WHAT'S BEHIND THE DECLINE IN THE NAIRU?

Robert G. Murphy*
Department of Economics
Boston College
Chestnut Hill, MA 02467
murphyro@bc.edu

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Abstract

This paper assesses the apparent decline during the 1990s in the unemployment rate associated with stable inflation—the so-called "NAIRU." The paper argues that supply shocks alone are not sufficient to account for this decline and that changes in labor markets are in part responsible. I consider several popular labor-market explanations for the decline. Although a demographic shift toward a more experienced workforce, a growing use of temporary employees, and a skyrocketing prison population probably have contributed to the decline in the NAIRU, they do not adequately explain the timing of an acceleration in that decline during the mid-1990s. I propose an alternative explanation based on evidence showing an increase during the 1990s in the synchronization of regional economic conditions. In particular, I suggest that greater uniformity in economic conditions across regions during the current business expansion has limited spillovers of wage and price pressures from one region of the country to another, thereby lowering the national NAIRU.

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1. Introduction

The unemployment rate in the United States has been well below 5 percent over the past two years, yet price inflation has fallen to a rock-bottom level not seen since the early 1960s. This remarkable combination of low unemployment and nearly non-existent inflation has led to a reevaluation of the Phillips curve framework used by many economists and policymakers for studying business cycle fluctuations. The Phillips curve predicts that inflation will rise when unemployment falls below the rate associated with full utilization of the economy's resources—commonly referred to as the "non-accelerating inflation rate of unemployment" or "NAIRU." With the unemployment rate in recent years consistently far below virtually all estimates of the NAIRU, the quiescence of inflation has been puzzling.

Some observers have questioned the framework itself, arguing that recent evidence completely refutes the NAIRU theory.[1] Others claim that the persistence of low inflation despite low unemployment largely can be explained by two factors: favorable supply shocks and a decline in the NAIRU.[2] Supply shocks clearly have helped keep inflation in check since the mid-1990s, with an appreciating dollar damping import prices and the recent world oil glut placing downward pressure on energy costs. And statistical estimates that allow the NAIRU to vary over time find a pronounced decline in the NAIRU during the 1990s.[3] If the NAIRU has indeed fallen, then the current low rate of unemployment would represent less pressure on prices.

In a recent paper, Gordon (1998) attributes much of the apparent decline in the NAIRU to a new set of supply shocks. He argues that plummeting computer prices, sharp deceleration in health costs, and methodological improvements in the Consumer

Price Index, together with declines in traditional supply shocks such as energy and import prices, can explain the recent stability of inflation. Furthermore, he finds little evidence of shifts in the relationship between wage inflation and unemployment—arguing that, if anything, wages have risen more rapidly than would have been predicted by Phillips curves for wage inflation. Gordon concludes that the beneficial effect on price inflation from supply shocks likely is temporary and probably will be reversed.

On the other hand, Katz and Krueger (1999) point to changes in labor markets as the prime reason for the decline in the NAIRU over the past decade. Unlike Gordon, they argue that the relationship between wage inflation and unemployment has shifted favorably in the 1990s. They highlight the demographic trend toward an older, more experienced workforce, increased incarcerations rates, and greater use of temporary help services as factors leading to a secular decline in the unemployment rate since the mid-1980s.

The present paper achieves three goals. First, it reexamines the evidence concerning which, if any, of the aggregate relationships among wages, prices, unemployment, and capacity utilization have shifted in recent years. I find that a shift has occurred for both the wage-Phillips curve as well as the price-Phillips curve, with much of the shift happening during the 1990s. Interestingly, I find no evidence of a similar shift in the relationship between capacity utilization and price inflation.[4] My findings imply that changes in labor markets, in addition to fortuitous supply shocks, likely have been responsible for the confluence of low price inflation and low unemployment.

Second, the paper reconsiders several popular explanations for why unemployment has fallen sharply without spurring wage pressures. I find that demographic shifts toward

an older, more experienced workforce, increased use of flexible temporary employment, and a skyrocketing prison population probably have pushed the unemployment rate lower than it otherwise would be. But I argue that these factors should have lowered the NAIRU by the late 1980s rather than during the 1990s. The step-up in productivity growth during the past several years is often cited as another reason why unemployment has fallen without increased wage pressure. Here, the timing appears to fit. I argue, however, that even though faster trend productivity growth implies faster long-run output growth, it will lower the NAIRU only temporarily, with the effect reversed once workers adjust their wage aspirations upward to reflect the higher trend growth of productivity.

Finally, the paper proposes that an increase in the synchronization of regional economic conditions may be part of the reason for the apparent shift downward in the NAIRU during the 1990s. This greater synchronization can be seen in the much smaller dispersion across states and regions of unemployment rates, job growth, and output growth during the expansion of the 1990s than during earlier expansions. Several forces may be responsible for this synchronization, including a more efficient national labor market and a greater diversification of regional economies—perhaps reflecting the declining share of the manufacturing and the rising share of the services in output and employment. Because the current expansion has been more uniform across regions than previous expansions, I argue that "spillover effects" on wage and price expectations have been muted, leading to less price pressure as the national unemployment rate has fallen. In past expansions, labor and product markets may have tightened much sooner in some regions than in others, leading to rising wages and prices that affect expectations about inflation in regions where markets are still slack. To the extent that this shift in

expectations affects actual inflation in these "slack" regions, the NAIRU will tend to be higher than if such spillover effects were absent.

The paper is organized as follows. Section 2 documents the apparent decline in the NAIRU during the 1990s. I argue that supply shocks alone are not sufficient to account for this decline and that changes in labor markets are in part responsible. Section 3 discusses several popular labor-market explanations for this decline, but argues that their timing implies the NAIRU should have declined sharply by the late 1980s. Section 4 presents data showing an increase during the 1990s in the synchronization of regional economic conditions. I suggest that this greater uniformity in economic conditions across regions during the current business expansion has been a key factor leading to a decline in the NAIRU.

2. The Decline in the NAIRU: What Exactly Has Changed?

The continuing drop in price inflation over the past couple of years as the unemployment rate has reached its lowest level in a generation has puzzled analysts and policymakers. Figure 1 plots several measures of price inflation over the last ten years.[5] For all measures, a marked downtrend is evident, particularly for core inflation which excludes food and energy costs. And this downtrend has occurred despite, as Figure 2 shows, unemployment rates (both overall and for prime-age adults) that have steadily declined during this same period.

According to the Phillips curve framework, when the unemployment rate falls below the NAIRU, price inflation will increase. Figure 3 uses annual data to plot the change in CPI inflation against the unemployment rate and illustrates the trend line for a simple

regression over the period 1973 to 1993.[6] The point where this trend line crosses the x-axis (6.9 percent) is an estimate of the NAIRU, since this is unemployment rate for which inflation is predicted to remain unchanged. As is clear from the diagram, inflation should have risen significantly since 1995 if the earlier relationship had remained unchanged. Obviously it has not.[7]

The failure of Phillips curve model to predict the decline of inflation during recent years may be the result of favorable shocks that have kept inflation restrained for a given level of labor-market cost pressure. Over the period from 1993 to 1998, the energy component of the consumer price index declined during 4 out of 6 years. And from 1996 through 1998 a strengthening dollar led to a sharp fall in import prices. These "traditional" supply shocks in principle could account for the apparent overprediction of inflation.

Another factor that has contributed to the deceleration in measured inflation during recent years is the set of methodological changes that the Bureau of Labor Statistics has implemented in the official index of consumer prices.[8] These changes, which have been introduced on an on-going basis since the mid-1990s, generally have lowered the rate of inflation compared to earlier methodologies. Because the official CPI is never revised, however, the introduction of these changes likely has exaggerated the year-to-year decline in inflation.[9]

This past summer, the Bureau of Labor Statistics provided a research series that incorporates retroactively most of the methodological changes of the past 20 years. This series begins in 1978 and is available for the all-items category and various subcategories. Figure 4 plots inflation for the past two decades using both the official

CPI and the research series. As can be seen, the major difference is for years prior to and including 1983, when the rental equivalence measure of homeowner costs was introduced into the official CPI. In recent years, the series differ only slightly, by a couple of tenths of a percent. Thus, only a very small portion of the decline in official inflation can be attributed to these changes.

To assess slightly more formally the role of supply shocks and methodological changes in the CPI as factors recently restraining inflation, I estimated a conventional textbook Phillips curve with controls for lagged inflation and supply shocks.[10] Table 1 reports the implied value of the NAIRU derived from these estimates for several periods since 1962 using both the official CPI and the methodologically consistent CPI research series.[11] These periods were chosen in part by looking for statistically significant shifts in the underlying Phillips curve used in computing the estimates. Panels 1 to 3 in Table 1 report results using data for 1962 to 1998 and panels 4 to 6 report results using data from 1973 to 1998. Italicized estimates indicate that the reported NAIRU is statistically different from the value given in column 1.[12]

Consistent with conventional wisdom, the point estimates show an upward shift in the NAIRU after the early 1970s and a downward shift in the late 1980s and 1990s.[13] As illustrated in Panels 1 to 3, estimates for 1994-98 are statistically indistinguishable from estimates for 1962-72, while estimates for the intervening years of 1973-93 are statistically different. Panels 4 to 6 use data since 1973 to show that drift downward in the NAIRU since the late 1980s becomes statistically important only during the period 1994-98.

Regardless of whether the official CPI series or the new research series is used, I find nearly identical statistical evidence of a shift in the NAIRU during the past several years. Thus, methodological changes do not appear to explain very much of the recent restraint in inflation. On the other hand, supply shocks do enter significantly in these Phillips curve equations and therefore are an important determinant of the inflation process. But they do not fully explain the recent restraint in inflation because the NAIRU shows a statistically significant shift downward in recent years after controlling for these shocks. If supply shocks were the entire story, then we should observe no shift in the NAIRU.[14]

The results in Table 1 support two conclusions. First, supply shocks and methodological changes in the CPI can not fully explain the recent restraint in inflation. Second, the shift downward in the NAIRU is statistically significant only very recently, suggesting the need to focus on recent phenomenon for possible explanations. This points to the likelihood that conditions in labor markets may have shifted favorably during the current expansion, allowing for less cost pressure at any given level of labor market tightness. Before turning to a direct assessment of wage behavior, I first examine evidence concerning the relationship between capacity utilization and price inflation.

Figure 5 plots the change in inflation against the capacity utilization rate and shows the trend line estimated for the period 1973 to 1993. The results are similar to Figure 3 (which uses the unemployment rate) in that inflation since 1994 has been lower than would have been predicted based on the earlier relationship. But the recent underprediction, particularly the last two years, is much smaller when using the capacity utilization rate than the unemployment rate. To assess the statistical stability of this capacity-utilization Phillips curve, I re-estimated the equations underlying Table 1

substituting the capacity utilization rate for the unemployment rate. I find no evidence of a structural break during the 1973-98 time period, although I find some evidence of a shift between the periods before and after 1973. These findings are consistent with the recent behavior of the capacity utilization rate, which, as Figure 6 shows, has fallen since 1995 even though employment as a share of the labor force has steadily risen. This divergence suggests that the unemployment rate may be overstating the extent of tightness in labor markets. But one needs to interpret this conclusion with caution because the capacity utilization measure covers economic sectors that include less than 20 percent of payroll employment.

Labor Costs, Unemployment, and Productivity Growth

Figure 7 reports annual rates of change over the past decade for three commonly used measures of labor costs. Although these series show somewhat different patterns and rates of increase, they all indicate a rise in wage pressures from 1995 through 1997 and a decline in wage pressures during the past year or so. Despite this recent easing in wage pressures, the rate of increase for all three measures remains above the level of 1995. The employment cost index, which is often viewed as the most comprehensive measure of labor costs and is based on a quarterly survey of employers, shows a step-up of 0.5 percentage point in its rate of increase since 1995. Average hourly earnings, which covers production or non-supervisory jobs and accounts for roughly 80 percent of the workforce, shows a gain of about 1 percentage point in its rate of increase since 1995. Compensation per hour, a broad measure of labor costs which is computed using income data from the National Income and Product Accounts, shows a sharp rise of over 3 percentage points in its rate of increase since 1995.[15]

To assess whether the recent pattern of labor costs has been more restrained than past experience would have suggested, Figure 8 plots the annual percentage change in the employment cost index minus price inflation against the unemployment rate. I use the employment cost index for total compensation, which is available starting only in 1979, and adjust for price inflation using the methodologically consistent CPI research series. The trend line is estimated through 1993, and shows that the inflation-adjusted growth of labor costs has been lower than one would have predicted. But the overprediction is small compared to that shown for price inflation in Figure 3.[16]

The wage Phillips curve in Figure 8 implicitly assumes that the expected rate of trend productivity growth was constant over the past two decades. Accumulating evidence, however, now points to a step-up in trend productivity growth since 1995.[17] Figure 9 presents a wage Phillips curve that incorporates a shift in trend productivity growth. Based on the updated productivity estimates recently released by the Bureau of Labor Statistics, I assume that expected trend productivity growth was 1.4 percent per year from 1980 to 1994 and (a conservative) 2.0 percent per year from 1995-98. The trend line in Figure 9 is estimated through 1993 and shows that labor cost growth adjusted for both inflation and productivity gains has been much lower over the past three years than would have been predicted based on the earlier relationship.[18]

One possible reason for the restraint in wages despite a boost to trend productivity is that workers have not yet incorporated a higher rate of productivity growth into their "wage aspirations." Once they do, wages will rise more rapidly and the apparent shift downward in NAIRU will have proved temporary.[19] Alternatively, workers may have already incorporated the shift in productivity, but other factors may have restrained wage

pressures. In this case, the decline in the NAIRU is due to other forces that may be permanent or temporary and which I discuss in the next section. Of course, if the recent gain in productivity growth is not a shift in trend growth but only a transitory business cycle-related gain, then growth in labor costs are less out of line (as Figure 8 shows). Still, even in this case, some shift in the wage Phillips curve is apparent for total compensation, implying a decline (albeit smaller) in the NAIRU.[20]

3. Accounting for Shifts in the NAIRU

This section assesses several proposed explanations for changes in the value of the NAIRU. First, I consider changes in the demographic composition of the workforce that are associated with a rise in experience levels. Next, I assess the increasing prevalence of temporary employment arrangements. Finally, I examine the possibility, recently pointed to by Katz and Krueger (1999), that an exploding prison population may have had a quantifiable effect in reducing unemployment. I find that these factors may explain some of the decline in the NAIRU, but can not account for why it fell sharply in the mid-1990s rather than more gradually starting in the mid-to-late 1980s.

