Economic Quarterly—Volume 94, Number 4—Fall 2008—Pages 311–359

The Phillips Curve and U.S. Macroeconomic Policy: Snapshots, 1958–1996

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The curve first drawn by A.W. Phillips in 1958, highlighting a negative relationship between wage inflation and unemployment, figured prominently in the theory and practice of macroeconomic policy during 1958–1996.

Within a decade of Phillips' analysis, the idea of a relatively stable long-run tradeoff between price inflation and unemployment was firmly built into policy analysis in the United States and other countries. Such a long-run tradeoff was at the core of most prominent macroeconometric models as of 1969.

Over the ensuing decade, the United States and other countries experienced stagflation, a simultaneous rise of unemployment and inflation, which threw the consensus about the long-run Phillips curve into disarray. By the end of the 1970s, inflation was historically high—near 10 percent—and poised to rise further. Economists and policymakers stressed the role of shifting expectations of inflation and differed widely on the costliness of reducing inflation, in part based on alternative views of the manner in which expectations were formed. In the early 1980s, the Federal Reserve System undertook an unwinding of inflation, producing a multiyear interval in which inflation fell substantially and permanently while unemployment rose substantially but temporarily. Although costly, the disinflation process involved lower unemployment losses than predicted by consensus macroeconomists, as rational expectations analysts had suggested that it would.

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By 1996, the central bank of the United States had constructed a large-scale rational expectations model, without any long-run tradeoff, which it began to use to evaluate alternative policy scenarios. Monetary policymakers at that time accepted the idea that there was no long-run tradeoff at, and above, the then-prevailing price inflation rate of 3 percent. Yet many felt that there were important tradeoffs over short-run horizons, diversely defined, and some saw long-run tradeoffs near zero price inflation.

This article reviews the evolving role of the Phillips curve as an element of macroeconomic policy during 1958–1996, as well as academic and central bank research on it, via a series of snapshots over this roughly 40-year period. In conducting the research summarized in this article, my motivation is to better understand the mindset about the tradeoff between inflation and unemployment over an important period of U.S. history with an eye toward ultimately better understanding the joint behavior of the Federal Reserve and the U.S. economy during that period. Diverse research in macroeconomics—notably Sargent (1999), Orphanides (2003), and Primiceri (2006)—has sought an explanation of inflation's role in the behavior of a central bank that has an imperfect understanding of the operation of the private economy. The perceived nature of the Phillips curve plays an important role in these analyses, so that my reading of U.S. history may provide input into future work along these lines. I draw upon two distinct and complementary sources of information, published articles and documents of the Federal Open Market Committee (FOMC), to trace the evolving interpretation of the tradeoff over this roughly 40-year period.

The discussion is divided into six sections that follow this introduction. Section 1 provides a quick overview of the U.S. experience with price inflation and unemployment during 1958–1996. As the objective of this article is to provide a description of how policymakers' visions of the Phillips curve may have evolved during this time, resulting from empirical and theoretical developments, it is useful to have these series in mind as we proceed. Section 2 describes the birth of the Phillips curve as a policy tool, highlighting three core contributions: Phillips' original analysis of U.K. data, Samuelson and Solow's (1961) estimates of the curve on U.S. data and their depiction of it as a menu for policy choice, and the econometric analysis by Klein et al. (1961) and Sargan (1964) of the interrelationship between wage inflation, price inflation, and unemployment, which formed the background for wage and price blocks of macroeconomic policy models. Section 3 depicts the battle against unemployment that the United States waged during the 1962–1968 period and its relationship to the Phillips curve in then-prominent macroeconomic policy models. Section 4 discusses the breakdown of the empirical Phillips curve during 1969–1979, a period including intervals of stagflation in which unemployment and inflation rose together, and theoretical criticisms of the Phillips curve as a structural macroeconomic relation. Section 5 indicates the role of

the Phillips curve during the unwinding of inflation in the United States during 1980 through 1986. Section 6 concerns several aspects of policy modeling and policy targeting in 1996 as the United States returned to a sustained interval of relatively low inflation. Section 7 concludes.

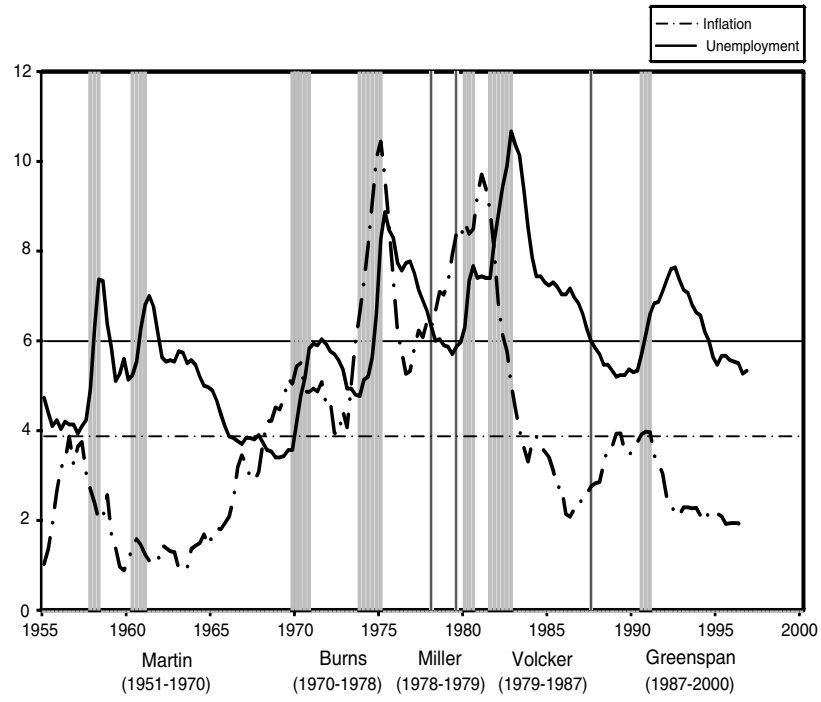
1. INFLATION AND UNEMPLOYMENT, 1958–1996

Since my discussion focuses on studies of inflation and unemployment that were written during 1958 through 1996, it seems useful to start by providing information on U.S. inflation and unemployment over that historical period, augmented by a few initial years, as in Figure 1. As measured by the year-over-year percentage change in the gross domestic product deflator, inflation averaged just under 4 percent, starting and ending the 1955–1996 interval at about 2.5 percent. Inflation twice exceeded 10 percent, in 1974–75 and 1981. The unemployment rate averaged 6 percent, starting and ending the sample period near 5 percent. Recession intervals, as dated by the National Bureau of Economic Research (NBER), are highlighted by the shaded lines in Figure 1.

My snapshots of the Phillips curve and its role in macroeconomic policy are usefully divided into five periods.

- *The formative years* in which the initial studies were conducted, 1955–1961. During this interval, there were two recessions (August 1957 through April 1958 and April 1960 through February 1961), each of which was marked by declining inflation and rising unemployment.
- *The battle against unemployment* from 1962 through 1968 during which unemployment fell substantially, with inflation being at first quiescent and then rising substantially toward the end of the period.
- *The breakdown of the Phillips curve* empirically and intellectually came from 1969 through 1979. In this period, there were two recessions. During December 1969–November 1970, both inflation and unemployment rose but there was a brief decline in inflation within the recession. During November 1973 through March 1975, inflation and unemployment both rose dramatically. This period was a tumultuous one, marked by departure from gold standard, wage and price controls, energy shocks, as well as difficult political and social events.
- *The unwinding of inflation* took place during 1980 through 1985, with a substantial reduction in inflation accompanied by a sustained period of unemployment.
- In *the aftermath*, 1986–1996, the Phillips curve assumed a new form in monetary policy models and monetary policy discussions.

Figure 1 Inflation and Unemployment, 1955–1996

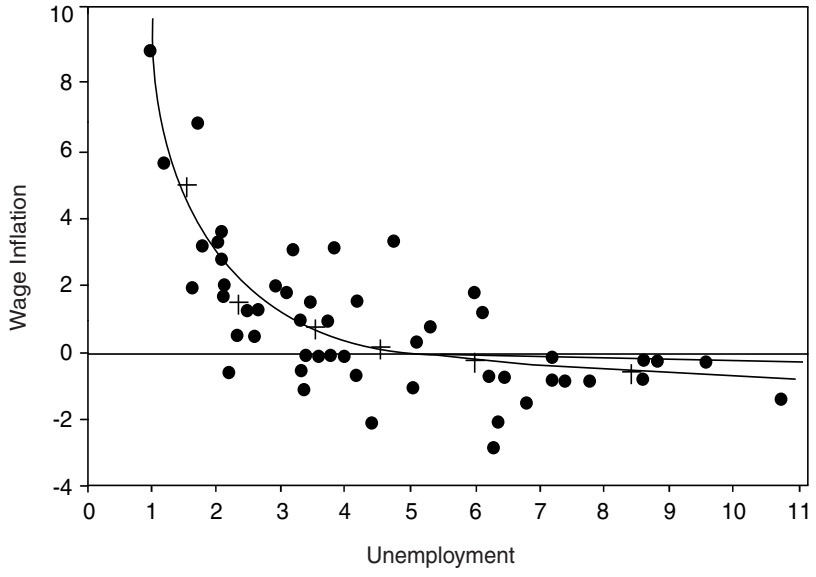


Notes: The inflation rate is the year-over-year change in the gross domestic product (GDP) deflator, the unemployment rate is the civilian unemployment rate, quarterly averages of monthly figures. All data from the Federal Reserve Economic Database (FRED) at the Federal Reserve Bank of St. Louis. The shaded grey areas are NBER recessions, while the vertical black lines separate the tenures of the various Federal Reserve chairman whose names appear below the horizontal axis.

2. THE FORMATIVE YEARS

Figure 2 is the dominant image from Phillips' initial article: a scatter plot of measures of wage inflation and unemployment in the United Kingdom over 1861–1913 supplemented by a convex curve estimated by a simple statistical procedure. During the 1960s, U.S. macroeconomic policy analysis and models were based on a central inference from this figure, which was that a permanent rise in inflation would be a necessary cost of permanently reducing unemployment. However, as background to that period, it is useful for us to understand how the Phillips curve was estimated initially, how it crossed the Atlantic, and how it was modified so that it could be imported into macroeconomic policy models.

Figure 2 Phillips' Curve



Notes: This is Figure 1 from Phillips (1958), displaying the relationship between unemployment and wage inflation over 1861–1913. The dots represent annual observations, while the crosses represent trade cycle averages.

The Original Study

Phillips (1958) described the objective of his study as follows: "to see whether statistical evidence supports the hypothesis that the rate of change of money wage rates in the United Kingdom can be explained by the level of unemployment and the rate of change of unemployment, except in or immediately after those years in which there was a very rapid rise in import prices, and if so to form some quantitative estimate of the relation between unemployment and the rate of change of money wage rates."[1] He began with the study of inflation and unemployment over multiyear periods, which he called trade cycles, and then he assembled these intervals into the overall curve that bears his name.

Trade cycles and the Phillips curve

The celebrated trade-off curve was derived by a complicated procedure. First, Phillips explored the behavior of a measure of wage change and unemployment

[1] Phillips (1958, 284).

over a series of historical United Kingdom "trade cycles," an alternative label for the sort of business cycles that Burns and Mitchell (1946) had identified for the United States.[2] The cycle for 1868–1879 is shown in Panel A of Figure 3. It begins with several years of falling unemployment and rising wage inflation, then an interval of rapidly declining wage inflation and modestly rising unemployment, then a number of years of wage declines accompanied by substantially increasing unemployment. Over the course of this cycle, there was an initial interval (1868–1872) during which inflation rose by about 10 percent, while unemployment dropped by about 5 percent. Then, from 1872–1875, there was a period of sharply declining inflation accompanied by modestly rising unemployment. Finally, from 1876–1879, there was a period of negative inflation (-1 to -3 percent per year) coupled with dramatically rising unemployment.

Phillips' identification of the tradeoff between inflation and unemployment did not rely on the shape of the cyclical pattern over the course of this and other individual trade cycles. Instead, the wage inflation and unemployment observations over the 1868–1879 trade cycle were averaged by Phillips to produce one of the "+" points in Figure 2, with the long-run curve adjusted so that it fit through these cycle averages.[3] The curve, fitted to six "+" points, contained three free parameters and implied that very low values of unemployment would lead to very high inflation, while very high values of unemployment would lead to very low inflation.[4]

Thus, the Phillips curve was based on average inflation and unemployment observations over the course of trade cycles of varying lengths. Although it was sometimes criticized as capturing short-run relations, Phillips' procedure contained significant lower frequency information. Yet, these cycle averages were drawn from the period when the United Kingdom was on the gold standard so that there were limits to the extent of price inflation or deflation.

Exploration of subsequent periods

After estimating the long-run curve on 1861–1913 data, Phillips then examined the extent to which the subsequent behavior of wage inflation and unemployment could be understood using the curve.

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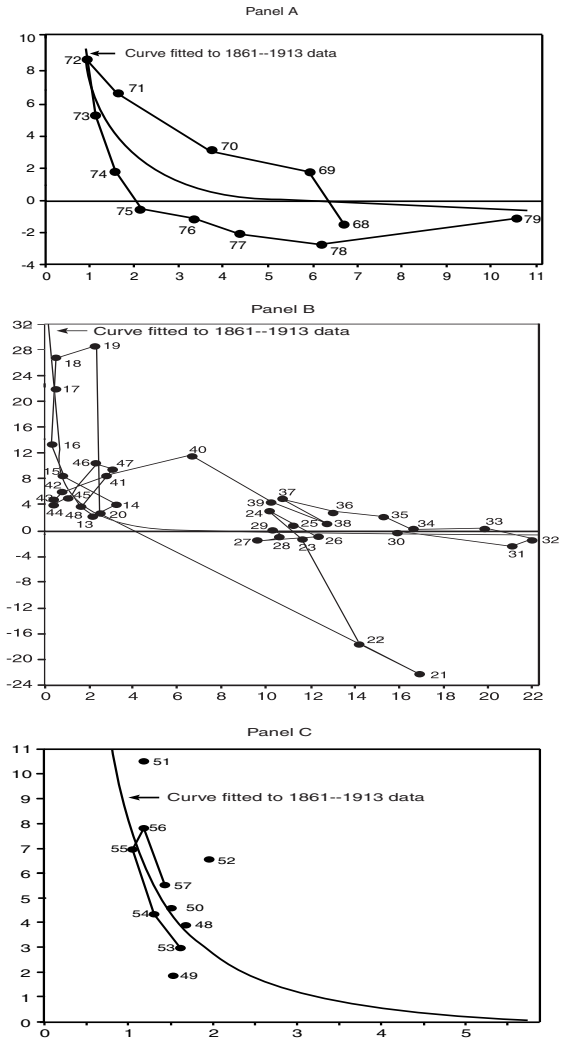
[2] Phillips' annual wage inflation observations are effectively a two-period average of the inflation rate in the future year and the current year.

