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Equipment Expenditures since 1995: The Boom and the Bust

Jonathan McCarthy

Business investment in equipment surged in the 1990s, then fell back sharply after mid-2000. A popular explanation of these trends holds that the soaring stock market and declining computer prices of the last decade encouraged excess investment, setting the stage for the retrenchment that followed. Yet an analysis of the factors underlying investment suggests that capital spending patterns in the late 1990s would have been quite similar had stock values and equipment prices remained near their recent historical averages.

One pillar of the late 1990s expansion was the strength of business investment in equipment and software. This category of expenditures captures firms' purchases of computers and other high-tech equipment as well as purchases of more traditional forms of machinery such as industrial and construction equipment, aircraft, and trucks. Although business investment spending accounts for less than 10 percent of U.S. GDP—a far smaller share than that claimed by consumer spending—the rapid growth of these expenditures provided an unusually strong stimulus to GDP growth in the second half of the last decade. Indeed, capital spending is widely regarded as a key contributor to the productivity gains that enabled the economy to grow strongly with little inflation during this period.¹

Now, with the slowdown in the economy, expenditures on equipment and software have fallen dramatically. Predictably perhaps, this reversal has given rise to the view that businesses, responding to a strong stock market and rapidly declining prices in many high-tech capital goods, *overinvested* in these goods in the 1990s. Proponents of this view suggest that the resulting glut of high-tech products has prompted firms to cut back sharply on investment—a move that, over time, could lead to significantly lower output and productivity growth.

In this edition of *Current Issues*, we investigate the recent behavior of equipment expenditures with an eye toward evaluating this view of investment trends. We begin by tracking the growth of the components of equipment spending to determine whether high-tech expenditures have in fact dominated the investment boom and bust. Our analysis suggests that while the capital spending surge of the late 1990s was concentrated in the high-tech sector, the decline in equipment expenditures since mid-2000 has been broad based, affecting investment in transportation equipment and other conventional machinery as well as purchases of computers and software.

In the remainder of the article, we develop an empirical forecasting model to explain the changes in business investment behavior over 1995-2001. The model results suggest that the standard economic determinants of investment can account for most of the boom in the late 1990s but not the steep drop-off in 2000-01. We then use our model to test the notion that a robust stock market and declining equipment prices led businesses to overinvest during the last decade. Significantly, we find that investment would probably have been strong in the late 1990s even if stock values and relative equipment prices had followed paths near their recent historical averages.

Although we do uncover evidence that the stock market decline has contributed to the investment bust, its effect appears modest relative to the severity of the slowdown.

Equipment and Software Expenditures since 1995

Real expenditures on equipment and software boomed during the late 1990s, growing more than 12 percent annually between 1995 and the second quarter of 2000 (Table 1, column 1). As one might expect, the boom was greatest for high-tech expenditures: information equipment increased at an annual rate of more than 20 percent during this period, and computers rose at a 45 percent rate. Spending on other components of equipment also rose markedly, but at single-digit rates.

Since the second quarter of 2000, however, equipment and software expenditures have declined precipitously (Table 1, column 2). As recent press reports suggest, much of the drop has been in high-tech equipment. After many years of very high growth, real computer and software expenditures have barely risen in the past year. Meanwhile, spending for information equipment excluding computers and software has fallen more than 10 percent, principally because of weakness in telecommunications equipment.

Significantly, however, more traditional forms of equipment have also shown sizable declines in their rates of growth. Although the slowdown in high-tech expenditures has captured most of the press attention, the retrenchment in spending has in fact been widespread. In particular, expenditures for transportation equipment have declined almost 13 percent, and spending on “other equipment”—a category that includes furniture and fixtures as well as machinery for agriculture, construction, mining, and the service industry—has fallen more than 4 percent.

Table 1
The Investment Boom and Decline

Annualized Growth Rate of Expenditures, in Percentage Points

Category	1995:Q1 - 2000:Q2	2000:Q3 - 2001:Q2	Change
Total equipment and software	12.37	-4.00	-16.37
Information equipment	20.32	-2.08	-22.39
Computers	45.11	1.69	-43.43
Software	17.30	3.76	-13.54
Other information equipment	10.33	-10.67	-21.00
Industrial equipment	4.76	1.43	-3.32
Transportation equipment	8.06	-12.80	-20.86
Other equipment	6.59	-4.23	-10.81
Memo: GDP growth (annualized percentage rate)	3.94	1.32	-2.62

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Note: Expenditures are measured in 1996 chain-weighted dollars.