The Shifting Demographics of the Labor Force

The U.S. labor force has undergone dramatic shifts in age structure over the past four decades, as illustrated in Figure 10. Between the early 1960s and the late 1970s, the labor-force share of young workers increased while the share of middle-aged workers decreased. This shift reflected the entry of the "babyboom" generation into the workforce. Younger workers tend to have less experience than older workers and generally have less attachment to the workforce. Because workers with less experience

have higher average rates of unemployment, this shift toward a more youthful workforce probably raised the NAIRU during the 1970s and early 1980s. Over the past 15 years, this shift has reversed, with the share of middle-aged workers climbing back toward earlier levels and the share of young workers falling. This shift toward an older, more experienced workforce probably contributed to a lower NAIRU, but can not explain the timing of a decline during the 1990s because the shift in age structure was well underway by the late 1980s.

As a simple way of quantifying the effect of a shifting age structure on the unemployment rate, Figure 11 compares the actual unemployment rate with a demographically-adjusted unemployment rate that holds constant the labor-force share of each age cohort at their 1979 values.[21] Over the past 20 years, as the age composition of the labor force has shifted toward more experienced workers the difference between the adjusted and actual unemployment rates has widened. As shown in Figure 12, the unemployment rate in 1998 was approximately 0.6 percentage point lower than it would have been if the age structure had remained unchanged. But roughly two-thirds of this demographically-driven decline in unemployment had already occurred by 1989. Only about 0.2 percentage points of the decline occurred during the 1990s.

Another demographic factor often cited to explain an increase in the NAIRU during the 1970s is the rise in labor force participation by women during the late 1960s and early 1970s. Because women on average had less work experience than men, women on average had higher rates of unemployment. Accordingly, during the 1970s the rising proportion of women in the workforce likely led to an upward movement in the NAIRU. Beginning in the early 1980s, however, the unemployment rate for women had converged

to the rate for men, so that any effects from women's increased labor force participation on the NAIRU would have been reversed by the mid-1980s.[22]

The Rise of the Temporary Help Industry

Employment in the temporary help industry has risen from under 0.5 percent of total nonfarm employment in 1982 to almost 2.5 percent today, as shown in Figure 13, with the share increasing more rapidly in the 1990s than in the 1980s. Furthermore, growth in the temporary help industry accounted for over 9 percent of the total gain in employment from 1991 to 1998 compared to about 4.5 percent during 1982 to 1990.

While obviously the industry has grown in importance, the effect on the NAIRU is not so clear cut. The effect depends on two issues. First, many firms who employ contract or temporary workers today would have directly hired such workers in the past. Thus, many temporary employees probably would have been employed in traditional jobs. Using the rather generous assumption that 30 percent of temporary help agency workers would otherwise have been unemployed during 1997, Katz and Krueger (1999) find a small 0.2 to 0.3 percentage point reduction in unemployment for that year. And this 30-percent share of temp agency workers with a high propensity toward unemployment did not suddenly appear in 1997—these workers would have been around to help depress unemployment in earlier years. So any effects on unemployment would have been spread over many years starting in the 1980s.

Second, and probably more importantly, the growing presence of a temporary help industry may have altered the wage setting process in a way that reduces pressures on labor costs at any given unemployment rate. This might occur because firms now find it easier to hire workers as needed without the overhead costs of training, benefits, etc. In

addition, temporary help workers may feel greater insecurity and be less willing to demand higher pay from their agencies. Katz and Krueger (1999) provide some preliminary evidence that wage gains appear to be more restrained in states with larger temporary help industries. But, in principle, one can imagine the opposite type of effect: greater use of temporary workers reflecting greater rates of job turnover, which would tend to raise the NAIRU.

The Growth of the Prison Population

The share of the population in jail or prison has nearly quadrupled over the past 30 years. Since the early 1980s, the inmate population has risen by nearly one million. Official measures of unemployment and the labor force exclude prisoners. Thus, to the extent that prisoners on average are more likely to be unemployed, a sharp rise in the prison population would lower the measured unemployment rate. Katz and Krueger (1999) provide estimates of this effect under various assumptions concerning the likely employment rates and labor force participation rates of prisoners if they had not gone to jail. Katz and Krueger provide a "best-guess" that the rise in prison population has lowered the unemployment rate in the late 1990s by 0.17 percentage point compared with the mid-1980s.

As shown in Figure 14, the share of the population in prison has increased relatively steadily over the past two decades, with no apparent sharp surge in the 1990s. Thus, the timing of a change in the NAIRU during the 1990s is at odds with the steady growth in prison inmates over the past two decades. Effects on unemployment and the NAIRU should have been apparent by the late 1980s.

4. Regional Economic Synchronization and the NAIRU: A Possible Explanation?

Debate about why the NAIRU might have declined recently sometimes emphasizes the effects of increased production efficiencies and intense market competition in restraining wage and price increases (Stiglitz, 1997). These potential explanations, however, are usually offered as a catchall to explain the timing of the recent decline in the NAIRU that other factors cannot fully account for. And the evidence provided is typically anecdotal, e.g., the increased use of computers for just-in-time inventory management, the increased openness of the U.S. economy to foreign competition, or the reduced prevalence of labor unions.[23]

One way to quantify the effects of increased economic integration and efficiency is to consider the pattern of labor market conditions and economic activity across regions of the United States. Figure 15 shows the dispersion of state employment growth rates by decade since 1960.[24] The dispersion of employment growth rose sharply in the 1970s, fell back a bit in the 1980s, and then declined further in the 1990s, returning to its value of the 1960s. A similar pattern of decline in the 1990s emerges for the dispersion of state unemployment rates and the dispersion of gross state product growth rates, as shown in Figure 16.[25]

Averaging these dispersion measures by decade, of course, may mask differences in behavior due to the amount of time the economy spent in expansion versus contraction phases. To control for the business cycle, Figures 17 to 20 show these dispersion measures averaged over various periods of economic expansion and contraction.[26] The figures illustrate that the dispersion of employment growth, unemployment rates, and output growth rates across states clearly has declined in the 1990s compared to the 1980s,

regardless of whether one considers expansions or contractions. A similar decline over time in the dispersion of unemployment rates is also apparent if one looks across census regions rather than states.

The decline in dispersion of unemployment rates may have resulted from greater mobility of workers across regions and better matching of unemployed workers to available jobs, and accordingly would reflect a national labor market that has become more integrated and efficient. Greater labor market efficiency likely would lead to lower wage pressures for any national rate of unemployment than in the past.

More generally, the decline in dispersion of employment growth, output growth, and unemployment rates also could reflect an increase in the diversification of regional economies, so that expansions and recessions are now more uniform in their effects across states or regions than in the past. To the extent that this decline in dispersion reflects increased synchronization of regional business cycles, then price pressures are less likely to emerge first in one region and spill over into inflation expectations in other regions. Instead, price pressures would tend to emerge uniformly across regions, limiting the tendency for expectations about inflation in one region to shift up in response to market pressures in some other region. Accordingly, the change in the national rate of inflation associated with any given national unemployment rate likely would be lower.[27]

Of course, the greater synchronization of economic conditions across regions may just reflect plain good luck, in the sense that the shocks hitting the economy have been different during the 1990s than earlier.[28] To the extent that these shocks have caused more uniformity in regional economic conditions, the dampening of spillover effects on

expectations would still be important. But this dampening effect would represent only temporary good fortune.

5. Conclusion

Evidence presented in this paper strongly suggests that the unemployment rate associated with stable inflation, the so-called "NAIRU," has declined during the 1990s. The paper argues that supply shocks alone are not sufficient to account for this apparent decline and that changes in labor markets are partly responsible. I assess several popular labor-market explanations for the decline. Although a demographic shift toward a more experienced workforce, rising use of temporary employees, and a skyrocketing prison population probably have contributed to the decline in the NAIRU, they do not adequately explain the timing of the a sharp decline during the mid-1990s.[29] I propose an alternative explanation based on the increase during the 1990s in the synchronization of regional economic conditions. More specifically, I suggest that greater uniformity in economic conditions across regions during the current business expansion has limited spillovers of wage and price pressures from one region of the country to another, thereby lowering the national NAIRU.[30]

Footnotes

[1] See, "Nairu, R.I.P.," editorial of The Wall Street Journal, April 23, 1999. Also, see Coen, et al. (1999).

[2] See Gordon (1998) and Murphy (1999).

[3] Staiger, Stock, and Watson (1997) find a decline in NAIRU during the 1990s, but argue that their estimated NAIRU is very imprecise with wide confidence bounds. Gordon (1997) likewise estimates a time-varying NAIRU that declines in the 1990s, but does not provide confidence bounds.

[4] Stock and Watson (1999) and Gordon (1998) likewise find that the relationship between capacity utilization and inflation has remained stable.

[5] Price index data for GDP and personal consumption expenditures are from the benchmark revision released in October 1999 by the Bureau of Economic Analysis.

[6] The data period for this trend line begins in 1973 because the NAIRU is thought to have shifted upward after the early 1970s. The CPI index in the figure is the official index for all urban consumers. Using either the price index for GDP or the price index for personal consumption expenditures gives similar results.

[7] Sophisticated analyses using quarterly data that account for the complex lag structure of the inflation process also overpredict inflation during the last few years. For details, see Brayton, et al (1999) and Gordon (1998).

[8] See Stewart and Reed (1999).

[9] A related problem also was present in price data from the National Income and Product Accounts, which are constructed in part by using lower-level components of the CPI. With the release in October of its benchmark revision of the NIPA data back to 1959, the Bureau of Economic Analysis has now incorporated into the price indexes for GDP and personal consumption expenditures the full set of recent methodological changes in the CPI.

[10] My approach is similar to that used by Gordon (1982) to compute estimates of the NAIRU. The Phillips curve equations maintain the assumption that lagged inflation feeds one-for-one into current inflation. Estimates in Table 1 use an equation that expresses the CPI inflation rate as a function of lagged inflation, the civilian unemployment rate, and the relative rate of food and energy price inflation (measured by the rate of change in the all-items CPI minus the core CPI). Results are similar when the rate of change in relative import prices (measured by the rate-of-change in the price index for imports minus the price index for GDP) is included as an additional supply shock variable. Other measures of inflation, such as the rate of change in the GDP price index, provide comparable estimates of shifts in the NAIRU.

[11] As noted in the text, the main difference between the official and the research series prior to 1983 reflects the treatment of housing costs. Starting in 1983, a homeowner's equivalent rent adjustment was incorporated into the official CPI replacing the earlier method of measuring housing costs. The Bureau of Labor Statistics, however, has produced an experimental series, CPI-U-X1, that incorporates the rental adjustment back to 1967. Accordingly, I extend the new research series back to 1967 by linking to the CPI-U-X1. For years prior to 1967, the series is linked to the official CPI.

[12] More precisely, the statistical tests are for shifts across time periods in the constant term of the Phillips curve equation. Under the maintained assumption that the coefficient on the unemployment rate is the same across time periods, my tests are equivalent to testing for differences in the NAIRU.

[13] Estimates using time-varying parameter methods (Gordon, 1997; Staiger, Stock and Watson, 1997) find a similar pattern of movement in the NAIRU over the past three decades.

[14] Gordon (1998) considers an additional set of "supply shocks" that includes computer prices and medical costs. He finds that restraint in these prices can explain much of the recent deceleration in inflation as measured by the GDP deflator. I argue below, however, that the absence of a shift in the relationship between capacity utilization and inflation, along with direct evidence of a shift in the wage Phillips curve, indicate that some sort of change has occurred in labor markets.

