Was the Economy of the 1990s a New One?

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Introduction

The miracle of U. S. economic performance in the late 1990s was a source of pride at home, of envy abroad, and of puzzlement among economists and policymakers. The Federal Reserve presided over quarter after quarter of output growth so rapid as to break any speed limit believed to be feasible as recently as 1997. As the unemployment rate inched ever lower, reaching 3.9 percent in April, 2000, the Fed reacted with a degree of neglect so benign that early in the year 2000 short-term interest rates were no higher than they had been five years earlier and long-term interest rates were considerably lower.

Policy reactions were different in the late 1990s because the economy appeared to have experienced a sharp change in behavior along at least two dimensions. Unemployment could be allowed to decline, because throughout 1998 and 1999 inflation not only failed to accelerate in response to the continuing decline in unemployment but actually decelerated. This called into question the continuing relevance of the Phillips curve, the longstanding mainstream view that unemployment could not be allowed to fall below the natural rate or "NAIRU," for that would inevitably be accompanied by an acceleration of inflation.[1] The second change of behavior was in the growth of productivity. After resigned acceptance of the so-called "productivity slowdown," more than two decades following 1973 when output per hour grew at barely one percent per annum, analysts were astonished to observe productivity growth at a rate of nearly three percent as the average annual rate for 1996-99 and an unbelievable 5.9 percent annual rate in the last two quarters of 1999.

Falling unemployment, low inflation, and accelerating productivity growth brought many other good things in their wake. In February, 2000, the American economy set a

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1. "NAIRU" stands for the Non-Accelerating Inflation Rate of Unemployment.

record for the longest business expansion since records began in 1850. Profits surged and stock market prices grew even faster than profits, showering households with unheard-of increases in wealth that in turned fueled a boom in consumption and an evaporation of household saving (at least as conventionally measured, excluding capital gains). The Federal government participated in the good times, enjoying a 64 percent increase in personal income tax revenues between 1994 and 1999, fueled by strong income growth and the capital gains. And the gains from the boom were not limited to the top 5 or 10 percent of the income distribution. For the first time since the early 1970s, gains in real income were enjoyed by households in the bottom half of the income distribution, and in April, 2000, the unemployment rates for blacks and Hispanics reached the lowest levels ever recorded.

Perhaps the greatest contrast of all was between the glowing optimism in early 2000 that all was right with the American economy, especially in contrast to most of the other developed nations, whereas a decade earlier nothing seemed to be going right. Japan was king of the mountain, and the United States then appeared to be clearly inferior to Japan along every dimension, including inflation, unemployment, productivity growth, technical dynamism, and income inequality.

In contrast to the dismal years of the productivity slowdown, when economists could find no clear link between technological retardation and disappointing productivity growth, the underlying source of the American economic miracle in the 1990s was widely believed to be an acceleration of technological change, particularly in information technology (IT), and the invention of the Internet. Led initially by journalists in the face of skepticism by

economists, the emphasis on the role of technology has been accepted in recent studies by the leading academic experts on the interrelations between IT and economic growth. In short, Solow's paradox ("we can see the computer age everywhere but in the productivity statistics") is now obsolete and its inventor has admitted as much.[2]

Inflation and Unemployment

Figure 1 plots the unemployment rate on the same scale as the inflation rate for the Personal Consumption deflator. The unemployment rate in 1999-2000 fell to four percent, the lowest rate since the 1966-70 period during which inflation accelerated steadily. Yet in 1998 and early 1999 inflation decelerated rather than accelerating. Taking a general view of the unemployment-inflation relationship, it appears superficially that the only support for a negative Phillips-curve unemployment-inflation tradeoff is based on the 1960s Vietnam-era experience, with a bit of further support from the economic expansion of the late 1980s. In other periods, especially during 1972-85 and 1995-99, the unemployment and inflation rates appear to be positively correlated, with the unemployment rate behaving as a lagging indicator, moving a year or two later than inflation.

Instead of rejecting the Phillips curve, research revived it in the 1970s and showed that inflation could be either negatively or positively correlated with unemployment, depending on whether shocks to aggregate demand or to aggregate supply (taking the form of sharp up or down movements in energy or import prices) were more important. During

2. Solow is quoted as such in Uchitelle (2000).

the 1980s and the first half of the 1990s this more general model became standard, but in the late 1990s it was challenged again by the simultaneous decline in unemployment and deceleration of inflation evident in Figure 1.

At the end of the decade no consensus had yet emerged to explain the positive correlation of inflation and unemployment in the late 1990s. I have attempted to use a common framework to explain why the performance of the 1970s was so bad and of the 1990s was so good, pointing to the role of adverse supply shocks in the earlier episode and beneficial supply shocks more recently. In my interpretation inflation in 1997-98 was held down by two "old" supply shocks, falling real prices of imports and energy, and by two "new" supply shocks, the accelerating decline in computer prices (see Figure 10 below) and a sharp decline in the prices of medical care services made possible by the managed care revolution. This is the sense in which the New Economy, in the form of an acceleration of technical change, was in part responsible for low inflation and the Fed's relaxed monetary policy stance.

Figure 2 compares (with annual rather than quarterly data) the actual unemployment rate with the natural unemployment rate (or NAIRU). The concept of the natural unemployment rate used here attempts to measure the unemployment rate consistent with a constant rate of inflation in the absence of the "old" supply shocks, changes in the relative prices of imports and energy. The acceleration of inflation during 1987-90 and the deceleration of inflation during 1991-95 are explained by movements of the actual unemployment rate below and then above the natural rate. It is the dip of the actual

unemployment rate below the natural unemployment rate in 1997-2000 which raises questions about the behavior of inflation. Perhaps the natural rate has declined more than is depicted here (although a student of mine has struggled for months to find some econometric specification that will push the NAIRU below 5.0 percent and cannot do so).

Figure 2 leaves us with two questions. First, why has the NAIRU declined? The answers include several factors likely to persist, especially the influence of the New Economy in pushing down computer prices at a faster rate than before 1995, and some changes in the labor market — a smaller share of teenage workers, a larger share of potentially unemployed young males in prison, and a larger role of temporary help agences. One factor that pushed down the NAIRU in the 1996-99 period has already reversed, and that is the behavior of medical care prices and benefit costs. The second question is why the actual unemployment rate has fallen a point or more below the NAIRU, and this has at least three answers. First, as would be expected with a low unemployment rate, upward pressure on core inflation has begun. Second, until early 1999 falling real import and energy prices allowed unemployment to stay below the NAIRU. Third, accelerating productivity growth can cause a temporary decline of inflation if real wages lag in their response to more rapid productivity growth.

