Lessons from Monetary Policy in the 1990s

(Preliminary and incomplete. Not for Citation. If you would like to redistribute, please send a request to the author)

Michael T. Kiley*

March 20, 2025

Abstract

The 1990s have been called the “Fabulous Decade”. Monetary policy played a role, stabilizing inflation around 2 percent while the labor market strengthened. Many accounts suggest the Greenspan Fed followed a discretionary approach and that the good performance of monetary policy reflected prescience of Greenspan with respect to a productivity acceleration. I review the data and narrative record. These suggest that FOMC behavior was guided by concerns over stabilizing inflation and employment in a manner consistent with standard monetary policy rules. The lessons for today are threefold: Monetary policy should act systematically to stabilize inflation, stabilize employment, and to balance these objectives when in conflict. These lessons can be implemented via reference to simple policy rules as guides.

* Federal Reserve Board. Email: mkiley@frb.gov. The views expressed herein are those of the author and do not reflect the views of the Federal Reserve or its staff. This research has used artificial intelligence tools for simple editing and assistance in summarizing historical materials such as FOMC transcripts.

Introduction

In the second half of the 1990s, Federal Reserve policymakers faced rapid economic growth and a high-pressure labor market. While Federal Reserve Chairman Alan Greenspan's early identification of accelerated structural productivity growth is often credited with the success of monetary policy in achieving low inflation and low unemployment, a retrospective analysis suggests a more traditional set of factors—the level of inflation and estimates of resource utilization, especially the level of unemployment relative to its natural rate—guided effective monetary policy.

The importance of these factors in the 1990s points to lessons for today. For example, discussions of the potential for artificial intelligence to lead to a productivity acceleration have led to suggestions that monetary policymakers should "do what Greenspan did" in the 1990s. Alternatively, shifting global trade pressures and shocks to energy markets raise concerns of a return to the 1970s. But what "did Greenspan do" and how can economists draw lessons from the 1990s for the practice of effective monetary policy today?

The key issues span three categories. First, appreciation for the challenges in measuring resource utilization and techniques to address these issues—in the measurement of productivity and the natural rate of unemployment, among other areas—grew rapidly over the 1990s and were incorporated in analyses of government agencies, including the Federal Reserve. Second (and relatedly), policymakers and researchers focused on the definition of price stability, the role of an inflation target as a nominal anchor, and the factors that influence the appropriate level of the inflation target including, among other issues, measurement biases in price indexes and the effective lower bound on nominal interest rates. Third, academic research and policy discussions emphasized the role of systematic policy processes, including nominal interest rates rules and inflation targeting frameworks, as guidelines for policy and as tools to improve the public's understanding of policy.

These factors combined to shape monetary policy in ways underemphasized in narratives centered on the 1990s productivity acceleration. The FOMC's decisions in the late 1990s reflect a concerted effort to stabilize inflation, implicitly adopting a target near 2 percent for the personal consumption expenditures price index and emphasizing the importance of anchoring inflation expectations. This approach called for accommodation as inflation fell below 2 percent in the second half of the 1990s. Simultaneously, policymakers recognized uncertainty about the natural rate of unemployment and the likely decline in the natural rate relative to levels that prevailed in earlier decades. This recognition limited federal funds rate increases even as unemployment fell below 5 percent. The importance of these developments can be seen in the similarity of the FOMC's federal funds rate decisions to

those implied by systematic policy guidelines akin to the Taylor rule in real-time discussions, as such policy rules called for a balancing of low inflation and a tightening labor market.

The lessons for current monetary policy are clear: follow inflation data, acknowledge uncertainty in sustainable unemployment rates while leaning against overheating, and maintain stable long-run inflation expectations—all within a framework of systematic policy processes. This traditional approach, grounded in a standard model of monetary policy, underpinned the successful navigation of the unique economic landscape of the 1990s and can continue to inform policy decisions today.

A Brief Review of the 1990s

Our starting point is the evolution of the data from 1987—the start of Alan Greenspan's tenure as Chairman of the Federal Reserve Board—to 2001, when recession ended "the Fabulous Decade" (the moniker for the 1990s adopted by Blinder and Yellen, 2001).

Figure 1 presents the evolution of the federal funds rate, real GDP per capita and nonfarm business labor productivity, the unemployment rate, and inflation as measured by the personal consumption expenditures price index. (Current vintage data is used.)

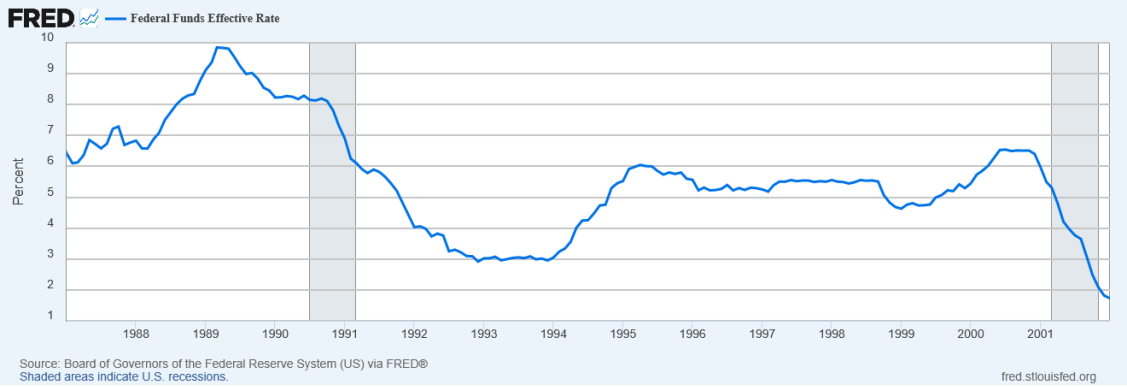
After declining the in the early 1990s recession, real GDP rose over the decade. Notably, growth accelerated and reach high levels in the second half of the 1990s. Moreover, productivity growth also picked up in the latter half of the decade.

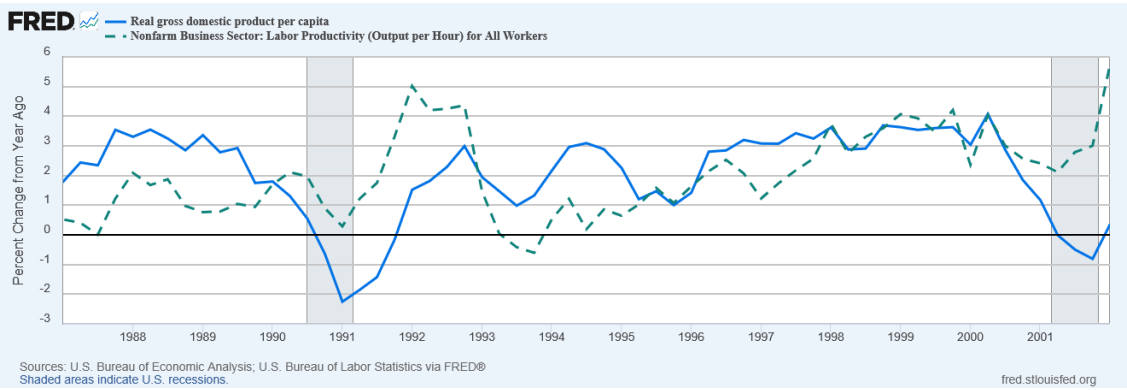
The unemployment rate followed the business cycle. Importantly, the long expansion led to a steady decline in the unemployment rate over the 1990s. The decline in the unemployment rate to below 4 percent by 2000 is among the developments contributing to the "fabulous decade" label.

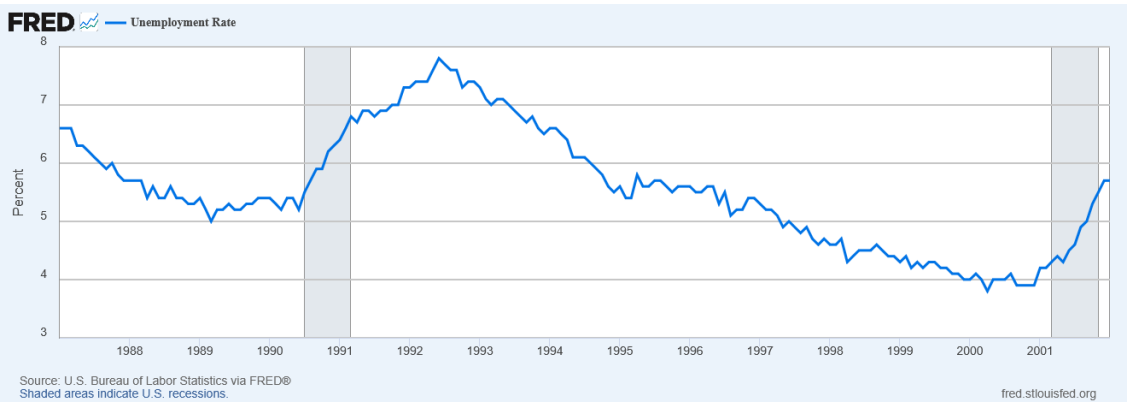
Inflation fell to near 2 percent by 1994 and then below 1 percent in 1998, despite strong growth and low unemployment.