[15] See Katz and Krueger (1999) and Abraham et al. (1999) for further details about the properties of these wage and compensation series.

[16] The overprediction is even smaller when the wages and salaries component of the employment cost index is used to measure labor costs. This faster growth of wages and salaries probably reflects an offset to the much slower growth of benefits in recent years. Because wages and benefits likely are highly fungible, I focus in Figure 8 on the total compensation measure.

[17] Revised estimates of nonfarm productivity growth since 1959 were released in November 1999 by the Bureau of Labor Statistics and show an annual pace of 3 percent for the 1960-73 period, 1.4 percent for the 1973-1995 period (also for the 1973-89 period), and 2.4 percent for the 1995-98 period.

[18] Econometric tests using the ECI-total compensation, ECI-wages and salaries, and the NIPA hourly compensation measures of labor costs, with adjustment for a recent increase in trend productivity growth, find statistically significant shifts in the wage Phillips curve for the period since the late 1980s. For the ECI-total the shift occurs after 1993, for the ECI-wages and salaries the shift occurs after 1988, and for NIPA hourly compensation two shifts are apparent: one after 1988 and one after 1993.

[19] Some analysts in recent years have argued that the economy has entered a "new era" in which a step-up in the trend rate of productivity growth is underway, leading to a faster potential rate of growth for the economy. Faster productivity growth by itself, however, need not alter the value of the NAIRU, which is determined in labor markets by the demand for and supply of labor (see Blanchard and Katz, 1997). An increase in productivity allows firms to pay higher real wages (at least eventually), but workers probably will increase their "reservation wage, " i.e. the wage they consider to be appropriate. Provided that the "aspirations" of workers concerning appropriate wages eventually match the productivity gain, the NAIRU will be unaffected. Only if productivity growth somehow changes the structure of labor markets, altering the rates of transition into and out of unemployment, can it ultimately affect the NAIRU. For example, improvements in the speed and quality of matching unemployed workers with jobs will lead to a lower level of "frictional" unemployment and thus a lower NAIRU.

[20] Econometric tests that assume no change in trend productivity growth also find a statistically significant (though weaker) shift in the wage Phillips curve during the 1990s.

[21] This measure assumes that the unemployment rate for each age cohort is unaffected by the shift in composition. I use the labor-force shares for seven age categories in computing the adjusted unemployment rate. See Shimer (1998) for discussion of this and related demographically-adjusted unemployment measures.

[22] Adjusting the unemployment rate for shifts in both the age and gender composition of the labor force gave results virtually identical to those shown in Figures 11 and 12 for shifts in age alone.

[23] The expansion of the temporary employment industry, discussed above, is often portrayed as both a consequence and cause of improved economic efficiency.

[24] The dispersion measure is an employment-weighted standard deviation of annual state employment growth rates. The annual values of the dispersion measure are averaged for each decade. A similar approach is used to compute dispersion measures for state unemployment rates and gross state product growth rates.

[25] Consistent data for regional unemployment and output growth rates are available only since 1978 for most states and 1980 for all states and census regions.

[26] The expansion and contraction periods were chosen depending on whether the national unemployment rate was rising or falling on an annual basis (with a few exceptions to avoid periods containing only a single year).

[27] The statistical significance of the dispersion of unemployment in Phillips curve regressions was identified by Archibald (1969), but seems to have been ignored in recent decades. I find that my dispersion measures are statistically significant for explaining some of the shift in the Phillips curve during the 1990s.

[28] Clark (1998) explores the relative importance of national, regional, and industry-specific shocks in determining the degree of synchronization of business cycles across U.S. census regions.

[29] One issue not addressed here but deserving of future research is the quantitative effect, if any, that work requirements under the national welfare reform legislation of 1996 may have had on the national labor market and the NAIRU.

[30] In related work, I am currently developing a theoretical framework for understanding how spillovers in expectations about price and wage inflation across different regions may influence the national wage and price setting process.

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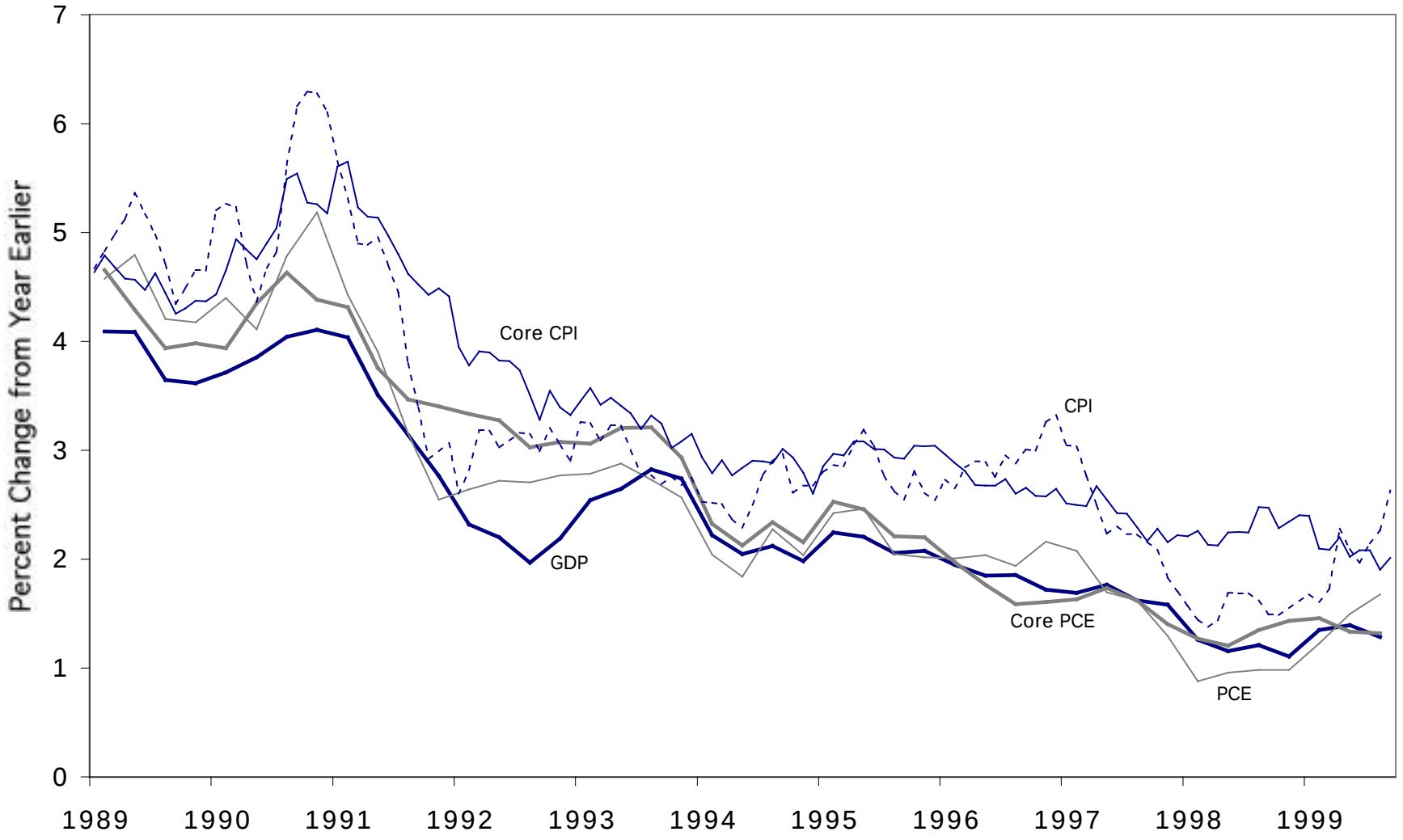
Table 1
Estimates of the NAIRU
Various Time Periods, 1962-1998

1.	**Time Period:**	1962-72	1973-93	1994-98	
	CPI	5.1	***6.9***	5.2	
	CPI-RS	5.2	***6.9***	5.2	
2.	**Time Period:**	1962-72	1973-88	1989-93	1994-98
	CPI	5.1	***7.1***	***6.3***	5.2
	CPI-RS	5.2	***7.1***	***6.3***	5.2
3.	**Time Period:**	1962-72 & 1994-98	1973-93		
	CPI	5.1	***6.9***		
	CPI-RS	5.2	***6.9***		
4.	**Time Period:**	1973-88	1989-98		
	CPI	7.1	***5.7***		
	CPI-RS	7.1	***5.7***		
5.	**Time Period:**	1973-88	1989-93	1994-98	
	CPI	7.1	6.3	***5.2***	
	CPI-RS	7.1	6.3	***5.2***	
6.	**Time Period:**	1973-93	1994-98		
	CPI	6.9	***5.2***		
	CPI-RS	6.9	***5.2***		

Note: Estimates are provided using the official consumer price index (CPI) and a research series (CPI-RS) that incorporates, retroactively, most of the methodological changes in the CPI since 1978. See text for details. Italics denote estimate is statistically different at 5 percent level from estimate reported in first column. All estimates are computed from a standard Phillips curve with controls for changes in the relative price of food and energy. Estimates in panels 1 to 3 use annual data from 1962 to 1998 and estimates in panels 4 to 6 use annual data from 1973 to 1998.

