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How Credible are Capital Spending Surveys as Forecasts?

by Gerald H. Anderson and John J. Erceg

Business analysts should be aware that the survey of capital spending plans published by the U.S. Department of Commerce has several limitations as a forecast of quarterly and annual fixed investment. Although the annual expectations are relatively reliable, the quarterly spending projections are often less accurate than other inexpensive and equally accessible forecasts. This *Economic Commentary* compares the reliability of the Commerce Department survey with that of several alternative forecasts, and suggests some underlying reasons for the discrepancies between the survey's projections and actual capital expenditures.

Capital spending is one of the most volatile sectors of the U.S. economy, typically accounting for one of the largest shares of the variation in GNP. Business analysts, who often use capital spending surveys to generate fixed-investment forecasts, commonly rely on the one prepared by the U.S. Department of Commerce. That survey's July-August data show that businesses plan to increase their capital spending in 1990 by 5.4 percent from last year's level, implying that this sector of the economy will likely contribute only half as much to the growth rate of GNP this year as it did in 1989.[1]

How reliable are these results? This *Economic Commentary* evaluates not only the accuracy of the Commerce Department's capital spending survey, but its usefulness in forecasting business investment.

■ The Commerce Department Surveys: An Overview

In addition to being one of the most widely used capital spending surveys, the Commerce Department survey is also one of the oldest.[2] Initiated in 1947, it reports actual and anticipated U.S. plant and equipment (P&E) expenditures five times for a given year. Surveys are taken quarterly, and about 5,000 businesses generally respond.[3] The survey's coverage (that is, the proportion of an industry's output represented by the firms surveyed) varies widely, ranging from 99 percent for nonferrous metals manufacturing to 12 percent for personal and business services.

The initial survey for a particular year, taken in October and November and published in December of the preceding year, includes planned expenditures for the first and second quarters and also for the full year. Second-half projections are easily derived by subtracting first-half spending from the annual data. The figures are then revised by a survey taken in January and February and published in April. However, it is not until results are in from a third survey, taken in April and May and published in June, that spending predictions for each of the four quarters are published. Surveys taken in July and August (published in September) and in October and November (published in December) update both actual and anticipated expenditures for the year.

Actual and planned expenditures are reported to the Commerce Department in nominal dollars. The planned figure is only the survey respondent's best estimate of what course a firm's future P&E spending will take. Actual spending, however, can deviate from the initial estimates for various reasons. For

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example, a firm's board of directors might appropriate a different amount or alter its previous appropriation because of a change in business conditions or in capital stock needs. Variations can also result from a company's inability to arrange financing, or because the terms of financing are not as expected. Furthermore, the timing of expenditures is dependent upon the ability of the capital goods vendor to deliver on schedule.

In addition to publishing the data in nominal dollars, the Commerce Department also reports real anticipated expenditures, which it calculates using implicit price deflators extrapolated from actual price changes over the latest four-quarter period.[4] Survey data are also adjusted for reporting biases; that is, for consistent differences between some companies' reports of planned and actual spending. Quarterly levels are published in seasonally adjusted annual rates.

■ Anticipating Annual Changes

How accurate are the initial surveys, and how have the succeeding four surveys fared in terms of anticipating the magnitude of spending changes for the coming year? Since 1970, the initial annual survey has had a mixed record. However, accuracy tends to improve substantially by the time the third survey is taken in April and May.

The average absolute difference between the percent change in spending indicated by the initial survey and the actual change was 2.9 percentage points between 1970 and 1989 (table 1), or nearly 40 percent of the 7.5 percent average annual change in actual P&E spending. Moreover, there is considerable variation around that 2.9 percent average. In 10 of the 20 years between 1970 and 1989, the initial survey anticipated spending changes within 2.1 percentage points of the actual yearly change, while in the remaining years the difference ranged between 3 percentage points and 9 percentage points.