[3] To explain the cyclical pattern around the long-run curve, Phillips developed a theory in which wage inflation was affected negatively both by the rate of change and level of unemployment. That part of his analysis was less broadly taken up by subsequent researchers, although there was a significant literature on "Phillips loops" during the 1970s.

[4] As in Phillips, letting y be the wage inflation and x be unemployment, the fitted curve took the form $y = -.9 + 9.638x^{-1.394}$, with the paremeters selected by a combination of least-squares and trial-and-error (Phillips 1958, 285).

Figure 3 Trade Cycles and the Phillips Curve



Notes: A key part of Phillips' analysis was to study the behavior of unemployment and wage inflation over various trade cycles, with three early cycles shown in this figure. For each, Phillips computed a cycle average, which was then used as one of the central data points through which he drew the long-run curve shown in Figure 1 (+). Panel A is Figure 3 from Phillips (1958); Panel B is Figure 9 from Phillips (1958); Panel C is Figure 10 from Phillips (1958). In all panels, the horizontal axis is unemployment and the vertical axis is wage inflation, as in Figure 2.

Looking at 1913–1948 as shown in Panel B of Figure 3, Phillips concluded that the general approach worked well. In particular, the trade cycle of 1929–1937 fit his general pattern, but he puzzled somewhat over the relatively high rates of inflation in 1935–1937. Other parts of the 1913–1948 interval fit in less well. As potential explanations of the behavior of wage inflation during both the First World War and the subsequent deflation to return the pound to its pre-war parity, Phillips discussed the potential importance of cost-of-living changes (effects of price inflation on wage-setting) as contributing to wage inflation in the wartime period and to wage deflation during the post-WWI interval). The sharp declines in nominal wage rates in 1921 and 1922, as Britain returned to pre-war parity with gold, stand out dramatically in Panel B of Figure 3. Although these points lie far from the curve based on 1861–1913 data, they are dramatic outliers that nevertheless show a negative comovement of inflation and unemployment in line with Phillips' general ideas.

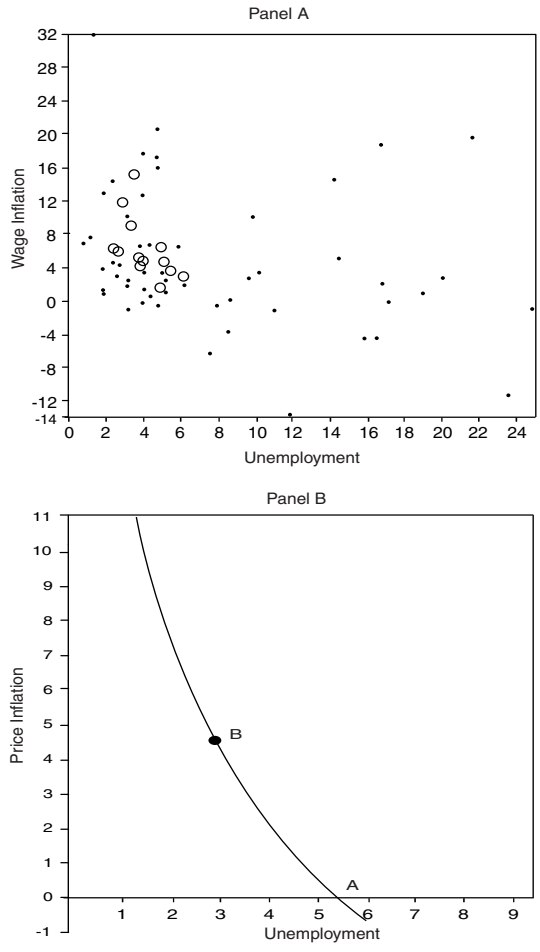
Phillips also explored the consistency of the period following the Second World War, 1948–1957, with his long-run curve. During this period, U.K. unemployment was at a remarkably low level (between 1 and 2 percent) and inflation varied widely, as shown in Panel C of Figure 3. Phillips commented on several aspects of this interval. First, he noted that a governmental policy of wage restraint was in place in 1948 and apparently temporarily retarded wage adjustments. Second, he noted that the direction of the trade-cycle "loop" had reversed from the earlier period, which he suggested might be due to a lag in the wage-setting process. Third, he used this period to show how his curve could be used to partition wage inflation into a "demand-pull" component, associated with variation in unemployment along the curve and other factors, which induced departures from the curve. After looking at retail price inflation during this period, Phillips suggested that some of the wage inflation observations, such as the 1948 value that lies well above the curve, could have arisen from "cost-push" considerations in which workers bargained aggressively for higher nominal wages. However, Phillips concluded that the post-WWII period was broadly consistent with the curve fit to the 1861–1913 data.

U.S. Background to a Vast Experiment

In 1960, Paul Samuelson and Robert Solow examined U.S. data on the rate of change in average hourly earnings in manufacturing and the annual average data on unemployment over an unspecified sample period, which is most likely 1890 through the late 1950s.[5] Their empirical analysis most closely resembles

[5] Samuelson and Solow (1960) indicate that their study is based on the data of Rees, which is most likely his 1961 monograph on real wages in manufacturing, where the earliest data is 1890.

Figure 4 Phillips Curves of Samuelson and Solow



Notes: Panel A shows annual unemployment and wage inflation in U.S. data (this is Figure 1 from Samuelson and Solow [1961]), with their figure notes indicating that circled points are for "recent years." Panel B shows the trade-off curve that Samuelson and Solow discussed for the United States (this is Figure 2 in their article).

the 1861–1913 Phillips analysis that we have just looked at, but the overall association was looser, as dramatically displayed in Panel A of Figure 4.

Like Phillips, Samuelson and Solow looked at sub-samples, noting that money wages rose or failed to fall during the high unemployment era of 1933 to 1941, which they suggested might be due to the workings of the New

Deal. Further, they noted that the World War I period also failed to fit into the expected pattern, in line with Phillips' findings discussed above.

Overall, though, Samuelson and Solow argued that "the bulk of the observations—the period between the turn of the century and the first war, the decade between the end of that war and the Great Depression, and the most recent ten or twelve years—all show a rather consistent pattern. Wage rates do tend to rise when the labor market is tight, and the tighter the faster." They noted with interest that "the relation, such as it is, has shifted upward slightly but noticeably in the forties and the fifties." In the early years, before and after the first war, "manufacturing wages seem to stabilize absolutely when 4 or 5 percent of the labor force is unemployed; and wage increases equal to the productivity increase of 2 to 3 percent per year is the normal pattern at about 3 percent unemployment" and described this finding as "not so terribly different" from Phillips' results. In the later years, 1946–1959, Samuelson and Solow judged that it "would take more like 8 percent unemployment to keep money wages from rising and that they would rise at 2 to 3 percent per year with 5 or 6 percent of the labor force unemployed."[6] It is these later years that Samuelson and Solow circled in Panel B of Figure 4.

To describe the policy implications of their findings, Samuelson and Solow (1961) drew a version of the Phillips curve as representing tradeoffs between *price* inflation and unemployment. Essentially, this involved using the idea that price inflation and wage inflation were different mainly by the growth of labor productivity, suggesting an implicit model of relatively quick pass-through from wages to prices.

To obtain price stability under the assumption that real wages would grow at 2.5 percent per year, they suggested that the American economy would have to experience a 5 to 6 percent rate of unemployment (this option is marked as point A in Panel B of Figure 4). By contrast, they suggested that "in order to achieve the nonperfectionist's goal of 3 percent unemployment, the price index might have to rise by 4 to 5 percent per year" (this option is marked as point B).[7]

Seeking to understand whether inflation originated from cost-push or demand-pull factors, Samuelson and Solow described a "vast experiment" in which "by deliberate policy one engineered a sizeable reduction in demand" so as to explore the effects on unemployment and inflation. Although they were not explicit about the mechanism, they likely shared the prevailing Keynesian view of the time that fiscal and other policies that cut aggregate demand would first increase unemployment, with higher unemployment then reducing wage and price inflation. One interpretation of the subsequent 30

[6] All quotations in this paragraph are from Samuelson and Solow (1961, 189).

[7] Samuelson and Solow (1961, 192).

years of U.S. history is that versions of such experiments, with both increases and decreases in demand, were repeatedly undertaken.[8]

The Samuelson and Solow analysis led to a detailed research program of estimating the long-run tradeoff between inflation and unemployment in the United States. Given that interpretation and the subsequent development of macroeconometric models, it is interesting to note that Samuelson and Solow (1961) included a foreshadowing of future critiques of the long-run tradeoff: "aside from the usual warning that these are simply our best guesses, we must give another caution. All of our discussion has been phrased in short-run terms, dealing with what might happen in the next few years. It would be wrong, though, to think that our menu (Figure 4B) that relates obtainable price and unemployment during the next few years will maintain its shape in the longer run." They pointed to two reasons for potential instability—one was that "wage and other expectations" might shift the position of the Phillips curve and the other was that "institutional reforms" including product and labor market regulations or direct wage and price controls might shift the American Phillips curve downward and to the left.[9] Both expectations and wage-price controls were to play an important role in the subsequent history of the Phillips curve in the United States and other countries.

Wages, Prices, and Lags

Macroeconomic models along Keynesian lines first aimed at capturing the dynamics of aggregate demand. Thus, for example, the Duesenberry, Eckstein, and Fromm (1960) simulation study of the U.S. economy in recession used a quarterly econometric model with 14 equations governing aggregate demand: it contained neither a monetary sector nor a wage-price block. That is, the interaction between shocks and the components of aggregate demand was viewed as first order for understanding the behavior of the U.S. economy in a recession, with implications for wages and prices or their influences taken as less important. Fiscal policy measures rather than monetary policy measures were introduced in many studies of the time, reflecting a professional focus on fiscal rather than monetary policy tools.

Yet, after these first stages, U.K. and U.S. modelbuilders introduced a block of equations for wages and prices, stimulated in part by the work of Phillips (1958). The monograph by Klein et al. (1961) reports on a multiyear project to construct quarterly U.K. data and to estimate an econometric model with a

[8] All quotations in this paragraph are from Samuelson and Solow (1961, 191).

[9] All quotations in this paragraph are from Samuelson and Solow (1961) page 193 except for the final one, which is from page 194.

wage-price sector. These authors found that distributed lags were important in the wage and price equations.[10]

In contrast to the specifications of Klein et al. (1961), one notable element of Sargan's (1964) investigation was that he required that his equations display homogeneity, so that the absolute levels of wages and prices were not important for model properties. Sargan, therefore, studied a wage equation of the form

$$W_t - W_{t-1} = \lambda(W_{t-1} - P_{t-1}) + \beta u_{t-1} + \gamma t + \xi f_t + \phi(P_{t-1} - P_{t-4}), \quad (1)$$

where W_t is the log nominal wage rate in quarter t, P_t is the log nominal price level, u_t is the unemployment rate, and f_t is a measure of the political party in power. He divided the analysis of this equation into two components. First, an equation that described wage changes as deriving from deviations from an equilibrium real wage,

$$W_t - W_{t-1} = \lambda[W_{t-1} - P_{t-1} - \overline{w}_{t-1}], \quad (2)$$

and a specification for the equilibrium real wage

$$\overline{w}_{t-1} = [\frac{\beta}{\lambda}u_{t-1} + \frac{\gamma}{\lambda}t + \frac{\xi}{\lambda}f_t + \frac{\phi}{\lambda}(P_{t-1} - P_{t-4})]. \quad (3)$$

This is simply an algebraic decomposition, but Sargan (1964) was insistent that the elements of the equilibrium wage process made internal sense, for example requiring that the coefficient $\frac{\gamma}{\lambda}$ is interpretable as the effect of productivity growth on the real wage. He also interpreted the parameter λ as a speed of adjustment toward the equilibrium.[11]

Following the work of Klein et al., Sargan also estimated a price equation that linked prices to wages. Sargan explored measures of productivity, demand, and relative input costs as additional determinants of prices. Combining the wage and price equations, Sargan was able to trace out dynamic consequences of changes in the unemployment rate on wages and prices. These were influenced by the strength of the equilibrating tendencies (λ) and the influence of the price terms (ϕ) from the wage equation. For example, even if there were no lags of wages in the wage equation, there still could be indirect effects coming from the presence of price lags.

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[10] These results echoed the earlier findings of Fisher (1926) who had, in fact, *invented* the concept of a distributed lag for the purpose of empirical analysis of inflation and interest rates. More generally, the estimation of wage-price blocks has provided the basis for many advances in time series econometrics. In particular, Sargan (1964) used the wage-price block of Klein et al. (1961) as the basis for an investigation that was the starting point for the so-called London School of Economics (LSE) approach to econometric dynamics. For a recent study of the UK Phillips curve, using Sargan's work as its starting point, see Castle and Hendry (Forthcoming).

[11] Sargan also investigated generalization of the first specification to allow for additional lags of wage changes, $W_t - W_{t-1} = \lambda[W_{t-1} - P_{t-1} - w^e_{t-1}] + \sum_{j=1}^{J} \delta_j (W_{t-j} - W_{t-j-1})$ to enrich this dynamic adjustment process toward equilibrium.

Sargan (1964) concluded that there was a long-run tradeoff between wage inflation and unemployment, but that there were also lengthy average lags so that changes in unemployment and other variables would take several years to be fully reflected in wage inflation. These broad properties were widely built into Keynesian macroeconometric models, as wage and price sectors were added to the initial aggregate demand constructions.

