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What Investment Patterns across Equipment and Industries Tell Us about the Recent Investment Boom and Bust

Jonathan McCarthy

A study of capital expenditure trends identifies investment in information technology as a major factor in the 1990s boom and subsequent bust. Spending on computers and software, fueled by Y2K preparations and the rise of the Internet, drove investment growth in the late 1990s but slowed in 2000, while overly optimistic profit expectations by communications industries likely prompted an unsustainable investment surge in 2000.

A notable feature of the long economic expansion of the 1990s was the exceptional strength of business investment in equipment and software. In mid-2000, however, expenditures of investment capital began a marked decline that continued through the first half of 2002. Although these expenditures subsequently rebounded modestly, the reduction in investment, particularly in information technology, was a major factor behind the 2001 recession and the subsequent slow growth.¹

This edition of *Current Issues* takes an in-depth look at the role played by capital expenditure patterns in the recent investment boom and bust. Specifically, we analyze spending trends across types of equipment and industries. Special attention is paid to the communications industries—telephone and telegraph, and radio and television—whose unique investment behavior around the end of the boom was singled out by many observers.² Putting our analysis into a broader context, we also examine investment patterns more generally to determine whether the 2001 bust was spurred by firms' excessive optimism about their

profit prospects during the boom. Such overexuberance may have led to capital overhangs among these firms—capital levels greater than what is needed for economically efficient production—which may have had a negative effect on their investment activity.

We find that investment trends in the communications industries indeed had a disproportionate effect—in relation to the industries' share of the overall economy—on both the end of the boom in 2000 and the onset of the bust in 2001. Significantly, investment by these industries in 2000 likely reflected a severe misperception of future returns. For example, real returns in the telephone industry, by our calculations, would have had to be more than twice their “normal” levels to justify the investment rate that year.

We also find, more broadly, that the higher investing industries of the late 1990s tended to reduce their investment rate more in 2001. This pattern likely reflects two complementary factors underlying the depth of the investment bust: the presence of capital overhangs attributable to the boom and a reassessment by firms of future expected

sales growth following the recession. Accordingly, we conclude that the 2001 investment bust—and possibly the recession—likely stemmed in part from firms' excessive optimism of the late 1990s.

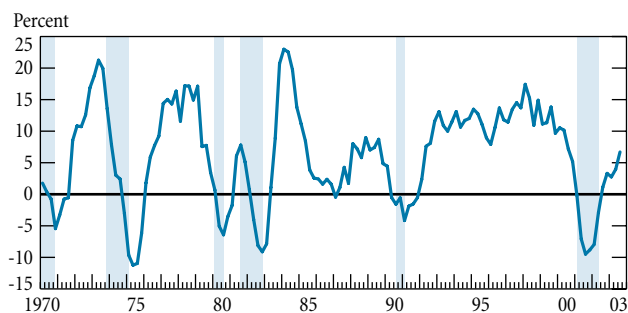
The Recent Investment Boom and Bust

The investment boom of the 1990s was distinguished by its persistence. During most of the decade, expenditures on equipment and software grew at double-digit rates after languishing during the late 1980s and early 1990s (Chart 1). Although the 1970s and early 1980s saw episodes of higher investment growth rates, the persistently high growth of the 1990s expansion was unique over the past thirty years.

To put the 1990s investment boom in historical perspective, we examine investment growth rates for overlapping ten-year periods back to 1911 (Chart 2). The growth rate in equipment spending in the ten years through 2000 was nearly 10 percent. This rate was exceeded only in ten-year periods that included major wars: periods ending in 1918 (World War I), the late 1940s (World War II), and the early 1950s (World War II and the Korean War). In addition, the investment growth rates of the 1990s easily topped those of the 1920s, a decade of notable innovations associated with rapid appreciation in equity prices.

