How the Fed Affects the Economy:
A Look at Systematic Monetary Policy

BY MICHAEL DOTSEY

When assessing the economic effects of monetary policy, economists have, until recently, emphasized the role of unanticipated changes in policy. But are these policy shocks likely to be the most important influence on the economy? Mike Dotsey believes not. It seems more likely that the Fed's systematic behavior plays a bigger part in what happens in the U.S. economy. In this article, Dotsey explains the ways in which systematic policy influences economic activity.

A great deal of attention has been paid to the economic effects of monetary policy. Until recently, the emphasis has been almost entirely on the consequences of unanticipated changes in policy, or what are referred to as monetary policy shocks. Specifically, if the Fed were to do something unexpected, how would the economy respond? Will output increase or decrease in response to the change in policy, or will the inflation rate rise or fall?

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Surprises, however, are unlikely to be the most important part of monetary policy. While no one has clairvoyance regarding what the Fed will do at a particular point in time, financial market participants, as well as firms and investors, pay close attention to how the Fed behaves. Generally, they are fairly good predictors of monetary policy. The Fed, on its part, regularly communicates its outlook on the economy through speeches and congressional testimony. Further, the language in FOMC policy statements usually gives a fairly clear indication of the current stance of policy. With all this communication and scrutiny, monetary surprises of any consequence are likely to be rare events, implying that the Fed's systematic behavior will be its primary method of affecting the economy — specifically, how the Fed moves the interest rate in response to economic variables such as inflation and output growth. This article explores the ways in which systematic policy influences economic activity.[1]

In doing so, I will analyze two different policies that have the same long-term goal: price stability. One policy is the long-held monetarist prescription of a constant growth rate of money; the other is an interest rate rule that attempts to keep the price level fixed. The economic response to an increase in the level of productivity relative to its trend is much different under these two policies. The interest-rate rule allows the economy to take full advantage of the increase in productivity. The constant-money-growth-rate rule does not and, instead, dampens the effects of increased productivity, leading to what appears to be a much smoother path for output and employment. This smoother behavior reduces economic welfare in the sense that everyone is less well-off and highlights one important lesson of this article, namely, that smoothing output fluctuations is not necessarily good policy.

Given that different monetary policy designs affect the way the economy reacts to economic disturbances, it would be interesting to examine how well, in theory, a rule that approximates current Federal Reserve behavior performs. As I will show,

[1] Recent articles that also emphasize the role of systematic policy are my 1999 and 2002 articles and the one by Jordi Gali, David Lopez-Salido, and Javier Valles.

it appears that the design of policy is actually quite good.

CHANGES IN PRODUCTIVITY

In exploring the importance of systematic monetary policy, I will concentrate on how changes in productivity influence economic activity and, in turn, how monetary policy affects that influence. The level of productivity determines how much output can be produced from a particular amount of labor and capital. The more that can be produced, the more productive the economy is. Multi-factor productivity is a broad concept that includes not only technological innovations such as new inventions or improved machines that increase production but also advances in management practices or ways of organizing labor that enhance efficiency.

In addition, changes in government regulation or the legal environment can influence how many goods or services can be produced from a given amount of labor and capital. Basically, anything that affects the efficiency of productive inputs falls under the heading of a change in productivity.

With respect to various types of shocks, the economic effects of changes in productivity are perhaps the best understood and most clearly delineated of all economic shocks. Economists have described the importance of productivity changes for business-cycle behavior, and indeed, more scientific attention has been paid to the effects of changes in productivity than to the effects of any other economic disturbance.

To get an idea of the importance that changes in productivity have for movements in output, Figure 1 graphs changes in productivity, measured as a deviation from trend growth (productivity shocks), along with output growth in the United States from 1948 to 2000. As you can see, the changes are quite variable, sometimes exceeding 2 percent. A positive change in productivity of 2 percent means that 2 percent more output can be produced using the same amount of capital and labor. The other important feature shown in Figure 1 is the high degree of co-movement between changes in productivity and economic growth. When the change in productivity is positive, output tends to grow strongly; when it's negative, output growth is often negative as well. The correlation coefficient between productivity shocks and output growth is 0.83.[2] Thus, changes in productivity appear to be quite important to economic growth. Given their importance, how does monetary policy affect the way these productivity shocks influence economic activity?

As Satyajit Chatterjee describes in his 1995 article, when productivity is high, output, employment, and investment are also high.

Economists have described the importance of productivity changes for business-cycle behavior.

