Federal Reserve Bank of Cleveland

Oil Prices, Monetary Policy, and the Macroeconomy

by Charles T. Carlstrom and Timothy S. Fuerst

Recessions are associated with both rising oil prices and increases in the federal funds rate. Are recessions caused by the spikes in oil prices or by the sharp tightening of monetary policy? The authors discuss how to disentangle these two effects.

Every recession since 1971 has been preceded by increases in the price of oil and a rise in the federal funds rate (figure 1). Are recessions caused by spikes in oil prices or by a sharp tightening of monetary policy? Or are they caused by a confluence of both factors, the so-called "perfect storm"?

This *Commentary* discusses the efficacy of different federal funds rate movements in response to oil price shocks. Such movements may be direct responses to oil prices or, more likely, indirect responses. For example, a shock to energy prices tends to increase inflation, so that an inflation stabilization objective would lead to increases in the federal funds rate. To investigate the appropriate policy response, we must gain some idea of the differing economic impacts of oil prices and funds rate movements. Hence, this *Commentary* first discusses how to disentangle the contributions of oil price increases from those of funds rate increases. Some have argued that the problem is less the oil shocks per se than the Federal Reserve's tendency to increase the funds rate (either directly or indirectly) in response to these shocks.

There are two approaches to disentangling the impacts of oil prices and funds rate movements on the typical recession: empirical modeling and theoretical modeling. Both of them attempt to answer the counterfactual question, "How much would output have fallen if the Federal Reserve had kept the funds rate constant in the wake of the oil price shock?" We argue that the empirical approach, which has formed policy discussion, does not handle expectations very well. Empirical work estimates changes based on historical data, but these data are formed by the public's expectations of how the Fed will behave. If these expectations were to change, however, the future might be very different from the past.

That is, the empirical approach to answering the counterfactual question investigates how far output would have fallen after an oil shock, under the implicit assumption that the public expects interest rates to increase in response to that oil shock, as they have in the past. The public is thus surprised when the Fed keeps the funds rate constant in the wake of the oil shock. But if the Fed were to stop responding to oil shocks, and the public understood this policy change, the answer to the counterfactual question might be far different. Using a theoretical model to address the effect of such an anticipated policy change, we conclude that deviating once, and not allowing the funds rate to increase, could have some advantageous effects. But it would be unwise to deviate repeatedly, because once such a policy is anticipated, the presumed output gains of the constant funds rate policy disappear.

Disentangling Oil Price Hikes and Funds Rate Hikes

In an influential article, economists Bernanke, Gertler, and Watson (BGW) approached the issue of how to disentangle oil and funds rate increases by asking the counterfactual question, "How much would output have fallen if the Federal Reserve had kept the funds rate constant in the wake of the oil price shock?" As a first step, BGW estimate how the economy typically behaves if both oil and the funds rate increase. (Some economists have questioned whether BGW's estimates remain valid or stable in the most recent period, from 1983 to the present).

Figure 2 contains BGW's empirical estimates of the impact a 10 percent oil price shock would have on GDP if the funds rate increased with oil price hikes. Because oil price changes tend to have asymmetric effects, BGW focus only on oil price increases that exceed anything experienced over the previous four quarters. The analysis suggests that a one-time increase in oil prices and the ensuing funds rate increase would lower GDP by 0.7 percent. But part of this decline would probably result from the increase in the funds rate. Specifically, a one-time hike of 10 percent in energy prices is typically associated with a 150 basis point increase in the funds rate, designed to head off a rise in inflation. To disentangle these two effects, BGW ask how much output typically declines after the funds rate increases by 150 basis points.

With this information, they estimate the impact on output of a 10 percent energy price hike under the counterfactual

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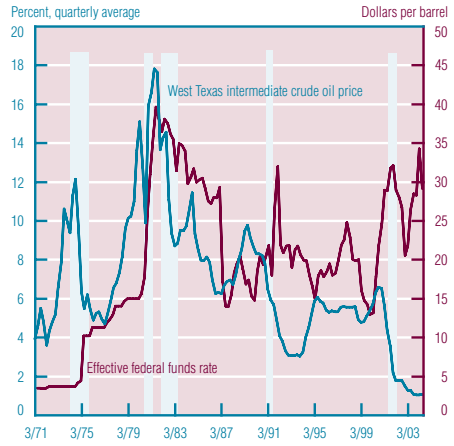
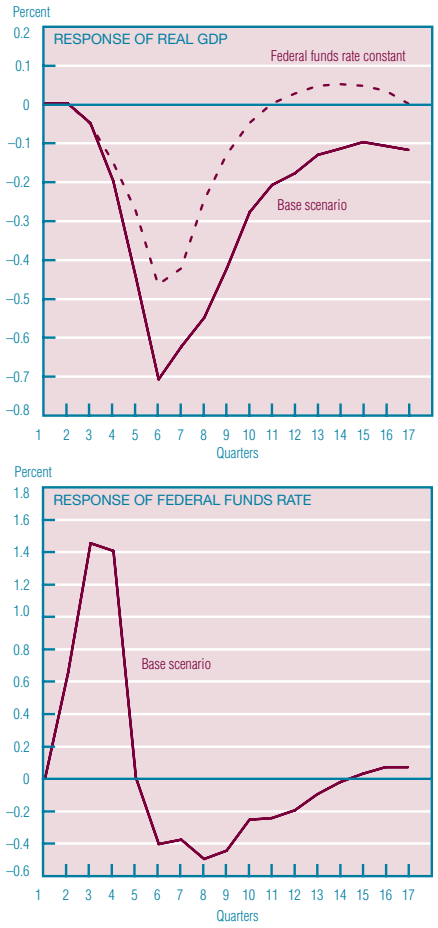
FIGURE. 1 OIL PRICES AND EFFECTIVE FEDERAL FUNDS RATE



