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Program Report

Monetary Economics

N. Gregory Mankiw*

Understanding what monetary policy can do to enhance economic performance (and, just as importantly, what it cannot do) is a continuing challenge for economic policymakers around the world. Researchers in the NBER's Monetary Economics Program contribute to this effort with a combination of theoretical and empirical studies on the effects of central bank actions and the design of monetary policy. These studies are circulated as NBER Working Papers, presented and discussed at regular Program meetings, and subsequently published in NBER volumes and academic journals.

Our regular program meetings also aim to facilitate interaction between researchers working in universities and those working in central banks. Much frontier research on monetary economics occurs within research staffs of the Federal Reserve System and other central banks around the world. These central bank researchers often are invited to present their work and to participate in the discussion of other recent studies. We are delighted that Ben S. Bernanke, one of our long-term members and program director for the past two years, was appointed by President George W. Bush in 2002 to become a Governor of the Federal Reserve. When he was confirmed, I returned to the role of Program Director, which I had held previously.

In this report, I summarize a few of the strands of research on monetary economics that have engaged NBER researchers in recent years. None of these issues is fully settled, but significant progress has been made. In the process, I will offer a few of my own judgments about what we know and about where more research is still needed.

The Dynamic Effects of Monetary Policy

According to textbook theory, changes in monetary policy influence employment and production in the short run but, in the long run, affect

* *Mankiw is Director of the NBER's Program on Monetary Economics and the Allie S. Freed Professor of Economics at Harvard University (see page 24). The numbers in brackets throughout this report refer to NBER Working Papers. A complete list of NBER Monetary Economic Working Papers can be found at <http://papers.nber.org/papersbyprog/ME.html>*

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only prices and inflation rates. When a central bank slows the rate of money growth, for instance, the end result will be a lower rate of inflation, but the transition to lower inflation can take some time, and it often entails a period of depressed economic activity, including higher unemployment. This short-run tradeoff between inflation and unemployment is often called the Phillips curve, after the classic study of this topic by A. W. Phillips in the 1950s. Much research in the NBER Monetary Economics Program has been devoted to documenting and explaining these dynamic responses to monetary policy.

One approach to this empirical issue is to study particular episodes of disinflationary policy. A classic study following this approach is that by Christina Romer and David Romer. [2966] Following in the footsteps of NBER researchers Milton Friedman and Anna Schwartz and their renowned *Monetary History of the United States*, the Romers read through the minutes of the meetings of the Federal Open Market Committee to identify episodes in which Fed policy switched toward a tougher stance against inflation. They find that after each of these so-called Romer dates, the economy experienced a substantial decline in production and employment. The Romers interpret their findings as strong evidence for the effect of monetary policy on real economic activity.

In another study, Laurence M. Ball looked at data from OECD countries and found every episode in recent history during which the inflation rate experienced a significant and sustained decline. [4306] In almost every episode that Ball identified, the country also experienced a period with output below trend. This is consistent with a short-run tradeoff between inflation and real economic activity. Ball reports that the output effects are smaller (that is, reducing inflation is less costly) when the disinflation is rapid and when a country has more flexible labor contracts.

More recent studies on the dynamic effects of monetary policy have taken a very different approach to the data, but they have reached broadly similar conclusions. A common methodology is to try to identify "monetary policy shocks" — movements in some measure of monetary policy that cannot be predicted or explained contemporaneously with the economic variables that typically drive monetary policy. These random movements in policy are interpreted as a natural experiment that can be used to determine the policy's effect. Once these shocks are identified, statistical techniques can be used to trace their effects on

employment, production, inflation, and other variables of interest.

Lawrence J. Christiano, Martin Eichenbaum, and Charles Evans summarize these studies as follows: “The literature has not yet converged on a particular set of assumptions for identifying the effects of an exogenous shock to monetary policy. Nevertheless, there is considerable agreement about the qualitative effects of a monetary policy shock in the sense that inference is robust across a large subset of the identification schemes that have been considered in the literature.” [6400] This robust conclusion includes the classic textbook result that monetary policy first influences employment and production and only later affects inflation.

The accumulation of many empirical studies following varied strategies has led to a consensus among economists about how monetary policy affects the key measures of macroeconomic performance. The exact timing is open to debate, but a rough rule of thumb is that employment and production respond about six months after a change in monetary policy, whereas it takes a year or more before there is any significant movement in the inflation rate.

The Amazingly Low Inflation and Unemployment of the 1990s

During the late 1990s, the United States experienced an unusual combination of low inflation and low unemployment. In 1999, for instance, the unemployment rate averaged 4.2 percent for the year, while the inflation rate as measured by the consumer price index was a mere 2.2 percent. To some casual observers, these fortuitous events suggested that the short-run tradeoff between inflation and unemployment no longer existed, or perhaps that it never existed at all.

Many NBER researchers have rejected this interpretation of the recent data. Indeed, the Phillips curve as an empirical phenomenon is still very much alive and well. For example, James Stock and Mark Watson have

examined the best methods for forecasting inflation. They conclude that, “Inflation forecasts produced by the Phillips curve generally have been more accurate than forecasts based on other macroeconomic variables, including interest rates, money and commodity prices.” [7023].

