued jointly by the Federal Trade Commission and the Securities and Exchange Commission. The conventional accounting concept of profits—total net revenues less total costs—is used in the *QFR* income statements. The composite sample (for 62:1, the FTC segment was 100 firms and the SEC segment was 526) from which the *QFR* estimates are generated has an obvious large-company (size) bias. At present, the sample consists of about 2 per cent of all manufacturing corporations with total assets of less than $1 million, 25 per cent of all those firms with total assets between $1 and $5 million, and all manufacturing corporations whose total assets are over $5 million.

Since the *QFR* income statements are estimated from a sample of business enterprises classified as manufacturers and required to file U.S. Corporation Income Tax Form 1120, the asset size distribution of the composite FTC-SEC sample may be compared with the population figures for fiscal year 1960, the latest year for which such information has been published by the Internal Revenue Service in *Statistics of Income*. Of the 156,296 Forms 1120 filed by the active manufacturing corporations with accounting periods from July 1959 to June 1960, some 136,255 were filed by firms whose total assets were between $1 and $5 million, and 3,890 were filed by companies with total assets greater than $5 million.

The long-term bond yield was taken from *Moody's Industrial Manual.* The quarterly series was obtained by taking a simple average of the monthly bond yields on grade Aaa industrial debt securities. Using the Aaa bond yield on industrials rather than some other (lower) rated bond yield is justified in that the rating of the debt securities issued by the largest U.S. manufacturing corporations would typically if not always fall in the Aaa rating category and hence usually exhibit the lowest long-term yield.

The index of common stock prices (1957–59 = 100) used in this study was taken from the Securities and Exchange Commission's *Statistical Bulletin.* The SEC stock price index is an index of the weekly closing prices of some 300 common stocks regularly traded on the New York Stock Exchange (NYSE). The index for the durable goods manufacturing sector includes thirteen two-digit industry categories, four more than the corresponding number included in the same subaggregate of the NICB capital appropriations survey. Since the durables sector stock price index is the weighted average of the last sale price each week of 108 selected common stocks, these weekly indexes were averaged over successive three-month intervals so as to obtain a comparable quarterly index.

The weighting system used by the SEC in calculating the index is to multiply the individual stock price by the corresponding number of common shares outstanding. Companies with common stock traded on the NYSE are initially classified according to their standard industrial classification, i.e., according to their major activity. All of the manufacturing industry groups which individually accounted for more than 1 per cent of the aggregate trading volume on the NYSE during 1958 were selected for inclusion in the SEC index. On this basis, thirteen durable goods manufacturing industries qualified for inclusion and in each of these the most actively traded issues were chosen until a coverage of at least 60 per cent of the trading volume in each of the selected industry groups was accounted for.

For purposes of the present study, it was necessary to construct two price indexes, one for capital goods and the other for manufacturers' new orders. The capital goods price deflator was used to reduce all of the NICB investment statistics as well as the *QFR* cash flow series to constant (1954) dollars. The FRB capacity estimates are, of course, already in "real" terms, the long-term bond yield is expressed in percentage points, and the common stock prices are expressed as the quarter-to-quarter *increments* of an index based on monetary units.

The basic price data used in the construction of the capital goods price index were two component price series of the implicit GNP deflator, namely, for nonfarm, nonresidential construction and for producer durable equipment. These were taken from the U.S. national product accounts as tabulated in the annual issues of *U.S. Income and Output* (Department of Commerce). The most obvious difficulty is that these conventional price indexes are derived from the prices of inputs into the construction and producer durables industries rather than from the prices of their outputs. Aside from the conceptual difficulties which this shortcoming may involve, it probably also results in a significant upward bias in these investment goods price indexes. Moreover, it is clear that the coverage of these two components of the implicit GNP price deflators is much greater than that of the NICB survey data and therefore most certainly include some prices more relevant to commercial, school, and hospital construction as well as to durable goods purchases by such nonmanufacturing enterprises as transportation companies and regulated public utilities.