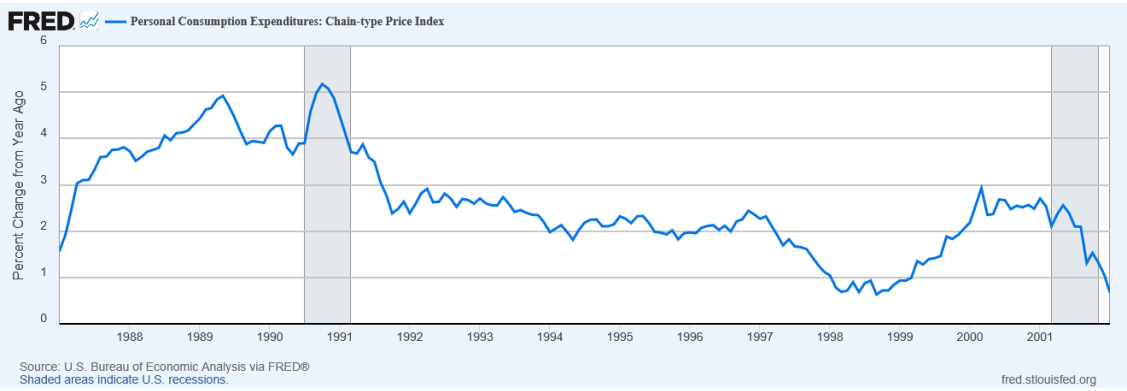
The federal funds rate was reduced in the wake of the 1990-91 recession and raised over the course of 1994. Subsequently, the federal funds rate was remarkably steady until 2000, when it was raised. The onset of the 2001 recession led to reductions in the funds rate.

Figure 1: The U.S. Economy, 1987-2001









Overall, monetary policy during the period has been viewed as remarkably successful (e.g., Blinder and Reis, 2005). How was this success achieved? The consensus narrative regarding 1990s monetary policy has two core elements. First, the FOMC, under the leadership of Chairman Alan Greenspan, valued a discretionary approach to monetary policy that cannot be captured in any simple academic framework. Second, Alan Greenspan identified the 1990s acceleration in productivity early, allowing the FOMC to avoid tightening monetary policy during the strong period of growth in the late 1990s.

Table 1highlights some well-known summaries of the discretionary approach to policy during the era. Mankiw (2001), Blinder and Reis (2005), Friedman (2006), and Blinder (2024) all emphasize discretion, free of a framework, as the core of Greenspan's approach to monetary policy: as Mankiw (2001) says of Greenspan, "If a successor tries to emulate the Greenspan Fed, he won't have any idea how."

Table 1: The Standard View of the Greenspan Policy Strategy

Author	Views on discretion
Mankiw (2001)	"Imagine that Greenspan's successor decides to continue the monetary policy of the Greenspan era. How would he do it? The policy has never been fully explained. Quite the contrary: The Fed chairman is famous for being opaque. If a successor tries to emulate the Greenspan Fed, he won't have any idea how. The only consistent policy seems to be: Study all the data carefully, and then set interest rates at the right level. Beyond that, there are no clearly stated guidelines."
Blinder and Reis (2005)	"Greenspan cherishes option value. Federal Reserve policy under his chairmanship has been characterized by the exercise of pure, period-by-period discretion, with minimal strategic constraints of any kind, maximal tactical flexibility at all times, and not much in the way of explanation. He is a careful manager of the many different risks facing the Fed, and he is prepared to adjust interest rates in response to incoming data and news—which he watches like a hawk. But that does not mean that monetary policy under Greenspan has been haphazard. In fact, it has become rather predictable in recent years as the Fed has become more transparent."
Friedman (2006)	"The more important change in policy practice, however—indeed, what stands out from the Greenspan era as a whole, in retrospect—has been the ongoing movement away from mechanistic restrictions on the conduct of monetary policy, together with a willingness, on occasion, to depart even from what more flexible guidelines dictated by contemporary conventional wisdom would imply, in the interest of carrying out the Federal Reserve System's dual mandate to pursue both stable prices and maximum employment " "The Greenspan era, therefore, may stand as the modern-day pinnacle of 'discretion,' rather than 'rules,'"
Blinder (2022)	"Trust in the Fed's ability to steer the economy with discretionary monetary policy reached fantastic heights during this time."

The early identification of a productivity acceleration by Greenspan is by now well-known and well-documented. Anderson and Klieson (2012) provide a comprehensive review. As early as December 1992, Greenspan questioned in the FOMC meeting whether the recovery in productivity following the early 1990s might reflect an acceleration in structural productivity. In 1994, he connected his views on a potential productivity acceleration to the delays in technology adoption and the slow-moving effects of technological innovations on productivity associated with the work of Paul David (1990). Blinder (2022), in his review of the period, emphasizes how Greenspan was discussing the idea of an underlying acceleration in structural productivity growth in 1995—and how he, as Vice Chairman at the time, and other policymakers did not see evidence for such an acceleration in the data. Blinder and Yellen (2001) discuss their experience at the FOMC in the mid-1990s and highlight how Greenspan discussed an acceleration in productivity early in the period. Meyer (2004) discusses his experience as a Governor at the Federal Reserve in the second half of the 1990s similarly. Woodward (2000) emphasizes Greenspan's identification of faster productivity growth as a key element of Greenspan's assessment of the economy at the time.

Greenspan's views on productivity were clearly ahead of the data and related academic research. Academic research during this period initially struggled to identify the productivity acceleration that Greenspan suspected. This "productivity paradox" is evident in early studies. Robert J. Gordon (1993) concluded that the rapid productivity growth of 1991-92 was largely cyclical, questioning the "widespread journalistic view that a new era of productivity-led growth is at hand." Oliner and Sichel (1994) similarly found that the "puzzle" of computers' impact on productivity was not substantial. Partly as a result, Greenspan spurred staff analysis: for example, Corrado and Slifman (1999) delved into the challenges of measuring productivity in more difficult-to-measure sectors (in work that began much earlier, in 1996).

Some academic work drew parallels between the computer revolution and the introduction of the electric dynamo highlighted in David (1990), suggesting that productivity gains from major technological shifts can take decades to materialize. Greenwood and Yorukoglu (1997) proposed that the introduction of information technologies in the 1970s might have initially caused both a productivity slowdown and increased income inequality, similar to previous industrial revolutions. Hornstein and Krusell (1996) explored how technological improvements could paradoxically cause productivity slowdowns due to learning effects and measurement issues. Similarly, Kiley (1999, 2001) developed models in which structural shifts—in demographics or information technology—can initially slow productivity growth as an economy adjusts owing to adjustment costs or reallocation. These studies highlighted the complexities and potential frictions in adopting new

technologies, ideas that resonated with policymakers grappling with conflicting economic signals.

By the late 1990s, the academic consensus began to acknowledge faster productivity growth as a structural shift. Oliner and Sichel (2000) found that information technology accounted for about two-thirds of the acceleration in productivity growth between the first and second halves of the 1990s. Gordon (2000), while more skeptical, acknowledged a strong revival in U.S. productivity growth from 1995-99, though he argued it was largely confined to the durable manufacturing sector. And this consensus informed government assessments more broadly, with the Council of Economic Advisors highlighting the new economy in its 2000 Economic Report of the President. Even so, this recognition came late, and this evolution in academic thought demonstrates that Greenspan was indeed ahead of the curve in recognizing the productivity acceleration.

But what does this standard view on Greenspan's assessment of productivity imply for monetary policy? Baseline approaches, like a Taylor rule or inflation targeting, consider inflation and resource utilization. The struggle to answer the question of what monetary policy did in the 1990s is no doubt compounded by with the standard view of Greenspan acting under discretion, in a hard to duplicate way. This discretion view loosely leads to the following principles: 1. Identify big structural shifts and 2. Do the right thing in light of such structural shifts.