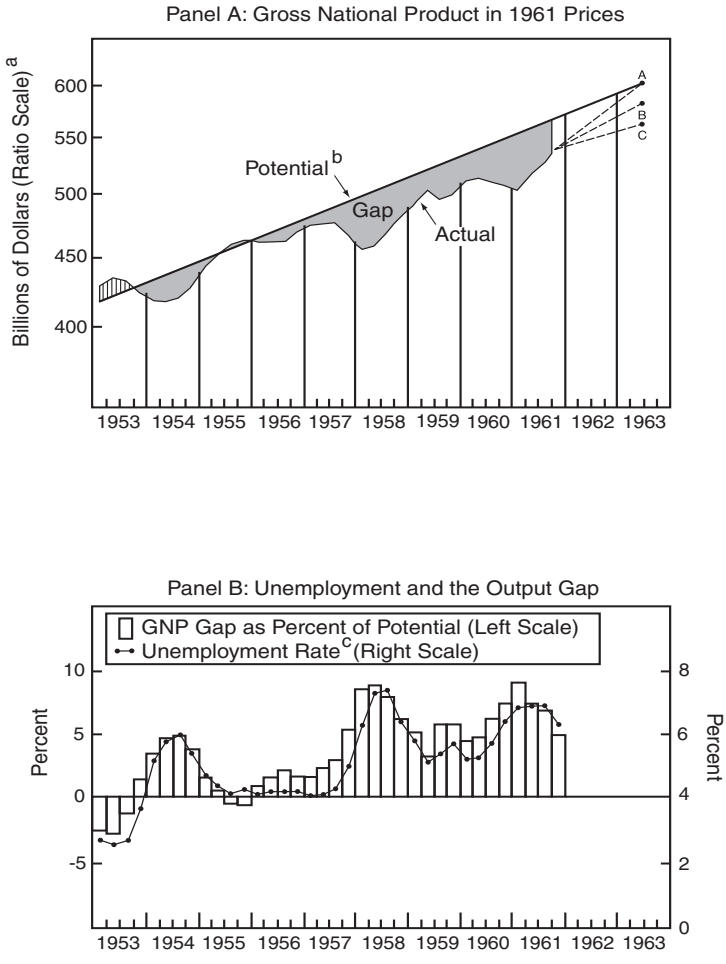
3. THE BATTLE AGAINST UNEMPLOYMENT

The 1962 *Economic Report of the President* was the first prepared by the Kennedy Council of Economic Advisors (CEA), which was eager to implement "The New Economics" originating in the work of Keynes.[12] The 1962 *Report* discussed the origins of unemployment in labor market frictions and in aggregate demand conditions, concluding that the "objective of maximum employment" would have to use policies aimed principally at labor market conditions. The 1962 *Report* argued that "in the existing economic circumstances, an unemployment rate of about 4 percent is a reasonable and prudent full employment target for stabilization policy," further stressing that additional policy interventions to reduce structural unemployment would make it possible to further reduce that target. At the same time, the *Report* built the case that the macroeconomic conditions of the late 1950s and early 1960s had led to an "output gap" of between 4 and 10 percent. As shown in the top panel of Figure 5, the output gap was the difference between actual output and a smooth trend line, based on an assumed level and rate of growth of capacity. Based on the work of a young economist at the CEA (Okun 1962), unemployment was linked to the output gap, so that a 2-percentage-point higher unemployment rate was related to an output gap of 5 percent. That is, the *Report* built in an Okun's Law coefficient of 2.5 to produce the second panel of Figure 5. While the "Phillips curve tradeoff" is now frequently discussed in terms of inflation and the output gap using some version of Okun's Law, this article will maintain the original linkage between inflation and unemployment as its focus.

In fact, the Kennedy-Johnson administration did deliver a substantial decline in unemployment, as a look back at Figure 1 confirms. In keeping with the tenor of the times, in which a package of fiscal, structural, and monetary policies was viewed as necessary for and capable of producing this decline, the present article will not seek to separately identify the contributions of different types of policies. Histories of the period, such as Hetzel (2008, chapters 6 and 7), stress the coordination of fiscal and monetary decisionmaking, so that such an identification could be quite subtle.

[12] Walter Heller was the chairman of the Council of Economic Advisors from 1961–64, with the other members being Kermit Gordon and James Tobin. The terminology "new economics" was widely used at the time and apparently dates back to a 1947 volume by Seymour Harris.

Figure 5 Unemployment and Output Gap in the 1961 CEA Report



Notes: Panel A is the CEA's potential, actual, and output gap decomposition, while Panel B shows the link between the output gap and the unemployment rate. The CEA economists attached notes as follows: ^{a}Seasonally adjusted annual rates; ^{b}potential output based on a $3\frac{1}{2}$ percent trend line through the middle of 1955; ^{c}unemployment as a percent of civilian labor force, seasonally adjusted; A, B, and C represent GNP in the middle of 1963, assuming an unemployment rate of 4 percent, 5 percent, and 6 percent, respectively. They listed their sources as: Department of Commerce, Department of Labor, and Council of Economic Advisors.

The 1962 *Report* did note that "the economy last experienced 4 percent unemployment in the period May 1955–August 1957. . . . During this period, wages and prices rose at rates which impaired the competitiveness of some U.S. goods in world markets. However, there is good reason to conclude that upward pressures of this magnitude are not a permanent and systematic feature of our economy when it is operating in the neighborhood of 4 percent unemployment." Looking back at Figure 1, the reader will notice that the inflation rate rose by several percentage points during the 1955–1957 period alluded to in the CEA report, while unemployment averaged about 4 percent.

By the late 1960s, some version of the long-run Phillips curve tradeoff had become a cornerstone of economic policy. It entered centrally in macroeconomic models and more ephemerally in macroeconomic reports.[13]

Macroeconomic Models

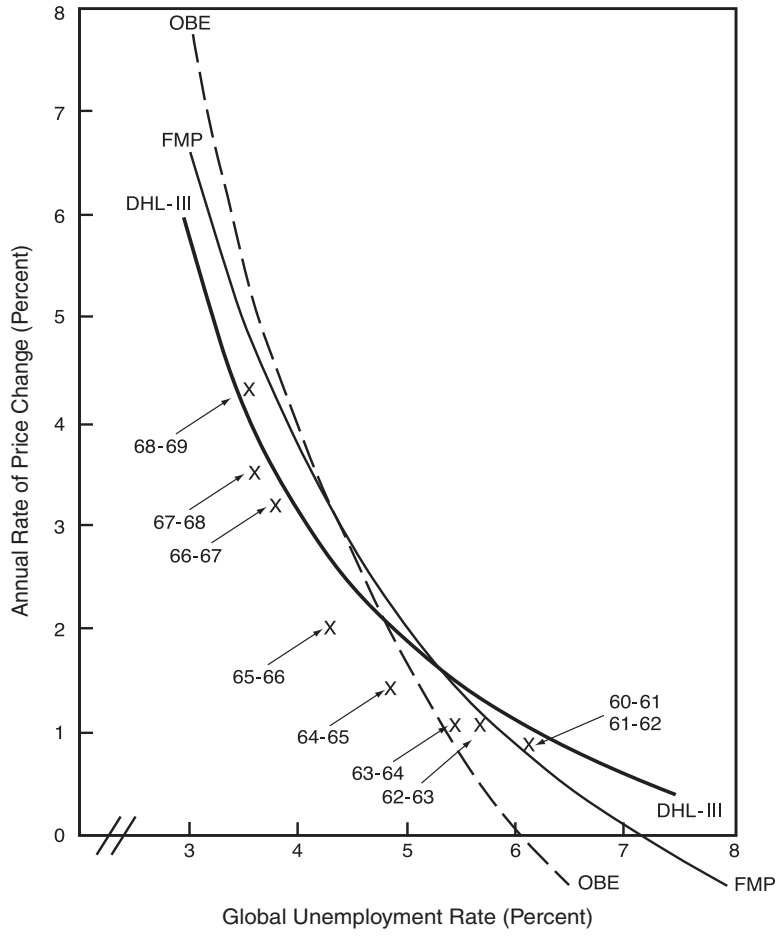
In fall 1970, the Federal Reserve System sponsored a major conference on "The Econometrics of Price Determination," which contained a wide range of studies and later appeared in 1972 as a volume edited by Otto Eckstein. Drawn from one of these studies, Figure 6 displays the long-run relationship between price inflation and unemployment as of 1969 within three prominent macroeconomic models of the sort used by the U.S. private sector for forecasting purposes, by the executive branch of the U.S. government, and by the U.S. central bank. This figure is reproduced from the Hymans (1972) survey of the price dynamics within the Office of Business Economics (OBE) model used by the executive branch, the Federal Reserve-MIT-Penn (FMP) model used by the central bank, and the DHL-III model developed by Hymans and Shapiro at the University of Michigan.

As Hymans explains (1972, 313), this figure was produced by taking the wage-price block of the various models and evaluating these equations at alternative unemployment rates. One first finds the long-run inflation rate when the unemployment rate is constant at, say 5 percent, and then one finds the long-run inflation rate at 4 percent and so on.

By and large, these estimates of the long-run relationship accord well with that portrayed by Samuelson and Solow (1961) and reproduced as Panel B of Figure 4 in this article. Further, the increase in the inflation rate from about 1 percent in 1960–61 to about 4.5 percent in 1968–69 is particularly well captured by the FMP and DHL models. Although each long-run Phillips curve is nonlinear and there are differences in models, the "average" tradeoff

[13] As, for example, in the "Phillips plot without a Phillips curve" of the 1969 *Report*, discussed further below. Presumably, the economists at the CEA were not too interested in taking "credit" for the effect of low unemployment on inflation, while the economists at the Federal Reserve Bank (FRB) had a model that featured the tradeoff and could not escape the connection.

Figure 6 The Long-Run Tradeoff in Major Macroeconomic Models



Notes: The long-run inflation and unemployment tradeoff in three prominent macroeconometric models as of 1970. The figure also shows actual unemployment and inflation (annual averages) during 1960–1969.

Source: Hymans (1972).

over this range is that lowering unemployment by 2.5 percent (from 6 to 3.5) costs about 3.5 percent in terms of inflation (from 1 percent to 4.5 percent). Smaller changes in inflation and unemployment feature a roughly one-for-one tradeoff.

The dynamics of wages and prices were studied by many authors under a variety of assumptions within the FMP and other large models. For example,

de Menil and Enzler (1972) considered the effect of changing the unemployment rate from 4 percent to 5 percent in the FMP model: The results of their investigations are shown in Figure 7. The economy is assumed to be in an initial steady state with price inflation of 3.4 percent per year (wage inflation is just over 6 percent) and unemployment of 4 percent. Then, unemployment increased to 5 percent at date 1 and at all future dates. The inflation rate declines to 2.7 percent after four quarters, to 2.2 percent after three years and to 1.9 percent after five years. Compensation per man-hour (the wage measure) drops from 6 percent to 4.9 percent after a year, to 4.6 percent after three years, and to 4.4 percent after five years. The more rapid response of wage inflation is related to the fact that unemployment affects wages immediately, with effects of wages on prices occurring only with a distributed lag.[14]

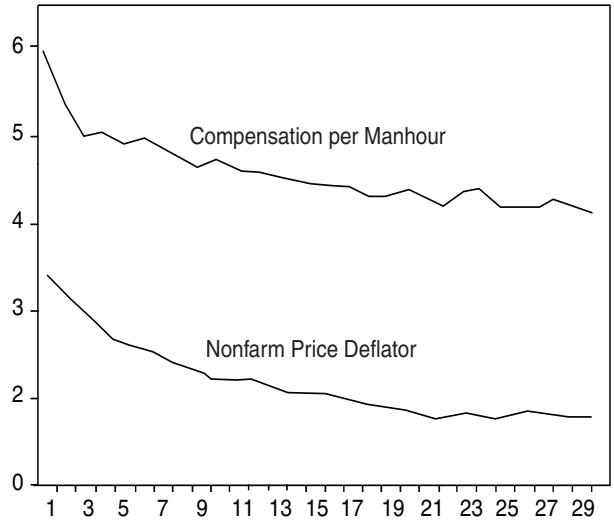
Overall, the short-run Phillips curve reported by de Menil and Enzler (1972) is flatter than the long-run one that they report (essentially that for the FMP in Figure 6): a 1 percent increase in unemployment brings about a .7 percent change after a year's time, but a 1.5 percent decline in inflation after five year's time. From the standpoint of the econometric modelers of the time, this was a natural result of the lags in the wage-price components of their model, built in along Klein-Sargan lines. Looking at Figure 6, economists such as de Menil and Enzler likely saw a consistency with the dynamic specification of the macroeconomic policy model: the historical inflation rate initially lies below the long-run Phillips curve in the early 1960s during the start of the transition to lower unemployment.

Macroeconomic Reports

The 1969 *Economic Report of the President* was the last report of the Kennedy-Johnson era and was prepared under the leadership of Arthur Okun. With inflation rising, early 1968 saw a new cabinet-level Committee on Price Stability charged to recommend actions to contain inflation. President Johnson's introductory remarks in the Report distinguished between "roads to avoid" and "roads to reducing inflation." The roads to avoid were an "overdose of fiscal and monetary restraint" or "mandatory wage and price controls." The "roads to follow" included a combined fiscal and monetary program—including a continuation of the 1968 tax surcharge—as a "first line of defense," but also

[14] Note that de Menil and Enzler's (1972) experiment assumes an immediate and permanent change in unemployment induced by macroeconomic policies. Given the nature of the wage-price block in the FMP model, it was conceptually feasible to simply change unemployment and trace out the implications for wage and price inflation. However, since changes in fiscal and monetary instruments had only a gradual effect on aggregate demand and unemployment within the FMP and similar models, responses to more standard policy changes were more complicated and had gradual effects on both inflation and unemployment.

Figure 7 The Dynamic Tradeoff in the FMP Model circa 1970



Notes: The vertical axis measures annualized percentage rates of change of the wage and price series. The horizontal axis is in quarters of a year.