The most obvious source of weights to be used in combining the above two component price indexes is the annual series given in *U.S. Income and Output* for the purchases of structures and equipment by manufacturers. Alternatively, suitable weights might have been derived from the estimates of investment spending in constant dollars made by the Commerce Department (OBE) in their *Capital Goods Study*. Since both of these sources of the distribution of investment spending would be based on annual time series, an appropriate method of interpolation would have had to have been applied to yield a quarterly capital goods price series. For this reason and because the coverage is more suitably defined, we used the information supplied by the NICB on the quarterly distribution of capital appropriations between plant and equipment for the durable goods manufacturing industries. Since this breakdown is available only from 59:1 on, we experimented with fixed and variable weights for the period 59:1 to 63:4 and determined that the final capital goods price index was relatively insensitive to the weighting system. We, therefore, derived a suitable set of fixed weights and applied these to the GNP price components for the entire forty-four-quarter period under consideration.

The price index used to deflate the Bureau of Census' new orders series was constructed by the National Bureau in a preliminary study by Thor Hultgren. The present writers extended the relevant NBER price series to 63:4 and rebased the entire series from 1947–49 = 100 to 1957–59 = 100 by making direct use of the rebasing factors published by the Bureau of Labor Statistics (BLS).

It is evident that the firms included in the durable goods manufacturing category are engaged in a wide range of production and that a wide variety of commodities are manufactured by these firms and industries. Given this heterogeneous composition of new orders and output as well as the existence of duplication—orders are for final products as well as for inputs of the same products—it is clear that a suitable price deflator will necessarily have to be an index number which *combines* the prices of those commodities manufactured by the durables sector.

The reclassification of the commodity groupings used in the BLS wholesale price index (WPI) is required to conform more nearly to the outputs of the durable goods manufacturing sector. This regrouping is done by two-digit industry, and the weights used in calculating these composite price indexes are the 1947–49 FRB production or value-added weights. These weights are somewhat crude in that they do not incorporate the great diversity of production associated with the two-digit durable goods manufacturing industries. Moreover, the weights are fixed whereas the configuration of an industry's output changes almost continuously. In extending the NBER price series from 61:4, the same base (1947–49 = 100) value-added weights were used since the FRB weights have not really changed significantly in the decade to 1957–59. Weekly BLS wholesale commodity price indexes were simply averaged to obtain quarterly figures.

It is important to emphasize that the composite price indexes were constructed by the NBER so as to be relevant to the products *characteristic* of a given two-digit manufacturing industry and were essentially intended to represent the approximate quarter-to-quarter movements of the prices received by these industries. The resulting new orders price index for the durables sector obviously does not refer to all the commodities produced by the manufacturing enterprises classified in this sector.

The well-known dummy variable technique of seasonal adjustment was used to remove the systematic seasonal variation inherent in most time series analyses done with data taken for a time interval shorter than one year. It should be noted that all of the regression equations discussed in the context of this study contain three seasonal dummy variables. The specification of these three shift variables (Si, where $i = 1, 2, 3$) is 1 in the t^{th} quarter and 0 in all others. Since in the fourth quarter $s_1 = s_2 = s_3 = 0$, the fourth seasonal dummy variable is implicit.

The advantages of this method of correction for seasonal variation are several. We begin with all of our quarterly data on a comparable basis, seasonally unadjusted, rather than with data which have been adjusted by applying a variety of nonparametric methods. Moreover, there is no ambiguity as to the relation of the original data series to the corresponding adjusted series. There is no danger of removing either more or less than the seasonal component. Lastly, this method of adjustment in principle allows part or all of the seasonal variation in the dependent variable (s) to be "explained" by or within the context of our investment model.

There are, of course, some shortcomings in this parametric seasonal adjustment procedure. It implies a fixed additive seasonal or one that is invariant with respect to its pattern over the period 1953–63. Moreover, it implies that the functional relation being statistically estimated undergoes quarter-to-quarter parallel shifts in its position. Only a change in the intercept of the relation is accounted for by the introduction of the dummy variables, whereas it is evident that the effect of seasonal variation (s) may also be to change the slopes as well as the intercepts of the relevant relations. Such a distortion may lead to inaccurate estimates of the regression coefficients and autocorrelation in the residuals.