The remainder of the analysis will investigate whether a more standard framework can help understand 1990s monetary policy and its lessons for today.

A Framework to Understand 1990s Monetary Policy

The discussion of 1990s monetary policy is framed within a simple New-Keynesian model.[1] The small model takes a form familiar from academic research (e.g., Clarida, Gali, and Gertler, 1999; Woodford, 2003; Gali, 2008).

The model

The first ingredient is the Phillips curve—specifically, a New-Keynesian Phillips curve linking inflation to expected inflation, the output gap, and a cost-push (supply) shock, as in

Equation 1: $\pi(t) = E\{\pi(t+1)\} - \big(u(t) - u^n(t)\big) + e(t).$

In equation 1, π denotes inflation, $E\{\quad\}$ is the expectations operator based in period t information, y is the output gap, u is the unemployment rate and u^n is its natural rate, e the

[1] Small models can illustrate properties that are shared by larger models (e.g., Kiley, 2016).

supply shock, and κ is a (positive) parameter. Unemployment above/below its natural rate lowers/raises inflation. Note that a coefficient of unity is assumed on expected inflation to ensure the long-run neutrality of inflation.

The second ingredient is the IS curve governing output and an Okun's law equation linking the output and unemployment gaps, given by

Equation 2: $y(t) = E\{y(t+1)\} - \sigma[r(t) - E\{\pi(t+1) - r^*(t)\}$,

Equation 3: $\mathrm{u}(\boldsymbol{t}) - \mathbf{u}^{\mathbf{n}}(\boldsymbol{t}) = -\boldsymbol{\chi y}(\boldsymbol{t})$.

In equation 2, r represents the short-term interest rate, r^* is an aggregate demand shock, and σ is a parameter. The deviation of output from potential depends negatively on the real interest rate.

The third ingredient is a policy rule for the nominal interest rate of the Taylor (1993) form, in which the policy rate responds to the deviation of inflation from target and the unemployment gap. (Note the unemployment gap replaces the output gap, reflecting both the dual mandate focus on employment and Okun's law.)

Equation 4: $\boldsymbol{r(t) = r^{ss} + \pi^* + \varphi\{\pi(t) - \pi^*\} - \phi\{u(t) - u^{n*}(t)\}}$.

An immediate question is whether the framework represents a reasonable one to employ as a tool to understand policymaker behavior in the 1990s. A strict view would suggest no: it seems implausible that policymakers directly consulted such a model to form their policy views. Even today, when this model arguably is the starting point for monetary policy analysis, the model is controversial and its flaws are widely acknowledged. But a more holistic view would acknowledge (at least) three factors suggesting that the framework is a useful starting point.

First, the Phillips curve/IS curve model has been the core textbook model for a long time, and the New-Keynesian model is simply a modern formulation of this model. The basic elements of the monetary policy transmission mechanism in the simple New-Keynesian model are the same as those in models that have been used at the Federal Reserve for decades: real interest rates affect broad financial conditions, influencing economic activity and inflation.[2]

Second, literature on New-Keynesian models and monetary policy rules had notable effects on Federal Reserve staff research and policy analysis. The New-Keynesian consensus that culminated in Clarida, Gali, and Gertler's (1999) "science of monetary

[2] Boivin, Kiley, and Mishkin (2010) discuss the continuity in approaches to the monetary policy transmission mechanism over time and how such views are embodied in New-Keynesian DSGE models.

policy" had a strong impact on staff modeling. The role of expectations in inflation dynamics and household and business spending decisions had a strong effect on the development of the core model introduced at the Federal Reserve in the mid-1990s (e.g., Brayton and Tinsley, 1996; Reifschneider, Stockton, and Wilcox, 1996). Relatedly, the literature on monetary policy rules surrounding Taylor (1993) included important contributions from Federal Reserve researchers (e.g., Bryant, Hooper, and Mann, 1993; Henderson and McKibbin, 1993; Fuhrer and Moore, 1995) and the ability to consider such exercises was a motivation for the introduction of the Federal Reserve's new model in 1996 (Reifschneider, Stockton, and Wilcox, 1996).

Third, there was a sharp rise in PhD economists among the ranks of FOMC participants in the 1990s, which is a plausible source of an increase in model-based thinking (Fox, 2014).

The subsequent analysis will use historical records to illustrate the usefulness of the approach.

What the model suggests should guide the policy discussion

The framework maps directly to the concepts that should be considered in an examination of the historical record and FOMC actions. In this initial discussion of concepts and data, current vintage data is used. The historical analysis below will use real-time data.

Two key sets of factors determine policy within the framework—inflation relative to target and unemployment relative to its natural rate. These considerations bring in a broader set of developments, including factors related to the productivity acceleration emphasized in accounts of the Greenspan era.

Inflation, the Inflation Target, Inflation Expectations, and Supply Shocks

The first consideration shaping policy is inflation developments. Three factors should be jointly considered.

1. Inflation developments: The first factor is the level of inflation. Price stability is one leg of the dual mandate and a systematic approach—a "rule" (Equation 4) responds to inflation to deliver price stability. Central to this is the measure(s) of inflation the factor into policymakers discussions. The degree to which the FOMC is focused on developments in the personal consumption expenditures (PCE) price index or the Consumer Price Index (CPI) can be an important consideration. As shown in Figure 2, inflation as measured by the PCE price index had fallen to 2 percent by the mid-1990s, whereas CPI inflation was closed to 3 percent during this period.
2. Inflation expectations: Inflation expectations influence inflation through the Phillips curve (Equation 1), influence unemployment through the IS curve and Okun's law

(Equation 2 and Equation 3), and hence affect both legs of the dual mandate and the stance of policy through the rule (Equation 4). These expectations are particularly important when thinking about preemptive monetary policy adjustments. Moreover, the anchoring of expectations can improve the tradeoff between unemployment and inflation, by preventing shits in inflation from becoming persistent and requiring a more aggressive monetary policy response. As shown in Figure 3, inflation expectations (from the Michigan Survey) were near 4 percent in the 1980s and moved up notably with energy prices and overall inflation during the early 1990s Gulf War. Inflation expectations stabilized near the 3 percent level that prevailed for the CPI by the mid-1990s, with a small and temporary dip below this level in the late 1990s.

3. The inflation target: Stabilizing inflation requires an implicit or explicit target in the rule (Equation 4). Discussions about this implicit target are an important consideration when examining the historical record.
4. Supply shocks: Inflation is affected by additional factors (supply shocks). Among these are factors such as import and energy prices, as well as a potential role for productivity accelerations. The review of the record will examine how policymakers and others discussed such factors.

Figure 2: PCE and CPI inflation, 1987-2001

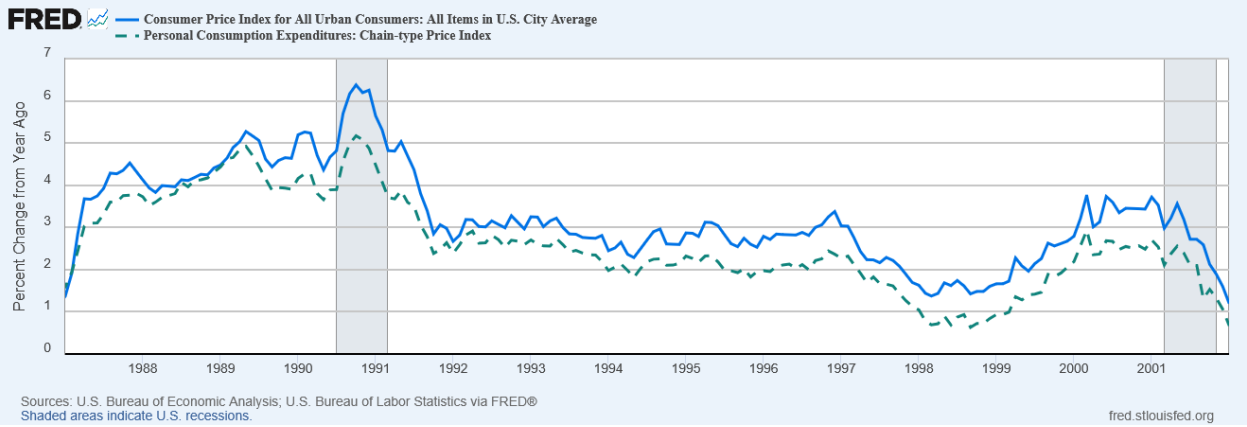
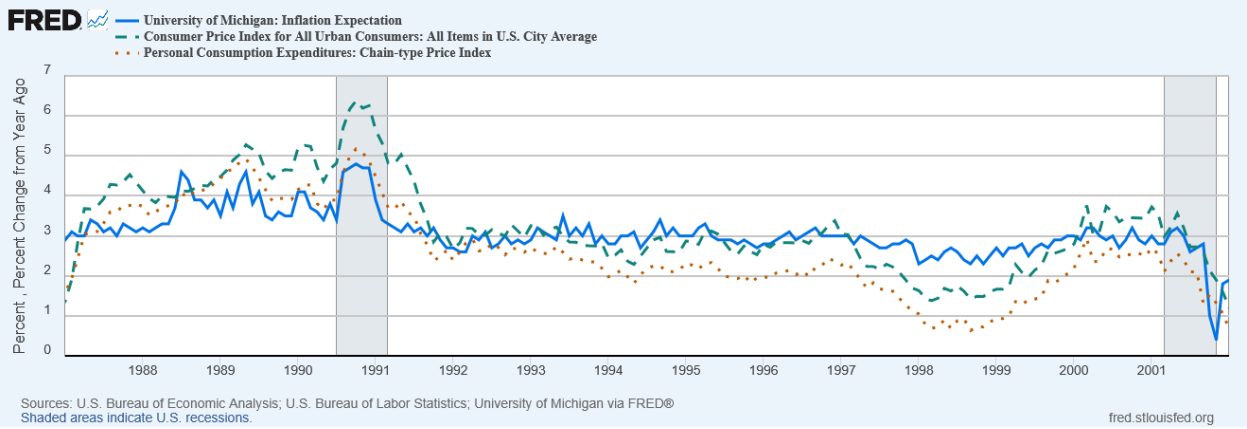