One way to evaluate the survey's reliability is to compare its errors with those of some inexpensive alternative forecasts. Two such alternatives rely solely on past capital spending data: the "naive" forecast, which assumes that each year will mirror the preceding one, and the Autoregressive Integrated Moving Average (ARIMA) forecast, which is generated by a process involving all past data in the series.[5] Both approaches are relatively inexpensive to develop because they rely on readily available information and do not require a theoretical model of investment determinants. Of the three forecasts, errors in the capital spending survey are the smallest. For the 1970-89 period, the average absolute error of the initial capital spending surveys was 2.9 percentage points (as previously noted), while the respective figures for the naive and the ARIMA forecasts were 6.2 and 5.9 percentage points.[6]

TABLE 1 ACTUAL VS. EXPECTED ANNUAL P&E SPENDING

	P&E Spending[a]		Absolute Error[b]		
Year	Actual Data	Initial Survey	Initial Survey	Naive Forecast	ARIMA Forecast
1970	5.5	9.3	3.8	6.0	6.2
1971	1.9	1.4	0.5	3.6	1.5
1972	8.9	9.1	0.2	7.0	8.2
1973	12.8	12.9	0.1	3.9	1.8
1974	12.7	12.0	0.7	0.1	13.9
1975	0.3	4.6	4.3	12.4	4.3
1976	6.8	5.5	1.3	6.5	5.0
1977	12.7	11.3	1.4	5.9	3.5
1978	13.3	10.1	3.2	0.6	8.9
1979	17.0	11.2	5.8	3.7	11.4
1980	9.3	10.9	1.6	7.7	4.9
1981	8.7	10.8	2.1	0.6	3.5
1982	-1.6	7.4	9.0	10.3	8.8
1983	-4.8	-1.3	3.5	3.2	11.3
1984	16.3	9.9	6.4	21.1	5.0
1985	9.2	8.2	1.0	7.1	2.3
1986	-2.0	2.4	4.4	11.2	8.7
1987	2.4	0.9	1.5	4.4	6.7
1988	10.3	7.3	3.0	8.1	1.0
1989	10.4	6.0	4.4	0.1	0.2
Average absolute error (1970-89)			2.9	6.2	5.9

a. Percent change from previous year.
b. In percentage points.
NOTE: Underlying data are in nominal dollars.
SOURCES: U.S. Department of Commerce, and authors' calculations.

TABLE 2 ANNUAL P&E SPENDING

For Spending in:	Error[a] of Survey Taken in: Oct.–Nov.	Jan.–March	April–May	July–Aug.	Oct.–Nov.
1970	3.8	4.3	2.3	1.1	1.1
1971	-0.5	2.4	0.8	0.3	0.3
1972	0.2	1.6	1.4	0.8	0.1
1973	0.1	1.0	0.4	0.4	0.4
1974	-0.7	0.3	-0.5	-0.2	-0.5
1975	4.3	3.0	1.3	0.7	0.7
1976	-1.3	-0.3	0.5	0.6	0.7
1977	-1.4	-1.0	-0.4	0.6	1.0
1978	-3.2	-2.4	-2.1	-1.0	-0.6
1979	-5.8	-5.7	-4.3	-3.8	-2.3
1980	1.6	2.7	0.5	-0.7	-0.5
1981	2.1	1.5	-0.3	0.1	0.4
1982	9.0	8.9	3.8	2.3	1.1
1983	3.5	3.1	1.4	1.7	0.6
1984	-6.4	-2.3	-1.5	-2.0	-2.0
1985	-1.0	-0.5	0.0	-0.9	-0.8
1986	4.4	4.3	2.2	0.1	0.3
1987	-1.5	0.6	0.1	0.1	0.5
1988	-3.0	-1.5	0.4	0.3	0.1
1989	-4.4	-1.3	-0.5	-0.4	-0.1
	Average Absolute Error				
1970-89	2.9	2.4	1.2	0.9	0.7
1970-79	2.1	2.2	1.4	1.0	0.8
1980-89	3.7	2.7	1.1	0.9	0.6

a. Planned percent increase less actual percent increase.
NOTE: Underlying data are in nominal dollars.
SOURCES: U.S. Department of Commerce, and authors' calculations.