Productivity and Income per Capita

Now it is time to focus explicitly on the single most important factor which made all of this possible, namely the sharp acceleration in productivity growth that started at the end

of 1995 and that was presumably caused entirely or in large part by the technological acceleration that we have labelled the "New Economy." Figure 7 divides the postwar into three periods using the standard quarterly data published by the Bureau of Labor Statistics (BLS), the "golden age" of rapid productivity growth between 1950:2 and 1972:2, the dismal slowdown period extending from 1972:2 to 1995:4, and the revival period since 1995:4. The top frame shows that for the nonfarm private economy, the revival period registered a productivity growth rate that actually exceeded the golden age by a slight margin, while the middle frame shows that for manufacturing there never was a slowdown, and that the revival period exhibits productivity growth well over double the two previous periods. As a result of the buoyancy of manufacturing, productivity growth outside of manufacturing in the revival period fell well short of the golden age although also exhibited a recovery from the slowdown period.

A comprehensive measure of well-being, per-capita real income, allows us to illustrate the progress that the U. S. economy has made in the last few years relative to the two other largest industrialized nations, Germany and Japan. Using measures that have been adjusted for the differing purchasing power of other currencies, U. S. per capita income was 25 percent higher than Germany in 1999, compared to margins of 21 percent in 1995, 16 percent in 1990, and 15 percent in 1980. Japan's rapid economic growth continued to 1990 and then stalled, and so it is not surprising that the U. S. margin over Japan widened from 22 percent in 1990 to 31 percent in 1999. However, those who would interpret these comparisons as evidence of U. S. technological success, or even more broadly as evidence

that the U. S. has the "best" economic system, are reminded that growth rates of per capita income between these countries are not comparable. Only the U. S. measures the prices of computers with a hedonic price deflator, and this difference in measurement methodology alone over the 1995-99 interval adds about half a percent per year to per-capita U. S. real income growth and, as stated above, subtracts about the same amount from U. S. inflation. But this lack of comparability should not be overstated. Some comparisons of U. S. economic performance with leading foreign nations, e.g., those showing that the U. S. unemployment rate has declined faster and stock market valuations have increased faster, are unaffected by which technique is used to deflate computer expenditures.

The Role of Information Technology in U. S. Economic Success

How important has the New Economy and IT revolution been in creating the U. S. productivity revival which appears directly or indirectly to be responsible for most other dimensions of the late-1990s U. S. economic miracle? Fortunately we do not need to explore this question from scratch, since recent academic research has produced a relatively clear answer which is summarized and interpreted in this section. The basic answer is that the acceleration in technical change in computers, peripherals, and semiconductors explains most of the acceleration in overall productivity growth since 1995, but virtually all the progress has been concentrated in the durable manufacturing sector, with surprisingly little spillover to the rest of the economy.

To provide a more precise analysis we must begin by distinguishing between the growth in output per hour, sometimes called average labor productivity (ALP), from the

growth of multi-factor productivity (MFP). The former compares output growth with that of a single input, labor hours, while the latter compares output with a weighted average of several inputs, usually labor and capital. Growth in ALP or output per is equal to growth in MFP plus the contribution of "capital deepening," that is, the response of output to the growth of the capital-labor ratio

What is the counterpart of the New Economy in the official output data? As shown in the top frame of Figure 10, the remarkable event which occurred at the end of 1995 was an acceleration of the rate of price change in computer hardware (including peripherals) from an average rate of -14.7 percent during 1987-95 to an average rate of -31.2 percent during 1996-99. Computers did not become more important as a share of dollar spending in the economy, which stagnated at around 1.3 percent of the nonfarm private business economy, as shown in the bottom frame of Figure 10. The counterpart of the post-1995 acceleration in the rate of price decline was an acceleration in the rate of technological progress; apparently the time cycle of Moore's Law shortened from 18 months to 12 months at about the same time.[3]

We now combine two different academic studies to assess the role of IT in contributing to the economywide acceleration in ALP and MFP growth since 1995. First, we use the recent results of Oliner and Sichel to compute the contribution of computers and semiconductors both to capital deepening and to the MFP acceleration in the overall economy. Second, we summarize my recent study that adds two elements to the work of

3. This fact is based on a conversation between Gordon Moore and Dale W. Jorgenson, related to the author by the latter.

Oliner and Sichel, the distinction between durable goods and the rest of the economy, and the cyclical effect of above-trend output growth in creating an unsustainable burst of productivity growth.

The results displayed in Table 2 allow us to assess the direct and spillover effects of computers on output per hour and MFP growth during the period between 1995:Q4 and 1999:Q4. The first column refers to the aggregate economy, i.e., the NFPB sector including computers. Of the actual 2.82 percent annual growth of output per hour, 0.54 is attributed to a cyclical effect and the remaining 2.28 percent to trend growth, and the latter is 0.81 points faster than the 1972-95 trend. How can this acceleration be explained? A small part on lines 6 and 7 is attributed to changes in price measurement methods and to a slight acceleration in the growth of labor quality. The remaining 0.62 points can be directly attributed to computers. The capital-deepening effect of faster growth in capital relative to labor in the aggregate economy accounts of 0.33 percentage points of the acceleration (all due to computers), and an acceleration of MFP growth in computer and computer-related semiconductor manufacturing account for all of the rest. Nothing is left for a structural acceleration in MFP outside of the computer-producing sector.

A different way of assessing the role of computers is displayed in the second column of Table 2. Here we subtract output and hours in computer manufacturing from the NFPB economy and find that the structural acceleration of labor productivity on line 8 is 0.43 percentage points, compared to 0.62 for the total NFPB economy. Line 11 indicates a small structural deceleration in MFP of 0.09 points. Thus far we conclude that the impact of

capital deepening has created a genuine revival in growth in output per hour (ALP) in the non-computer economy but that spillover effects on MFP in the non-computer economy are absent (column 1) or slightly negative (column 2).

However, this conclusion is far too optimistic regarding the effect of computers outside of durable manufacturing, i.e., the NFND sector examined in the final column of Table 2. Starting from a much lower actual growth rate of 2.05 percent, a slightly larger cyclical effect is subtracted, leaving an acceleration in trend on line 5 of only 0.24 percent. Almost all of this can be explained by price measurement and labor quality, leaving a structural acceleration in output per hour growth of only 0.05 percent, far less than is accounted for by capital deepening (line 9). As a result, line 11 shows that there has been a *substantial structural deceleration* in MFP growth in the NFND sector.

Thus the "New Economy" is alive and well, but only within computer manufacturing and the remainder of the manufacturing durable sector. This surprising finding can be interpreted either as a "literal" deceleration in MFP growth compared to the 1972-95 period or as suggesting that the acceleration of computer investment has had a negligible payoff, implying a near-zero rate of return of computer investment outside of durable manufacturing. How could there be such a low payoff to computer investment in most of the economy where the vast majority of the computers are located? In this sense the Solow computer paradox survives intact for most of the economy.

Conclusion

The outstanding performance of the American economy in the late 1990s raises the

danger of a resurgent American triumphalism, perhaps symbolized by an imaginary *Arc de Triomphe* erected over Sand Hill Road at the border between Palo Alto and Menlo Park, CA, the heart of the venture capital industry that has funded many of the start-up companies of the New Economy. But while the aftermath of the glorious inflation-free growth of 1928-29 is very unlikely to recur, we should be careful about extrapolating the successes of the recent past or in pretending that success has been universal.

