Working Paper Series

# What Remains of Milton Friedman's Monetarism?

WP 17-09

Robert L. Hetzel
Federal Reserve Bank of Richmond



FEDERAL RESERVE BANK OF RICHMOND®
Richmond ▪ Baltimore ▪ Charlotte

# What Remains of Milton Friedman's Monetarism?

**Robert L. Hetzel**
**Senior Economist**
**Federal Reserve Bank of Richmond**
**Research Department**
**P. O. Box 27622**
**Richmond VA 23261**
**804-697-8213**
**robert.hetzel@rich.frb.org**

**July 13, 2017**

**Working Paper No. 17-09**

Abstract: From the early 1960s until the early 1970s with the emergence of rational expectations, under the rubric of monetarism, Milton Friedman defined macroeconomic debate. Although the Keynesian consensus that he challenged has disappeared, the current academic literature makes little reference to monetarist ideas. What happened to them? The argument here is that those ideas remain relevant but require translation into terms expressible in modern macroeconomic models and in the monetary policies of central banks, neither of which contain any obvious references to money. Moreover, the Friedman and Schwartz methodology for identifying shocks retains relevance.

JEL: B22

The author is senior economist and research advisor at the Federal Reserve Bank of Richmond. He thanks Edward Nelson for helpful comments. The views in this paper are the author's, not those of the Federal Reserve Bank of Richmond or of the Federal Reserve System.

DOI: https://doi.org/10.21144/wp17-09

As exposited by Milton Friedman, monetarism incorporated two hypotheses. One is that the price level is a monetary phenomenon in that its behavior depends upon the institutions for controlling money creation. The second is that the price system works well in order to attenuate cyclical fluctuations provided the central bank follows a rule that creates a stable nominal anchor and that allows market forces to determine real variables. Professional consensus seems assured over Friedman's view that the severity of the Great Depression owed to contractionary monetary policy while the inflation of the 1970s owed to inflationary monetary policy. Following Friedman's challenge to Keynesianism, economists no longer attribute failure of the price system to the replacement of competitive markets by monopolies and inflation to the exercise of monopoly power.

Nevertheless, monetarism today appears to be just a name for ideas consigned to the history of thought. The monetarist/Keynesian debate appears dated. In a PBS (2006) obituary, a newspaper columnist characterized Milton Friedman as "a bookend to John Maynard Keynes." Macroeconomic research has moved away from empirical estimation of money demand functions. No one proposes that central banks target money growth through the adoption of reserves-money multiplier procedures. Much of the monetarist literature appears as event studies with little obvious relevance to current central bank practices. Because of the absence of an explicit model, Friedman's work in monetary economics is difficult to read for the new generation of economists.

In addition, with the Great Recession, there has been a change in the intellectual environment hostile to monetarist hypotheses. Some have argued that inflation targeting contributed to the Great Recession by ignoring financial stability (Curdia and Woodford 2009; Woodford 2012). Market commentators have argued that the appearance of the zero lower bound on interest rates has limited the ability of central banks to achieve their inflation targets.

The argument here is that Friedman's ideas can still stimulate debate. However, they need to be translated into a language that is accessible to the new generation of economists. Specifically, one can use the New Keynesian (NK) model as a Rosetta stone for translating his ideas. Ultimately, monetarist hypotheses will survive or decline based on the acceptance of the NK model. Moreover, in choosing among models in monetary economics, it is essential to keep in mind the poor experimental design that generates the data. It remains important to understand how Friedman's methodology for the identification of shocks dealt with that fact.

Section 1 offers reasons why economists today find Friedman hard to read. Section 2 discusses his methodology in the context of the Cowles Commission debate. Section 3 reviews his critique of the stop-go monetary policy. Section 4 summarizes the data that monetarists drew upon in this critique. Section 5 relates monetarist ideas to the NK model. Section 6 provides a monetarist overview of the Great Recession. Section 7 concludes.

## 1. Why is Friedman hard to read?

In the 1960s through the early 1970s with the advent of rational expectations, Milton Friedman was the dominant voice challenging the Keynesian consensus (Nelson, forthcoming). The debate addressed the fundamental issues of macroeconomics. When left to operate without "management" by the fiscal and monetary authorities, can the price system stabilize macroeconomic fluctuations? Alternatively, is that management itself destabilizing? What is the nature of inflation? What is the nature of the interaction between inflation and unemployment? Despite the continued relevance of these issues, economists today no longer read Friedman's work. Why is that?

Most obviously, his work includes no explicit model. The expositions in Friedman (1969 [1969]; 1989) start with the conceptual experiment of a doubling of the money stock that leads to a doubling of the price level. In itself, the conceptual experiment offers no guidance on how to test the hypothesis of the neutrality of money. The exposition then jumps to a summary of NBER style cyclical timing relationships involving money. The empirical relationships between money and cyclical peaks in the business cycle and between money and inflation, however, no longer offer guidance on how to test hypotheses about the role of money in the transmission of monetary policy.

Friedman's comparative advantage was as an applied statistician not as a model builder. Moreover, Friedman developed his ideas over time in the context of contemporaneous debate. Today, the disappearance of that context can render opaque the underlying issues. Consider two examples. First, Friedman challenged the prevailing view of the Great Depression as evidence of failure of the price system. According to the real bills views then prevalent among policymakers, the role of the Fed was to proportion the supply of credit to the demand for credit arising from legitimate (nonspeculative) uses. Given the view that it should only accommodate the demand for credit, the Fed allowed the money stock to collapse. In their turn, Keynesians employed the idea of a liquidity trap in order to dismiss the relevance of monetary policy to the Depression. In opposition, Friedman used a reserves-money multiplier framework with reserves as an exogenous variable to argue that money was a causal factor. Second, given his methodology for testing hypotheses based on their predictive power, using OLS regressions, Friedman and Meiselman (1963) compared the power of money versus exogenous expenditures (investment) for predicting consumption. The organization of Friedman's ideas around the exogeneity of money makes his work seem dated now.

## 2. Identification: Friedman versus Cowles

In order to understand Friedman's methodology for identification of the forces causing macroeconomic instability, it is helpful to place it in the context of the debate that took place around 1950 at the University of Chicago between Friedman and members of the Cowles Commission. This debate in turn arose in the context of the movement away from the institutionalism that emphasized descriptive reality and how the structure of the economy would change as institutions changed. Economics became a discipline that tested hypotheses based on the predictions of a model. The need for a model in order to disentangle causation from correlation now constitutes a bedrock principle of the discipline of economics. In this respect, the Cowles Commission set the research agenda for modern macroeconomics (Christ 1952). The holy grail of macroeconomics has become construction of a structural model of the economy grounded in microeconomic theory.

One motivating force behind the Cowles agenda was the creation of a structural model that could be used to implement a policy of aggregate-demand management. Lawrence Klein (1964, 2) wrote: "At an early stage, it was recognized that this policy implementation would require accurate predictions of the macro-economy, and econometric model building has this goal precisely in mind." He led the profession in the estimation of large-scale econometric models of the economy subject to identification restrictions such as the exclusion restrictions in individual equations.[1]

---

[1] Friedman (1953, 8) criticized this method of identification by pointing out that in dynamic models in which the future is important expectations affect both supply and demand. "[T]he simple and even

In *A Theory of the Consumption Function*, Friedman (1957a) contributed to the Cowles agenda of constructing micro-founded structural models. However, as reflected in his critique of aggregate-demand management and his advocacy of rules that relied upon unfettered operation of the price system to assure macroeconomic stability, Friedman was skeptical of economists' ability to construct adequate large-scale econometric models. Accordingly, as an alternative to identification through estimation of such models, Friedman looked for episodes in which the Fed interfered with the operation of the price system as flags for predicting cyclical turning points in the economy.

In this spirit, Friedman investigated how the practice of controlled experiments in the hard sciences could be applied to economics.[2] In "The Methodology of Positive Economics," Friedman (1953) argued that the validity of a hypothesis lies not in its descriptive realism but rather in whether its predictions can be refuted. Only with the abstractions of a model rather than with a complicated description of reality is it possible to make predictions that can be refuted rather than rationalized ex post (Hetzel 2016a). Friedman also stressed that the test of a model was not how well it fit the data but rather how well it predicted when applied to data not available to the economist at the time of formulating the model (Friedman and Schwartz 1991; Hammond 1996).

In testing monetarist hypotheses, Friedman organized the historical record in a way that isolated episodes in which the Fed interfered with the price system. The challenge is that the forces generating the phenomena of concern—inflation and cyclical fluctuations—are obscured by the poor experimental design that gives rise to them. As evidenced by the historical narrative in Friedman and Schwartz (1963a), Friedman therefore pursued an identification strategy characterized here as the concatenation of semicontrolled policy experiments. During the monetarist heyday, Friedman flagged them from monetary accelerations and decelerations (Friedman and Schwartz 1963b). The use of historical narrative in order to concatenate episodes of monetary disorder would hopefully wash out other forces that could not be held constant (Hammond 1996, 103).[3]

---

obvious step of filing the relevant factors under the headings of 'supply' and 'demand' effects a great simplification…. But the generalization is not always valid. For example, it is not valid in a … speculative market."

[2] One can see the different approaches to identification in Koopmans' (1947, 166-7) criticism of Burns and Mitchell's NBER approach to the study of the business cycle:

> [E]conomic theories are based on … knowledge of the motives and habits of consumers and of the profit-making objectives of business…. The mere observation of regularities in the interrelations of variables then does not permit us to recognize or to identify behavior equations among such regularities. In the absence of experimentation, such identification is possible, if at all, only if the form of each structural equation is specified.

Friedman (1960, 23) chose to push the idea of "experimentation" in his narrative exploration of the hypothesis that "Governmental intervention in monetary matters, far from providing the stable monetary framework for a free market economy that is its ultimate justification, has proved a potent source of instability." See Hetzel (2016a).

[3] The earliest example of Friedman's concatenation methodology was "Price, Income, and Monetary Changes in Three Wartime Periods" (Friedman 1952 [1969]). Friedman argued for inflation as a

Certain phenomena do not wash out, however. The alternations of phases of growth and decline that characterize the business cycle entail the alternation of market psychology from optimism about the future and debt accumulation to pessimism about the future and debt deleveraging. Endowing these alternations of market psychology with causal influence motivates real bills and Keynesian animal-spirits explanations of the business cycle as self-generating cycles of instability in a capitalist system. Human nature produces periodic bouts of excessive speculation followed inevitably by a period of purging required in order to eliminate the imbalances created by prior speculation. Friedman therefore used historical information specific to place and time in order to argue that the actions of the central bank often arose in response to adventitious events rather than within a framework of a consistent response to the behavior of the economy.[4]

Recognition that the estimation of micro-founded DSGE models defines the research agenda in macroeconomics is consistent with admission that the models remain misspecified and thus problematic for identifying the shocks that cause cyclical fluctuations (Chari et al. 2009). For example, Andrle (2014, 5-6) wrote:

> The assumption of uncorrelated structural shocks is always a point of departure when the models are formulated…. However … it is a rule rather than exception that the uncovered shocks are strongly correlated…. The issue is extremely common with DSGE models, where the positive co-movement of output, consumption, investment, and hours is hard to achieve…. Economists must work with misspecified models, because there are no other models.

The historical narrative approach of Friedman and Schwartz to identification probably makes many uncomfortable because it involves judgment and is not quantitatively replicable. In a world in which poor experimental design renders purely econometric techniques inconclusive, however, economists

---

monetary phenomenon using the Civil War, World War I, and World War II. He pointed to the consistency of money per unit of output as a predictor of the price level while fiscal policy and union power varied greatly in each wartime instance. One can find another example in a letter that Friedman (1957b) wrote Arthur Burns criticizing Burns' manuscript for the book *Prosperity without Inflation*. Friedman argued that one should consider the effect of the money stock on nominal expenditure and prices independently of the operation of the credit market. "[I]t is striking that changes in the stock of money have had very similar effects under widely different institutional arrangements for bringing about changes in it, some under which the credit market was of minor importance...."