TABLE A-1

Actual Versus Plan-Image Values of Capital Expenditures Using Plan Image Based on Appropriations: Levels and Three-Quarter Increments

(million 1954 dollars per calendar quarter)

Year and Quarter	Levels of Capital Expenditures: Actual	Levels of Capital Expenditures: Plan Image	Seasonally Adjusted Levels of Expenditures, Actual $:X_t$: i	ii	iii	Plan Image $:P_t$: i	ii	iii	Three-Quarter Increments in Seasonally Adjusted Expenditures, Actual $:X_t-X_{t-3}$: i	ii	iii	Plan Image $:P_t-X_{t-3}$: i	ii	iii
1954:1	749				919									
2	964		908											
3	874			891										
4	1043				912									
1955:1	720	702	890			872			-18			-36		
2	823	872		767			816			-124			-75	
*3	946	814			963			831			51			-81
4	1259	1187	1128			1056			238			166		
1956:1	1064	1084		1234			1254			467			487	
2	1422	1463			1366			1407			403			444
3	1466	1532	1483			1556			355			428		
4	1816	1814		1685			1683			451			449	
1957:1	1353	1389			1523			1559			157			193
2	1524	1348	1468			1292			-15			-191		
3	1427	1325		1444			1342			-241			-343	
4	1542	1431			1411			1300			-112			-223

(continued)

TABLE A-1 *(continued)*

Year and Quarter	Levels of Capital Expenditures		Seasonally Adjusted Levels of Expenditures						Three-Quarter Increments in Seasonally Adjusted Expenditures					
	Actual	Plan Image	Actual $:X_t$			Plan Image $:P_t$			Actual $:X_t-X_{t-3}$			Plan Image $:P_t-X_{t-3}$		
			i	ii	iii	i	ii	iii	i	ii	iii	i	ii	iii
1958:1	883	1010	1053			1180			-415			-288		
2	896	1051		840			995			-604			-449	
3	800	912			817			929			-594			-482
4	828	959	697			828			-356			-225		
1959:1	638	620		808			790			-32			-50	
2	828	820			772			764			-45			-53
3	799	826	816			843			119			146		
4	1044	1127		913			996			105			188	
1960:1	895	840			1065			1010			293			238
2	1083	1024	1027			968			211			152		
3	1067	1074		1084			1094			171			181	
4	1169	1195			1038			1064			-27			-1
1961:1	770	815	940			985			-87			-42		
2	873	942		817			886			-267			-198	
3	807	854			824			871			-214			-167
4	974	956	843			825			-97			-115		

(continued)

TABLE A-1 *(concluded)*

Year and Quarter	Levels of Capital Expenditures		Seasonally Adjusted Levels of Expenditures						Three-Quarter Increments in Seasonally Adjusted Expenditures					
			Actual $:X_t$			Plan Image $:P_t$			Actual $:X_t-X_{t-3}$			Plan Image $:P_t-X_{t-3}$		
	Actual	Plan Image	i	ii	iii	i	ii	iii	i	ii	iii	i	ii	iii
1962:1	710	648		880			818			63			1	
2	873	873			817			817			-7			-7
3	914	836	930			852			87			9		
4	1083	1110		953			980			73			100	
1963:1	798	723			968			893			151			76
*2	1009	940	953			884			23			-46		
3	1024	1071		1040			1087			87			134	
4	1215	1148			1085			1018			117			50
Data not used in determining relations														
1964:1	1009	879	1179			1049			226			96		
2	1250	1121		1194			1065			154			25	
3	1352	1204			1368			1220			283			135
4	1715	1420	1585			1290			406			111		
1965:1		1244					1610						416	
2		1412						1356						-12
3		1352				1352						233		

TABLE A-2

Additive Seasonal Coefficients for Capital Appropriations and Expenditures Equations in Tables 1 – 7

(million 1954 dollars per calendar quarter; to be subtracted from observations or from calculated values of dependent variables to obtain adjusted figures)

Equation	Dependent and Explanatory Variables	Seasonal-Adjustment Coefficients: January-March	April-June	July-September	October-December	Largest Standard Error of Any Coefficient
	Appropriations, explained by:					
C-1	Pure seasonal	143	- 37	-239	133	216
C-2	Autoregression	131	-192	-285	346	135
C-3	Cash flow only	206	-223	-173	190	197
C-4	Bond yield only	99	- 68	-211	180	159
C-5	Cash flow and bond yield	146	-244	-147	240	133
C-6	Cash flow with bond yield and stock-price increment	173	-216	-248	291	112
C-7	Orders-capacity only	143	-100	-208	165	127
C-8	Orders-capacity with cash flow	129	-262	-135	268	107
C-9	Orders-capacity with cash flow and bond yield	280	-216	-255	191	90
	Expenditures, explained by appropriations:					
A-1	Pure seasonal	-167	0	- 10	177	123
A-2	Single appropriations flow	-252	10	109	133	60
A-3	Single appropriations backlog	-150	37	- 34	147	46
A-4	One flow term, one backlog	-113	- 10	- 36	159	42
A-5	Consecutive series of flows	-106	11	- 52	147	52
A-6	Plan image based on flows not more recent than (t-3)	-170	56	- 17	131	59