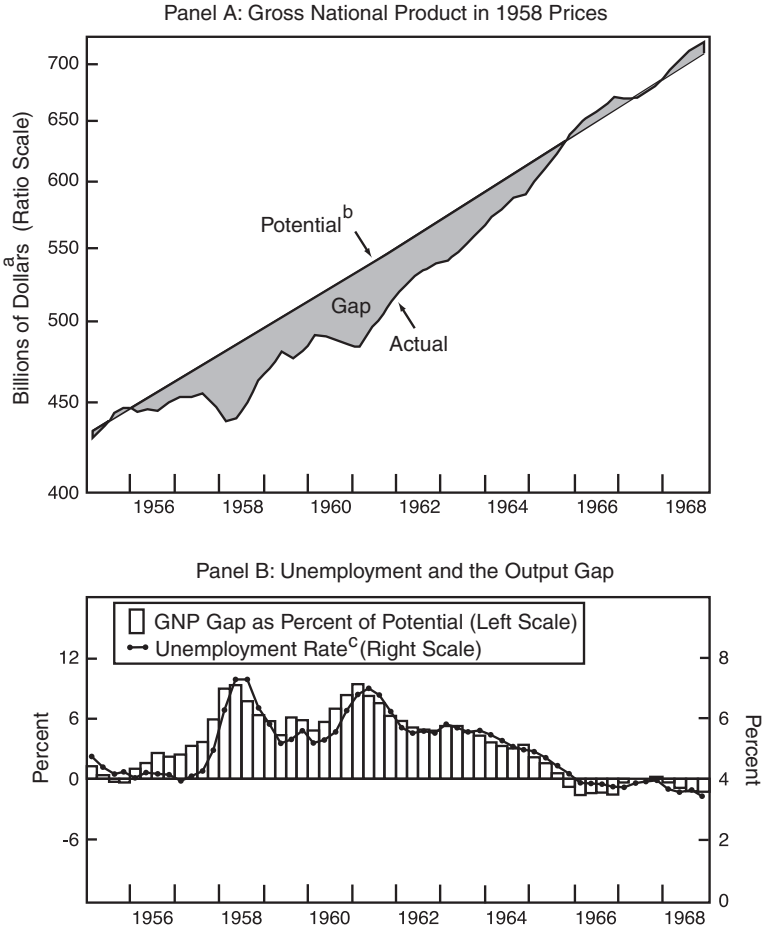
Source: de Menil and Enzler (1972).

voluntary cooperation in wage and price setting to aid the process of reducing inflation.

The 1969 *Report* portrayed the U.S. economy as running at or slightly above potential output, with associated unemployment in the neighborhood of 4 percent. As portrayed in Figure 8, the potential output series resembles that presented in the 1962 *Report* (Figure 5), but the detailed notes make clear that potential output grew at 3.5 percent over 1955–1962; at 3.75 percent over 1963–1965; and at 4 percent over 1966–1968. Thus, an acceleration of potential output growth was necessary to fit together the 1962 *Report*'s view of 4 percent as the unemployment target, which finally was hit in the latter years of the Kennedy-Johnson era, with the behavior of output during those years. With more modest potential output, there would have been a very negative output gap during the final years of the Kennedy-Johnson era, whereas it is only slightly negative in Figure 8.

The 1969 *Report* also featured a Phillips scatter plot, from 1954–1968, highlighting the historical relationship between "price performance and

Figure 8 Unemployment and Output Gap in the 1961 CEA Report



Notes: Panel A shows the CEA's potential, actual, and output gap decomposition, while Panel B shows the link between the output gap and the unemployment rate. The CEA economists attached notes as follows: [a]Seasonally adjusted annual rates;[b]potential output is a trend line of $3\frac{1}{2}$ percent through the middle of 1955 to 1962 IV, $3\frac{1}{4}$ percent from 1962 IV to 1965, and 4 percent from 1965 IV to 1968 IV; [c]unemployment as a percent of civilian labor force, seasonally adjusted. They list as sources: Department of Commerce, Department of Labor, and Council of Economic Advisors.

unemployment" during the Kennedy-Johnson years, although no trade-off curve was displayed. The decline in unemployment from the 5.5 percent level of 1963 to the 3.5 percent level of 1968 was associated with a rise in inflation from 1.5 percent to close to 4 percent. The *Report*'s accompanying discussion

of the historical record stresses the importance of a wage-price spiral arising from demand growth in excess of capacity growth. It argued that "once such a spiral starts, it becomes increasingly difficult to arrest, even after productive capacity has caught up with demand and the initial pressures have largely subsided."

Thus, the *Report*'s explicit stand is that the U.S. economy in 1969 was operating close to capacity, with a rate of unemployment that was not necessarily inflationary, a viewpoint that echoes the appraisal in the 1962 *Report*. The rise in inflation over the eight years of the Kennedy-Johnson administration is, therefore, implicitly portrayed as arising from the effects of a wage and price spiral, not a purposeful movement along a long-run Phillips curve.

4. BREAKDOWN, 1969–1979

The breakdown of the consensus concerning the long-run Phillips curve involved a major revision of macroeconomic theory along with an unusual pattern of inflation and unemployment, with these intertwined developments reinforcing each other.

Macroeconomic Theory

As the Phillips curve played an increasing role in macroeconomic models, and as inflation rose during the mid-1960s, economists began to take a harder look at its theoretical underpinnings. The implications of new models were then compared to unemployment and inflation data, with results that sparked a major empirical controversy and a revolution in macroeconomic modeling.

The natural rate hypothesis

In the late 1960s, Milton Friedman and Edmund Phelps made separate arguments about why the long-run Phillips curve should be vertical. Friedman (1968) began from a vision of the labor market in which real wages and employment (or unemployment) were jointly determined in response to local and aggregate conditions of supply and demand. His natural rate of unemployment was "the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on." He then imagined a situation in which firms offered workers nominal rather than real wages, with workers evaluating labor supply opportunities based on their best estimate of the purchasing power of those wages. With a known path for the price level, this calculation is easy for

workers, but it becomes harder when the price level is changing. Friedman (1968) imagined the central bank increasing the growth of the money supply and stimulating the demand for the final product. To hire additional workers, firms would offer higher nominal wages. Faced with higher nominal wages that were interpreted as higher real wages, workers would supply more hours and potential workers would accept more jobs. So, it was possible for Friedman's model to reproduce a Phillips curve of sorts. However, if workers correctly understood that the general level of prices was increasing as a result of a monetary expansion, there would be no real effects: The rate of inflation and the rate of wage growth would jointly neutralize the effect of a higher rate of monetary growth, leaving real activity unaffected.

Phelps (1967) analyzed the problem in more Keynesian terms, based on a specification of a price equation of the following type:[15]

$$P_t - P_{t-1} = \pi_t = \beta(u_t - u^*) + \pi_t^e, \tag{4}$$

where u^* is the "natural rate of unemployment," in Friedman's terminology, and π^e is the expected rate of inflation. Phelps argued for this sort of "expectations-augmented Phillips curve" specification on grounds similar to those of Friedman that we have already discussed: labor suppliers should make their decisions on real, not nominal grounds.

Further, Phelps studied this inflation equation under the assumption of adaptive expectations,

$$\pi_t^e = \theta\pi_{t-1} + (1-\theta)\pi_{t-1}^e, \tag{5}$$

where $0 < \theta < 1$ governs the weight placed on recent information in forming expectations. This specification implies that if inflation were maintained at any constant level, $\overline{\pi}$, then expected inflation would ultimately catch up to it since the sum of coefficients in the distributed lag representation of expected inflation,

$$\pi_t^e = \theta \sum_{j=0}^{\infty} (1-\theta)^j \pi_{t-j-1},$$

is equal to one.

The "expectations-augmented Phillips curve" means that unemployment would be low ($u < u^*$) only if agents are surprised. Thus, a policy of maintaining low unemployment requires consistent underforecasting of inflation, $\pi < \pi^e$. But low unemployment could only be brought about by raising

[15] There are several cosmetic differences with Phelps' (1967, equation 3) specification. First, Phelps worked in continuous time while the text equation is in discrete time. Second, Phelps' specification is in terms of a general utilization variable rather than unemployment. Third, Phelps worked with the expected return on money, which is the negative of the expected inflation rate. Fourth, Phelps employed a nonlinear (convex) specification of the link from utilization to inflation rather than a linear one as in the text.

the inflation rate to a higher and higher level, with expectations always lagging behind because of the adaptive mechanism (5). Hence, the view of Friedman and Phelps became known as the "accelerationist hypothesis" in some quarters.

Phelps also stressed that the accelerationist model meant that a temporary period of low unemployment would bring about a permanently higher rate of inflation. He recognized that this led to an important new dynamic element in policy design, relative to traditional work that had stressed the Phillips curve as a stable "menu of policy choice" for the long run. Generally, a period of temporarily high unemployment would be necessary to permanently reduce inflation and some basic economic mechanisms—such as a momentary social planner objective that attributes increasing cost to high unemployment—making it desirable to smooth the adjustment process.

Overall, the natural rate/accelerationist hypothesis moved the worries of Samuelson and Solow (1961) about the effects of expectations on the Phillips curve from second-order to first-order status.

Tests of Solow and Gordon

From the perspective of wage and price adjustment equations of the form prominent in Keynesian theoretical and empirical models, the arguments of Friedman and Phelps suggested that there were important omitted expectational terms. Solow (1969) and Gordon (1970) devised tests to determine whether there was a long-run tradeoff between inflation and unemployment. To capture the spirit of these tests, consider a wage equation along the Klein-Sargan lines, such as (1) above. As above, the nominal wage at a given date will be W_t and the real wage will be $w_t = W_t - P_t$. However, the inflation terms in (1) are replaced by expected inflation, π_t^e, with a coefficient α attached,

$$\Delta W_t = \lambda(w_{t-1} - w_{t-1}^*) + \beta(u_t - u_t^*) + \alpha\pi_t^e; \tag{6}$$

other time-varying terms will be omitted for simplicity.[16]

The tests of Solow and Gordon made diverse use of price and wage equations, but the essential features can be simply described using this expression. First, in the wage equation above, the Friedman-Phelps conclusion obtains if $\alpha = 1$ since this is simply a restriction on expected real wages and unemployment,

$$w_t - w_{t-1} = \lambda(w_{t-1} - w_{t-1}^*) + \beta(u_t - u_t^*) - (\pi_t - \pi_t^e). \tag{7}$$

There is, thus, no influence of inflation if expectations are correct and no tradeoff between real and nominal variables. Solow and Gordon proposed

[16] In this expression, w^* would be the "natural" real wage, similar to the natural rate of unemployment, u^*.

to directly estimate the parameter α and to evaluate the accelerationist view by testing whether α differed significantly from unity. Second, this test is challenging to implement because expectations are unobservable. However, if expectations are formed adaptively, as in (5), then it is possible to conduct the test. Solow (1969) estimated parameters such as α for a range of different values of θ, while Gordon (1970) used a more general distributed lag but maintained the requirement that the coefficients summed to unity. This sum of the coefficients restriction was rationalized by the Phelpsian thought experiment, comparing a zero inflation steady state to a positive inflation steady state at rate π: If the sum of coefficients is one, then expected inflation is $\pi^e = 0$ in the first case and $\pi^e = \pi$ in the second case.

All of their diverse estimates suggested values of α that were positive, but significantly less than one. Thus, an aggregate demand policy that lowered unemployment in a sustained manner would create rising inflation over time, as expectations increased, but it would not ultimately be unsustainable.

Rational expectations critique

Sargent (1971) and Lucas (1972a) criticized the tests of Solow and Gordon by invoking two arguments. First, Sargent and Lucas insisted that expectations formation should be rational along the lines of Muth (1961). Second, they constructed example economies in which the accelerationist position was exactly correct, but in which an econometrician using the methods of Solow and Gordon would reach an incorrect conclusion.

A valuable example arises when inflation (π) has a persistent (x) and temporary (η) component, so that it is generated according to

$$\begin{aligned} \pi_t &= x_t + \eta_t \\ x_t &= \rho x_{t-1} + e_t, \end{aligned}$$

where η_t and e_t are serially uncorrelated, zero mean random variables and $|\rho| < 1$.

As analysis along the lines of Muth (1960) determines, rational expectations then are formed according to

$$E_{t-1}\pi_t = \rho[\theta\pi_{t-1} + (1-\theta)E_{t-2}\pi_{t-1}] = \rho\theta\sum_{j=0}^{\infty}(1-\theta)^j\pi_{t-j-1}, \qquad (8)$$

with $0 < \theta < 1$. This is broadly the same form as the adaptive expectations formula above, except that the distributed lag now is multiplied by ρ, which captures the degree of persistence of inflation.[17]

[17] The inflation process implies $\pi_t = \rho\pi_{t-1} + e_t + \eta_t - \rho\eta_{t-1}$. A "Wold representation" is $\pi_t = \rho\pi_{t-1} + a_t - \rho(1-\theta)a_{t-1}$, with a_t a forecast error for π_t relative to its own past history. These two processes are observationally equivalent if they imply the same restrictions on

In particular, suppose that inflation is somewhat persistent but stationary so that $0 < \rho < 1$, and that there is no effect of inflation on the real wage, i.e., $\alpha = 1$. Then, an econometrician constructing a measure of expectations $\widehat{\pi}_{t-1} = \theta \sum_{j=0}^{\infty} (1-\theta)^j \pi_{t-j-1}$ for any $\theta < 1 = \rho \pi_{t-1}$ would face data generated according to

$$W_t - W_{t-1} = \gamma(w_{t-1} - w^*_{t-1}) + \beta(u_t - u^*_t) + \rho\widehat{\pi}_{t-1}, \tag{9}$$

and would conclude that $\alpha = \rho$. That is, the econometrician would estimate that there was a long-run tradeoff, $\alpha < 1$, even though none, in fact, existed.

The critique played an important role in the evolution of macroeconomic modeling. Lucas (1972b) built a small-scale general equilibrium macroeconomic model with a short-run Phillips curve arising without any long-run tradeoff, providing an analytical interpretation of Friedman's (1968) suggestion about the nature of the link between inflation and real activity. Lucas (1976) expanded the critique of the policy invariance of parameters within 1970s macroeconometric models into a general challenge, noting that similar difficulties were contained in the consumption function and the investment function, as well as the wage-price block. He stressed that rational expectations and dynamic optimization, which seemed useful as basic postulates for model construction, inevitably led to such problems. A major revolution in econometric model construction ensued, leading central banks around the world to develop new models for forecasting and policy analysis during the 1990s, as we discuss in Section 6.

Shifting unemployment-inflation tradeoffs

What is wrong with the sum of coefficients restriction employed by Solow and Gordon? Sargent (1971) notes that inflation through the mid-1960s did not display much serial correlation, so it is not well forecasted by a moving average with weights that sum to unity. Intuitively, in an economy in which there are never any permanent changes in inflation, rational expectations are not designed to guard against this possibility.

Yet, as inflation rose and stayed high through the 1970s, empirical model-builders found estimates of parameter values drifting toward one and were

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the variance and first-order autocorrelation of $\pi_t - \rho\pi_{t-1}$. (All other autocovariances are zero.) Using the Wold representation, the forecast is

$$\begin{aligned} E_{t-1}\pi_t &= \rho\pi_{t-1} - \rho(1-\theta)a_{t-1} = \rho\pi_{t-1} - \rho(1-\theta)(\pi_{t-1} - E_{t-2}\pi_t) \\ &= \rho[\theta\pi_{t-1} + (1-\theta)E_{t-2}\pi_{t-1}] \end{aligned}$$

as reported in the text. The covariance restrictions imply $var(a_t) = var(\eta_t) + \frac{1}{1+\rho^2} var(e_t)$ and $\theta = 1 - \frac{var(\eta_t)}{var(a_t)}$.

more open to accelerationist models of the Phillips curve. I have searched for, but have not found, a 1970s study that succinctly shows this drift in coefficients. McCallum (1994) calculates the sum of coefficients implied by a fifth-order autoregression for inflation estimated over various periods: it is about one-third in 1966–67, two-thirds in 1968–70, and between .88 and 1.02 for 1973–1980. McCallum's exercise indicates why econometric modelers found increasing evidence for the accelerationist hypothesis as the evidence from the 1970s was added.