[4] Friedman (1960, 22-23) wrote:

> This sketch of our monetary experience has concentrated on the major economic fluctuations—those substantial inflations and severe contractions that have from time to time produced widespread distress…. Every such episode has been accompanied by a significant monetary disturbance…. The monetary disturbances have had a largely independent origin in enough cases to establish a strong presumption that they are contributory causes rather than simply incidental effects of the economic fluctuations….

For more recent examples, see Romer and Romer (1989) and for the United Kingdom, Cloyne and Hürtgen (2016).

should continue to consider as one tool for identification Friedman's methodology, which treats recessions as a series of concatenated event studies in which the central bank interferes with the operation of the price system.

## 3. Friedman's critique of activist policy

Friedman advanced three criticisms of the Fed's activist policy in the 1970s. The intention was to achieve low, stable unemployment at an acceptable cost in terms of inflation as measured by the Phillips curve. First, he associated a policy of aggregate-demand management with a simple feedback rule running from the economy to the Fed's instrument—money. Using the price level as an example, Friedman (1960, 87) argued

> that the link between price changes and monetary changes over short periods is too loose and too imperfectly known to make price level stability an objective…. While the stock of money is systematically related to the price level *on the average*…. there is much evidence that monetary changes have their effect only after a considerable lag and over a long period and that the lag is rather variable. [Italics in original][5]

Stimulative policy in recession might be appropriate, but attempts to implement such a policy contemporaneously can destabilize the economy as its effects might emerge only after recovery had begun. Friedman and Friedman (1984, 100) highlighted the lag in the effect of monetary accelerations on real output of nine months and on inflation of two years and argued that "using today's prices to determine today's monetary growth is like fighting the last war." (See Figures 1 and 2.) In the figures, the lag in money starts in 1956 when the lean-against-the-wind (LAW) procedures of the William McChesney Martin Fed came fully into effect (Hetzel 2008, Ch. 4). Note that in the stop-go era when inflation did emerge, the Fed responded strongly to it (Figure 3).

Friedman (1980, 270) wrote:

> The United States has embarked on rising monetary growth four times during the past twenty years. Each time the higher monetary growth has been followed first by economic expansion, later by inflation. Each time the authorities have slowed monetary growth in order to stem inflation. Lower monetary growth has been followed by an inflationary recession.... [W]e have overreacted to the recession by accelerating monetary growth, setting off on another round of inflation, and condemning ourselves to higher inflation plus higher unemployment.

Friedman (1968 [1969], 109) explained stop-go as follows:

> The reason for the propensity to overreact seems clear: the failure of monetary authorities to allow for the delay between their actions and the subsequent effects on the economy. They tend to determine their actions by today's conditions—but their actions will affect the

[5] In the context of discussion of the NK model, a later section will return to the Friedman criticism in the quotation of making "the price level an objective" and the Friedman (1975 [1983]) criticism, reproduced below, of using the funds rate as an instrument.

> economy only six or nine months later. Hence they feel impelled to step on the brake, or the accelerator, as the case may be, too hard.

The monetarist narrative identified stop-go policy with cyclical inertia in the adjustment of the Fed's funds rate target (see, for example, Poole 1978, 105).[6] Friedman (1984, 27) wrote:

> Rising concern about inflation, and growing recognition of the role played by monetary growth in producing inflation, led Congress in 1975 to require the Federal Reserve to specify targets for monetary growth…. In practice, it continued to target interest rates, specifically the federal funds rate, rather than monetary aggregates, and *continued to adjust its interest rate targets only slowly and belatedly* to changing market pressure. The result was that the monetary aggregates tended on average to rise excessively, contributing to inflation. However, *from time to time, the Fed was too slow in lowering rather than raising the federal funds rate*. The results were a sharp deceleration in the monetary aggregates and an economic recession. [italics added]

In his second critique, Friedman (1981 [1983], 244-247) criticized the Fed's practice of "pegging the federal-funds rate" with the result that "mistakes are cumulative and self-reinforcing."

> [I]f the Fed picks too high a funds rate, it must drain an excessive amount from the [monetary] base, discouraging spending, decreasing demand for loans, and ultimately adding to downward pressure on interest rates…. [I]n using the federal-funds rate as its operating target, the Fed is always balancing on a knife-edge…. [C]ontrolling the base directly and letting the market determine interest rates could produce steady and predictable monetary growth…. The belief that the Fed can or does control interest rates is a myth….

Friedman (1975 [1983], 230) wrote earlier, "So long as the Fed tries to control monetary growth through the federal-funds rate, it will fail."

In his third critique of activist policy, Friedman (1968 [1969]) criticized the idea of assuming predictable trade-offs between inflation and unemployment represented by the Samuelson-Solow (1960 [1966]) Phillips curve. As part of the hypothesis that a market economy does not assure full employment, Keynesians assumed the pervasiveness of institutionally determined nominal prices including wages. The resulting taxonomic classification of inflation included demand-pull, cost-push, and wage-price spiral. As a result of demand-pull inflation, fluctuations in aggregate demand, real or nominal, would cause inverse movements in inflation and unemployment while cost-push inflation would shift inflation upward for a given level of unemployment (Hetzel 2013a).

Friedman criticized the implication of the above reasoning that real variables lack well-defined values but rather fluctuate in response to variation in aggregate demand. In doing so, he reintroduced the idea of natural values. The price system works well to determine unique, market-clearing values of real variables. The Phillips-curve correlations between prices and output result

---

[6] Fève et al. (2009, 13) repeat for Europe this monetarist critique: "[T]he form of monetary policy, namely monetary policy inertia, has played an important role in the large and persistent increase of the real interest rate and the sizeable output losses that have followed from disinflation policies of the eighties." See also Fève et al. (2010).

from central bank behavior that causes the price level to evolve in an unpredictable manner. Over a period long enough to identify changes in aggregate nominal demand due to monetary policy, firms undo the effects of monetary policy on output and employment.

The pre-1981 period constituted an extraordinary period for testing monetarist hypotheses. Because the real demand for the monetary aggregate M1 was interest insensitive, nominal money bore a fairly stable relationship to nominal output. Money then served as a reliable indicator of the stance of monetary policy.[7] The ability of money to predict nominal GDP and inflation is consistent with variations in money arising from discrepancies between the real value of the Fed's funds rate target and the natural rate of interest. (See Figures 1 and 2.)

**4. Identification of episodes of contractionary monetary policy as event studies**

Friedman's methodology for identifying fluctuations in money as arising independently of nominal income and prices used the intuition of price fixing in an individual market applied to Fed interference with the market determination of the real interest rate (Friedman 1968 [1969], Sec. I. A; 1981 [1983], 244-247 cited above). In the absence of a structural model of the economy capable of measuring a divergence between the real rate of interest implied by the central bank's interest rate target and the natural rate of interest, Friedman and Schwartz (1963b) highlighted the associated monetary accelerations and decelerations. Following them, Figures 4 and 5 show annualized M1 growth rates using step functions fitted to the monthly observations as a visual aid to seeing the alternations in money growth rates. As shown, monetary contractions predict cyclical peaks.

As noted in footnote 7, this method of identification lost relevance in the early 1980s. In order to give continued empirical content to the monetarist view that the price system works well to attenuate cyclical fluctuations in the absence of monetary disturbances, it is useful to note that recessions are infrequent events. It follows that the central bank must possess a baseline rule that allows the price system to work. That rule was never one of explicit monetary control but rather, in the words of William McChesney Martin, was one of "lean-against-the-wind" (LAW). In a measured, persistent way, the Fed raises the funds rate above its prevailing value when output grows at a sustained rate in excess of potential (rates of resource utilization are increasing and the unemployment rate is falling) and conversely in the case of sustained economic weakness.

The lag in lowering rates after cyclical peaks resulted in monetary deceleration while the lag in raising rates after cyclical troughs resulted in monetary acceleration (Friedman 1984, 27, cited above). That cyclical inertia originated in the Fed's periodic attempt to manipulate an output gap. As reflected in the appellation "stop-go" monetary policy and as criticized by Friedman (1968 [1969]), the Fed wanted to create a negative output gap in order to lower inflation after cyclical peaks and wanted to speed reduction in the magnitude of the negative output gap after cyclical troughs (Hetzel 2008, Chs. 23-25).

---

[7] With the deregulation of interest rates legislated in the *Monetary Control Act of 1980*, real money demand became interest sensitive and the behavior of M1 became countercyclical. For example, in recession, which calls for cyclically low interest rates, M1 growth rises.

Figures 6 and 7 show the weakening of real GDP growth prior to cyclical peaks. Figures 8 and 9 fit a trend line to real personal consumption expenditures from peak to peak for a given cycle and extend it through the subsequent recession (monthly data become available in 1959). (A single trend line is fitted to the short 1980 recession and the 1981-82 recession.) As shown, consumption weakened relative to trend prior to cyclical peaks. Figures 10 and 11 show the cyclical lag at peaks in the decline in the real rate of interest.[8] Figure 12 shows the real rate series from Figure 11 and the output gap measured by the Congressional Budget Office.

Standard Fed rhetoric is that because interest rates are at cyclical lows during recessions, monetary policy is easy. However, the relevant characteristic of policy is the inertia the Fed imparts to the funds rate prior to cyclical peaks while the economy weakens. Although Fed policymakers never talk in terms of trade-offs, effectively at these times they were trying to create a negative output gap in order to lower inflation.

Figures 13 and 14 organize a narrative account of Fed behavior.[9] Going into recessions, inflation (the solid line) is at a cyclical high. Examination of FOMC transcripts shows that the priority of the Fed at these times was to reduce inflation (Hetzel 2008, 2012, 2013a, 2013b; Romer and Romer 1989). As a consequence, the Fed raised the funds rate until the economy weakened, as illustrated by the way in which consumption fell below trend (dashed line). It then maintained a cyclically high real rate (diamonds) in order to create a negative output gap. Over the course of the recession, the real rate declined. With the exception of the recovery from the July 1981 to November 1982 cyclical contraction, during the economic recovery short-term real interest rates fell to zero. However, by then it was too late to undo the effects of contractionary monetary policy.

The criteria used above in order to associate contractionary monetary policy with the onset of recession provide causal substance to the common practice of using the yield curve as a predictor of recession. As illustrated by Estrella and Trubin (2006), forecasters associate a flattening of the yield curve with an increased probability of recession. While the Fed is raising short-term rates out of concern for inflation, in response to a weakening economy, markets are lowering long-term rates. Wright (2006) shows that a better predictor of recession is the combination of a flattening of the yield curve and a cyclically high short-term interest rate, as is evident in Figures 10 and 11.

The validity of monetarist hypotheses depends upon the interpretation of the experiment in the Volcker-Greenspan era of abandoning stop-go. In the Volcker-Greenspan era, the Fed

---

[8] Figure 10 uses inflation forecasts from the Livingston survey, which is biannual and available after 1945. Figure 11 uses inflation forecasts contained in the Board of Governors staff document called the Greenbook prepared for FOMC meetings. See "Appendix: Real Rate of Interest."

[9] An empirical Taylor-rule literature characterizes Fed behavior. In these regressions, the constant term plus the output gap capture the cyclical behavior of short-term interest rates over the cycle while the inflation term captures the relationship between trend inflation and short-term interest rates. Because these regressions are reduced forms, two caveats arise. First, they only partially capture the relevant structural reaction function used by the Fed. Second, to the extent that they do capture the latter, there is no reason to believe they express optimal policy around cyclical peaks when the Fed responds directly to inflation it considers too high (Hetzel, forthcoming).

accompanied its LAW procedures with communication to financial markets that changes in the funds rate would cumulate to whatever extent required in order to maintain low, stable inflation. The marker for the credibility of this commitment was the absence of inflation premia in bond rates.[10] The most dramatic tests of the Fed's credibility in the Volcker-Greenspan era occurred as "inflation scares" (Goodfriend 1993; Hetzel 2008, Ch. 14). The need to establish credibility with the "bond market vigilantes" required rejection of the earlier stop-go policy of attempting to manipulate Phillips curve relationships through trading off between an output gap and inflation (Goodfriend and King 2005).