Figure 3: Inflation Expectations



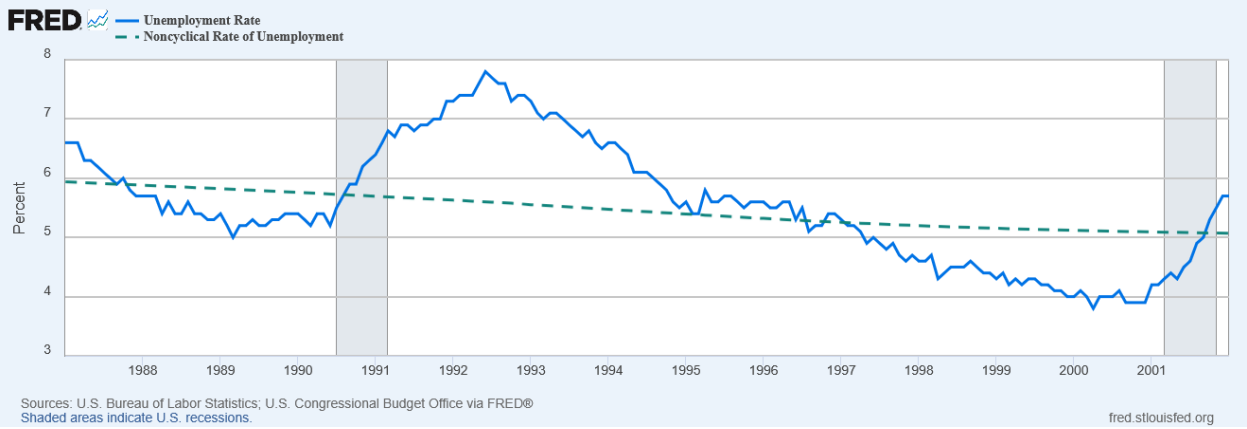
Unemployment, the Natural Rate of Unemployment, the Output Gap, and Potential Output

The second consideration shaping policy is unemployment and its deviation from the natural rate. This brings into consideration developments affecting potential output, including productivity.

The three important factors in the framework are the following.

1. Unemployment rate: Employment is one leg of the dual mandate and a systematic approach—a "rule" (Equation 4) responds to the employment gap both to stabilize employment and to deliver price stability. As shown in , the unemployment rate rose in the early 1990s and then fell to historically low levels by the late 1990s.
2. The natural rate of unemployment: The unemployment gap in the rule (Equation 4) depends on a estimate of the natural rate of unemployment. As shown in , the Congressional Budget Office estimates that the noncyclical rate of unemployment was declining over this period. Our review will focus on related discussions in the literature and at the FOMC.
3. The output gap and potential output: Through Okun's law (Equation 3), the unemployment gap depends on the output gap—and hence on potential output. This is a natural channel through which changes in structural productivity shape monetary policy with the framework.

Figure 4: The Unemployment Rate and the Noncyclical Rate of Unemployment



The next section will examine the record with respect to each of these factors to draw lessons from monetary policy from the 1990s.

Explaining 1990s Monetary Policy with the Framework

We now consider each piece in turn.

Inflation Measurement and the Inflation Target

Consider first the real-time evolution of inflation. Figure 5 presents the evolution of inflation as measured by four price indexes: the GDP price index, the PCE price index, the core PCE price index, and the CPI. Several features are apparent that are relevant for our discussion.

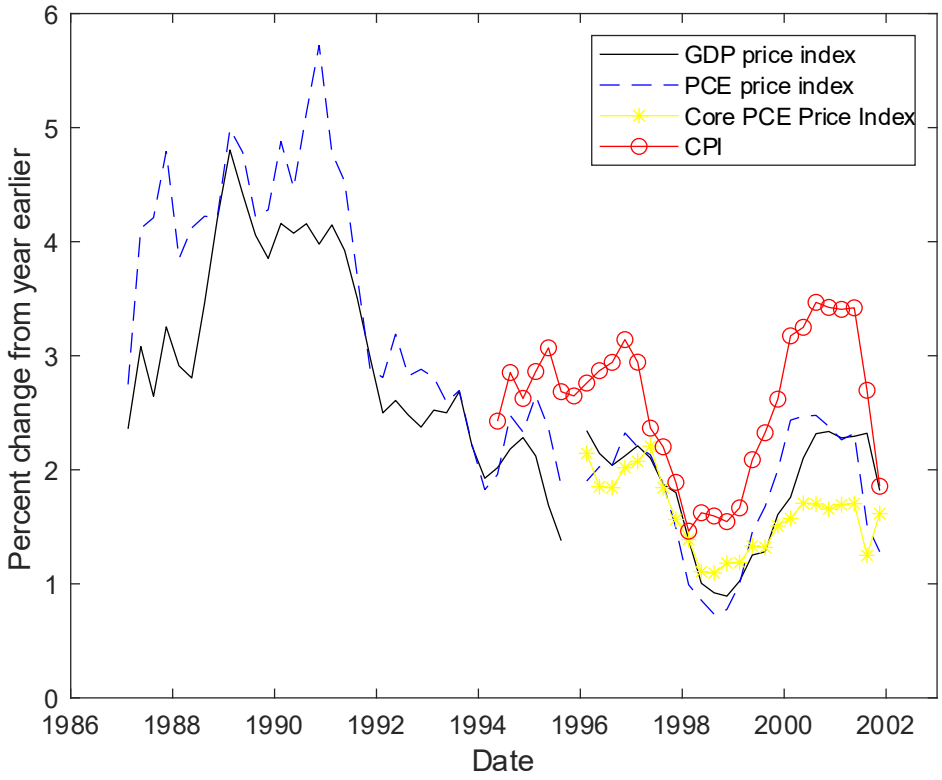
First, as with the current vintage of data, inflation fell from the early 1990s to the mid-1990s. Between 1997 and 1999, inflation fell notably. The decline in inflation is a plausible reason why the stance of monetary policy would not be tightened in response to strong growth within the framework.

Second, and also as apparent in the current vintage of data, inflation measured on a PCE basis ran notably below inflation measured on a CPI basis. An observer focused on the CPI in a policy rule would, all else equal, look for a tighter stance of monetary policy.

Third, core inflation remained low after 1999, whereas other measures picked up. A focus on core, rather than total, inflation would prescribe a more accommodative stance.

Finally, the GDP and PCE measures were generally close to 2 percent from the mid-1990s whereas the CPI measure was generally higher. During the 1990s, advanced-economy central banks that adopted inflation targeting often chose targets centered at 2 percent.

