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The Phillips Curve and US Monetary Policy: What the FOMC Transcripts Tell Us

Federal Reserve Bank of St. Louis, Research Division, P.O. Box 442, St. Louis, MO 63166

The Phillips Curve and US Monetary Policy:
What the FOMC Transcripts Tell Us[*]

Ellen E. Meade
meade@american.edu

Daniel L. Thornton
thornton@stls.frb.org

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Abstract: The Phillips curve framework, which includes the output gap and natural rate hypothesis, plays a central role in the canonical macroeconomic model used in analyses of monetary policy. It is now well understood that real-time data must be used to evaluate historical monetary policy. We believe that it is equally important that macroeconomic models used to evaluate historical monetary policy reflect the framework that policymakers used to formulate that policy. To that end, we use the Federal Open Market Committee (FOMC) transcripts to examine the role that the Phillips curve framework played in Fed policymaking from 1982 through 2003. The FOMC's transcripts allow us to trace the evolution in policymakers' discussion of the Phillips curve framework over time. Our analysis suggests that the Phillips curve was much less central to the formulation and implementation of US monetary policy than it is in models commonly used to evaluate that policy.

1. Introduction

The economic concept known as the "Phillips curve" celebrated its 50th birthday in 2008. In 1958, New Zealand economist A.W.H. Phillips (Phillips, 1958) documented a negative relationship between unemployment and wage inflation in the United Kingdom over a nearly 100-year period (1861 to 1957).[1] The Phillips curve concept has been re-defined with the advancement of economic thought, and remains important and influential in the canonical macroeconomic model and in most discussions of monetary policy. In the canonical model, the Phillips curve relates some measure of slack in the real economy – the output gap or deviation of unemployment from its natural rate – to present or expected future inflation in some form of the expectations-augmented Phillips curve.[2] The Phillips curve is also a key component of most models of a central bank reaction function, which typically rely on some form of a Taylor rule.[3]

Following the work of Orphanides (2001, 2005) and others, it is now well understood that researchers must use real-time data (that is, the data that policymakers actually observed) in order to analyze policy decisions. We believe that it is at least as important – and perhaps even more important – that the model used to analyze monetary policy reflect the framework that policymakers actually relied upon when making such decisions. Given the importance of the Phillips curve in analyses of monetary policy, we investigate the role that the Phillips curve framework played in Federal Reserve

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[1] Robert King (2008) provides a nice discussion of Phillips' original work and the chronological development of the Phillips curve concept.

[2] The seminal contributions of Milton Friedman (1968) and Edmund Phelps (1967) led to the distinction between the "short-run" Phillips curve and its "long-run" variant. Because of this work, the standard Phillips curve uses the deviation of unemployment from its estimated natural rate or the deviation of output from its estimated potential level, long-run levels that constrain the performance of the real economy.

[3] This need not be independent of the Phillips curve because a positive coefficient on the output gap in a Taylor rule can occur, even if policymakers place no importance on economic stabilization, given the role that the gap in determining inflation via the Phillips curve.

policymaking from 1982 through 2003. We do this by analyzing the verbatim transcripts of meetings of the Federal Open Market Committee (FOMC). Our document analysis is supplemented by an analysis of forecasts of inflation, unemployment, and the output gap formulated by the Federal Reserve Board staff and included in the "Greenbook."[4] While these forecasts do not necessarily reflect the views of Committee members about the role of the Phillips curve framework in the policymaking process, they constitute a starting point for the policy discussion of the economic and inflation outlook at FOMC meetings.

To preview our findings, at an abstract level it is clear that most policymakers thought that inflation should be related to the gap between aggregate demand and aggregate supply. Nevertheless, the transcripts show wide differences of opinion among policymakers about the usefulness of gap measures – the output gap, NAIRU, or potential output – for explaining or predicting inflation and, consequently, for making monetary policy decisions. Indeed, some FOMC meetings were punctuated by debate about the relevance of the Phillips curve concept, with policymakers dividing into "pro" and "con" camps. Overall our analysis suggests that the Phillips curve framework appears to have played a much less prominent role in Fed policymaking than it does in macroeconomic models used to evaluate Fed policy. This finding is supported by an investigation of the role that the Phillips curve played in Greenbook inflation forecasts. Our analysis suggests that the contribution of the output gap to Greenbook inflation forecasts declined over the sample period, paralleling a rise in the frequency of discussion about the usefulness Phillips curve framework.

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[4] The Greenbook includes a detailed forecast for the US economy and is given to policymakers prior to the FOMC meeting.

The remainder of the paper is divided into four sections. Section 2 reviews the relevant literature. Section 3 explains how we analyzed the FOMC transcripts and documents the evolution of the discussion of the Phillips curve in FOMC deliberations. Section 4 presents an empirical analysis of the Federal Reserve Board staff's forecast for inflation. Section 5 concludes.

2.   Literature review

In a recent paper, Robert King (2008) provides an excellent historical overview of the Phillips curve for the US economy from 1958 to 1996. His analysis focuses on the role of the Phillips curve in academic and central bank research, but provides little insight into the role that Phillips curve analyses played in policymaking. Our analysis extends King's by investigating the extent to which policymakers relied on the Phillips curve framework in making policy decisions. Ideally, one would like to determine the role Phillips curve analyses played in setting the target for the Federal funds rate. This cannot be done for at least three reasons: First, as Thornton (2006) has noted, the FOMC's current procedure of targeting a specific value of the Federal funds rate evolved slowly over time. Second, while some policymakers clearly found the Phillips curve framework useful, others did not. Third, with a few exceptions, it is impossible to tell from the transcripts the extent to which a particular policymaker's vote on the FOMC policy directive was motivated by the Phillip curve framework. Consequently, we focus on the extent to which Phillips curve analyses were used in FOMC discussions of monetary policy and reflected in Greenbook inflation forecasts.