Figure 2 examines the behavior of four very important variables following a shock to productivity. This behavior is based on a simple theoretical model known as a real-business-cycle model. The key point about this model is that it describes the correlation of these

[2] The correlation coefficient measures the degree to which variables move together. A correlation coefficient of 1 means that the variables move in lock step; a correlation coefficient of 0 implies that the variables are unrelated; and a correlation coefficient that is negative means that the variables move in opposite directions.

FIGURE 1

Productivity Shocks and Output Growth

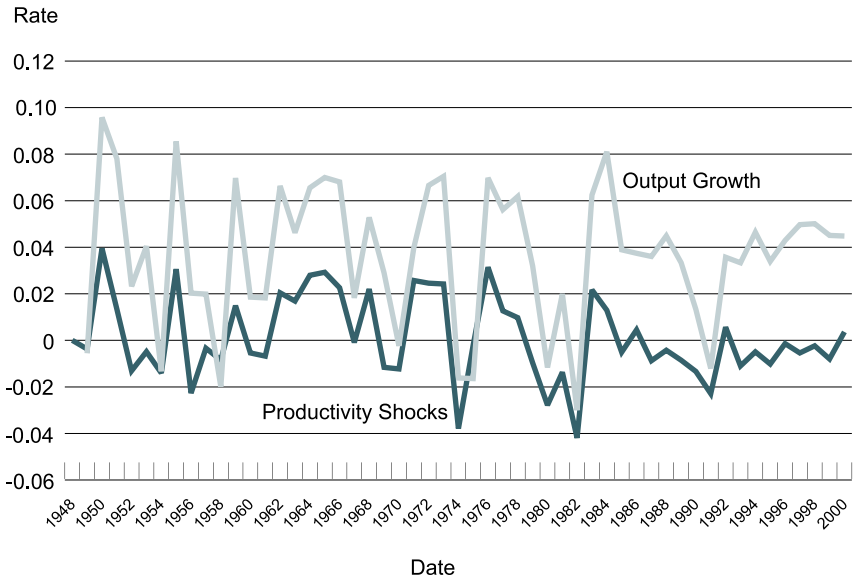
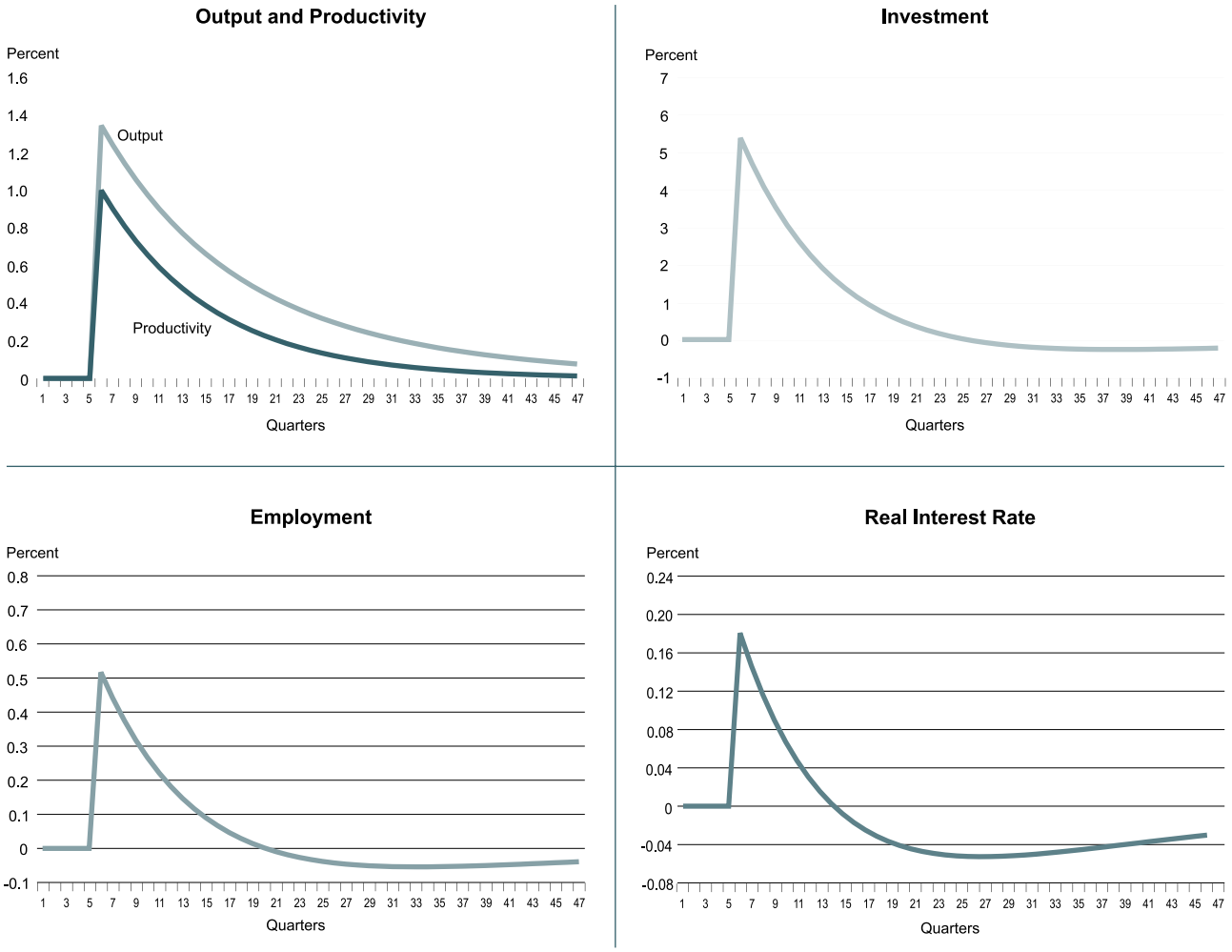