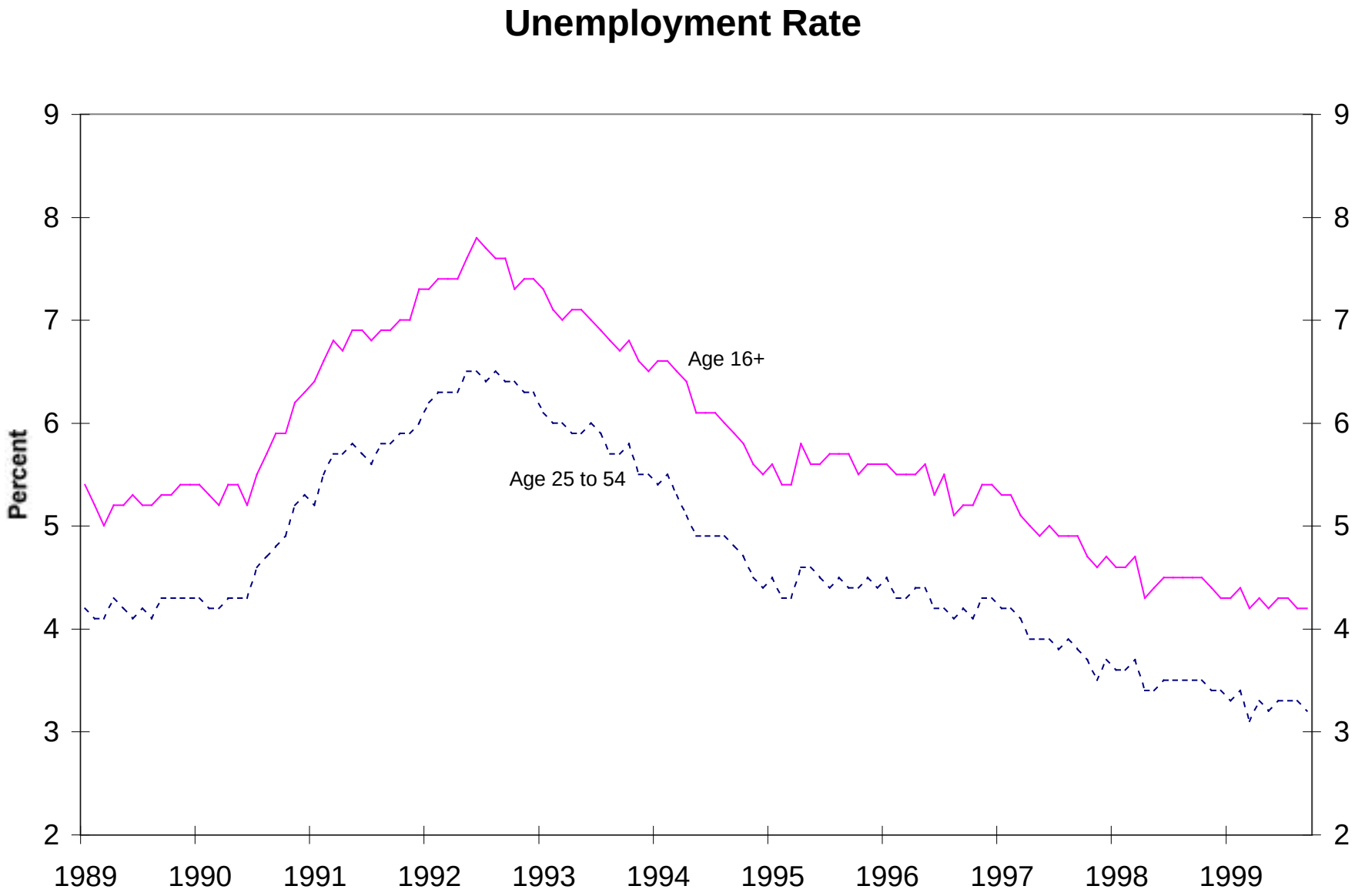
Figure 1

Price Inflation



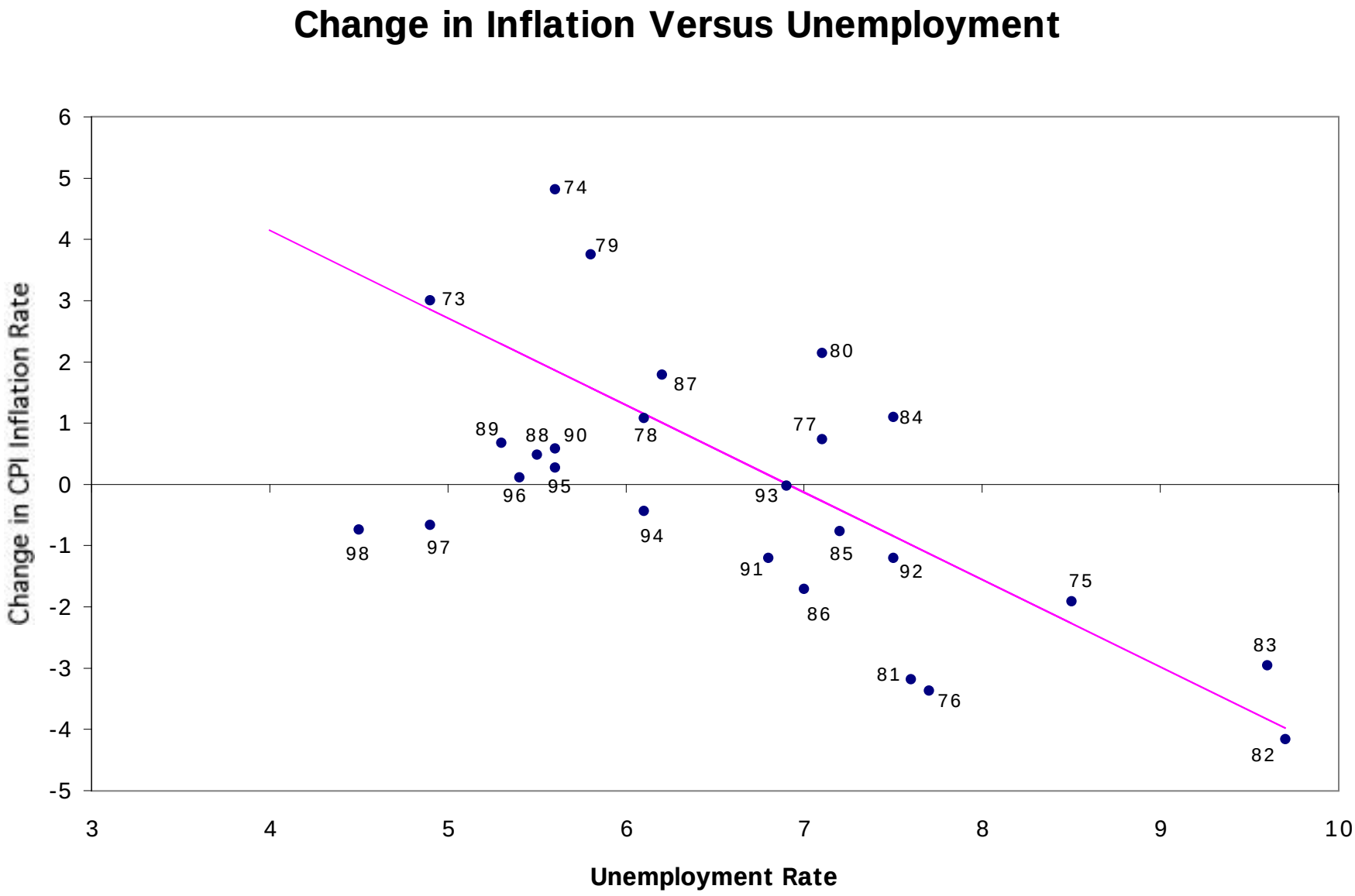
Source: Bureau of Economic Analysis and Bureau of Labor Statistics. Data are chain-type price indexes for GDP and personal consumption expenditures (PCE). CPI is all-urban consumer price index. Core measures exclude food and energy costs.

Figure 2



Source: Bureau of Labor Statistics.

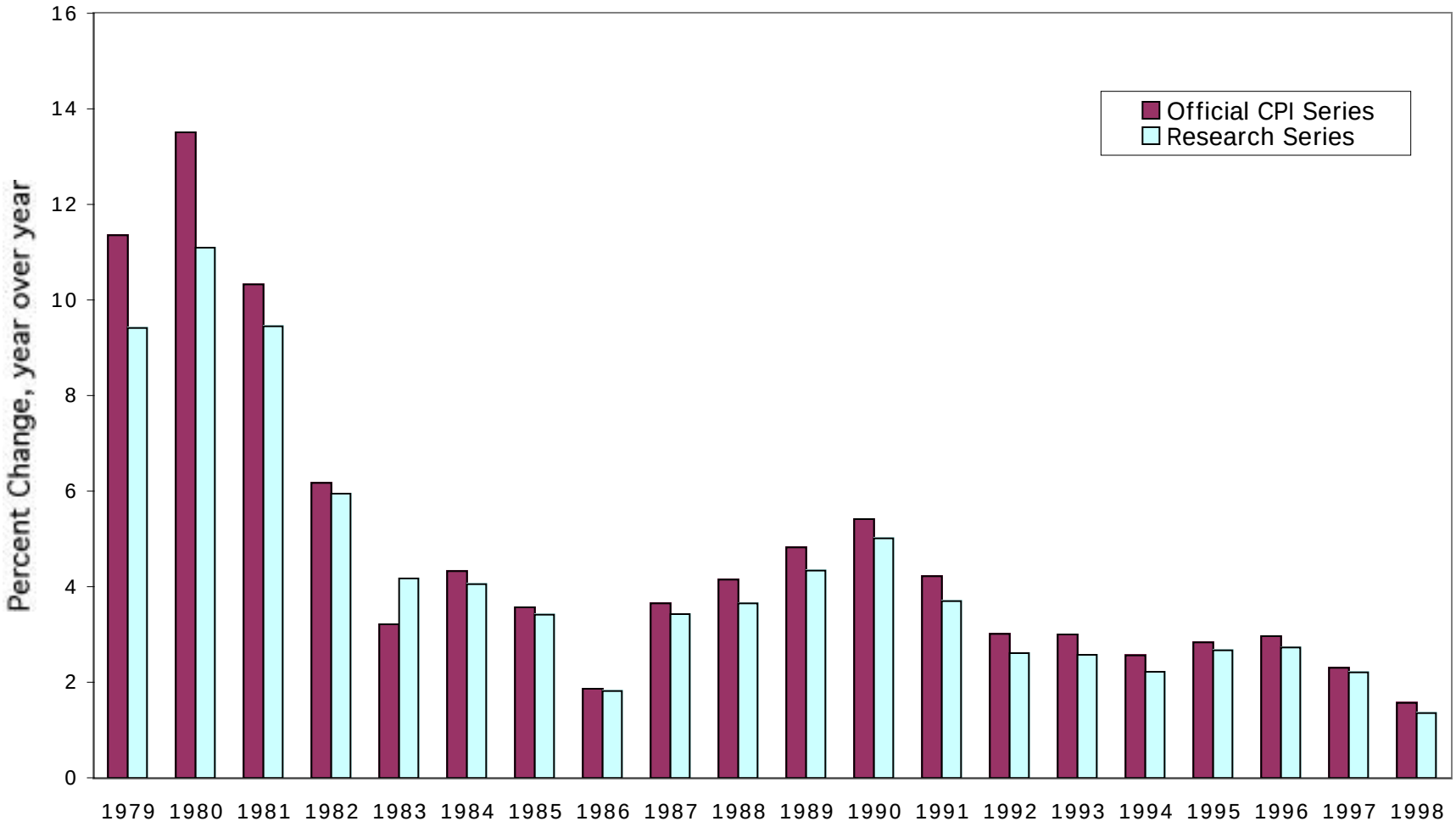
Figure 3



Source: Bureau of Labor Statistics and author's calculations. Trend line is fitted using annual data for 1973 to 1993.

Figure 4

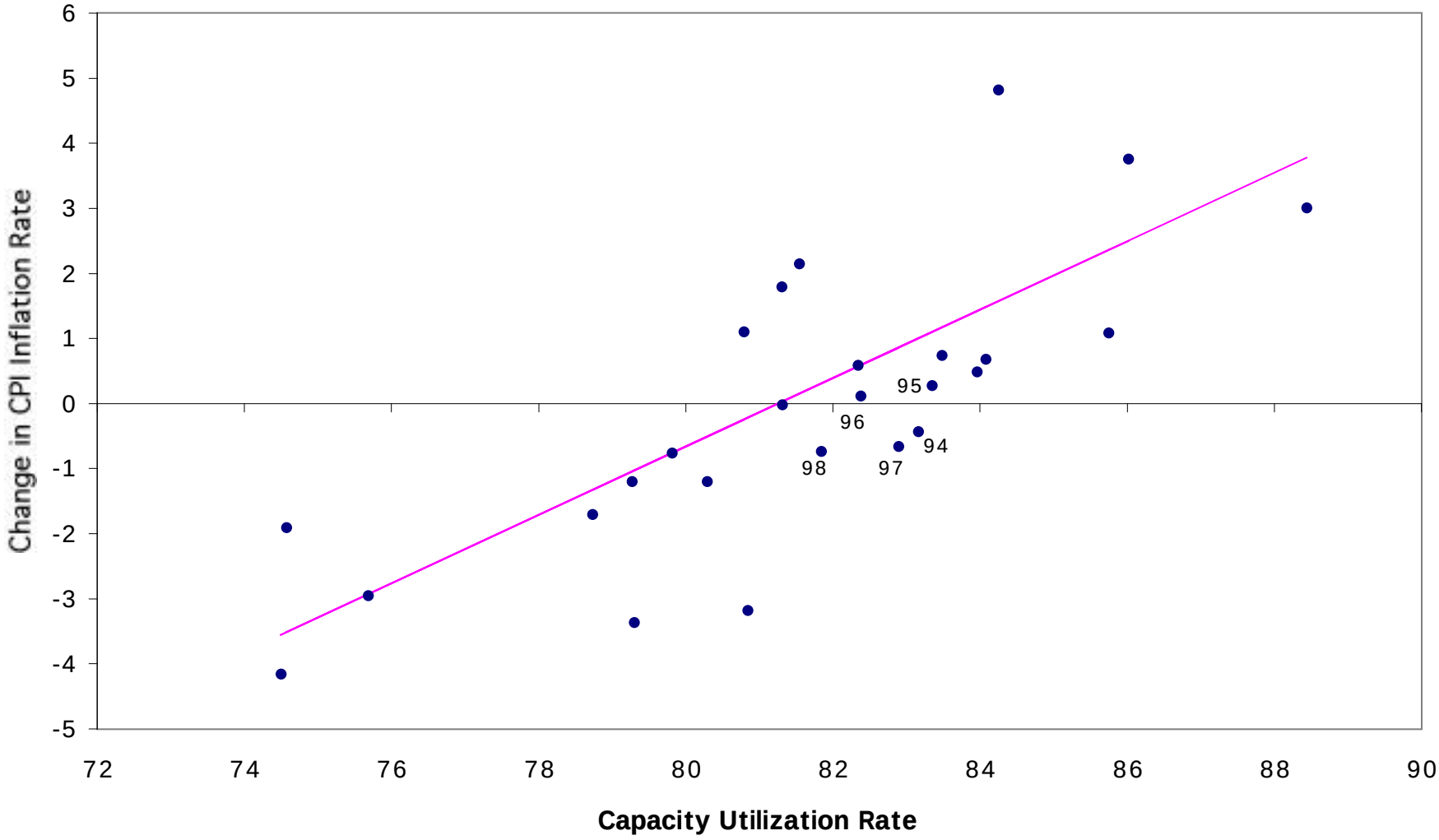
Consumer Price Inflation: Official and Research Series



Source: Bureau of Labor Statistics.

Figure 5

Change in Inflation Versus Capacity Utilization Rate



Source: Board of Governors of the Federal Reserve System, Bureau of Labor Statistics, and author's calculations. Trend line is fitted using annual data for 1973 to 1998.