This paper is part of a growing literature that uses the FOMC transcripts and other documentary evidence to analyze US monetary policy. For example, Goodfriend and

King (2005) use the transcripts to examine the Volcker disinflation period in the early 1980s in order to determine the extent to which FOMC members regarded long-term interest rates as a signal of inflation expectations and of the credibility of monetary policy.[5] We too are concerned with inflation expectations; however, the expectations we care about are those of the FOMC and the process through which Committee members arrived at those expectations.

There is a vast literature on the estimation of Phillips curves. Some of this literature uses the Phillips curve to estimate the natural rate of unemployment; see, for example, Ball and Mankiw (2002) or Staiger, Stock, and Watson (1997). Other papers focus specifically on whether a Phillips curve model yields accurate inflation forecasts or whether some alternative model is preferable; for a sample of this work, see Atkeson and Ohanian (2001), Fisher, Liu, and Zhou (2002), and Williams (2006). Modern macroeconomic models recognize that supply shocks can affect potential output and argue that conventional measures of the output gap significantly overstate its size (see Nelson and Neiss (2005), Kiley (2010), and Federal Reserve Bank of St. Louis (2009)). Unlike these papers, we do not estimate a Phillips curve but instead evaluate the extent to which the Federal Reserve Board staff's inflation forecasts reflected the Phillips curve framework.

3.   How did the FOMC use the Phillips curve in policy decisions?

The methodology

We have reviewed 22 years of FOMC meeting transcripts in order to catalogue and assess the extent to which policymakers relied on the Phillips-curve framework for determining policy, and staff used that framework for making inflation forecasts. Rather

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[5] Both of us have contributed to this literature; see Meade (2005) and Thornton (2006).

than reading entire transcripts for all 22 years, we employed a search procedure to identify and isolate relevant portions of the text. The search procedure involved scanning each transcript for key words that would be likely to be mentioned in a discussion of the Phillips curve. Once a portion of text was identified, we then read the discussion surrounding the key word. In some cases, the search yielded an isolated comment or question and, in other cases, the search identified a longer discussion (or, less frequently, a presentation) involving the Phillips curve or a gap-based framework for forecasting inflation. Initially, we considered a large number of key words. However, we found that we could reliably identify the relevant discussions by focusing on just four key words: "potential," "gap," "Phillips," and "NAIRU." In the case of "potential" and "gap," the search procedure yielded many false hits. We subsequently narrowed the selection to those instances that referred to the Phillips curve framework.

Overall, we identified over 1,000 interventions made by policymakers in the 176 transcripts between 1982 and 2003. We defined an intervention as a separate remark in the transcripts; each key word was counted once per policymaker intervention, even if the key word was used multiple times during that intervention. Table 1 lists the total number of interventions made by FOMC policymakers for the four key words by year for the entire sample.[6] In addition, the table includes the number of policymaker interventions for each word made during the "policy deliberation" portion of the meeting. The policy deliberation is last substantive item on the formal agenda of each FOMC meeting. Before the policy discussion, the agenda includes procedural issues, discussion of the staff's

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[6] We also identified a sizable number of non-policymaker interventions made by staff and other non-Committee meeting participants, but we do not report them in table 1.

forecast and economic conditions, and from time-to-time, a special topic.[7] Interventions during the policy discussion are the most relevant because they reflect the policymaker's view about the role of the Phillip curve framework for determining the stance of monetary policy.

Of the more than 1,000 policymaker interventions, fewer than 30 percent occurred when the FOMC was debating its policy options. As we discuss later, starting in 1994 and continuing for several years thereafter, prominent academic economists were appointed to policymaker positions in the Federal Reserve System. With these appointments, the discourse in FOMC deliberations became decidedly more academic in tone, with much more economic jargon and explicit reference to economic models. Importantly, this parallels the increasing attention paid in the economics literature to monetary policy rules, and John Taylor's (1993) well-known rule in particular.[8] Not surprisingly, we identified far fewer interventions prior to 1994, although most of them involved the discussion of economic slack, capacity, or operating potential and its implications for inflation. Having defined the methodology we used to extract relevant portions of the transcripts, we now turn to a discussion of our findings.

The early years

Table 1 shows that references to the Phillips curve framework were relatively rare from 1982 through 1993. There was virtually no mention of NAIRU or "gap." Moreover, very few of the interventions occurred during the deliberation over policy. Discussions of

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[7] On the formal agenda, the policy discussion takes place during "Current monetary policy and domestic policy directive," which was shortened in March 1999 to "Current monetary policy." Until 2001, the FOMC set monitoring ranges for the monetary aggregates at its January/February and June/July meetings and this discussion also preceded the policy discussion.

[8] The Taylor rule was first mentioned in an FOMC discussion by Governor Janet Yellen in 1995 at the January 31-February 1 meeting.

economic prospects and current or future inflation sometimes involved an analysis of the available slack in the economy, the level of operating capacity, or some measure of resource utilization. In most cases, this discussion arose during the pre-policy discussion portion of the meeting and was an exchange between a policymaker and a staff member who was explaining the approach underlying the staff's Greenbook forecast. From these interventions it is clear that the staff was using some sort of output gap measure to project inflation – in other words, a Phillips curve model. One exchange between Federal Reserve Governor Martha Seger and staff member Michael Prell in 1988 illustrates the sort of Phillips curve discussion typical of this period:[9]

> Seger: My second question is one involving a statement in the Greenbook that staff continue to believe that additional pressure in financial markets would be required to slow the expansion, etc. And I guess this goes to Mike: Do you think you've seen the full impact of the tightening moves that we've had to date?

> Prell: No, but our thought is that even after we have absorbed those, that we will not open up enough slack, so to speak, or reduce the pressures on the economy enough, to relieve the inflationary pressures. Therefore, we need to hold growth below potential for a period of time. What we have in our forecast is a very slight shortfall of actual growth from potential and very slight easing pressures on resources. And we think that, given the underlying tendencies in the economy, we are going to need a bit more restraint to keep things under control over the last two or three quarters of 1989.