TABLE 3 SUMMARY OF FORECAST ERRORS
(Average absolute percentage points)

Forecast of:	Results of: P&E Survey	Naive Forecast	ARIMA Forecast
Annual change, 1970-89			
P&E spending	2.9	6.2	5.9
NRFI	4.3	7.7	6.7[a]
Quarterly change, 1979:IQ-1989:IVQ			
P&E spending	2.1	2.1	1.7
NRFI	2.2	2.4	2.2

a. Twenty-year moving average.
SOURCE: Authors' calculations.

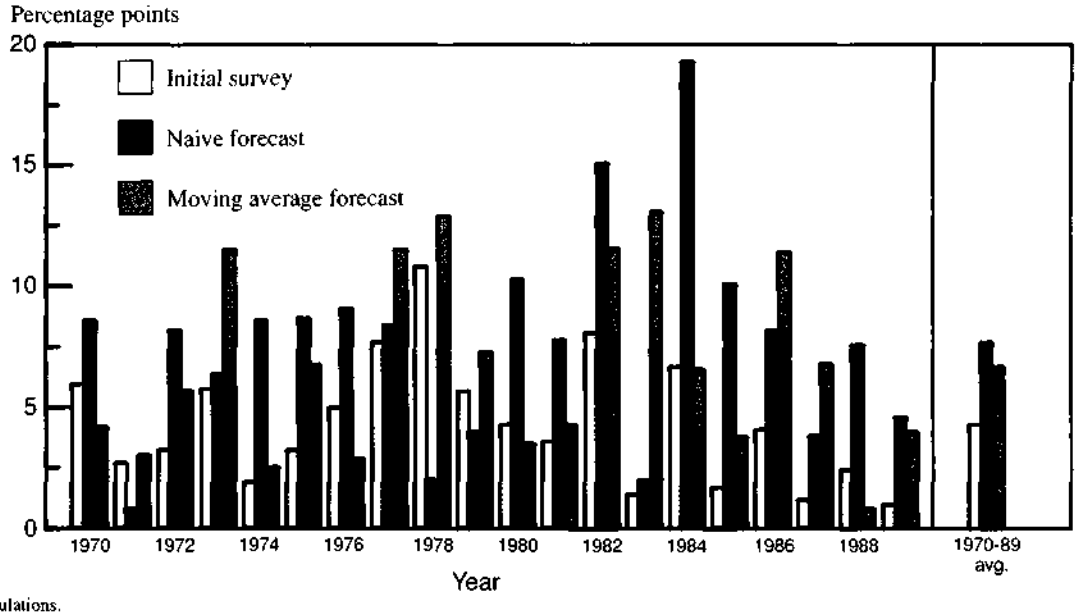
The second survey (January-March) improves only slightly upon the first (reducing the average error to 2.4 percentage points), even though respondents generally alter their spending projections to reflect changing perceptions of the investment outlook (table 2). Succeeding surveys show considerable improvement, however. Measured in percentage points, the error is reduced to 1.2 by the third survey (April-May), 0.9 by the fourth survey (July-August), and 0.7 by the fifth survey (October-November).

In using the Commerce Department data, business analysts should take into account that the results have tended to overestimate the strength of capital spending during recessions and to underestimate its strength during expansions. In the recession years of 1970 and 1982, the initial surveys overshot actual annual spending by 3.8 percentage points and 9.0 percentage points, respectively (table 2), while they underestimated the strength of capital spending in four of the five years of the 1975-79 expansion and in five of the first seven years of the expansion that began in 1982. Only during the 1971-73 upturn did the survey avoid substantial underestimation. For those three years, the average error was less than 4 percent of the average annual change in P&E spending.

One final point must be made about the initial annual capital spending surveys: The differences between actual and anticipated changes appear to be increasing. In the 1970s, the average annual difference was 2.1 percentage points. In the 1980s, that figure rose to 3.7 percentage points, even though the average of the actual changes was greater in the earlier decade.