NOTE: Shaded bars represent recessions.
SOURCE: Charles T. Carlstrom and Timothy S. Fuerst. 2005. "Oil Prices, Monetary Policy, and the Macroeconomy," Federal Reserve Bank of Cleveland, *Policy Discussion Paper*, no. 10.

FIGURE 2. RESPONSE TO AN OIL PRICE SHOCK



NOTE: Sample is 1965:IQ–1995:IVQ.
SOURCE: Ben S. Bernanke, Mark Gertler, and Mark Watson. 2004. "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy: A Reply," *Journal of Money, Credit, and Banking*, vol. 36, no. 2, 287–91.

scenario in which interest rates did not increase but were held constant at pre-shock levels. The implicit assumption in this calculation is that the public anticipated an increase of 150 basis points and would be surprised when no policy move occurred.

Their empirical analysis concludes that raising the funds rate would be expected to decrease output by 0.3 percent. Hence output's fall in the wake of the oil shock would have been muted considerably if interest rates had been held constant; specifically, output would have declined only 0.4 percent.

It is instructive to put these numbers into context. Given that oil prices increased 30 percent between the first quarter of 2004 and the fourth quarter of 2004 (from $33 to $45 a barrel), one would expect that if the funds rate were allowed to increase as in past episodes, output would decline by 2.1 percent. If the funds rate were held constant, however, BGW's analysis suggests that the same shock would reduce output only 1.2 percent. The difference in these two estimates is that a one-time oil price hike of 30 percent typically is associated with a funds rate increase of nearly 450 basis points.

Oil Prices and Monetary Policy: Some Simulations

The analysis made above holds policy expectations fixed when conducting the counterfactual exercise. This may help us understand the effect of an unexpected one-time policy shift, but does not necessarily help us understand a systematic policy change that is likely to become expected. Since expectations are not directly observable, we cannot use empirical analysis to understand the effects of a permanent, systematic change in policy. But a theoretical model allows us to conduct such an experiment.

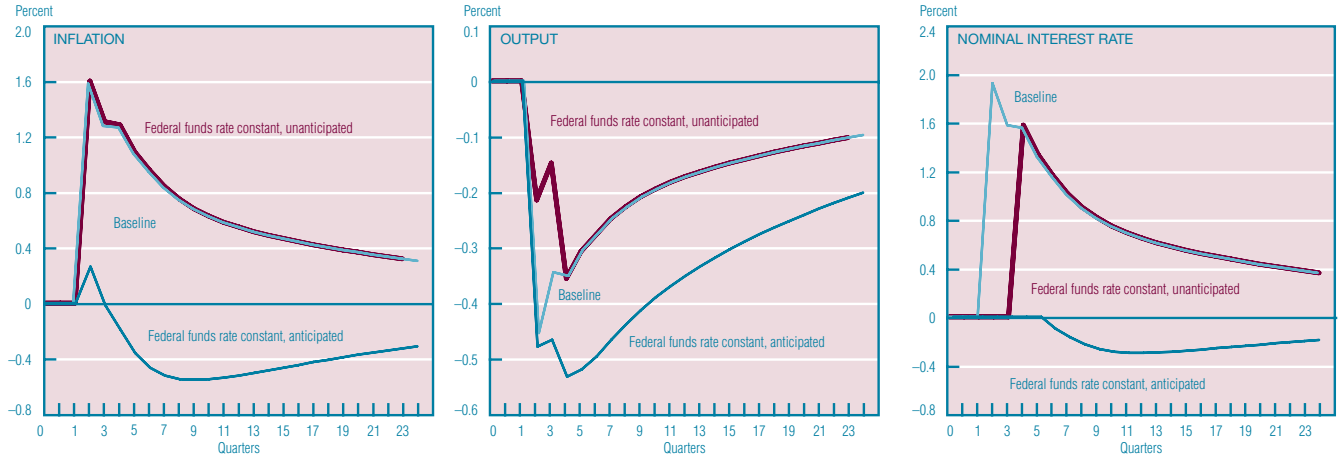
The model assumes that oil is used in producing output and that the model is calibrated to match evidence on the share of energy in U.S. production. We use the average share but, because this share has shown a secular decline, our model probably overestimates oil's current impact on the economy. The model also ignores potential asymmetries in the impact of oil price movements. Finally, the model includes the assumption that the Federal Reserve raises the funds rate in response to increases in inflation. That is, the Fed's response to energy is only indirect. This indirect effect is what leads to a tightening of policy in the wake of an oil shock. If our model's estimates are to be taken seriously, they should be roughly similar to those in figure 2.