Table 2
Equipment Expenditures' Contribution to GDP Growth

Average Annual Contribution, in Percentage Points

Category	1995:Q1- 2000:Q2	2000:Q3- 2001:Q2	Change	Share of Nominal GDP (Percent)
Total equipment and software	1.07	-0.38	-1.44	9.04
Information equipment	0.74	-0.08	-0.82	4.23
Computers	0.35	0.04	-0.32	0.88
Software	0.23	0.07	-0.16	1.84
Other information equipment	0.16	-0.18	-0.34	1.50
Industrial equipment	0.08	0.03	-0.05	1.65
Transportation equipment	0.15	-0.26	-0.41	1.73
Other equipment	0.10	-0.07	-0.16	1.45
Memo: GDP growth (annualized percentage rate)	3.94	1.32	-2.62	

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Note: The figures in the right-hand column (“Share of Nominal GDP”) are as of second-quarter 2001.

Paralleling the growth and subsequent cutback in equipment expenditures has been a strong shift in equipment expenditures' contribution to GDP growth. Although these expenditures make up less than 10 percent of GDP, they accounted for almost 1.1 percentage points of the growth in GDP from the first quarter of 1995 through the second quarter of 2000 (Table 2, column 1). Given that GDP growth during this period averaged a little under 4 percent, equipment expenditures' growth contribution far exceeded their share of GDP. Information equipment provided the largest boost to growth: its contribution was about $\frac{3}{4}$ percentage point (almost a one-fifth share), even though its share of nominal GDP is only about $\frac{1}{4}$ percent.

Since the middle of 2000, however, the contribution of equipment expenditures to GDP growth has turned negative (Table 2, column 2). Indeed, equipment investment accounts for more than one-half of the slowdown of GDP growth during this period (Table 2, column 3). Although computer and software expenditures continued to grow, information equipment contributed about 0.8 percentage point to the slowdown. Nevertheless, the more traditional, low-tech sectors account for almost as much of the slowdown as the high-tech sectors. For example, transportation equipment has contributed slightly more to the slowdown than has information equipment exclusive of computers and software.

Clearly, equipment and software expenditures have played a greater role in the economic expansion and slowdown of recent years than their share of GDP would seem to justify. For this reason, an examination of the factors underlying the behavior of equipment

expenditures is likely to shed significant light on recent economic fluctuations. In the next section, we consider some of these factors in detail.

What Drives Investment?

Standard economic theories and intuition point to three factors as determinants of business investment. One factor is GDP growth, whose role is straightforward. When GDP growth accelerates, firms desire to increase their capital stock to meet heightened demand, and investment consequently increases.² By this logic, the 1990s investment boom stems partly from the strong economic growth of the period.

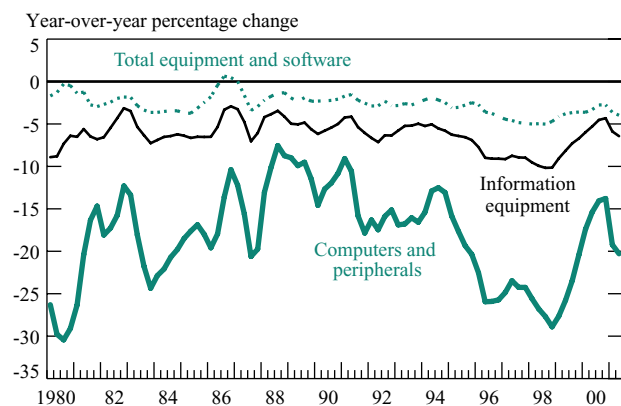
A second factor likely to drive investment is the rental cost of capital—that is, the cost of purchasing and holding investment goods.³ Rental costs will reflect not only depreciation and interest rates but also changes in the price of capital goods relative to other goods (relative price). When capital goods become less costly, firms will desire to hold more capital and thus will increase investment. In particular, holding all else constant, a decline in the relative price of investment goods should boost investment.

Of course, relative prices of investment goods did decrease during the 1990s, largely because of the drop in computer prices (Chart 1). Although the trend toward lower equipment prices has been evident since the early 1960s, relative prices fell particularly sharply during the investment boom of the late 1990s. The timing of this steep decline appears to support the view that relative prices figured importantly in the investment boom.