Figure 5: Real-time Inflation

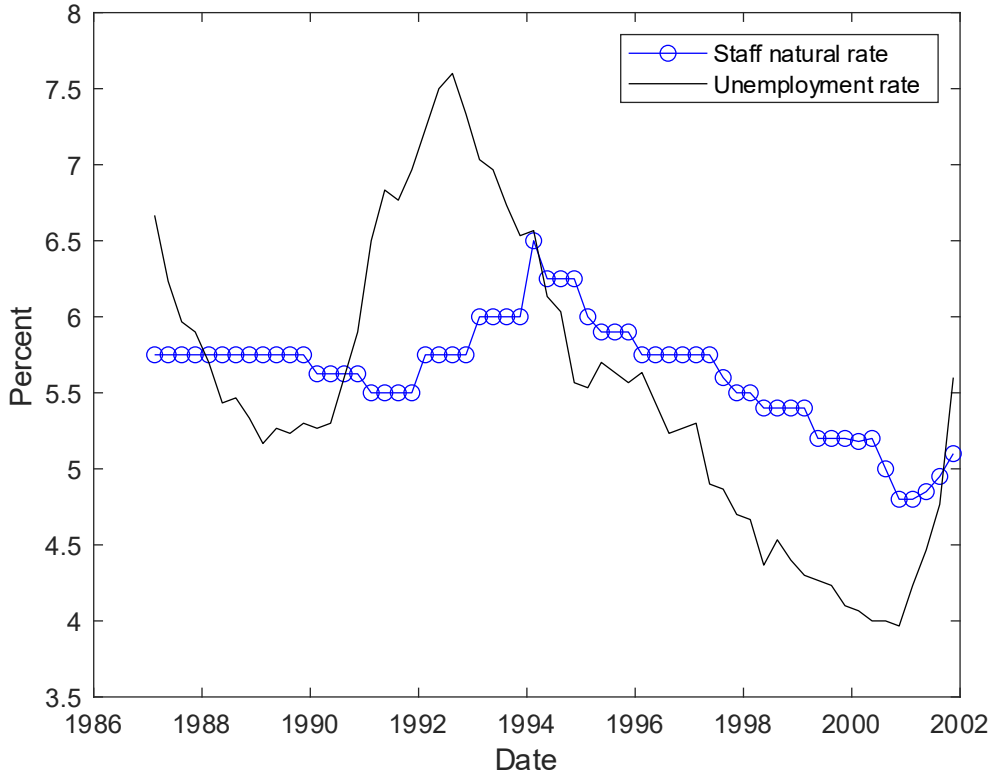


These developments suggest that our analysis of FOMC discussions and related research should consider whether the FOMC focused on inflation as measured by the PCE price index, whether core inflation played an important role, and whether an implicit target of 2 percent featured prominently in FOMC deliberations.

Measuring Resource Utilization

No consider the real-time evolution of resource utilization. As shown in Figure 6, the unemployment rate fell from its post-1990-91 recession peak of 7½ percent to just below 4 percent by the end of 2000. This was the strongest labor market in decades. All else equal, this would call for a notable tightening in monetary policy. At the same time, the Federal Reserve staff was revising down its estimate of the natural rate of unemployment from the mid-1990s, starting above 6 percent and falling to below 5 percent by late 2000. This movement would, all else equal, temper a tightening in monetary policy.

Figure 6: The Unemployment Rate and Federal Reserve Staff Estimates of the Natural Rate



These developments suggest that our analysis of FOMC discussions and related research should consider whether the FOMC focused on a declining natural rate of unemployment as an important factor tempering its response to falling inflation. Given the connection between the output gap and the unemployment gap implies by Okun's law, an additional consideration is the extent to which views on an acceleration of productivity may have interacted with views on a declining natural rate of unemployment.

Putting the Pieces Together in a Policy Rule

The initial hypothesis is that the FOMC behaved as if it

1. Implicitly targeted 2 percent inflation in the PCE price index, with consideration of underlying inflation through some reference to core inflation to avoid overreacting to transitory movements in food and energy prices.
2. Adopted a balanced approach in which deviations of unemployment from its natural rate were an important factor in addition to deviations of inflation from target;
3. This strategy was well captured by the Taylor (!999) rule, called the balanced approach rule in Yellen (2017).

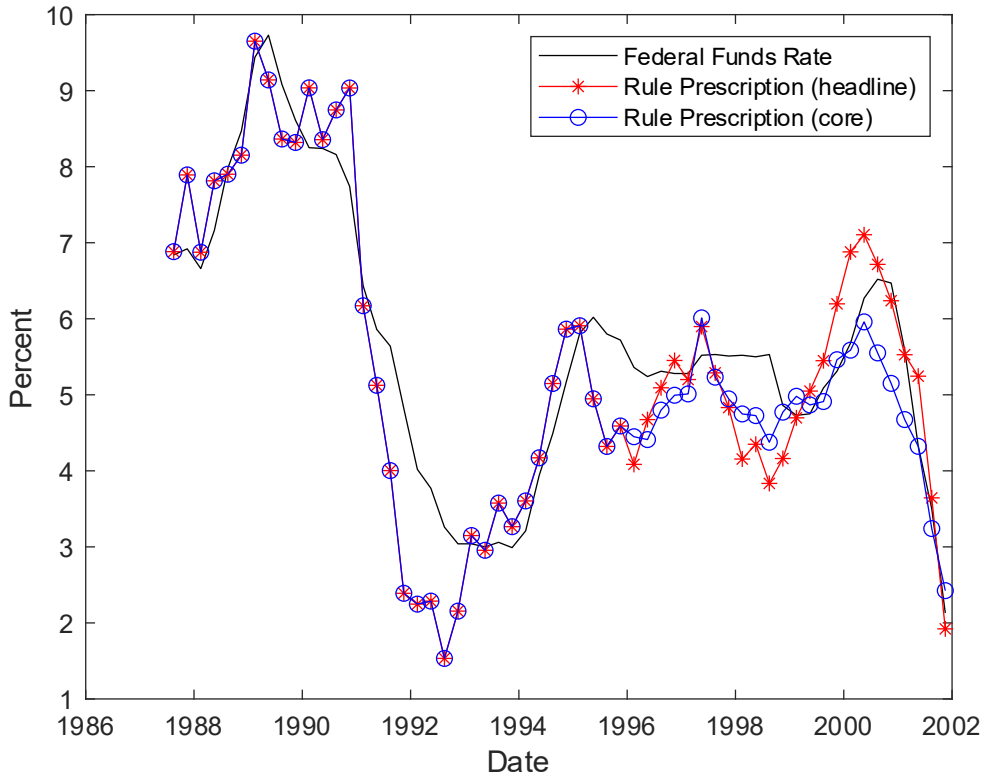
The form of the rule is

Equation 5: $r(t) = 2 + \pi(t) + .5\{\pi(t) - 2\} - 2\{u(t) - u^n(t)\}.$

X presents an implementation of this hypothesis in which the natural rate of unemployment in the rule is the Federal Reserve staff real-time estimate of u^n. The real-time estimate of core PCE inflation are only available after 1995, so overall PCE prices are used for the earlier period. Two implementations are presented-one with headline inflation and one with core. Overall, the rule using real-time data tracks the federal funds rate remarkably well. With regard to the late 1990s, when some accounts view the lack of tightening by the FOMC as remarkable, the results are clear. The implementation using both core and headline inflation tends to lie close to, but below, the federal funds rate prior to 1999. In 1999, when the federal funds rate is rising, the rule based on headline inflation rises more and the rule based on core inflation rises by less.

Overall, the rule analysis does not point to notable restraint on the part of the FOMC. Unemployment was low. But inflation was also low, and the uptick in inflation in 1999 was concentrated in the volatile food and energy category.

Figure 7: Implementation of the Balanced Approach Rule over 1987:Q3-2001:Q4



This initial analysis suggests that a reasonable hypothesis is that the 1990s monetary policy involved implicitly targeting 2 percent inflation in the PCE price index in a balanced way that included a role for deviations of unemployment from its natural rate in a manner well captured by the Taylor (!999) rule. The remaining analysis will consider supporting evidence.

Evidence for the Explanation

An Implicit PCE Inflation Target of 2 Percent

The FOMC did not have an explicit inflation target until 2012. Discussions in the years leading up to the adoption of a specific numerical inflation target, in academia, the public, and at the FOMC, debated the benefits of an explicit target. And there were clear disagreements on the appropriate level of inflation among FOMC participants in the 1990s. Any assertion to the contrary is clearly false.

But the idea that the FOMC had an implicit inflation target of 2 percent defined in terms of PCE price inflation during the 1990s is supported by historical accounts.