While there was very little explicit reference to the Phillips curve during this period, the few interventions that we found were generally supportive of the Phillips curve framework. Governor Lyle Gramley, for instance, championed the Phillips curve approach at the November 1983 meeting, saying:[10]

> Well, in light of the results in chart 17, the remarkable thing is how well the Phillips curve model has done to explain what actually has happened. It got a little off track for a while in 1981, but in terms of the overall performance of the economy from 1978 on it has done very, very well indeed. So, I think the result that the staff is

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[9] FOMC Transcripts, September 1988, p. 5.
[10] FOMC Transcripts, November 1983, p. 16.

presenting to us is eminently reasonable in terms of outcome. If what you want to do is get back to price stability, this is what you're going to have to suffer. And if you want to get back to the natural rate of unemployment, you're going to have to have a worse inflation outlook.

However, there was one policy official who voiced doubt about using a gap-based measure to forecast inflation or about the Phillips curve: Alan Greenspan. In March 1988, shortly after his appointment as Chairman of the Federal Reserve, Greenspan pointed to the difficulty of getting an accurate estimate of economic potential, saying:[11]

> When we look at capacity – and the Fed is the official source of these data – capacity is a very dubious concept. You really don't know whether or not you have run into capacity until you have some objective measures of the inability to meet customer orders. That is really what it's all about.

In addition, during the February 1990 meeting, following a question by Federal Reserve Bank President Robert Parry about the consistency of the staff's projected range for the monetary aggregate M2 with the forecast for inflation, Greenspan commented that the answer "depends to a large extent on the accuracy of the Phillips curve type of model" (p. 26). Our reading of Greenspan – throughout the entire sample period – is that he was eclectic with regard to economic models, including (perhaps particularly) the Phillips curve framework. In other words, he used models when they worked but was not wedded to them when they went off track. In what follows, we discuss additional evidence of Greenspan's "model opportunism" that surfaces in later years of the sample period.

The infrequent use of the Phillips curve framework by policymakers generally, and especially during policy deliberations, suggests that, while the Phillips curve framework was evident in the staff's presentations of their inflation forecasts and many Committee members believed that inflation was or at least should be influenced by the amount of economic slack in the economy, its role in the formulation of monetary policy

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[11] FOMC Transcripts, March 1988, pp. 40-41.

appears to have been limited. While the Fed was focusing increasing attention on the funds rate as a policy instrument during this period (Thornton, 2006), there is no evidence that it was using any measure of the gap to determine its objective for the funds rate in the manner suggested by policy rules that are ubiquitous in modern macroeconomic models.

1994 and beyond

The marked increase in the FOMC discourse on the Phillips curve in 1994 coincided with the appointment of Alan Blinder and Janet Yellen to the Board of Governors.[12] Blinder and Yellen were strong proponents of the Phillips curve framework. Blinder resigned his position in June 1996 just as Laurence Meyer, another strong proponent of the Phillips curve framework and a forceful advocate of NAIRU, became a Governor.[13] The role of Blinder, Meyer, and Yellen in policy discussions using the Phillips curve framework is illustrated in table 2, which shows the proportion of their interventions in total interventions for each key word by year from 1994 through 2000. From the start, Blinder and Yellen used the Phillips curve framework to evaluate incoming data and the Greenbook's inflation forecasts. In November 1994, for instance, Yellen remarked that "the performance of wages and prices accords quite well with the predictions of a Phillips curve model in which the economy is currently in the vicinity of the natural rate" (p. 30). And, at the subsequent meeting, Blinder made a lengthy intervention in response to remarks from other FOMC policymakers that the staff's forecast for inflation was perhaps too modest in light of projected rapid output growth:[14]

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[12] Blinder and Yellen served as Governor from June 1994 until June 1996, and August 1994 until February 1997, respectively.
[13] Meyer resigned his position as Governor in January 2002.
[14] FOMC Transcripts, December 1994, pp. 27-29.

Let me take a few minutes to defend the conventionality of the Greenbook forecast against some of the objections that were raised…. Simple evidence… is that the conventional Phillips curves are fitting this episode extraordinarily well. They have very small residuals…. Standard econometric estimates would say that a 1 percent overshoot – 1 percent as measured by the unemployment rate [relative to the NAIRU] for an entire year – would add about l/2 percent to the inflation rate…. there is no particular reason to think that it [the Greenbook inflation forecast] is too low rather than too high. It is the best guess…

By the end of 1994, real GDP was close to or perhaps even beyond staff estimates of potential output. At the December FOMC meeting, Board staff member Michael Prell mentioned several times that the unemployment rate was currently below the staff's estimated NAIRU of 6 percent and had been hovering in that range for several months.[15] Moreover, the civilian unemployment rate, which dropped to 6 percent in 1994, fell further (to 5.6 percent) in 1995. Consumer price inflation was under 3 percent in 1994, but all signs pointed to an increase ahead. Not surprisingly in this environment, the FOMC continued its on-going monetary tightening, raising its target for the Federal funds rate by 50 basis points to 6 percent in February 1995.