Hetzel (2008) termed these latter procedures "LAW with credibility." The evidence for credibility became the condition that in response to "news" about the economy, say, that it was growing more strongly than previously anticipated, the yield curve would move in a stabilizing way with all of the movement in real forward rates and none in inflation premia (Hetzel, forthcoming). When the Fed follows a rule such that it consistently sets its funds rate target based on a forecasted path that will keep real output growing at potential, markets will forecast the pattern of forward rates that will cause the yield curve to keep output growing at potential. In this way, the Fed constrains itself to set the funds rate to track the natural rate of interest. Although LAW with credibility was not a money growth rule, it was monetarist in spirit. The price system works in that financial markets use information efficiently. The Friedman long-and-variable-lags critique applied to LAW procedures implemented as stop-go. With LAW with credibility, the Fed was tracking the real rate and thus giving free rein to market forces to determine real variables, not attempting to control the real rate in order to manipulate an output gap.[11]

## 5. The NK model as a monetarist model

The monetarist stylized facts of Section 4 do not substitute for a model. With the NK model, monetarists got a model. The benchmark for judging optimality became the real business cycle (RBC) core of the NK model (Kydland-Prescott 1982). That core summarizes a competitive market economy predicated on the assumption that the price system works well to assure full employment of resources. Forward-looking households and firms with rational expectations process information about the future efficiently (Kydland and Prescott 1977; Lucas 1980 [1981]). The monetarist argument for a rule gained a theoretical foundation built on the way in which a rule conditions expectations about future monetary policy to respond in a stabilizing way in response to "news" about the economy. Those characteristics of the NK model challenged the Keynesian recourse to animal spirits and periodic bouts of pessimism that presumably overwhelm the stabilizing properties of the price system and the intertemporal consumption-smoothing property of the real interest rate.

---

[10] After the Treasury-Fed Accord in 1951, these procedures began to evolve under William McChesney Martin and Winfield Riefler. The Fed abandoned them initially in response to pressure from the Johnson administration and later in the 1970s Burns-Miller era but returned to them in the Volcker-Greenspan era (Hetzel 2008, Chs. 5-7 and 14-15).

[11] In the Greenspan era, the minor recessions of 1990-91 and 2001 continue to exhibit the combination of a weakening of the economy prior to cyclical peaks and persistent, cyclically high real rates of interest. In the former, policy aimed at moving from 4 percent inflation to price stability. The latter reflected a minor go-stop policy set off by the Asia crisis (Hetzel, Chs. 15 and 17).

Goodfriend and King (1997) highlighted the monetarist character of the NK model by pointing out that a policy of price stability eliminates the nominal friction that prevents the economy from behaving as a competitive market economy. Blanchard and Gali (2007) referred to the simultaneous occurrence of price stability and full employment as "divine coincidence." The practical implication of an objective of price stability is that the Fed follows a rule that turns the determination of real variables over to market forces. In the monetarist literature, the nominal anchor entailed a real balance effect based on the assumption of an exogenously given monetary aggregate (Patinkin 1965). In the NK model, the nominal anchor is a monetary policy that causes "sticky-price" firms, which set dollar prices for multiple periods, to coordinate on the central bank's inflation target. The counterpart of the objective of price stability is the objective of maintaining expected inflation equal to the inflation target. With that nominal anchor, the central bank can control trend inflation while allowing firms to separate the determination of relative from absolute prices. The NK model thus embodies the spirit of monetarism that the central bank can follow a rule that provides for economic stability by separating the determination of relative prices from the price level.

To counter this version, which does not allow for Phillips curve trade-offs as part of optimal policy, Blanchard and Gali (2007) introduced markup shocks, which reflect the exercise of monopoly power in pushing up prices and make such trade-offs optimal. However, in the stop-go period, the Fed was not successful in using Phillips-curve trade-offs in order to achieve a socially acceptable combination of inflation and unemployment. In this period, the Fed interpreted inflation as arising from cost-push shocks, that is, from markup shocks reflecting the exercise of monopoly power by large corporations and unions. It misjudged the character of inflation and introduced instability through attempts to exploit inflation-unemployment trade-offs (Hetzel 2008; Orphanides 2001).

In the spirit of the Cowles/Klein agenda of estimating large-scale econometric models, economists have estimated structural versions of the NK model in order to identify the shocks that drive the business cycle, for example, Smets-Wouters (2007). Motivated by the disruption to financial intermediation that followed the Lehman bankruptcy on September 15, 2008, economists have worked on models that allow for financial intermediation and financial frictions, for example, Christiano et al. (2013). As in Bernanke et al. (1999), an external finance premium that moves negatively with the net worth of firms creates a financial-accelerator mechanism that amplifies the effect of macroeconomic shocks. A "credit-risk" shock in the form of a positive exogenous shock to the external finance premium captures the idea of a financial crisis.

Nevertheless, in the NK model, monetary policy still possesses strong stabilizing powers. The reason is that the output gap equals the cumulated sum of the current and future values of the differences between the real rate of interest and the natural rate of interest (multiplied by the negative of the intertemporal rate of substitution in consumption). Even with the zero lower bound, policy retains its stabilizing powers because the central bank can commit to keeping the real rate below the natural rate after the latter turns positive (Eggertsson and Woodford 2003).[12] Stated negatively, in order to explain a recession with the NK model, one must assume contractionary monetary policy.

---

[12] Kaplan et al. (2016) limit the power of monetary power by assuming liquidity-constrained households, which cannot borrow in order to redistribute consumption to the present. The issue then is empirical: what fraction of households is liquidity constrained? At the same time, the existence of

The stabilizing power of monetary policy also appears in the NK model in that the central bank can neutralize the impact on consumption of a demand shock (a shock to the intertemporal consumption Euler equation) by following the change in the natural rate with its policy rate. In the basic NK large-scale DSGE model without financial frictions, a demand shock (a positive savings shock) would by itself raise investment by lowering consumption.[13] Similarly, in a model with financial frictions, a credit-risk shock that depresses investment increases consumption (see for example, Kollmann et al. 2016, Fig. 3e). Models that include financial frictions then also include demand shocks. As just noted, however, with demand shocks, the central bank can neutralize the impact on the real economy by keeping the real rate equal to the natural rate. At the same time, adding a financial friction in addition to sticky prices creates one more objective in the central bank's objective function. The central bank should go beyond the divine coincidence that entails tracking the natural rate and trade off among objectives (Carlstrom et al. 2010). Optimal policy in a financial crisis would then require missing the inflation and output objectives on the upside, not on the downside as occurred in the Great Recession.[14]

## 6. Monetarism and the Great Recession

The Great Recession has posed a challenge to acceptance of the NK model. Economists have criticized the objective of price stability or "inflation targeting" as preventing central banks from intervening in order to prevent the financial excess presumed responsible for the Great Recession (Curdia and Woodford 2009). Such explanations often assume that the low interest rates in the early 2000s initiated a boom-bust cycle in housing whose fallout led to the Great Recession (Taylor 2009).

With the Great Recession, one confronts the difficulties of identification caused by the poor experimental design that generates the data given to economists. It is plausible that the uncertainty surrounding the Lehman bankruptcy in September 2008 produced a sharp decline in the natural rate of interest.[15] If the central bank puts inertia into declines in the policy rate relative to the natural rate,

---

liquidity-constrained households offers the central bank additional avenues to stimulate demand. The issue is empirical. The monetarist hypothesis is that as long as the central bank does not disturb the operation of the economy by interfering with the price system, households will remain optimistic about the future. Friedman's permanent income hypothesis will then be a valid characterization of household behavior.

[13] In order to generate the simultaneous decline in consumption and investment characteristic of recession, modelers include a marginal efficiency of investment (MEI) shock that increases the relative price of investment in terms of the consumption good.

[14] Del Negro et al. (2016) simulate a model in which a liquidity shock can explain a decline in output and the nominal interest rate. However, they do not perform a simulation with optimal credit policy in which the central bank replaces risky assets in the public's portfolio on a massive scale with safe assets or a simulation with optimal monetary policy in which the central bank commits to keeping the real rate below the natural rate after the natural rate again becomes positive.

[15] Using a DSGE model for the United States, for the period 2008Q1 through 2009Q1, Gali et al. (2012) estimated a decline of about 6 percentage points for the output gap and 12.5 percentage points for the natural rate of interest. Numbers kindly supplied by Rafael Wouters.

nominal rigidities require that real income decline in order to offset the incipient increased demand for the risk-free asset. There is, however, no clear way to disentangle the effect on output of a disruption to financial intermediation from a decline in the natural rate of interest not tracked by a reduction in the funds rate.[16]

With a single episode, economists will never agree on the relative importance of monetary contraction and financial frictions in making the Great Recession so severe. However, an implication of the NK model is that a decline in both the output gap and in inflation is inconsistent with optimal monetary policy. Also, the persistent decline in inflation below the FOMC's 2 percent target must reflect monetary policy (Figure 15). In the monetarist spirit of identification, does the NK model flag central bank interference with the operation of the price system in the Great Recession?

One characteristic of the Great Recession is the close correspondence of cycle peaks in developed countries (Hetzel 2016b). An explanation for this commonality is the similar response of central banks to a prolonged inflation shock. Analogously to the stop phases of past recessions, the central banks of the developed countries kept interest rates at cycle highs while their economies weakened in order to create a negative output gap that would restrain high headline inflation. The unacceptably high inflation in 2008 emerged not from prior monetary expansion but rather from a worldwide increase in commodity prices. Illustrative of the increase in commodity prices, Figure 16 shows the sustained rise in the real price of oil that began in summer 2004 and peaked in summer 2008. Figure 15 shows how the inflation shock pushed headline inflation above core inflation.

Earlier, using the NK model, Kosuki Aoki had applied monetarist arguments relevant to the Great Recession. In order to allow the price system to determine relative prices, central banks should have allowed high headline inflation, which originated in the flexible-price sector, to pass through to the price level. Aoki (2001, 57 and 75) pointed out that a policy designed to achieve divine coincidence stabilizes the aggregate output gap by pursuing price stability in the sticky-price sector.

> [T]here is a trade-off between stabilizing the aggregate output gap and aggregate inflation, but … there is no trade-off between stabilizing [the] aggregate output gap and stabilizing core inflation…. [S]uppose there is an increase in the price of food and energy … putting an upward pressure on aggregate inflation…. The central bank could respond with a sharp contractionary policy and reduce aggregate demand by a large amount so as to decrease prices in the sticky-price sector…. However, our model shows that such a policy is not optimal. The optimal policy is to stabilize core inflation.

The remainder of the section provides the narrative that fills out this monetarist identification. The increase in energy and commodity prices produced the decline in consumption below trend shown in Figure 17 by depressing real personal disposable income (PDI). Average annualized monthly changes in real personal consumption expenditures (PCE) went from 3.2 percent from

[16] The panic of fall 2008 when Ben Bernanke, Tim Geithner (New York Fed president), and Henry Paulson (Treasury secretary) warned that the economy was teetering on the brink of another Great Depression likely lowered the natural rate of interest while the FOMC was trying to keep the funds rate up using IOER (interest on excess reserves) out of a concern for inflation (Hetzel 2012, Ch. 12).

January 2005 through December 2006 to 1.3% from January 2007 through November 2007.[17] Residential investment, which began to fall in 2005Q3, provided an additional shock.

As the economy weakened, following its LAW procedures, the FOMC lowered the funds rate from its cyclical peak of 5.25 percent at its September 18, 2007, meeting to 2 percent at its April 29-30, 2008 meeting. The peak of the business cycle occurred in December 2007. In the March 13, 2008 Greenbook, the Board (2008a, March 13, I-1 and I-7) staff projected that for 2008 real final sales to private domestic purchasers would decline 1.6 percent and wrote that "[P]rivate payrolls are estimated to have contracted about 100,000 per month since the turn of the year…. We are anticipating a further retrenchment in consumer spending in the next few months; Consumer confidence has plummeted; soaring energy prices are biting into household purchasing power; the labor market is weakening; and real estate values are dropping."