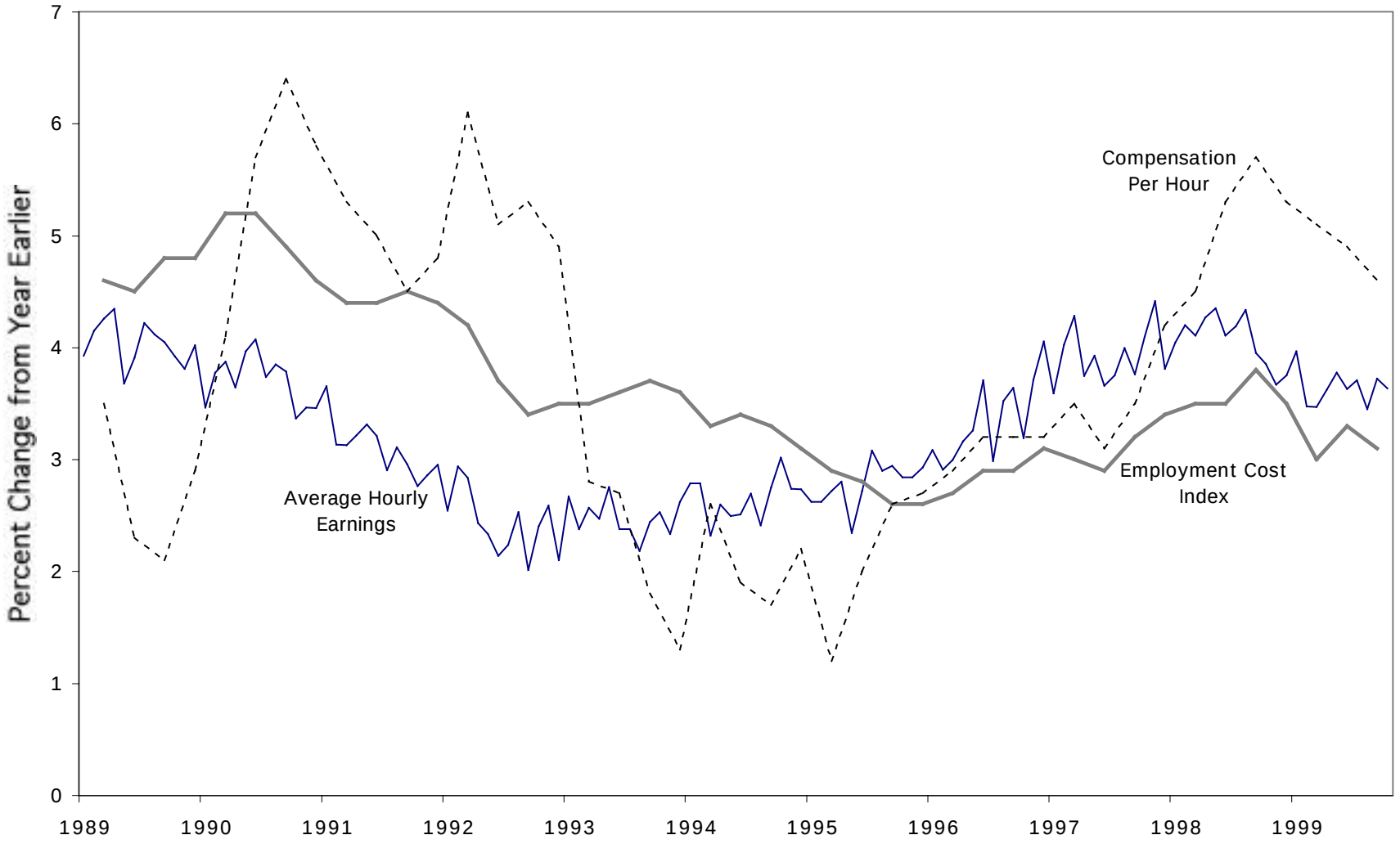
Figure 6

Employment Rate and Capacity Utilization Relative to 1987

Source: Bureau of Labor Statistics, Federal Reserve Board, and author's calculations. Employment rate is computed as one minus the civilian unemployment rate. Both variables are scaled to equal 100 in 1987.

Figure 7

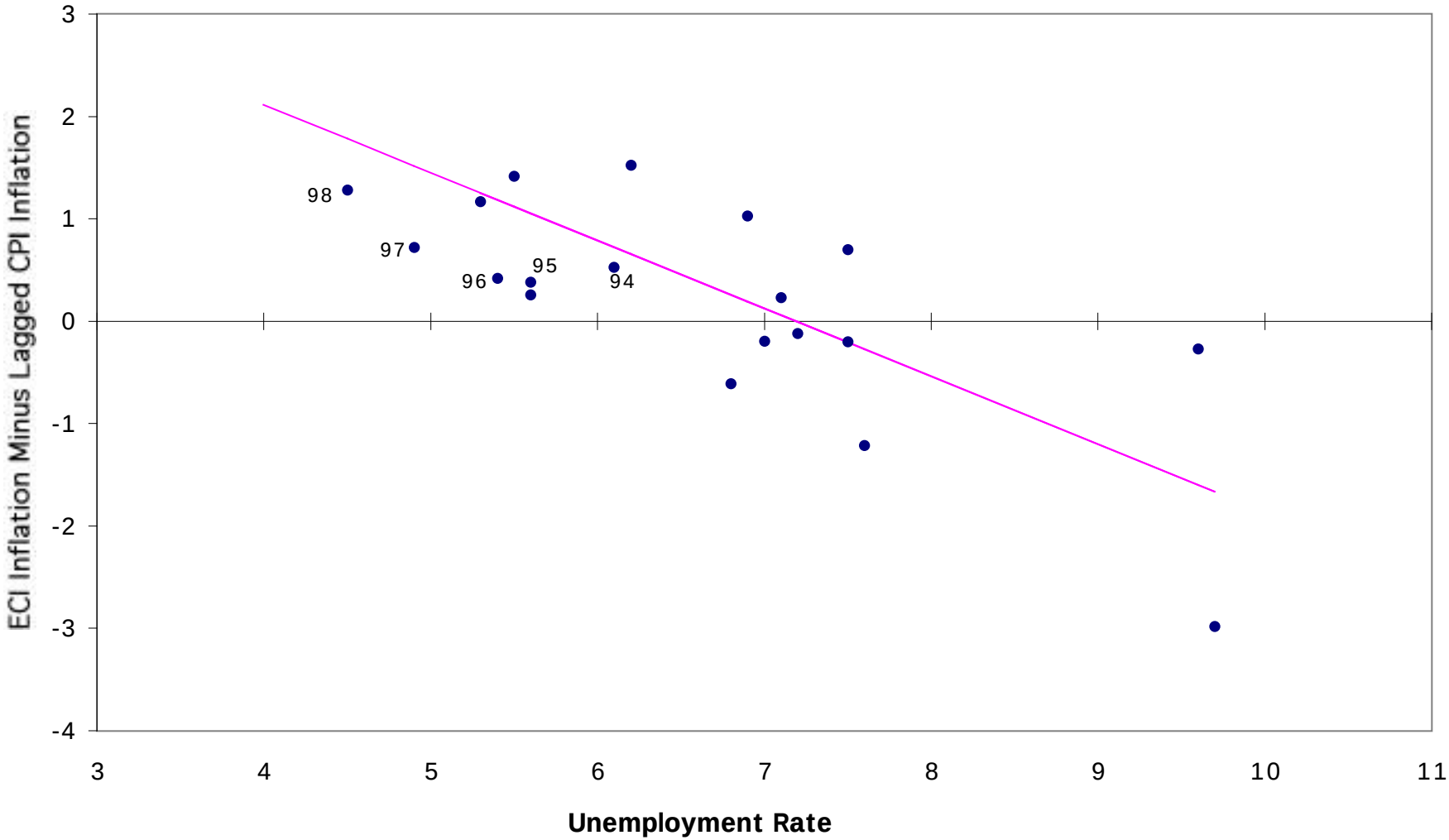
Labor Costs



Source: Bureau of Labor Statistics. Employment cost index is total compensation for private industry. Compensation per hour is for nonfarm business sector. Average hourly earnings is for production and non-supervisory workers in private industry.

Figure 8

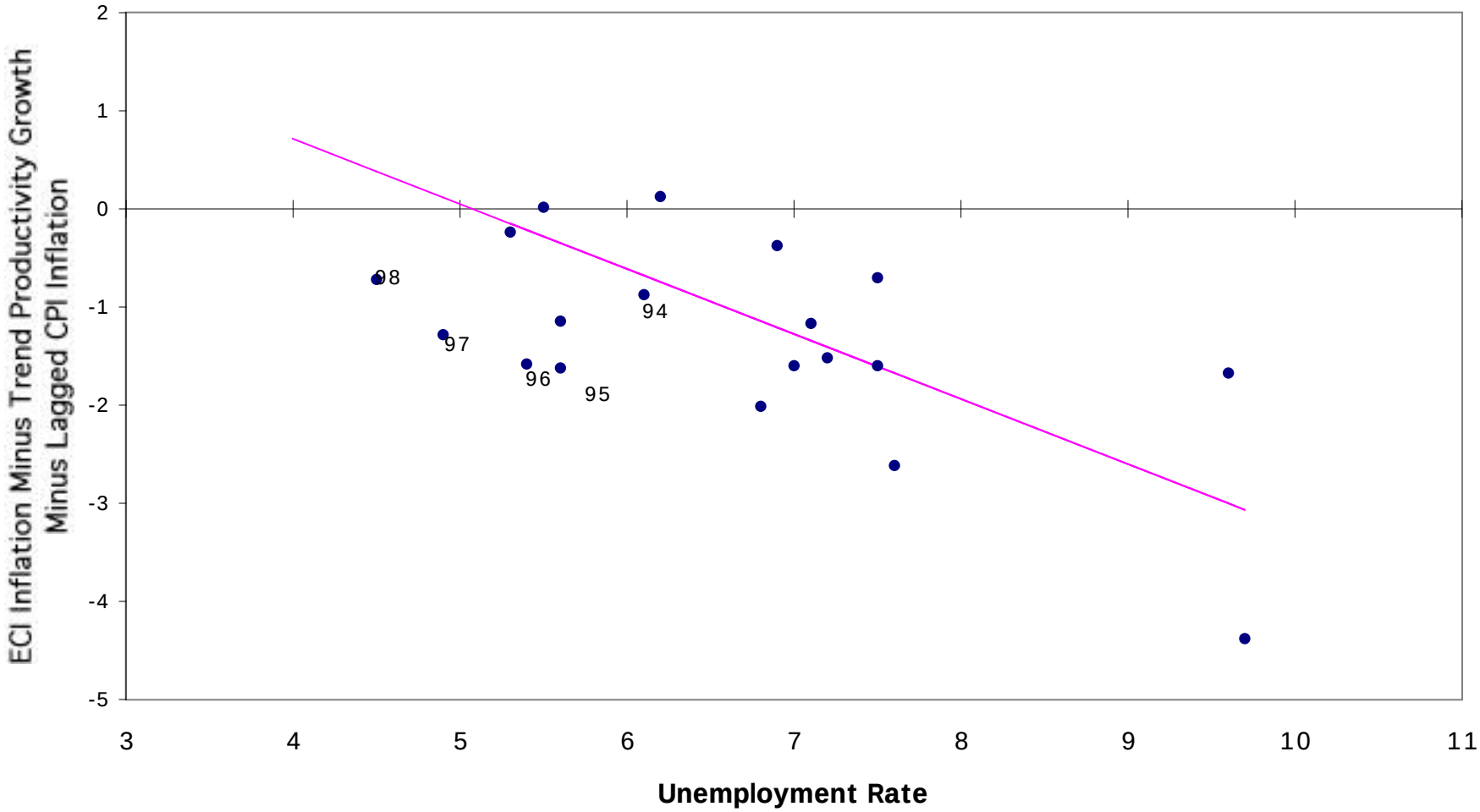
Phillips Curve Using Employment Cost Index



Source: Bureau of Labor Statistics and author's calculations. Employment cost index is total compensation for private industry. CPI research series is used for price inflation. Trend line is fitted using annual data for 1980 to 1993.