In his backward-looking review of his experience, Laurence Meyer (a Federal Reserve Governor during the late 1990s and early 2000s) notes that "The FOMC is already an implicit inflation targeter; and policy has been successful in achieving a low rate of inflation, while preserving flexibility to pursue stabilization policy." (Meyer, 2004). In their review of the work of Marvin Goodfriend (a longtime staff economist at the Federal Reserve Bank of Richmond) and his discussions with Al Broaddus (President of the Federal Reserve Bank of Richmond during the period), King and Lu (2022) discuss the efforts to adopt an inflation target in the 1990s and the implicit adoption of a 2 percent target by 1996.

Table 2 presents some examples of the evolution of ideas. Inflation targets in the neighborhood of 2 percent were discussed by FOMC members, although there was a clear range of views. More generally, advanced economies that were adopting explicit targets were settling in the range of 1-3 percent, as emphasized by Stanley Fischer in his Jackson Hole contribution in 1996. The Taylor rule (Taylor, 1993) had asserted the FOMC was implicitly trying to stabilize inflation at 2 percent years earlier (and was often discussed at the FOMC, as highlighted later). And inflation stabilized near 2 percent by 1994. Whether opportunistic or deliberate, the narrative evidence is consistent with the impression from the data that the FOMC set policy to stabilize inflation near 2 percent.

Table 2: Evolution of the 2 Percent Implicit Inflation Objective

Date	Event / Forum	Key Issue	Discussion
Sept 1994	FOMC Meeting	President Broaddus (Richmond) advocates for multi-year targets to close a "credibility gap" in market expectations.	"One way to deal with the credibility problem might be to consider announcing explicit multi-year inflation rate targets leading to price stability… say 3 percent for 1995, 2-1/2 percent for 1996, and so forth."
July 1996	FOMC Meeting	Landmark debate over defining price stability; Janet Yellen argues for a "measurement buffer" due to index bias.	"Greenspan suggested that 'price stability is that state in which expected changes in the general price level do not effectively alter business or household decisions'… He responded that 'the number is zero, if inflation is properly measured.' Yellen said that she preferred 2 percent 'imperfectly measured.'"
Aug 1996	Jackson Hole Symposium	Stanley Fischer presents an academic rationale for a 1–3% target range for industrialized nations.	"These arguments point to a target inflation rate in the 1 to 3 percent range; more specifically, they suggest that inflation should be targeted at about 2 percent."
Dec 1996	FOMC Meeting	Robert Parry (San Francisco) applies the Taylor Rule using an assumed 2 percent target for core CPI.	"At our Bank, we consult two monetary policy rules… an estimated version of Taylor's rule and a nominal income growth rate rule. Even if we assume a 2 percent target for core CPI inflation, both rules suggest that the funds rate should be left at about 5-1/4 percent."
Feb 2000	Monetary Policy Report	Official pivot to PCE as the primary reporting index; forecasts center 2%.	"The chain-type price index for PCE… avoids some of the upward bias associated with the fixed-weight nature of the CPI… the central tendency of the FOMC participants' inflation forecasts… is 1-3/4 percent to 2 percent."

Source: FOMC Transcripts; Fischer (1996); Monetary Policy Report

Whether the FOMC was focused on PCE inflation, CPI inflation, or some other measure is also not crystal clear, but the balance of evidence suggests that PCE inflation became the primary focus by the second half of the 1990s. In his review of experience over the 1990s in 2007, Don Kohn (longtime Fed staffer, then Governor and later Vice Chairman) noted that

“Over the past fifteen years, the Federal Reserve has emphasized the inflation rate as measured by changes in the price index for personal consumption expenditures (PCE). “ (Kohn, 2007)

Part of the pivot to PCE prices reflected the substantial work on price measurement in the 1990s. Of the first half of the 1990s, a number of analysts claimed that the consumer price index overstates the true rate of increase of the cost of living, reflecting both methodological issues and challenges associated with the introduction of new goods and quality improvements. Note that the latter is directly related to changes in the “new economy” associated with information technology, where quality improvements (e.g., processor speed, etc.) where an important element. For example, Gordon (1990, 1993) were landmark empirical studies of quality-change bias in durable goods, which estimated that this mismeasurement implied that the CPI for durable goods overstates inflation by at least 1.5 pp/year from 1947 to 1983. Lebow, Roberts, and Stockton (1994) provided ranges for various bias components, highlighting within-strata substitution, a new-items effect, a new-outlets effect, and a quality change effect. Importantly, these authors emphasize monetary policy implications (and this research was conducted at the Federal Reserve).

Concerns over price mismeasurement were an important policy issue across government. For example, Congressional Budget Office (1995) emphasized fiscal implications: A permanent 0.5 pp reduction in CPI growth would reduce the federal deficit notably through its effects on tax and spending policies, making CPI measurement a high-priority policy issue. The Advisory Commission to Study the Consumer Price Index, chaired by Michael Boskin, was formed after Congressional hearings to investigate potential biases in the CPI. In their December 1996 Final Report, the Commission estimated a total upward bias of 1.1 percentage points per year, attributing 0.25 points to lower-level substitution bias, 0.15 points to upper-level substitution bias, 0.60 points to inadequate treatment of quality change and new products, and 0.10 points to new outlet bias. The Commission made 16 recommendations to the Bureau of Labor Statistics (BLS), with the overarching recommendation being that the BLS should establish the economic concept of a cost-of-living index (COLI) as the measurement objective for the CPI.

These issues shaped discussions by FOMC policymakers, including Greenspan, with some examples provided in Table 3. Three takeaways are important. First, policymakers acknowledged that no one index was sufficient – a broad array of data was necessary to assess developments (as indicated, for example, by Greenspan’s remarks in his July 1998 testimony). This is consistent with only implicit targeting of PCE prices. Second, the measurement biases associated with the CPI were in focus and led to a preference for PCE prices, as highlighted in 1995, 1996, 1999, and 2000. Finally, the benefits of looking at core

were acknowledged. This can be seen in, for example, Greenspan's discussion at the July 1996 meeting.

More generally, research on core measures to identify underlying inflation was active, especially within the Federal Reserve)e.g., Bryan and Cecchetti, 1994). In his discussion of experience in the 1990s, Don Kohn notes that "Many researchers have also explored the use of core price indexes, which exclude the volatile food and energy components, as better predictors of future inflation or as more robust indicators of the sticky prices that some theories say should be the targets of policy." (Kohn, 2007) Note how Kohn explicitly references sticky prices, in a nod to the New-Keynesian frictions emphasized in Woodford (2001).

Overall, both discussions by FOMC policymakers and the general tenor of related research at the time highlight a focus on PCE prices for U.S. monetary policy, including a role for core inflation.

Table 3: Measurement Issues and a Focus on PCE Prices

Date	Event / Forum	Key Point	Supporting Quotation
Jan 1995	Senate Finance Testimony	Chairman Greenspan first publicly estimates that the CPI overstates inflation by 0.5 to 1.5 percentage points.	"the consumer price index... is currently overstating changes in the true cost of living by approximately 1 percentage point per year."
July 1996	FOMC Meeting	Greenspan declares core PCE the superior consumer index, signaling a departure from the "mistake" of over-relying on CPI.	"the core PCE chain price index... is the best consumer price index by far... The emphasis that we have been putting on the consumer price index... is turning out to have been a mistake."
Dec 1996	Boskin Report	The Commission formalizes the 1.1 percentage point annual upward bias estimate in the CPI.	"the U. S. Consumer Price Index (CPI) overstated inflation by 1.1 percent per year for the time period... 1995-96."
July 1998	Humphrey-Hawkins Testimony	Greenspan highlights the technical superiority of chain-weighting in alternative indexes to avoid substitution bias.	"it would be a mistake... to focus on any single index... Their chain-weighting avoids some aspects of so-called substitution bias."
March 1999	FOMC Meeting	Greenspan identifies the CPI as a "flawed statistic" due to housing weights and recommends the "far superior" PCE deflator.	"the CPI is a flawed statistic... a considerable divergence from the far superior PCE deflator."
Feb 2000	Monetary Policy Report	The FOMC officially switches its primary reporting and forecasting metric to the PCE chain-type index.	"The chain-type price index for PCE... avoids some of the upward bias associated with the fixed-weight nature of the CPI."

The Evolving Natural Rate of Unemployment

By the mid-1990s, economists were actively working to estimate the NAIRU and understand its policy implications. Joseph Stiglitz (1997) argued that the NAIRU had fallen dramatically in the previous decade and was a reliable guidepost for policy; while he

acknowledged the potential for measurement error, he argued such errors would be recognized in time to be corrected. This view was similar to that of Robert Gordon. Robert J. Gordon (1997) estimated a time-varying NAIRU, finding it had ranged between 5.4% and 6.5% over the previous forty years. Notably, he estimated the NAIRU at 5.6% for 1996:Q2, attributing its decline to factors such as global competition, immigration, and rapidly declining prices of computers, thereby connecting the “new economy” narrative with the evolving natural rate of unemployment narrative. Staiger, Stock, and Watson (1997) were less sanguine regarding estimates, highlighting that the NAIRU was imprecisely estimated and suggesting deemphasizing the NAIRU in public discourse about monetary policy and instead relying on a richer variety of inflation indicators.