Up a derivative: NAIRU models

As inflation rose during the mid-1970s, the wage and price blocks of standard macroeconometric models were augmented in various ways. One route was to include expectations terms explicitly but to make these expectations respond sluggishly to macroeconomic conditions. Another, arguably initially more popular strategy originates in the work of Modigliani and Papademos (1975). These authors argued that empirical models of price and wage dynamics would have better success if they related changes in inflation measures to levels of real variables. Modigliani and Papademos viewed inflation as likely to accelerate if unemployment was low relative to a benchmark value and as likely to decelerate if unemployment was high relative to a benchmark. They argued that this feature, as indicated by points A and C in Figure 9, was far more important for policy analysis than the question of whether the long-run Phillips curve had a negative slope (as in P P′) or was vertical (as in F F′).[18] Further, they stressed that "the shading of an area on either side of NAIRU indicates both uncertainty about the exact location of NAIRU and the implausibility that any single unemployment rate separates accelerating and slowing inflation."

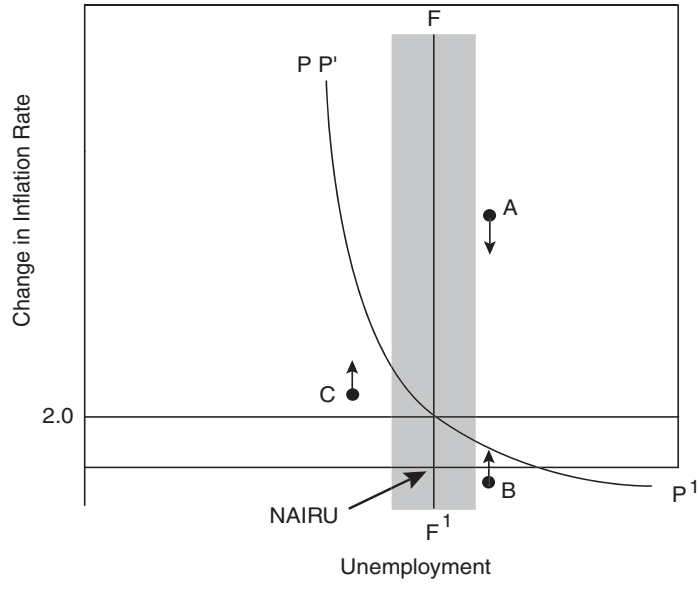
The NAIRU model has been commonly captured by a simple model of the form,

$$\pi_t = \pi_{t-1} + \beta(u_t - u^n), \tag{10}$$

a specification closely related to that of Phelps (equation [4]), but with past inflation replacing expected inflation. Moving up a derivative allowed for a continuation of empirical research on price and wage inflation, which investigated the consequences adding lags of inflation and unemployment as well as adding shift variables to the basic NAIRU model. Thus, such empirical investigations built in a particular assumption on the "accelerationist hypothesis" that differed from the earlier research following Phillips, but continued to study many similar questions. However, uncertainty about the location of

[18] In the original unnumbered figure early in the Modigliani and Papademos (1975) article, the non-accelerating inflation rate of unemployment is marked "NIRU," but Figure 9 follows the now-standard acronym. It also corrects a typo in the labelling of the vertical axis.

Figure 9 The NAIRU Substitute for the Original Phillips Curve



Notes: Modigliani and Papademos (1975) posited a relationship between unemployment and the *change* in the inflation rate. They stressed that there was a range of unemployment rates (gray area) over which the effect on inflation was quite uncertain. In the longer run, they did not take a firm stand on whether there was a tradeoff between the level of unemployment and the acceleration of inflation (the curve P P′) or not (the curve F F′).

the NAIRU, as Modigliani and Papademos had suggested, led to challenges in the application of this approach in forecasting and policy analysis.[19]

Macroeconomic Policy

The Nixon administration came into office in 1969 with the aim of reducing inflation via a combination of orthodox fiscal and monetary methods, but sought to do so without prolonging the recession that the country was then experiencing.

[19] Staiger, Stock, and Watson (1997) document the considerable uncertainty surrounding estimates of the NAIRU.

Gradualism

The Nixon administration initially embarked on a course of "policy gradualism" in an attempt to reduce inflation while maintaining real activity and unemployment at relatively constant levels. In a mid-course appraisal, Poole (1970) provides a useful definition of such policies: "The prescription of gradualism involves the maintenance of firm but mild restraint until the objectives of anti-inflationary policy are realized. Real output is to be maintained somewhat below potential until the rate of inflation declines to an acceptable level." The policies outlined in the 1970 *Economic Report of the President*, produced under the leadership of CEA chairman Paul McCracken, contained both fiscal and monetary components designed to generate a modest reduction in output for the purpose of reducing inflation.[20]

Rising understanding of the importance of expectations

Arthur Burns became head of the Federal Reserve System in early 1970, replacing William McChesney Martin, who had served since 1951. During 1969, Martin had undertaken restrictive monetary policy to reduce inflation, indicating that "expectations of inflation are deeply imbedded. . . . A slowing in expansion that is widely expected to be temporary is not likely to be enough to eradicate such expectations" and "a credibility gap has developed over our capacity and willingness to maintain restraint."[21] The phrase "credibility gap" had a particularly harsh ring to it, even as part of a self-criticism, as it had been widely used to describe the Vietnam policies of the Johnson administration: The Tet offensive of September 1968 had convinced many that there was no credibility to the administration's previous upbeat forecasts for military success or its description of the offensive as a disastrous defeat for the Viet Cong. Martin believed that unemployment was unsustainably low and that economic growth would need to slow to reduce inflation, which was at about 5 percent during late 1968 when Richard Nixon was elected president. But the restrictive monetary policy of 1969–1970 started by Martin, envisioned as part of a gradualist strategy by McCracken, and continued by Burns, resulted only in a slowing of inflation, but not a major decline, during the recession of December 1969–November 1970.

As Hetzel (1998) stresses, Burns had a long-standing belief that expectations were important for inflation, writing in the late 1950s that: "One of the main factors in the inflation that we have had since the end of World War II is

[20] Gradualist policies were advocated by a range of economists and policymakers. On this dimension, the monetarist economists of the Shadow Open Market Committee (SOMC) shared some of the reservations of their Keynesian counterparts. See Meltzer (1980) for a discussion of the SOMC perspective on gradualism.

[21] Martin's February 26, 1969, testimony to Congress, quoted in Hetzel (2008, 75).

that many consumers, businessmen, and trade union leaders expected prices to rise and therefore acted in ways that helped to bring about this result."[22] After taking over the Fed, he made the case that it was possible to side-step the Phillips curve through the imposition of wage and price controls, which he believed would exert a substantial effect on expectations.[23]

Incomes policies

By the middle of 1971, the Nixon administration lost patience with gradualism, imposing a 90-day temporary freeze on prices on August 15, 1971, and ending the convertibility of the dollar into gold. The temporary freeze evolved into a multiyear incomes policy with various phases differing in intensity and coverage. The 1973 *Economic Report of the President* noted that "1972 was the first full year in American history that comprehensive wage and price controls were in effect when the economy was not dominated by war or its immediate aftermath" (page 51). The *Report* indicated that there had been three purposes for the controls (page 53). First, the controls were intended to directly affect the rate of inflation, lower the probability of its increase, and raise the probability of its decline. Second, the controls were aimed at "reducing the fear that the rate of inflation would rise or not decline further." Third, the controls were designed to "strengthen the forces for expansion in the private economy and to free the Government to use a more expansive policy." In describing the conditions in the spring and summer of 1971 that led to the imposition of the controls, the *Report* specifically discussed "anxiety" about increasing inflation as holding back consumer spending and rising long-term interest rates that "may have signalled rising inflationary expectations." Overall, a key motivation for the controls was to affect expectations of inflation and their incorporation into price and wage setting.

Many analysts see the incomes policy period as involving expansionary monetary policy—as in the third *Report* point above—with fiscal policy under the Nixon team and monetary policy under Burns producing an economic expansion. Unemployment hovered in the 6 percent range through 1971, dropping to 5 percent by the end of 1972 as Nixon won a landslide re-election. Inflation, according to the gross domestic product deflator shown in Figure 1, had fallen from 5 percent in 1971 to 4 percent in 1972, but it then rose to a 7 percent annual rate by the end of 1973.

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[22] Burns 1957, p. 71, quoted in Hetzel (1998).

[23] Burns had played a leading role in the Council of Economic Advisors during the Eisenhower administration and knew Nixon well. As chairman of the Fed, he played an important role in administration policy more broadly, including the mid-August 1971 meetings at Camp David that formulated major changes in Nixon administration economic policies.

Skepticism about government goals

By the time of the publication of the 1973 *Economic Report of the President*, many economists were becoming more skeptical about both the long-run Phillips curve and, more specifically, about whether government plans were consistent with the available information on the historical linkage between inflation and unemployment. The review of the 1973 *Report* by the mainstream economist Carl Christ provided one clear presentation of this skepticism. He noted that every economic report contains an overall statement of objectives by the President followed by a more detailed and nuanced report by his economic advisors.

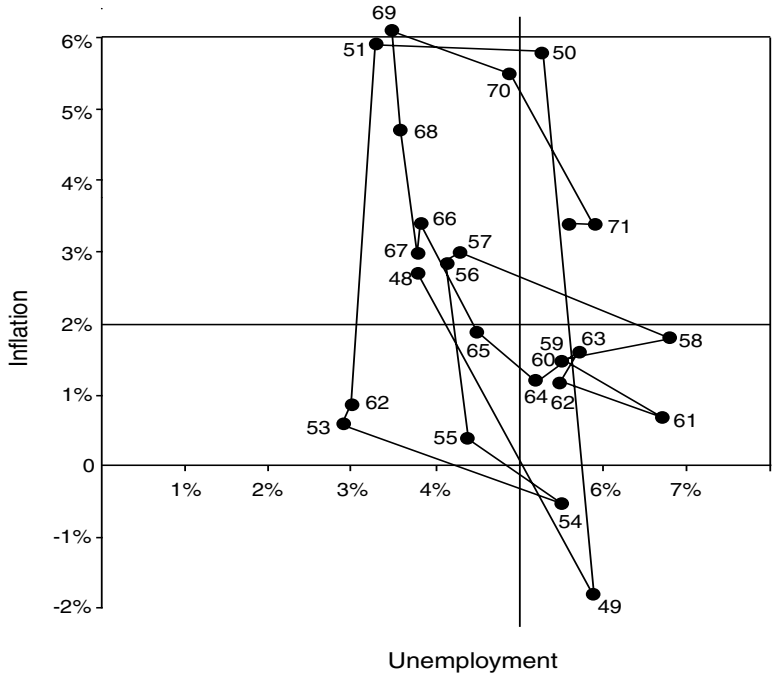
An initial quote from Christ's review summarized the condition of the previous year for us: "Mr. Nixon's report begins with a review of the good things about 1972: a $7\frac{1}{2}$ percent rise in real output, a reduction of the inflation rate (measured by the consumer price index) to about 3 percent from about 6 percent in 1969, and a reduction of the unemployment rate to 5.1 percent in December 1972 from 6 percent in December 1971."

The 1973 goals of the Nixon administration were summarized by Christ using a series of quotations from Nixon's message: "Output and incomes should expand. Both the unemployment rate and the rate of inflation should be reduced further, and realistic confidence must be created that neither need rise again. The prospects for achieving these goals in 1973 are bright—if we behave with reasonable prudence and foresight" (p. 4); "We must prepare for the end of wage and price controls..." (p. 6). Christ notes that this buoyant optimism on inflation and unemployment is "reminiscent of Mr. Nixon's statement in January 1969, shortly after taking office, that he would reduce inflation without increasing unemployment and without imposing wage and price controls."

Christ then proceeded to argue that the optimism was unwarranted: "The evidence strongly suggests it is not possible for the American economy, structured as it has been since World War II, to achieve simultaneously unemployment rates that remain at 4.75 percent or less, and consumer price increases that remain at 2.4 percent a year or less, without wage or price controls. In the 25 years since consumer prices leveled off at the end of World War II, this has been achieved in only 4 years: 1952, 1953, 1955, and 1965.... In those same 25 years, the average unemployment rate was 4.8 percent, and the average increase in consumer prices was 2.4 percent a year."

Figure 10 was produced by Christ using data from the 1972 *Report*. Notice that Christ's argument is *not* that the long-run Phillips curve is vertical, although that view is not inconsistent with his figure. Instead, it is that public policy goals ought to be consistent with the available evidence and that unemployment far below the 1972 level of 5 percent and inflation below the 1972 level of 3 percent did not seem consistent with U.S. experience.

Figure 10 Christ's Summary of U.S. Inflation and Unemployment Experience



Notes: Using data from the 1973 Annual Report, Christ showed that the announced administration objectives of inflation below 3 percent and unemployment below 5 percent did not seem consistent with prior U.S. experience.

Christ's warning was a timely one: The remainder of the Nixon-Ford administration saw the onset of stagflation, as a look back at Figure 1 reminds us. The United States was not to see 5 percent unemployment and 3 percent inflation at any time in the next two decades.

Humphrey-Hawkins

While Christ may have been skeptical about the internal consistency of the *Economic Report of the President* in 1973, the debates over the legislation put forward by Representative Augustus Hawkins and Senator Hubert H. Humphrey five years later illustrated that other elements of government and society continued to seek very low unemployment.

As initially passed by the House in March 1978, the Full Employment and Balanced Growth Act specified the goal of lowering the unemployment rate to 4

percent for all working age individuals and 3 percent for all individuals over the age of 20. Early drafts of the House bill had mandated that the government be an "employer of last resort" for the long-term unemployed, but this provision was dropped, while the focus on unemployment was maintained. The national unemployment goal was to be reached within five years and the bill called for cooperation between the executive branch, Congress, and the Federal Reserve Board in working toward the specified target. It also specified that the President should submit an annual economic report to Congress including numerical goals for employment, unemployment, and inflation, as well as some other macroeconomic indicators. Amendments to add budget balance as a goal at the five-year horizon and to include an inflation goal of 3 percent at that time were defeated. The bill evolved substantially in order to gain Senate approval. In the process, inflation objectives were reinstated. It was signed into law by President Jimmy Carter on October 27, 1978.