FIGURE 2

Real-Business-Cycle Model



important variables and gives us a theory as to why productivity affects the economy the way it does.

An important feature of the model is that there are no impediments to allocating resources or changing prices. All prices are flexible and changed costlessly. Specifically, the price of a good changes whenever the marginal cost of producing the good changes. Similarly, the wage rate and the rental rate on capital change whenever there is a change in productivity. Although not totally realistic, the model provides a necessary and important benchmark for evaluating the effects of monetary policy in a more realistic environment.

First, examine the behavior of the productivity shock itself and output. The two variables are graphed in the upper left part of Figure 2. Each variable is plotted relative to its normal level.

Take productivity, for instance. A value of 0 means that productivity is at its normal level, not that there is no productivity. A value of 1 implies that productivity has increased 1 percent above its normal level. The shock to productivity we examine is one that dies out slowly over time and is the type of productivity shock that

is typically studied in business-cycle analysis.

Because higher productivity implies that more output can be produced from the same amount of capital and labor, it is not surprising that output should be high when productivity is high and that as the shock to productivity dissipates, so does the increase in output. It is important to note, however, that output rises a good deal more than productivity. For this to occur, other factors of production — that is, inputs such as capital and labor — must increase as well. If they did not, the behavior of output would exactly mirror the behavior of productivity. The magnified increase in output is primarily due to an increase in hours worked or employment.

This increase is depicted in the bottom left panel of Figure 2. Why should people work harder when productivity is high? When productivity is high, so is the amount of output that can be produced from an hour of work. Higher labor productivity translates into an increased demand for labor by firms and into higher real wages. Higher real wages induce people to work more. For example, in times of very high productivity, firms often ramp up production and increase the amount of overtime paid to workers.

The other avenue that leads to an increase in output that is greater than the increase in productivity is investment. Higher productivity not only makes labor more productive, it also makes capital more productive. As a result, there is a greater demand for capital and a higher return to owners of capital. This higher return spurs investment, which results in a larger capital stock.

The higher return to capital is reflected in a higher real interest rate, which is displayed in the bottom right panel of Figure 2. The real interest rate is the difference between the nominal rate of interest – the rate at which each of us borrows and lends – and the expected rate of inflation. It indicates how many more goods can be consumed in the future if one sacrifices current consumption and saves a bit more. Similarly, the marginal product of capital indicates how many more goods will be produced when the capital stock is increased by one unit. The way to increase the capital stock is to forgo some consumption and invest. Therefore, a higher marginal product of capital implies that more goods can be consumed in the future if current consumption is sacrificed in favor of more investment. Thus, a higher marginal product of capital is associated with a higher real interest rate. The rise in the real interest rate is beneficial. It is a consequence of greater productivity and encourages saving, which, in turn, provides the means for greater investment.

There is substantial evidence that firms do not adjust prices instantaneously.

Finally, a very important point to understand about the cascade of effects that occurs because of an increase in productivity is that these effects are optimal from the standpoint of every individual in the economy. The increases in output, hours worked, investment, and the real interest rate result from individuals and firms taking advantage of the rise in productivity. The increase in productivity has created additional opportunities for producing, raised wages, and raised the return on investing. All the decisions made by households and firms are voluntary and reflect the efforts of each entity to maximize welfare and profits. Further, there is nothing to prevent the economy from responding fully and flexibly to the increase in productivity.

