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PART III

THE BEHAVIOR OF INVESTMENT COMMITMENTS AND EXPENDITURES

9

INDICATORS AND STAGES OF INVESTMENT IN PLANT AND EQUIPMENT

Introduction: Some Important Aspects of the Investment Process

The process of capital formation in durable producer goods consists of two sets of lagged reactions: (1) Investment decisions respond, presumably with varying delays, to changes in a number of determining factors. (2) The implementation of these decisions requires time, hence expenditures lag appropriations, contracts, etc.

The lags in the implementation of investment decisions (2) are in a sense more tangible than the lags in the formation of decisions (1), and probably easier to establish. It is necessary to draw a clear distinction between the two lagged relations, both of which are of major importance in the analysis of the investment process and in theories of business cycles and the effects of stabilization policies.

Plant and equipment is a generic term denoting a vast variety of capital goods needed to satisfy the demand for capital services. The investment process is set in motion as this demand changes and the need to acquire the capital goods is recognized. The initial stages of technical and economic planning and cost estimation may be long and important, but they apparently are not directly represented in the data available for measuring aspects of the investment process. In time, the decision to invest becomes firmer, with respect to both the details of the project and the time it is to be initiated; and funds to finance it are budgeted, appropriated, and contractually committed. These latter stages can be measured by the current aggregative series on capital appropriations and investment orders and contracts.

It is at this point that orders data may find their first application to investment analysis. As the orders for equipment and contracts for plant are filled, payments are made on their account. Meanwhile, the capital goods, which are to be the end product of the process, as far as their sellers are concerned, assume their material form and economic function. That is, they are produced, built, shipped, and installed—in short, acquired in some way to render services to the user.

The demand for capital services is a function of the demand for the output which these services help to produce. The demand for outputs of manufacturing industries is measured by manufacturers' orders. This is the second point at which orders data appear as potentially useful for investment analysis. The two applications are certainly different in concept and in their data requirements.

On the Role and Timing of Investment Decisions

The view that investment expenditures play a central role in business cycles is an old one, held by many economists. Its main sources are the following notions or observations: (1) that these expenditures are neither constrained nor required by prior receipts, and are not closely related to the latter; (2) that they fluctuate during business cycles with wider relative amplitudes than other major expenditure categories; (3) that they lag, often by long intervals, the *decisions* to invest; and (4) that the investment decisions themselves have a cyclical pattern and a tendency to lead at peaks and troughs in aggregate economic activity.

Point (1) has been particularly emphasized in those Keynesian models where investment is treated as an important category of "autonomous" expenditures that set in motion the multiplier process; but it is also found, *mutatis mutandis,* in some older theories in which much weight is attached to investment. The other points concern empirical observations: (2) can be said to have long been well established; (3) is plausible enough and was often assumed, but the relevant measurements have until recently been few and quite crude—which is not surprising, as it is not easy to measure investment "decisions"; and (4) is even more difficult to establish for the same reason, and is much more in need of being documented since it is far from obvious.

A cyclical model of the economy can be constructed on the basis of (1), (3), and (4); (2) is neither a necessary nor a sufficient condition here. However, positing (1), interpreted to mean that investment is independent of income, cannot be simply taken for granted. It is a hypothesis which, far from being established empirically, is widely viewed as dubious and unsatisfactory. The situation for (3) and (4) is very different: There is already much evidence to validate and quantify these statements, owing largely to recent gains in assembling data that reflect investment decisions, such as orders and appropriations.

The existence of (4) is particularly important because it appears to be a necessary condition for the validity of any hypothesis that ascribes to investment the prime causal role in business cycles. It is difficult to see how any hypothesis in this class could be successfully defended if the decisions to invest and the resulting commitments did not tend to move ahead of aggregate production and income. Expenditures on plant and equipment actually lag at business cycle turns, which was deemed by some to be the major argument against the investment hypothesis of the cycle. But this is not convincing, since it ignores the possibility that investment commitments may lead and have important influences of their own.

In fact, the early cyclical timing of commitments can be well documented, as will be shown in this chapter. But it must be recognized that acceptance of both (3) and (4) is still *not* sufficient for a demonstration that investment is indeed the prime mover in major fluctuations of the economy. As elsewhere, one must guard here against the *post hoc, ergo propter hoc* fallacy. Even if the amounts of investment decided upon begin to swell and shrink ahead of the troughs and peaks of the economy at large, this does not necessarily mean that these early changes in investment commitments are "the cause" and the later changes in general business activity "the effect." Investment decisions are necessarily the antecedent and can be treated as the proximate "cause" of investment spending [as stated in (3)]. There are also further propagation effects to the extent that increases in this spending stimulate and decreases discourage other types of expenditure. But it is conceivable that other factors, more "autonomous" than investment, determine first the investment decisions and then spending.[1]

[1] Cf. Milton Friedman and Anna J. Schwartz, "Money and Business Cycles," *Review of Economics and Statistics, Supplement*, February 1963, p. 48, n. 21.

Issues Relating to the Cyclical Behavior of Investment

The lag of investment expenditures behind investment decisions is an essential element in several otherwise quite different theories of business cycles. Consider the hypothesis that downturns of investment are attributable to the stresses of advanced expansion in aggregate income and output. It could be used to explain why investment decisions (or commitments) begin to decline. But investment expenditures can hardly be assumed to decline simultaneously in a degree sufficient to bring about a general business downturn, for this would at once cut off the rise in income, whereas income must be permitted to rise if the changes that are unfavorable to investment are to develop. Introduction of an expenditure lag removes this logical difficulty by reminding us that investment undertakings can already be declining while investment expenditures and income are still rising. The undertakings determine future spending on investment, but current income is associated with current spending. Thus it can be argued that the lag in the execution of investment projects (contracts or orders) plays a critical role in explaining business cycle reversals in theories that link investment decisions to elements of current and recent incomes and their distribution.

An argument along the above lines was made by Milton Friedman in his interpretation of Wesley Mitchell's view of the investment process and its role in business cycles.[2] To recall its salient points, Mitchell's analysis (first developed in his 1913 *Business Cycles*) relates investment decisions to profits expectations and the latter to current profits and their distribution. As a business expansion unfolds, aggregate income rises and so do both the volume of sales and average profit margins; hence, total profits must increase. Later in the expansion, however, profit margins begin to decline because of rising cost schedules and the tendency for many buying prices to increase faster than selling prices. When the decline in margins eventually outweighs the continuing increase in sales, total profits turn down. These developments influence strongly the timing of decisions to implement investment projects. New investment commitments begin to decline, which is an early factor of great importance in the process leading to the gen-

[2] Milton Friedman, "Wesley C. Mitchell as an Economic Theorist," *Journal of Political Economy*, December 1950; reprinted in Arthur F. Burns, ed., *Wesley Clair Mitchell, The Economic Scientist*, New York, NBER, 1952; see in particular pp. 263–66.

eral business downturn. Investment expenditures, on the other hand, lag in this process, reflecting the long periods of time that are required for completion of many undertakings to build and equip productive plant.

An early appearance of the distinction between orders and deliveries of capital goods marks a business cycle model by Kalecki (1933). In this system, deliveries lag behind orders for capital goods by a given "gestation period," θ. Gross saving or "accumulation" equals production of capital goods, which proceeds at a rate measured by the average volume of unfilled investment orders over the interval θ. Net investment, or the change in capital stock, equals capital goods deliveries minus depreciation of capital equipment due to wear and tear and obsolescence. The ratio of new investment orders to capital stock is a function of the rate of profit, and real gross profit itself is related to gross accumulation. The model implies that new investment orders are an increasing function of capital goods production and a decreasing function of the existing capital stock. It produces a cyclical movement by letting the capital stock itself fluctuate, that is, capital goods deliveries periodically fall short of replacement requirements.[3]

In models based on the interaction of savings and investment functions, fluctuations can come about by assumption either of certain time-lags or of certain nonlinearities or both. In his 1940 model, Nicholas Kaldor employs nonlinear functions and deliberately abstracts from lags.[4]

The familiar business cycle model of J. R. Hicks (1950) represents a theory which employs both lags and nonlinearities. For investment in plant and equipment, Hicks suspends the accelerator over a part of the cycle (because of surplus capacity), making it operative only in the later stages of expansion and at the beginning of the contraction. Dis-

[3] M. Kalecki, "A Macrodynamic Theory of Business Cycles," *Econometrica*, 1935, pp. 327–44 (paper presented in 1933). This business cycle model underwent several changes in Kalecki's later works, but the feature of the orders-delivery lag for capital goods has been retained throughout this development. Given the structural coefficients of these models, the length of that lag determines the duration of the implicit cycles and whether or not they are damped (in the absence of erratic shocks).

[4] N. Kaldor, "A Model of the Trade Cycle," *Economic Journal*, March 1940, pp. 78–92. Kaldor regards it as a virtue of his model that it does not depend on particular parameters, lags, or initial "shocks." But a theory of business cycles may also suffer from being overly self-contained (endogenous) and too dependent on particular nonlinearities. The virtual disregard of lags can hardly be a merit if the theory is to retain contact with fluctuations in the real world, which surely include certain lags as one of their foremost features. And it is not established at all that lags *should* be important only "in determining the *period* of the cycle" and have no part "in explaining its existence" (*ibid.*, p. 92).

tributed lags are worked into the consumption function and are also included, somewhat cursorily, in the discussion of induced investment. The main effect of replacing a simple discrete lag by a longer lag, which spreads the response of investment to changes in output over several periods, is to prolong the expansion (for any given combination of values for the coefficients of the consumption and induced investment functions).[5]

Whether simple or distributed, the lags are assumed to remain unchanged over the cycle, as are the coefficients of the system. Yet in the case of the fixed investment function, one can expect the lags to increase late in expansion, when, due to the strain on capacities of capital goods producers, more time is likely to be required, on the average, for investment contracts to materialize in deliveries and installations. Such a development would be accompanied in part by price increases and in part by unfilled orders accumulations, which may temporarily provide some further stimulation of investment demand. It seems improbable that the latter would then be kept in check by the current and recent increases in output or for that matter that it would bear any fixed relation to these increases.

The extension of the lag, however, may tend to prolong the expansion (in analogy to Hicks's comparison of simple and distributed lags). The resulting increase in the orders backlog may also tend to make the downturn more gradual and the early stages of contraction less severe, for old unfilled contracts can provide a reserve of work to be carried out long after new investment has been curtailed.[6] Gestation periods for various types of investment projects vary widely. Also, the peaks of orders for different categories of capital goods usually fall on dates that are scattered over a substantial period rather than being heavily concentrated at one time. These facts make for a less sharp decline in aggregate investment orders and for a more gradual and lagged decline

[5] J. R. Hicks, *A Contribution to the Theory of the Trade Cycle*, Oxford, England, 1950, pp. 113–15.

[6] On the other hand, depletion of the backlog may worsen the economic situation in the midst of a downswing. Expenditures on, and presumably also completions of, investment projects tend to reach their peaks when a business decline is already in progress. Burns draws attention to a suggestive fact when he notes that "it appears that the crop of newly completed factories reaches its maximum when contraction is well under way—or just in time to intensify the competitive struggle then in progress." Cf. Arthur F. Burns, "Economic Research and the Keynesian Thinking of Our Times," *Twenty-Sixth Annual Report of the National Bureau of Economic Research*, New York, June 1946; reprinted in Burns, *The Frontiers of Economic Knowledge*, New York, NBER, 1954; see p. 23.

in investment expenditure than could be hypothesized in disregard of them. They create a presumption against the concept of abrupt downturns in general economic activity being caused by a recurring collapse of confidence in the profitability of investment undertakings and a consequent collapse of "aggregate investment" as such.[7]

It is indeed likely that the demand for new plant and equipment will weaken and eventually fall off when capacity increases begin to overtake output increases, or when most firms come to hold the expectation that this is imminent. But the concepts involved are extremely difficult to handle. Short-term changes in the demand for its products currently appear to a firm as erratic in a large degree. It is not easy to distinguish with sufficient confidence a change that is just transitory from one that is more lasting and less risky to use for extrapolation. Measurement of existing capacities is difficult, and estimation of required capacities even more so. The analyst also faces formidable problems of aggregation.

As shown by this brief and selective survey, important issues in business cycle analysis relate to the internal lag structure and the cyclical timing of investment stages. These matters require much further study before the lagged relations involved can be adequately specified, estimated, and tested. This chapter and the next will report merely on a few small steps in this direction.

Investment Plans, Commitments, and Outlays

New Orders for Producer Equipment and Construction Contracts for Plant

The aggregate of new orders received by durable goods manufacturers contains not only some that correspond to the "equipment" component of business fixed investment outlays, but also a large variety of other kinds. These include orders placed by domestic intermediate (nonfinal) users for resale purposes, those placed by foreigners, and those placed by the government.[8]

[7] This idea, found in many recent writings, goes back to Keynes and his, certainly understandable, preoccupation with the rapid business contraction of the early 1930's. Cf. Burns, *Frontiers*, pp. 18–19.

[8] All orders for consumer durable goods must, of course, be excluded in deriving the business investment order series. But these would typically be "resale" orders, received from the trade sectors, as consumers do not ordinarily place direct orders with manufacturers.

The breakdown by major industries used in the published Commerce figures on new orders permits only a very crude approximation to what is needed here: a series on commitments for the purchase of equipment by business enterprise. However, much better estimates of new orders for industrial and other productive equipment were made available in 1961 by the Department of Commerce on the basis of a more detailed classification of their orders data.[9]

The series of new orders for machinery and equipment in its present form includes new orders received by the following thirteen durable goods industries: steam engines and turbines; internal combustion engines; construction, mining, and materials-handling machinery; metalworking machinery; miscellaneous equipment; special industrial machinery; general industrial machinery; office and store machines; service industry machinery; electrical transmission, distribution equipment; electrical industrial apparatus; other electrical machinery; and shipbuilding and railroad equipment. Orders for other industries do not, for the most part, represent business purchases of equipment. The exclusion of these industries, however, does mean omitting such important items as trucks and commercial aircraft.[10] On the other hand, inclusion of all *orders* received by the machinery and equipment industries results in overstatement, since some of these orders are placed by government and foreign buyers.

The information needed to correct for these elements of under- and overestimation is essentially lacking because the statistics are reported by the receiving industry rather than by product and user categories. Also, like the output of multiproduct companies that are included in an industry according to the definition of their main productive activity, orders received by an industry are highly diversified. However, a significant improvement in the latter respect has probably resulted from

[9] These estimates were introduced in Victor Zarnowitz, "The Timing of Manufacturers' Orders During Business Cycles," in Geoffrey H. Moore, ed., *Business Cycle Indicators*, Princeton for NBER, 1961, Vol. I, pp. 475 ff. The data were published in *ibid.*, Vol. II, series 6.1, p. 90. Since autumn 1961, the monthly figures have been reported regularly in U.S. Department of Commerce, *Business Cycle Developments*, as series 24, "Value of manufacturers' new orders, machinery and equipment industries." Since December 1963, this series has been published in revised form to reflect the 1963 revision of the Industry Survey data and to exclude fabricated metal products.