The rate of output growth in the American economy since 1995 has been facilitated by two unsustainable "safety valves," as they have been labelled by Alan Greenspan, the steady decline in the unemployment rate and the steady increase in the current account deficit. Since neither can continue forever, growth in both output and in productivity are likely to be less in the next half-decade than in the last, and the likely adjustment in the stock market may cause at least part of the American economic miracle to unravel. Further, a basic finding of my recent research as summarized earlier in this paper, the failure of the Internet and a massive investment in computers to spur a productivity revival outside of durable manufacturing, suggests that the New Economy may be less revolutionary than is often asserted.

Table 1

**Output per Hour and Alternative Real Wage Concepts,
Nonfarm Private Business Sector, Alternative Intervals 1959-99:4
(Percentage Growth Rate at Annual Rate)**

	1959-1972 (1)	1972-1987 (2)	1987-1995 (3)	1995-1999:4 (4)
1. Output per Hour	2.83	1.52	1.38	2.75
2. Real Compensation per Hour				
a. Deflated by Nonfarm Nonhousing Deflator	3.14	1.55	0.92	2.92
b. Deflated by Personal Consumption Deflator	2.99	1.23	0.38	2.39
3. Average Hourly Earnings deflated by Consumer Price Index	1.87	-0.66	-0.56	1.44

Sources: *Economic Report of the President*, February 2000, Tables B-7, B-10, B-11, B-45, and B-47,
updated from *Economic Indicators,* March 2000.

Table 2

Decomposition of Growth in Output Per Hour, 1995:4-1999:4, Into Contributions of Cyclical Effects and Structual Change in Trend Growth (Percentage Growth Rates at Annual Rate)

	Nonfarm Private Business	NFPB Excluding Computer Hardware Manufacturing	NFPB Excluding Durable Manufacturing
1. Actual Growth	2.82	2.42	2.05
2. Contribution of Cyclical Effect	0.54	0.55	0.62
3. Growth in Trend (line 1 - line 2)	2.28	1.87	1.43
4. Trend, 1972:2 - 1995:4	1.47	1.25	1.19
5. Acceleration of Trend (line 3 - line 4)	0.81	0.62	0.24
6. Contribution of Price Measurement	0.14	0.14	0.14
7. Contribution of Labor Quality	0.05	0.05	0.05
8. Structural Acceleration in Labor Productivity (line 5 - line 6)	0.62	0.43	0.05
9. Contribution of Capital Deepening	0.33	0.33	0.33
10. Contribution of MFP Growth in Computer and Computer-Related Semiconductor Manufacturing	0.29	0.19	-.--
11. Structural Acceleration in MFP (line 7 - lines 8 through 10)	0.00	-0.09	-0.28

Sources: See Gordon (2000). Lines 7, 9, and 10 are based on Oliner and Sichel (2000), Tables 2 and 4.