In the second half of 2000, the boom ended abruptly. Year-over-year investment growth turned sharply negative in the first half of 2001, reaching lows not seen since the severe recessions of 1973-75 and 1981-82 (Chart 1). It is not surprising, then, that this abrupt, large, and relatively persistent decline in investment at the start of the last recession led

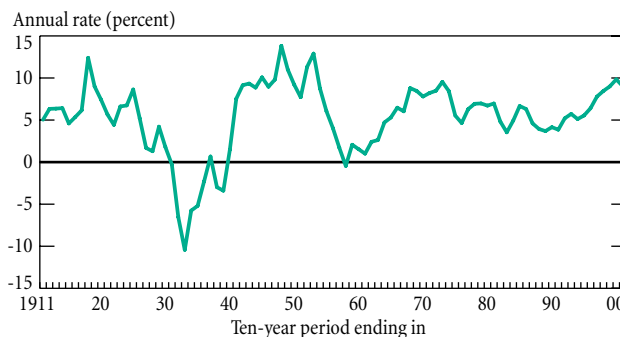
Chart 1
Nonresidential Investment in Equipment and Software
Year-over-Year Growth



Sources: U.S. Department of Commerce, Bureau of Economic Analysis; Haver Analytics.

Note: The shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

Chart 2
Ten-Year Investment Growth Rates



Sources: U.S. Department of Commerce, Bureau of Economic Analysis; Haver Analytics.

many analysts to point to overinvestment as a primary contributor to the downturn.³

The boom also had a profound effect on the capital stock. Although investment spending focused heavily on computers and software—products that depreciate at a fast rate—the strong investment climate of the late 1990s resulted in the rapid growth of the real stock of equipment and software during this period. Capital stock increased nearly 7 percent per year from 1998 to 2000 after rising only less than 2 percent in the late 1980s.⁴ This strong growth, particularly in high-tech equipment and software, has been cited as an important factor in the rise of trend productivity growth rates going back to 1995.⁵ Moreover, while investment spending declined in 2001, the capital stock still grew nearly 4 percent that year—a rate well above the prevailing rates of the 1980s.

Investment Patterns across Equipment Types

To analyze investment growth in the 1990s, we first identify the types of equipment that attracted the most spending during the period. We then investigate whether the reductions in investment during the bust occurred in these same types of equipment. For this exercise, we use as our measure the contributions to the growth of overall investment—roughly, the growth of a component multiplied by its share of investment⁶—from four major types of equipment: information equipment and software, industrial equipment, transportation equipment, and “other” equipment.⁷

Among these types of equipment, information equipment and software played the largest role in the investment fluctuations of the late 1990s through the early 2000s (see table). In the boom years of the late 1990s, the share of investment

growth attributable to information equipment was about two-thirds. This share was even larger in the slower growth years of 2000 and 2002. In fact, the growth contribution of information equipment was larger than the investment growth of total equipment in each of these years, indicating that expenditures on other equipment fell. In the bust year of 2001, the decline in spending on information equipment accounted for more than half of the fall in overall equipment spending.

Within information equipment, a shift occurred in the 1998-2002 period in the types of equipment that led investment growth. Computers and software were the major contributors to the boom in the late 1990s. In 1998 and 1999, these two categories accounted for about half of the high capital spending growth of the period, even though their

share of investment was less than 30 percent.⁸ At the time, Y2K preparations and the Internet boom were large factors behind the robustness of these expenditures. However, in 2000, with Y2K having passed and the Internet bubble beginning to deflate, spending on computers and software slowed significantly, and the growth contributions of the two categories amounted to just half of their 1999 levels.

In 2000, communications equipment became the major driver of investment spending. It contributed almost 3 percentage points to investment growth—well more than half of the investment growth that year—whereas its share of investment was slightly more than 12 percent. This growth contribution from communications equipment was the highest since the recovery from the 1973-75 recession, and it appeared to stem from deregulation, the proliferation of wireless communications, and the Internet boom and associated investments in broadband Internet connections.

Communications equipment had a similarly large role in the bust of 2001, adding nearly 4 percentage points to the decline in investment one year after making a sizable contribution to growth. This swing reflects the dramatic change in the financial condition of the industry: in 2000, communications had booming stock prices and seemingly great prospects, but by 2001, it was facing the woes of overburdened balance sheets from license overpayments on wireless broadcasting spectra as well as a large surplus of capital stock with little immediate prospect of positive returns.