[10] Most of the output of the motor vehicle industry consists of consumer durables (civilian passenger automobiles). Military purchases are also important here, but even more so in the nonautomotive transportation equipment industry, particularly aircraft. This explains the decision to omit these industries from the aggregate of private orders for capital equipment.

the 1963 revision that put the data on a divisional instead of company basis (see the description of the current Census data at the beginning of Chapter 3, above).

Before 1963, the series of new orders for machinery and equipment included fabricated metal products. The selection of this industry seems to have been largely an error, since fabricated metals represent mainly materials to be further processed rather than capital goods bought by first users. However, since we have used the old data in the part of the subsequent analysis that predated the 1963 changes in the orders series, Chart 9-1 presents these data in two versions: with and without new orders for fabricated metal products (see curves 2 and 3). The two series run a closely similar course, although their levels differ substantially, since the fabricated metal orders add up to rather large monthly amounts.

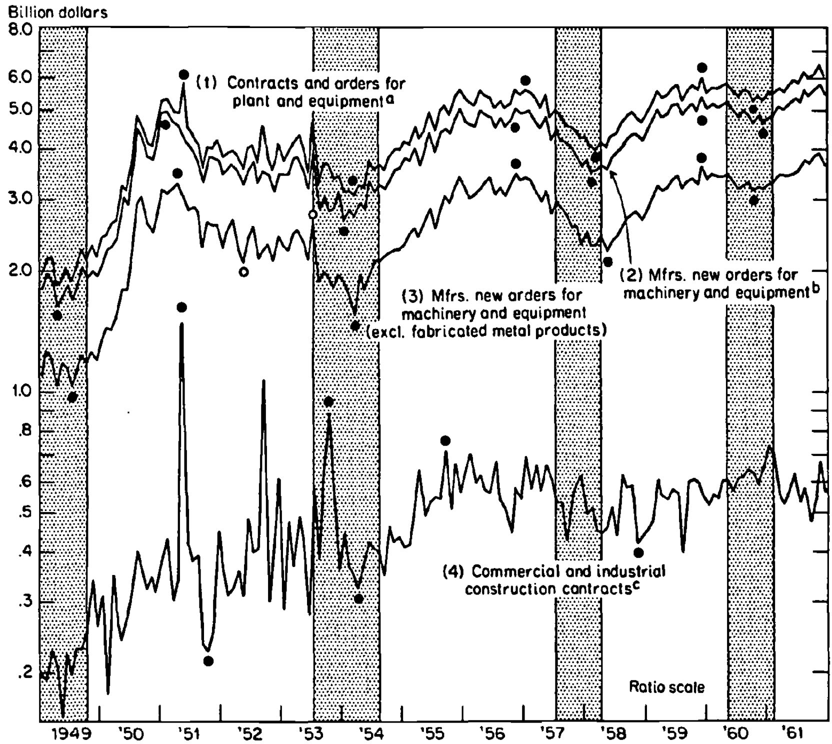
The "plant" component of business capital formation is not directly represented in the new-order aggregate. The best counterpart to it among the commitments data is the series of contracts awarded to building contractors for industrial and commercial construction, plus contracts for privately owned public works and public utilities, as compiled by the F. W. Dodge Corporation. This series is plotted as curve 4 in Chart 9-1.[11]

The aggregate of current commitments to invest in plant and equipment combines series 2 and 4. Since the data on construction contracts as well as those on new orders are in current-dollar values, the series can be combined by simple addition. In the resulting totals, the component categories are weighted by the transaction volumes they represent. The estimated totals of equipment orders and plant contracts are shown as curve 1 in Chart 9-1.

The chart makes it clear that the construction contract values form a highly volatile series with large month-to-month variations, especially in the period before 1954. New orders are much less erratic and have a considerably clearer cyclical pattern. It is also evident that the total

[11] The Dodge data cover private projects of $10,000 minimum valuation (previously, lower valuations were included). The data available for our purpose cover thirty-seven eastern and southern states in 1948–56 and forty-eight states since then. They include contracts for commercial buildings such as banks, offices, stores, garages, etc., and for manufacturing buildings (e.g., processing, mechanical). Adjustments for cancellations, additions, and corrections are made when ascertained. For more detail, see the description and references in Moore, ed., *Business Cycle Indicators*, Vol. II, series 6.0, pp. 12–14.

Chart 9-1
Manufacturers' New Orders for Machinery and Equipment and Contracts for Plant Construction, 1949–61



Note: Shaded areas represent business contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles; circles identify minor turns and retardations.

Source: U.S. Department of Commerce, Office of Business Economics; F. W. Dodge Corporation.

[a] This series is the sum of series 2 and 4 in this chart.

[b] Includes new orders for fabricated metal products.

[c] Includes contracts for privately owned public works and utilities.

investment orders-and-contracts series reflects the behavior of new orders much more than contracts, because orders are a large, and contracts a relatively small, component of the total.

In fact, the new-order data overstate investment in equipment and the contracts data understate investment in plant greatly. For example, the value of new orders received by industries producing machinery and equipment averaged \$52 billion (annual rate) in 1956–58 if fabricated metal products are included, and \$35 billion if they are excluded. In the same period, the producer durable equipment component of gross national product had an average annual value of \$27 billion. There is no doubt that the new orders aggregates include products that should be regarded as "materials" rather than "final" capital goods. Elimination of fabricated metals appears to remedy much but not all of this overstatement. Materials can of course be counted repeatedly at successive production stages. The orders figures are gross, while the investment expenditure data on the GNP basis are net, of such duplications. (The latter are presumably "gross" only in the sense of covering outlays for replacements as well as new net additions to the stock of real capital held by business.)

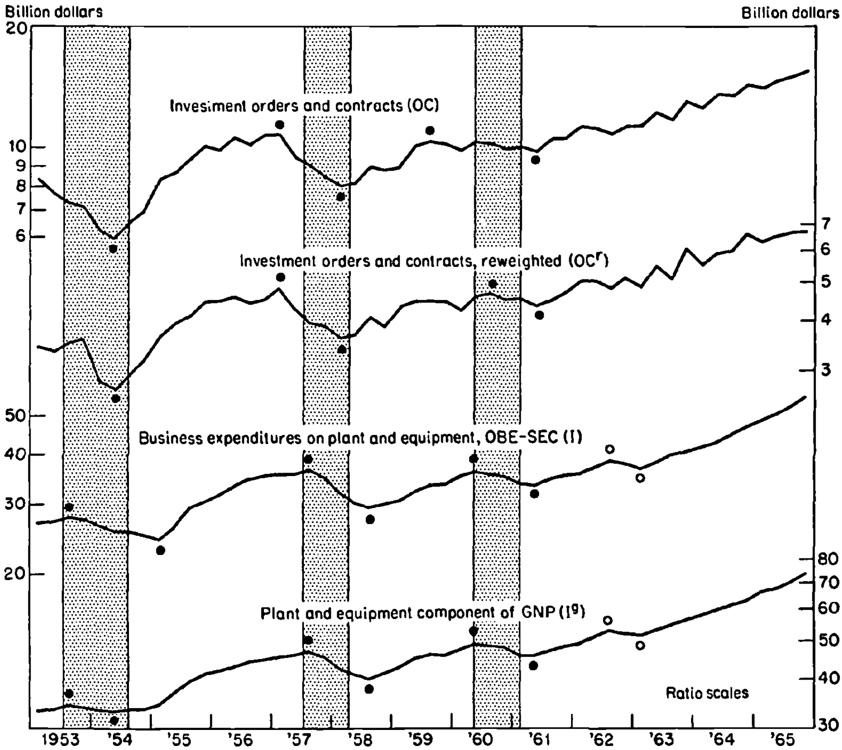
For the construction contracts component of our investment commitments series, the annual average value for 1956–58 was somewhat less than \$7 billion. The corresponding figure for the value of industrial and commercial construction and other private nonfarm nonresidential construction was somewhat more than \$14 billion. In part, this large difference in levels reflects conceptual divergencies, but it does indicate the amount of undercoverage of construction projects in the contracts data.[12]

An approximate correction for the overstatement of equipment orders (EO) and understatement of plant contracts (PC) in the simple aggregate of orders and contracts (OC) was made by constructing a reweighted aggregate, OC^r, according to the formula $OC^r = (1.6/4.9)(EO) + PC$. Here new orders for producer equipment (excluding fabricated metal products) are given only about one-third of their former weight relative to plant contracts. This is done because the average ratio for 1957–59 of producer durable equipment to nonresidential structures was approximately 1.6, according to the national income accounts of the Department of Commerce, while the corresponding average ratio of equipment orders to plant contracts was about 4.9.

In Chart 9-2, the first curve shows OC and the second shows the re-

[12] Commercial and industrial building contracts accounted for about 78 per cent of the value of this type of construction completed in 1956–58; other private nonfarm nonresidential construction contracts (of which not all are included in our series) accounted for only 42 per cent of the value put-in-place. The proportion for both categories combined was approximately 59 per cent. (See Moore, ed., *Business Cycle Indicators*, Vol. II, p. 14.) Before 1956, the coverage of the Dodge statistics was considerably lower because eleven western states were excluded. It is estimated that construction in these states amounted to 20 per cent or more of the national total in the period 1926–56.

Chart 9-2
Commitments and Expenditures for Plant and Equipment, Quarterly, 1953–65



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles; circles, minor turns and retardations.

Source: U.S. Department of Commerce; Securities and Exchange Commission; F. W. Dodge Corporation.

weighted series OC^r, each in quarterly, seasonally adjusted form, for 1953–65. These graphs are based on the most recent Census data on new orders of the machinery and equipment industries and also the latest Dodge data on commercial and industrial contracts. The relative movements of the two series are on the whole quite similar; the effects of the reweighting are thus fairly small. The short variations in OC^r are often a little larger than those in OC (see the curves for 1953 and 1962–64), which reflects the relatively large erratic movements in the

PC series, which is given greater weight in OC^r than in *OC*. The cyclical turning points in the two series coincide, except for the peaks in 1959–60, where *OC* seems to have an earlier major turn; but even here the difference is marginal.[13]

Fixed-Investment Orders and Expenditures

The investment orders-and-contracts series—both the simple (*OC*) and the reweighted (OC^r) aggregates—can be used as indicators of business expenditures on plant and equipment. The investment commitments and expenditures data are compared in quarterly form in Chart 9-2.

The capital outlay estimates denoted as *I* (curve 3) are compiled by the Office of Business Economics, U.S. Department of Commerce (OBE), and the Securities and Exchange Commission (SEC). They are derived from reports by corporations registered with the SEC, by unincorporated and incorporated companies reporting to the OBE, and by a group of transportation firms under the jurisdiction of the Interstate Commerce Commission. The total sample accounts for over 60 per cent of aggregate new investment in plant and equipment, but coverage varies among the industries.[14] These figures, then, reflect the actual quarterly costs that are charged to capital accounts. Ordinarily, depreciation accounts are maintained for such outlays. The data come from the reports of those who, having placed the investment orders and contracts, incur the costs as measured by the expenditure. On the other hand, the value of investment commitments is estimated in large part from the reports of firms in the machinery and equipment industries, i.e., those who have received the orders.

The OBE-SEC business capital outlays series (*I*) is not as comprehensive as the plant-and-equipment component of GNP (I^g) (curve 4 in Chart 9-2). The OBE-SEC data exclude, while the GNP data include, investment by professionals, nonprofit institutions, real estate firms, and insurance companies; expenditures for petroleum and natural gas well drilling; and capital outlays charged to current expense (e.g., hand tools). The average annual value of business expenditures

[13] A double-peak configuration will be noted in each of the two series during this period. In *OC*, the 1959 peak is a little higher than the 1960 one, while the reverse applies to OC^r (see Chart 9-2).

[14] It is high in railroad transportation, public utilities, and some manufacturing industries, and low in real estate and parts of the financial sector. See description and references in Moore, ed., *Business Cycle Indicators*, Vol. II, series 22.0, pp. 54–55.

on plant and equipment in 1956–58 was $34 billion according to the OBE-SEC estimates, but $41 billion in the GNP accounts.[15] Despite these differences in coverage between I and I^g, the relative movements in the two series resemble each other closely most of the time (the only significant divergence shown on the chart is in the second half of 1954).

The orders-contracts figures are more nearly comparable to I than to I^g, and the OBE-SEC data will be used more intensively in the analysis to follow than the GNP data. However, only the latter provide a division of the expenditures into those for producer durable equipment (*PDE*) and those for plant or nonresidential structures (*Str*), which makes it possible to set up separate investment realization functions for the two types of capital goods. In the OBE-SEC data, outlays on equipment and construction are not available separately.

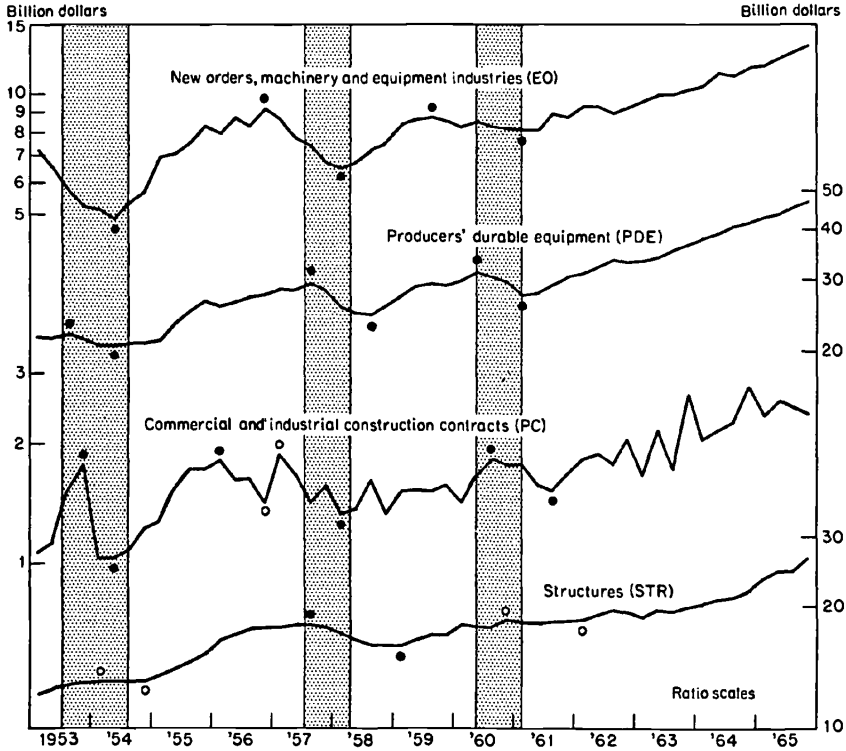
Chart 9-2 accords with general expectations of what the relation between investment commitments and expenditures should be. The time-path of outlays on investment goods resembles the course of new orders and contracts for such goods, but the fluctuations in outlays lag behind those in orders and have smaller relative amplitudes. Two-quarter lags of expenditures are observed at the I-1957 peaks and again at the I-1958 troughs of commitments (regardless of whether orders are represented by OC or by OC^r and whether expenditures are measured by I or by I^g). Three-quarter lags of I are recorded at the II-1954 trough and at the III-1959 peak of OC.[16] However, the upturns of investment orders and expenditures coincide in the second quarter of 1961.