Figure 1. Unemployment rate vs. inflation rate, 1960-2000

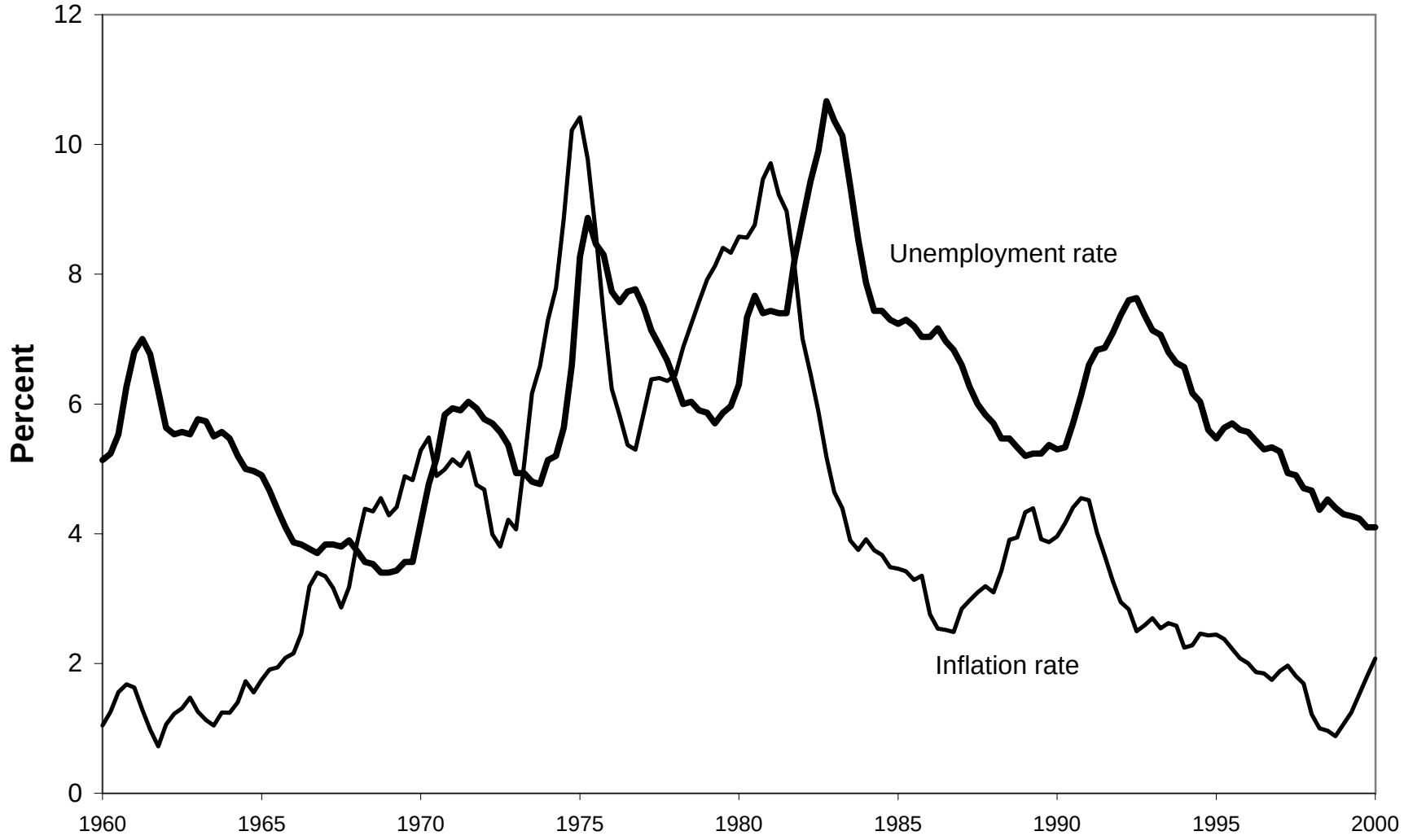


Figure 2. Unemployment rate vs. natural unemployment rate, 1960-00

Figure 3. Fed funds rate vs. corporate bond rate, 1960-1999

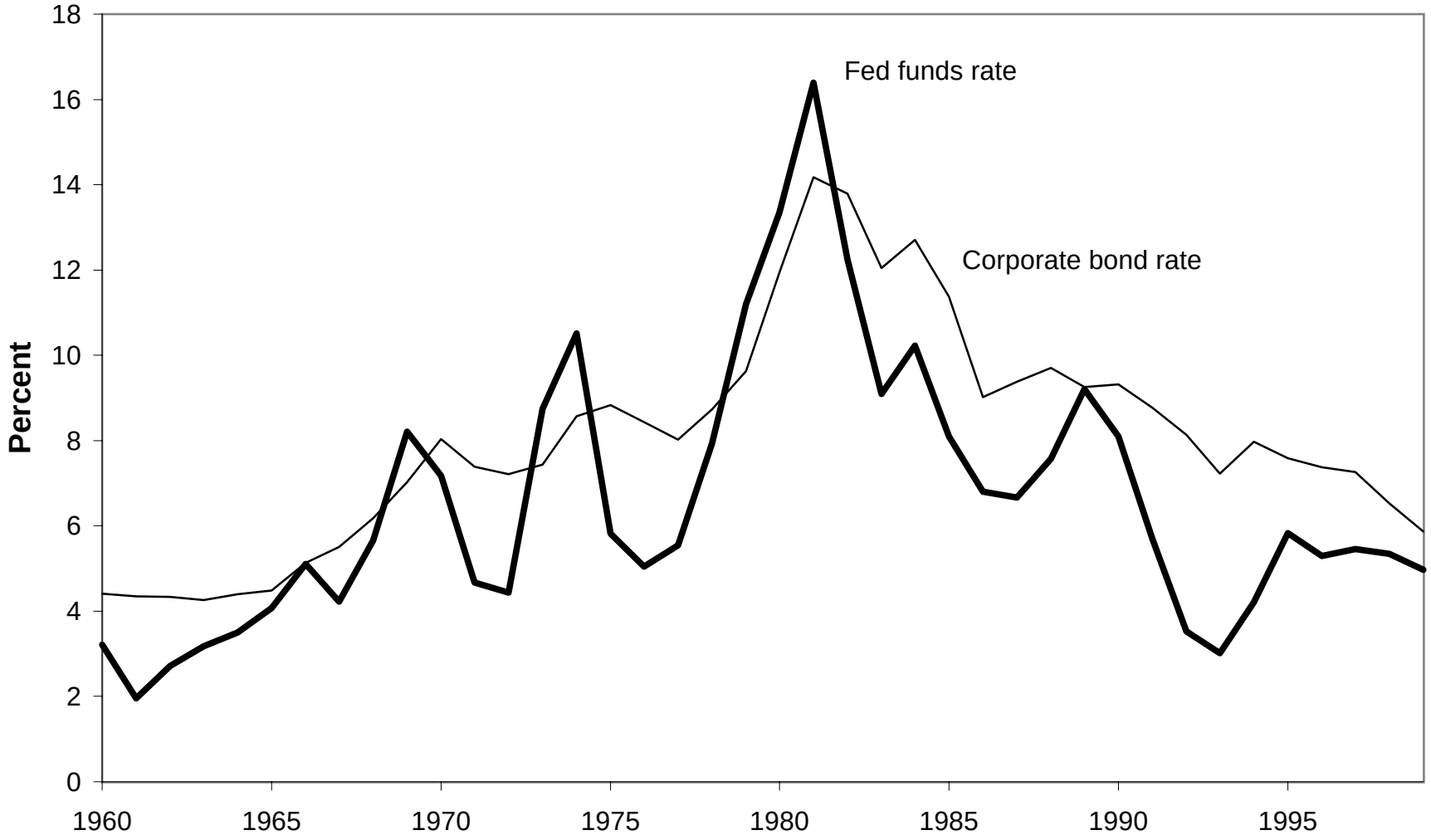


Figure 4. Fiscal surplus vs. current account surplus

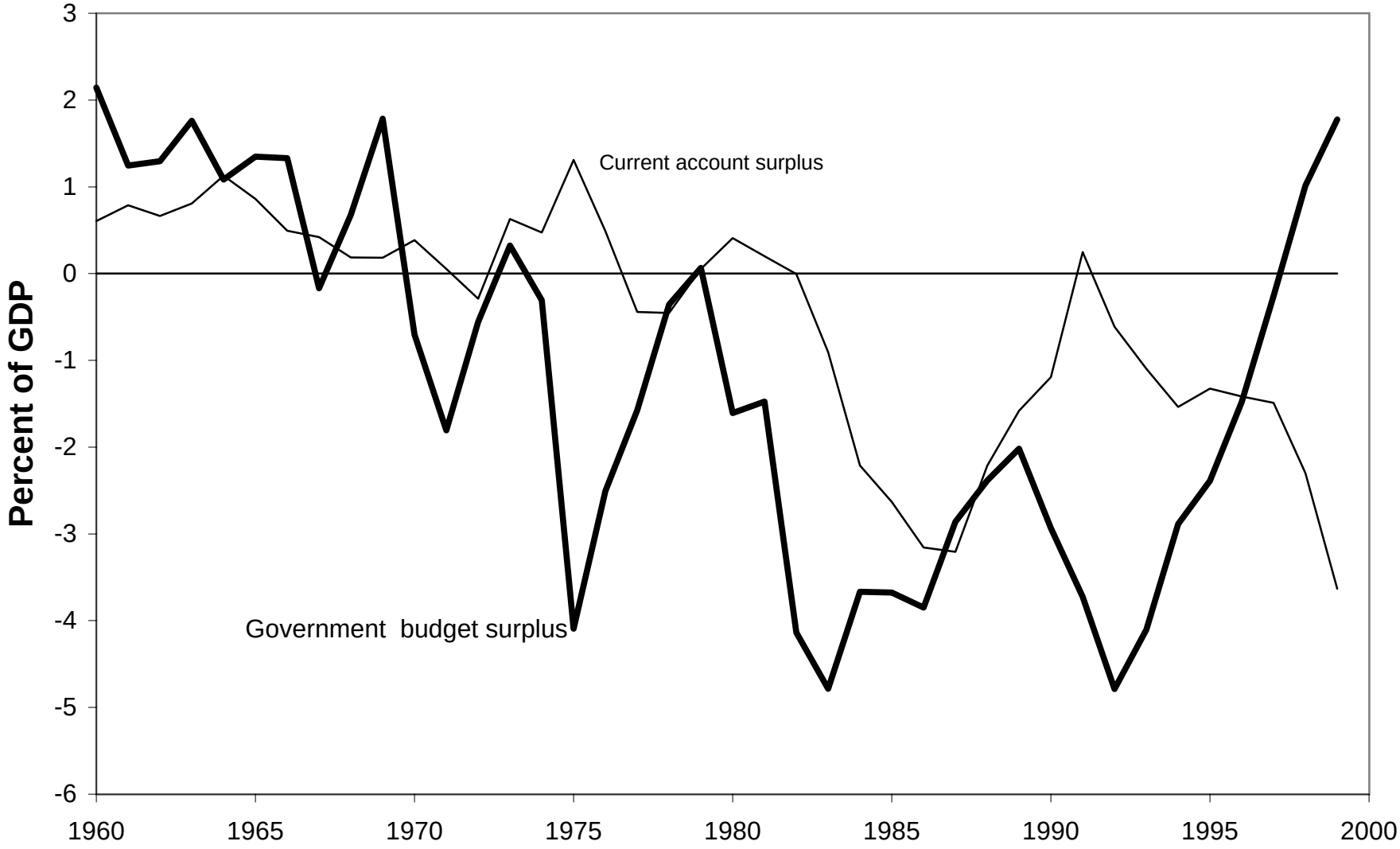