Spending on high-tech equipment—computers, software, and communications equipment—certainly received the most attention during the boom, but the strength of high-tech and the health of the overall economy also appeared to spill over into low-tech equipment. In particular, growth in transportation equipment was robust during the late 1990s, reflecting the rapid expansion of trucking companies and airlines to satisfy the increasing demand for shipping and travel services. As one might expect, spending on low-tech equipment—especially industrial equipment—also shrank during the bust.⁹

Finally, the disproportionate role of equipment expenditures in GDP fluctuations during this period merits consideration. In the boom years, these expenditures accounted for a share of GDP growth that was much larger than their share of nominal GDP. In the investment bust, the role was even more pronounced: the negative GDP growth contribution from equipment expenditures was a major factor restraining GDP growth to a minimal level in 2001.

Effects of the Investment Boom and Bust across Equipment Types

Percent Except as Noted

Category	1998	1999	2000	2001	2002
Equipment and software growth (fourth quarter to fourth quarter)	14.9	9.7	5.2	-8.8	3.3
Growth contributions (percentage points)					
Information equipment and software	9.4	6.6	5.8	-4.9	4.1
Computers and peripherals	4.2	2.6	1.6	-0.4	1.9
Software	3.2	2.5	1.0	-0.5	1.1
Communications equipment	1.9	1.6	2.9	-3.9	0.2
Other information equipment	0.1	-0.1	0.3	-0.1	0.9
Industrial equipment	0.2	0.7	1.5	-2.1	0.1
Transportation equipment	4.1	1.9	-2.7	-0.8	-1.7
Other equipment	1.3	0.3	0.6	-0.9	0.8
Memo:					
Real GDP growth (fourth quarter to fourth quarter)	4.8	4.3	2.3	0.1	2.9
GDP growth contribution of equipment and software (percentage points)	1.3	0.9	0.5	-0.8	0.3
GDP growth share of equipment and software	27.5	21.1	22.2	N.A.	9.1
Nominal GDP share of equipment and software	9.3	9.6	9.7	8.7	8.1

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

Note: Growth contributions do not necessarily sum to totals because of rounding.

One could conclude that the 2001 recession most likely would have been milder had the investment bust not occurred. Despite the evidence that the investment bust was influential, aggregate studies of the bust, such as McCarthy (2001, 2003) and Kliesen (2003), have been unable to identify its source. This inability, combined with the importance of equipment expenditures in recent economic fluctuations, suggests that an examination of capital spending by industry could provide new insight into the sources of the investment bust and thus the recent recession.

Investment Patterns across Industries

Communications Industries

Communications equipment played a key role both at the end of the investment boom and during the bust. Accordingly, we begin our examination of capital spending by industry by focusing on the two communications industries: telephone and telegraph (telephone hereafter) and radio and television (radio-TV hereafter). These industries are the primary users of communications equipment, accounting for more than half of total investment spending on this category.

It should thus come as no surprise that developments in the telephone and radio-TV industries were indicative of overall trends in the communications equipment boom and bust (Chart 3).¹⁰ Using the standard economic measure of investment intensity—the investment rate, or ratio of investment to capital stock—we find that through the 1980s and mid-1990s, the investment rate of the telephone industry fluctuated between 15 and 20 percent. Yet in 2000, the industry experienced a surge in capital spending that resulted in an investment rate of almost 33 percent—the

highest since 1948. Moreover, despite the dramatic reversal in 2001, the industry investment rate still exceeded its 1970-98 average. The surge in capital spending by the radio-TV industry occurred earlier than it did in the telephone industry, but the general patterns of the two industries are similar.

The telephone industry is especially noteworthy because it already had a large capital base and was relatively mature—industry characteristics usually not associated with investment surges. One possible explanation for the heightened investment by the telephone industry is that recent developments in telecommunications technologies—in particular, the Internet and wireless booms—increased the industry’s perceived profit potential, which encouraged more investment in capital goods.