The April Greenbook remained pessimistic about the economy. "With mounting job losses and outsized increases in energy prices holding down real income, falling home values cutting into household net worth, and consumer sentiment deteriorating further, we would, all else equal, expect a noticeable decline in PCE in the second quarter" (Board 2008a, April 23, I-6). Nevertheless, the *Minutes* (Board 2008b, April 29-30, 9) for the April 29-30 FOMC meetings put financial markets on notice that that the easing cycle had likely ended:

> [A]lthough downside risks to growth remained, members were also concerned about the upside risks to the inflation outlook, given the continued increases in oil and commodity prices and the fact that some indicators suggested that inflation expectations had risen in recent months.… [R]isks to growth were now thought to be more closely balanced by the risks to inflation. Accordingly, the Committee felt that it was no longer appropriate for the statement to emphasize the downside risks to growth…. In that regard, several members noted that it was unlikely to be appropriate to ease policy in response to information suggesting that the economy was slowing further or even contracting slightly in the near term, unless economic and financial developments indicated a significant weakening of the economic outlook.

---

[17] The three spikes in real PDI in the years 2008 and 2009 shown in Figure 17 derived from the Bush tax rebate, augmented social security payments, and the Obama stimulus program. The following figures are for annualized growth rates of monthly real PCE:

12/2007 – 2/2008: -1.9 percent
3/2008 – 5/2008: 1.7 percent
6/2008 – 9/2008: -3.8 percent
10/2008 – 12/2008: -4.5 percent

The interruption of negative growth in March, April, and May 2008 came from the boost to income from the Bush tax cut signed into law February 12, 2008. Although the rebates arrived in the month of May, households anticipated them. Real PDI rose at an average monthly rate of $12.1 billion from January 2007 through September 2007; at the average rate of $6.6 billion from October 2007 through April 2008; and then soared to $562.1 billion in May 2008.

Monetary policy actions comprise the information the FOMC conveys to markets about the future path of the funds rate that it anticipates. With the April 2008 meeting, the focus changed from a deteriorating economy to inflation (Hetzel 2012, 217-219). For observations the day following an FOMC meeting, Figure 18 plots the difference between the 3-month (6-month) Treasury bill rate and the funds rate target. The difference is positive when markets expect the FOMC to raise the funds rate. The series declined after the May 9, 2007, FOMC meeting and declined significantly after the September 18, 2007, FOMC meeting. At the April 29-30, 2008, meeting, the FOMC lowered the funds rate from 2.25 percent to 2 percent. However, in line with the message sent by the FOMC about the likely direction of the next move in the funds rate, as shown in Figure 18, the yield curve jumped. (The decline after September 2008 reflected the flight to safety offered by Treasury's.)

In June 2008, Chairman Bernanke (2008) expressed the dual concerns that continued high headline inflation would erode the FOMC's credibility and that the dollar would depreciate:

> Another significant upside risk to inflation is that high headline inflation, if sustained, might lead the public to expect higher long-term inflation rates, an expectation that could ultimately become self-confirming…. We are attentive to the implications of changes in the value of the dollar for inflation and inflation expectations and will continue to formulate policy to guard against risks to both parts of our dual mandate, including the risk of an erosion in longer-term inflation expectations.

For the September 2008 FOMC meeting, the Board (2008a, September 10, 2008, I-1) staff based its forecast for the economy on the assumption that the funds rate would remain at 2% and then rise toward the end of 2009. As indicated by the sharp rise in the inventory/sales ratio and sharp decline in the ISM manufacturing index in July 2008, however, the economy had already entered into a deep recession earlier in the summer (Hetzel 2012, 207). The Board (2008a, October 22, I-1) staff later made this point. "[I]ncoming data on consumer and business spending, industrial production, and employment suggest that aggregate output had already decelerated sharply during the summer—before the recent intensification of financial turmoil…." The reference to financial turmoil was to the flight of the cash investors from financial institutions with illiquid, opaque portfolios following the Lehman bankruptcy on September 15, 2008. The FOMC did not lower the funds rate until October 6, 2008, however, and did not reduce its range to 0-25 basis points until December 15, 2008.

Once the cyclical peak had occurred, the December 2007 to June 2009 contraction displayed relatively low real interest rates. At the time, FOMC Chairman Bernanke (2009) interpreted the low level of short-term interest as evidence of expansionary monetary policy.[18] Based on this assessment, he discounted the efficacy of monetary policy and advocated credit policy based on programs intended to revive the flow of credit to specific sectors of the economy. The underlying assumption was that dysfunction in credit markets was preventing funds from flowing from savers to investors with viable investment projects. The FOMC then was slow in aggressively adopting forward guidance in order to bend down the yield curve.

---

[18] That assumption conflicts with the fact that the real rate of interest stayed somewhat below zero for years during the recovery without the reemergence of inflation (Figure 11).

The prescient comments of Aoki (2001) highlight the continuing relevance of the Keynesian/monetarist debate over the role of the Phillips curve in monetary policy. Following the basic NK model exposited by Goodfriend and King (1997), the Fed should implement a rule that provides for the separation of the determination of the price level from relative prices and real quantities—the classical dichotomy. In the design of such a rule, it is important to decompose inflation into the parts that arise in the sticky-price sector and in the flexible-price sector. The unfettered movement of relative prices requires controlling inflation in the sticky-price sector while allowing inflation in the flexible price sector to pass through completely into headline inflation. The FOMC then follows a rule that moves the funds rate in a way that tracks movements in the natural rate of interest. A monetarist critique of policy in the Great Recession is that the Fed reverted to manipulating an output gap in order to control inflation.

## 7. A summary of the issues

The issues raised in the monetarist/Keynesian debate remain relevant. If the price system does not work well to attenuate cyclical fluctuations, then the Fed is forced into trading off between price and output stability. In a Keynesian world in which cost-push pressures cause increases in relative prices to pass through to the price level, a goal of price stability would exacerbate real instability. Similarly, in a Minsky world in which investor euphoria lowers the external finance premium (the wedge between intertemporal rates of substitution for households and firms), the Fed should create a negative output gap and below-target inflation in order to prevent the emergence of asset bubbles. An exclusive goal of price stability would again exacerbate real instability.

If the price system does work well in the absence of central bank interference that imparts unpredictability to the evolution of prices, then the basic NK model is an apt representation of monetarist principles. Monetarists were wrong in their normative prescriptions about the central role that money should play in the formulation of policy and about the nature of a stable nominal anchor. Nevertheless, money remains central. Although in the Volcker-Greenspan era, the Fed did not move to a stable nominal anchor using a money target: money remained central as the "stick in the closet." The power to discipline inflationary expectations originates in the ability of the central bank to create a difference between the real rate of interest and the natural rate through money creation and destruction. That power allows it to enforce a rule that creates a stable nominal anchor in the form of nominal expectational stability. As exposited in the NK model, that rule not only causes firms to set dollar prices in a way that aggregates to a price level conformable with the central bank's inflation target but also separates the determination of relative prices from the determination of the price level.

In order to maintain price stability, the central bank must have procedures that cause nominal money to grow in line with real money demand. Those conditions hold regardless of whether the central bank exercises explicit control over money. If the NK model is relevant, then the central bank should follow the monetarist golden rule of providing a stable nominal anchor and allowing the price system to determine the real interest rate and, by extension, other real variables. With an interest-rate target, nominal money will then follow the real money demand consistent with growth in potential output and with price stability.

Finally, there is no self-evident experimental design to the forces that cause recessions. As a result, economists will never form a consensus over the cause of a particular recession. Various approaches toward the identification of the shocks that cause recessions exist. All offer some insight but there is no econometric technique that does not incorporate significant judgment. The Friedman-

Schwartz methodology of concatenating episodes of monetary and real instability in the hope of "washing out" extraneous third factors remains essential. Their approach entails judgment about the adventitious factors that cause the central bank to set its policy rate in a way that interferes with the operation of the price system. Economists must resign themselves to the incessant, trained intellectual combat of economics. It would, however, help if central banks communicated in terms of a strategy, made explicit forecasts based on that strategy, and after the fact evaluated the appropriateness of the strategy. That is, as urged by Friedman, they should follow an explicit rule.

## Appendix: Real Rate of Interest

The real interest rates shown are the difference between either the Treasury bill rate or the commercial paper rate and Greenbook (now Tealbook) inflation forecasts. The Greenbook contains forecasts of the National Income and Product Accounts prepared by the staff of the Board of Governors before FOMC meetings. Because FOMC meetings fall unevenly within quarters, the maturity of the real rate varies from somewhat more than one quarter to somewhat less than two quarters. The commercial paper rate is for prime nonfinancial paper placed through dealers (A1/P1). The dates for the interest rates match the publication dates of the Greenbooks. From 1965 through 1969, interest rate data are from the New York Fed release "Commercial Paper." Subsequently, they are from the Board of Governor's database or from Bloomberg. From 1965 through April 1971, the paper rate is for 4-6 month paper. Thereafter, if there are fewer than 135 days from the Greenbook date to the end of the subsequent quarter, the 3-month paper rate is used; otherwise, the 6-month paper rate is used.

From 1966 through 1970, the forecasted inflation series is for the implicit GNP deflator. From 1971 through March 1976, it is for the GNP fixed-weight index. Thereafter, until January 1980, the series used is the gross business product fixed-weight index. The Board staff forecasts for "core" inflation become available in January 1980. From January 1980 until February 1986, the gross domestic business product fixed-weight index excluding food and energy is used. Thereafter, until January 2000, the CPI excluding food and energy is used. From January 2000 onward, the personal consumption expenditures chain-weighted index excluding food and energy is used.

A weighted-average inflation rate for the period from the Greenbook date to the end of the succeeding quarter is calculated from the Greenbook's inflation forecasts for the current and succeeding quarter. The weight given to the current quarter's inflation rate is the ratio of the number of days left in the current quarter to the number of days from the Greenbook date until the end of the succeeding quarter. The weight given to the succeeding quarter's inflation rate is the ratio of the number of days in that quarter to the number of days from the Greenbook date until the end of the succeeding quarter. This weighted-average forecasted-inflation rate is subtracted from the market rate of interest in order to construct the series for the real rate of interest.

In the 1960s, the FOMC usually met more than 12 times per year. For example, it met 15 times in 1965. In order to make the real rate series monthly through 1978, if there was more than one meeting per month, an observation was recorded only for the first meeting of the month. The FOMC met only nine times in 1979. (Because the October 6, 1979, meeting was unscheduled, there was no Greenbook and no real rate is calculated for this date.) It met 11 times in 1980. Starting in 1981, it

has met eight times a year. For this reason, starting in 1979, the observations of the Greenbook real rate series are less frequent than monthly.

The real rate series begins in November 1965 because the Greenbook first began to report predictions of inflation for the November 1965 meeting. Until November 1968, for FOMC meetings in the first two months of a quarter, the Greenbook often reported a forecast of inflation only for the contemporaneous quarter. For this reason, for the following FOMC meeting dates, the real rate calculated is only for the period to the end of the contemporaneous quarter, not to the end of the succeeding quarter: 11/23/65, 1/11/66, 2/8/66, 4/12/66, 5/10/66, 6/7/66, 7/26/66, 11/1/66, 12/13/66, 1/10/67, 7/18/67, 10/24/67, 11/14/67, 1/9/68, 2/6/68, 4/30/68, 5/28/68, 7/16/68, 10/8/68, 10/17/72, and 11/20-21/72. For these dates, the maturity of the interest rate used to calculate the real rate varies between one and three months. For other dates, the maturity varies between three and six months. For this reason, some of the variation in real rates reflects term-structure considerations. This variation is a consequence of the fact that the FOMC meets at different times within a quarter and the Greenbook inflation forecasts are for quarters.