EFFECTS OF MONETARY POLICY WHEN PRICES DO NOT ADJUST INSTANTANEOUSLY

In the previous discussion, the economic response to an increase in productivity was instantaneous. Notably, the prices of all products adjusted immediately. In such a setting, monetary policy is irrelevant. Such an environment is, however, unrealistic. That lack of realism implies that to understand the importance of monetary policy, we must provide a better description of the economy.

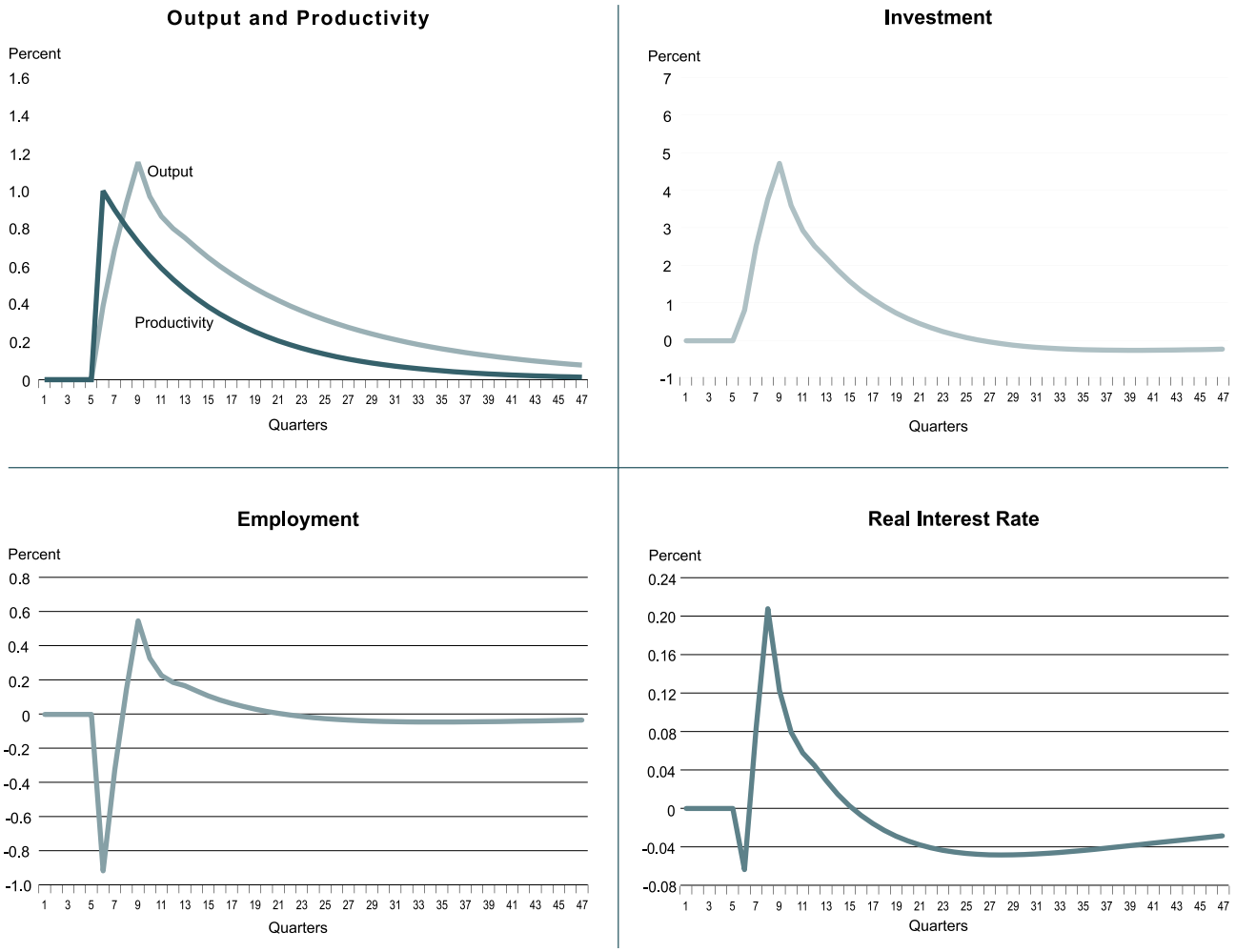
The major change will involve altering the assumption of perfect flexibility in prices. There is substantial evidence that firms do not adjust prices instantaneously. For example, Alan Blinder and co-authors have surveyed firms and found that many firms do not change the price of their products for up to a year. Mark Bils and Peter Klenow, in their recent and detailed look at price changes of goods and services, examined the price behavior of more than 350 products and documented how frequently the price of each good changed. They found that many prices remain fixed for up to six months, although 30 to 40 percent of prices do change each quarter.