Why, then, did the U.S. economy experience a rare combination of low unemployment and low inflation during the late 1990s? Part of the answer is that the Fed had produced low inflation during the previous decade, which in turn made credible monetary policymakers’ claims that they were aiming for low inflation in the future. Lower expectations of inflation shift the short-run tradeoff between inflation and unemployment in a favorable direction because these expectations influence the behavior of wage and price setters.

Yet lower expectations of inflation are not the whole story behind the impressive macroeconomic performance of the 1990s. Part of the answer also lies in the widely noted acceleration in productivity growth that occurred in the second half of the decade. As Robert J. Gordon puts it, “The post-1995 technological acceleration, particularly in information technology and accompanying revival of productivity growth, directly contributed both to faster output growth and to holding down the inflation rate.” [8771].

The current state of the inflation-unemployment tradeoff is often summarized in a statistic called the NAIRU, an ugly acronym that stands for the non-accelerating inflation rate of unemployment. The NAIRU is like a speed limit for the economy, for if the economy grows so fast that unemployment falls below the NAIRU, inflation tends to rise. Yet the NAIRU is not constant over time. [5735] In particular, several recent studies have suggested that an acceleration of productivity growth will cause the NAIRU to fall, at least for a while. [8320, 8421, 8614, 8940] The reason for the apparent link between productivity growth and the NAIRU is very much an open question that should lead to future research. One possible explanation is that workers are slow to adjust their

wage demands to changes in their productivity. Until workers adapt to the new environment, a shift in productivity growth may alter the economy’s normal level of unemployment.

Thus, shifts in productivity growth impinge on the short-run tradeoff between inflation and unemployment and, indirectly, on the choices facing monetary policymakers. When productivity slows down, as it did during the 1970s, monetary policymakers face a deteriorating short-run tradeoff between inflation and unemployment. When productivity speeds up, as it did during the 1990s, monetary policymakers face an improving tradeoff between these two measures of economic performance.

The Puzzle of Sluggish Inflation

Many empirical studies of the inflation process suggest that inflation is sluggish. This sluggishness of inflation appears in various guises. In studies of the Phillips curve, inflation is found to exhibit substantial inertia; that is, inflation is strongly correlated with its own lagged values. [5735] In studies of particular disinflationary episodes, inflation is found to fall only gradually. [4306] In studies that use statistical techniques to identify monetary policy shocks and their effects, these shocks are found to have a gradual and delayed effect on the inflation rate. [5146, 6400] Certainly, these conclusions are consistent with the conventional wisdom of central bankers, who believe they can influence the inflation rate only with a substantial lag. This lag between central bank actions and inflation is one reason why central banks that have chosen to target inflation often look at expected inflation a year or two ahead when judging whether they are on target.

Why does monetary policy influence inflation with such a long lag? The answer is not at all obvious. Standard theories of the real effects of monetary policy emphasize the stickiness of wages or prices. According to these theories, monetary fluctuations have real effects in the short run because wages and prices do not adjust

instantly. [For surveys of this topic, see 2285, 4677.] Even if this line of thought is accepted, however, it fails to explain the sluggishness of inflation — the change in the price level. The stickiness of prices can explain why the price level does not jump to a level ensuring full employment, but the inflation rate is determined by those prices that are changing, and those prices could respond quite quickly to changes in monetary policy. Yet for some reason not found in standard theories of price adjustment, they don't. The failure to explain sluggish inflation shows that the dynamic behavior of prices remains a fundamental puzzle for students of business cycle theory. [7884]

There have, however, been several recent attempts to explain the sluggishness of inflation. These all depart significantly from standard models of price setting. But several of the attempts are similar in their underlying assumptions, and this common structure may well point the way toward a final resolution of the sluggish-inflation puzzle. The common assumption is that price setters are inattentive: prices keep rising after changes in monetary policy because most price setters are not paying close attention to the policy change and, therefore, keep marking up prices as if no change had occurred.

One approach to modeling inattentive price setters, explored by Michael Woodford, is to use the tools of information theory and to assume that humans have a limited channel for absorbing information. [8673] That is, the human brain is assumed to be imperfect in the same way as a computer with a slow internet connection would be. Woodford uses this assumption to build a model of inflation dynamics. His model can explain sluggish inflation, as well as the persistent effects of monetary policy on output. He emphasizes that because not everyone shares the same information, price setting depends on “higher order expectations.” That is, price setters care about not only their own expectations of monetary policy, but also their expectations of others' expectations, and their expectations of others' expectations of still others' expecta-

tions, and so on.

Ball has proposed another approach to this problem. [7988] He suggests that when forming expectations of any variable, people optimally use all information in the past values of that variable, but fail to incorporate information from other variables. That is, expectations are based on optimal univariate forecasts. He argues that this approach to forecasting is nearly rational, as multivariate forecasts offer only slight improvement over univariate forecasts. Ball shows that this “near rational” approach to expectations can explain why inflation appears so sluggish in recent data, while it was less sluggish in data from early in the twentieth century.