However, this story has a potential complication. If a price decline today leads firms to expect even greater price decreases in the future, then firms may delay current purchases of capital goods in order to take advantage of lower prices in the future. Essentially, the prospective price declines imply that buying and holding investment goods is costly, even though the current purchase price has declined. Such reasoning would prompt firms to reduce investment—a possibility that makes the effect of declining prices on investment more ambiguous than it initially appears.⁴

A third factor thought to influence investment is the market value of firms relative to their underlying capital assets (a factor typically designated by economists as q).⁵ When the stock market values firms and their future prospects highly, investments in physical assets such as capital goods are more profitable for firms than financial investments such as stock repurchases, mergers, and corporate takeovers. Consequently, holding all else constant, higher equity values should lead to greater investment in equipment and software. This relationship implies that the strong stock market during

Chart 1
Relative Price of Equipment and Software



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Note: The prices of investment goods are measured relative to the deflator for GDP of the nonfarm business sector.

the 1990s may have helped spur the investment boom in the second half of the decade.

Although theory and intuition alike suggest that rental costs and stock values are key determinants of investment, empirical studies have generally failed to bear out the importance of these factors. Studies relating investment to rental costs have shown only a modest effect from this variable, although some recent research suggests that relative prices—one component of rental costs—may have a larger impact.⁶ Similarly, estimates of q models typically do not find a strong effect on investment from this variable, probably in part because of problems constructing empirical counterparts to the unobserved theoretical q variable.⁷

Modeling Investment Growth: 1995-2001

To assess the influence of the factors outlined in the preceding section—GDP growth, rental costs, and equity values—on investment in 1995-2001, we incorporate all three in an empirical forecasting model more inclusive than the models typically used to analyze investment. Comparing the forecasts produced by this model with actual investment growth rates over the period reveals the extent to which these standard economic variables can explain the recent changes in investment growth.

In addition to the features just cited, our model assumes that previous investment behavior will affect current behavior. To account for such effects, we include “lagged”—or past—values of investment growth as explanatory variables.⁸ The model also allows for cash flow effects on investment, a factor considered important by many analysts.⁹ Finally, the model assumes that

investment adjusts so that the capital stock slowly approaches its desired level.¹⁰

We use the model to produce a series of one-step-ahead forecasts of the investment growth rate from the first quarter of 1995 through the second quarter of 2001. For each quarter, we estimate the model using data from 1960 through the end of the previous quarter (that is, the quarter immediately preceding the one that is the subject of our forecast). We then use the estimated model to generate the forecast of investment growth. For example, to predict investment growth in the first quarter of 1995, we estimate the model over a period beginning in 1960 and extending through the fourth quarter of 1994, then use the estimated model to arrive at the forecast.¹¹ By repeating this procedure for each subsequent quarter, we can project the course of investment growth from 1995 to 2001.

Comparing the forecasts with actual investment growth rates during the 1995-2001 period, we find that the model tracks investment growth fairly well through the end of 2000 (Chart 2). This result suggests that standard economic variables can, in fact, explain the strong investment growth during the mid-to-late 1990s. The model is also fairly successful in identifying the middle of 2000 as the period when equipment expenditures began to slow down.

What the model fails to do, however, is to capture the depth of the decline in investment spending and, in particular, the sharp drop in the first two quarters of 2001. Clearly, the historical relationship between investment and its economic determinants cannot account for the sustained decline since mid-2000. By including GDP

growth and stock values as explanatory variables, the model allows the recent general economic slowdown and the stock market tumble to influence investment. But despite the inclusion of these factors, the model predicts a slowdown much more moderate than the one that actually occurred.

Seeking an explanation for this puzzle, many observers have suggested that the seeds of the investment decline were planted in earlier years. One popular hypothesis along these lines is that the stock market boom and the rapid fall in equipment prices encouraged “too much” investment in the 1990s, paving the way for a sharp pullback in equipment expenditures when the expected strong demand did not materialize. In the next section, we examine this hypothesis in more detail.