To capture this facet of behavior, we will assume that each firm adjusts its price once a year, with 25 percent of all firms adjusting prices in each quarter.[3] That is, in any given

[3] A more rigorous treatment of price adjustment, like the one I developed with Robert King and Alex Wolman, can be used without changing the main thrust of the results presented in this section.

FIGURE 3

Sticky Prices and Constant-Money-Growth Rule



quarter, 25 percent of firms adjust their price and 75 percent of firms charge the same price they charged in the previous quarter. This type of price adjustment is referred to as a Taylor contract because it is based on the work of John Taylor.

When price setting is sluggish, economic behavior depends on monetary policy. The policy I examine first is constant money growth. This particular policy, which has a long tradition in monetary theory, is most notably associated with Milton Friedman. The main justification for prescribing this policy is that it controls the rate of long-run inflation while at the same time providing enough money, on average, for the economy to efficiently carry out the desired amount of transactions.

However, as a response to a persistent increase in productivity, this policy does not look like a good one. Even though this policy makes the economy behave in a smoother, or less volatile, fashion than occurs in the real-business-cycle model, individuals are less well off. The sluggishness in price setting translates into an overall sluggishness in activity.

First, examine output, as shown in the top left panel of Figure 3. Now, it increases only by about half the increase in productivity. The reason for this lack of responsive-

ness is seen in the bottom left panel, which shows that employment actually falls. In contrast to what happens in the flexible-price real-business-cycle model, the increase in productivity is actually causing employment to decline. Thus, workers are losing out on a big portion of potential gains. Investment is also comparatively less responsive, and the real interest rate declines.

Why does the economy behave so differently? The key reason is the sluggishness of price adjustment. The inability of firms to lower their prices in response to increased productivity and the resulting lower costs of production interact with monetary policy, producing the economic outcome depicted in Figure 3. The key reason the economy does not expand as vigorously as in the real-business-cycle model is that overall demand is linked to the amount of money in the economy. With money growing at a prefixed rate, demand does not increase as fast as productivity; instead, demand increases at the same prefixed rate as money. That means the dollar amount of goods bought is not growing fast enough to take advantage of the economy's increased productive capacity. Because prices are more or less fixed, the number of goods purchased is well below what the economy is capable of producing. With greater production efficiency, less labor is needed to satisfy the modest increase in demand. Rather than benefiting from being more productive, workers actually lose out.

Over time, as firms are free to lower their prices, output continues to increase, and eventually, employment increases as well. After every firm has adjusted the price of its product, the behavior of the economy begins to look like the behavior of the real-business-cycle economy. Output, employment, investment, and the real interest rate return to their average values as the increase in productivity dies out.

An important point of this exercise is that the constant-money-growth rule actually smoothes the economic response of output to the increase in productivity. Output does not immediately rise as much in response to a change in productivity and increases only gradually. This smoothing of output's behavior is not a good thing and results in additional volatility of employment. Individuals would be better off if they could respond more aggressively to the increase in productivity and take maximum advantage of productivity when it is at its highest.

> Rigidity in price setting has serious consequences for economic behavior.

The basic lesson of this section is that rigidity in price setting has serious consequences for economic behavior. The fact that firms are unable to change prices flexibly means that the optimal degree of economic expansion cannot take place under the constant-money-growth rule. If monetary policy were more expansionary in the face of the opportunities afforded by the increase in productivity, nominal output — that is, output measured in current dollars — could increase and so could real output — output measured in constant dollars, that is, adjusted for inflation. Such policy could, in principle, help the economy achieve an outcome more similar to what would occur if prices were in fact flexible. In doing so, that policy would increase economic welfare.