Chart 9-3 demonstrates a very similar relationship between the equipment components of fixed-investment commitments and outlays. In the period from I-1953 to II-1954, new orders for machinery and equipment (*EO*) declined strongly, while the *PDE* expenditures rose a little in the first two quarters of this interval and decreased gently in the next three. Then *EO* turned up sharply between II-1954 and I-1955, while *PDE* barely increased, describing a "flat-bottom" movement that

[15] This is approximately the sum of $27 billion of producer durable equipment and $14 billion of private nonresidential nonfarm construction. (Of course, this aggregate, like that for business capital outlays compiled by the OBE-SEC, excludes expenditures by farmers and on all residential housing.)

[16] The 1954 trough in I^g falls in the second quarter, just like the troughs in OC and OC^r, but actually I^g did not start rising significantly until after I-1955, i.e., three quarters later (see the text below about the underlying behavior of expenditures on producer durable equipment). The use of the late peak of OC^r in 1960 could also lead to a misleading timing comparison (see note 13, above).

Chart 9-3
Commitments and Expenditures for Producers' Durable Equipment and for Structures, Quarterly, 1953–65



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles; circles, minor turns and retardations.

Source: U.S. Department of Commerce; F. W. Dodge Corporation.

only in 1955 ended in a decisive upswing. Thus, although the troughs or lowest standings of the two series technically coincide in II-1954, the actual recovery of *PDE* lagged behind the upturn in *EO* by three quarters. At the peaks of 1956–57 and 1959–60, two lags of *PDE* relative to *EO* of three quarters each are clearly seen on the chart. The 1958 troughs are separated by a two-quarter lag. Again, only the II-1961 troughs appear to be really coincident.

Contracts for commercial and industrial plant construction (*PC*) and outlays for the nonresidential structures component of fixed investment (*Str*) differ much more. *PC* shows large erratic variations, but *Str* follows a generally quite smooth course (Chart 9-3). The erratic appearance of *PC* is no doubt in considerable measure due to the limited sample coverage of this series, but a marked differentiation of this sort between commitments and realizations would be expected in this area and is believed to represent a real and basic phenomenon. Structures presumably require substantially longer gestation or "delivery" periods than does equipment; hence there is more room here for stabilization of the flow of funds spent relative to the flow of funds committed—which reflects the stabilization of production relative to demand.

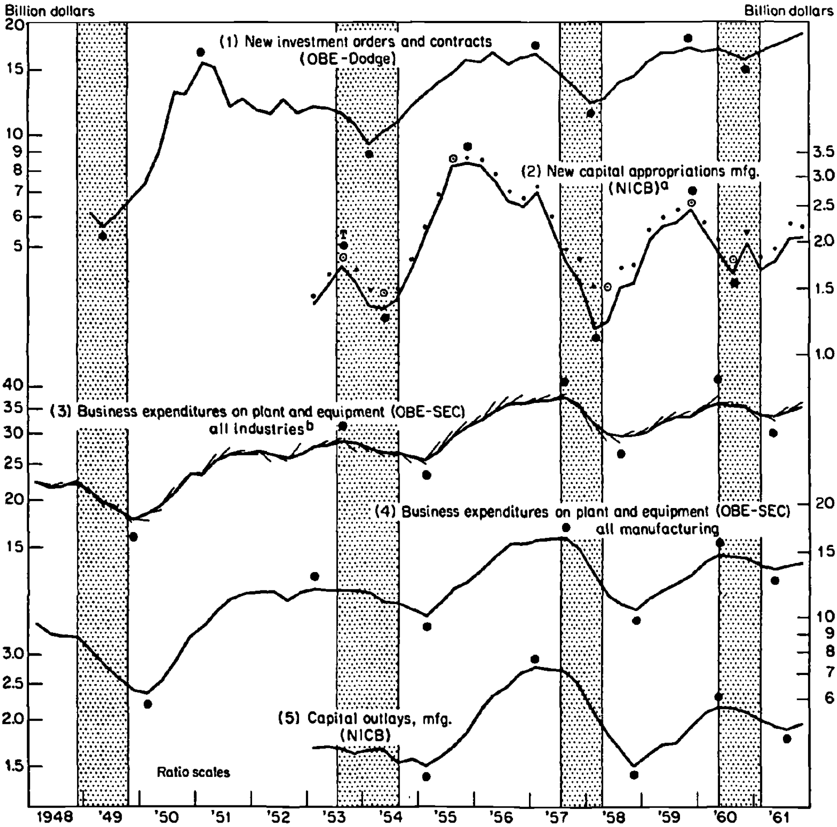
As a result, the two series for investment in plant show particularly sharp contrasts on several occasions. Thus in 1954 *PC* first declined steeply and then rose substantially, while *Str* merely flattened off. In 1960–61, *Str* responded similarly, with a prolonged sideward movement, to a marked contraction and recovery in *PC*. In 1963–65, short up-and-down movements in *PC* were transformed into a smooth upward drift in *Str*. Such strong smoothing suppresses turning points, and thus few direct timing comparisons can be made, but the estimates leave little doubt about the pronounced tendency of expenditures for plant construction to lag behind contracts. These retardations in *Str* lag behind the contractions in *PC* by intervals of one to two quarters. Longer lags—six quarters at the 1956–57 peaks and four quarters at the 1958–59 troughs in the two series—can also be observed, although there is some uncertainty about these observations because of double-turn configurations in *PC*.[17]

Older data covering the earlier postwar years show the same type of relationship between new investment orders and contracts and business expenditures on plant and equipment. Curve 1 from Chart 9-1 is reproduced in quarterly form in Chart 9-4 (the OBE-Dodge series including fabricated metals orders). With it are shown the OBE-SEC series for fixed-investment outlays of all industries and all manufacturing, 1948–61 (curves 3 and 4). Again, it is evident that the cyclical movements in outlays follow with substantial lags and smaller relative amplitudes the corresponding fluctuations in new orders. The one con-

[17] Thus, when measured from the secondary peak of *PC* in I-1957, the lag of *Str* is two quarters, but such a comparison would ignore the fact that *PC* declined strongly in 1956, while *Str* kept increasing.

Chart 9-4

Investment Orders and Contracts, Actual and Anticipated Business Expenditures on Plant and Equipment, and New Capital Appropriations and Outlays by Manufacturing Companies, 1948–61



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify specific peaks and troughs of specific cycles.

Source: U.S. Department of Commerce, Office of Business Economics; Securities and Exchange Commission; F. W. Dodge Corporation; National Industrial Conference Board.

[a] Net of cancellations. Computed by addition of series for component industries, seasonally adjusted by NBER. The gross appropriations figures, seasonally adjusted by NICB, are shown as points lying above the net appropriations curve. (The encircled points represent the specific-cycle turns in the gross appropriations series.)

[b] The solid curve shows actual expenditures. The points linked with the curve are "first anticipations" of the expenditures converted to the present levels. They are obtained by taking the first anticipated changes ($A_1 - A_2$) and adding these changes, observing signs, to the present levels. The links connect actual expenditures of any given quarter with the anticipated expenditures of the next quarter; the former is the quarter in which the projection was made; the latter is the quarter to which the projected figure refers. The anticipations data are seasonally adjusted by the source since 1953; for the earlier years, they were adjusted by means of the average seasonal factors for 1953–58.

spicuous difference between these series is that the short but pronounced "Korean" cycle in investment orders, with a high peak in the first quarter of 1951, is largely smoothed out in the series on expenditures for plant and equipment (as it is in the corresponding production and shipments series).

On five occasions, two-quarter lags of business capital outlays are recorded at cyclical turns of new investment orders in Chart 9-4 (compare curves 1 and 3). At the 1954 trough, the lag is four quarters, and at the 1951 peak it is as long as ten quarters. That peak, of course, was associated with the heavy accumulation of unfilled order backlogs during the first year of the Korean War. The average lag of outlays in the period since 1949 turns out to be 10.3 months according to these data. For the period since 1954, it is 7.2 months, similar to the average lag of 6 months obtained by using the new data from Chart 9-2.

To conclude, it is reassuring to find that the main results of the analysis in this section show a certain degree of robustness in that they do not depend critically on which of the different sets of data for fixed-investment orders and expenditures are used.

Capital Appropriations, Commitments, and Spending

Chart 9-4 includes quarterly series on new capital appropriations and capital expenditures of several hundred large manufacturing companies reporting to the National Industrial Conference Board.[18] An "approved capital appropriation" is an authorization by top management (typically the board of directors or president) of a future capital expenditure. Appropriations cover new plants and buildings, additions to or improvements of plants and buildings, new machinery, office machines, storage equipment, and motor vehicles for business use. Ex-

[18] The number of reporting companies has increased over time. Data for 1953–54 from a 353-company subsample were linked to the 1955–58 data from a 507-company subsample; the latter again were linked to the 1958–60 data for the currently responding 602-company sample. The series have recently been adjusted for seasonal variation. (The NICB publishes the figures in unadjusted form in the *Conference Board Business Record* but provides the user with some charts of the adjusted series.) In addition to statistics of newly approved capital appropriations, cancellations, and expenditures, the NICB compiles data on volume ("backlog") of appropriations outstanding, amounts committed and spent, and the percentage of companies reporting increases in appropriations. All these measures are based on a continuing quarterly survey among the nation's largest manufacturing companies. For a description of statistical procedures, the survey coverage, and limitations of the data, see *Conference Board Business Record*, October 1956 and July 1960; and Morris Cohen, "The National Industrial Conference Board Survey of Capital Appropriations," in *The Quality and Economic Significance of Anticipations Data*, Universities–National Bureau Conference 10, Princeton for NBER, 1960.

cluded are funds earmarked for land purchase, maintenance and repair, acquisition of existing companies, used equipment and buildings, and capital spending outside the United States.

The approval of a capital appropriation confirms or changes the annual capital budget of the company. In setting up the budget, the first stage is to complete the process of planning and executing capital outlays; the second stage is the appropriations procedure in which the budget is disaggregated and "tested" by individual projects.[19] The third stage, logically, would be the commitment of the money, i.e., placing of the order or contract for equipment or plant. Actual outlays may begin as construction work takes place and machinery and equipment are produced, shipped, and installed. In the last stage the payment for the capital goods acquired is completed and the expenditure is recorded.

In this sequence, appropriations lead commitments (investment orders). In fact, for those companies in the NICB sample which report commitments as distinguished from expenditures, commitments of appropriated funds do show some lag vis-à-vis the approvals of such funds, though the lag appears to be relatively short and irregular.[20] The amplitudes of appropriations exceed those of commitments. These observations, however, are highly tentative as they are based on slender evidence. Only about 35 per cent of the companies in the NICB sample are able to report their commitments.[21]

New authorizations made during a quarter add to the backlog of appropriations outstanding at the beginning of the quarter; commitment or spending, as well as cancellation, of the appropriations reduce the backlog. Hence the change in the appropriations backlog during a given quarter equals the difference between new approvals and the sum of the appropriations committed, spent, or cancelled. For the companies unable to report commitments—the majority of the sample—outstanding appropriations are taken to expire only when spent or cancelled. The fact that the appropriation backlog series is largely on an expended rather than "committed" basis makes it less forward looking than it

[19] Cohen, "Capital Appropriations," p. 300.

[20] Thus, for 117 durable goods manufacturers, a downturn in appropriations occurred in IV-1955 and a downturn in commitments in II-1956; but both series moved briefly down together in III-1956, whereupon commitments reached a secondary peak in IV-1956 and appropriations in I-1957. In 1958, both appropriations and commitments turned up together in the third quarter. See *Conference Board Business Record,* July 1960, p. 7.

[21] Cohen, "Capital Appropriations," p. 307.

would be otherwise. Since the placement of orders precedes spending, uncommitted appropriations backlogs should be an earlier anticipatory series than the unexpended backlogs.[22]

For comparisons with orders and expenditures, appropriations are best taken net of cancellations. The latter, however, are apparently not large enough to create major discrepancies between the time-paths of gross and net appropriations; the two series tend to move closely together and turn at the same time, as shown in Chart 9-4.[23]

Relating the Aggregative Data on Investment Stages

Even if manufacturers' new capital appropriations (*App*) should lead investment orders placed by the same companies, they need not lead our investment orders-contracts series (*OC*), which has a different and broader scope. The investment orders are reported by the firms that receive them; the appropriations, by those that place the orders. The former data relate to orders to be processed by manufacturers and to contracts for plant construction to be put in place by builders. These orders and contracts originate in many sectors of the U.S. economy as well as abroad; but appropriations all originate with large domestic manufacturing corporations.[24]

Nevertheless, it would not be implausible if appropriations actually did have a definite tendency to lead new orders for capital goods. It cannot be firmly established that this is actually so, since the timing of these series appears to have been more nearly coincident on a few occasions, notably at troughs in 1954, 1958, and 1967; but on the average a short lag of orders is indicated, at least at the peaks. At the height

[22] Let B_t be the appropriations backlog *at the end* of the quarter; A_t^g, gross new appropriations; C_t, cancellations; $A_t^n = A_t^g - C_t$, net new appropriations; O_t^*, capital commitments for those companies that report them; E_t^*, capital expenditures for the other companies; $E_t = O_t^* + E_t^*$, appropriations committed or spent. (All these variables, except B, which is a stock, are flows *during* the quarter.) Then, $B_{t-1} + A_t^g - C_t - O_t^* - E_t^* = B_t$ or $B_t - B_{t-1} = \Delta B_t = A_t^n - E_t$.

For those companies which report appropriations on a commitment basis, B_t represents capital appropriations outstanding that have yet to be committed, i.e., the backlog of capital goods orders yet to be placed. This should be a foreshadowing series for unfilled orders recorded by the receiving companies in the capital-goods-producing industries. However, for all those firms that do not report commitments, outstanding totals of appropriations represent unexpended, rather than uncommitted, backlogs. Here the orders may have been placed earlier; all that the totals tell us is that a certain sum of money is yet to be spent. It is important to note that this distinction applies to the meaning of the appropriations backlogs, not to the newly approved appropriations which, unless cancelled, do represent investment orders to be placed. See *Conference Board Business Record*, October 1956, p. 425.

[23] Cancellations did increase in the vicinity of troughs in appropriations, particularly in 1958 and less so in 1954. Compare gross and net appropriations in Chart 9-4.