The Full Employment and Balanced Growth Act in final form established national goals of full employment, growth in production, price stability, and balance of trade and public sector budgets. More specifically, it specified that by 1983, unemployment rates should be no more than 3 percent for persons aged 20 or over and no more than 4 percent for persons aged 16 or over. Inflation should be no more than 4 percent by 1983 and 0 by 1988. Thus, in its nonbinding goals, it displays the same tendencies that Christ identified in the *Economic Report of the President*.

While these goals were nonbinding, the Humphrey-Hawkins Act did require that the Federal Reserve Board of Governors transmit a report to Congress twice a year outlining its monetary policy.

5. UNWINDING INFLATION

By the late 1970s, a wide range of economists and politicians were becoming concerned about high inflation and recommending disinflation. However, economists and politicians differed widely on the costs of reducing inflation.

Forecasting the Costs of Disinflation

Surveying six estimates of "macroeconomic Phillips curves," Okun (1978) found that the experience of the 1970s had led to the abandonment of the long-run Phillips curve. Yet, he also stressed that "while they are all essentially accelerationist, implying no long-run tradeoff between inflation and unemployment, they all point to a very costly short-run tradeoff." Thinking about the Phelpsian question of how fast unemployment should be raised from a situation of initially low capacity utilization, in terms of the consequences for long-run inflation, he calculated "for an extra percentage point of unemployment maintained for a year, the estimated reduction in the ultimate inflation

rate." Comparing the various studies, he found that this disinflation gain for a given amount of unemployment ranged between $\frac{1}{6}$ and $\frac{1}{2}$ of a percent, with an average estimate of 0.3 percent.

To put Okun's numbers in a specific context, consider the unemployment cost attached to a 5 percent reduction in long-run inflation. The estimates reported by Okun meant that this cost would be between $10 = [5/(1/2)]$ and $30 = [5/(1/6)]$ "point years of unemployment," with an average estimate of 16.7[5/.3]. That is, if the cost of eliminating a 5 percent inflation was spread evenly over four years, then each year would see an unemployment rate that was between 2.5 and 7.5 percent above the natural rate with a mean estimate of over 4 percent.

It is now more standard to discuss disinflation costs as a ratio of point years of unemployment arising from a one percent change in inflation, which is called the "sacrifice ratio."[24] Okun's estimates were that the sacrifice ratio was in the range of 2 to 6, with a mean of 3.3 in that each percentage point reduction in inflation would involve very major economic costs.

Put another way, by the late 1970s, policymakers may have abandoned the long-run Phillips curve in the face of evidence and theory. But most major econometric models continued to maintain a tradeoff over horizons of four or more years, as originally described by Samuelson and Solow. Just as there had been a protracted period of low unemployment as inflation had risen, so too did Okun envision a protracted period of high unemployment as inflation was reduced.

The perceived severity of a potential reduction in inflation is perhaps best illustrated in an excerpt from James Tobin's (1980) review of stabilization policies at the close of the first decade of the Brooking's Panel. To put the excerpt in context, Tobin's review described the accelerationist hypothesis as having been a core part of macroeconomics for the better part of the previous decade. Tobin wrote that it was broadly recognized that "inflation accelerates at high employment rates because tight markets systematically and repeatedly generate wage and price increases in addition to those already incorporated in expectations and historical patterns. At low utilization rates, inflation decelerates, but probably at an asymmetrically slow pace. At the Phelps-Friedman "natural rate of unemployment," the degrees of resource utilization and market tightness generate no net wage and price pressures up or down and are consistent with accustomed and expected paths, whether stable prices or any other inflation rate. The consensus view accepted the notion of a nonaccelerating inflation rate of unemployment (NAIRU) as a practical constraint on

[24] The sacrifice ratio is now perhaps more commonly described as the output gap.

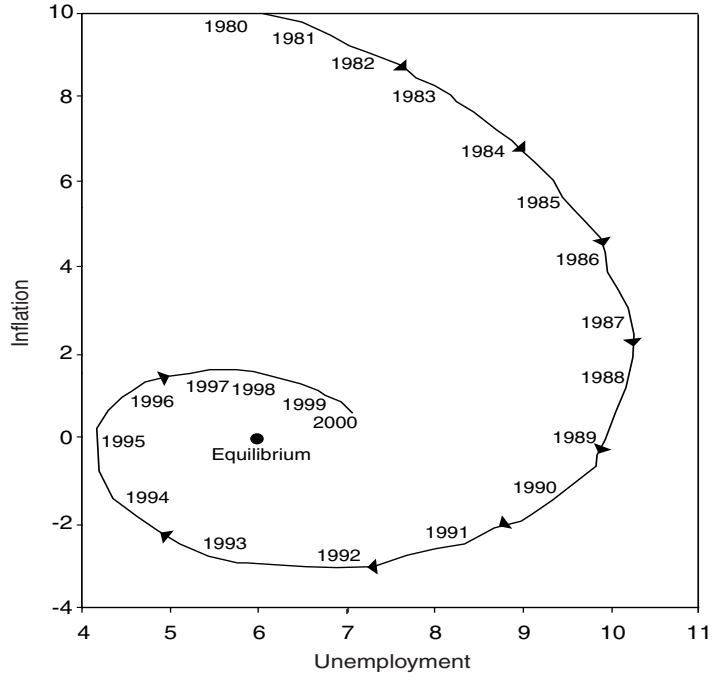
policy, even though some of its adherents would not identify NAIRU as full, equilibrium, or optimum employment."[25]

To put the potential costs of a disinflation in front of his audience, Tobin used a very simple inflation model with a NAIRU of 6 percent unemployment and assumed that the economy originated from an inflation rate of 10 percent. As displayed in Figure 11, he studied a gradual disinflation in which the central bank reduced the growth rate of nominal aggregate demand smoothly so that it falls by 1 percent each year for 10 years. Thus, after a decade, the conditions for price stability are met from the aggregate demand side. Tobin also assumed that the expectations term was an eight-quarter, backward-looking average of recent inflation rates. Tobin stressed that the result was "not a prediction!. . . but a cautionary tale. The simulation is a reference path, against which policymakers must weigh their hunches that the assumed policy, applied resolutely and irrevocably, would bring speedier and less costly results." The cautionary tale of Figure 11 involves an initial decade in which unemployment looks to average about 8.5 percent, 2.5 percent higher than its equilibrium value, so that the sacrifice ratio during this period is about 2.5 since inflation is being reduced by 10 percent. So, while the tale was cautionary, the message was consistent with the range of Okun's sacrifice ratio estimates and, hence, meant to depict some potential consequences of disinflation.

There were some skeptics. William Fellner (1976) viewed the government policies of the 1970s as sharply inconsistent with the objective of bringing about low inflation, echoing Christ's 1973 concerns. Fellner argued that households and firms would be similarly skeptical and that the disinflation process was costly in part because of the imperfect credibility of policies, so he endorsed a policy of gradualism like that which Tobin explored in his simulation coupled with strong announcements about future policy intentions. However, economists like Tobin were quite skeptical about the practical importance of this line of argument, while accepting the basic logical point that expectations effects could mitigate some of the output losses associated with his gradualist simulation. Considering the benefits of preannounced stabilization plan credibility, Tobin (1980) wrote: "The question is how much. One obvious problem is that a long-run policy commitment can never be irrevocable, especially in a democracy. Important economic groups will not find it wholly credible, and some will use political power to relax or reverse the policy. Even assuming credibility and understanding by private agents,

[25] Thus, Tobin uses the "natural rate" and the "NAIRU" interchangeably when it comes to the analysis of inflation. However, many Keynesian economists did not want to assume that the level of real activity consistent with constant inflation was an efficient level. As discussed above, Friedman had written that the natural rate was to include "the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on," but these conditions had sometimes been ignored in the debate over the efficiency and inevitability of the natural rate.

Figure 11 Tobin's Cautionary Tale



Notes: A simulation study of the unemployment and inflation implications of a gradual reduction in the rate of growth of the money supply, as described in more detail in Tobin (1980).

their responses are problematic. In the decentralized but imperfectly competitive U.S. economy, wage and price decisions are not synchronized but staggered. It is hard to predict how individual firms, employees, and unions will translate a threatening macroeconomic scenario into their own demand curves. If each group worries a lot about its relative status, each group will decide that the best strategy is to disinflate very little." Thus, Tobin (1980) argued that it would be "recklessly imprudent to lock the economy into a monetary disinflation without auxiliary incomes policies. The purpose of these policies would be to engineer directly a deceleration of wages and prices consistent with the gradual slowdown of dollar spending." In contrast to Fellner's case for gradualism, rational expectations theorists like Sargent began to explore actual disinflation experiences, using the lessons of the models that they had developed in the mid-1970s. In particular, in his "Ends of Four Big Inflations," circulated no later than spring 1981, Sargent argued that dramatic, sustained

anti-inflation policies could bring about reductions in inflation with relatively low unemployment costs, as long as such policy changes were credible and that their dramatic nature enhanced their credibility.

The Volcker Disinflation

Paul Volcker assumed the chairmanship of the Federal Reserve System (FRS) in August 1979. Looking back at Figure 1, we can see that inflation was substantially reduced, while there was a lengthy period of high unemployment. As cataloged in many discussions, the Federal Reserve made a high-profile announcement of a shift to monetary targeting in October 1979 in the face of rapidly rising inflation; there were two recessions during the period, one short and relatively mild, one lengthy and severe, and the inflation rate had declined dramatically by 1984.

There are many questions about the Phillips curve during this important historical period, but our focus in this section will be limited to two. First, how did the unemployment cost of the actual disinflation line up with the suggestions of Okun and others? Second, how did the Federal Reserve perceive the menu of policy choice during this period?

The unemployment cost

Mankiw (2002, 369–701) calculates the unemployment cost of the Volcker disinflation under the assumption that there was a 6 percent natural rate of unemployment during 1982–1985, with the inflation rate falling from 9.7 percent in 1981 to 3 percent in 1985. His annual average unemployment numbers were 9.5 percent in 1982 and 1983, 7.4 percent in 1984, and 7.1 percent in 1985 so that there was a total cyclical unemployment cost of 9.5 percent of unemployment. One can argue about details of this calculation, for example with whether the disinflation should be viewed as starting in 1980 or in 1981, about the natural rate of unemployment, and so on. But it is a reference textbook calculation familiar to many: The sacrifice ratio during the Volcker disinflation is estimated by Mankiw to be about $9.5/6.7 = 1.5$.

Mankiw's sacrifice ratio is about one-half of that which Okun suggested on the basis of his mean estimate and lies below the low end of the range in the studies that he reviewed. The 6.7 percent decline in the inflation rate should have had the effect of raising the unemployment rate by a total of 22 percent over the period according to the average estimate, 13.4 percent according to the low estimate, and over 40 percent for the high estimate. Put another way, the mean estimate implies that unemployment should have been higher by more than 5 percent over each year of a four-year disinflation period.

Some have suggested that this lower cost was due to increased credibility of the Fed and its disinflationary policies under Volcker; others have

suggested that the cost was largely due to the central bank's imperfect credibility.[26] However, as McCallum (1984) points out, the testing of hypotheses about credibility is subtle because the measures of private expectations about policy that must be constructed are more involved than in standard rational expectations models.

The Fed's Perceived Unemployment Cost

One key question about this disinflation period is "How did the Federal Reserve System view the tradeoff between inflation and unemployment?" The developments reviewed above, in which the nature of the tradeoff was subject to substantial controversy and evaluated in an evolving model, makes this a particularly interesting question. It is also not an easy question to answer, as any central bank is a large organization with many differing viewpoints and its policymakers do not file survey answers about their perceived tradeoffs.

However, the question can be answered in part because the Humphrey-Hawkins legislation requires testimony by the FRS chairman twice a year, in late January or early February and again in July. For the six FOMC meetings each year, the research staff under Volcker prepared a basic forecast of the economy's developments within the "Green Book" under a particular benchmark set of policy assumptions. For the FOMC meetings that precede the chairman's testimony, the staff also prepared a set of alternative policy options within the "Blue Book" of which Table 1 provides examples at two FOMC meetings. In both cases, then, the alternative strategies were framed in terms of growth rates for the M1 concept of money and were based on the Board's quarterly macroeconometric (MPS) model along with staff judgemental adjustments, so that they reflected the effects of pre-existing economic conditions as well as alternative paths of policy variables.[27] Projections

[26] To my mind, the role of imperfect credibility in the Phillips curve in U.S. history remains an open, essential area of research at present. Goodfriend and King (2005) argue that Volcker's actions were based significantly on his perception that his policy actions were not perfectly credible and that the nature of the disinflation dynamics was also substantially influenced by imperfect credibility of policy.

[27] The Federal Reserve Bank of New York (1998, 123) describes the preparation of "blue book" material, from which the Table 1 entries are taken, as follows: "The blue book provides the Board staff's view of recent and prospective developments related to the behavior of interest rates, bank reserves, and money. The blue books written for the February and July meetings contain two extra sections to assist the Committee in its preparation for the Humphrey-Hawkins testimony. The first of these sections provides longer-term simulations, covering the next five or six years. One of these simulations represents a judgmental baseline, while two or three alternative forecasts use a Board staff econometric model to derive the deviations from the judgmental baseline under different policy approaches. Typically, at least two scenarios are explored: one incorporates a policy path that is designed to bring economic activity and employment close to their perceived long-run potential paths fairly quickly, and another is intended to achieve a more rapid approach to stable prices. The section also offers estimates of how different assumptions about such factors as fiscal policy, the equilibrium unemployment rate, or the speed of adjustment to changed inflationary expectations would affect the predicted outcome."