## References


Aoki, Kosuke. "Optimal Monetary Policy Responses to Relative-Price Changes." *Journal of Monetary Economics* 48 (2001), 55-80.

Balke, Nathan S. and Robert J. Gordon. "Appendix B: Historical Data." In Robert J. Gordon, ed., *The American Business Cycle*: Continuity and Change." Chicago: The University of Chicago Press, 1986, 781-810.

Bennett, Barbara A. " 'Shift Adjustments' to the Monetary Aggregates." Federal Reserve Bank of San Francisco *Economic Review* (Spring 1982), 6-18.

Bernanke, Ben S. "Remarks on the Economic Outlook." Federal Reserve Board. International Monetary Conference, Barcelona, Spain, June 3, 2008.

_____. "The Crisis and the Policy Response." Speech delivered at the Stamp Lecture, London School of Economics, London, England, January 13, 2009.

Bernanke, Ben S.; Mark Gertler and Simon Gilchrist. "The Financial Accelerator in a Quantitative Business Cycle Framework." in Michael Woodford and John Taylor. *Handbook of Macroeconomics.* Volume 1. New York: North Holland-Elsevier, 1999, 1342-1367.

Blanchard, Olivier and Jordi Gali. "Real Wage Rigidities and the New Keynesian Model." *Journal of Money, Credit, and Banking* 39 (February 2007), 35-65.

Board of Governors of the Federal Reserve System. *Banking and Monetary Statistics*: *1914-1941*. Washington, D.C., 1943 and 1976.

_____. "Current Economic and Financial Conditions, Part 1," various issues, 2007 and 2008a.

Board of Governors of the Federal Reserve System. *Minutes*, 2008b.

Burns, Arthur F. *The Anguish of Central Banking*. Belgrade, Yugoslavia, Per Jacobsson Foundation, 1979.

Carlstrom, Charles T.; Timothy S. Fuerst; and Matthias Paustian. “Optimal Monetary Policy in a Model with Agency Costs. *Journal of Money, Credit and Banking*, Supplement to Vol. 42, No. 6 (September 2010), 37-70.

Chari, V. V.; Patrick J. Kehoe, and Ellen R. McGrattan. “New Keynesian Models: Not Yet Useful for Policy Analysis.” *American Economic Journal*: *Macroeconomics* 1 (January 2009), 242-66.

Christ, Carl. “History of the Cowles Commission, 1932-1952.” In *Economic Theory and Measurement*. Chicago: Cowles Commission for Research in Economics, 1952, 3-67.

Christiano, Lawrence; Roberto Motto; and Massimo Rostagno. “Risk Shocks.” NBER Working Paper 18682, January 2013.

Cloyne, James and Patrick Hürtgen. “The Macroeconomic Effects of Monetary Policy: A New Measure for the United Kingdom.” *American Economic Journal: Macroeconomics* 8(4), October 2016, 75-102.

Curdia, Vasco and Michael Woodford. “Credit Spreads and Monetary Policy.” NBER Working Paper 15289, August 2009.

Del Negro, Marco; Gauti Eggertsson; Andrea Ferrero; and Nobuhiro Kiyotaki. “The Great Escape? A Quantitative Evaluation of the Fed’s Liquidity Facilities.” *American Economic Review* 107(3), (March 2017), 824-857.

Eggertsson, Gauti B. and Michael Woodford. “The Zero Bound on Interest Rates and Optimal Monetary Policy.” *Brookings Papers on Economic Activity*, 1, 2003, 139-211.

Estrella, Arturo and Mary R. Trubin. “The Yield Curve as a Leading Indicator: Some Practical Issues.” Federal Reserve Bank of New York *Current Issues in Economics and Finance* (12) 5, July/August 2006.

Fève, Patrick; Julien Matheron; Jean-Guillaume Sahuc. “Inflation Target Shocks and Monetary Policy Inertia in the Euro Area.” Document de Travail No. 243, Banque de France, August 2009.

_____. “Disinflation Shocks in the Eurozone: A DSGE Perspective.” *Journal of Money, Credit and Banking* 42 (March-April 2010), 289-323.

Friedman, Milton. “The Methodology of Positive Economics.” in Milton Friedman, ed., *Essays in Positive Economics*. Chicago: The University of Chicago Press, 1953.

_____. *A Theory of the Consumption Function*. Princeton: Princeton University Press for the National Bureau of Economic Research, 1957a.

_____. Letter to Arthur Burns, Burns folder, Hoover Institute, 1957b.

_____. *A Program for Monetary Stability*. New York: Fordham University Press, 1960.

_____. “Price, Income, and Monetary Changes in Three Wartime Periods” (1952); “The Role of Monetary Policy” (1968); “The Optimum Quantity of Money” (1969) in Milton Friedman, ed., *The Optimum Quantity of Money and Other Essays*. Chicago: Aldine Publishing Company, 1969.

_____. *Free to Choose*. New York: Avon Books, 1980.

_____.“What Is the Federal Reserve Doing?” (1975) in William R. Allen, ed., *Bright Promises, Dismal Performance: An Economist's Protest*. New York: Harcourt, Brace, Jovanovich, 1983, 228-231.

_____. "A Memorandum to the Fed." (1981) in William R. Allen, ed., *Bright Promises Dismal Performance: An Economist's Protest*. New York: Harcourt Brace Jovanovich, 1983, 241-249.

_____. "Monetary Policy for the 1980s." In *To Promote Prosperity: U.S. Domestic Policy in the mid-1980s*, ed. John. H. Moore, Stanford: Hoover Institution Press, 1984, 23-60.

_____. "The Quantity Theory of Money." in John Eatwell, Murray Milgate, and Peter Newman, eds., *The New Palgrave Money*. New York: W. W. Norton, 1989, 1-40.

Friedman, Milton and Rose. *Tyranny of the Status Quo*. New York: Harcourt Brace Jovanovich, 1984.

Friedman, Milton and David Meiselman. "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958." in *Stabilization Policies*. Commission on Money and Credit. Englewood Cliffs, N. J.: Prentice-Hall, 1963, 165-268.

Friedman, Milton and Anna J. Schwartz. *A Monetary History of the United States*, 1867-1960. Princeton: Princeton University Press, 1963a.

_____. "Money and Business Cycles." *Review of Economics and Statistics* 45 (February 1963b), 32-64.

_____. *Monetary Statistics of the United States*. New York: National Bureau of Economic Research, 1970.

_____. "Alternative Approaches to Analyzing Economic Data." *American Economic Review* 81 (March 1991), 39-49.

Gali, Jordi; Frank Smets; and Rafael Wouters. "Slow Recoveries: A Structural Interpretation." National Bureau of Economic Research WP 18085, May 2012.

Goodfriend, Marvin. "Interest Rate Policy and the Inflation Scare Problem." Federal Reserve Bank of Richmond *Economic Quarterly* 79 (Winter 1993), 1-24.

Goodfriend, Marvin and Robert G. King. "The New Neoclassical Synthesis." NBER *Macroeconomics Annual*, eds. Ben S. Bernanke and Julio Rotemberg, 1997.

_____. "The Incredible Volcker Disinflation." *Journal of Monetary Economics* 52, (July 2005), 981-1015.

Hammond, J. Daniel. Theory and Measurement: Causality Issues in Milton Friedman's Monetary Economics. Cambridge: Cambridge University Press, 1996.

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

_____. The Great Recession: Market Failure or Policy Failure? Cambridge: Cambridge University Press, 2012.

_____. "The Great Inflation of the 1970s." in Randall Parker and Robert Whaples, eds., *The Handbook of Major Events in Economic History*. New York, NY and Oxford, UK: Routledge. 223-238, 2013a.

_____. "The Monetarist-Keynesian Debate and the Phillips Curve: Lessons from the Great Inflation." Federal Reserve Bank of Richmond *Economic Quarterly* 99 (Second Quarter 2013b), 83-116.

_____. "Arthur Burns and Milton Friedman: Why did the Master (Burns) and the Disciple (Friedman) Understand Inflation in a Diametrically Opposed Way?" in eds. Robert A. Cord and J. Daniel Hammond, *Milton Friedman: Contributions to Economics and Public Policy*. Oxford: Oxford University Press, 2016a.

_____. "What Caused the Great Recession in the Eurozone?" Federal Reserve Bank of Richmond Working Paper, August 2016b.

Kaplan, Greg; Benjamin Moll; and Giovanni L. Violante. "A Note on Unconventional Monetary Policy in HANK." January 28, 2016.

Klein, Lawrence R. "The Keynesian Revolution Revisited." in *The Economic Studies Quarterly* (Tokyo) XV (1), November 1964.

Kollmann, Robert; Beatrice Pataracchia; Rafal Raciborski; Marco Ratto; Werner Roeger; and Lukas Vogel. "The Post-Crisis Slump in the Euro Area and the US: Evidence from an Estimated Three-Region DSGE Model." Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute. Working Paper No. 269, February 2016.

Koopmans, Tjalling. "Measurement Without Theory." *The Review of Economic Statistics* 28 (August 1947), 161-72.

Kydland, Finn E. and Edward C. Prescott. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy* 85 (June 1977), 473-91.

_____. "Time to build and Aggregate Fluctuations." *Econometrica* 50 (November 1982), 1345-70.

Lucas, Robert E., Jr. "Rules, Discretion, and the Role of the Economic Advisor (1980)." in Robert E. Lucas, Jr., *Studies in Business-Cycle Theory*. Cambridge, MA: The MIT Press, 1981.

Nelson, Edward. *Milton Friedman and Economic Debate in the United States*, Book 1 1932-1972, forthcoming.

Orphanides, Athanasios. "Monetary Policy Rules Based on Real-Time Data." *The American Economic Review* 91 (September 2001), 964-85.

Patinkin, Don. *Money, Interest, and Prices*, New York: Harper & Row, 1965.

PBS Newshour. "Nobel Prize-Winning Economist Milton Friedman Dies at Age 94," November 16, 2006.

Poole, William. *Money and the Economy: A Monetarist View*. Reading, MA: Addison-Wesley Publishing Company, 1978.

Romer, Christina D. and David H. Romer. "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz." in NBER *Macroeconomics Annual 1989*, vol. 4, pp. 121-170.

Samuelson, Paul and Robert Solow. "Analytical Aspects of Anti-Inflation Policy (1960)," in Joseph Stiglitz, ed., *The Collected Scientific Papers of Paul A. Samuelson*. vol. 2, no. 102, 1966, 1336-53.

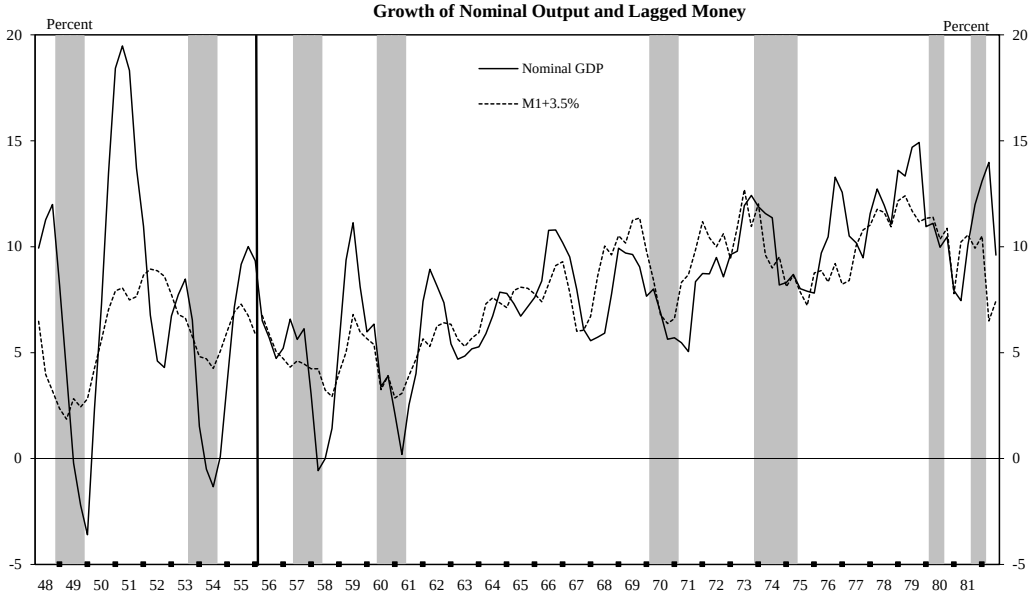
Smets, Frank and Rafael Wouters. "Shocks and Frictions in US Business Cycles: a Bayesian DSGE Approach." *American Economic Review* 97 (2007), 586-606.