Figure 5. Components of Net Saving and Investment, 1960-1999

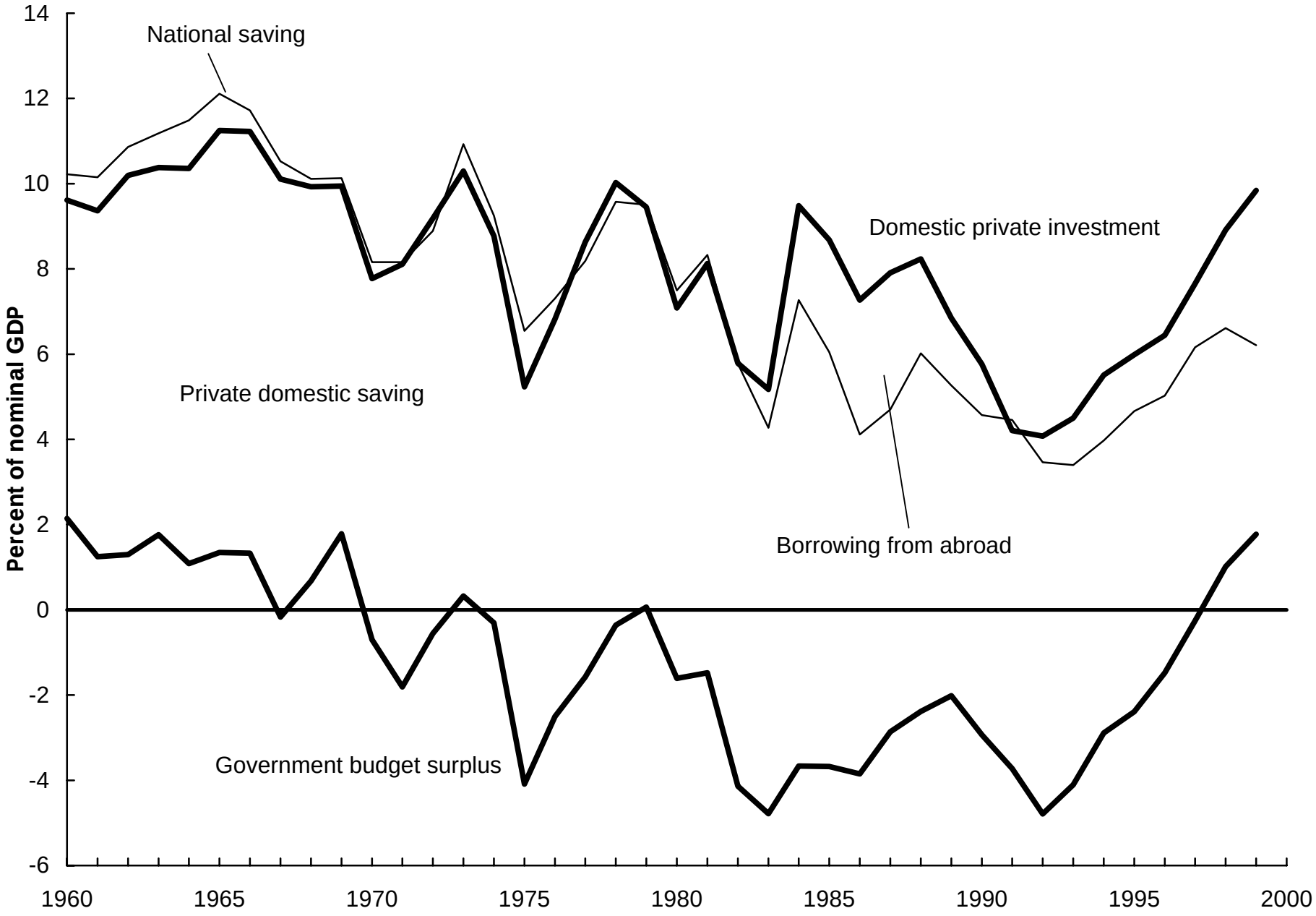


Figure 6. S&P 500/nominal GDP vs. household saving rate

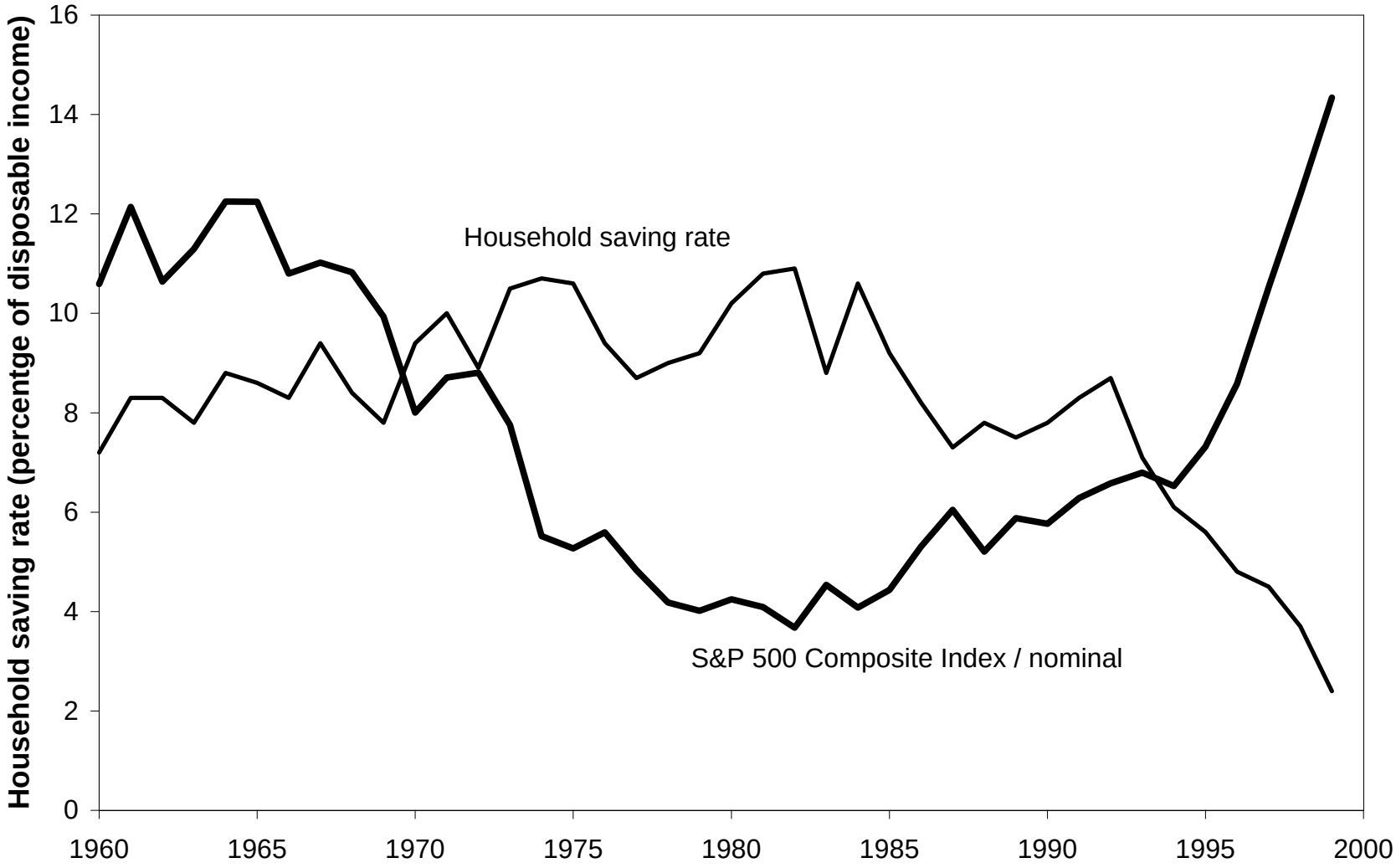
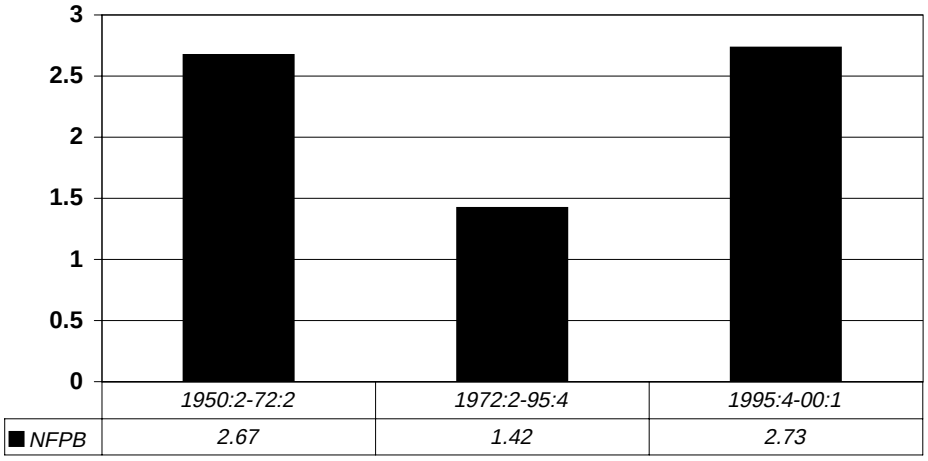
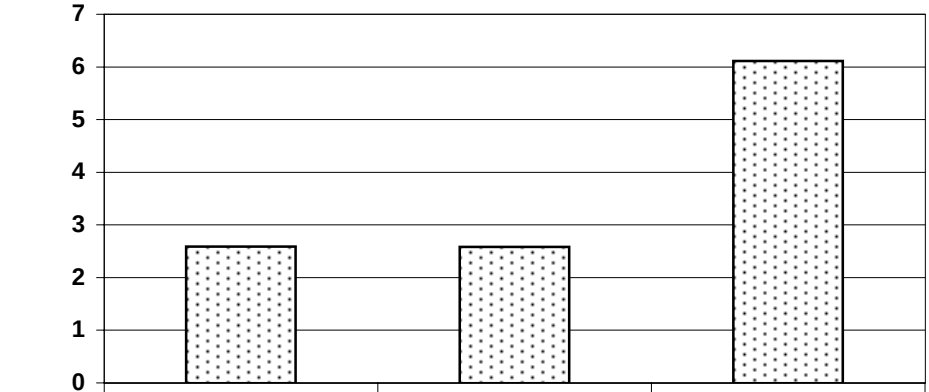


Figure 7.a. Output per Hour, Nonfarm Private Business, Annual growth rates by interval