By summer, however, the FOMC began to reverse the direction of monetary policy. In addition to slowing demand for US exports coming from Mexico's tequila crisis and its knock-on effects in other emerging market countries, the Greenbook's inflation forecast had begun to veer substantially off track – but not in the direction feared by the FOMC officials who had worried that inflation was on the rise. Instead, actual price and wage growth were lower than expected. Chart 1 shows the evolution of the prediction errors in the Greenbook forecast for core consumer price inflation in the calendar year following the FOMC meeting (computed as actual less projected inflation)

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[15] In the December 1994 Greenbook, the Fed staff estimated the 1994 unemployment rate at 6.1 percent, well above the Congressional Budget Office's real-time estimate of the NAIRU (just under 5.5 percent). See also FOMC Transcripts, December 1994 (for example, pp. 2, 4, and 6).

from 1987 through 2003.[16] The Greenbook over-predicted core inflation for the subsequent calendar year nearly every meeting from mid-1993 until the end of 1998, and then again in 2001 and 2002, with particularly large errors in 1996 and 1997. It is interesting to note that, starting in 1995, the frequency of interventions in the policy deliberation portion of the meeting began to rise (see table 1) reflecting debate about the estimated value of the NAIRU or potential output and the usefulness of such estimates for predicting future inflation.

In many of the FOMC meetings in the late 1990s, the committee devoted a substantial amount of time to debating the limits to economic expansion, the Phillips curve framework, and the outlook for inflation. With regard to the first of these, many policymakers focused on the precise estimate of the NAIRU (or, less frequently, the assumed level of potential output), whether it should be reduced below the 5.5 percent that was assumed starting with the February 1995 Greenbook, and how sensitive projected inflation was to alternative NAIRU estimates. Many of these interventions implicitly accepted the Phillips curve framework so long as the estimate of the natural rate or output gap was accurate. Governor Meyer was the most vocal about this issue, and the following comment from the February 1999 meeting is typical of his comments:[17]

> I would remind you that in the 20 years prior to this recent episode, the Phillips curve based on NAIRU was probably the single most reliable component of any large-scale forecasting model. It was very useful in understanding the inflation episode over that entire period. Certainly, there is greater uncertainty today about where NAIRU is, but I would be very cautious about prematurely burying the concept.

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[16] The Greenbook forecast for inflation is measured fourth quarter to fourth quarter. Forecast errors were calculated using real-time data so that the errors are consistent with those that would have been examined by FOMC policymakers and the Fed staff. Our sample period is determined by the availability of Greenbook output gap projections and is thus begins a few years later than our transcript search.

[17] FOMC Transcripts, February 1999, p. 118.

Some participants were more skeptical about the usefulness of NAIRU or the gap in forecasting inflation. In December 1995, Greenspan noted wryly, "saying that the NAIRU has fallen, which is what we tend to do, is not very helpful. That's because whenever we miss the inflation forecast, we say the NAIRU fell" (p. 39). Similarly, Thomas Melzer (President of the Federal Reserve Bank of St. Louis), commented that "whenever we get to whatever the NAIRU is, people decide it is not really there and it gets revised lower" (July 1996, p. 61).[18]

Other policymakers faulted the framework itself. In May 1996, for example, Jerry Jordan, President of the Federal Reserve Bank of Cleveland, remarked, "Perhaps the staff could at least humor those of us with analytical frameworks that differ from the gap or the NAIRU approach by including a reasonableness check." He continued:[19]

> It would say that to achieve a goal for inflation… one would need a specified growth in productivity over the interval to 1998. The staff also would indicate what counterpart reduction in the natural rate of unemployment would occur and provide some idea of the rate of sustained economic growth that would be consistent with reaching the inflation goal without reference to the notion of a Phillips curve tradeoff or sacrifice of output. Then, I and perhaps others could look at that analysis and decide whether it was a reasonable approximation of what was going on in the economy in terms of faster growth in productivity, the result of all of the investments taking place, and faster growth in capacity than allowed for in the staff model. I could decide whether I was willing to base policy on it.

Jordan was a frequent critic of the Phillips curve framework and he was joined by several other Federal Reserve Bank Presidents including Melzer, William Poole (Melzer's successor), and Edward Boehne from Philadelphia. For example:[20]

> Boehne: As far as NAIRU is concerned, my personal view is that it is a useful analytical tool for economic research but that it has about zero value in terms of making policy because it bounces around so much that it is very elusive. I would not

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[18] The Congressional Budget Office's current estimates of the NAIRU show a downward trend throughout this period.

[19] FOMC Transcripts, May 1996, p. 42.

[20] FOMC Transcripts, February 1999, p. 116, and June 1999, p. 106, respectively.

want our policy decisions to get tied all that closely to it, especially when most of the NAIRU models have been so far off in recent years.

Poole: I certainly count myself among those who believe that the Phillips curve is an unreliable policy guide. What that means is that the predictive content for the inflation rate – and I'll emphasize the "predictive" – of the estimated employment gap or GDP gap, however you want to put it, seems to be very low.

Furthermore, Poole argued, it was not the gap or NAIRU but inflation expectations that were the key:[21]

To make it very simple and straightforward, if we look at this in terms of a Phillips curve issue, there is a lot of concentration on growth or on the gap or whether the natural rate of the NAIRU has changed. In fact, I think the expectations component of the Phillips curve is at least as important and that the best way to understand what has happened in the last couple of years is to say that expectations have trumped the gap. The reason that we have been able to run an economy as well as it has unfolded is that there have been firm expectations of continuing low inflation. But expectations will not continue to trump the gap forever. The underlying realities of the pressure on resource markets will gradually take hold; and once we lose the advantage on expectations, I believe it is going to be painful and difficult to get it back.

However, some Board members and Bank Presidents continued to support the Phillips curve framework:[22]

Parry: … as far as I know, the Phillips curve is still the best model available to forecast inflation and our analysis suggests that the Phillips curve is basically on track.

McDonough: We use the gap between actual and potential GDP as the best tool of inflation forecasting.

Minehan: Some people would debate the validity of this structure. Certainly, if we continue to have accelerating productivity growth, these estimates of output gap and NAIRU and so forth may be wrong. But in a time of uncertainty, it certainly seems that relying on constructs that have helped us bring about nearly 20 years of better economic conditions—milder cyclical turns, ever lower inflation, lower unemployment, and more sustained growth—has validity. It seems appropriate to look back on the things that have helped us create the kind of environment that President McDonough referred to, one in which more people are working, more

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[21] FOMC Transcripts, May 1999, p. 64.
[22] FOMC Transcripts, September 1996, p. 13, May 1997, p. 41, and June 1999, p. 112, respectively.

people have that experience of working, and the benefits of growth are shared more fully by all.