By the late 1990s, economists were grappling with the unexpected combination of low unemployment and low inflation. Gordon (1998) addressed the "Goldilocks economy," noting that despite forecasts of accelerating inflation as unemployment dipped below 6%, inflation actually decelerated between 1994 and 1998, which led him to attribute part of this good performance to a decline in the natural rate of unemployment (with the rest attributed to changes in measurement of inflation, discussed below, and various transitory shocks). Krueger and Katz (1999) highlighted the extraordinary performance of the U.S. economy, with unemployment remaining below 5% for more than twenty consecutive months while inflation continued to decline. They suggest a range of structural factors led to a decline in the natural rate of unemployment, including demographic shifts toward older workers, Changes in labor efficiency due to developments in the temporary help industry, and growth of the incarcerated population. Robert Shimer (1999) argued that the lower unemployment rate was largely due to demographic changes, particularly the aging of the population.

This evolving academic understanding of the natural rate of unemployment played a crucial role in shaping policy decisions in the latter half of the 1990s. Outside the FOMC, the Council of Economic Advisors devoted substantial effort to understanding the evolution of the natural rate. Table 4 provides key examples at the FOMC. The reliance on the natural rate/Phillips curve framework was broad, as reflected in the selected quotes from Blinder, Yellen, Meyer, Gramlich, and Moskow. Even FOMC participants with some degree of skepticism toward the framework acknowledged its central role, as in the discussion of Ferguson and Poole.

In addition, the discussions emphasize the evolution of the natural rate over time. Overall, these discussions, the related academic work, and the evolving Federal Reserve staff estimates of the natural rate suggest it is reasonable to expect the FOMC’s behavior to have reflected a time-varying natural rate of unemployment.

Table 4: FOMC Discussions of the Natural Rate of Unemployment in the 1990s

Date / Event	Speaker / Source	Policy Issue & Epistemological Shift	Supporting Quotation
Feb 1, 1995 *FOMC Meeting*	**Governor Alan Blinder**	**Confronting NAIRU's Standard Errors**	"As I weigh all those factors, plus the standard errors around them, which are substantial in many cases, the odds seem to me less than 50/50 that we will in fact eradicate the inflationary gap by the end of 1996..."
Mar 13, 1996 *NABE Speech*	**Governor Janet Yellen**	**Defending the Natural Rate Theory.**	"Like most mainstream economists, I accept the natural rate theory, as a first approximation, of how the inflation process works... any attempt to push the economy to operate with labor market slack below some minimum level is apt to entail... accelerating inflation."
Sep 17, 1997 *Speech*	**Governor Laurence Meyer**	**Updating the NAIRU.**	"It is possible that the Phillips Curve and NAIRU is simply the wrong analytical framework, but I doubt it... my response is to update my estimate of NAIRU and add other explanations... but not to abandon this concept."
Feb 27, 1998 *Eastern Economic Assoc.*	**Governor Edward Gramlich**	**Uncertainty of NAIRU and Policy Rules.**	"The unexpectedly quiescent behavior of inflation in the face of low unemployment... has led economists into major soul-searching about NAIRU... This NAIRU uncertainty then transfers over to output gap uncertainty... Rather than replacing judgment, in the end rules may aid judgment."
Jun 19, 1998 *Speech*	**President Michael Moskow**	**Changing NAIRU**	“I will take seriously that the NAIRU moves around somewhat over time. But what are the factors that account for this variation?”
Jul 9, 1998 *Speech*	**Governor Roger Ferguson**	**NAIRU Uncertainty.**	"The NAIRU never was measured with precision; statistical inference has always provided a distribution of likely values around a point estimate... we may have to rely more on measures other than apparent excess demand to get reliable indications of pending changes..."
Feb 2-3, 1999 *FOMC Meeting*	**President William Poole**	**Operating Below NAIRU.**	"I believe there is far too much emphasis on the NAIRU... That does not mean that the unemployment rate is not below what is sustainable in the long run... we probably are operating below the NAIRU."

Policy Rules and Constrained Discretion

Alongside increasing experience with inflation targeting following the Reserve Bank of New Zealand's pioneering introduction of a formal inflation target in 1990, the 1990s saw a growing academic focus on inflation targeting as a policy framework, including Bernanke and Mishkin (1997) and Bernanke et al (1999). At the same time, there was a proliferation of on monetary policy rules—spawned in no small part by Taylor's (1993) influential paper and culminating, at least for the literature of the decade, in the presentation of a simple Taylor-type rule as the optimal policy under discretion in a simple New-Keynesian model in Clarida, Galí, and Gertler (1999).

The parallel development of these literatures even led to cross-fertilization and emphasis on the degree to which inflation targeting was, or was not, a policy rule. Bernanke et al (1999) emphasized that inflation targeting was a "framework" of constrained discretion, not a rule. In contrast, Svensson (1999) defines inflation targeting as a monetary policy rule derived from an explicit optimization problem, implying direct connections with Clarida, Gali, and Gertler (1999).

As Taylor (1993a) showed, his rule closely tracked the actual path of the federal funds rate from 1987 to 1992. Taylor (1999) showed how this continued throughout the 1990s, although the balanced approach version, which raised the coefficient on the output gap to one (and that on the unemployment gap, via Okun's law, to two) fit better. The Taylor rule also spurred interaction between academic and central bank economists.

The impact on FOMC discussions was strong, as reviewed in Asso et al (2007). X presents some highlights, drawing on Asso et al (2007) and other material. At the first meeting of 1995, Janet Yellen described the rule and its close approximation to actual FOMC policy. She would mention the Taylor rule often subsequently. Other Committee members—especially Governors Meyer and President Parry—also relied heavily on the Taylor Rule. Even Greenspan acknowledged how the rule was a useful guide.

Overall, the narrative record suggests that a simple rule like the Taylor (1999) rule was a guide for FOMC deliberations and may provide a benchmark with which to understand 1990s monetary policy.

Timeline of Positive Views on Monetary Policy Rules (1990–2001)

Date	Event / Forum	Speaker	View on Rule Usefulness	Quotation
Jan 31, 1995	**FOMC Meeting**	**Janet Yellen** (Governor)	Utilizes the Taylor rule as a fundamental benchmark for assessing the reasonableness of the current funds rate.	"I use the Taylor Rule to provide me 'a rough sense of whether or not the funds rate is at a reasonable level.'"
Nov. 1995	**FOMC Meeting**	**Lawrence Lindsey** (Governor) **and Gary Stern** (Minneapolis Fed President)	Debate on stance using the Taylor Rule	Stern questioned whether policy should be tighter than indicated by the Taylor Rule "to bend inflation down further from here." Lindsey responded that, with inflation above the assumed Taylor Rule target of 2 percent, the prescription for policy from the rule itself was deliberately restrictive.
Mar 13, 1996	**NABE Speech**	**Janet Yellen** (Governor)	Argues that rules provide a "nominal anchor" and clarify the Fed's "reaction function" to the public.	"The framework of a Taylor-type rule could help the Federal Reserve communicate to the public the rationale behind policy moves, and how those moves are consistent with its objectives."
Sept 8, 1996	**NABE Meeting**	**Laurence Meyer** (Governor)	Describes the Taylor rule as a disciplined method for balancing the dual mandate of price stability and full employment.	"The Taylor Rule is a simple example of a strategy that juggles the two objectives in a disciplined manner without losing sight of the long-run price stability objective."
Dec 1996	**FOMC Meeting**	**Robert Parry** (S.F. Fed President)	Applies the Taylor Rule using an assumed 2% core CPI target to justify current rates.	"Even if we assume a 2 percent target for core CPI inflation, both [Taylor-style] rules suggest that the funds rate should be left at about 5-1/4 percent."
Sept 5, 1997	**CEPR 15th Anniversary Conference**	**Alan Greenspan** (Chair)	Acknowledges the rule as a valuable "guidepost" despite a preference for discretion.	"Taylor-type rules or reaction functions have a number of attractive features. They assume that central banks can appropriately pay attention simultaneously to developments in both output and inflation."
Dec 22, 1998	**FOMC Meeting**	**William Poole** (St. Louis Fed President)	Emphasizes the rule's role in establishing market expectations through consistent and predictable behavior.	"I do believe that it is very important that monetary policy be consistent and predictable over time."