How can the larger errors of the 1980s be explained? A major source of forecast errors may be that after a survey is made, changes occur in the perceived after-tax profitability of potential investments. In both the 1970s and the 1980s, oil price shocks, recessions, episodes of unanticipated inflation and disinflation, and changes in tax laws all affected the

FIGURE 1 FORECASTS OF NONRESIDENTIAL FIXED INVESTMENT
(Absolute errors)



SOURCE: Authors' calculations.

investment outlook. However, unlike the tax changes of the 1970s, which were designed to stimulate overall demand, many of the tax laws passed in the 1980s were designed as fixed-investment incentives. (Incentives were increased by 1981 legislation and then reduced by 1982 and 1986 legislation.) These differences may explain why the annual changes in actual investment had a greater standard deviation during the 1980s, even though the average annual change was smaller then. During the processes of debating, enacting, interpreting, and discovering loopholes in such tax changes, views about the profitability of new capital spending can ebb and flow, causing substantial modifications in plans and, therefore, larger forecast errors.

Another major problem in economic forecasting is anticipating turning points; that is, the dates when an economic series reaches its peak and trough. During the last 20 years, capital spending changed direction four times (1982, 1984, 1986, and 1987). The survey correctly anticipated the upturns of 1984 and 1987, but failed to predict the downturns of 1982 and 1986 (table 1).

■ Anticipating Quarterly Changes

A few characteristics of the quarterly surveys should be noted. First, the initial surveys were front-loaded during most of the 1980s; that is, they anticipated level or higher capital spending for the first half of the year, followed by implied decreases during the second half. However, *in every case*, actual spending during the last six months turned out to be greater than first-half spending. This characteristic appears to be a reporting bias for which the Commerce Department has not made a correction.

Since 1985, the absolute difference between the initial survey of anticipated first-quarter capital spending and actual spending has averaged 3.5 percentage points. (The initial survey for 1986:IQ overstated the final figure by 10.4 percentage points.) As might be expected, each succeeding survey becomes more accurate because, as time passes, firms gain additional information about their sales prospects, their profits, and their need to replace or add to capital stock. However, the second survey, taken during the first quarter, still has an average absolute error of 2.6 percentage points. Even the third survey, taken in April and May, has an average absolute error of 0.6 percentage point. Similar patterns of inaccuracy can be found in the anticipations for other quarters.

In contrast to the surveys of expected *annual* changes in P&E spending, the *quarterly* surveys do not fare quite as well when compared to the naive and ARIMA forecasts. Over the last 44 quarters, forecasts of the growth rate of P&E expenditures for the coming quarter, based on the latest survey prior to the quarter in question, had an average absolute error of 2.1 percentage points. Naive forecasts also had an average absolute error of 2.1 percentage points, while the corresponding figure for the ARIMA forecasts was 1.7 percentage points. Thus, taken alone, the Commerce Department survey of quarterly P&E spending changes seems to be no better than the naive forecasts and is less reliable than the ARIMA forecasts.

■ Forecasting NRFI

Analysts often use the latest P&E spending survey to forecast the business fixed-investment sector of GNP. Nonresidential fixed investment (NRFI) consists of producers' durable equipment

and business structures. Businesses make fixed investments as they seek to bring their capital stock in line with some desired level. The amount of investment needed to make the adjustment varies greatly from one year to the next, which in turn contributes to wide swings in NRFI and in overall economic output (even though fixed investment accounts for only about 11 percent to 12 percent of GNP).

P&E spending and NRFI differ in at least two major respects, and therefore exhibit different quarterly and annual percentage changes. First, NRFI is a broader series, including industries such as farming, real estate, and professional services.[7] Second, NRFI is based on construction put in place (structures) and manufacturers' shipments of equipment (producers' durable equipment), whereas P&E data are based on expenditures, which generally occur later. Therefore, differences exist in the timing of the two broad series. In addition, NRFI is organized by type of investment, while P&E survey data are organized by industry.

Despite their differences, the two investment series track reasonably well over the long term. Nevertheless, the *annual* percent changes in actual NRFI and P&E spending have differed by an average of 2.1 percentage points over the last two decades. Moreover, the absolute difference in the quarterly percent changes has averaged 1.4 percentage points over the past 11 years.