(continued)

TABLE A-2 *(continued)*

Equation	Dependent and Explanatory Variables	Seasonal-Adjustment Coefficients: January-March	April-June	July-September	October-December	Largest Standard Error of Any Coefficient
	Expenditures, explained by autoregression:					
B-1	Latest previous expenditure	-313	146	- 14	181	54
B-2	Practical autoregression	-259	-207	180	286	72
B-3	Strongest autoregression	-387	173	- 19	233	52
	Expenditures, explained by latest previous expenditure with appropriations, with:					
B-4	One backlog					
B-5	One appropriations flow	-224	97	- 53	180	36
B-6	Series of appropriations flows	-201	81	- 50	171	52
	Expenditures, explained by variables used in Table 3, bypassing appropriations:					
D-1	Cash flow only	-169	75	- 55	149	143
D-2	Bond yield only	-198	- 11	6	203	96
D-3	Cash flow with bond yield	-179	62	- 54	170	94
D-4	Cash flow with bond yield and stock-price increment	-197	49	- 24	172	96
D-5(=F-3)	Orders-capacity only	-160	26	- 5	139	45
D-6	Orders-capacity with cash flow	-143	45	- 33	148	41

(continued)

TABLE A-2 *(concluded)*

Equation	Dependent and Explanatory Variables	Seasonal-Adjustment Coefficients				Largest Standard Error of Any Coefficient
		January-March	April-June	July-September	October-December	
	Expenditures, explained by appropriations with other variables:					
E-1	With cash flow	-85	17	-99	167	42
E-2	With cash flow and stock-price increment	-86	15	-104	175	39
E-3	With orders-capacity	-92	31	-72	133	60
	Expenditures, plan-image functions, based on:					
F-1	Appropriations only	-167	0	-29	177	123
F-2	Bond yield with cash flow and stock-price increment	-246	50	69	127	84
F-3(=D-5)	Orders-capacity only	-160	26	-5	139	45
F-4	Orders-capacity with cash flow and stock-price increment	-214	45	27	142	44
F-5(=A-5)	Appropriations flows only	-106	11	-52	147	52
F-6	Appropriations flows with orders-capacity	-168	49	-22	141	52

TABLE A-3

Data Used in Econometric Operations: Deflated, with Pure Seasonal Adjustment of Each Series

		Data from NICB Capital Appropriations Survey for 627 Durable Goods Manufacturing Corporations (million 1954 dollars per calendar quarter)			
Year	Quarter	Capital Expenditures X	Flow of New (gross) Capital Appropriations A	Backlog of Unspent Appropriations at Opening of Quarter B	Cancellations of Unspent Capital Appropriations C
1953	1	999	800	4,142	22
	2	962	992	3,860	54
	3	916	1,113	3,807	54
	4	876	913	3,965	68
1954	1	909	727	3,935	76
	2	957	793	3,662	81
	3	888	859	3,406	60
	4	876	691	3,300	51
1955	1	880	1,414	3,058	49
	2	816	1,879	3,513	57
	3	961	2,154	4,471	60
	4	1,092	2,000	5,499	58
1956	1	1,224	2,240	6,266	57
	2	1,415	1,814	7,078	71
	3	1,480	1,244	7,297	80
	4	1,649	1,511	6,814	59
1957	1	1,513	1,514	6,559	50
	2	1,516	1,244	6,427	90
	3	1,441	862	6,004	70
	4	1,375	680	5,320	101
1958	1	1,043	575	4,514	134
	2	888	723	3,893	74
	3	814	821	3,637	45
	4	662	800	3,563	91
1959	1	798	1,199	3,601	49
	2	821	1,151	3,939	48
	3	813	1,073	4,185	61
	4	877	1,220	4,388	18

(continued)