Figure 3 shows the model's estimate of the effect that a 10 percent oil price shock would have on real GDP. The baseline experiment allows the funds rate to increase in response to the oil price hike. In contrast to the empirical analysis, where the impact of a 10 percent oil price shock (and the ensuing funds rate increase) causes output to fall around 0.7 percent, we estimate the effect to be nearly 0.5 percent. Similarly, the empirical estimate was that the funds rate would rise by 1.5 percentage points in response to the oil shock. Our model estimates the change to be about 2.0 percentage points.

Figure 3 also illustrates our model's estimates of the effect that a 10 percent oil price increase would have on the economy if the funds rate were held constant when the public expected it to rise. Like the empirical estimates, our model suggests that the negative impact of oil on real GDP would be muted considerably. Instead of declining by 0.5 percent, it would fall by 0.2 percent.

Taking these factors into consideration, we believe that our small-scale theoretical model is roughly consistent with the empirical estimates. The advantage of our model, however, is that it also allows us to analyze the anticipated-policy experiment, in which the public understands that the funds rate will no longer rise in response to energy price shocks in order to keep inflation from rising. This experiment was not performed by BGW; it would be difficult, if not impossible,

FIGURE 3. SIMULATED INFLATION, OUTPUT, AND NOMINAL INTEREST RATE AFTER AN OIL PRICE SHOCK



SOURCE: Charles T. Carlstrom and Timothy S. Fuerst. 2005. "Oil Prices, Monetary Policy, and the Macroeconomy," Federal Reserve Bank of Cleveland, *Policy Discussion Paper*, no. 10.

to perform empirically because expectations are not directly observable. But in our theoretical model, it is a simple matter to alter the public's behavior so that the policy change is anticipated. Our experiment with anticipated policy produces very different results: It suggests that if the public correctly anticipates that the central bank will not systematically respond to oil price movements but will keep the funds rate stable, the economy contracts by roughly as much as in the baseline case. Thus if the Fed had systematically held the funds rate constant after every oil shock, output would have declined by an amount comparable to the decline actually observed.

The behavior of inflation explains this result. In all three cases, the oil price increase leads to an immediate increase in inflation. In the baseline and anticipated-policy experiment, the subsequent inflation movements are fully anticipated, so the output responses are similar. In the unanticipated-policy experiment, however, the level of inflation exceeds anticipations. The level of expected inflation is given by the baseline case because the public expects the central bank to raise rates. However, the actual level of inflation exceeds expectations when the funds rate is unexpectedly kept constant. This unexpected inflation leads to an expansion of output relative to both the baseline and the anticipated-policy experiments. In the theoretical model, nominal prices and wages are very sticky, so unexpected inflation has a large output effect. In short, the surprise stabilization of the funds rate has a larger output effect than does the anticipated rate change.

■ Conclusion and Policy Implications

This paper presents evidence about the likely effect of an oil price shock on output and inflation. We do this by modeling two hypothetical relationships between oil and the funds rate—one in which the funds rate increases endogenously because of oil's impact on inflation and output, and one in which the Fed actively offsets this rate increase by holding the funds rate constant. Furthermore, we show the effect of the latter experiment under two different scenarios—one in which the Fed engineers the constant fed funds rate by systematically surprising the public (as is typically assumed in the empirical work), and another in which the public understands that the Fed will no longer allow short-term interest rates to increase in response to energy price hikes. By "surprising the public" we mean that the public expects the Fed to follow its policy rule, which calls for it to raise the funds rate, but the Fed keeps the rate constant instead.

Our unanticipated-policy experiment, in which the public is surprised, had output declining by a small 0.2 percent in response to a 10 percent hike in energy prices. Once this policy became anticipated, however, the output decline increased to 0.5 percent. The output response to a 10 percent oil price shock is essentially the same as it was in our baseline experiment, where interest rates were allowed to increase in response to rising oil prices.

The policy implication of this difference is clear. Our experiments suggest that delaying further increases in the funds rate could help the economy through any potential "soft patch" caused by recent oil price hikes—without increasing the chance of inflation—but that the gains from such a change may be short-lived. Our anticipated-policy experiment demonstrates the downside of such a policy choice. The only reason that holding the funds rate constant substantially mitigated the output decline is that the public didn't expect the Fed to do it. It might work once, but if the same response to oil price increases is given every time, it will eventually be anticipated by the public and do nothing to mitigate the output decline.

■ Recommended Reading

Ben S. Bernanke, Mark Gertler, and Mark Watson. 1997. "Systematic Monetary Policy and the Effects of Oil Price Shocks." *Brookings Papers on Economic Activity* 1, 91–142.

Ben S. Bernanke, Mark Gertler, and Mark Watson. 2004. "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy: A Reply," *Journal of Money, Credit, and Banking*, vol. 36, no. 2, 287–91.

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Owen F. Humpage and Eduard Pelz. 2003. "Do Energy Spikes Cause Inflation?" Federal Reserve Bank of Cleveland, *Economic Commentary*, April 1.

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