

Possible Monetary Policy Responses to the Iraqi Oil Shock

By George A. Kahn and Robert Hampton, Jr.

The oil-price increase resulting from the Iraqi invasion of Kuwait poses a dilemma for monetary policymakers. In the past, sharp increases in oil prices have simultaneously increased inflation and reduced economic growth. If policymakers try to offset the inflation effects of higher oil prices, output suffers. If policymakers try to offset the output effects, inflation rises.

This article uses a small economic model to estimate the effects of higher oil prices under alternative monetary policies. The model provides a relatively simple characterization of these effects. It focuses on the main channels of influence of higher oil prices, ignoring many of the channels that would be incorporated in larger, more complicated models of the economy. Based on the simple model, the article argues the likely effects of the Iraqi oil-price

shock will be small, providing monetary policy does not overreact. That is, with a policy that remains roughly constant or “neutral,” higher oil prices will cause inflation to increase and real output to decline—but these effects will be small and temporary.

The first section of the article shows why the options available to monetary policymakers cannot completely solve the dilemma. The second section presents estimates of how the various options will affect the economy over the next several years.

I. The Monetary Policy Dilemma of Higher Oil Prices

Monetary policy is ill-equipped to deal with the damage caused by higher oil prices. When oil prices rise sharply, consumers and businesses reduce overall spending, and businesses face higher costs. Monetary policy can, at best, reverse the decline in spending caused by higher oil prices. Monetary policy cannot reverse the increase in costs. As a result, some combination of lower output and higher inflation is the inevitable outcome of higher oil prices.

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Effects of higher oil prices on inflation and output

Higher oil prices have adverse short-run demand and supply effects. The demand effect results from a decline in spending on U.S.-produced goods and services. Although putting downward pressure on inflation, this effect also causes real output to fall. The supply effect results from increases in production costs. It raises inflation and lowers real output.¹ Because past oil shocks have typically caused inflation to rise, most analysts believe the supply effect dominates the demand effect.

Demand effects. Higher oil prices reduce aggregate demand by reducing spending on U.S.-produced goods and services. This reduced spending stems largely from consumers. Because higher oil prices force consumers to spend more of their income on petroleum products, such as gasoline and home heating oil, consumers must cut back on purchases of other goods and services.²

Reduced spending by consumers on other goods and services reduces overall spending in the economy even though spending on energy increases. Overall spending declines because much of the increase in energy spending goes to foreign oil producers. Since the United States imports much of its oil, income is shifted from the United States to oil-exporting countries.³ The income shifted abroad is no longer available to U.S. consumers for spending at home. Thus, overall spending on U.S. goods and services declines.

Partly offsetting these effects of higher oil prices is the increased income of domestic and foreign energy producers. But these beneficiaries of higher oil prices will spend only part of their higher income on U.S.-produced goods and services. The remainder of their higher income will go to increased spending on foreign goods and services or to increased savings. As a result, on balance, higher oil

prices will likely reduce the demand for U.S. products.⁴

With a reduction in demand for U.S. products, other things held constant, real output and inflation will decline. As output falls below the level required to maintain full employment, labor and other resources will be underutilized. As a result, wages and other input prices will moderate, and inflation will fall as production costs moderate and as businesses try to sell excessive inventories. Over time, the moderation of labor and other input costs will increase employment of labor and other resources, causing output to increase. Output will continue to increase and inflation will continue to moderate until full employment has been re-established.

Supply effects. The supply effects of higher oil prices are more pervasive than the demand effects. Oil is not only an input in the production of energy, but also an input in the production of other goods and services. These goods and services include fertilizers, plastics, and indeed any product that must be transported.

Higher oil prices reduce aggregate supply by raising overall costs of production. Oil-price increases have little or no immediate effect on the price of non-energy inputs such as labor, however, because these input prices are often set by long-term contracts. Without offsetting reductions in these other input prices, oil-price increases raise overall production costs. Businesses faced with higher oil prices must raise product prices for any given level of total sales. Alternatively, for any given level of prices, businesses must cut back their production of goods and services. Aggregate output declines, and inflation rises.

These effects are temporary, however, because the decline in real output decreases the employment of inputs, such as labor. As a result, prices of non-energy inputs—the wage rate, for example—moderate as contracts are eventually renegotiated. As these input prices moderate, businesses raise production, and output returns

to its full-employment level. The inflation rate also returns to its original level, providing monetary policymakers have not permanently increased monetary growth in response to higher oil prices. Thus, the short-run supply effects of higher oil prices eventually correct themselves. But before they self-correct, they can do substantial harm.

Supply and demand effects combined. The combination of supply and demand effects implies that higher oil prices lead to higher inflation and lower output in the short run. Demand effects and supply effects reinforce each other in reducing real output. In contrast, demand effects partly offset supply effects on inflation. But because supply effects dominate demand effects, higher oil prices increase inflation in the short run.⁵

Alternative policy responses to higher oil prices

How should monetary policymakers respond to the dilemma of higher oil prices? Even if policymakers knew the exact magnitude of the oil-price shock, understood fully its effects over time on the economy, and could take actions that affected the economy in precisely the right way at precisely the right time, policymakers would face a dilemma. Although policymakers could completely offset the demand effects of higher oil prices, they could not completely offset the supply effects.

Policymakers could ease monetary policy—that is, lower short-term interest rates by increasing the availability of reserves to the banking system—to offset the demand effects of higher oil prices. Such a policy would increase interest-sensitive spending, returning aggregate demand to its pre-oil-shock level. Completely offsetting the demand effect, however, would require quick action by monetary policymakers. Quick action would be necessary because the demand effects of higher oil prices might hit the

economy relatively rapidly, while the effects of monetary policy actions take time. And even quick action might not be quick enough if the effects of higher oil prices are immediate. Monetary policymakers would also need to have considerable information about the magnitude and timing of the effects of the oil shock in order to design an offsetting policy response for demand effects.