Figure 9

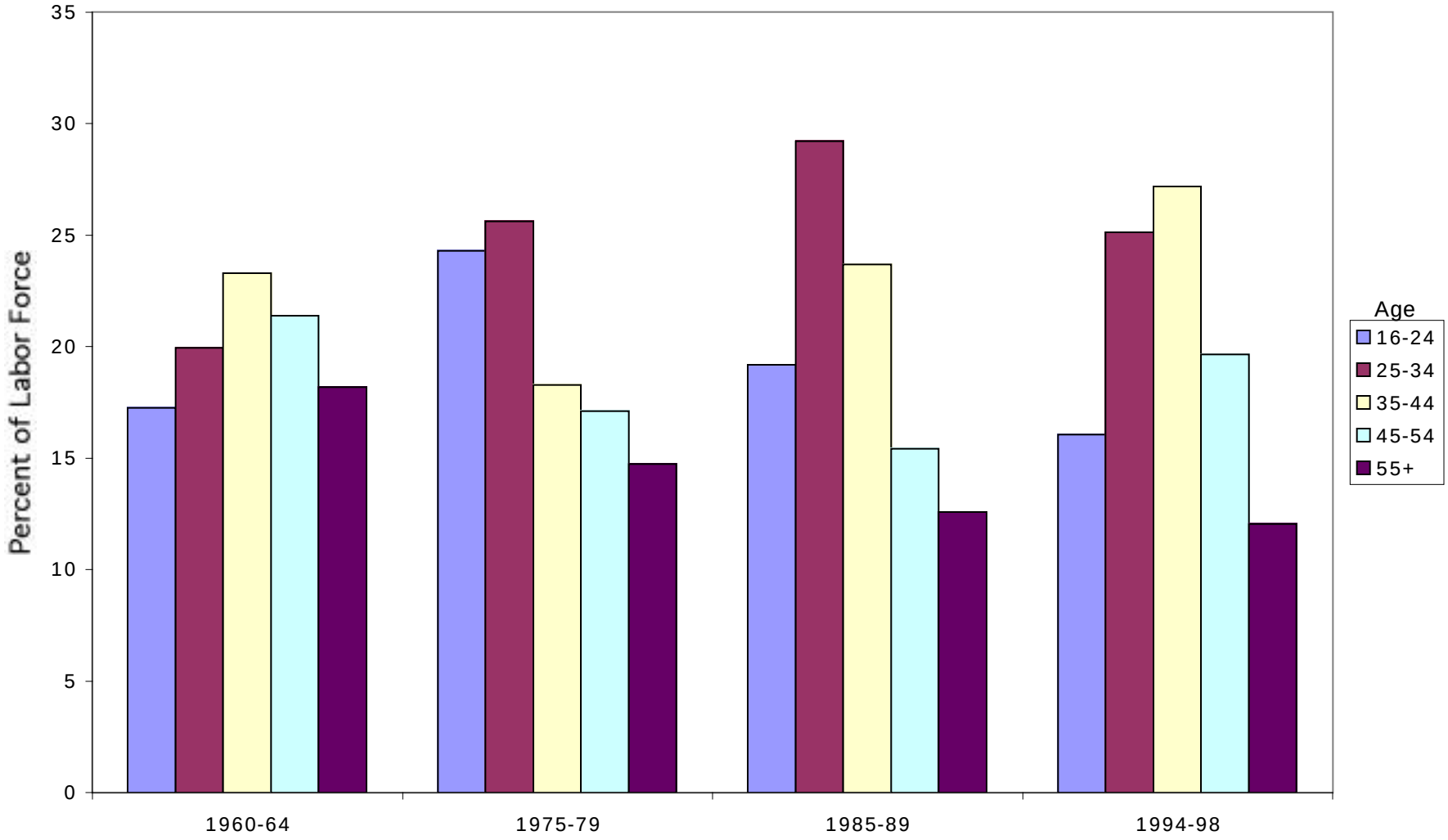
Phillips Curve Using Employment Cost Index (adjusted for shift in trend productivity growth)



Source: Bureau of Labor Statistics and author's calculations. Productivity is assumed to grow 1.4 percent per year from 1980 to 1994 and 2.0 percent per year from 1995 to 1998. Trend line is fitted using annual data for 1980 to 1993.

Figure 10

Age Structure of the Labor Force



Source: Bureau of Labor Statistics and author's calculations.

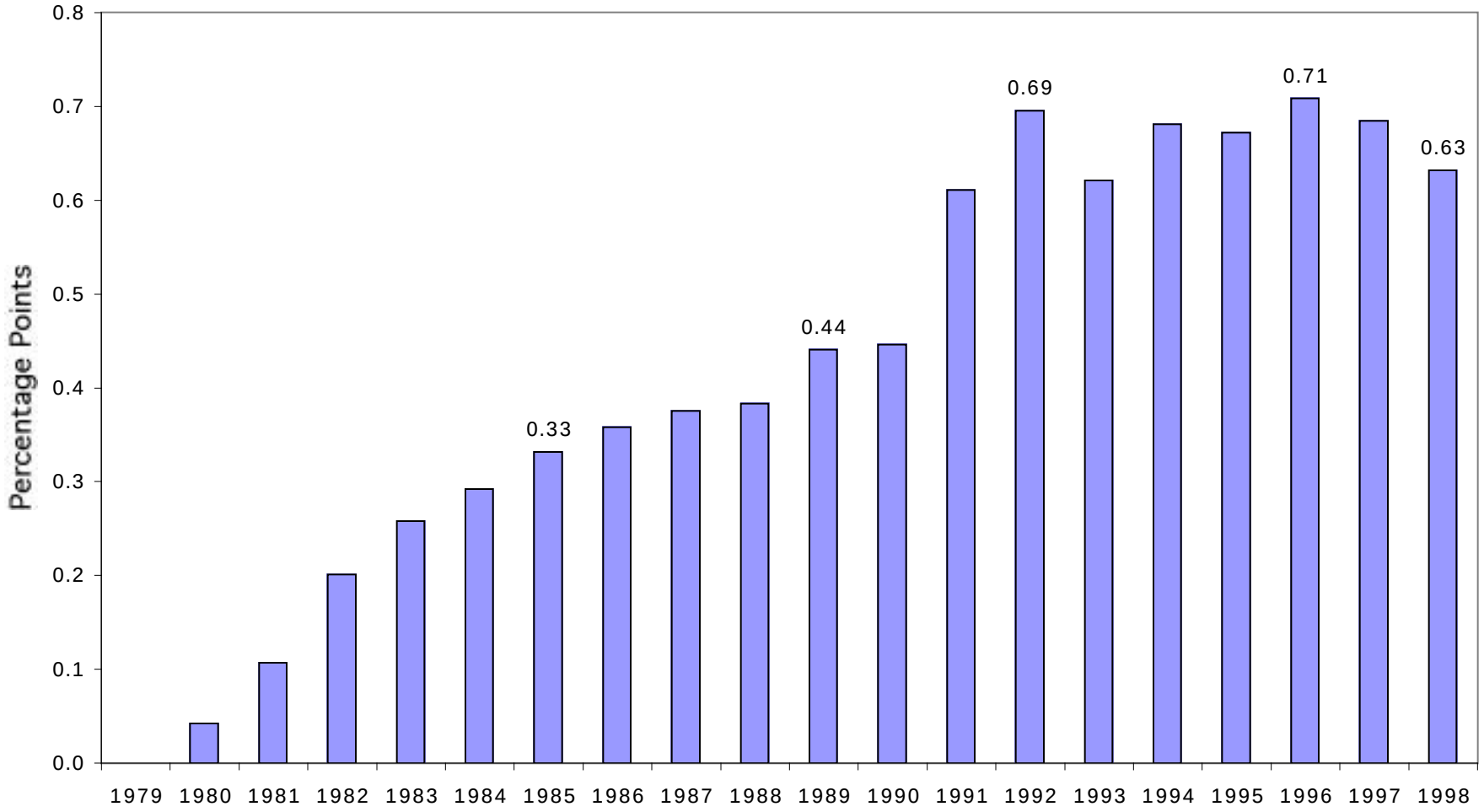
Figure 11

Demographically-Adjusted Unemployment Rate

Source: Bureau of Labor Statistics and author's calculations. The adjusted unemployment rate holds constant at 1979 values the labor-force shares for each of seven age groups.

Figure 12

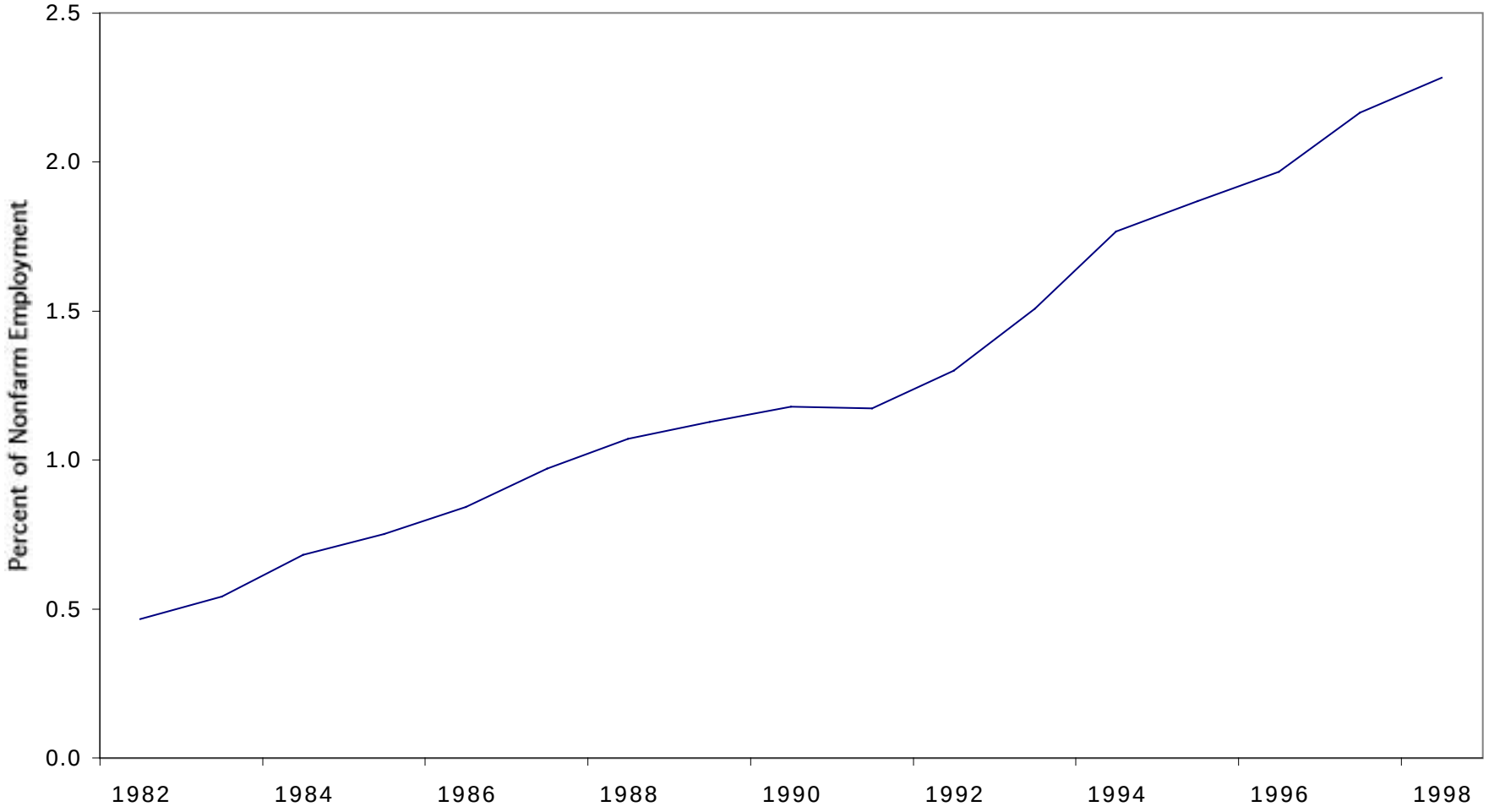
Difference Between Actual and Demographically-Adjusted Unemployment Rates



Source: Bureau of Labor Statistics and author's calculations. Chart shows how much higher the unemployment rate would have been if the age structure of the labor force had remained unchanged from 1979 onward.

Figure 13

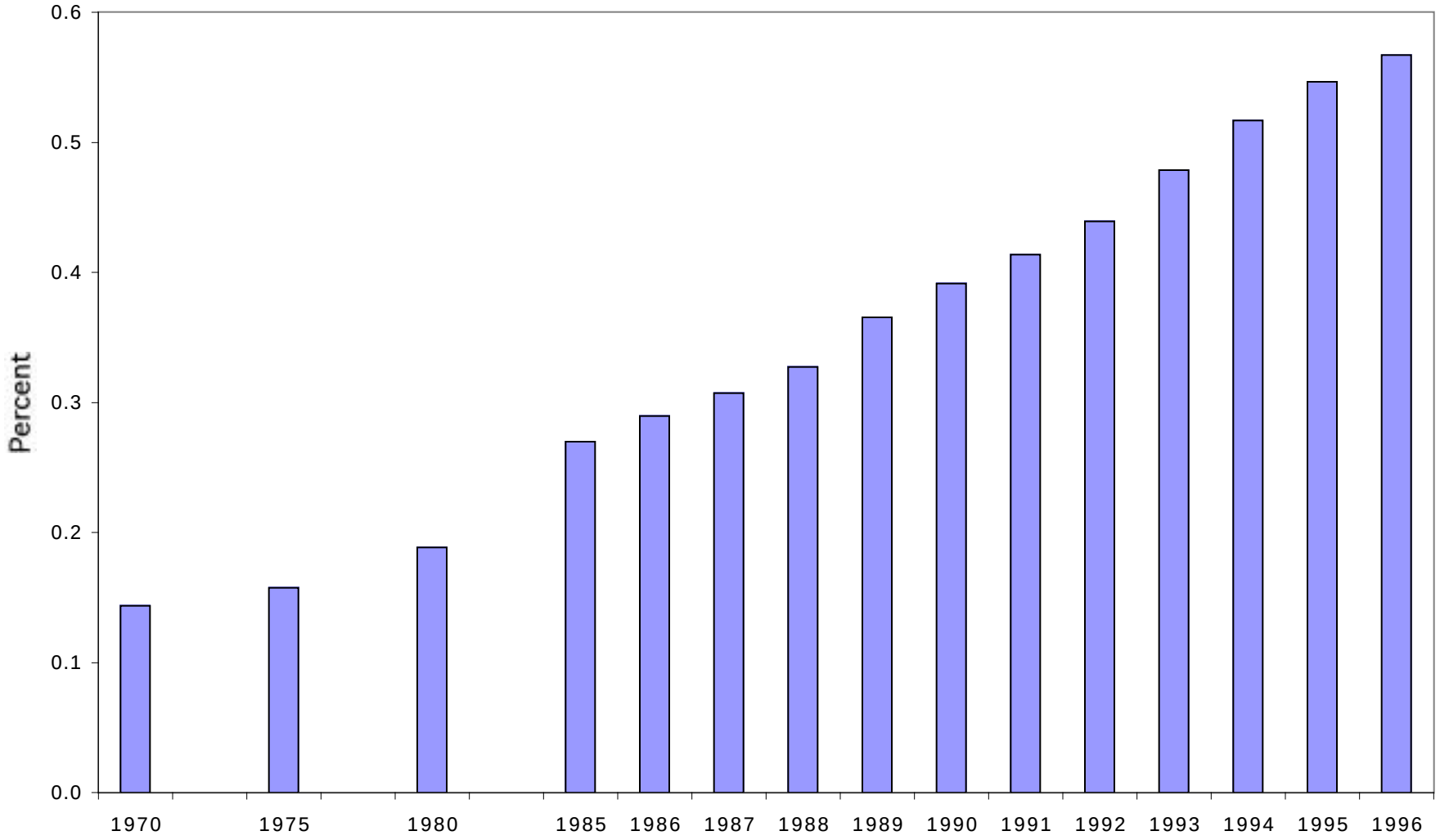
Temporary-Help Employment As a Share of Total Employment



Source: Bureau of Labor Statistics and author's calculations.