BETTER MONETARY POLICY

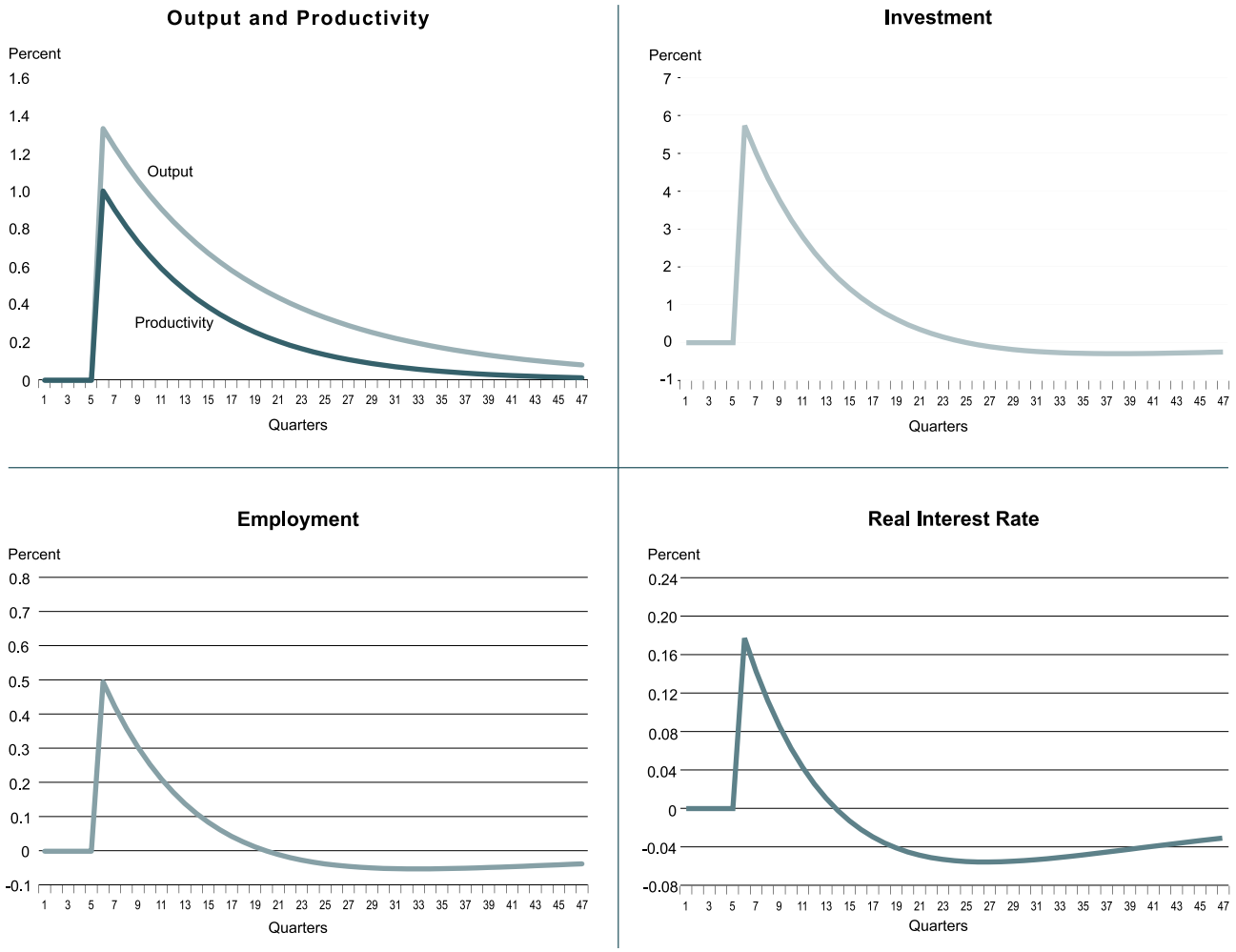
We just witnessed how sluggishness in price adjustment can impair the economy's response to a productivity shock. Can a central bank do something about this? For example, what if the central bank could make it desirable for firms to keep their prices constant even if they could freely change them? Then the lack of price flexibility might not present any impediment, and a better economic outcome would follow.

For example, suppose that firms thought the central bank could keep the overall price level from moving. A firm would then want to keep its prices in line with what other firms were expected to charge and not raise its price today. If a firm has no desire to change its prices, the fact that prices are inflexible will be of no consequence. One might guess that in such circumstances, the economy would behave very much like a flexible-price economy. The key question is whether the central bank can engineer this type of behavior in response to a change in productivity.

The answer is yes. The central bank can, in fact, make this happen by following an interest-rate rule, aggressively raising the interest rate if prices start to rise or aggressively lowering the interest rate if prices start to fall. In our model economy, this policy leads to the economic outcomes depicted in Figure 4.