In work I have undertaken with Ricardo Reis, the assumption of imperfect information among price setters is explored from a different angle. [8290, 8614] We assume that each period there is a fixed probability that a price setter updates his information set; otherwise, he continues to set prices based on old plans and outdated information. We show that this model of “sticky information” can explain why inflation is so sluggish, and that it produces dynamic responses to monetary policy similar to those estimated in the empirical literature.

In all three of these models, inflation is sluggish because inflation expectations respond too slowly to changing circumstances. Christopher Carroll has written an intriguing empirical study that gives some support to this prediction. [8695] Carroll uses survey data to compare the inflation expectations of the general public to the inflation expectations of professional forecasters. He reports three notable findings. First, he confirms that professional forecasters are better at forecasting inflation than is the general public. Second, he finds that the public responds to the professionals' expectations with a lag that averages about one year. Third, he reports that when the news media are producing more stories about inflation, the public's expectations adjust more quickly to the professional forecasts. These findings do not prove that the sluggishness of inflation is attributable to the inattentiveness of price setters, but

they are certainly consistent with that hypothesis.

Rules for Monetary Policy

The study of monetary policy aims not only to understand the effects of central bank actions but also to produce better monetary policy. Toward this end, a large literature has emerged that studies monetary policy rules. A policy rule is a contingency plan that specifies how the central bank will respond to varying economic conditions.

There are two reasons for interest in monetary policy rules. One reason put forward by some economists is that monetary policy might possibly be better if central banks did not have discretion but were committed to following a monetary rule. Some of these economists have argued that central banks use discretion unwisely and end up being the cause, rather than cure, for the business cycle. Others argue that discretionary monetary policy is inherently inflationary. Monetary policymakers often claim that their aim is price stability, but once expectations are formed, they are tempted to renege on this announcement and take advantage of the short-run tradeoff between inflation and unemployment. The only way to avoid this time-inconsistency, it is argued, is to commit the central bank to a policy rule.

Even if these arguments against discretionary policy are rejected, however, there is another reason for interest in policy rules — as guidelines for policymakers with discretion. Monetary policymaking is a difficult business, and policymakers are always eager to hear objective, reasoned advice on how to respond to economic conditions. A policy rule that performs well by some criterion can be viewed as such advice.

There is a large literature that uses the tools of modern monetary theory to derive optimal policy rules. An excellent introduction to this literature is a paper by Richard Clarida, Jordi Gali, and Mark Gertler, with the alluring title “The Science of Monetary Policy: A New Keynesian Perspective.”

[7147] One conclusion from this literature is that optimal policy can often be written as a form of a “Taylor rule,” according to which the short-term interest rate set by the central bank responds to inflation and a measure of real economic activity, such as the deviation of output from its potential. [For a recent example, see 9149; for an opposing view, see 9421.]

Another conclusion from this literature is that optimal policy should

obey the “Taylor principle,” which states that the nominal interest rate should rise more than one-for-one with the inflation rate. In many standard models of the business cycle, this principle ensures that shocks to the economy do not induce inflation to get out of control. There is considerable evidence that the successes of monetary policy over the two decades, compared to the problems in the 1970s, can be explained by reference to the

Taylor principle. [6442, 6768, 8471, 8800] That is, the Fed has responded aggressively to changes in inflation when choosing its target interest rate during the recent period, whereas the Fed appears to have responded much less to inflation in the earlier period. This insufficient response to inflation may explain why inflation got out of hand in the United States in the 1970s.

Research Summaries

Explaining Exchange Rate Behavior

Menzie D. Chinn*

In an era characterized by increasingly integrated national economies, the exchange rate is the key relative price in open economies. As such, a great deal of attention has been focused on characterizing its behavior. Unfortunately, it is unclear how much success there has been in predicting this critical relative price. As recently remarked, “There may be more forecasting of exchange rates, with less success, than almost any other economic variable.”¹ While this characterization may be quite apt — a point I will return to later — it should not prevent us from attempting to identify the empirical determinants of exchange

rates, an enterprise separate from forecasting exchange rates.

The Impact of Productivity Changes

The first major line of inquiry I’ve followed links changes in productivity to changes in nominal and real exchange rates. There is a long and venerable literature that links these two variables theoretically, most notably associated with Balassa and Samuelson.² In these models, differences in productivity levels between traded and nontraded sectors affect the relative prices of these goods. Further, with traded goods prices equalized in common currency terms, real exchange rates — which incorporate the prices of nontraded good — will be affected.

The post-War yen has been the traditional candidate for explanation by

this type of model.³ In addition, the model typically is applied to economies experiencing rapid growth, since such growth often is associated with rapid productivity change in the tradable (manufacturing) sector. Hence, a natural application of the model is to the East Asian countries. Unfortunately, the data necessary for a direct test of the model do not readily exist. Instead, most analyses rely on observations on relative prices to infer the validity of the approach. In order to conduct a direct test, I compiled sector-specific employment and output data for China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand, and estimated the implied relationships. The time-series evidence did not support the model except in a few cases. Using panel regression techniques adapted to persistent time series,⁴ I find that the model applies to the set of countries including Indonesia, Japan, Korea,

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