Figure 14

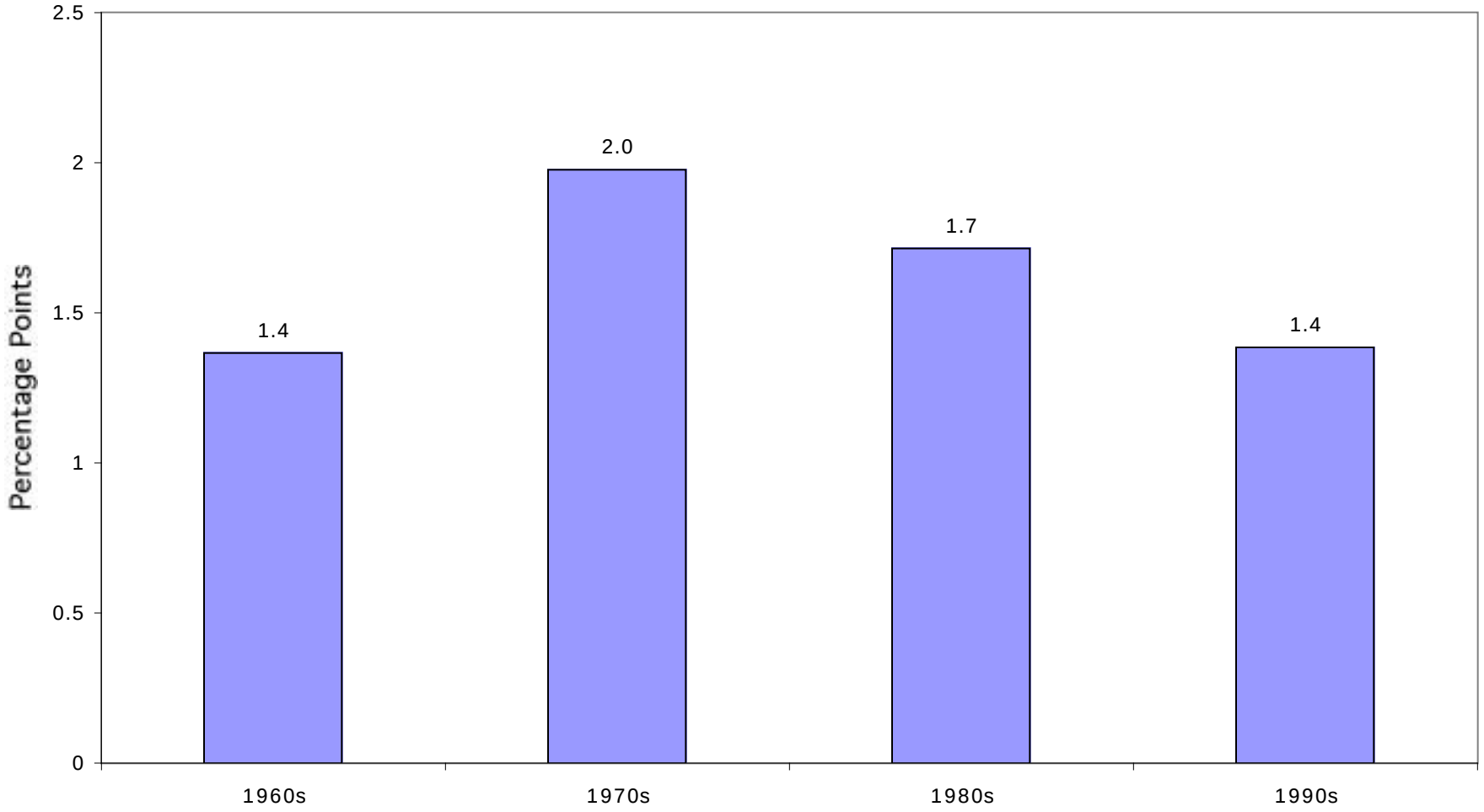
Percent of Population in Jail or Prison



Source: Bureau of Justice Statistics, Bureau of Labor Statistics, Statistical Abstract of the United States, and author's calculations.

Figure 15

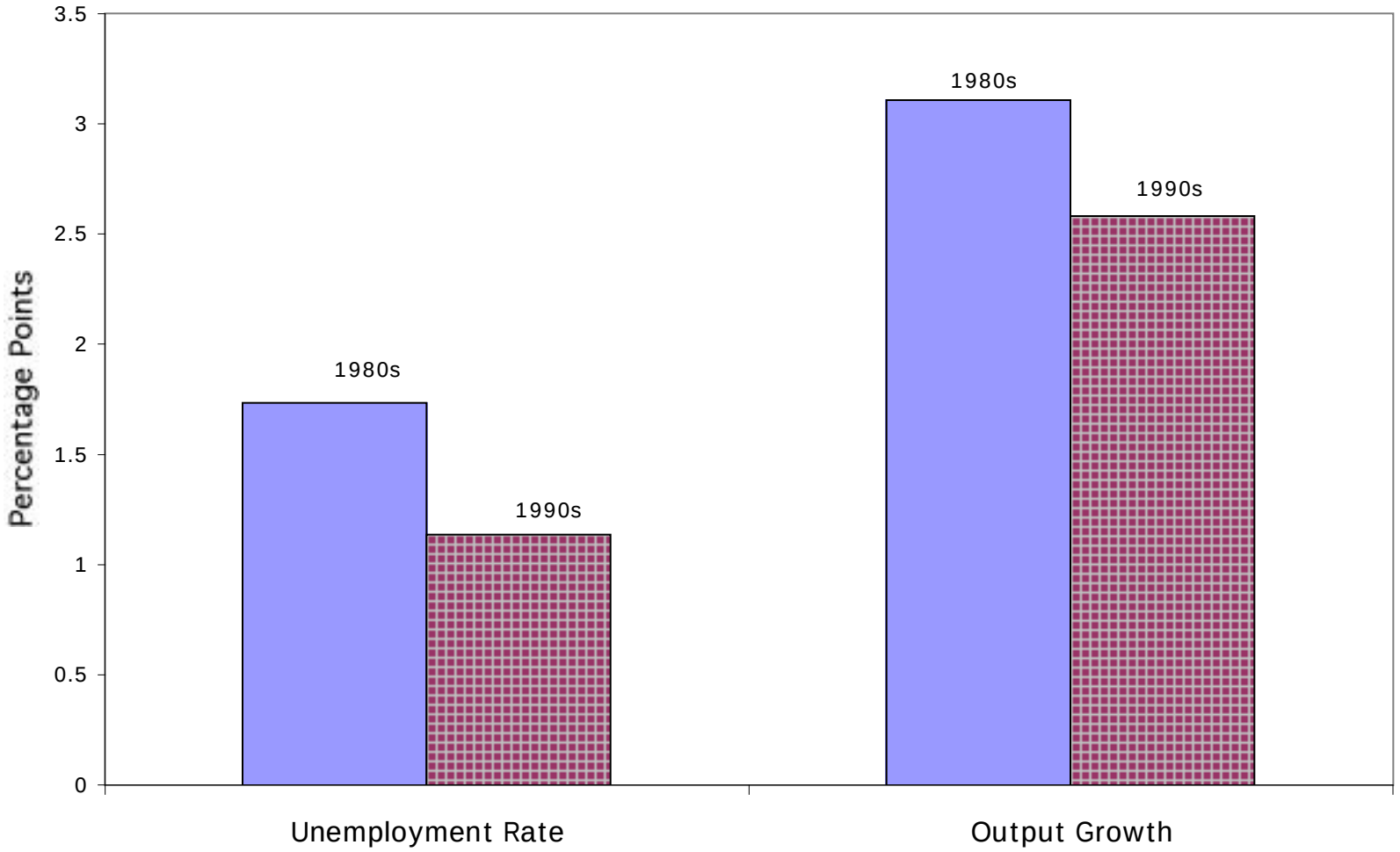
Dispersion of State Employment Growth By Decade



Source: Bureau of Labor Statistics and author's calculations. Dispersion measure is the weighted standard deviation of nonfarm employment growth across states, using the state shares in total national employment as weights.

Figure 16

Dispersion of State Unemployment Rates and State Output Growth By Decade

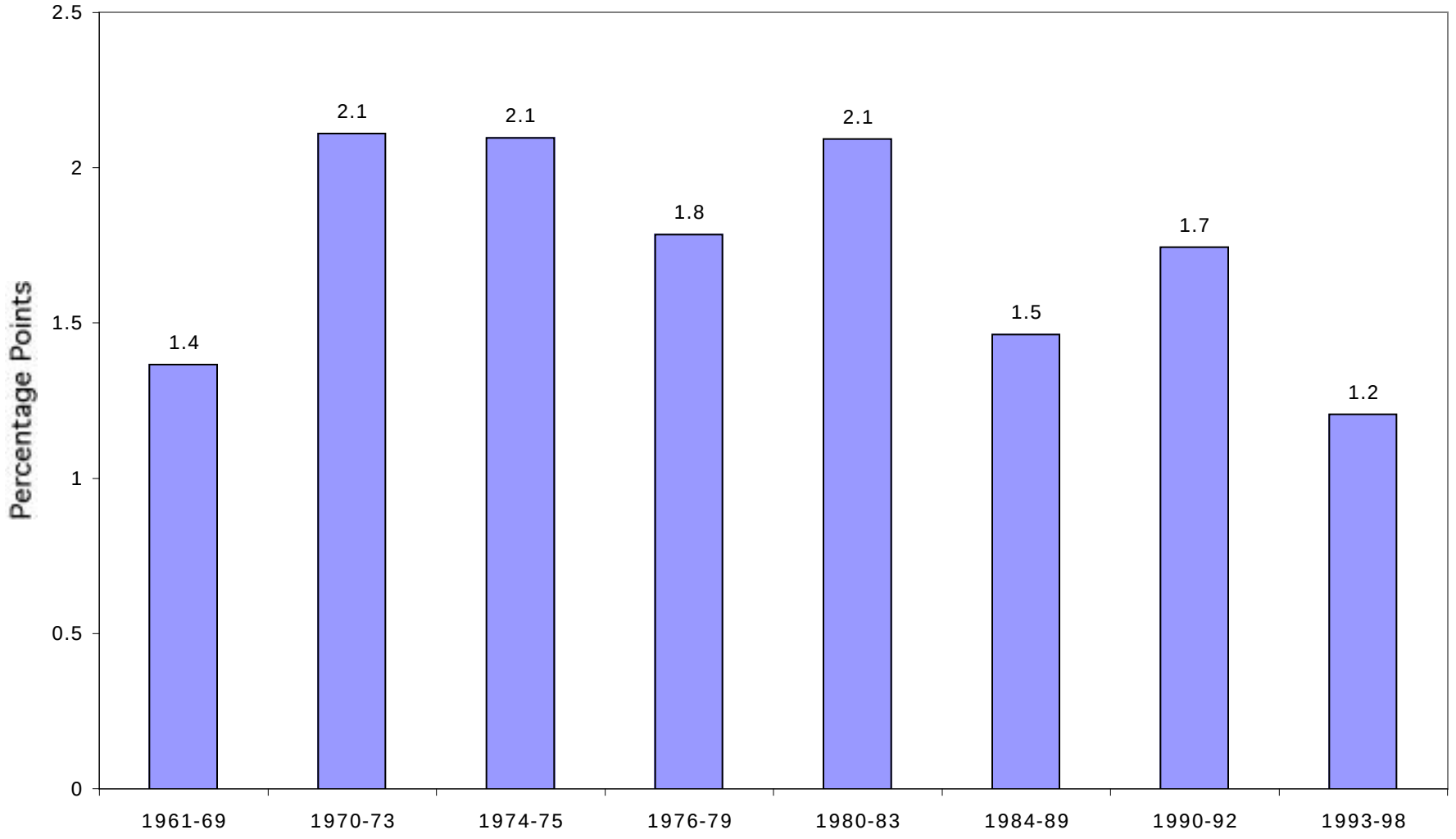


Source: Bureau of Labor Statistics, Bureau of Economic Analysis, and author's calculations. Dispersion measure is the weighted standard deviation across states of either civilian unemployment rates or gross state product growth rates.