Although most policymakers pitted themselves firmly on one side or the other, Greenspan remained noncommittal about the Phillips curve:[23]

> I am merely indicating that there is something quite unusual going on here, and we have been aware of this for a considerable period of time. As I have argued many times in the past and despite the latest set of employment data, employment cannot increase indefinitely at the rate it has been increasing. Leaving the Phillips curve aside, leaving NAIRUs aside, leaving everything aside, I do not know how one can put negative people in an equation and then run it out. At some point, something has to give. We cannot increase productivity merely by an act of will. There are upside limits, so that if effective demand continues to grow as it has, there is no question that inflationary pressures have to emerge. …We cannot keep getting such numbers and continue to say that inflation is about to rise. As we keep projecting a higher rate of inflation, it keeps going down, and there has to be an admission at some point that something different is affecting prices.

What is striking in reading the FOMC transcripts is that, by 1999, there was a clear separation of those policymakers who regarded the Phillips curve as a still-relevant, albeit battered, framework for forecasting inflation, and those who disregarded it but were frustrated about an absence of alternative concepts used in formulating Greenbook inflation forecasts.

A particularly interesting discussion of the Phillips curve occurred at the June 2002 meeting, when Arthur Rolnick, Director of Research at the Federal Reserve Bank of Minneapolis, made a presentation entitled, "Are Phillips Curves Useful for Forecasting Inflation? 40 Years of Debate." Rolnick's analysis, largely based on the work of Atkeson and Ohanian (2001), suggested three conclusions: First, the Phillips curve has not been stable. Second, unemployment is not useful for forecasting inflation (it cannot forecast better than a naïve model). Finally, in the long run, money growth is a more reliable predictor of inflation. Nearly all members agreed that the Phillips curve framework had

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[23] FOMC Transcripts, December 1997, pp. 68-69.

been problematic in predicting future inflation since the mid-1980s. Some (specifically,

Board member Gramlich and Bank Presidents Broaddus and Minehan) thought the poorer

performance of the Phillips curve was a result of the Fed's success in reducing and

stabilizing inflation – with inflation low and inflation expectations more firmly anchored,

there was a less reliable relationship between the output gap and inflation.

Michael Moskow, President of the Federal Reserve Bank of Chicago, was the

only member to endorse the continued usefulness of the Phillips curve, saying "there are

limitations to these Phillips curve types of models, but I wouldn't discard them

completely. I think there is some benefit to policymaking from these types of

approaches."[24] There was general agreement that money growth determines inflation

over the long run, but that the monetary aggregates are not useful for conducting short-

run monetary policy. In addition, there was consensus that inflation is determined by a

variety of factors, but that there were no viable alternatives to the Phillips curve model.

As President Poole noted, "I think one of the problems here is that, with all the

difficulties of the Phillips curve, we need a horse to beat a horse. We need something

better but we don't have a framework that is a whole lot better. And the framework that

emphasizes money growth… just doesn't do the job that needs to be done over the short

horizon."[25]

Interestingly, Greenspan suggested that the relative failure of the Phillips curve

since the mid-1980s likely reflected a more general phenomenon, namely:[26]

> that the economic structure that drives this economy is under continuous change...
> until we can find some significant, stable set of relationships that seems to capture
> something fundamental and unchanging in the economy, we will have no choice but

[24] FOMC Transcripts, June 2002, p. 13.
[25] FOMC Transcripts, June 2002, p. 38.
[26] FOMC Transcripts, June 2002, pp. 19-20.

to move to looking at a wide variety of data and information… A lot of people out there are asking why we can't come up with something simple and straightforward. The Phillips curve is that, as is John Taylor's structure. The only problem with any one of these constructs is that, while each of them may be simple and even helpful, if a model doesn't work and we don't know for quite a while that it doesn't work, it can be the source of a lot of monetary policy error. That has been the case in the past… I hope we can find some stable structure out there. I suspect that we will not.

Skepticism about the usefulness of economic models for policymaking because the economy was undergoing continuous change was an idea that Greenspan brought up from time-to-time in FOMC discussions and is a central theme in Greenspan (2007).

4.   Evaluation of Greenbook inflation forecasts

In this section, we use the output gap from each Greenbook, along with Greenbook projections for inflation in the current and subsequent calendar year, to assess the extent to which the staff inflation forecasts were consistent with the Phillips curve framework. Given its important role in the canonical macroeconomic model and the lack of a rival framework, it is not surprising to find that Fed staff relied on the Phillips curve framework to explain the Greenbook's inflation forecasts. This occurred even as uncertainty about the size of the output gap and NAIRU increased, and inflation was consistently over-predicted. Greenbook forecasts are a combination of model forecasts and judgment. As Bernanke (2007) has noted, Greenbook inflation forecasts are "… developed through an eclectic process that combines model-based projections, anecdotal and other 'extra-model' information, and professional judgment," and that "most of the models used are based on versions of the New Keynesian Phillips curve." Given that the forecasts are a mix of model-based projections and judgment, it is reasonable to assume that the role played by the output gap and NAIRU would have changed over time. Rather

than estimating a Phillips curve *per se*, we simply evaluate the extent to which the

Greenbook forecasts reflected the Phillips curve framework.