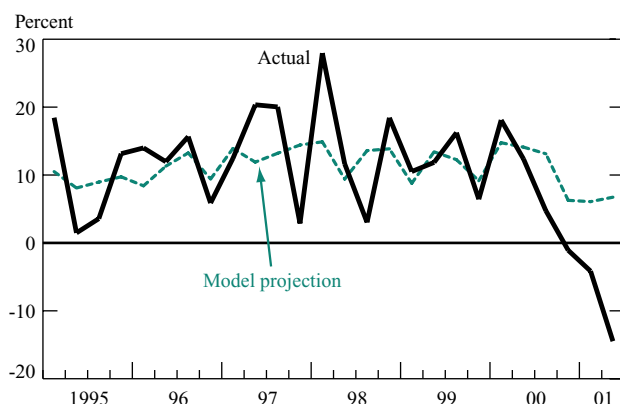
The Role of the Stock Market and Relative Prices

To determine whether the behavior of stock prices and equipment relative prices in the 1990s prompted the steep decline in investment, we can compare the model projection from the previous section with two counterfactual projections based on the same model. The first counterfactual assumes that equity values increase at a constant rate equal to their 1980-94 average. In this scenario, there is no stock market boom and bust and the equity value at the end of first-quarter 2001 is about 13 percent below the actual value. The second counterfactual assumes that the relative price of equipment and software decreases at a constant rate equal to its 1980-94 average. In this scenario, there is no period of especially rapid price decline.¹²

Comparing the stock market counterfactual projection with the base projection from the previous section, we see little difference until 2001 (Chart 3). The consistency of the two projections over the second half of the 1990s suggests that, given the behavior of the other variables in the model, equipment investment probably would have grown at double-digit rates during this period even if equity values increased at a rate near their historical average. Therefore, the stock market boom by itself is unlikely to have planted the seeds of a sharp retrenchment in capital spending by encouraging overinvestment in the 1990s.

Nevertheless, the fact that the counterfactual projection is noticeably above the base projection in 2001 suggests that the stock market decline over the past year has exacerbated the investment slowdown. Specifically, it appears that equipment expenditure growth would have been about 4 percentage points higher had stock values not dropped sharply. Still, the effect of the stock market decline on investment appears rather modest when we recall that equipment expenditure growth has fallen more than 16 percentage points from its average over the 1995-2000 period.

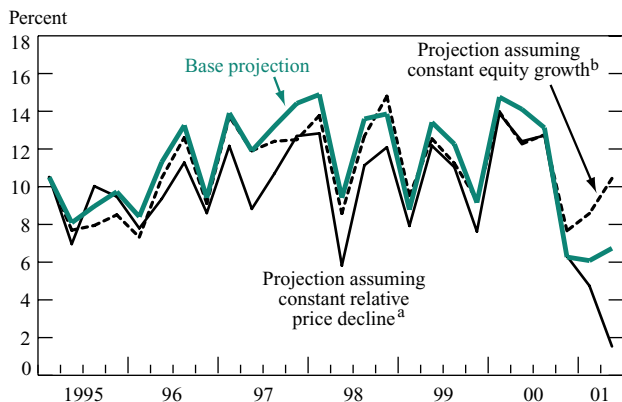
Chart 2
Equipment and Software Expenditure Growth:
Actual Growth versus Forecast Model Projection
Annualized Growth Rate



Sources: U.S. Department of Commerce, Bureau of Economic Analysis; author's calculations.

Chart 3
Effect of Equity Values and Relative Prices on Equipment and Software Expenditure Growth

Annualized Growth Rate



Source: Author's calculations.

^aRelative price decline equal to 1980-94 average decline.

^bEquity growth rate equal to 1980-94 average growth rate.

When we shift our attention to the relative price counterfactual projection, we find a greater degree of disparity with the base projection, indicating that equipment relative prices historically have had a larger effect on investment than equity values (Chart 3). Throughout the late 1990s, the counterfactual projection of equipment expenditure growth is noticeably below the base projection. The implication is that expenditure growth probably would have been somewhat lower in this period if the rapid drop in equipment relative prices had not buoyed up investment. Nevertheless, under the counterfactual scenario, equipment investment would still have grown at double-digit rates. Thus, it is doubtful that the sharp decline in relative prices by itself encouraged excess investment.

The large gap between the projections for 2001 merits some comment. The base projection is about 5 percentage points higher than the counterfactual projection, suggesting that the recent resumption of large price decreases would ordinarily have mitigated the slowdown in investment. Since actual investment plunged sharply during the year, we can infer that the recent decline in equipment relative prices most likely stems from weak demand, not from the technology improvements that drove price declines in the 1990s.