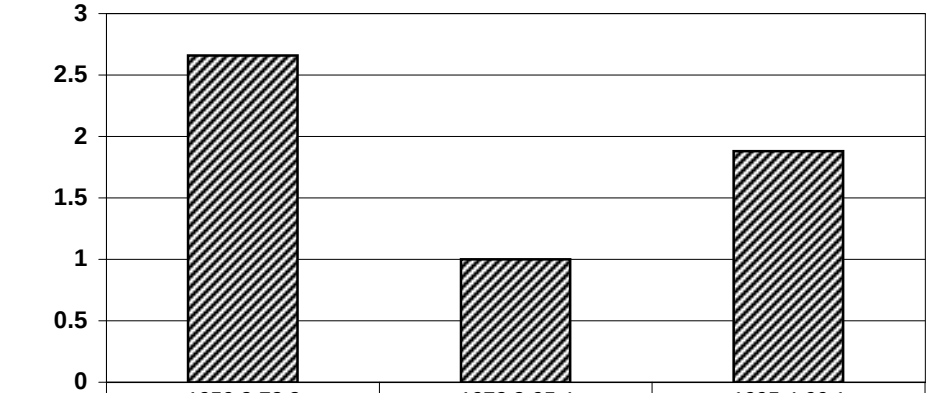
	1950:2-72:2	1972:2-95:4	1995:4-00:1
NFPB	2.67	1.42	2.73

Figure 7.b. Output per Hour, Manufacturing, Annual growth rates by interval



	1950:2-72:2	1972:2-95:4	1995:4-00:1
Manfg	2.59	2.58	6.11

Figure 7.c. Output per Hour, Nonfarm Non-Manufacturing, Annual growth rates by interval