Table 1 FRB Economic Projections Associated with Alternative Monetary Growth Strategies

	January 1980			
	Strategy	**1980**	**1981**	**1982**
Money Growth	1	6.0	6.0	6.0
	2	4.5	4.5	4.5
	$\Delta = 1 - 2$	−1.5	−1.5	−1.5
Inflation	1	9.5	8.7	7.7
	2	9.1	8.2	6.8
	$\Delta = 1 - 2$	−0.4	−0.5	−0.9
Unemployment	1	8.1	8.9	9.3
	2	8.4	10.1	11.6
	$\Delta = 1 - 2$	0.7	1.2	2.3
	January 1982			
	Strategy	**1982**	**1983**	**1984**
Money Growth	1	4.0	3.5	3.0
	2	5.5	5.0	4.5
	$\Delta = 2 - 1$	−1.5	−1.5	−1.5
Inflation	1	6.4	5.1	4.2
	2	6.5	5.4	5.3
	$\Delta = 2 - 1$	−0.1	−0.3	−0.9
Unemployment	1	9.3	9.1	8.9
	2	9.0	8.2	6.9
	$\Delta = 2 - 1$	0.3	0.9	2.0
T-Bill	1	13.0	12.5	11.0
	2	9.7	8.3	8.4
	$\Delta = 2 - 1$	3.3	4.2	2.6

Notes: These table items are drawn from the Federal Reserve Blue Books "Monetary Aggregates and Money Market Conditions," January 4, 1980, page 11, and "Monetary Policy Alternatives," January 29, 1982, page 7.

under alternative strategies during the Volcker deflation also took into account forecasted developments in fiscal policy, which were being revamped by the Reagan administration at the time.

The first meeting is the January 1980 FOMC session, at which the benchmark strategy (called strategy 1 in this meeting) was for 6 percent money growth over each of three years: 1980, 1981, and 1982. Under this benchmark policy, as can be seen by reading across the relevant row of the table, the forecast was that U.S. inflation would gradually decline from 9.5 percent in 1980 to 7.7 percent in 1982, but that there would be high and rising unemployment in each year (8.1 percent in 1980, 8.8 percent in 1981, and 9.3 percent in 1982). In this general sense, the forecast incorporated a Phillips curve but one that depended in a complex manner on initial conditions and

shocks. However, the staff also forecasted unemployment and inflation under an alternative policy, 4.5 percent money growth. Hence, it is possible to use the difference in forecasts to gain a sharper sense of the tradeoff under alternative monetary policies. The forecast differences are listed as the row Δ in the table. The January 1980 FOMC meeting corresponded with the onset of a recession, as later dated by NBER researchers.

The second meeting is the January 1982 FOMC session, at which the benchmark strategy (again called strategy 1 in this meeting) was for a gradually declining path of money growth: 4.0 percent in 1982, 3.5 percent in 1983, and 3.0 percent in 1984. Again, the FRS staff forecasted declining inflation (from 6.4 in 1982 to 4.2 in 1984) but this time with declining unemployment (from 9.3 percent in 1982 to 8.9 percent in 1984). The perceived Phillips curve was less evident in these forecasts, but an opportunity to appraise its nature is afforded by the fact that the staff also prepared forecasts under the assumption of higher money growth (strategy 2).

There are a number of aspects of the benchmark policy projections that are notable. First, in each case, strategy 1 is the assumption under which the Federal Reserve staff made its "Green Book" forecast for inflation and real activity for the coming years. In both 1980 and 1982, inflation was expected to decline by about two percentage points under the benchmark forecast. Second, in both 1980 and 1982, the projections implied that a policy change (lowering money growth by 1.5 percent for three years) would have no effect on inflation within the first year. Third, looking out two years after such a policy change, the alternative Blue Book policy scenarios suggested substantial effects on both unemployment and inflation of changing monetary policy. A shift from strategy 1 to strategy 2 in 1980 was projected to produce a .9 percent decline in inflation in 1982 and a 2.3 percent increase in unemployment in 1982. Seen in terms of a "menu of policy choice," the unemployment cost in two years of a 1 percent reduction in inflation was 2.3 percent. A 1982 shift from strategy 1 to strategy 2 was predicted to have the same effect on inflation at a two-year horizon, at an unemployment of 2.0 percent.

Proceeding further, we can set a *lower bound* on the perceived unemployment cost of disinflation by cumulating the "deltas" over the three-year period and viewing the result as the first part of a transition to a 1.5 percent lower inflation rate.[28] From that standpoint, in 1980 and 1982, the Fed's perception was that the first three years of restrictive monetary policy would cost about 4 point years of unemployment to lower the inflation rate by 1.5 percent. Thus, a 6.7 percent decline in the inflation rate was perceived to cost no less than 18

[28] It is a lower bound because the staff projection would certainly have viewed unemployment as remaining high beyond the three-year projection in the Blue Book; the unemployment Δ is highest in the third year.

point years of unemployment and it could have been a good bit higher once fourth-year costs were included.

Overall, in 1980 and 1982, it seems that the Fed's perception was that the disinflation would be at least twice as costly as the cyclical unemployment that was actually experienced. The perceived cost was not too much different across these years, although it was modestly smaller in 1982, and it was in line with the consensus estimates of Okun (1978). Accordingly, it does not seem that the Fed undertook the disinflation because its research staff, at least, believed that the costs would be small.

The Consolidation of Disinflation Gains

The reduction in inflation during the early 1980s had to be followed up by a lengthy period of inflation fighting, as discussed in Goodfriend (1993). In particular, upon taking over as chairman in 1987, Alan Greenspan had to fight a series of inflation scares. Yet, by 1994–1995 it seemed that the United States had settled into a period of low inflation (about 3 percent) and low unemployment (about 5 percent), essentially returning to conditions that resembled those in the mid-1950s, where we started our Phillips curve documentary.

6. IN THE AFTERMATH

The year 1996 saw two novel developments on the Phillips curve front, which are closing snapshots: the completion of version 1 of a new quarterly Federal Reserve Board macroeconometric model of the United States and an explicit discussion of Phillips curve tradeoffs by the FOMC.

The Model

The structure and results of large-scale models are notoriously difficult to convey in a compact and coherent manner. In that regard, the 1996 "Guide to FRB/US: A Macroeconomic Model of the United States," edited by Brayton and Tinsley, is a remarkable document. It provides the reader with a clear model-building vision and a set of clean experiments that can be used to learn about the model.

The wage-price block of the new model combines the sort of forward-looking price-setting and wage-setting specifications that are standard in modern macroeconomic analysis, with a set of gradual adjustment specifications of the variety that applied econometricians have found useful for fitting data since the days of Fisher, Klein, and Sargan. The specific modeling is in the tradition of the approach to time series econometrics initiated by Sargan and refined by Hendry and others.

For example, the price-level specification of the model contains a long-run relationship that makes

$$P_t^* = .98 * (W_t - a_t) + .02 * P_t^f - .003u_t,$$

so that the "equilibrium" price level strongly depends on the gap between the log nominal wage rate (W) and productivity (a) with weaker effects from the nominal energy fuel price (P_t^f), consistent with factor share data. Further, the unemployment rate has a small effect, via an effect on the desired markup (the units of measurement imply that a 1 percent increase in unemployment lowers the desired markup by .3 percent). The adjustment dynamics indicate that inflation is high as the price level adjusts gradually toward this target level, via

$$\begin{aligned} P_t - P_{t-1} \quad = \quad & .10(P_{*t-1} - P_{t-1}) + .57\text{lags}_2[P_{t-1} - P_{t-2}] \\ & + .43\text{leads}_\infty[P_{t+1}^* - P_t^*]^e. \end{aligned}$$

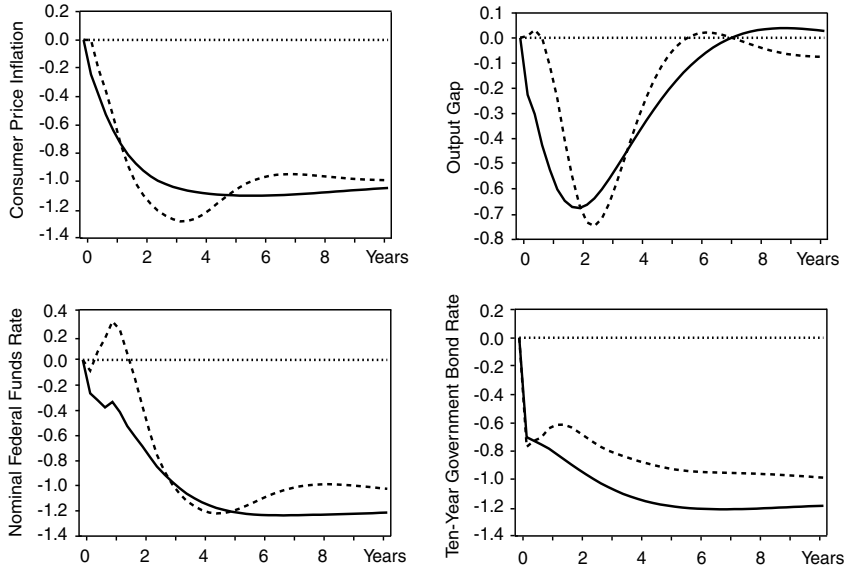
That is, there is a gradual elimination of .1 of the gap ($P_{t-1}^* - P_{t-1}$) each quarter, some additional backward-looking adjustment terms with substantial weight, and variations in the expected target. The requirement that the structural lead and lag coefficients sum to one, along with similar restrictions in the companion wage equation, means that the FRB/US model features no long-run tradeoff between inflation and unemployment.

Thus, the new model represented a blend of the Klein-Sargan approach, with a new macroeconomic theory that stresses expectational elements of pricing and other behavior. The new FRB/US model also had common elements with a set of small, fully articulated dynamic models then being developed in academia (King and Wolman [1996] and Yun [1996]), which were early examples of the types of new macroeconomic models explored elsewhere in this *Economic Quarterly* issue.

The frictions in the model are substantial, as Brayton and Tinsley (1996) make clear, in that they apply to changes as well as levels. The associated distributed lags and leads are lengthy, averaging 3.3 quarters for unanticipated shocks. Hence, there is a short-run Phillips curve in the model that involves dynamics over many quarters. Figure 12 shows the response to a permanent decline in the inflation rate within the FRB/US model, essentially obtained by shifting down the constant term in an interest rate rule along Taylor (1993) lines.

The FRB/US model can be solved under alternative assumptions about expectation formation, with rational expectations being one specification and a modern version of adaptive expectations being the other. More precisely, the second specification is expectations based on a vector-autoregression estimated from a model's data for a subset of just three of that model's variables. The model implies a gradual disinflation process as a result of the lags

Figure 12 Credible Disinflation Dynamics in the FRB/US Model



Notes: The FRB/US model can be used to calculate the implications of a permanent shift down in the target inflation rate, with results that are reported in Brayton and Tinsley (1996) and displayed above. The model can be solved under full rational expectations (solid line) or under a simpler procedure of vector-autoregression (VAR) expectations.

in the price and wage specification, but the transition to the new lower inflation rate is completed within about two years, although the real consequences are present for several years. Overall, since the reported simulations are in terms of an output gap, they cannot be directly compared to those considered above. Yet a back-of-the-envelope calculation suggests that they are quite major but smaller than those experienced in the Volcker period or in the MPS model discussed above. To see why, suppose that we summarize the figure as indicating that an upper bound on the output loss is a .5 percent output gap on average for 6 years; this is a 3 percent cumulative output loss. Suppose also that we use the same Okun's Law coefficient of 2.5 that links unemployment to output gaps as in the 1962 *Economic Report*. Then, the unemployment cost of a permanent disinflation is about 1.2 point years of unemployment for each point of inflation, a number that is in line with ratios reported by Brayton, Tinsley, and collaborators. The FRB/US team also reported that imperfect

credibility of monetary policy actions can more than double the unemployment cost of a disinflation.

A notable feature of the disinflation simulation displayed in Figure 12 is that monetary policy initially works heavily through expectational channels. On impact, at date 0, the long-term bond rate drops dramatically (say, 80 basis points), while the federal funds rate moves by much less and only averages about a 40-basis-point decline over the first year. By contrast, the MPS model simulations of a lower money growth rate displayed nominal interest rate increases by an average of over 300 basis points for the first three years as shown in Table 1. Thus, the FRB/US model differs importantly from its MPS predecessor in terms of other areas, notably the term structure of interest rates, in ways that are important for monetary policy.

The Background to the Meeting

In 1996, the FOMC conducted a remarkable discussion of its long-run policy goals, stimulated by earlier calls for an increased emphasis on price stability by some of its members, as well as the adoption of inflation-targeting systems by other countries around the world. Notably, at a January 1995 meeting, Al Broaddus, the then-president of the Richmond Fed, had called within the FOMC for a system of inflation reports each year to accompany the Fed chairman's Humphrey-Hawkins testimony.[29] Broaddus' suggestion was opposed by FRB Governor Janet Yellen in January 1995, but the FOMC had agreed to continue the discussion in the context of future meetings that preceded the Humphrey-Hawkins testimony.

When the FOMC met in January 1996, the U.S. economy had been experiencing low inflation and strong macroeconomic activity for some time. In the first quarter of 1996, inflation was running at about 2 percent per year, with unemployment in the neighborhood of 5.5 percent. Since 1980, the United States had experienced the major decline in inflation described in the last section, during which unemployment had ranged over 10 percent in the last quarter of 1982 and the last two quarters of 1983. In the last year of Volcker's chairmanship and during the first few years of Greenspan's, a rise in inflation had taken place—from the 2 percent range in 1986 to about 4 percent in 1990—which had been accompanied by a decline in unemployment.[30] Subsequently, during 1991 and 1992, there had been a rise in unemployment while inflation fell back in the 2 percent range. Most recently, from mid-1992 through the end

[29] Broaddus (2004) used his proposals at this meeting as one of three examples of his use of macroeconomic principles in practical monetary policy discussion.

[30] At the time of Greenspan's appointment in August of 1987, inflation was at 2.8 percent, while unemployment was 5.8 percent.

of 1995, there had been about 2 percent inflation, while unemployment was between 5.5 and 6 percent.