FIGURE 4

Sticky Prices and Interest-Rate Rule



First, if we compare Figures 2 and 4, it is clear this policy duplicates the flexible-price outcome. The combination of the interest-rate rule the central bank is following and the initial desire for firms to lower their prices leads to a drastic increase in the supply of money. Basically, the interest-rate rule implies that the central bank will supply enough money so that the demand for goods and services (output) increases exactly as much as the supply of goods and services would increase under flexible prices. The result is that demand and supply are equal at the initial price level and there is no incentive for firms to change their price. Prices remain fixed, and the increase in output is identical to what happened when money was fixed and prices fell. Under flexible prices, real output rose 1.4 percent and prices fell 1.4 percent, leaving the demand for money unchanged at its fixed supply. Under the interest-rate rule, prices remain the same, output again rises 1.4 percent, and the supply of money increases 1.4 percent to support the increased output.

Because there is no change in prices, the nominal interest rate does not have to react to a change in the price level. Any pressure for the price level to fall ends up pumping money into the economy to keep the price level from moving. The nominal

interest rate moves one for one with the underlying real interest rate, and an optimal use of economic resources ensues. The latter point is one of the main messages in recent work by Robert King and Alexander Wolman.

A question that naturally arises from this analysis is: Why don't central banks follow this rule in practice? The answer is that for other types of shocks, such as demand shocks (for example, changes in government spending), this policy would not produce the best economic outcome. A different policy, generally one that accommodated some short-run increase in inflation, can make people better off. In our simplified experiment, we assumed the monetary policymaker knew the exact nature of the economic disturbance. In practice, that would not be the case; so the central bank may not be able to react in as precise a fashion as it does in the particular example discussed here. Also, accurate contemporaneous knowledge of what is happening to the economy as well as the fact that economic variables are often measured with error further complicates the design of actual policy. However, one key element of the analysis presented above does carry over to more complicated and richer investigations of policy: The central bank should not try to smooth economic activity but rather let the economy efficiently allocate resources in response to whatever shock has occurred.

ACTUAL POLICY

The lesson from the previous section is that it's possible for monetary policy to induce an optimal economic response to changes in productivity even in the presence of sluggish price adjustment. In reality, the economy is buffeted by many types of shocks. For example, changes in fiscal policy or changes in private demand, perhaps induced by large swings in equity or housing prices, are all recognizable features of the real world. Designing the optimal response to all of these types of shocks is a difficult proposition, which recent advances in theory are beginning to address.

Policymakers, however, do not have the luxury of waiting for theorists and must do the best they can in an uncertain environment. It would, therefore, be an interesting exercise to examine how well a policy rule estimated over the period 1987Q1 through 2000Q4 under Alan Greenspan's chairmanship does in response to a persistent productivity disturbance.

Accurate contemporaneous knowledge of what is happening to the economy as well as the fact that economic variables are often measured with error further complicates the design of actual policy.