Taylor, John B. *Getting Off Track: How Government Actions and Interventions Caused, Prolonged, and Worsened the Financial Crisis*. Stanford, CA: Hoover Institution Press, 2009.

Woodford, Michael. “Inflation Targeting and Financial Stability.” NBER Working Paper 17967, April 2012.

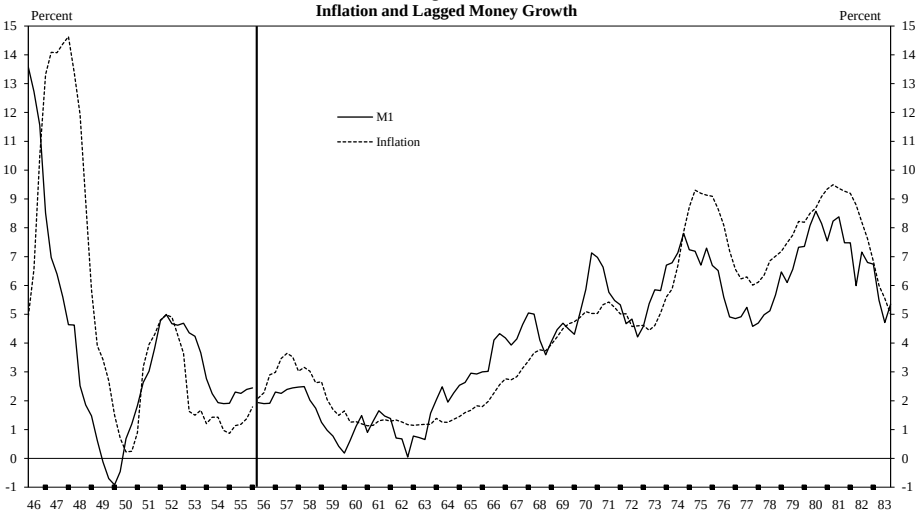
Wright, Jonathan H. “The Yield Curve and Predicting Recessions.” Finance and Economics Discussion Series Working Paper 2006-7, Board of Governors of the Federal Reserve System, February 2006.

**Figure 1**
**Growth of Nominal Output and Lagged Money**



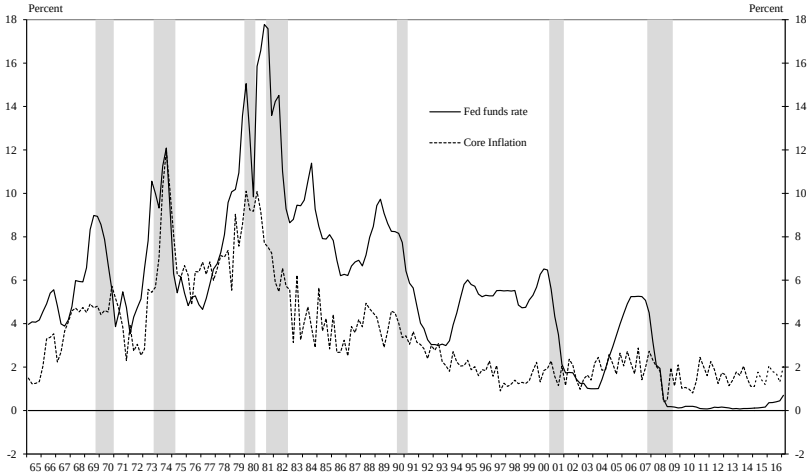

*Notes*: Quarterly observations of 4-quarter moving averages of nominal GDP and M1. Beginning in 1956, M1 is lagged 2 quarters. The vertical line separates lagged and unlagged M1 growth. In 1981, M1 is shift-adjusted M1 (Bennett 1982). The M1 series is augmented by 3.5 percentage points. Shaded areas indicate recession. Heavy tick marks indicate fourth quarter of year.

**Figure 2**
**Inflation and Lagged Money Growth**



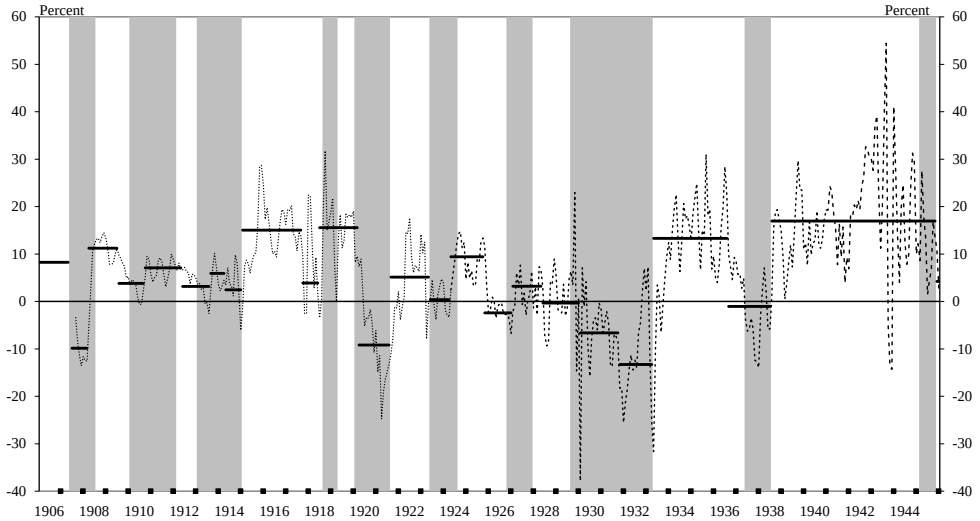

Notes: Inflation is the annualized percentage change in the fixed-weight GDP deflator over an 8-quarter period. The GNP deflator from Balke and Gordon (1986) is used before 1947. Money growth is the annualized percentage change in M1 over an 8-quarter period. Beginning in 1956 M1 is lagged 7 quarters. The vertical line separates lagged and unlagged M1 growth. In 1981, M1 is "shift-adjusted" (Bennett 1982). Heavy tick marks indicate fourth quarter of the year.

**Figure 3**
**Fed Funds Rate and Core PCE Inflation**



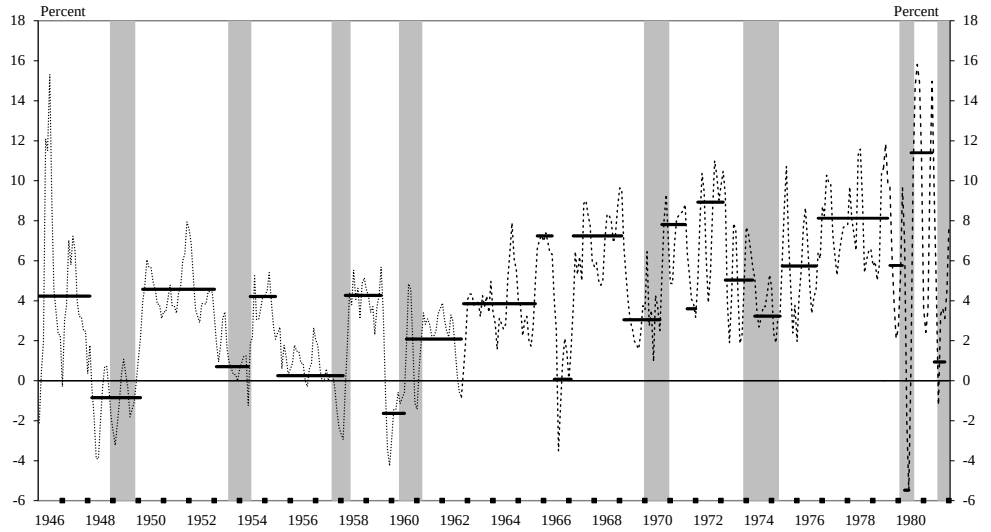

Notes: Quarterly observations of annualized percentage changes in the core personal consumption expenditures deflator and the federal funds rate. Shaded areas indicate NBER recessions. Tick marks indicate first quarter of year. Source: Data from Haver Analytics.

**Figure 4**
**M1 Step Function and Recessions: 1906-1945**



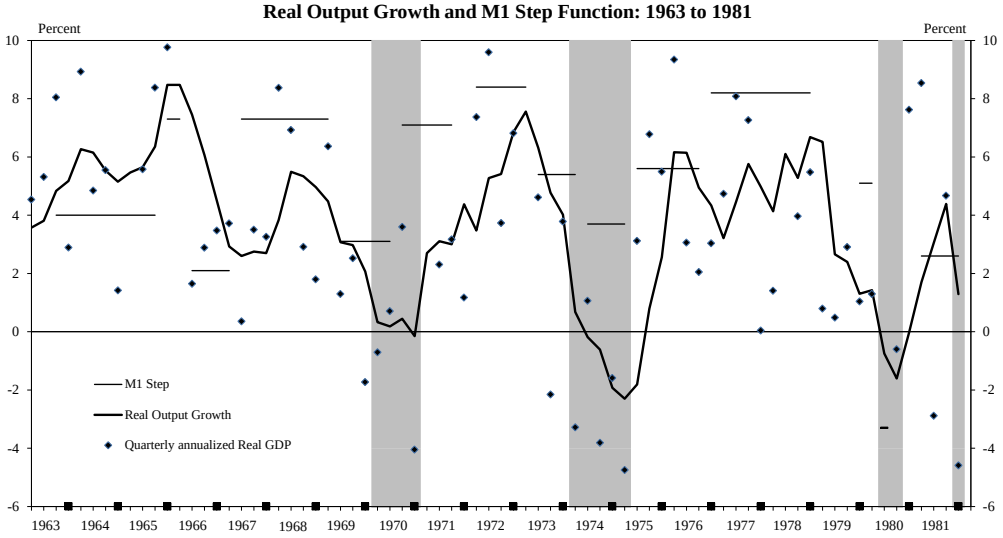

Notes: Series are a three-month moving average of the annualized monthly money growth rates and a step function fitted to monthly annualized growth rates of money. Step function before May 1907 uses annual growth rates based on June observations of M2 from 1900-1907. Observations for money from June 1900 to May 1914 are for M2; observations from June 1914 to December 1945 are for M1. Data are from Friedman and Schwartz (1970). Shaded areas indicate NBER recessions. Heavy tick marks indicate December.

**Figure 5**
**M1 Step Function and Recessions: 1946-1981**



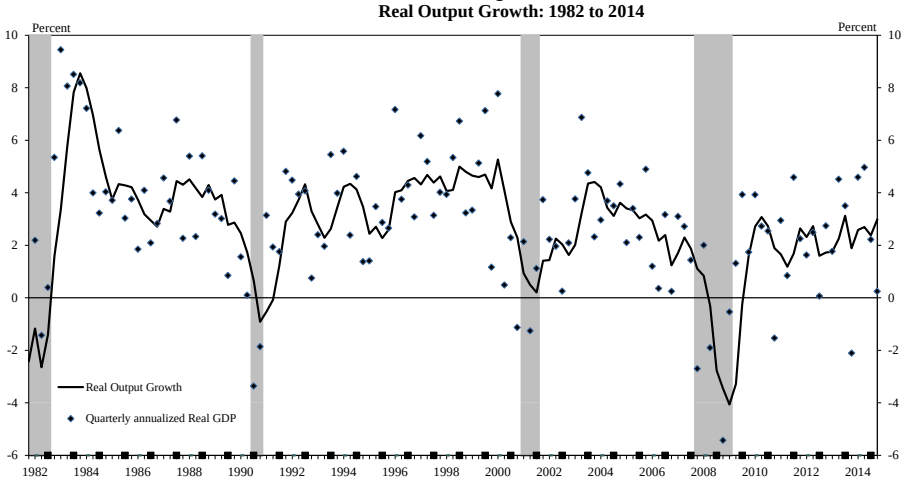

Notes: Series are a three-month moving average of the annualized monthly money growth rates and a step function fitted to monthly annualized growth rates of money. Data on money (M1) from January 1946 to December 1958 from Friedman & Schwartz (1970). From January 1959 to December 1980 data from Board of Governors. January 1981 to December 1981 M1 is "shift-adjusted M1" (Bennett 1982). Shaded areas indicate NBER recessions. Heavy tick marks indicate December.