[24] Recently, the NICB has also begun reporting appropriation figures for electrical and gas utilities.

of the investment boom of the mid-1950's, appropriations did in fact lead orders by a long interval (compare curves 1 and 2 in Chart 9-4). For the 1959 peaks, the comparison is somewhat inconclusive, depending as it does on which of the orders-contracts series is used (compare the *OC* curves in Charts 9-2 and 9-4), but the best indication is one of roughly coincident timing. However, it is particularly notable here that *OC* declined initially very little in 1960, lingering at high levels well after *App* dropped off sharply. In 1966, *App* reached a peak in the second quarter, *OC* in September (or third quarter); and most recently *App* had its highest value in the third quarter of 1969, *OC* in January 1970.[25]

Manufacturers' appropriations have considerably larger percentage amplitudes of cyclical movement than the total investment orders (compare curves 1 and 2 in Chart 9-4). Similarly, the NICB capital outlays of manufacturers move in larger cycles, measured in percentages, than do total business expenditures on plant and equipment (cf. curves 3 and 5). These results may in part be due to technical reasons such as differences in sample size, but they also reflect the fact that investment by manufacturers is more cyclical than investment by nonmanufacturing business—perhaps because of the greater cyclical sensitivity of manufacturing output compared with that of other sectors of the economy. Evidence of that behavior is provided by the OBE-SEC series on plant and equipment expenditures, which show larger relative fluctuations for manufacturers alone than for business as a whole (cf. curves 3 and 4). The NICB capital outlays series resembles the OBE-SEC figures for manufacturing rather well, those for all business appreciably less (cf. curve 5 with curves 3 and 4).

New capital appropriations very definitely lead plant and equipment expenditures, not only as estimated by the NICB for the same sample of large manufacturers, but also total business and the total manufacturing outlays on fixed investment as estimated by OBE-SEC (see Chart 9-4). These are all leads of either 2 or 3 quarters, except for a few longer leads (4–7 quarters) that are associated mainly with the IV-1955 peak in appropriations. On the average, expenditures lagged appropriations by 10 to 11 months at the five turning points of the

[25] See charts and figures in the latest issue of the *Business Conditions Digest* (*BCD*) available at the time of this writing: the April 1970 issue, pp. 23–24 and 72, series 10 and 11. (My charts were prepared much earlier and have not been updated.)

1954–60 period. This may be compared with average lags of 6 to 8 months obtained by comparing the corresponding turns in expenditures and new investment orders. There is no indication of a systematic difference in timing between the different capital expenditure series compared here.

As would be expected, the association between the two NICB series is much closer than that between manufacturers' appropriations and the comprehensive investment outlays. The latter bear more resemblance to new investment orders than to the appropriations series, allowing for the lags. This is suggested by graphical comparison (see Chart 9-4) and confirmed by Table 9-1, which shows that business expenditures on plant and equipment (I) are more closely correlated with investment orders and contracts (OC) than with appropriations (App). The regressions use lags of I of one to three quarters (see lines 1e and 1f and 3a–3c in the table). The best result for the orders-contracts series was obtained with a two-quarter lag of I. In this relationship (Table 9-1, line 1f), where the data are expressed in billions of dollars,

$$I_t = 11.1 + 1.48 OC_{t-2} + u_t.$$

About seven-eighths of the variance of the investment expenditures are statistically explained ($\bar{r}^2 = .871$) and the standard error of estimate (SE) is \$1.3 billion. The best result for appropriations (Table 9-1, line 3c) was obtained with a three-quarter lag of I:

$$I_t = 20.3 + 1.57 App_{t-3} + v_t.$$

But here $\bar{r}^2$ is smaller (.786) and SE is higher (\$2.5 billion). Note also that the intercept in (3c) is more than 80 per cent larger than the intercept in (1f).[26]

Regressions based on the new data for 1953–65 yield results consistent with the above. Close correlations exist between expenditures on plant and equipment and prior values of new investment orders and contracts, and it matters relatively little whether OC or OC^r and whether I or I_g are used (the distinctions between these series were discussed earlier; see Chart 9-2 and text). Again, higher correlations are obtained with a two-quarter lag of expenditures than with a one-quarter

[26] In these equations, gross appropriations seasonally adjusted directly by the NICB were used, rather than the net appropriations series with the NBER adjustment (the latter is plotted as curve 2 in Chart 9-4). In later work, however, regressions with the net appropriations series were computed, and the results were not improved. In fact, the determination coefficient for the relation between I_t and App_{t-3} (net) is $(.742)^2 = .551$, i.e., significantly lower than for the corresponding relation with gross appropriations (3c in Table 9-1).

Table 9-1
Simple Correlations of Plant and Equipment Expenditures on Each of Three Symptomatic Variables, 1949–61 and 1954–61

Ind. Var. Corr. with Plant and Equip. Expend. (I)	Lag of I Relative to Ind. Var. (qrs.) (1)	r (2)	$\bar{r}^2$ (3)	Stand. Error of Est. (bill. dol.) (4)	Period[a] (5)
1. NEW INVESTMENT ORDERS AND CONTRACTS (OC)					
a.	0	.776	.594	3.3	1949–61
b.	1	.870	.752	2.5	1949–61
c.	2	.918	.843	2.1	1949–61
d.	3	.910	.824	2.1	1949–61
e.	1	.868	.745	1.8	1954–61
f.	2	.936	.871	1.3	1954–61
g.	3	.924	.849	1.4	1954–61
2. FIRST ANTICIPATIONS OF PLANT AND EQUIPMENT EXPENDITURES (A_1)	[b]	.979	.957	1.1	1949–61
3. NEW CAPITAL APPROPRIATIONS, MANUFACTURING (App)					
a.	1	.686	.454	2.7	1954–61
b.	2	.850	.714	1.9	1954–61
c.	3	.891	.786	2.5	1954–61
4. LAGGED PLANT AND EQUIPMENT EXPENDITURES (I_{t-1})	1	.975	.950	1.2	1949–61

Source: Variable 1, Office of Business Economics–Dodge Corporation; variables 2 and 4, OBE–Securities and Exchange Commission; variable 3, National Industrial Conference Board.

[a] Regressions for 1949–61 are based on series of 50–52 quarterly observations; those for 1954–61, on 33 quarterly observations.

[b] Released two and a half to three months before the middle of the quarter to which they refer (see text).

or zero lag; the r coefficients between I_t and OC_t, OC_{t-1}, and OC_{t-2}, respectively, are .929, .958, and .971. Moreover, when all three OC terms are included simultaneously, OC_t proves redundant.

Short-Term Anticipations of Capital Outlays

Their Nature and Predictive Value

The OBE-SEC quarterly data on capital outlays are accompanied by data on *anticipated* capital outlays compiled from reports of the same sample of companies. About 4–6 weeks after the beginning of each quarter, the firms are asked to provide figures on their plant and equipment expenditures for the quarter just passed and on expected expenditures for the current and succeeding quarter. Both the current-quarter and the next-quarter expectations (called "second anticipations," A_2 and "first anticipations," A_1, respectively) are released in the third month of the quarter. Thus A_1 becomes available less than four months prior to the end of the quarter to which it refers, and nearly six months ahead of the date of release of the preliminary actual data. The reported A_2 figure, which of course utilizes more current information, has only about half as long a lead over the date of release of the first estimate of the actual outlay and a lead of less than one month relative to the end of the quarter concerned.

Anticipations do not represent a "stage" of the investment process in the sense in which this term was applied to capital appropriations, contracts and orders, and outlays. They are not a measure of early planning of investment expenditures that is to be followed by the above operational stages. Investment projects typically take much more time to gestate than the three or (at most) six months that separate the dates when anticipations are collected and the *end* of the period to which they refer. These figures, therefore, express not planned but expected expenditures. More specifically, they imply forecasts of how the outlays, which typically will have already been determined by previous appropriations and orders or contracts, would be allocated between the current and next quarters and the further future.

The forecasters are in this case highly qualified, since they represent the companies that incur the outlays. Coming from this source, and at a rather late point in the time scale of the investment process, when pertinent information should already be ample, the anticipations data promise to serve as a useful tool for forecasting plant and equipment outlays. However, the distribution over time of investment expenditures depends in part on the progress of the work underway, and hence must be related to the developments on the supply as well as on the demand side, including such factors as changes in prices and availability of capital goods. These considerations suggest that the relation between anticipated and actual investment may be subject to influences of major analytical interest.

A series made up of anticipated expenditures levels alone cannot be taken to show at what points of time the actual expenditures were expected to experience upturns or downturns. Such a series would show changes from a *previously anticipated* level to the next anticipated level, whereas, in fact, at any given time the anticipated change is from the latest available estimate of the *actual* level to the next anticipated level. To take this into account and, at the same time, to avoid the difficulties due to revisions of the expenditure series, the following mode of presenting the anticipations was adopted in Chart 9-4: (1) The anticipated *change* in expenditures between the current quarter (t) and the next quarter ($t+1$) is computed as the algebraic difference $\Delta A_{t+1} = A_{1,t+1} - A_{2,t}$. The base is the second anticipation rather than the actual outlay for the period t, because the latter figure is still unavailable when the first anticipation for $t+1$ is made. (2) The anticipated change is added to the present version of the actual expenditures series (I_t) to obtain the *levels* of first anticipations, adjusted for the effects of the revisions in the basic data: $A^*_{1t} = I_t + \Delta A_t$. (3) Points representing the levels of A^*_{1t} are plotted in Chart 9-4 to the common scale with the actual business outlays on plant and equipment, that is, along with the series I_t (curve 3). The points do not form a continuous series, but rather each is linked with the value of I in the preceding quarter. Thus the vertical differences between the points and the curve indicate the level errors of the adjusted first anticipations, and the differences between the slopes of the links and of the curve indicate the change errors (all in relative terms, since the chart uses vertical logarithmic scales).

This presentation puts the anticipations in a better light than would others of a more ex-ante character, for several reasons. First, revised actual data are used in a way implying elimination of those errors of measurement that are assumed to be corrected by the revisions. Second, the anticipations figures have been adjusted for seasonal variation. The official adjustment starts in the second half of 1952, but I have carried it back to the beginning of the anticipations series. Third, the anticipations figures have also been adjusted for the bias of underestimating, on the average, the changes in actual expenditures. Again, the bias adjustment by the source goes back to 1953 only, but I have carried it back through the earlier years covered by the data.

The improved processing of the reported figures since August 1952 caused a marked reduction in the aggregate anticipation errors. In particular, the correction for seasonal variations resulted in a decisive improvement.[27] Even after the adjustments, however, relatively large dispersion and errors are found in the anticipations figures for individual industries. Individual-company deviations from planned investment are often very substantial, but they tend to cancel out in industry projections; and, similarly, the errors in the latter tend to cancel out in the record for all industries combined.[28]

This may seem disappointing. It is easy to think of some factors that should enhance the predictive value of short-term investment anticipations. Certain projects involving outlays on plant and equipment are "autonomous" in the sense of being very little affected by current considerations. When such projects reach the point of being included in the anticipated outlay reports for the next quarter, one would assume them to be largely independent of such momentary fluctuations as may then be occurring in sales, profits, interest rates, etc. The influence of current changes in the business situation would be significant here only on those occasions where a current development causes the firm to revise the long-range expectations governing the given investment project. Another consideration that favors the projectability of investment by the firm is that capital outlays, unlike sales or profits, are to a large extent controllable. The rate at which the expenditures are made depends substantially on the firm's past planning and decisions. However, these arguments should not be pushed too hard. Plant and equipment outlays, viewed over short spans of time, are autonomous and controllable only in a limited sense and degree.

To the extent that bias is absent or effectively eliminated by data processing, it is certainly reasonable to expect that the larger the sample

[27] Before the correction, the anticipated changes in expenditures (A_1) averaged −3.1 per cent and the actual changes +1.2 per cent in the period 1953–58, yielding a bias of −4.3 per cent per quarter. After the correction, the mean relative changes were only 0.7 for first anticipations and 0.5 per cent for actual expenditures, which gives a bias of merely 0.2 per cent. As a result of both the regular seasonal adjustment and a separate residual bias correction, the directional errors of the anticipations of change and the dispersion of the anticipated about the actual changes were also drastically reduced. See "An Appraisal of OBE-SEC Estimates of Plant and Equipment Expenditures, 1947–1958," *Statistical Evaluation Reports*, Report No. 1, Office of Statistical Standards, Bureau of the Budget, October 1959, p. 40. This report was prepared by Raymond Nassimbene and Benjamin T. Teeter.

[28] *Ibid.*, Part IV, pp. 46 ff. Analyses of individual-company anticipations for selected years are given in Irwin Friend and Jean Bronfenbrenner, "Plant and Equipment Programs and Their Realizations," in *Short-Term Economic Forecasting*, Studies in Income and Wealth, Vol. 17, Princeton for NBER, 1955, pp. 65–68; and also in articles by Murray F. Foss and Vito Natrella, *Survey of Current Business*, January and March 1957.

the smaller will be the error of the aggregate. This explains in part the better showing of the all-industry anticipations in comparison to the individual-industry figures. But the collection of companies and investment projects covered by the anticipations aggregates is far from homogeneous, and offsetting biases among the component groups also contribute to the net error-reducing effect of aggregation. While relatively small firms tend to underpredict, the larger firms show a slight inclination to overpredict the levels of their actual capital outlays (but the latter are on the whole significantly better predictors than the former).[29]

The discrepancies between anticipated and realized capital outlays can in some periods be related to unexpected changes in prices and the availability of capital goods. Another factor is the errors in sales anticipations. Data on the latter are also collected by the SEC and the Commerce Department. The ex-ante approach of relating the errors of investment anticipations to the errors of sales expectations met with considerable success. When actual sales exceed (fall short of) expectations, investment plans generally are revised upward (downward) so that actual capital expenditures exceed (fall short of) anticipations. For example, annual data for all manufacturing show a positive correlation of .88 between the relative sales and investment deviations in 1948–56. This relationship, however, is much closer on the aggregate than on the company level.[30]

Eisner estimated quarterly "realization functions" by regressing the current errors of anticipations expressed as ratios $(I - A_1)/A_1$ on two

[29] See Murray F. Foss and Vito Natrella, "Business Anticipations of Capital Expenditures and Sales," *Survey of Current Business*, March 1957, p. 8; Friend and Bronfenbrenner, "Plant and Equipment," pp. 69–70; Robert A. Levine, "Capital Expenditure Forecasts by Individual Firms," in *Quality and Economic Significance of Anticipations Data*, pp. 361–62; and Murray F. Foss and Vito Natrella, "The Structure and Realization of Business Investment Anticipations," *ibid.*, pp. 391–95.

It may be noted that outlays for major investment projects (large percentage additions to the firm's fixed assets) tend to be forecast more accurately than those for small projects. The former are often slightly overstated, the latter considerably understated. The scale-of-investment factor reinforces the size-of-firm factors but each has some independent influence.