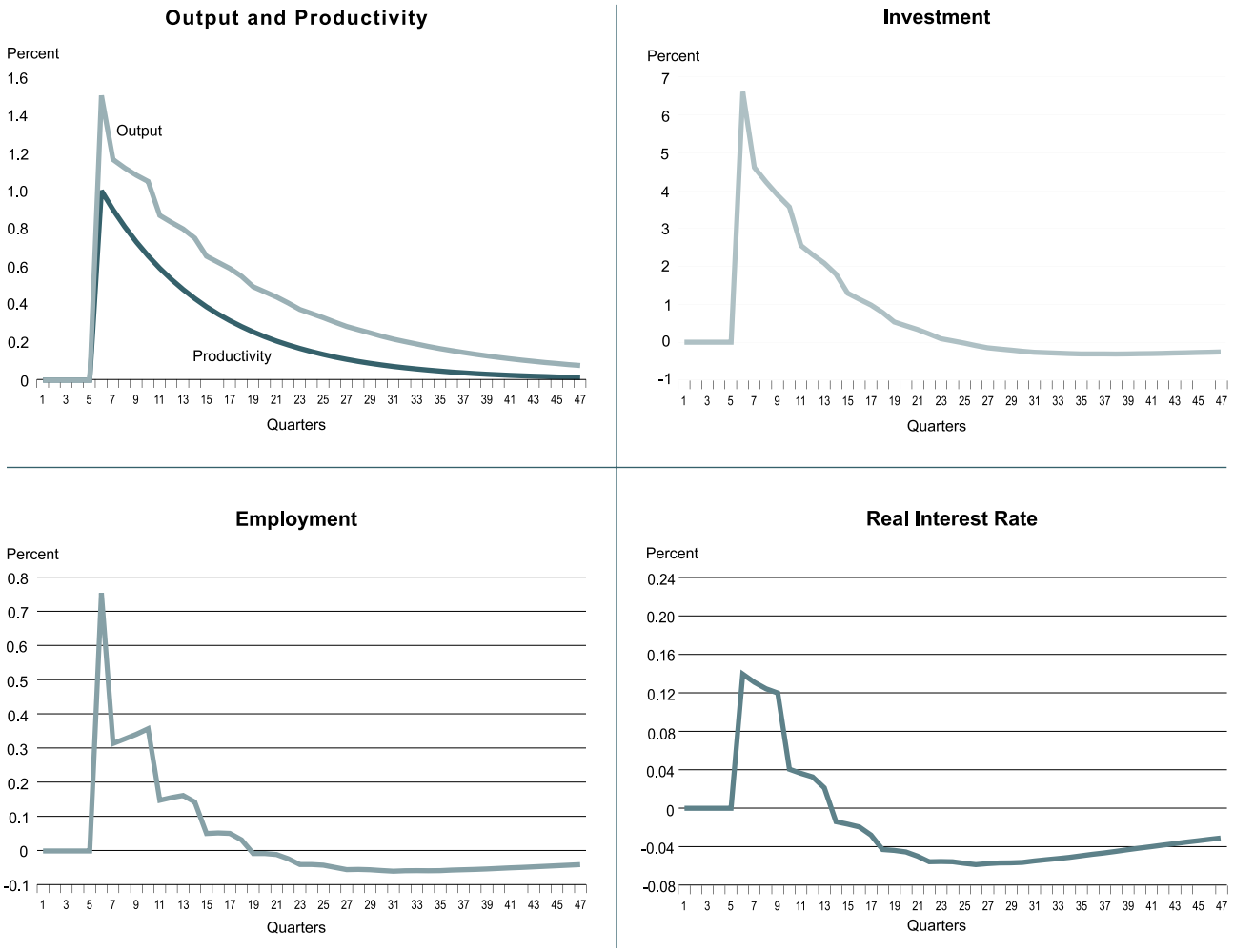
Because policy should be designed to respond well to all types of shocks, a central bank's behavior should not be expected to mimic the simple rule in the preceding section. But if designed appropriately, actual policy should not do too badly with respect to any particular shock. The rule I investigate, which is the one estimated by William English, William Nelson, and Brian Sack, involves tightening policy in response to inflation above a specified target and when output is above its trend growth rate. One should not interpret the latter response as an attempt to smooth activity, but rather as a recognition that when the economy is growing strongly, real interest rates should be high. The rule also involves a significant degree of interest-rate smoothing or inertia in policy, reflecting a concern on the part of the Fed for moving interest rates too rapidly or by sizable amounts in any one quarter.

The economy's response to the changes in productivity under a realistic estimation of policy is displayed in Figure 5. In fact, an estimated rule meant to capture the way the Fed responds to the economy implies that policy does fairly well in the sense that the response of output, employment, and investment is similar to that which would occur if prices were flexible.

In comparing the behavior of output, employment, and investment, one sees a slightly stronger response than occurs when prices are flexible. However, the overall pattern of activity is quite close to what is optimal, and it appears that an estimate of actual policy is fairly well designed for dealing with persistent changes in productivity. That is what one should expect if the Fed is doing a proper job of responding to underlying changes, or shocks, to the economy. The reason the economy responds slightly more aggressively is that monetary policy is a little bit easier. That is, the interest rate is slightly lower than what would be optimal if changes in productivity were the only type of shock that affected the economy. The Fed actually eases policy a bit, and the nominal interest rate is lower under the estimated rule than under an interest-rate rule that targets the price level. This relative easing of policy pumps more money into the economy, which, in turn, supports a higher level of activity.

FIGURE 5

Sticky Prices and Fed Policy Rule



SUMMARY

The systematic portion of monetary policy has an effect on economic activity because it influences the price-setting behavior of firms and the level of demand. A constant-money-growth rule drastically inhibits the economy's ability to respond efficiently to a change in productivity, whereas an interest-rate rule that targets the price level allows the economy to respond efficiently. Further, an estimated interest-rate rule fitted to the period corresponding to Alan Greenspan's chairmanship supports efficient use of resources in our model economy when it is subjected to a persistent increase in productivity.

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