Because of the differences between 1) the initial and the actual yearly P&E spending figures and 2) actual P&E spending and actual NRFI, the initial P&E survey is not a very accurate forecast of the forthcoming *annual* change in NRFI: The absolute error has averaged 4.3 percentage points over the last 20 years. Nevertheless, this is significantly less than the 7.7 percentage points error of a naive forecast and the 6.7 percentage points error of a moving average forecast that expects growth in a given year to equal the average of the preceding 20 years (see figure 1).[8]

The same cannot be said for the *quarterly* surveys of P&E spending as predictors of quarterly changes in NRFI. Those surveys are little better than the naive forecasts and no better than the ARIMA forecasts. Over the last 44 quarters, predictions of the coming quarter's NRFI growth rate based on the latest P&E spending survey had an average absolute error of 2.2 percentage points, while the respective figures for the naive and ARIMA forecasts were 2.4 and 2.2 percentage points (table 3).

■ Conclusion

Although the Commerce Department survey is often used as a forecast of capital spending, business analysts should be aware that its record for accuracy is mixed.

The annual survey is a more reliable predictor of P&E spending and NRFI than the naive and ARIMA forecasts. However, the survey's errors were greater in the 1980s than in the 1970s, and two of the four changes in the direction of annual capital spending went undetected.

Taken alone, the quarterly survey appears to be of little value as a forecast, not only because the differences between anticipated and actual spending have been large (at least until the fourth survey for a quarter), but because the reports have been front-loaded in recent years. Quarterly forecasts of equal or greater accuracy for both P&E spending and NRFI can be obtained with naive and ARIMA data.

■ Footnotes

1. Survey respondents report anticipated spending in current dollars only. The U.S. Department of Commerce estimates constant-dollar projections using these current-dollar figures and recent rates of price increase, then publishes capital spending anticipations in both current and constant dollars. Results reported here are based on the survey's current-dollar calculations and do not necessarily apply to the constant-dollar projections.

2. Commerce Department survey data are published in *Plant and Equipment Expenditures and Plans*. Two other surveys are the *McGraw-Hill Annual Survey of Preliminary Plans for New Plants and Equipment*, and the *Conference Board Survey of Newly Approved Capital Appropriations*. Responsibility for the Commerce Department survey was transferred in 1988 from the Bureau of Economic Analysis to the Bureau of the Census (both of which are in the U.S. Department of Commerce).

3. Until recently, the sample included about 12,000 businesses, with another 9,000 included in industries surveyed only annually, such as real estate, professional services, and forestry, fisheries, and agricultural services.

4. Price-adjusted, or real, data have been reported for each industry, but as of June 1990, the only real figure included is the all-industries total.

5. The naive forecasts of annual changes assume that capital spending will change in the coming year by the same percentage as in the year just ended. The naive forecasts of quarterly changes assume that capital spending will change in the coming quarter by the same percentage as in the period two quarters earlier, which would be the most recent quarter that has a growth rate known with reasonable certainty. ARIMA is a method of generating forecasts for a time series from the historical data for that series.

6. Comparisons of the root mean square errors of the forecasts lead to the same conclusions, here and throughout this study, as those reached using average absolute errors.

7. Although some of these industries are surveyed annually, their reports have been excluded from most of the P&E spending figures. In recent years, P&E expenditures have been about 85 percent of NRFI, but that figure increases to about 95 percent if the annually surveyed industries are included.

8. Actual changes in NRFI appear to be random about their average, and no forecast could be generated using the ARIMA process.

Gerald H. Anderson is an economic advisor and John J. Erceg is an assistant vice president and economist at the Federal Reserve Bank of Cleveland. *The authors would like to thank Michael Bryan and Randall Eberts for helpful comments on earlier drafts of this article, Theodore Bernard for valuable research assistance, and Michael Bagshaw for statistical consulting.*

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Federal Reserve Bank of Cleveland
Research Department
P.O. Box 6387
Cleveland, OH 44101

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