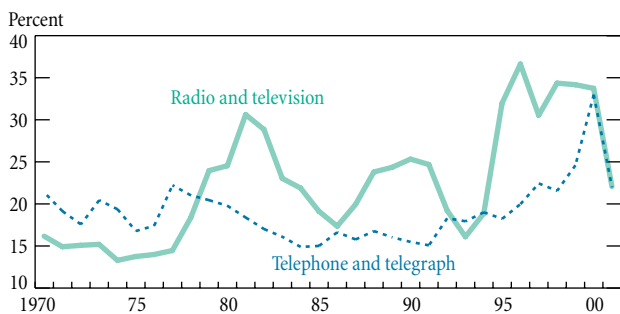
However, using a standard economic model of investment, we calculate that the telephone industry would have required an extraordinary increase in profit potential to have justified such investment. To illustrate, we assume that real profits in the industry were rising 3.5 percent per year before the investment surge, equipment capital was depreciating at a rate of 15 percent per year, and capital goods prices were declining 5 percent per year—assumptions that were all consistent with the experience of the telephone industry before the late 1990s. If these assumptions are accurate, then the rise of the investment rate from 18 percent (the 1970-96 average) to 33 percent (the 2001 level) implies that real profits in the telephone industry were expected to increase between 8.7 and 10.1 percent per year afterward, the precise rate varying with the cost of adjusting the capital base.¹¹ Such an increase in profit growth would indeed seem extraordinary in such a mature industry.

This result implies that the 1999-2000 investment boom in the communications industries reflects an overly optimistic view of the profit prospects of new technologies. Such optimism may have fueled the bust by leading to overinvestment and capital overhangs.¹² To investigate this hypothesis, we examine whether a general pattern of overinvestment and overhangs existed across industries. Specifically, we analyze the relationship between previous industry investment patterns and changes in investment rates across industries.

General Industry Investment Patterns

Did the investment boom and bust center in industries that had high investment rates? In terms of the boom, such a pattern could suggest a “momentum” scenario, in which high-investment industries were continuing to invest even more. Conversely, a pattern in which low-investment industries began to invest much more heavily could suggest that these industries were attempting to “catch up.”

Chart 3
Equipment and Software Investment Rates
of the Communications Industries



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

An industry comparison of the change in the investment rate in 1997-98 with the average rate over the previous five years uncovers neither of these patterns (Chart 4).¹³ Most of the industries we examine (thirty-eight of fifty-four) increased their investment rates between 1997 and 1998: these industries include ones with high investment rates during 1993-97 as well as ones with low investment rates.¹⁴ Moreover, among the industries that reduced their investment rates between 1997 and 1998 there is a comparable diversity of prior investment rates. Thus, the rise in investment rates during the boom was likely a general phenomenon rather than an example of traditionally high-investment industries investing even more or low-investment industries trying to catch up. This finding suggests that broad macroeconomic factors—including the strong economic growth during the period—were major contributors to the boom.¹⁵

In contrast, a definite industry pattern emerges during the bust of 2001. A similar comparison—in this case, the change in the investment rate in 2000-01 with the average investment rate over the previous five years—reveals a clear negative relationship, shown by the estimated trend line in Chart 5.¹⁶ With the exception of a few examples of extreme investment reduction, particularly in the telephone and radio-TV industries, most industries land near the trend line. This result suggests that the relationship is not dominated by a few special cases, but reflects a general pattern of investment reduction across industries.

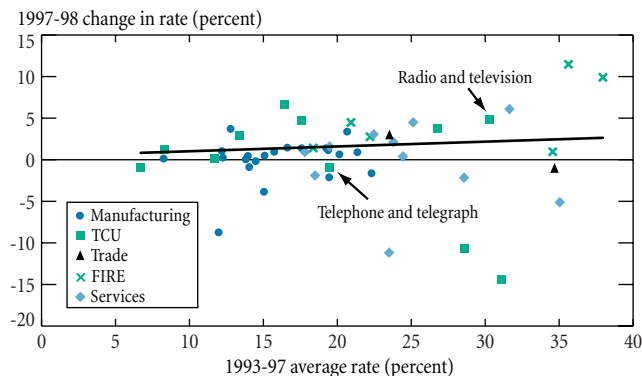
This pattern during the bust may reflect two possibly complementary scenarios.¹⁷ The first is that many of the

high-investment industries during the boom may have become too optimistic and thus overinvested. Consequently, they developed capital overhangs and began to correct them during the 2001 recession by curtailing investment. The communications industries appear to be an extreme case of this behavior. This interpretation is in contrast with the aggregate analysis of McCarthy (2003), who finds a modest overhang of aggregate capital in 2000-01. Therefore, this disaggregated analysis may reconcile the modest aggregate capital overhang with the severe correction in investment that took place during the bust.