Overall, these counterfactual exercises indicate that, given the behavior of the other variables in the model, equipment investment in the 1990s probably would have been strong even if equity values and equipment relative prices had followed paths closer to their historical averages. Moreover, it appears that although the

recent stock market tumble has contributed to the investment slowdown, its effect on capital spending is small compared with the depth of the investment decline. Thus, an analysis based on historical relationships provides little evidence that rising equity values and falling equipment relative prices precipitated the investment boom and bust.

Conclusion

This study makes two important points about the recent behavior of business investment expenditures. First, although the capital spending boom of the late 1990s was concentrated in the high-tech information sector, the capital spending slowdown of 2000-2001 has been broad based. Therefore, analyses that focus on the difficulties of the high-tech sector provide too narrow a picture of the slowdown. Second, even though many commentators assign the stock market and equipment relative prices a pivotal role in the sharp rise and fall of investment, capital spending patterns probably would have been roughly similar to those observed if stock values and equipment relative prices had moved in line with their recent historical averages.

While our findings allay concerns about overinvestment in the 1990s, they raise a new question: If stock values and capital goods prices did not drive the decline in equipment expenditures, what did? Within the forecasting model used in this article, the variable most responsible for the decline would appear to be slower output growth. To be sure, the reasoning behind this answer is somewhat circular—output growth, after all, has slipped in part because investment has slowed down—but it is consistent with the assessments of the economy that were current in 1999 and the first half of 2000. During this period, firms (along with many analysts) believed that the economic boom would continue and, as a consequence, they made capital expenditures based on this expectation. Then, as the economy began to slow in the second half of 2000, firms reevaluated their assumptions and abruptly revised down capital spending plans.

But while slower GDP growth may have figured in the investment decline, the plunge in capital spending is well beyond the predictions of most economic models, including the one used in this study. Since the standard economic variables cannot explain the magnitude of the slowdown, one recourse would be to appeal to “animal spirits.” Anecdotal evidence suggests that firm-manager psychology may very well have contributed to the investment slowdown: news reports have described how the fear of a future slump in demand led some managers to reduce capital expenditures, even before concrete evidence of a slowdown had emerged.¹³

In the end, such explanations are not very satisfying (nor are they testable), and instead point out how limited our knowledge of investment really is. A fuller understanding of the forces underlying investment growth will require more research, particularly in two areas. First, because high-tech equipment now accounts for such a large share of business capital expenditures, studies of the interactions between technological advancement, productivity, and investment are in order. Second, a close examination of how the shift to fast-depreciating capital goods such as computers and telecommunications equipment has affected investment behavior is likely to prove fruitful. Such studies, carefully conducted, should improve our future predictions about the growth of capital spending.

Notes

1. Federal Reserve Chairman Alan Greenspan (2001) summarized this point of view in a recent speech: "The synergies of key technologies markedly elevated prospective rates of return on high-tech investments, led to a surge in business capital spending, and significantly increased the underlying growth rate of productivity."
2. This is the intuition behind the accelerator model of investment (Clark 1917).
3. Both GDP growth and the rental cost of capital are important components of the neoclassical investment model (Jorgenson 1963), versions of which underlie the investment equations in many large-scale macroeconomic models.
4. Resolving this issue would require modeling investment in general equilibrium, a task that is beyond the scope of this article.
5. The intuition for the q theory of investment comes from Keynes (1936); Tobin (1969) began the formalization of the theory.
6. See Tevlin and Whelan (2000).
7. For more about the empirical evidence concerning this variable, see Chirinko (1993).
8. The estimates of the model indicate, however, that these effects are relatively small.
9. Several empirical studies (for example, Gilchrist and Himmelberg [1995]) have shown that cash flow affects investment, though standard economic theories would suggest otherwise.

10. This desired level is determined using a theoretical (neoclassical) benchmark.

11. Estimates of the model for selected periods are available from the author. All coefficients have the expected signs and are statistically significant at the 10 percent level when the model is estimated over the period from 1960 to second-quarter 2001.

12. Because the forecast model is a reduced-form partial equilibrium model, these exercises do not account for possible changes in expectations and feedback effects under the counterfactual path. Since our intent is to illustrate the historical relationship between these variables and investment, such effects can be ignored.

13. For example, see Uchitelle (2001).

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About the Author

Jonathan McCarthy is an economist in the Business Conditions Function of the Research and Market Analysis Group.

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