Our empirical analysis is confined to the 132 FOMC meetings from August 1987

through December 2003, a shorter period than we used in our transcript search, owing to

the limited availability of the Greenbook's output gap series.[27] We estimated Phillips

curves using different measures of inflation, but confine our discussion here to those

based upon core inflation as measured by the consumer price index excluding food and

energy. [28] Our output gap data consists of Greenbook estimates for the quarter before, the

quarter of, and the four quarters following the meeting.[29]

We evaluate the extent to which the Fed's inflation forecast reflected the Phillips

curve framework by estimating:

(1) $\tilde{\pi}_{t+1} = \alpha + \delta\tilde{\pi}_t + \beta_1 ygap_{t-1} + \beta_2 ygap_t + \beta_3 ygap_{t+1} + \beta_4 ygap_{t+2} +$

$\beta_5 ygap_{t+3} + \beta_6 ygap_{t+4} + \varepsilon_{t+1},$

where $\tilde{\pi}_{t+1}$ denotes the Greenbook forecast of core CPI inflation for the calendar year

following the FOMC meeting and $\tilde{\pi}_t$ denotes the projected rate of inflation for the

meeting year, based upon information available at the time of the meeting.[30] The

variable $ygap_{t+j}$ ($j = -1, 0, 1, ... 4$) is the Greenbook estimate of the output gap in the

corresponding quarter relative to the quarter of the meeting.

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[27] Both the Federal Reserve Bank of Philadelphia and Federal Reserve Bank of St. Louis make the Greenbook projections available on their web sites.

[28] When we estimated Phillips curves using other measures of inflation included in the Greenbook – such as overall consumer prices, the fixed-weight price index, and the GDP deflator – the fit of the equation in terms of adjusted R^2 was much lower.

[29] We also estimated an unemployment-based Phillips curve using the Greenbook forecasts for the annual unemployment rate and real-time NAIRU estimates produced by the Congressional Budget Office (as the NAIRU implicit in the Greenbook is not made public). Due to data limitations of the NAIRU estimates, the unemployment-gap Phillips curve is based upon a shorter sample of 104 meetings. Since the results are qualitatively similar to those for the output-gap Phillips curve, we do not report them here.

[30] The Greenbook inflation forecasts $\tilde{\pi}_{t+1}$ and $\tilde{\pi}_t$ are on a fourth quarter over fourth quarter basis.

The degree to which the Phillips curve framework is important for the Fed's inflation forecasts is reflected in the estimates of β_1 through β_6 from equation (1). Ordinary least squares estimates of the parameters are reported in table 3, along with standard errors and other summary statistics.[31] In addition, the table provides estimates when the gap terms are dropped altogether and inflation follows a random walk (a naïve model). The sum of the β terms in equation (1) is positive, and a Wald test rejects the null hypothesis that this sum is zero at the 1 percent level of significance. Thus, output above potential contributes positively to projected inflation.

Given the likelihood that the role of the Phillips curve framework changed over the sample period, we estimated equation (1) and the naïve model using a rolling window regression of 50 meetings.[32] Chart 2 shows the adjusted $\overline{R}^2$ from the rolling regressions plotted on the end date of the rolling sample. The fit of both models varied considerably in the 1990s with a substantial decline in the explained variation of the inflation forecast for equations estimated over a 50-period sample that ended between late 1995 and the end of 1999, parallel to the time when the FOMC was voicing increasing skepticism about the usefulness of the framework.

As a final exercise, we estimate the extent to which revisions in the Fed staff's forecasts of core inflation are related to revisions in their gap estimates:

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[31] The standard errors are obtained from heteroskedasticity-consistent covariances using White's procedure.
[32] A 50-meeting window spans a little more than six years. Our results are robust to window sizes of 40 and 60 meetings.

(2) $\Delta \tilde{\pi}_{t+1} = \alpha + \gamma_1 \Delta ygap_{t-1} + \gamma_2 \Delta ygap_t + \gamma_3 \Delta ygap_{t+1} + \gamma_4 \Delta ygap_{t+2}$

$$+ \gamma_5 \Delta ygap_{t+3} + \gamma_6 \Delta ygap_{t+4} + \eta_{t+1},$$

where $\Delta \tilde{\pi}_{t+1}$ denotes the change in the Greenbook inflation forecast between the current

meeting and the same meeting one year before, and the $\Delta ygap$ terms denote the change

in the estimated/projected output gap between these same two meetings. This equation is

also motivated by the high degree of persistence in the Greenbook inflation and output

gap forecasts which could distort estimates of the parameters and adjusted $\overline{R}^2$. If the

output gap is important for the Greenbook inflation forecasts, then changes in the two

should be closely linked. Parameter estimates are reported in table 3; a Wald test

indicates that the sum of the γs is significantly different from zero and the adjusted

$\overline{R}^2$ shows that changes in the gap estimates account for about 30 percent of the change in

the inflation forecasts over the sample period.

In addition, we estimated equation (2) using a 50-meeting rolling window and

recursive regressions (the recursive regressions begin with 50 observations), and plot the

adjusted $\overline{R}^2$ in chart 3. Once again, these results are broadly consistent with our reading of

the transcripts. Revisions in the gap forecasts initially account for about 50 percent of the

revision in the inflation forecast, before rising dramatically to over 75 percent for the 50

meetings ending in early 1997. After that, the contribution of the output gap revisions

falls steadily for both rolling and recursive regressions.

5.   Conclusions

The FOMC transcripts indicate, perhaps not surprisingly, that most policymakers

(including Greenspan) believed inflation to be the consequence of excess demand when

the real economy is at or near full employment. Despite the general reliance on an

aggregate demand/aggregate supply view of inflation, the transcripts indicate that views on the usefulness of the gap between actual and potential output or the NAIRU as a measure of excess demand (or as a guide for forecasting inflation) were strongly divided. Some thought estimates of the gap were useful for policymaking, while others thought that the relationship between gap measures and current or future inflation was so unreliable as to provide little or no guidance for policy. In addition, the transcripts indicate that, by the late 1990s, attitudes about the usefulness of the Phillips curve framework changed. Even those policymakers who thought that the gap measures were helpful were keenly aware of the difficulty of obtaining reliable real-time estimates of the output gap or NAIRU and, consequently, were more skeptical of their usefulness for policy decisions. Our analysis of the transcripts is generally supported by our empirical examination of the importance of the Phillips curve framework in Greenbook inflation forecasts. Hence, we conclude that the Phillips curve framework appears to have been significantly less important in actual monetary policymaking than is suggested by the canonical macroeconomic model or by widely-used policy reaction functions.