	1950:2-72:2	1972:2-95:4	1995:4-00:1
NFNM	2.66	1	1.88

Figure 8. Per-capita Income for the Germany, Japan and the U.S., 1960-99

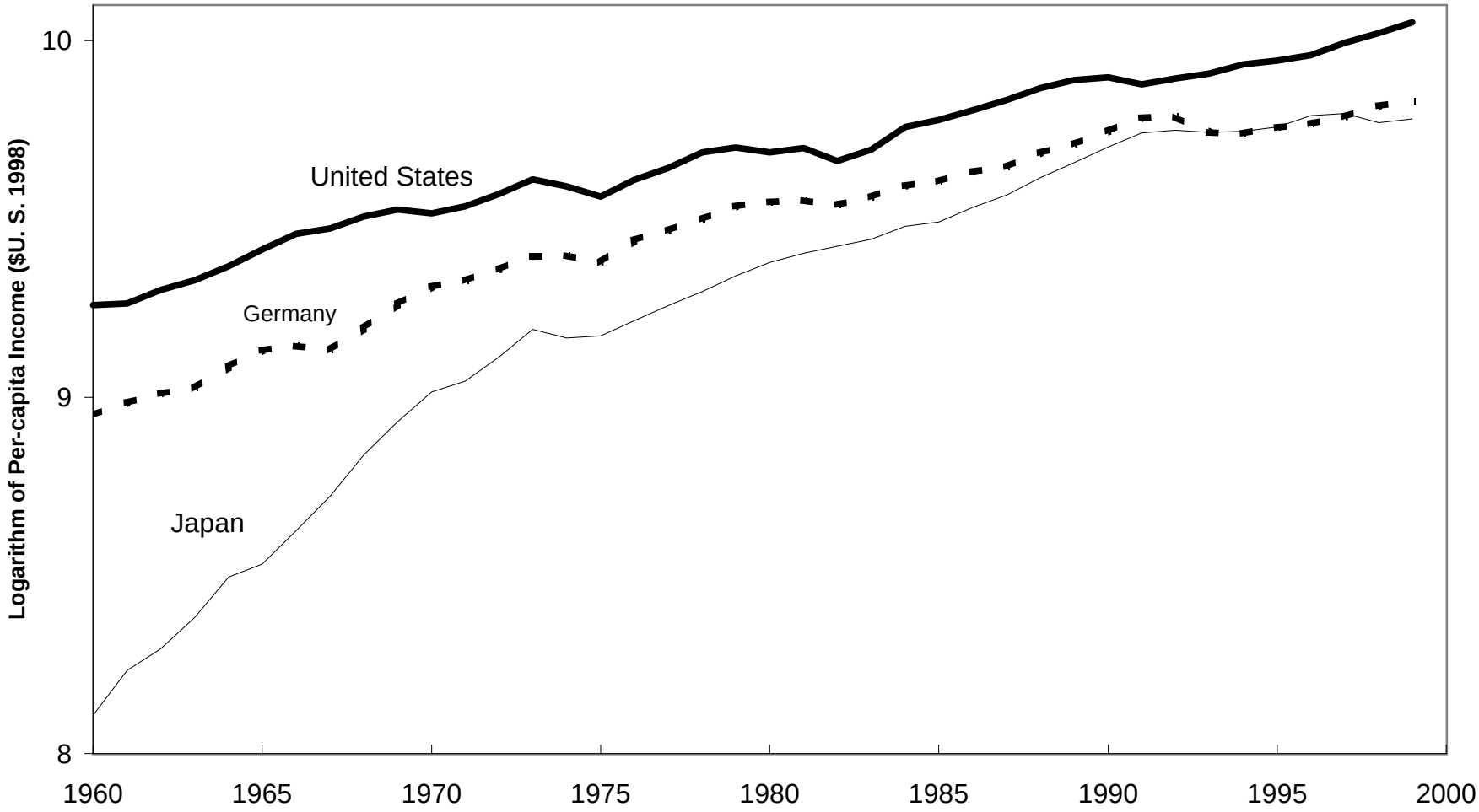
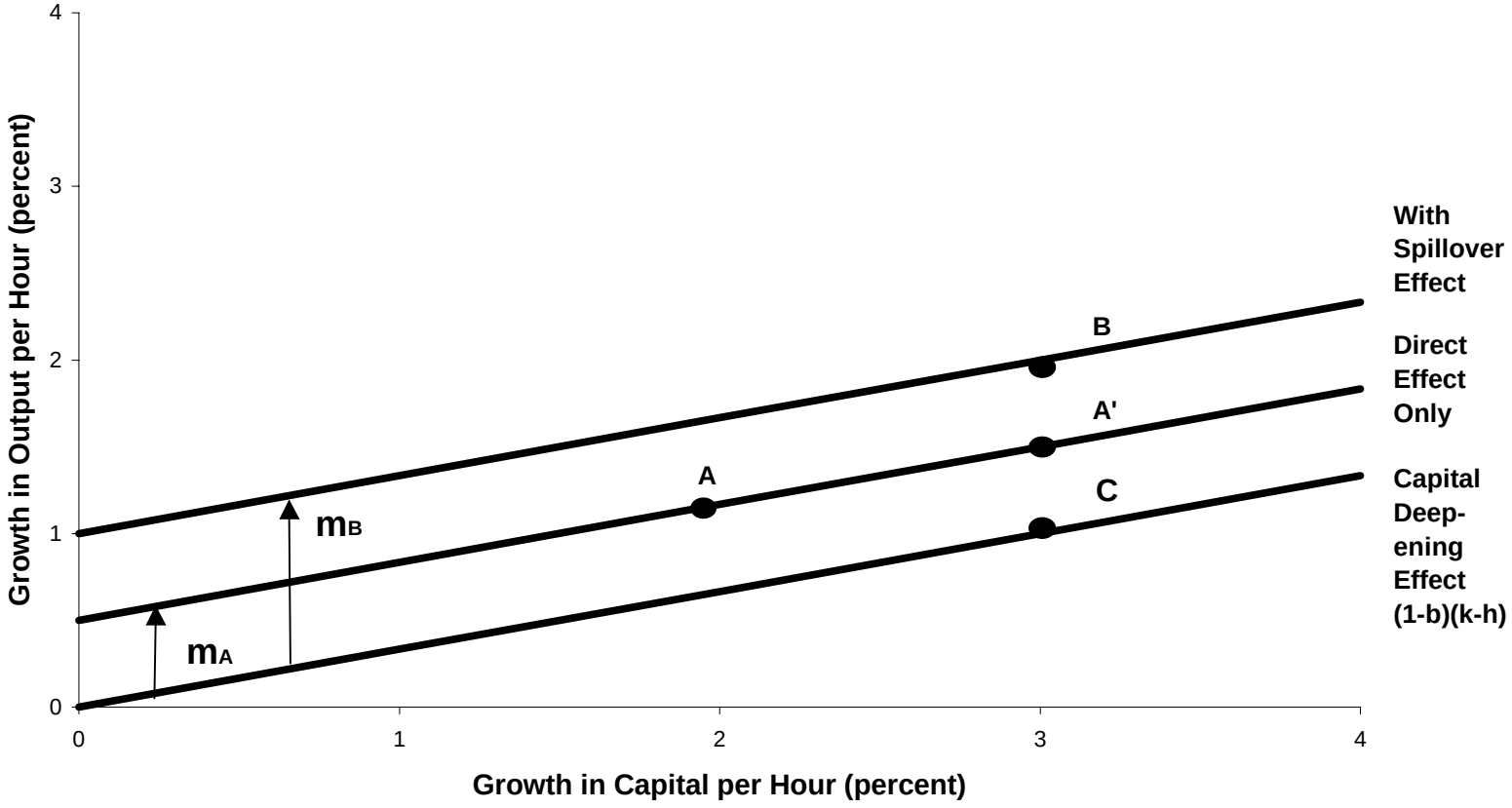
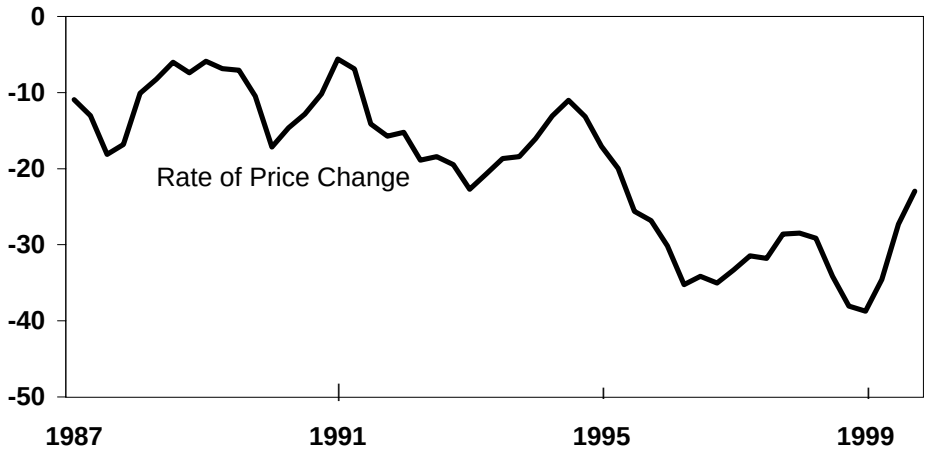