**Figure 6**
**Real Output Growth and M1 Step Function: 1963 to 1981**



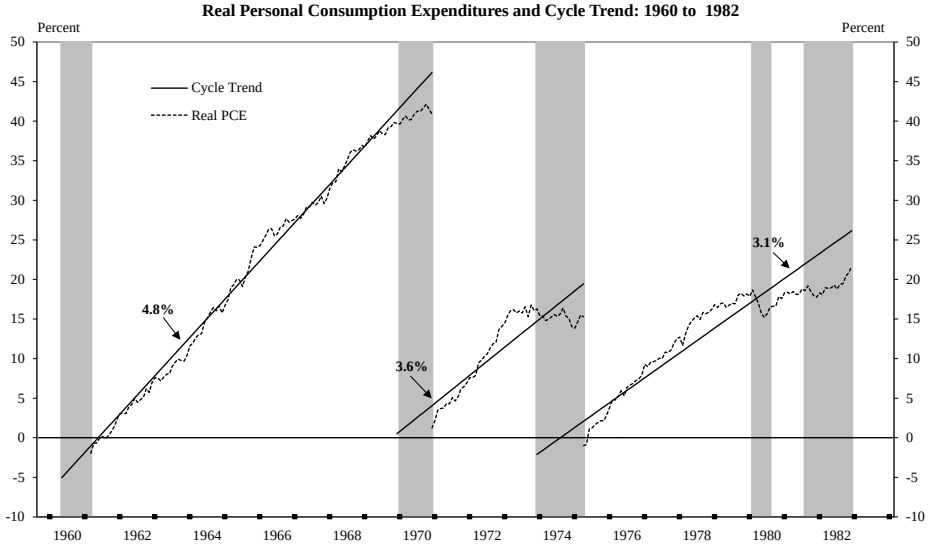

Notes: The M1 steps are an average of the annualized quarterly M1 growth rates. In 1981, M1 is "shift adjusted" (Bennett 1982). Real output growth is 4-quarter percentage changes in real GDP. Quarterly annualized real GDP is annualized quarterly growth rates. Shaded areas indicate NBER recessions. Heavy tick marks indicate fourth quarter.

**Figure 7**
**Real Output Growth: 1982 to 2014**



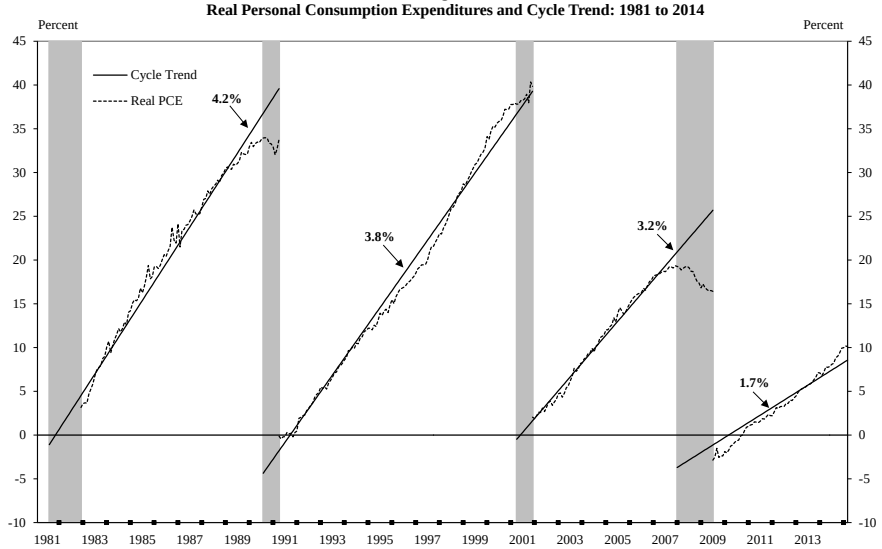

Notes: Real output growth is 4-quarter percentage changes in real GDP. Quarterly annualized real GDP is quarterly annualized growth rates. Shaded areas indicate NBER recessions. Heavy tick marks indicate fourth quarter. Source: Haver Analytics.

**Figure 8**
**Real Personal Consumption Expenditures and Cycle Trend: 1960 to 1982**



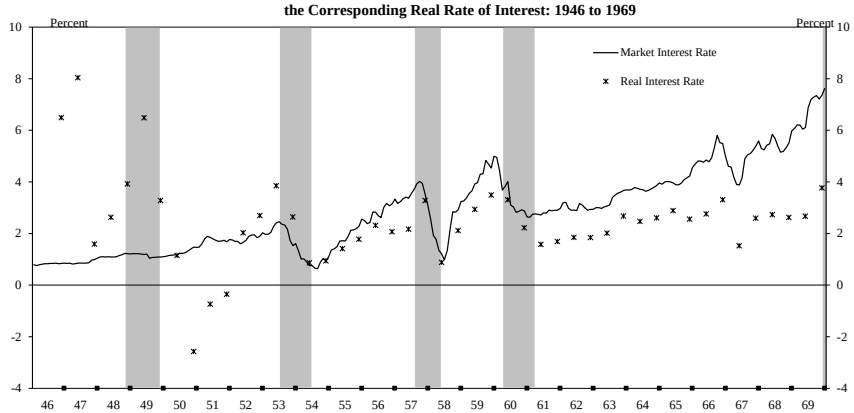

Notes: Observations are the natural logarithm of monthly observations of real personal consumption expenditures normalized using the value at the prior business cycle peak. Trend lines are fitted to these observations between peaks in the business cycle. The trend lines are extended through the subsequent recession. Shaded areas indicate NBER recessions. Heavy tick marks indicate December. Source Haver Analytics.

**Figure 9**
**Real Personal Consumption Expenditures and Cycle Trend: 1981 to 2014**



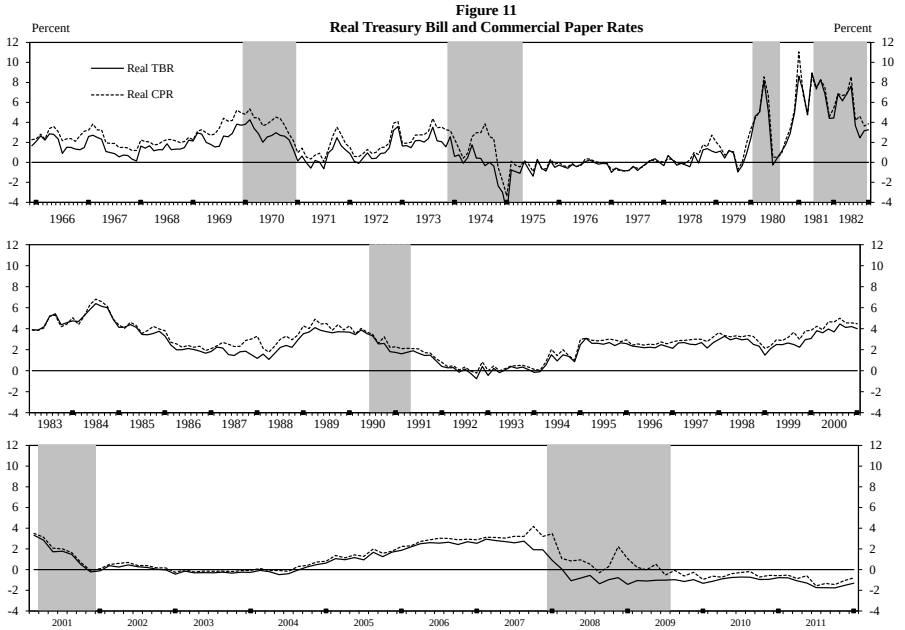

Notes: Observations are the natural logarithm of monthly observations of real personal consumption expenditures normalized using the value at the prior business cycle peak. Trend lines are fitted to these observations between peaks in the business cycle. The trend lines are extended through the subsequent recession. Shaded areas indicate NBER recessions. Heavy tick marks indicate December. Source: Haver Analytics.

**Figure 10**
**The One-Year Market Interest Rate on Government Securities and the Corresponding Real Rate of Interest: 1946 to 1969**




Notes: The market rate of interest is monthly observations of the yield on U.S. government securities from "Short-Term Open Market Rates in New York City" in Board of Governors (1976), *Banking and Monetary Statistics, 1941-1970*. Through July 1959 the series uses "9- to 12- month issues." Thereafter, it uses "one-year Treasury bills." The series for the real rate of interest is the market rate minus predicted CPI inflation from the Livingston Survey. Observations of predicted inflation are biannual and are for the months of May and November. See notes to Figure 4.4 (Hetzel 2008). Shaded areas indicate NBER recessions. Heavy tick marks indicate the November observation of the market interest rate.

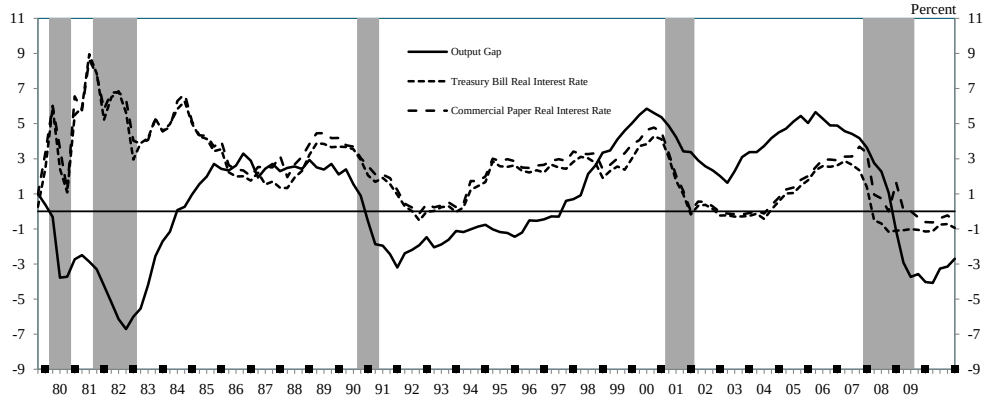
**Figure 11**
**Real Treasury Bill and Commercial Paper Rates**




Notes: The real interest rate series is either the Treasury bill rate or the commercial paper rate minus the inflation forecast made by the staff of the Board of Governors in the Greenbook (later Tealbook). For a description of the series, see "Appendix: Real Rate of Interest." Shaded areas indicate NBER recessions. Heavy tick marks indicate December FOMC meeting.