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Table 1. References to key words by Federal Reserve policymakers in FOMC meetings, 1982-2003*

| Year	Total interventions				Interventions from policy discussion**			
	"Potential" output	Output "gap"	"Phillips" curve	"NAIRU"	"Potential" output	Output "gap"	"Phillips" curve	"NAIRU"
1982	3	0	1	0	0	0	0	0
1983	2	0	3	0	1	0	0	0
1984	4	0	0	0	2	0	0	0
1985	78	0	0	0	6	0	0	0
1986	5	0	0	0	4	0	0	0
1987	3	2	2	0	0	0	0	0
1988	11	2	2	1	5	0	0	0
1989	11	2	5	0	5	1	3	0
1990	8	1	4	0	3	0	1	0
1991	3	1	0	0	0	0	0	0
1992	13	2	0	0	3	0	0	0
1993	6	2	1	1	3	0	0	0
1994	42	3	10	26	4	0	3	5
1995	43	9	4	29	13	3	0	5
1996	42	7	12	36	11	3	2	11
1997	27	13	8	32	11	4	8	14
1998	26	1	2	11	5	0	2	4
1999	30	16	9	35	7	10	9	22
2000	53	9	3	54	23	8	0	14
2001	34	9	0	6	2	3	0	1
2002	36	20	9	15	4	1	0	5
2003	41	67	5	5	9	13	2	0
Total	521	166	80	251	121	47	30	81

* Data collected from FOMC transcripts. Each key word is counted once per policymaker intervention, even if the key word is used multiple times during that intervention. Entries are computed using all available transcripts of meetings and conference calls in a given year, exclude staff interventions, and include Donald Kohn from August 2002 when he moved from the staff to become a Federal Reserve official.

**The discussion of policy alternatives takes place in the second part of the meeting and follows the discussion of the economic outlook.

Table 2. Interventions by Blinder, Meyer, and Yellen (percent of total interventions)

	"Potential" output	Output "gap"	"Phillips" curve	"NAIRU"
1994	11.9	33.3	20.0	19.2
1995	20.9	88.9	50.0	20.7
1996	23.8	28.6	16.7	50.0
1997	3.7	7.7	12.5	56.3
1998	7.7	0.0	50.0	0.0
1999	0.0	12.5	11.1	14.3
2000	20.8	11.1	66.7	20.0

Chart 1. Errors in Greenbook forecasts for core inflation (actual minus predicted), 1987-2003*
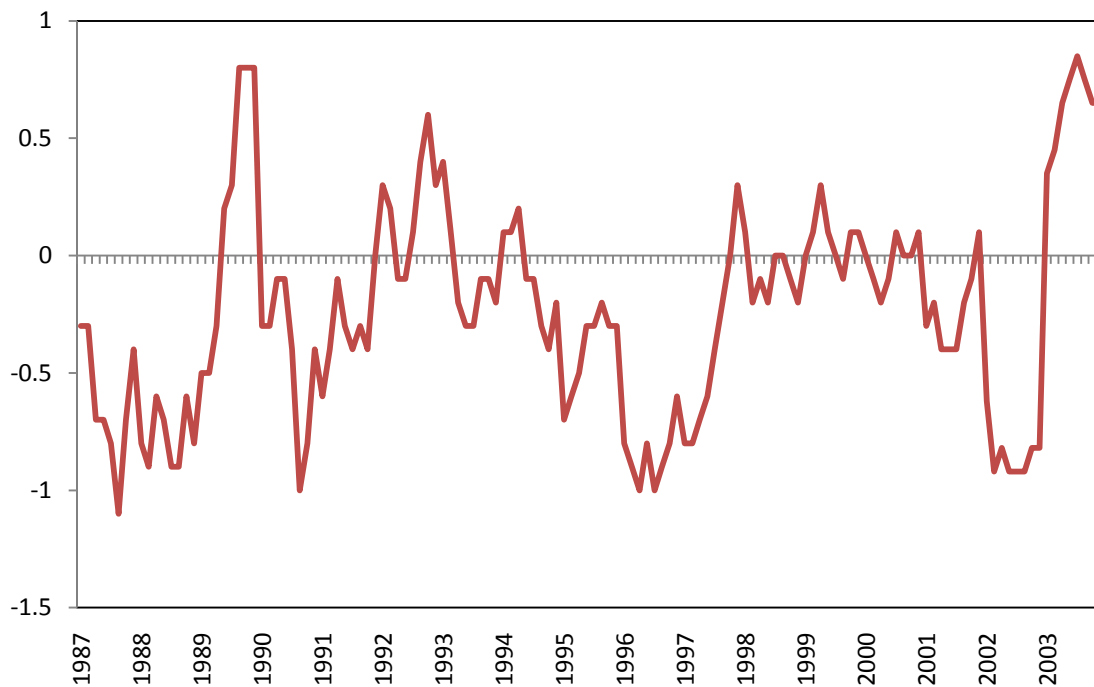
* Forecast is for Q4/Q4 CPI inflation in the calendar year following the FOMC meeting. Actual data are as published in the first quarter, two calendar years after the FOMC meeting.