In the second scenario, the more cyclical industries may have reassessed their growth prospects in light of the recession, determined that their outlook was too optimistic, and thus reduced investment. Preliminary work on our part, however, does not provide much support for this conclusion. Contrary to what our time-series evidence reveals, we find little relationship between GDP growth and investment rates across industries.¹⁸ Nevertheless, the evidence still does not preclude the second scenario. During recessions, firms typically reassess their profit prospects. If they did so in the most recent downturn, then the reassessments of future growth could explain the relationship observed between changes in investment in 2001 and previous investment rates.

To differentiate further between these two scenarios would require a more technical analysis than we can provide here. Still, the ultimate effects of the two scenarios—overinvestment and growth reassessment—are similar: high-investment industries would tend to reduce investment more

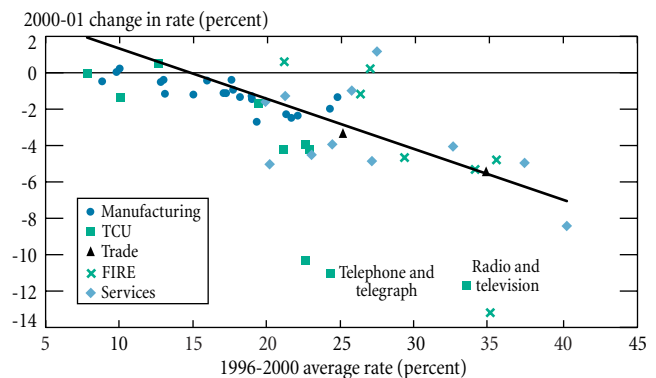
Chart 4
Industry Investment Rates: 1997-98 Change in Rate Compared with 1993-97 Average Rate



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

Note: TCU is transportation, communications, and utilities; FIRE is finance, insurance, and real estate.

Chart 5
Industry Investment Rates: 2000-01 Change in Rate Compared with 1996-2000 Average Rate



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

Note: TCU is transportation, communications, and utilities; FIRE is finance, insurance, and real estate.

in a recession. Therefore, it is reasonable to conclude that the excessive optimism of the late 1990s may have sown the seeds of the investment bust of 2001 and possibly the most recent downturn.

Conclusion

Our examination of investment patterns across equipment and industries suggests that investment in information technology, particularly in communications equipment, was a major factor in the investment boom and bust. The equipment investment patterns point to Y2K and the Internet bubble as important players in the boom and bust,¹⁹ while industry trends indicate that investment by the telephone industry had a sizable influence on aggregate investment.

More generally, the widespread increases in investment rates across industries during the boom suggest that macroeconomic factors—such as strong aggregate GDP growth—were major contributors to the boom. In contrast, during the bust, investment rates were found to decline more sharply in industries that previously had shown high investment rates. Two alternative conclusions could be drawn from this finding: high-investment industries curtailed their investment during the bust to compensate for their overexuberance during the boom, or these industries lowered their future profit expectations more sharply than did other industries. In either case, the 2001 investment bust and possibly the recent recession could be at least partially attributable to the excessive optimism displayed by investing firms in the late 1990s.

A final observation is that our findings shed only some light on the patterns underlying the investment boom and bust. One prominent issue outstanding is the role of large fluctuations in stock prices during the period. McCarthy (2001), for example, concludes that equity price fluctuations could not explain the boom and bust.²⁰ Nevertheless, industries with better performing stock may have secured financing for capital spending more easily during the late 1990s. Conversely, large declines in stock prices likely made the financing of capital purchases more difficult in some industries. Unresolved issues such as this one indicate that the recent patterns of investment spending will continue to inspire lively debate.