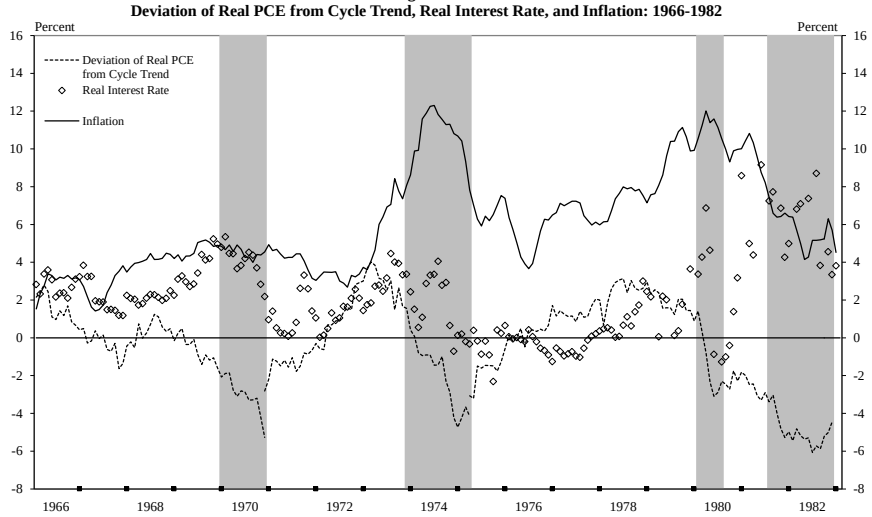
**Figure 12**

**Output Gap and Real Rates of Interest**



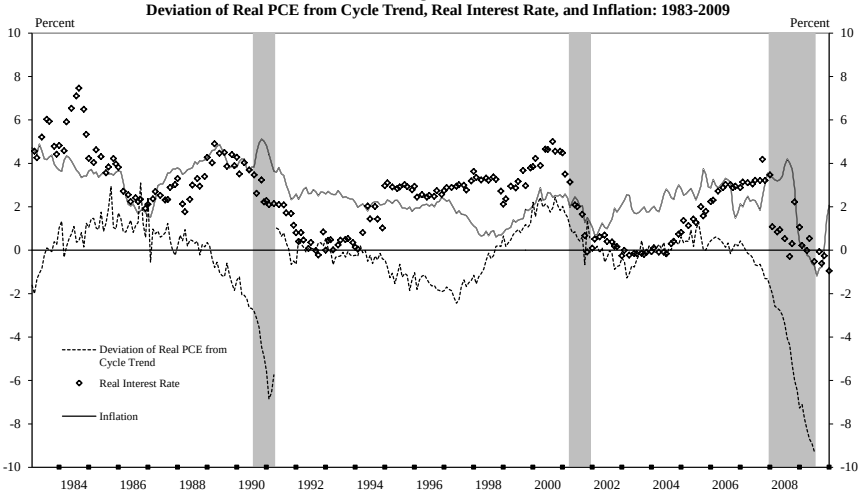

Notes: The output gap is the logarithm of real final sales to domestic purchasers minus the logarithm of potential output measured by the Congressional Budget Office. The real interest rate series are the commercial paper rate or the Treasury bill rate minus core inflation forecasts made by the staff of the Board of Governors before FOMC meetings. For a description of the series, see "Appendix: Real Rate of Interest." Shaded areas indicate NBER recessions. Heavy tick marks indicate fourth quarter.

**Figure 13**
**Deviation of Real PCE from Cycle Trend, Real Interest Rate, and Inflation: 1966-1982**



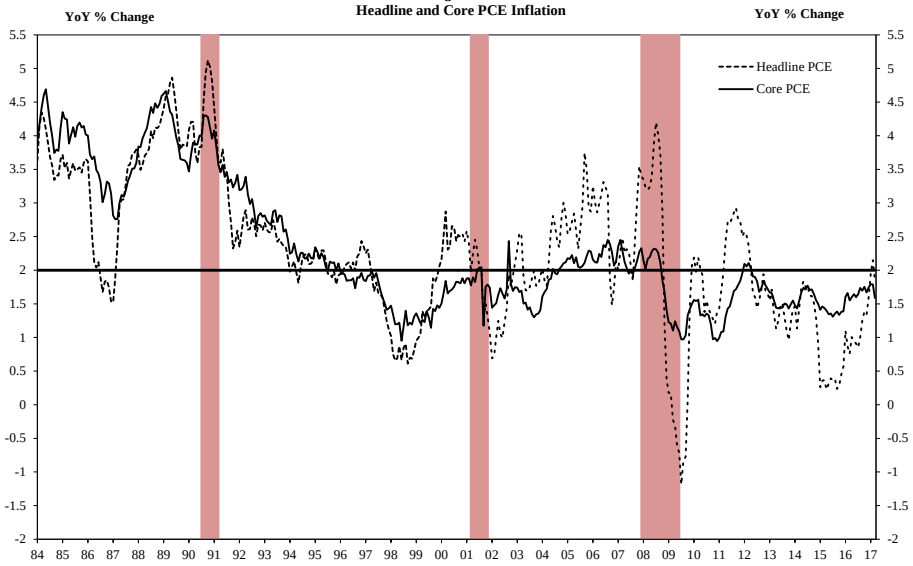

Notes: Deviation of Real PCE from Cycle Trend is the difference between the actual values and trend lines shown in Figure 8. Inflation is twelve-month percentage changes in the personal consumption expenditures deflator. The Real Interest Rate is the commercial paper rate minus inflation forecasts made by the staff of the Board of Governors shown in Figure 11. Shaded areas indicate NBER recessions. Heavy tick marks indicate December. Source: Inflation data from Haver Analytics.

**Figure 14**
**Deviation of Real PCE from Cycle Trend, Real Interest Rate, and Inflation: 1983-2009**



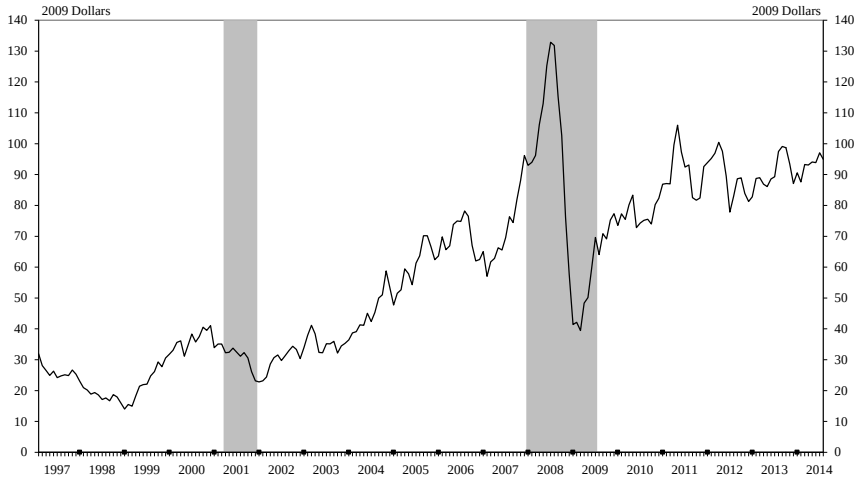

Notes: Deviation of Real PCE from Cycle Trend is the difference between the actual values and trend lines shown in Figure 9. Inflation is twelve-month percentage changes in the personal consumption expenditures deflator. The Real Interest Rate is the commercial paper rate minus the inflation forecasts made by the staff of the Board of Governors shown in Figure 11. Shaded areas indicate NBER recessions. Heavy tick marks indicate December. Source: Inflation data from Haver Analytics.

**Figure 15**
**Headline and Core PCE Inflation**



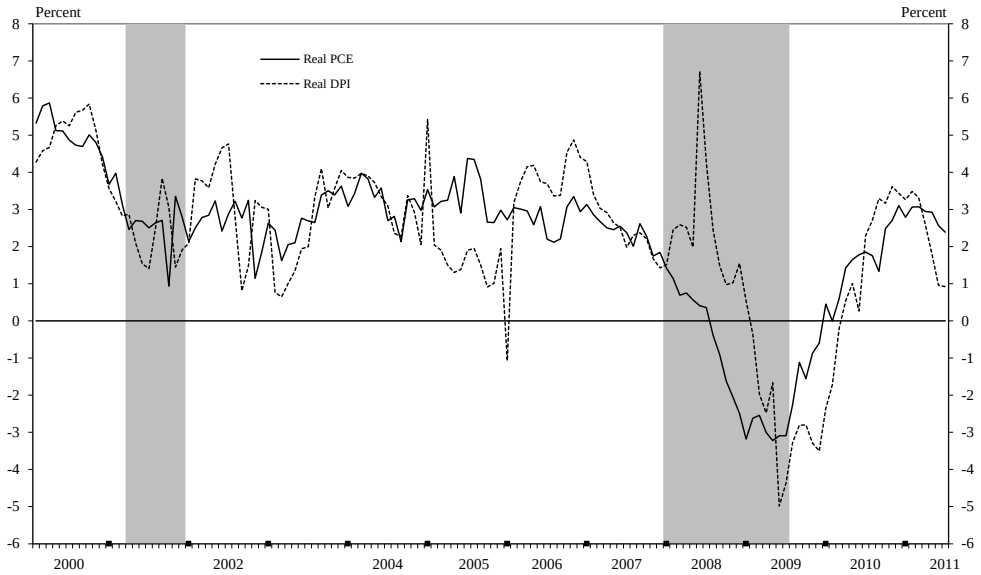

Notes: Data are monthly observations of 12-month percentage changes for the personal consumption expenditures (PCE) deflator and the core PCE deflator, which excludes food and energy. Shaded areas are NBER recessions. Tick marks indicate December. Data from Haver Analytics.

**Figure 16**
**Real Price of Oil**



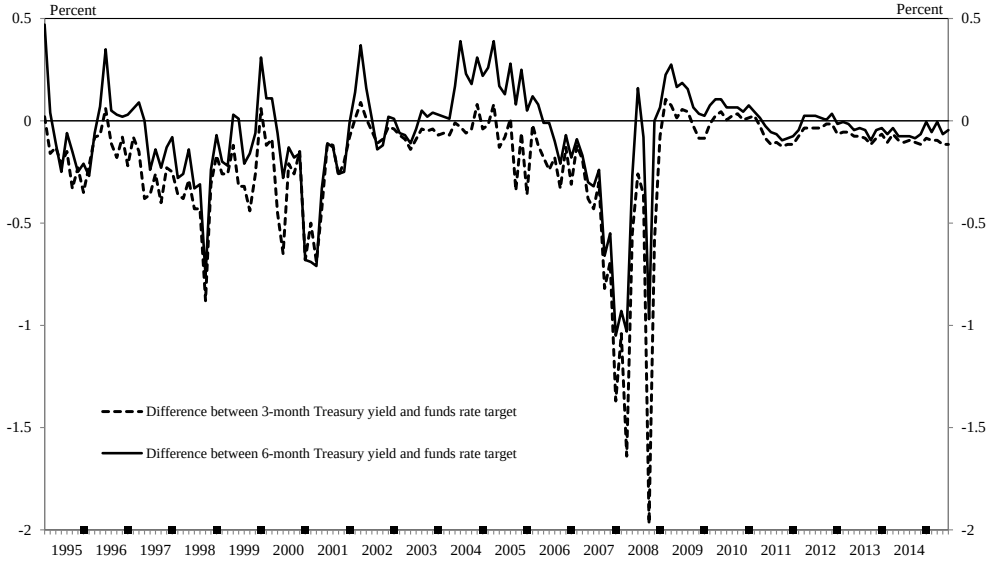

**Notes: Monthly observations of the West Texas intermediate crude oil spot price per barrel deflated by the personal consumption expenditures price index.** Data from the *Wall Street Journal* and Commerce Department via Haver Analytics. Shaded areas indicate NBER recessions. Heavy tick marks indicate December.

**Figure 17**
**Real Personal Disposable Income and Expenditures**




Notes: Twelve-month percentage changes in real personal consumption expenditures (PCE) and real disposable personal income (DPI). Shaded areas indicate NBER recessions. Heavy tick marks indicate December. Data from Haver Analytics.

**Figure 18**
**Term Structure of Interest Rates: 3-month and 6-month**




Notes: The series are the difference between three-month and six-month Treasury yields and the funds rate target. Treasury yields are from Board of Governors statistical release H.15 starting January 7, 2002 and from G.13 before. Starting October 2, 2001, yields are constant maturity. Before, they are the three-month and six-month yields. Observations are for the day after an FOMC meeting. Heavy tick marks indicate December.