Table 3. Explaining Greenbook forecasts for core inflation (standard errors in parentheses)[1]

	Equations:		
	Output-gap Phillips curve	Naïve model	Change in core inflation forecast[2]
	Equation (1)		Equation (2)
δ	1.07*** (0.035)	0.96*** (0.036)	
β_1	-0.34*** (0.086)		
β_2	0.46** (0.188)		
β_3	0.21 (0.143)		
β_4	-0.47*** (0.172)		
β_5	-0.21 (0.197)		
β_6	0.53*** (0.192)		
γ_1			0.18** (0.093)
γ_2			0.14 (0.196)
γ_3			-0.06 (0.256)
γ_4			-0.65** (0.315)
γ_5			0.65* (0.357)
γ_6			-0.04 (0.274)
adjusted $\overline{R}^2$	0.938	0.865	0.303
# obs	132	132	124

[1]Constant terms included but not reported. */**/*** indicates significance at the 10/5/1 percent level. Standard errors obtained from heteroskedasticity-consistent covariances using White's procedure.

[2]The change is relative to the Greenbook forecast for the same FOMC meeting in the previous year.

Chart 2. Adjusted $\overline{R}^2$ of naïve model (green line) and output-gap model (blue line), rolling regressions (50-meeting window)*
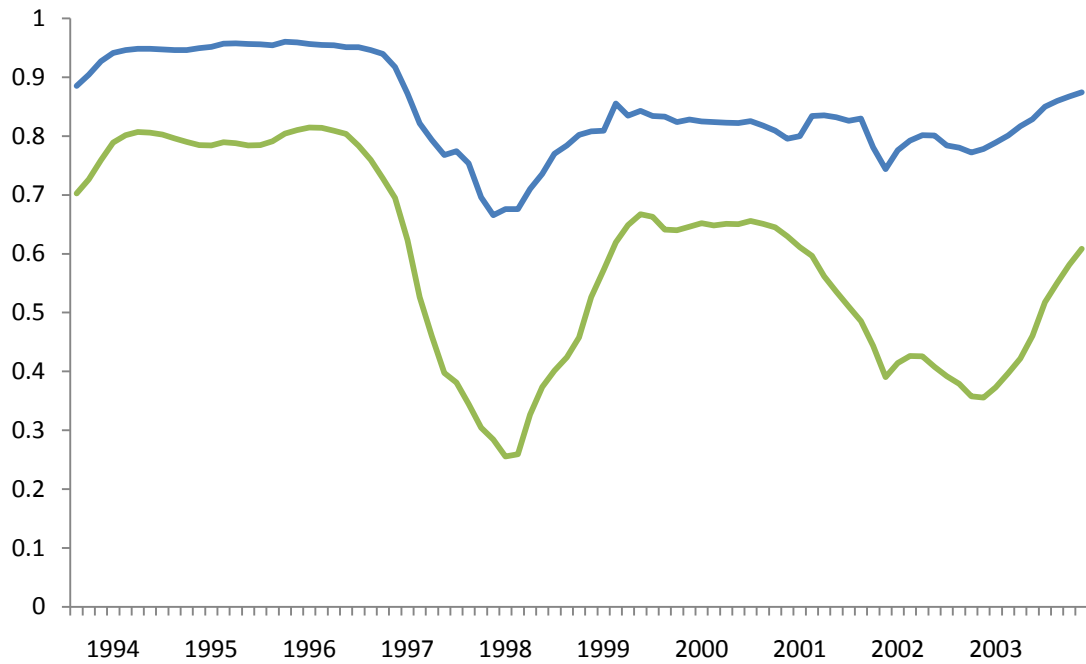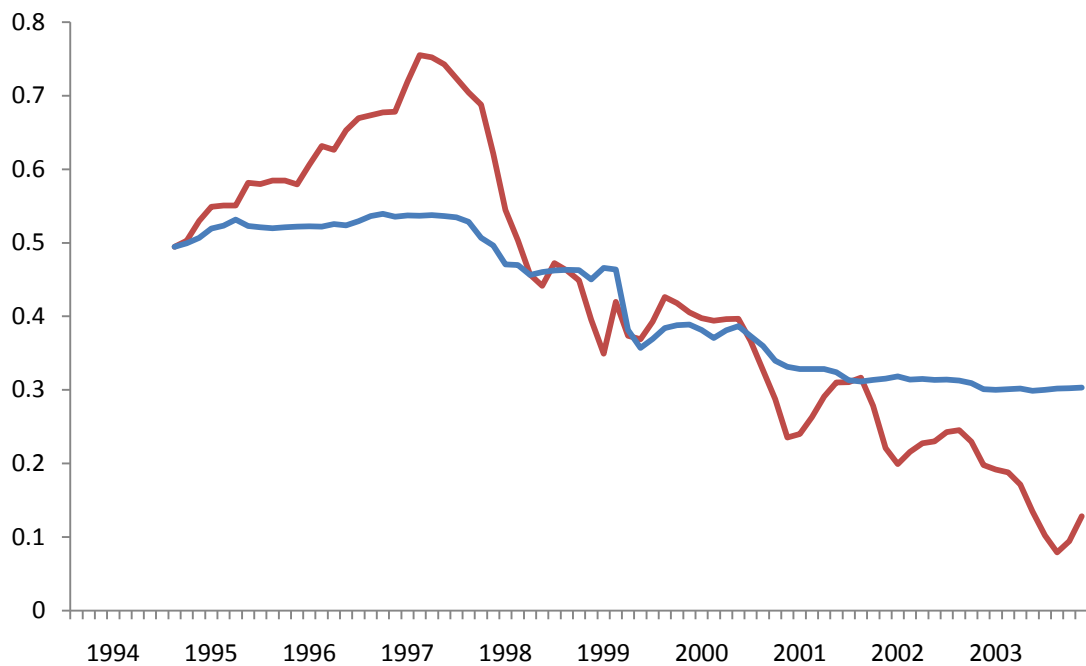

Chart 3. Adjusted $\overline{R}^2$ from Equation (2), rolling regressions (red line) using 50-meeting window and forward recursive regressions (blue line)*

* Plotted at the end date of the estimation window.