Source: Asso et al (2007) and Federal Reserve Records

What Role for Greenspan's Productivity Call?

The 1990s acceleration in productivity receives primary focus in discussions of Alan Greenspan and monetary policy in the late 1990s (e.g., Mankiw, 2001; Blinder and Reis, 2005; Friedman, 2006; and Blinder, 2024).

Even so, FOMC records, work by staff within the Federal Reserve System, and academic work during the period were equally, or more, focused on the evolution of the natural rate of unemployment and the implications of a potential fall in the natural rate alongside declines in the unemployment rate to historically low levels.

So what role might have Greenspan's identification of a coming acceleration of productivity played in monetary policy?

The 1990s were a period in which talk of a new economy was pervasive and started early in the decade. Alan Greenspan believed early in the decade that there were signs of a resurgence in productivity growth, devoted Federal Reserve resources to a measurement agenda to identify whether his hunches were correct, and argued for the importance of these developments at the FOMC.

Academic research during this period initially struggled to identify the productivity acceleration that Greenspan suspected. This "productivity paradox" is evident in early studies. Robert J. Gordon (1993) concluded that the rapid productivity growth of 1991-92 was largely cyclical, questioning the "widespread journalistic view that a new era of productivity-led growth is at hand." Oliner and Sichel (1994) similarly found that the "puzzle" of computers' impact on productivity was not substantial.

One story that emerged was the concept of technological revolutions causing initial slowdowns before yielding productivity gains. Paul David (1990) drew parallels between the computer revolution and the introduction of the electric dynamo, suggesting that productivity gains from major technological shifts can take decades to materialize. Greenwood and Yorukoglu (1997) proposed that the introduction of information technologies in the 1970s might have initially caused both a productivity slowdown and increased income inequality, similar to previous industrial revolutions. Hornstein and Krusell (1996) explored how technological improvements could paradoxically cause productivity slowdowns due to learning effects and measurement issues. Similarly, Kiley (1999, 2001) developed models in which structural shifts—in demographics or information technology—can initially slow productivity growth as an economy adjusts owing to adjustment costs or reallocation. These studies highlighted the complexities and potential frictions in adopting new technologies, ideas that resonated with policymakers grappling with conflicting economic signals.

Moreover, by the late 1990s, the academic consensus began to acknowledge faster productivity growth as a structural shift. Oliner and Sichel (2000) found that information technology accounted for about two-thirds of the acceleration in productivity growth between the first and second halves of the 1990s. Gordon (2000), while more skeptical, acknowledged a strong revival in U.S. productivity growth from 1995-99, though he argued it was largely confined to the durable manufacturing sector. Even so, this recognition came late, and this evolution in academic thought demonstrates that Greenspan was indeed ahead of the curve in recognizing the productivity acceleration.

At the same time, measurement challenges in assessing potential growth were front and center. Greenspan's focus on measurement issues spurred significant internal research at the Federal Reserve. For example, Corrado and Slifman (1999) delved into the challenges of

measuring productivity in more difficult-to-measure sectors. The evolving understanding of productivity growth and its measurement also had direct implications for monetary policy. Orphanides (2001) and Orphanides and van Norden (2002) highlighted the unreliability of real-time output gap estimates, underscoring the challenges faced by policymakers in assessing economic slack and demonstrating how real-time assessments of potential growth could lead to ex post policy mistakes. (Note that these examples of research were available much earlier—as early as 1996—reflecting publication lags.)

This set of factors suggest at least two critical ways in which Greenspan's focus on the productivity acceleration fostered the environment for the successful 1990s monetary policy he guided.

Greenspan was extremely focused on economic measurement and improving official statistics. This manifested in his discussions or productivity, but also on price measurement. This focus contributed to the increasing role of PCE prices and the acknowledgement of how measurement issues were contributing to disinflation in the 1990s.

Greenspan was also focused on the dynamism of the U.S. economy and the possibility of structural change. While the early identification of the productivity acceleration was one manifestation, the openness of the FOMC to shifts in the natural rate of unemployment was arguably another. Moreover, Greenspan's focus on possible beneficial supply-side developments focused attention on the gap between spending and productive potential—and the gap between the unemployment rate and the natural rate.

Lessons from the 1990s for Monetary Policy

Mankiw (2001) suggested that an observer would not have any idea on how to replicate Greenspan's 1990s success, but our review suggests otherwise. Three lessons emerge.

1. Follow the deviation of inflation from your target: While it is common to attribute the moderate tightening in monetary policy in the second half of the 1990s to prescience with respect to productivity, inflation was low over the period. Stabilizing inflation at 2 percent required not tightening excessively. In a simple rule framework, low inflation explains the path of policy in light of low unemployment.
2. Stabilize the unemployment gap: Monetary policy was tightened in the late 1990s as unemployment fell to low levels, despite low inflation. This preemption is an important component of the Greenspan period (e.g., Sinai, 2004).
3. In efforts to stabilize inflation and unemployment, follow a balanced approach.

Each of these is consistent with 1990s monetary policy through the lens of a simple rule and a review of the narrative record.

References

Akerlof, George A., William T. Dickens, and George L. Perry (1996). “The Macroeconomics of Low Inflation,” Brookings Papers on Economic Activity, 1:1996, pp. 1-76.

Black, Richard, Donald Coletti, and Sophie Monnier (1997). “On the Costs and Benefits of Price Stability,” in Price Stability, Inflation Targets, and Monetary Policy. Ottawa: Bank of Canada.

Brayton, F. and P. Tinsley, eds. 1996. A Guide to FRB/US: A Macroeconomic Model of the United States. Division of Research and Statistics, Federal Reserve Board. October.

Card, David, and Dean Hyslop (1997). “Does Inflation 'Grease the Wheels of the Labor Market'?" in Christina D. Romer and David H. Romer, eds., Reducing Inflation: Motivation and Strategy. Chicago: University of Chicago Press, 1997.

Fox, Justin, 2014. How Economics PhDs Took Over the Federal Reserve. Harvard Business Review Blog, February 3.

Fuhrer, J. and G. Moore (1995) “Monetary Policy Trade-offs and the Correlation between Nominal Interest Rates and Real Output,” American Economic Review. (March) 219-239.

Kahn, Shulamit, (1997). “Evidence of Nominal Wage Stickiness from Microdata,” American Economic Review, vol. 87 (December), pp. 993-1008.

Robert G. King and Yang K. Lu, 2022. Credibility and Explicit Inflation Targeting | Richmond Fed.

Kohn, Donald (2007) John Taylor Rules - Federal Reserve Board

Lebow, David E., John M. Roberts, and David J. Stockton (1992). “Economic Performance under Price Stability,” Finance and Economics Discussion Series 1992-125. Washington: Board of Governors of the Federal Reserve System.

Lebow, David E., David J. Stockton, and William L. Wascher (1995). “Inflation, Nominal Wage Rigidity, and the Efficiency of Labor Markets,” Finance and Economics Discussion Series 1995-94. Washington: Board of Governors of the Federal Reserve System.

Lebow, David E., Deborah Lindner, Daniel Sichel, and Robert Tetlow (1997). “Toward a Working Definition of Price Stability,” paper for the Federal Open Market Committee.

Orphanides, Athanasios, and Volker Wieland (1998). “Price Stability and Monetary Policy Effectiveness When Nominal Interest Rates Are Bounded at Zero,” Finance and Economics

Discussion Series 1998-35. Washington: Board of Governors of the Federal Reserve System, August.

Orphanides, Athanasios, Richard D. Porter, David Reifschneider, Robert Tetlow, and Frederico Finan (2000). “Errors in the Measurement of the Output Gap and the Design of Monetary Policy,” Journal of Economics and Business, vol. 52 (January-April), pp. 117-41.

David L. Reifschneider, David J. Stockton, and David W. Wilcox, 1996. Econometric Models and the Monetary Policy Process. Board of Governors of the Federal Reserve System. October.

Reifschneider, David, and John C. Williams (2000). “Three Lessons for Monetary Policy in a Low-Inflation Era,” Journal of Money, Credit, and Banking, vol. 32 (November), pp. 936-66

Clouse, James, Dale Henderson, Athanasios Orphanides, David Small, and Peter Tinsley (2000). “Monetary Policy when the Nominal Short-term Interest Rate Is Zero,” Finance and Economics Discussion Series 2000-51. Washington: Board of Governors of the Federal Reserve System, November