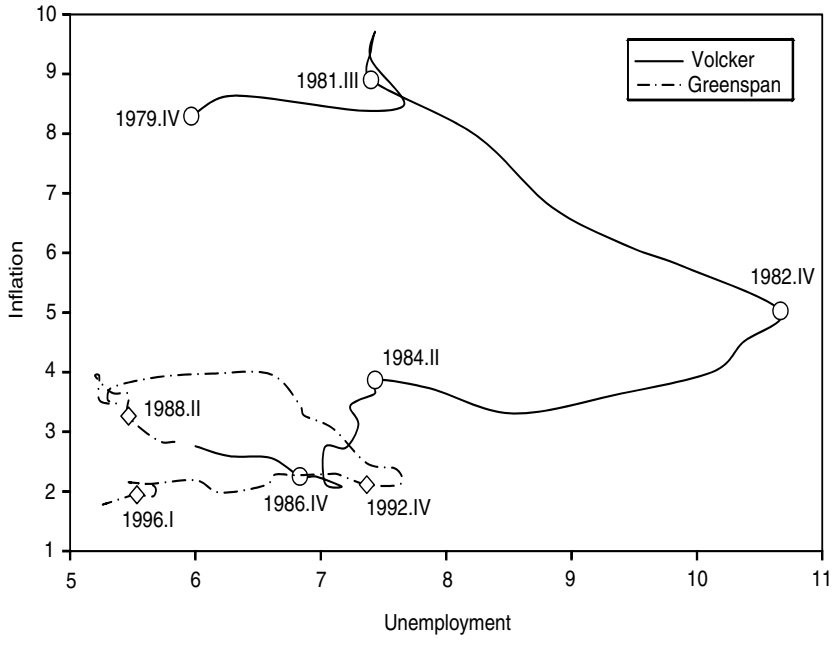
These developments are shown in Figure 13, which is a Phillips-style plot of unemployment and inflation during 1980 through 1996. Observations during the Volcker period are marked with a circle (o) and those during the Greenspan period are marked with a diamond (◇). This figure captures the background to the FOMC's 1996 discussion. The major disinflation is the first half-loop: an interval of declining inflation and rising unemployment between 1980 and mid-1983, followed by an interval of declining inflation and declining unemployment with inflation reaching the 4 percent range by the second quarter of 1984. Subsequently, there was a year in which inflation fell in the 2 percent range, with little accompanying change in unemployment. The increase in inflation between mid-1985 through 1989 was followed by a decline in inflation to the 2 percent range during late 1991 and early 1993, accompanied by increases in unemployment. In late 1993 through early 1995, unemployment fell sharply, with little change in inflation. Thus, the late-Volcker and early-Greenspan years trace out a full clockwise loop, after the disinflation of 1980–1984. The negative association between inflation and unemployment during the first stages of each of these three episodes (one of increasing inflation and one of decreasing inflation) corresponds to periods that FOMC members would have viewed as reflecting the phenomena isolated by Phillips.

The Meeting

At the time of the January 1996 meeting, there were two important economic conditions that occupied the FOMC's attention. First, there was a sense that key aspects of the U.S. economy were changing, with the possibility of a "New Economy" based on computer and communications advances. Second, and most important for the meeting, the inflation rate for personal consumption expenditures was running at about a 3 percent rate and its "core" component—that stripped of food, energy, and other volatile price components—was running at about 2.5 percent, but staff forecasts suggested that it was poised to rise to the 3 percent range as well. The strong real growth in the economy, coupled with a decline in unemployment to the range of 5.5 percent, had led some FOMC members to express concerns about inflation.

In detailed prepared remarks, Governor Janet Yellen discussed a cost-benefit approach to determining the optimal long-run rate of inflation and the transition path. She noted that the Board's new model indicated a cost of 2.5 point years of unemployment for every 1 percent decline in the long-run inflation rate, under imperfect credibility. To warrant a reduction in inflation, she argued that such a cost of permanently lower inflation had to be less than the discounted value of a stream of future benefits. However, Yellen also

Figure 13 Inflation and Unemployment, 1978Q4–1996Q4



Notes: The inflation rate is the year-over-year change in the gross domestic product (GDP) deflator, the unemployment rate is the civilian unemployment rate, quarterly averages of monthly figures. All data are from the Federal Reserve Economic Database (FRED) at the Federal Reserve Bank of St. Louis.

returned to a theme suggested by Phillips' original research, which was that there could be particular costs to low rates of inflation. Citing research by Akerlof, Dickens, and Perry (1996) which argued that worker-resistance to nominal pay cuts produced a long-run Phillips curve with a negative slope at low rates of inflation, Yellen also argued for a positive rate of long-run inflation "to grease the wheels of the labor market."

As they considered the appropriate long-run rate of inflation, the FOMC decisionmakers took into account their perceived transition costs, their sense of the benefits from permanently low inflation, and their sense of the costs of permanently low inflation. There was diversity in the views reflected in the statements of various members on each of these topics. But, as Broaddus noted, there was a consensus that the long-run inflation rate should not be higher than the current level of 3 percent. Broaddus and then-Cleveland Fed President Jerry Jordan stressed the importance of explicit public discussion of

inflation objectives as a means of enhancing Fed credibility and thus lowering the cost of further reductions in inflation.

The FOMC discussed how to define price stability as an objective of monetary policy. 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," but Yellen challenged him to translate that general statement into a specific numerical value. He responded that "the number is zero, if inflation is properly measured." Yellen said that she preferred 2 percent "imperfectly measured."

The FOMC settled on 2 percent inflation as an interim goal, with a policy of deliberately moving toward that lower level. Presumably, some members viewed it as the natural first step toward a lower ultimate inflation objective, while others thought of it as an end point. On the second day of the two-day meeting, Greenspan cautioned the committee that the 2 percent objective was included within "the highly confidential nature of what we talk about at an FOMC meeting." He noted that "the discussion we had yesterday was exceptionally interesting and important" but warned that "if the 2 percent inflation figure gets out of this room, it is going to create more problems for us than I think any of you might anticipate." He did not elaborate on whether he was concerned about market or political reactions to the inflation goal.

7. SUMMARY AND CONCLUSIONS

With a series of snapshots over a nearly 40-year period, this article has reviewed the evolution of the Phillips curve in macroeconomic policy analysis in the United States. During this period, U.S. inflation rose dramatically, initially during a decade of glittering economic performance and then further during an interval of stagflation. The reversal of inflation beginning in the early 1980s was associated with a major recession, although perhaps not as large a one as policymakers and economists had feared.

The rise and fall of inflation brought about a major change in the style of macroeconometric models that were used to evaluate policy choices. The earliest versions of these models featured a substantial long-run tradeoff consistent with the findings of Phillips over a near-century of U.K. data. The subsequent evolution of models first involved altering their wage-price block so that there was no long-run tradeoff and then, later, a more comprehensive rational expectations revision that included forward-looking wage and price-setting structured so that there was no long-run tradeoff.

More generally, the rise and fall of inflation led monetary policymakers to place greater weight on the role of expectations in governing macroeconomic activity, with central banks working to extract information in long-term interest rates about market expectations of inflation. Toward the end of the historical period examined here, the Federal Reserve System had decided to maintain a

goal of a low, but positive rate of inflation. Yet, it also chose not to communicate that long-run target directly to the public. The decision to choose a positive rate of inflation was traced, in part, to a concern about the transitory unemployment costs of moving to a zero rate of inflation and in part to a concern about high long-run costs of low inflation, in the spirit of Phillips' analysis.

REFERENCES

Akerlof, George A., William R. Dickens, and George L. Perry. 1996. "The Macroeconomics of Low Inflation." *Brookings Papers on Economics Activity* 1: 1–76.

Brayton, Flint, and Peter C. Tinsley. 1996. "A Guide to FRB/US: A Macroeconomic Model of the United States." FEDS Working Paper 96-42.

Broaddus, J. Alfred, Jr. 2004. "Macroeconomic Principles and Monetary Policy." Federal Reserve Bank of Richmond *Economic Quarterly* 90 (Winter): 1–9.

Burns, Arthur F., and Wesley C. Mitchell. 1946. Measuring Business Cycles. New York: National Bureau of Economic Research.

Castle, Jennifer, and David F. Hendry. Forthcoming."The Long-Run Determinants of UK Wages, 1860–2004." *Journal of Macroeconomics: Advances in Historical Analyses*.

Christ, Carl F. 1973. "The 1973 Report of the President's Council of Economic Advisers: A Review." *American Economic Review* 63 (September): 515–26.

de Menil, G., and Enzler, J. 1972. "Prices and Wages in the FR-MIT-PENN Econometric Model." In *The Econometrics of Price Determination*, edited by Otto Eckstein. Washington, D.C.: Federal Reserve Board of Governors.

Duesenberry, James S., Otto Eckstein, and Gary Fromm. 1960. "A Simulation of the United States Economy in Recession." *Econometrica* 28 (October): 749–809.

Federal Reserve Bank of New York. 1998. "The FOMC Meeting: Developing a Policy Directive." In *U.S. Monetary Policy and Financial Markets*. Available at www.newyorkfed.org/education/addpub/monpol/.

Fellner, William. 1976. *Towards a Reconstruction of Macroeconomics*. Washington, D.C.: American Enterprise Institute.

Fisher, Irving. 1926. "A Statistical Relationship between Unemployment and Price Changes." *International Labor Review* 47 (June): 785–92.

Friedman, Milton. 1968. "The Role of Monetary Policy." *American Economic Review* 58 (January): 1–17.

Goodfriend, Marvin. 1993. "Interest Rate Policy and the Inflation Scare Problem: 1979–1992." Federal Reserve Bank of Richmond *Economic Quarterly* 91 (Winter): 1–23.

Goodfriend, Marvin, and Robert G. King. 2005. "The Incredible Volcker Disinflation." *Journal of Monetary Economics* 52 (July): 981–1015.

Gordon, Robert J. 1970. "The Recent Acceleration of Inflation and Its Lessons for the Future." *Brookings Papers on Economic Activity* 1: 8–47.

Hetzel, Robert. 1998. "Arthur Burns and Inflation." Federal Reserve Bank of Richmond *Economic Quarterly* 84 (Winter): 21–44.

Hetzel, Robert. 2008. *The Monetary Policy of the Federal Reserve: A History*. Cambridge, U.K.: Cambridge University Press.

Hymans, Saul H. 1972. "Prices and Price Behavior in Three U.S. Econometric Models." In *The Econometrics of Price Determination*, edited by Otto Eckstein. Washington, D.C.: Federal Reserve Board of Governors, 309–24.

King, Robert G., and Alexander L. Wolman. 1996. "Inflation Targeting in a St. Louis Model of the 21st Century." Federal Reserve Bank of St. Louis *Review* 78 (Fall): 83–107.

Klein, L. R., R. J. Ball, A. Hazelwood, and P. Vandome. 1961. *An Econometric Model of the United Kingdom*. Oxford: Basil Blackwell.

Lucas, Robert E., Jr. 1972a. "Econometric Testing of the Natural Rate Hypothesis." In *The Econometrics of Price Determination*, edited by Otto Eckstein. Washington, D.C.: Federal Reserve Board of Governors, 50–9.

Lucas, Robert E., Jr. 1972b. "Expectations and the Neutrality of Money." *Journal of Economic Theory* 4 (April): 103–24.

Lucas, Robert E., Jr. 1976. "Econometric Policy Evaluation: A Critique." *Carnegie-Rochester Conference Series on Public Policy* 1 (January): 19–46.

Mankiw, N. Gregory. 2002. *Macroeconomics*, fifth edition. New York: Worth Publishers.

McCallum, Bennett T. 1984. "Credibility and Monetary Policy." In *Proceedings*. Federal Reserve Bank of Kansas City, 105–35.

McCallum, Bennett T. 1994. "Identification of Inflation-Unemployment Tradeoffs in the 1970s a Comment." *Carnegie-Rochester Conference Series on Public Policy* 41 (December): 231–41.

Meltzer, Allan M. 1980. "The Case for Gradualism in Policies to Reduce Inflation." Federal Reserve Bank of St. Louis *Review* April: 127–54.

Modigliani, Franco, and Lucas Papademos. 1975. "Targets for Monetary Policy in the Coming Year." *Brookings Papers on Economic Activity* 6: 141–65.

Muth, John F. 1960. "Optimal Properties of Exponentially Weighted Forecasts." *Journal of the American Statistical Association* 55 (June): 299–306.

Muth, John F. 1961. "Rational Expectations and the Theory of Price Movements." *Econometrica* 29 (July): 315–35.

Okun, Arthur M. 1962. "Potential GNP: Its Measurement and Significance." In *Journal of the American Statistical Association*; reprinted with slight changes in *The Political Economy of Prosperity* by Arthur M. Okun. Washington, D.C.: Brookings Institution.

Okun, Arthur M. 1978. "Efficient Disinflationary Policies." *American Economic Review* 68 (May): 348–52.

Orphanides, Athanasios. 2003. "The Quest for Prosperity without Inflation." *Journal of Monetary Economics* 50 (April): 633–63.

Phelps, Edmund S. 1967. "Phillips Curves, Expectations of Inflation, and Optimal Inflation over Time." *Economica* 34 (August): 254–81.

Phillips, A. W. 1958. "The Relationship between Unemployment and the Rate of Change of Money Wages in the United Kingdom 1861–1957." *Economica* 25 (November): 283–99.

Poole, William. 1970. "Gradualism: A Mid-Course View." *Brookings Papers on Economic Activity* 1: 271–301.

Primiceri, Giorgio. 2006. "Why Inflation Rose and Fell: Policymakers' Beliefs and U.S. Postwar Stabilization Policy." *Quarterly Journal of Economics* 121 (August): 867–901.

Samuelson, Paul A., and Robert M. Solow. 1961. "Analytical Foundations of Anti-Inflation Policy." *American Economic Review* 50 (May): 177–94.

Sargan, John D. 1964. "Wages and Prices in the United Kingdom: A Study in Econometric Methodology." In *Econometric Analysis for National Economic Planning*, edited by P. E. Hart, G. Mills, and J. K. Whitaker. London: Butterworth and Co. Ltd., 25–54; Reprinted as chapter 8 in *Contributions to Econometrics: John Denis Sargan*, edited by Esfandiar Maasoumi, Cambridge University Press.

Sargent, Thomas J. 1971. "A Note on the Accelerationist Controversy." *Journal of Money, Credit and Banking* 3 (August): 721–25.

Sargent, Thomas J. 1981. "The Ends of Four Big Inflations." Federal Reserve Bank of Minneapolis Working Paper 158 (May).

Sargent, Thomas J. 1999. *The Conquest of American Inflation*. Princeton, N.J.: Princeton University Press.

Solow, Robert M. 1969. *Price Expectations and the Behavior of the Price Level*. Manchester, U.K.: Manchester University Press.

Staiger, Douglas, James H. Stock, and Mark W. Watson. 1997. "The NAIRU, Unemployment and Monetary Policy." *The Journal of Economic Perspectives* 11 (Winter): 33–49.

Taylor, John B. 1993. "Discretion versus Policy Rules in Practice." Carnegie-Rochester Conference Series on Public Policy 39 (November): 195–214.

Tobin, James. 1980. "Stabilization Policy Ten Years After." *Brookings Papers on Economic Activity* 11:19–78.

Yun, Tack. 1996. "Nominal Price Rigidity, Money Supply Endogeneity, and Business Cycles." *Journal of Monetary Economics* 37 (April): 345–70.