Figure 9. Productivity Growth in the Non-Computer Sector



Note: Point A refers to 1972-95. Points B, A', and C represent alternative interpretations of the period 1995-99.

Figure 10. Final Sales of Computers and Peripherals, Four-quarter rate of Price Change and Nominal Share in Nonfarm Nonhousing Business GDP, 1987-99



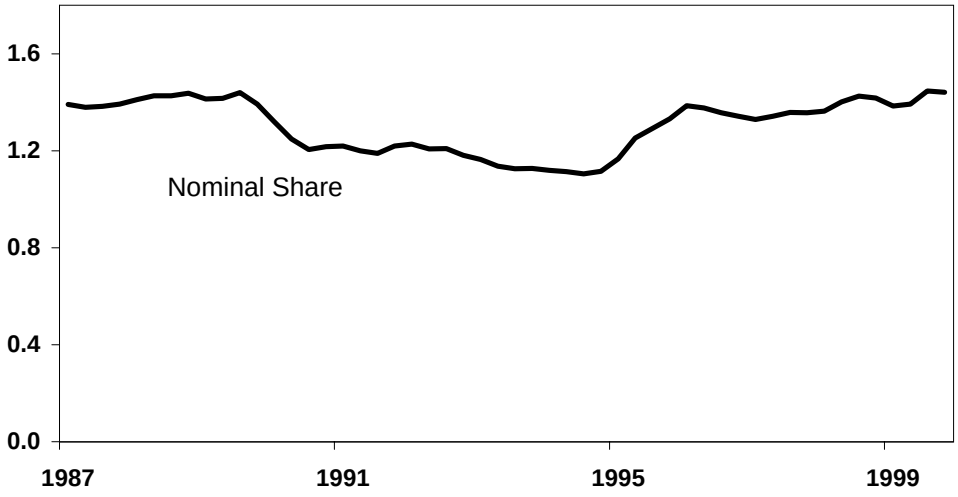
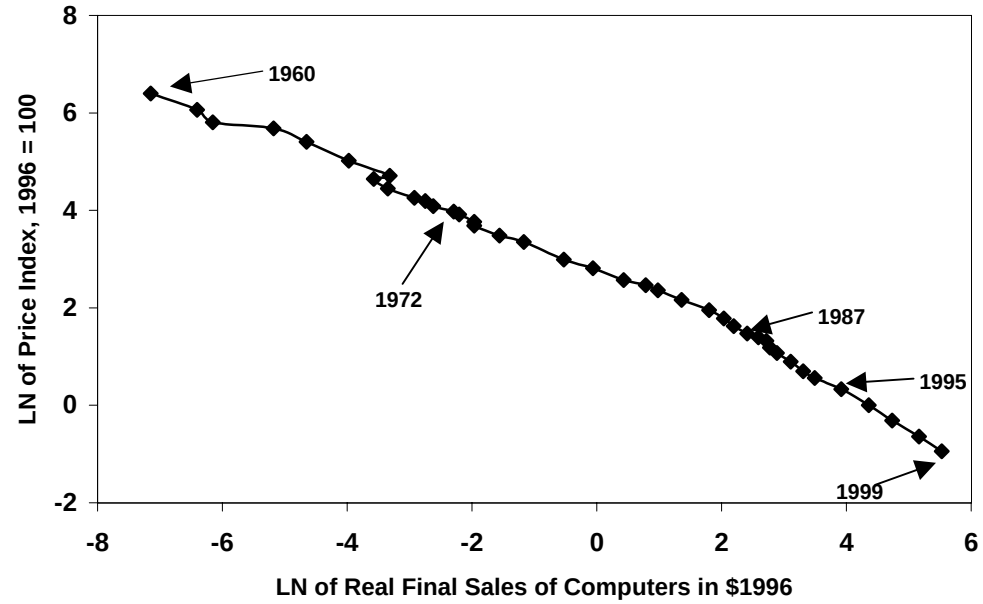
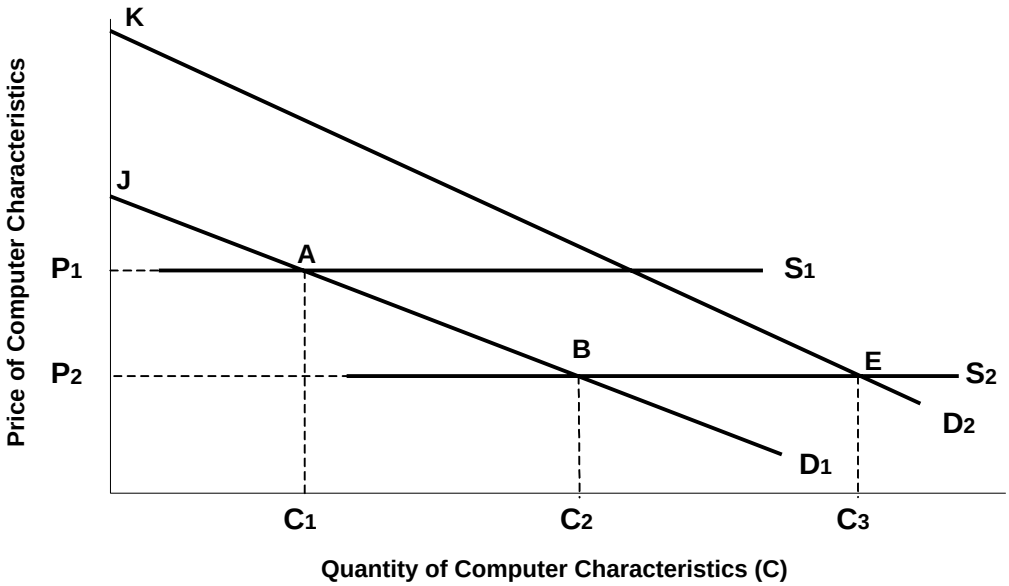


Figure 11. The Price and Quantity of Computer Characteristics





Source: Nominal final sales of computers and peripherals from BEA, linked to Producers' Durable Equipment for computers prior to 1987. Implicit Deflator from BEA back to 1972; for 1960-72 from Gordon (1990), Table 6.10, p. 226