TABLE A-3 *(continued)*

Year	Quarter	Data from NICB Capital Appropriations Survey for 627 Durable Goods Manufacturing Corporations (million 1954 dollars per calendar quarter)			
		Capital Expenditures X	Flow of New (gross) Capital Appropriations A	Backlog of Unspent Appropriations at Opening of Quarter B	Cancellations of Unspent Capital Appropriations C
1960	1	1,055	1,073	4,730	71
	2	1,076	926	4,662	49
	3	1,081	850	4,444	55
	4	1,002	701	4,138	58
1961	1	931	632	3,796	63
	2	866	783	3,445	66
	3	821	944	3,284	54
	4	807	753	3,339	61
1962	1	870	1,109	3,245	52
	2	866	797	3,422	46
	3	928	986	3,287	84
	4	916	1,384	3,263	59
1963	1	958	962	3,680	49
	2	1,002	1,141	3,624	36
	3	1,038	1,338	3,703	46
	4	1,048	1,591	3,936	48
1955-63	mean	1,037	1,169	4,445	62

Year	Quarter	Explanatory Variables Used in Explanations of Capital Appropriations and in Direct Explanations of Expenditures				
		Ratio of Orders to Capacity O	Cash Flow (million 1954 dollars) F	Long-Term Bond Yield (per cent) R	Stock Prices (1957-59 = 100) S	Increment of Stock Prices ΔS
1953	1	4.94	1,674	3.09	49.0	
	2	4.60	1,443	3.31	43.8	-5.2
	3	3.78	1,301	3.11	39.6	-4.2
	4	3.31	1,186	2.98	39.5	- .1
1954	1	3.20	1,508	2.96	48.6	9.1
	2	3.18	1,470	2.85	52.4	3.8
	3	3.55	1,558	2.74	56.1	3.7
	4	3.84	1,401	2.73	60.6	4.5

(continued)

TABLE A-3 *(concluded)*

		Explanatory Variables Used in Explanations of Capital Appropriations and in Direct Explanations of Expenditures				
Year	Quarter	Ratio of Orders to Capacity O	Cash Flow (million 1954 dollars) F	Long-Term Bond Yield (per cent) R	Stock Prices (1957-59 = 100) S	Increment of Stock Prices ΔS
1955	1	4.36	2,010	3.00	73.3	12.7
	2	4.36	2,099	3.02	75.0	1.7
	3	4.51	2,080	2.97	82.1	7.1
	4	4.68	1,835	2.99	82.9	0.8
1956	1	4.16	2,191	3.13	90.3	7.4
	2	4.08	1,953	3.24	90.2	-0.1
	3	4.10	1,856	3.31	93.6	3.4
	4	4.05	1,981	3.53	91.3	-2.3
1957	1	3.76	2,118	3.66	91.2	-0.1
	2	3.46	1,831	3.72	94.8	3.6
	3	3.38	1,906	3.91	91.7	-3.1
	4	3.21	1,647	3.75	76.1	-15.6
1958	1	2.71	1,192	3.52	82.9	6.8
	2	2.89	1,096	3.39	83.8	.9
	3	3.25	1,599	3.67	91.9	8.1
	4	3.51	1,982	3.88	103.0	11.1
1959	1	3.69	1,914	4.09	115.6	12.6
	2	3.75	2,259	4.31	120.1	4.5
	3	3.48	1,672	4.31	124.5	4.4
	4	3.44	1,676	4.37	121.9	-2.6
1960	1	3.21	1,989	4.51	122.7	0.8
	2	3.24	1,675	4.38	121.0	-1.7
	3	3.39	1,605	4.13	116.3	-4.7
	4	3.22	1,465	4.10	109.6	-6.7
1961	1	2.90	1,246	4.18	125.6	16.0
	2	3.31	1,628	4.17	129.9	4.3
	3	3.47	1,825	4.25	128.5	-1.4
	4	3.60	2,123	4.23	132.6	4.1
1962	1	3.51	2,009	4.38	137.0	4.4
	2	3.48	2,088	4.19	117.1	-19.9
	3	3.49	2,097	4.15	105.3	-11.8
	4	3.57	2,269	4.01	106.4	1.1
1963	1	3.58	2,058	4.13	122.6	16.2
	2	3.68	2,366	4.12	130.4	7.8
	3	3.64	2,409	4.13	129.5	-0.9
	4	3.60	2,342	4.17	134.7	5.2
1955-63 mean		3.60	1,891	3.86	106.8	2.1