Notes

1. For example, the Federal Reserve's "Monetary Policy Report to the Congress," submitted February 27, 2002, notes: "The boom in capital outlays that had helped drive the expansion through the late 1990s gave way to a softening of spending in late 2000 and to sharp declines [in 2001]. Spending dropped for most types of capital equipment and structures: cutbacks were especially severe for high-tech equipment, some types of which may have been overbought."

2. See, for instance, *Wall Street Journal* (2000).

3. Krugman (2002), for example, observes: "The key point is that this isn't your father's recession—it's your grandfather's recession. . . . It's a classic overinvestment slump, of a kind that was normal before World War II."

4. This calculation relies on data from the Fixed Assets Database, compiled by the U.S. Commerce Department's Bureau of Economic Analysis and available at <<http://www.bea.gov/bea/dn/faweb/details/index.html>>.

5. For example, see Jorgenson and Stiroh (1999, 2000), Oliner and Sichel (2000), and Stiroh (2001a, 2001b). However, a rising capital stock does not sufficiently explain stronger trend productivity growth. For instance, capital stock growth in the 1970s was as high or higher than it was during the 1990s, but trend productivity declined in the 1970s.

6. The exact formula used to calculate growth contributions is drawn from Moulton and Seskin (1999) and Whelan (2000).

7. When an aggregate is measured in chain-weighted dollars, as it is in the U.S. National Income and Product Accounts, its components do not add up to the aggregate level. Thus, it can be difficult to assess the contributions of the components. This problem becomes particularly severe when the relative prices of some components change considerably—a relevant consideration for investment because computer prices have dropped dramatically over the years (see Steindel [1995] and Whelan [2000]). In contrast to the component levels, growth contributions do sum to the aggregate's growth rate.

8. Because components of a nominal aggregate do add up, all shares are expressed as a percentage of nominal investment.

9. McCarthy (2001) observes that the investment decline of 2001 was broadly based.

10. The industry data are from the Fixed Assets Database of the Bureau of Economic Analysis (<<http://www.bea.gov/bea/dn/faweb/details/index.html>>). Because the aggregate investment rate is a ratio of two chain-aggregated real variables, we cannot calculate a sensible estimate of it simply by dividing aggregate investment by the aggregate capital stock. Instead, as in Whelan (2000), we compute investment rates using the detailed data (by industry and by type), aggregating the individual investment rates by type using each type's share of current-cost capital stock in the industry. Note that industry investment and capital stock data are available only through 2001.

11. Complete details of this calculation are available from the author at <jonathan.mccarthy@ny.frb.org>.

12. McCarthy (2003) finds large capital overhangs in communications equipment and in communications industries in 2000-01, and observes that they were largely worked off in 2002-03. French, Klier, and Oppedahl (2002) discuss the existence of capital overhangs in telecommunications, although their evidence pertains only to total capital (equipment and structures).

13. An examination of any of the boom years around 1998 would yield a similar conclusion.

14. Our industry sample excludes agriculture, mining, and construction because these industries had minor roles in the boom and bust.

15. This is one conclusion from McCarthy (2001).

16. The trend line takes into account industry size, as measured by GDP share. The estimated slope of the trend line is -0.266, with a standard error of 0.043; the R^2 of the regression is 0.403. Weighting has little effect: in a simple unweighted regression, the slope is estimated to be -0.252, with a standard error of 0.044; the R^2 is 0.402.

17. We repeated the analysis for the years prior to the most recent boom and bust. The pattern in most expansion years is similar to that of 1998; that is to say, there is little pattern. In contrast, many recession years display a negative pattern similar to that of 2001, although the pattern is not as stark as that of 2001.

18. Charts and regressions on this relationship are available from the author at <jonathan.mccarthy@ny.frb.org>.

19. This disaggregated view also attaches somewhat greater importance to Y2K than does Kliesen (2003), who finds relatively modest Y2K effects on aggregate investment and investment in information equipment and software.

20. Specifically, McCarthy finds that Tobin's q , through which stock prices should affect capital spending, has only a small effect on aggregate investment spending once the influence of variables such as GDP growth is taken into account.

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