[30] See Murray F. Foss and Vito Natrella, "Investment Plans and Realizations," *Survey of Current Business*, June 1957, pp. 16–17. Compare also Arthur M. Okun, "The Value of Anticipations Data in Forecasting National Product," in *Quality and Economic Significance of Anticipations Data*, pp. 439–42, and "The Predictive Value of Surveys of Business Intentions," *American Economic Review*, May 1962, p. 222. Interestingly, sales expectations are valuable in explaining investment deviations even though their record in predicting actual sales is poor. Sales errors are more systematic and investment errors are more volatile and random; so the former cancel out much less in the aggregate than the latter. Hence, "sales errors may explain only a trivial portion of the investment errors at the microeconomic level and yet explain a substantial fraction of aggregative investment errors" (Okun, "Anticipations Data," p. 441).

terms involving deviations for anticipations of I_{t-1} and on lagged relative changes in sales, in profits after taxes, and in unfilled orders for machinery.[31] In most cases, the resulting coefficients show the expected signs (positive for all the relative change variables), but are generally small relative to their standard errors, except for the terms that include the lagged values of the dependent variables. The record is admittedly "sufficiently mixed to call for careful attention to difficulties underlying this approach and to possible modifications in its application."[32]

Investment Anticipations, Orders, and Expenditures

As shown above, new orders and contracts for capital goods lead expenditures on plant and equipment consistently by substantial intervals. Production of equipment or construction of plant comes between ordering or contracting and payments. There may also be additional delays due to demand pressures and shortages on the supply side. For first anticipations, no such built-in leading scheme exists, other than that they are reported about one quarter earlier than the actual outlays. Indeed, when plotted in the quarter to which they refer, the anticipations, for optimal timing, should obviously have turning points exactly coincident with those for actual expenditures. The purpose of this index of investment intentions is not to give an intermediate-range prediction of turns in expenditures, but to forecast the levels of expenditures over a short range.

Chart 9-4 shows that the agreement in sign between the actual investment outlays and the corresponding first anticipations was indeed

[31] "Realization of Investment Anticipations," in J. S. Duesenberry, G. Fromm, L. R. Klein, and E. Kuh, eds., *The Brookings Quarterly Econometric Model of the United States*, Chicago-Amsterdam, 1965, pp. 95–128.

[32] *Ibid.*, p. 128. For a critique and countercritique, see also Zvi Griliches, "The Brookings Model Volume: A Review Article," *Review of Economics and Statistics*, May 1968, pp. 217–18; and Gary Fromm and Lawrence R. Klein, "'The Brookings Model Volume: A Review Article:' A Comment," *ibid.*, pp. 236–37.

It should be noted that Eisner earlier adopted a different, stepwise approach to the same general problem, by separately relating (1) the actual investment expenditures and (2) the anticipated investment expenditures to a common group of causal variables (several lagged sales changes, profits, and depreciation), then (3) making the actual values depend on the same variables plus the anticipations. See R. Eisner, "Investment: Fact and Fancy," *American Economic Review*, May 1963, pp. 237–46. In this and related papers ("A Distributed Lag Function," *Econometrica*, January 1960, pp. 1–29; "Capital Expenditures, Profits, and the Acceleration Principle," in *Models of Income Determination*, Studies in Income and Wealth, Vol. 28, Princeton for NBER, 1964, pp. 137–65), Eisner used data from the annual McGraw-Hill surveys of capital expenditures instituted in 1954.

very good (compare the slopes of curve 3 and of the attached projections in each successive quarter). A few directional errors (divergent slopes) did, of course, occur. At the seven major cyclical turns in expenditures, two such errors can be spotted. Realized investment reached a trough in the last quarter of 1949, but the anticipated change from that quarter to the next was negative. Again, actual outlays show a peak in II-1960, but the anticipated change at the mid-year was still positive. However, it should be noted that it takes only slight differences in levels to produce such timing discrepancies.

Quarterly percentage changes in first anticipations, computed as $100[(A_{1,t+1} - A_{2,t})/A_{2,t}]$, are plotted in Chart 9-5 along with the corresponding changes in actual plant and equipment outlays and in new investment orders and contracts.[33] The use of first differences, which reduces sharply the influence of common trends, provides a strong test for the short movements in the series and their possible association. The erratic elements are emphasized but the cyclical ones, if sufficiently valid to begin with, will not be suppressed. They are well in evidence in each of the series here considered.

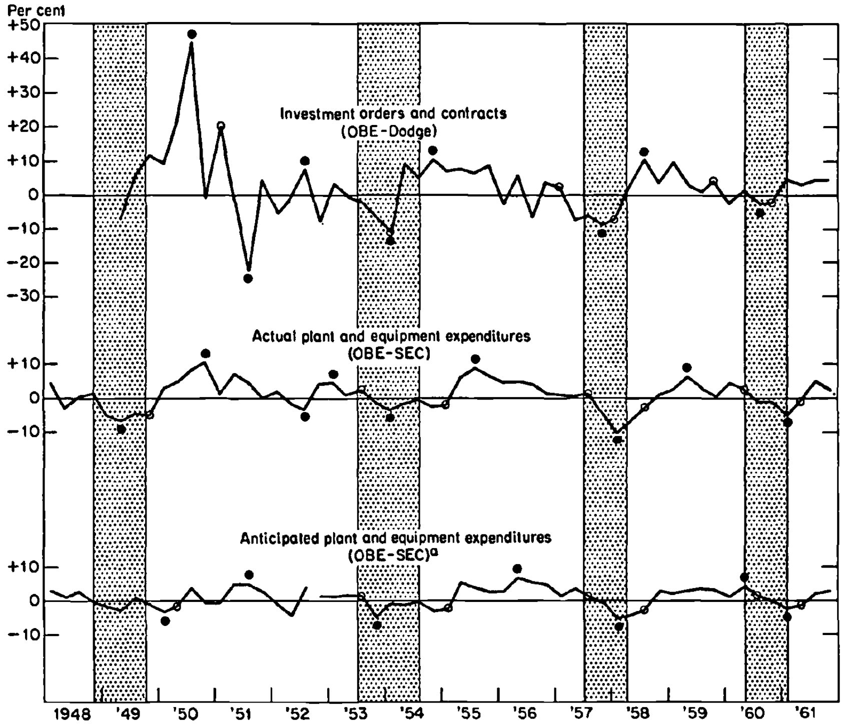
It is evident that the changes in orders-contracts are often considerably larger than those in expenditures. They are also more erratic and show more frequent sign reversals. Due to the adjustments noted before, there is little difference in the average size between the actual and the anticipated expenditure changes (but underestimation is still more frequent than overestimation).

Chart 9-5 gives additional evidence of the early timing of the orders-contracts series relative to investment expenditures. The leads relating to the aggregates themselves are shown here by the sequence of baseline crossings, which mark the transition from positive to negative changes, or vice versa. The turning points in the plotted quarterly rates of change (which, of course, correspond to the inflection points in the level series) typically follow the same sequence. Either type of measurement suggests that on the average expenditures lag behind orders by some 6 to 7 months.

[33] A similar chart appears in my article in Moore, ed., *Business Cycle Indicators*, Vol. I, p. 478, but the relative changes in first anticipations shown there for 1953–59 were computed differently. The figures used here are the correct ones in that they allow for the rate of second anticipations and for all available adjustments of the data.

Chart 9-5

Quarter-to-quarter Percentage Change in Investment Orders and Contracts and in Actual and Anticipated Plant and Equipment Expenditures, 1948–61



Note: Shaded areas represent business cycle contractions; unshaded areas, expansions. Dots identify peaks and troughs of specific cycles. Circles identify the timing of the turns in the corresponding aggregates (see Chart 9-4).

Source: See Chart 9-4.

[a] Anticipated changes are differences between the first anticipations for quarter $t + 1$ and the second anticipations for the current quarter (t). They are plotted in the center of the second quarter ($t + 1$). The anticipations data have been seasonally adjusted by the source since 1953; for earlier years, they were adjusted by means of the average seasonal factors for 1953–58.

Chart 9-5 also confirms the essential agreement in sign between anticipated and the actual capital outlay changes relating to the same time periods. Except in a few quarters, both curves representing these changes lie either in the positive or in the negative region (above or below these base lines, respectively). This can be interpreted as meaning that the two variables are basically synchronous.

There is much less agreement in size between the expected and the realized changes. The local maxima and minima of the two curves fall in most instances into different quarters, but without any systematic lags of either variable; consequently, the patterns involved are on the whole roughly coincident.[34]

The investment-orders estimates can be constructed with a lag of 1 to 2 months. Assume they predicted correctly the turn of investment expenditures with a lead of six months, as they did on several recent occasions. Then their net effective forecasting lead would be about four to five months to the middle of the quarter in which the turn occurred (defining the net lead as the measured lead minus the publication lag). Now the first anticipations figures are released about two months before the middle of the quarter to which they refer, and their expected timing relative to actual expenditures is coincident; thus two months is the net effective lead with which they can correctly predict a turn in expenditures. It follows that the lead of orders is two to three months longer than the lead of anticipations. This advantage of earlier signals offsets, in some degree, the advantage of greater predictive reliability held by the anticipations figures. Investment orders would probably yield more false leads (signals of turns that do not materialize) than would anticipations. As so often happens, the price of earlier forecasts is their larger average error.

A correlation analysis leads to the same general conclusion (see Table 9-1, line 2). Not surprisingly, first anticipations (A_1) are closely correlated with the investment expenditures (I) to which they directly refer. Over the period 1949–61 (series of 50 quarterly observations), correlating I and A_1 results in $r^2 = (.979)^2 = .958$, with a standard error of estimate of $1.1 billion. This is significantly better than the highest correlation between the OBE-Dodge investment orders and contracts (OC) and I, which is obtained for OC taken with a lead of two quarters (Table 9-1, line 1c): here $r^2 = (.918)^2 = .843$ and $SE = \$2.1$ billion. However, OC taken with a three-quarter lead is still almost as good a predictor of I as is OC taken with a two-quarter lead, judging from the

[34] Although it is difficult to identify the "turning points" in the anticipated changes, a close comparison of the two curves in Chart 9-5 shows a perceptible similarity between their longer fluctuations, which is probably all one could reasonably hope for.

correlation measures alone (Table 9-1, lines 1c and 1d). The net effective lead for this relation between I_t and OC_{t-3} is 7 to 8 months, which is more than three times that for the relation between I and A_1. Again one finds that for earlier availability of forecast OC is preferable to A_1, while for greater reliability of forecast A_1 is preferable.[35]

Distributed Lags of Expenditures

Regressions on Several Lagged Values of Commitments

Replications of the work done with the older data for 1949–61 were performed on the currently available quarterly series for 1953–65: the new Census-Dodge data for fixed-investment orders and contracts and the OBE-SEC or Commerce (National Income Division) data on expenditures for plant and equipment. These calculations confirm that the highest correlations between I_t and OC_{t-i} (or between I_t and OC^r_{t-i}) are obtained with two-quarter lags of expenditures ($i = 2$). Three-quarter lags give somewhat lower r's, and one-quarter and four-quarter lags rank third and fourth in this respect. All these correlations are high, usually exceeding the correlations obtained with the older data for 1949–61.

There is an indication that the association between outlays and commitments is closer and that it involves shorter lags for producer durable equipment than for the structures component of GNP. In the former case, correlation between PDE_t and EO_{t-i} is maximized when $i = 1$; in the latter, correlation between Str_t and PC_{t-i} is maximized when $i = 2$. However, the second-highest r's are just a little lower; in each case, because of high autocorrelations in the time series, the results associated with the different lags fall into relatively narrow ranges.[36]

[35] Compare Okun, "Predictive Value of Surveys," pp. 221–24. For 48 quarters from 1949-III to 1961-II, Okun obtained results similar to mine by regressing I on A_1. He reports that A_1 explained nearly 97 per cent of the variance of predicted quarterly outlays and yielded a standard error of \$0.95 billion (at annual rates). He comments on the relation between the OBE-Dodge investment orders and contracts series (here denoted OC) and the plant and equipment expenditures one (I), lagged by one to three quarters, saying that OC taken alone "does not nearly match the first anticipations series; taken with anticipations, [it] does not add significantly to the accuracy of the explanation" (p. 224). However, Okun does not present his numerical results on this point, does not allow for the length of the lead involved, and does not mention the trade-off between the gain in timeliness and the loss in accuracy.

[36] When the lag i is varied from zero to four quarters, the following values of r are obtained: (1) for I_t vs. OC_{t-i}, .925 to .970; (2) for I_t vs. OC^r_{t-i}, .920 to .961; (3) for PDE_t vs. EO_{t-i}, .886 to .963; and (4) for Str vs. PC_{t-i}, .812 to .844. The correlations with OC^r are slightly lower than those with OC, apparently because of the larger weight of structures in the former.

When included along with the values of OC for each of the two preceding quarters, the current value (OC_t) has no significant influence upon I_t; also OC_{t-2} then has a much stronger effect than OC_{t-1}.[37] Indeed, it seems reasonable to assume that some minimum gestation periods prevail so that the shortest-lag terms of OC have no significant effects of their own, although this assumption could well result in some error. In other words, the distributed-lag influence on I_t of OC_{t-i} starts essentially with $i = 2$ and extends to larger lags ($i > 2$).[38] For the equipment component of fixed investment, however, the one-quarter lag term, OC_{t-1}, will also be included.

In Table 9-2, investment expenditures in the period t are related to commitments in periods $t - j$, $t - j - 1$, and $t - j - 2$, where j is the lag that maximizes the simple correlation between expenditures and commitments. The best results for total fixed-investment outlays by business are obtained with lags of two and three quarters, that is, with two terms, OC_{t-j} and OC_{t-j-1}. The addition of the four-quarter lag term fails to improve the fit in any significant manner. Application of the reweighted orders-contracts series, OC^r, yields again very similar, though slightly lower, correlations (see lines 1–3 and 4–6).