Figure 17

Dispersion of State Employment Growth

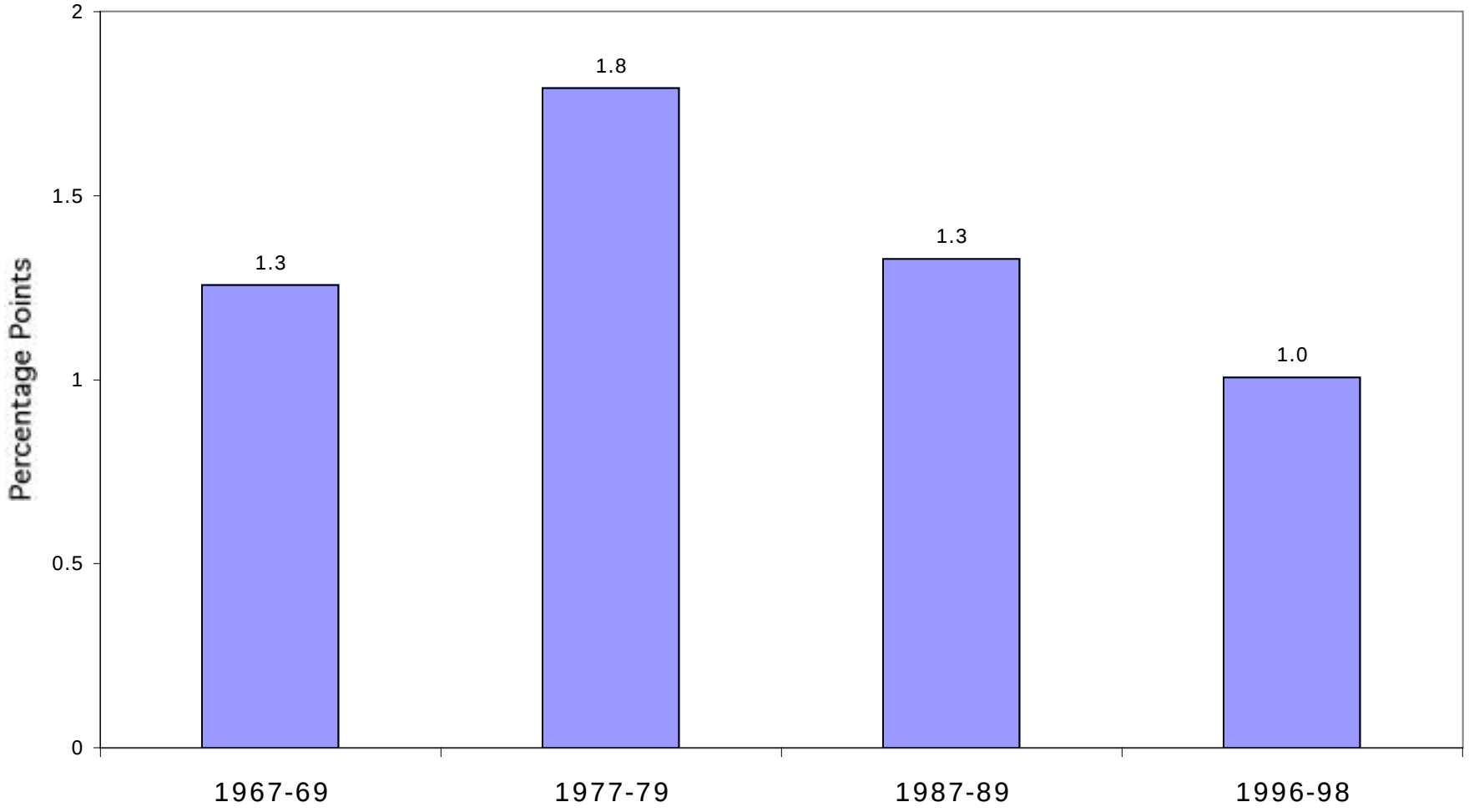
(Expansion and Contraction Periods)



Source: Bureau of Labor Statistics and author's calculations. Dispersion measure is the employment-weighted standard deviation of nonfarm employment growth across states.

Figure 18

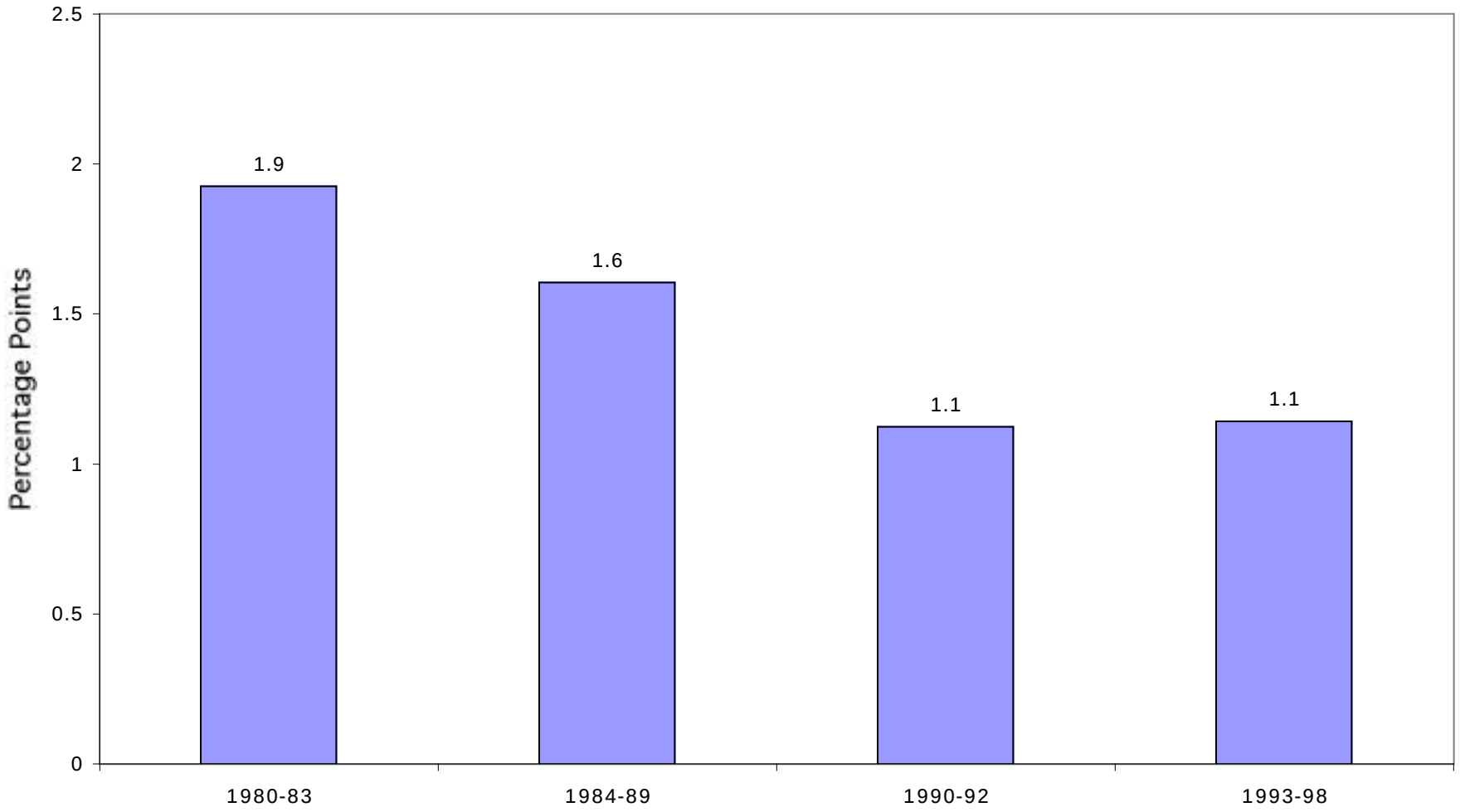
Dispersion of State Employment Growth
(Later Stage of Expansions)



Source: Bureau of Labor Statistics and author's calculations. Dispersion measure is the employment-weighted standard deviation of nonfarm employment growth across states.

Figure 19

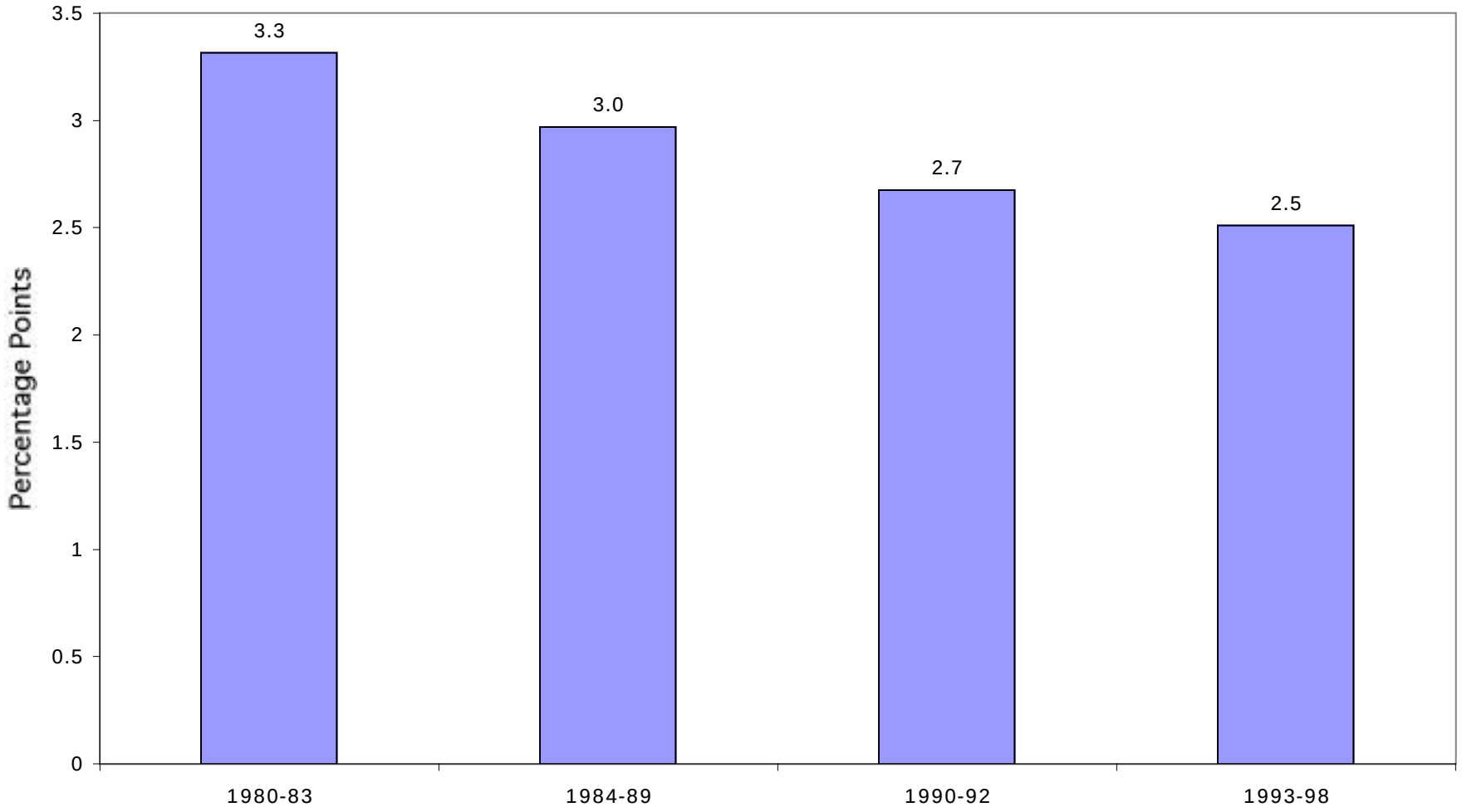
Dispersion of State Unemployment Rates
(Expansion and Contraction Periods)



Source: Bureau of Labor Statistics and author's calculations. Dispersion measure is the employment-weighted standard deviation of civilian unemployment rates across states.

Figure 20

Dispersion of State Output Growth
(Expansion and Contraction Periods)



Source: Bureau of Economic Analysis and author's calculations. Dispersion measure is the standard deviation of gross state product growth rates.