When the longer lags in commitments are included in the separate equations for the equipment component, more systematic improvements are observed. Here $j = 1$ and the addition of two- and three-quarter lag terms results in higher $\bar{R}^2$'s and lower SE's although the gains are small (lines 7–9). Larger relative improvements are achieved in the regressions for the plant component, where $j = 2$ and the three- as well as four-quarter lag terms are also definitely significant (lines 10–12). Again, however, the correlations for plant (structures) are appreciably lower than those for equipment (which in turn are slightly lower than those for total fixed investment). The Durbin-Watson statistics are low throughout in Table 9-2, indicating positive autocorre-

[37] Consider the regressions

$$\underset{(1.155)}{I_t = 3.147} - \underset{(.420)}{.035OC_t} + \underset{(.591)}{.979OC_{t-1}} + \underset{(0.435)}{2.266OC_{t-2}} + u_t;\ \bar{R}^2 = .945$$

and

$$\underset{(1.143)}{I_t = 3.146} + \underset{(.410)}{.944OC_{t-1}} + \underset{(0.430)}{2.265OC_{t-2}} + v_t;\ \bar{R}^2 = .946$$

[38] Regressions based on earlier data for 1949–61 also support this hypothesis. According to Table 9-1, OC_{t-2} and OC_{t-3} represent the choice of best simple leads relative to I_t. Using both terms,

$$(I_t)_{est} = 9.19 + \underset{(.224)}{.831OC_{t-2}} + \underset{(.217)}{.739OC_{t-3}};\ \bar{R}^2 = .859;\ SE = \$1.97 \text{ billion}.$$

Table 9-2
Regressions of Business Expenditures on Plant, Equipment, and Total Fixed Investment and Commitments Incurred One to Four Quarters Earlier, 1953–65

Depen. Var.[a] (1)	Independent Variables and Regression Coefficients[b] (2)	(3)	(4)	Constant Term[c] (5)	$\bar{R}^2$ (6)	Standard Error of Estimate (bill. dol.) (7)	Durbin-Watson Statistic (8)
REGRESSIONS FOR EXPENDITURES ON PLANT AND EQUIPMENT							
	OC_{t-2}	OC_{t-3}	OC_{t-4}				
1. I_t	3.215			3.243	.939	1.695	0.924
	(0.120)			(1.247)			
2. I_t	2.010	1.304		2.407	.948	1.557	0.421
	(0.406)	(0.423)		(1.178)			
3. I_t	2.009	1.179	.138	2.311	.947	1.573	0.428
	(0.410)	(1.576)	(.424)	(1.225)			
4. I_t	7.288			2.917	.921	1.925	1.539
	(0.311)			(1.443)			
5. I_t	4.218	3.427		1.521	.946	1.596	0.712
	(0.704)	(0.731)		(1.233)			
6. I_t	3.926	2.820	.995	1.168	.947	1.583	0.650
	(0.733)	(0.862)	(.762)	(1.252)			
REGRESSIONS FOR EXPENDITURES ON EQUIPMENT							
	EO_{t-1}	EO_{t-2}	EO_{t-3}				
7. PDE_t	3.565			−0.244	.926	1.826	0.651
	(0.147)			(1.285)			
8. PDE_t	2.137	1.528		−0.880	.935	1.710	0.412
	(0.541)	(0.560)		(1.226)			
9. PDE_t	2.226	0.502	1.017	−1.446	.939	1.661	0.432
	(0.528)	(0.763)	(0.531)	(1.227)			
REGRESSIONS FOR EXPENDITURES ON PLANT							
	PC_{t-2}	PC_{t-3}	PC_{t-4}				
10. Str_t	6.780			5.857	.706	1.621	1.277
	(0.635)			(1.169)			
11. Str_t	4.348	3.588		3.874	.804	1.324	0.876
	(0.718)	(0.733)		(1.037)			
12. Str_t	3.334	2.384	2.808	2.938	.857	1.130	0.905
	(0.659)	(0.688)	(0.667)	(0.913)			

Notes to Table 9-2

[a] As in the text, I denotes business capital outlays (OBE-SEC); *PDE*, expenditures for producer durable equipment; *Str*, expenditures for plant or nonresidential structures. Time subscripts, here as elsewhere, refer to quarters. All the variables are in quarterly totals at annual rates, in billions of dollars.

[b] *EO* denotes new orders for machinery and equipment (Census); *PC*, contracts for industrial and commercial construction (Dodge); *OC*, estimated total fixed-investment commitments (sum of *EO* and *PC*). In lines 4, 5, and 6, the reweighted orders-contracts series, OC^r is used, with the timing subscripts corresponding to those of *OC* in lines 1, 2, and 3. These variables are expressed in quarterly totals at quarterly rates, in billions of dollars. Standard errors of the regression coefficients are given underneath in parentheses.

[c] Standard errors of the constant terms are given underneath in parentheses.

lation of the residuals, and are not improved by the addition of longer lags (column 9).

Estimates of average lags can be obtained by multiplying the lags i by the corresponding regression coefficient and adding the products. Here, however, each coefficient must first be divided by 4, because the investment expenditure data used in the regressions are at annual rates, while the investment commitments data are at quarterly rates. The calculations yield average lags of about 2 to 2.5 quarters for the equations relating to total fixed investment and to equipment (lines 2, 8, and 9) and of about 5 to 6 quarters for the equations relating to plant (lines 11 and 12). In the light of other evidence to be discussed, these are in all likelihood substantial underestimates, and the presumed reason for this is that the method admits only two or at most three significant OC_{t-i} terms because of multicollinearity. Each additional term with a positive coefficient makes for an increase in the estimated average lag.

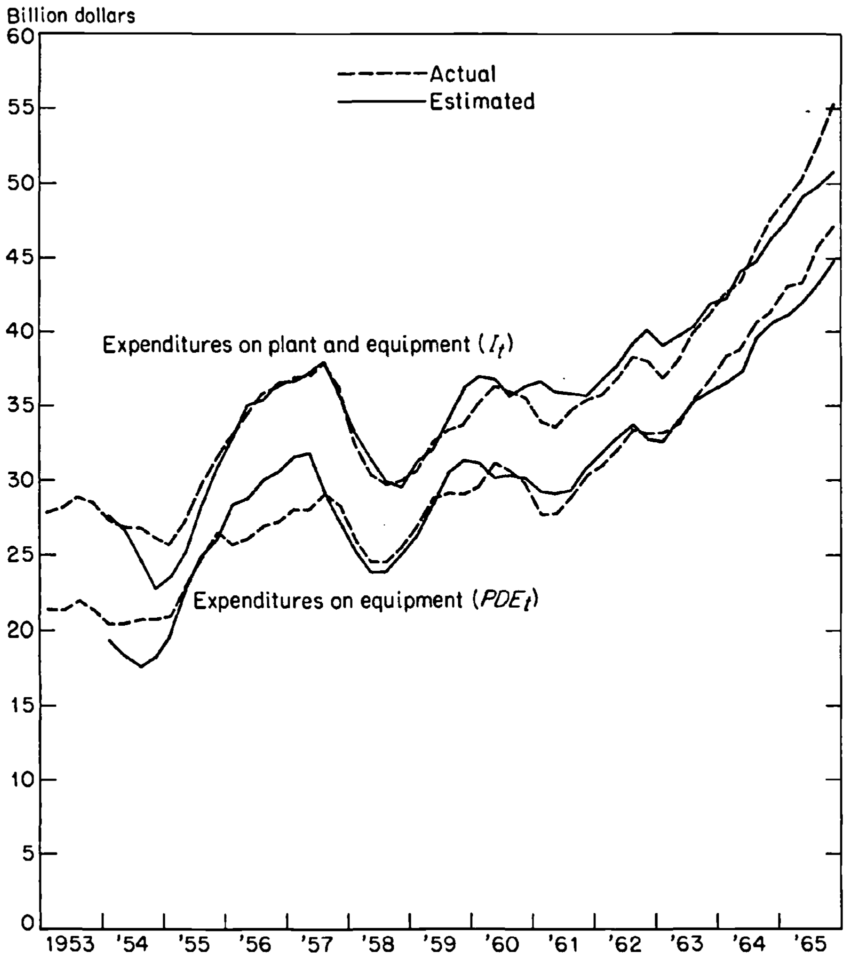
Chart 9-6 compares the estimates of total business capital outlays based on the regression that includes OC_{t-2} and OC_{t-3} (Table 9-2, line 2) with actual outlays. The fit is fairly good in that the estimated series has no systematic lead or lag relative to the actuals. Significant underestimation errors, however, can be seen at the 1954–55 trough and again at the end of the sample period in 1965, while overestimates prevail between mid-1959 and mid-1963. At other times, including the turning points of 1957–58, the estimated and observed values show a close agreement.

The lower part of Chart 9-6 presents a corresponding comparison

Chart 9-6
Regression Estimates for Business Equipment Expenditures and Total Fixed Investment Outlays, Based on Two Lagged Commitment Terms, Quarterly, 1953–65

$$(I_t)_{\text{est}} = 2.407 + 2.010(OC)_{t-2} + 1.304(OC)_{t-3}$$

$$(PDE_t)_{\text{est}} = -0.880 + 2.137(EO)_{t-1} + 1.528(EO)_{t-2}$$



for equipment expenditures estimated from lagged orders, EO_{t-1} and EO_{t-2} (Table 9-2, line 8). Here again there are no persistent timing differences between the estimates and the actual values, but there are substantial underestimates at the trough of 1954 and in 1964–65 and overestimates before the peaks of 1957 and 1960.

Variable Lag Coefficients

The argument developed in Chapter 5 in favor of variable, rather than fixed, lag coefficients in functions expressing the dependence of shipments on new orders applies, *mutatis mutandis,* also to the relations between investment commitments and expenditures. The method of allowing for the variability of the coefficients by making them depend on the backlog-shipment ratios, U/S, worked rather well in the analysis of the orders-shipments (N-S) relations, where matching data on N, S, and U was available. Its application to the investment functions now under study, however, is severely impeded because the data on hand at best permit only a crude approximation to the U/S ratios that are needed. Ratios can be constructed from series for the machinery and equipment industries, but no usable backlog statistics could be found for the plant component of business fixed investment. Furthermore, the method involves only two lagged terms in orders or commitments (say, for the periods $t-2$ and $t-3$), permitting the relative influence of the more distant term to rise when U/S, as a proxy for capacity utilization, increases. This limitation to shifts between two lag coefficients or weights is probably more detrimental here, where the lags are longer and more complex, than it was in the case of the simpler N-S relations.

Applied to total fixed investment, the variable-lag equation is

$$I_t = \alpha_{1,t}(OC)_{t-j} + \alpha_{2,t}(OC)_{t-j-1} + v_t, \tag{1}$$

where, $\alpha_{1,t} = \beta_0 + \beta_1(U/S)_{t-j}$ and $\alpha_{2,t} = \beta_2 - [\beta_0 + \beta_1(U/S)_{t-j-1}]$. The form actually used for calculations[39] is

$$I_t = \alpha + \beta_0\Delta(OC)_{t-j} + \beta_1\Delta[(U/S)(OC)]_{t-j} + \beta_2(OC)_{t-j-1} + u_t. \tag{2}$$

The estimates for both β_0 and β_1 turned out to be smaller than their standard errors. Better results were obtained in the separate regressions for equipment and for plant, which are, respectively:

[39] These formulations are analogous to equations 10–14 in Chapter 5.

$$(PDE_t)_{est} = \underset{(1.208)}{0.883} + \underset{(4.252)}{8.586}\Delta(EO)_{t-1} - \underset{(1.075)}{1.644}\Delta[(U/S)(EO)]_{t-1}$$

$$+ \underset{(0.140)}{3.655}(EO)_{t-2};\ \bar{R}^2 = .937;\ SE = 1.685;\ d = .546;$$

and

$$(Str_t)_{est} = \underset{(1.026)}{4.061} + \underset{(5.753)}{13.491}\Delta(PC)_{t-2} - \underset{(1.538)}{2.463}\Delta[(U/S)(PC)]_{t-2}$$

$$+ \underset{(0.564)}{7.843}(PC)_{t-3};\ \bar{R}^2 = .810;\ SE = 1.301;\ d = 1.063.$$

In each case, the estimates of α_1 and α_2 at the mean values of the U/S ratios come quite close to the values of the corresponding coefficients in the fixed-lag equations, as reported in Table 9-2.[40] Hence, approximately the same *average* lags are implied by both types of regressions, as should be expected. The backlog-shipment ratios for machinery and equipment came close to the high value of 6 early in 1953, but varied between 3 and 5 in the years 1954–66 (see Chart 6-6). According to the model, α_1 would be going from about 1 toward zero and α_2 would be going in exactly the opposite direction, as the U/S ratio in the equation for equipment increased from 3 to 6. Hence the implied lag for investment in equipment at $U/S = 6$ would be twice the lag at $U/S = 3$.

Geometric and Second-Order Lag Distributions

The model examined next is a form of geometric lag distribution which implicitly includes all lags equal to j and more quarters and excludes the lags shorter than j. For example, using the symbols for total business investment in plant and equipment, the equation reads

$$I_t = k + a(OC)_{t-j} + bI_{t-1} + u_t, \tag{3}$$

[40] These estimates are computed from the formulas $\bar{\alpha}_1 = \beta_0 + \beta_1(\bar{U}/\bar{S})_{t-j}$ and $\bar{\alpha}_2 = \beta_2 - [\beta_0 + \beta_1(\bar{U}/\bar{S})_{t-j-1}]$. When each coefficient is divided by 4 (see text above), the results are as follows:

	Avg. Variable-Lag Coefficients			*Fixed-Lag Coefficients*		
Investment Commitments	*Plant and Equipment*	*Equipment*	*Plant*	*Plant and Equipment*	*Equipment*	*Plant*
For $t-j$	.506	.567	1.005	.503	.534	1.087
For $t-j-1$	.321	.365	0.982	.326	.382	0.897

where u_t is supposed to have the usual assumed properties of the random disturbance. This form will be recognized as a variant of the familiar Koyck distributed-lag transformation. The results of its application are presented in Table 9-3, odd lines.

The regression coefficients of the lagged dependent variable, that is, of I_{t-1} or PDE_{t-1} or Str_{t-1}, are all highly significant (column 4). This, to be sure, could merely reflect the fact that investment expenditures, like most comprehensive economic aggregates, show a substantial degree of autocorrelation. But the investment commitments variables—OC_{t-2}, EO_{t-1}, and PC_{t-2} — retain in each case a strong effect upon expenditures having coefficients that are comfortably large relative to their standard errors (column 3). The regression constants do not appear to differ significantly from zero, except perhaps in the case of equipment (column 6). The values of $\bar{R}^2$ are appreciably higher and those of SE appreciably lower than the best corresponding figures in Table 9-2 (columns 7 and 8). The improvement here is particularly substantial for the estimates of investment in structures. On the other hand, the Durbin-Watson statistics are still mostly low in these equations, even though they are typically biased upward in such autoregressive forms (column 9).

The estimates listed on the even lines of Table 9-3 represent second-order lag distributions that use two autoregressive terms. For example, the equation for total business outlays on fixed investment contains I_{t-2} in addition to the factors included in (3), to read:

$$I_t = k' + a'(OC)_{t-j} + b'I_{t-1} + c'I_{t-2} + u'_t. \tag{4}$$

The coefficients of I_{t-2} are negative, and so is the coefficient of the corresponding term PDE_{t-2} in the regression for outlays on equipment; but the contribution of Str_{t-2} in the equation for expenditures on plant is effectively zero (column 5). Where the second lagged dependent variable turns out to be significant, its inclusion results in reductions of the coefficients of investment commitments and increases of the coefficients of the first autoregressive term, I_{t-1} or PDE_{t-1} (compare lines 2, 4, and 6 with lines 1, 3, and 5, respectively). The values of $\bar{R}^2$ are increased but slightly, while the standard errors of estimate are of course reduced; the values of d, the Durbin-Watson ratios, are raised considerably.

Most of the estimates in Table 9-3 seem quite respectable by con-

Table 9-3
Regressions of Fixed-Investment Expenditures on Commitments, Based on Alternative Assumptions of Geometric and Second-Order Distributed Lags, Quarterly, 1953–65

Line (1)	Investment Commitments Variable (2)	Regression Coefficients: Investment Commitments[a] (3)	Regression Coefficients: Lagged Dependent Variable[b]: For $t-1$ (4)	Regression Coefficients: Lagged Dependent Variable[b]: For $t-2$ (5)	Constant Term (6)	$\bar{R}^2$ (7)	Stand. Error of Est. (bill. dol.) (8)	Durbin-Watson Statistic (9)
	REGRESSIONS FOR EXPENDITURES ON PLANT AND EQUIPMENT (I_t)							
1	OC_{t-2}	1.154	0.706		−.772	.977	1.044	0.961
		(0.247)	(0.081)		(.895)			
2	OC_{t-2}	0.786	1.291	−.518	.312	.983	0.890	1.498
		(0.228)	(0.155)	(.122)	(.805)			
3	OC^r_{t-2}	2.075	0.784		−1.219	.973	1.121	1.068
		(0.576)	(0.082)		(.946)			
4	OC^r_{t-2}	1.416	1.402	−.581	.179	.982	0.921	1.659
		(0.493)	(0.146)	(.123)	(.830)			
	REGRESSIONS FOR EXPENDITURES ON EQUIPMENT (PDE_t)							
5	EO_{t-1}	0.991	0.775		−1.250	.982	0.891	1.363
		(0.223)	(0.064)		(.633)			
6	EO_{t-1}	0.870	1.026	−.235	−.818	.983	0.872	1.740
		(0.229)	(0.157)	(.134)	(.666)			
	REGRESSIONS FOR EXPENDITURES ON PLANT (Str_t)							
7	PC_{t-2}	.988	0.942		−.469	.964	0.565	1.698
		(.387)	(0.052)		(.535)			
8	PC_{t-2}	.990	0.940	.003	−.470	.963	0.572	1.695
		(.405)	(0.182)	(.171)	(.548)			

Note: For identification of symbols, see Table 9-2, notes a and b. Standard errors of the regression coefficients and constant terms are shown in parentheses underneath each statistic.

[a] As identified in column 2.

[b] I, PDE, or Str, as indicated in the heading, with the subscripts $t-1$ or $t-2$ as indicated in columns 4 and 5.

ventional statistical standards. The regression coefficients are several times larger than their standard errors and, hence, appear to be highly significant. The values of $\bar{R}^2$ are very high, too. However, a far more difficult and sensitive test for such equations is provided by the reasonableness and definiteness of what they imply about the lag structure of the investment processes.

It is helpful at this point to consider the long-run equilibrium aspects of these relations. If the orders-contracts series referred strictly and exclusively to new plant and equipment and were net of cancellations and duplications, and if expenditures covered exactly the same items and no others, then a unit increase in orders, indefinitely maintained, should be associated with a unit increase in expenditures. Briefly, a permanent rise in *OC* of, say, \$1 billion would result in an equal rise in *I*. This is the case of perfect measurement, which of course cannot be assumed. Actually, the equations for total fixed investment and for equipment in Table 9-3, lines 1–2 and 5–6, imply that a maintained change in commitments of one unit does induce a parallel long-run change in expenditures of approximately one unit. For example, for the regression on line 1 of the table, the estimated "total response" of *I* to a persistent unit rise in *OC* equals $0.2885/(1 - 0.7055) = 0.9695$. The corresponding value for the equation on line 2 is $0.1964/(1 - 1.2914 + 0.5177) = 0.8680$.[41] Similarly, estimates of 1.0996 and 1.0414 are obtained for the total long-run response of expenditures on *PDE* in the equations on lines 5 and 6 on Table 9-3, respectively.

The regressions for business investment in plant, however, imply a maintained increase of \$4,290 billion in expenditures (*Str*). This clearly reflects the large discrepancy in coverage between the series of nonresidential building contracts on the one hand and the series of capital outlays on structures on the other. The equations for total plant and equipment investment that use the reweighted orders-contracts data, i.e., OC^r, also yield long-run response estimates that exceed unity. The figures obtained here are 2.403 for the geometric and 1.979 for the second-order lag distribution (Table 9-3, lines 3 and 4). They are at least

[41] The figure for line 1 equals $(1/4)[a/(1 - b)]$, using the symbols from equation (3); the figure for line 2 equals $(1/4)[a'/(1 - b' - c')]$, using the symbols from equation (4). The formulas allow for the use of data at quarterly and annual rates but are otherwise familiar and equivalent to those used in Chapters 5 and 7, above.

twice as large as they should be because the scaling-down of the equipment orders component, designed to bring it into better relation with plant contracts, also reduces the average level of OC^r to less than half that of OC.

The tabulation below lists the average lags for the investment functions identified by their principal variables.[42] Except in the case of structures, investment expenditures taken with a two-quarter lead have significant negative coefficients (Table 9-3, column 5). This implies that the average lags calculated from the second-order functions are here preferable to those calculated from the geometric lag distributions that tend to be overestimates. The second-order model suggests mean lags of expenditures of three to four quarters for total fixed investment and equipment. For plant, however, the estimated average lag is as long as eighteen quarters.[43]

		Average Lag in Quarters	
Investment Function for	*Line No., Table 9-3*	*Geometric Model (odd lines)*	*Second-Order Model (even lines)*
Plant and equipment (I, OC)	1, 2	4.4	3.1
Plant and equipment (I, OC^r)	3, 4	5.6	3.3
Equipment (PDE, EO)	5, 6	4.4	3.7
Plant (Str, PC)	7, 8	18.4	18.4

The patterns of lagged response implied by the second-order equations can be computed by the stepwise method used before (see Table 5-6 for description and illustrations). For example, the results for the

[42] The averages are computed with the aid of the formulas $b/(1-b)$ for the geometric and $(b' + 2c')/(1 - b' - c')$ for the second-order lag distribution. Since the investment commitments variables bear the subscript $t-2$ for total fixed-investment and plant and $t-1$ for equipment, 2 and 1, respectively, must be added to the values calculated from the formulas. Compare the discussion of the corresponding measures in Chapter 5.

[43] It will be noted that the second-order models give a longer average lag for equipment alone than for plant and equipment combined. This is certainly unsatisfactory, since the lag for equipment must be presumed shorter. It is generally recognized that the lags for structures are much longer than those for equipment, and our results show this contrast very strongly. But let us recall that the dependent variable in the total fixed-investment regressions is represented by the OBE-SEC business capital outlays series (I), which is *not* equal to the sum of the two dependent variables in the separate regressions for equipment and for plant, where the GNP investment components (PDE and Str) are used. Hence the reported results are not internally inconsistent.

equipment regression from Table 9-3, line 6, which are tabulated below, suggest that the modal effect of equipment orders (*EO*) on outlays for producer durables (*PDE*) involves a lag of two quarters (the one-quarter effect is a little smaller). Nearly 60 per cent of the total long-run reaction would be accomplished within a three-quarter interval, but seven quarters are needed to reach the 90 per cent mark.

Length of Lag (i) *(quarters)*	*Effect of* EO_{t-i} *on* PDE_t	*Cumulative Effect as Per Cent of Total Effect*
1	0.218	20.9
2	0.223	42.3
3	0.178	59.4
4	0.130	71.9
5	0.092	80.8
6	0.064	86.9
7	0.044	91.1
Cumulative, 1–4	0.749	
Cumulative, 1–7	0.949	
Total effect $\{= (1/4)[a'/(1 - b' - c')]\}$	1.041	

The estimates from the second-order equations for total business capital outlays and equipment expenditures (Table 9-3, lines 2 and 6, respectively) are presented in Chart 9-7 for comparison with the observed values. The fits are very good indeed and appreciably closer than those in Chart 9-6. The estimates, however, lag slightly at some turning points and tend to understate somewhat the actual levels on the upgrade and overstate them somewhat on the downgrade. Such results are frequently observed for models with lagged dependent variables.

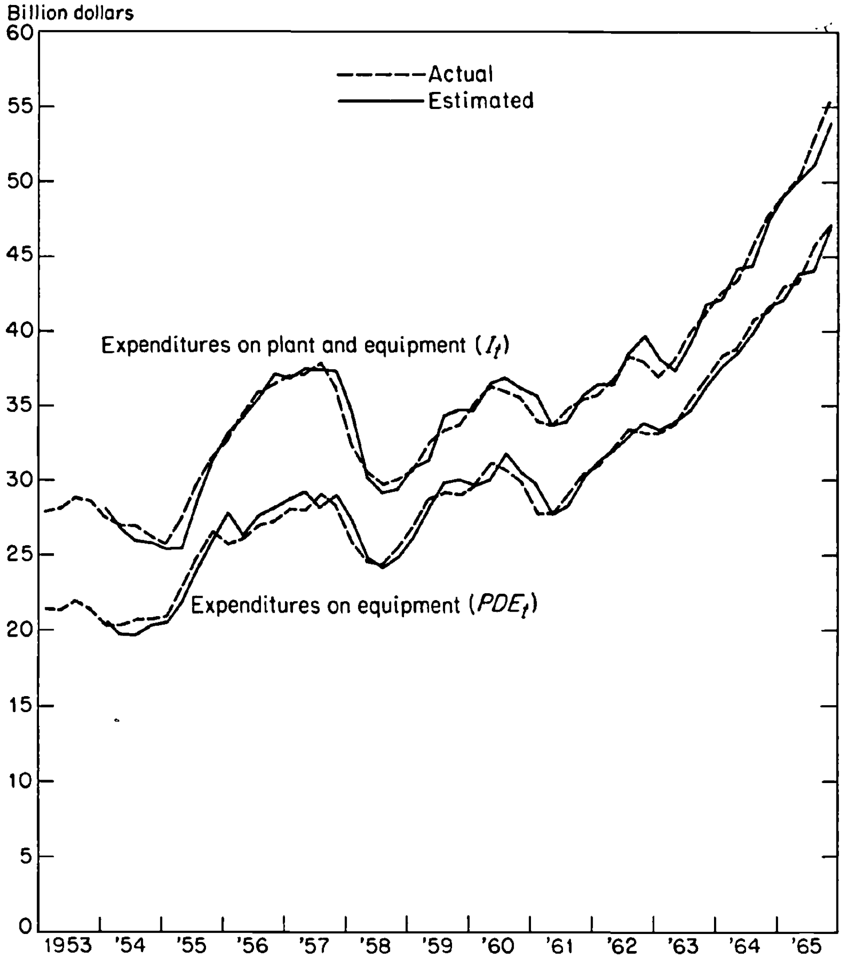
Additional Tests and Models

To test for possible misspecification of these models, it is desirable to include in the regressions additional lagged terms of the independent variable (compare note 29 and text in Chapter 5, above). This procedure also could conceivably result in improved estimates of the time structure of the investment process. Thus I_t was related stepwise to

Chart 9-7
Regression Estimates for Business Equipment Expenditures and Total Fixed Investment Outlays, Based on Second-Order Distributed Lags, Quarterly, 1953–65

$$(I_t)_{\text{est}} = .312 + .786(OC)_{t-2} + 1.291 I_{t-1} - .518 I_{t-2}$$

$$(PDE_t)_{\text{est}} = -.818 + .870(EO)_{t-1} + 1.026(PDE)_{t-1} - .235(PDE)_{t-2}$$



the terms of OC_{t-2}, OC_{t-3}, and OC_{t-4}, plus I_{t-1} and I_{t-2}, and similarly for the regressions that refer to the equipment and plant components of investment separately. In each case, then, three values of the commitments variable were included (for the lags j, $j+1$, and $j+2$), as well as two lagged values of the dependent variable. Corresponding forms are found in some recent empirical work on distributed-lag investment functions.[44] The possibility of comparing these estimates with the results of those studies was an additional motive for these experiments.

The tests refute the (a priori doubtful) hypothesis that capital outlays are simply a function of a single term in prior investment commitments with autocorrelated residuals. The addition of OC_{t-3}, for example, contributes little if anything to the regression of I_t on OC_{t-2} and I_{t-1}. However, multicollinearity presents a difficult problem for the equations considered here, as it probably does in other applications of models that include several lagged terms in both the independent and the dependent variables.[45] The coefficients of I_{t-1} retain values close to those listed in Table 9-3, but the coefficients of I_{t-2}, while still negative, tend to be considerably smaller and are not always significant by conventional standards. No gains at all result from adding the earlier values of investment commitments to the separate regressions for equipment and for plant; the coefficients of these terms are not significant.[46]

In equations (3) and (4) estimated in the preceding section, I_{t-1} is used as an explanatory variable and should be independent of u_t or of u'_t; but this desideratum may not be satisfied, since the assumed process makes I_{t-1} a weighted average of past disturbances. In one approach for dealing with this problem, the actual value of the lagged dependent variable is replaced (as in the section on "Instrumental Variables" in

[44] See Dale W. Jorgenson and James A. Stephenson, "The Time Structure of Investment Behavior in United States Manufacturing, 1947–1960," *Review of Economics and Statistics*, February 1967, pp. 16–27.

[45] In some cases, it is difficult to verify this supposition because the necessary information is lacking; for example, the Jorgenson-Stephenson article fails to list the standard errors of the regression coefficients presented there.

[46] To illustrate, the "best" of the equations of this type, that for total fixed investment using the reweighted commitments data, reads

$$\underset{(.858)}{(I_t)_{est} = .192} + \underset{(0.510)}{1.295(OC^r)_{t-2}} + \underset{(.571)}{.765(OC^r)_{t-3}} - \underset{(.594)}{.513(OC^r)_{t-4}} + \underset{(0.151)}{1.357I_{t-1}} - \underset{(.137)}{.553I_{t-2}},$$

and yields $\bar{R}^2 = .982$, $SE = .916$, and $d = 1.448$. The implied average lag is 3.3 quarters, the same as for the second-order model with one OC^r term only (see the tabulation on page 452, above).

Chapter 5) by an estimated value. In the present case, I_{t-1} estimated from past values of OC, as in Table 9-2, could be substituted for I_{t-1}. Accordingly, the regression

$$I_t = k^* + a^*(OC)_{t-j} + b^*I_{t-1} + c^*I_{t-2} + u_t^* \tag{4a}$$

was computed for total business capital outlays, with $j = 2$ and $I_t = 2.010(OC)_{t-2} + 1.304(OC)_{t-3}$, as in Table 9-2, line 2. Analogously, estimates from the equations shown on lines 8 and 11 of Table 9-2 were used to calculate regressions for PDE_t and Str_t, respectively.

The results thus obtained proved disappointing. The estimated coefficients of (4a), with their standard errors in brackets, are: $a^* = 1.994$ ($\pm$0.470); $b^* = 0.522$ ($\pm$0.306); and $c^* = -0.122$ ($\pm$0.218). It appears, therefore, that OC_{t-2} carries the brunt of such explanation as is offered here, since the effect of I_{t-1} is relatively weak and that of I_{t-2} insignificant. The fit ($\bar{R}^2 = .942$, $SE = 1.616$) is somewhat worse than in the regression of I_t on OC_{t-2} and OC_{t-3} (see Table 9-2, line 2). Apparently, the estimates I_{t-i} are not good enough for the role assigned them in equation (4a), even though they are certainly quite closely associated with the lagged values of the actual expenditures they replace (see Table 9-2, column 7). Corresponding calculations for equipment and for plant yield $\bar{R}^2$ coefficients that are somewhat higher than their counterparts in Table 9-2 but also significantly lower than those in Table 9-3. Such estimates of lag structure as can be derived from these equations are unsatisfactory.[47]

Another approach assumes a specific form of serial dependence among the disturbances, such as the simplest autoregressive scheme $u_t = \rho u_{t-1} + t$. Applying this to the residuals u from the regression $I_t = a + b(OC)_{t-2} + c(OC)_{t-3} + u_t$ (Table 9-2, line 2), ρ is estimated to be .6924. The relation between the transformed variables (compare equation 21 in Chapter 5) is

$$I_t - \rho I_{t-1} = a(1-\rho) + b[OC_{t-2} - \rho(OC)_{t-3}] \\ + c[OC_{t-3} - \rho(OC)_{t-4}] + \epsilon_t, \tag{5}$$

and the least-square estimates for this equation (with standard errors) are: $a(1-\rho) = -0.597$ ($\pm$0.738); $b = 1.900$ ($\pm$0.225); and $c = 1.816$

[47] The coefficients of the lagged values of estimated expenditures are low, and calculations based on them result in implausibly short average lags [e.g., little more than three quarters for the equation (4a)].

($\pm$0.223). Considering the usual effects of a transition from levels to differences, the correlation obtained is quite good ($\bar{R}^2 = .871$). The Durbin-Watson statistic is 1.394, a sharp increase from the value observed for the level regression ($d = 0.421$ in Table 9-2, line 2). The equation implies positive coefficients for OC_{t-2} and OC_{t-3}, and an average lag of about 5.2 quarters.

Chart 9-8 compares the estimates of business fixed-investment expenditures based on regression (5) with actual expenditures. The fit is very close indeed in the period from 1955 through the first half of 1958 and in the years 1963–65. The deviations of the estimates from the actual values are occasionally larger in the intervening period 1958–62, but even here the fit is on the whole good. The timing of estimated expenditures coincides with that of actual expenditures at most of the recorded turns: the peaks in 1957 and the troughs in 1958, 1961, and 1963. The behavior of I_t in the vicinity of its peak in the second quarter of 1960 is not well reproduced in the estimates, which were somewhat too low at the time but too high in the preceding and subsequent intervals, that is, in IV-1959 and IV-1960 and I-1961. There is also a one-quarter lag of $(I)_{\text{est}}$ behind I at the minor peak of I in 1962.

Comparisons with Other Estimates

Kareken and Solow estimate by least squares the equation

$$B_t = -7.330 + \underset{(.040)}{.314}N_t + \underset{(.009)}{.955}B_{t-1}; \qquad R^2 = .9927 \qquad \text{(KS)}$$

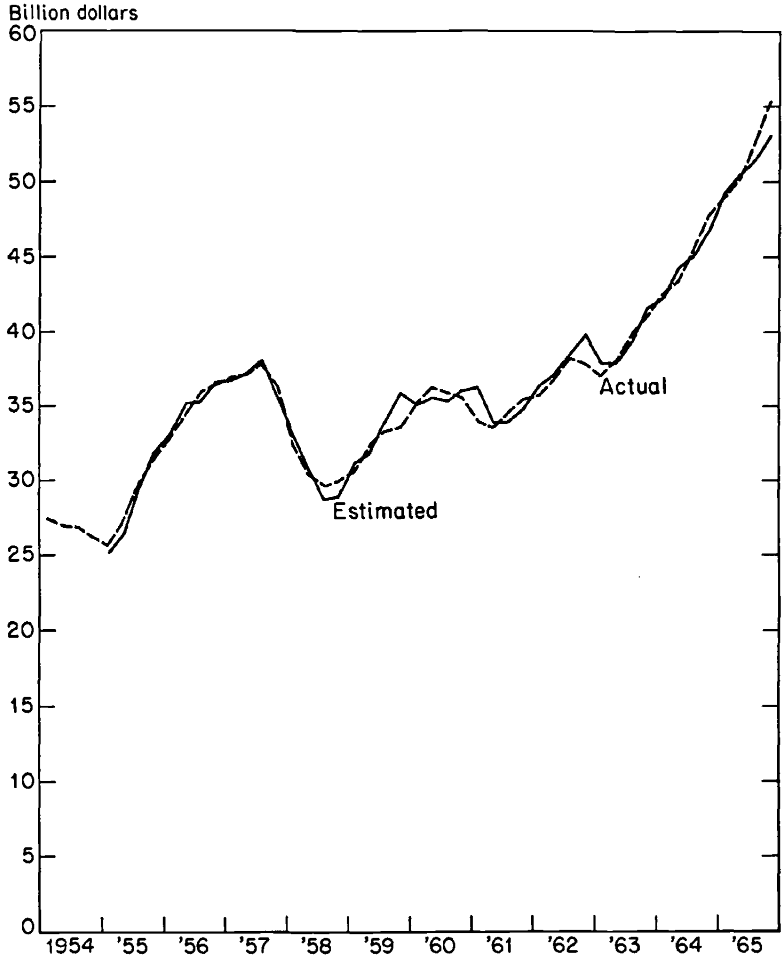
where B_t is the FRB index of production of business equipment (1957 = 100) and N_t is the OBE series on new orders for nonelectrical machinery, deflated by the BLS index of wholesale prices for machinery and motive products (1947–49 = 100). Both series are monthly and seasonally adjusted and cover the period from April 1947 to April 1960.[48]

To approximate the period covered by Kareken and Solow, their results are compared with a similar distributed-lag regression based on estimated fixed-investment commitments and outlays of business

[48] See John Kareken and Robert M. Solow, "Lags in Fiscal and Monetary Policy," Research Study One for the Commission on Money and Banking, in Albert Ando et al., *Stabilization Policies*, Englewood Cliffs, N.J., 1963, Part I, pp. 25–30.

Chart 9-8
Regression Estimates for Business Total Fixed Investment Outlays, Based on Transformed Variables, Quarterly, 1954–65

$$(I_t)_{\text{est}} = -.597 + 1.900[OC_{t-2} - .692(OC)_{t-3}] + 1.816[OC_{t-3} - .692(OC)_{t-4}] + .692I_{t-1}$$



in 1949–61. Here the older data on orders must be used, which alone are available before 1953 (as in the simple regressions of Table 9-1). My Koyck-type equation is

$$I_t = \underset{(0.828)}{2.452} + \underset{(.101)}{.422}OC_{t-2} + \underset{(.058)}{.738}I_{t-1};\ R^2 = .964;\ SE = 1.03 \qquad \text{(Z)}$$

Using the symbols a for the first and b for the second of the slope coefficients, let us compute for each of these two regressions:

$$q = \frac{a(1-b^n)}{1-b} \Big/ \frac{a}{1-b} = 1 - b^n \text{ or } n = \frac{\log(1-q)}{\log b}.$$

It will be recalled from Chapters 5 and 7 that q is the proportion of the "total effect" $[a/(1-b)]$ accounted for by an interval of n unit periods.

For five selected proportions, ranging from 30 to 90 per cent of the total response of investment expenditures to a unit change in commitments, the resulting lag distributions are as follows:

	Value of q				
n	0.3	0.5	0.7	0.8	0.9
For (KS)	2.6	5.0	8.7	11.6	16.7
For (Z)	2.2	4.3	6.0	7.3	9.6

These figures suggest a slower reaction for the Kareken-Solow equation than for my equation involving I and OC. In the first year, no significant difference appears: for $n = 4$, $q = .425$ in the former case and $q = .455$ in the latter (where allowance is made for the initial two-quarter lead of OC relative to I). But widening discrepancies can be observed in comparing the times required to absorb more than 50 per cent of the total response.

The meaning of such comparisons is, to be sure, rather uncertain, if only because the different explorations use very different data. There are, for example, these four sources of discrepancies between my results and those of Kareken-Solow: (1) their use of output rather than expenditures; (2) their use of the equipment component only, excluding plant; (3) their use of nonelectrical machinery orders only, rather than a more comprehensive orders aggregate; and (4) their reliance on series in "real" terms. General knowledge of the data suggests that (2) and

(3) are the most important of these sources, while (4) makes probably less of a difference and (1) perhaps still less. The *OC* series or rather its orders component should, despite its weakness, be definitely preferable to *N*. It is a much more comprehensive indicator of investment orders and therefore more suitable for use in connection with investment realization for equipment, whether the latter are measured by output or expenditures.

Kareken and Solow also estimated some distributed-lag relationships of a higher order by including additional lagged values of the dependent variable (B_{t-2} and B_{t-3}) in the regressions of B_t on N_t and B_{t-1}. This leads from the geometrically declining to unimodal lag distributions. The resulting lag structures are more concentrated; e.g., within the span of five quarters, one half of the total response is accounted for when only one lagged term is used, but with two terms the proportion rises to 56 per cent, and with three terms to 65 per cent. Shifts in the same direction are implied by my estimates in Table 9-3.

The relation between new capital appropriations and investment expenditures has recently been estimated for total manufacturing and seventeen subdivisions by Shirley Almon.[49] This study, based on the NICB large-company data for 1953–61, presents a new method of estimating distributed lags that employs polynomial interpolations between a few points obtained from regressions. Almon selects an eight-quarter lag distribution for "all manufacturing" as yielding the best fit and the most stable weights. The proportions of appropriations spent, according to this model, are 15 per cent within the first half year, 45 per cent in a year, 77 per cent during the first six quarters, and 92 per cent by the end of two years. The distribution is roughly symmetric, with the half-way point in spending being reached just after the fourth quarter.

The geometric and second-order models used previously yield, of course, highly skewed lag distributions that tail off slowly in an asymptotic fashion in the direction of long lags; this is quite unlike Almon's diversified but in general much more symmetrical patterns, with finite numbers of periods (mostly seven to nine quarters) in each distribution. The choice of the model of the lag distribution usually has to be made on empirical rather than theoretical grounds, and the statistical results

[49] "The Distributed Lag Between Capital Appropriations and Expenditures," *Econometrica*, January 1965, pp. 178–96.

as well as criteria are far from clear-cut. Hence, in practice, lag structures are commonly estimated by some more or less arbitrary and intuitive procedures, used partly because of computational convenience. Relatively small differences in the calculated regression coefficients can result in large differences between the associated lag patterns.[50] Consequently, it is very difficult to establish such patterns with any substantial precision. The more modest objective of estimating the average and perhaps also the variance of a lag distribution has a much greater chance of being reasonably well attained. Different models that inevitably yield very divergent lag patterns may well be in essential agreement on the length of the average lag. Thus the average lags of three to five quarters reported for the investment functions in the two preceding sections are approximately consistent with the average lag of somewhat more than four quarters that is implied by the all-manufacturing equation of Almon.[51]

Other equations for investment in plant and equipment that were examined employ "causal" variables, such as sales, profits, capital stock, and interest rates, either alone or in combination with "symptomatic" variables, such as appropriations, commitments, and anticipations. The lag patterns suggested by such functions are discussed and compared in the next chapter.

Summary

Series on new investment commitments—capital appropriations, orders, and contracts—reflect the change in the demand for services of capital goods that is embodied in the "investment decision." On the other hand, business expenditures on plant and equipment are typically concentrated in later stages of the investment process and also depend on the developments on the supply side—along with production, deliveries, and installations. A hypothesis that assigns to investment the major causal role in business cycles does not require that capital outlays lead aggregate production and income (actually, they tend to lag), but it presumably does require, among other conditions, that investment commitments lead, which they do.

[50] See Zvi Griliches, "Distributed Lags: A Survey," *Econometrica*, January 1967, pp. 29–31.

[51] If the contracting stage is thought of as following upon the appropriations stage, the lags using appropriations ought to be the longer ones, but the differences on this account may not be large (also, orders may sometimes precede appropriations).

Estimates of aggregate investment commitments can be obtained by adding the value of new orders received by industries mainly producing machinery and equipment to the value of new contracts for industrial and commercial construction. The resulting series (OC) has various shortcomings—most particularly, its equipment component is too large relative to its plant component—but this appears to affect chiefly the level of, not the relative changes in, these data. The time-path of business capital expenditures (I) resembles the course of new investment orders and contracts, but the fluctuations in I lag behind those in OC and have smaller percentage amplitudes. Most of the lags recorded at the cyclical turning points in these series are two- or three-quarter lags.

New capital appropriations of large manufacturing corporations (App) are roughly coincident with OC. The highest simple correlations with I are observed when App is taken with a lead of three quarters relative to I ($r = .89$) and when OC is taken with a lead of two quarters ($r = .94$).

The so-called first anticipations of plant and equipment expenditures (A_1) show a higher correlation with actual expenditures (I) than any other investment indicator. The close association between the two series is not surprising, since they have the same source and coverage and, importantly, since A_1 predicts I in the next quarter, that is, with a very short lead. Investment products typically take more time to gestate; consequently, the quarterly anticipations express not planned but expected expenditures. In other words, at this late stage, outlays are already largely known from previous commitments; remaining to be "anticipated" is how they will be allocated between the current and next quarters and the further future. The commitments series OC and App, when taken with subscripts $(t-3)$, have effective forecasting leads relative to I_t that are much longer than the lead of A_1. These series can give early signals of turning points in expenditures, while anticipations can only give current recognition of these turning points.

The estimates of business capital outlays improve when distributed lags are used. For example, when I_t is regressed on OC_{t-2} and OC_{t-3}, the calculated series coincides with the actual one at turning points and, on the whole, the observed discrepancies are not large. Autocorrelated disturbances present a problem, but this can be handled rather well by using modified first differences of the variables. Higher correlations are obtained with equations that include, in addition to the selected terms in earlier commitments, the previous values of the dependent variable, i.e., of expenditures. However, although the residual errors are then on the whole very small, they contain systematic elements, as manifested in short lags of the estimates at several turning points.

The distributed-lag regressions suggest that the average lags of *I* behind *OC* vary between three and five quarters. At least half of the expenditures are made within one year after commitment; two-thirds or more, within the first six quarters. There are some indications supporting the hypothesis that the lags vary directly with the degree of capacity utilization in the capital-goods-producing industries. Thus when the coefficients in the equation for expenditures on equipment are assumed to depend on the backlog-shipments ratio for equipment manufacturers, rises (falls) in that ratio produce relatively large increases (decreases) in the estimated lag of expenditures.