With an ability to influence only aggregate demand, policymakers cannot offset the supply effects of higher oil prices. But policymakers can influence the mix of higher inflation and lower output resulting from supply effects. Policymakers can do this along a range of possible outcomes. Two types of policy responses span this range. In both cases, policymakers would need to understand fully the effects of the oil-price shock and monetary policy on the economy. And, in both cases, policymakers are assumed to offset completely the demand effects of higher oil prices by easing monetary policy. The two types of responses would differ depending on how policymakers reacted to the supply effects of higher oil prices.

At one end of the range of options is an *accommodative policy*. With an accommodative policy, policymakers would completely offset the output effects of higher oil prices. Policymakers would ease monetary policy not only to offset demand effects but also to keep output equal to its full-employment level. The cost of such a policy would be higher inflation. The increase in inflation would likely be permanent because cost-of-living adjustment clauses in labor-market and other contracts raise input prices and thereby increase inflation expectations.

At the other end of the range is an *extinguishing policy*.⁶ With an extinguishing policy, policymakers would completely offset the inflation effects of higher oil prices. Although policymakers would need to ease policy to offset demand effects, policymakers would have to

tighten policy—that is, raise short-term interest rates by reducing the availability of reserves to the banking system—to offset the supply effects. Given that supply effects likely dominate demand effects, policymakers would, on balance, tighten policy to keep inflation constant. The cost of such a policy would be a greater decline in output.

In between the two extremes are any number of other policy options that produce alternative mixes of higher inflation and lower output. One such option would be to maintain constant monetary or nominal GNP growth.⁷ Such a response is called a *neutral policy*. With a neutral policy, policymakers would ease or tighten monetary policy as needed in the face of higher oil prices to maintain constant growth of, say, nominal GNP.⁸ This article assumes that a neutral policy can be achieved even though, in reality, the Federal Reserve cannot control nominal GNP growth precisely on a quarter-to-quarter basis. The purpose is to broadly characterize the implications of a neutral policy, not to indicate the definitive outcome of attempting to pursue a neutral policy.

With these caveats in mind, such a policy would have effects “in between” the effects of accommodative and extinguishing policies. Because the demand effects of an oil-price shock reduce both inflation and real GNP, they clearly reduce nominal GNP growth. As a result, a neutral policy would offset all of the demand effects of higher oil prices. Because the supply effects of an oil-price shock increase inflation but reduce real GNP, they lead to mostly offsetting effects on nominal GNP growth. By maintaining constant nominal GNP growth, policymakers would “accept” much, if not all, of the supply effects of higher oil prices.⁹ As a result, inflation would rise and output would fall under a neutral policy.

A neutral policy has several other distinctive features. First, it might be more feasible to implement than an accommodative or extin-

guishing policy. Because policymakers have greater short-run influence over nominal GNP growth than they have over real output or inflation, they might be better able to achieve a neutral policy (McCallum 1985). Second, unlike an accommodative policy, a neutral policy would prevent a permanent increase in inflation. Third, while a neutral policy would accept an oil-price-induced decline in output, the decline would be temporary and self-correcting. Finally, regardless of the policy response, the supply effects of higher oil prices hurt the economy—a neutral policy would divide the damage evenly between higher inflation and lower real output.

II. Effects of the Current Oil-Price Shock under Alternative Policies

What are the implications of the current oil-price shock given alternative monetary policy responses? The Iraqi invasion of Kuwait on August 2 caused the refiners’ acquisition cost of imported oil—one common measure of oil prices—to rise roughly 50 percent, from \$16 per barrel in the second quarter of 1990 to \$24 per barrel in the third quarter. Although oil prices rose further early in the fourth quarter of 1990, they have since come down to a level close to their third-quarter average. Despite monthly fluctuations in the price of oil, only that part of the price increase that persists is relevant for the analysis in this article. This article assumes the recent oil-price shock will permanently increase oil prices by \$8 per barrel, or 50 percent.

In contrast, past oil-price shocks increased the price of oil by 150 percent or more. Thus, the current oil shock is relatively small by historical standards. This section uses a small economic model to show that the current oil-price shock should have relatively small inflation and output effects provided monetary policy does not overreact.

Estimation results

The small model used to determine the effects of higher oil prices on inflation and output consisted of two equations that are described more fully in the appendix. One equation explained inflation in the implicit GNP deflator, on a quarterly basis, using data from the second quarter of 1954 to the second quarter of 1990.¹⁰ The other equation was an identity relating nominal GNP growth to the sum of inflation and real GNP growth. Assuming a path for nominal GNP, the inflation equation determined the inflation rate, while the nominal GNP identity determined the output effect.

The inflation and output effects of the recent increase in oil prices were projected by combining the estimated inflation equation with assumed paths for future oil prices and nominal GNP growth. Oil prices were assumed to remain permanently at their actual third-quarter level, which was \$8 higher than in the second quarter. Nominal GNP growth was allowed to vary depending on the monetary policy response to higher oil prices.

The inflation equation was simulated twice under each of three monetary policy assumptions. Simulations were run first assuming no increase in oil prices, then assuming the actual 50 percent increase in oil prices in the third quarter. Differences in these two sets of simulations were then plotted under alternative assumptions for monetary policy. The three assumptions for monetary policy were the accommodative, extinguishing, and neutral policies described earlier. All other influences on inflation were assumed to be the same in all simulations. Thus, the differences in the simulations show the effect of higher oil prices on inflation and output, given alternative monetary policies and holding constant all other influences on inflation and output.

Inflation effects. Except under an extinguishing policy, projected inflation increases

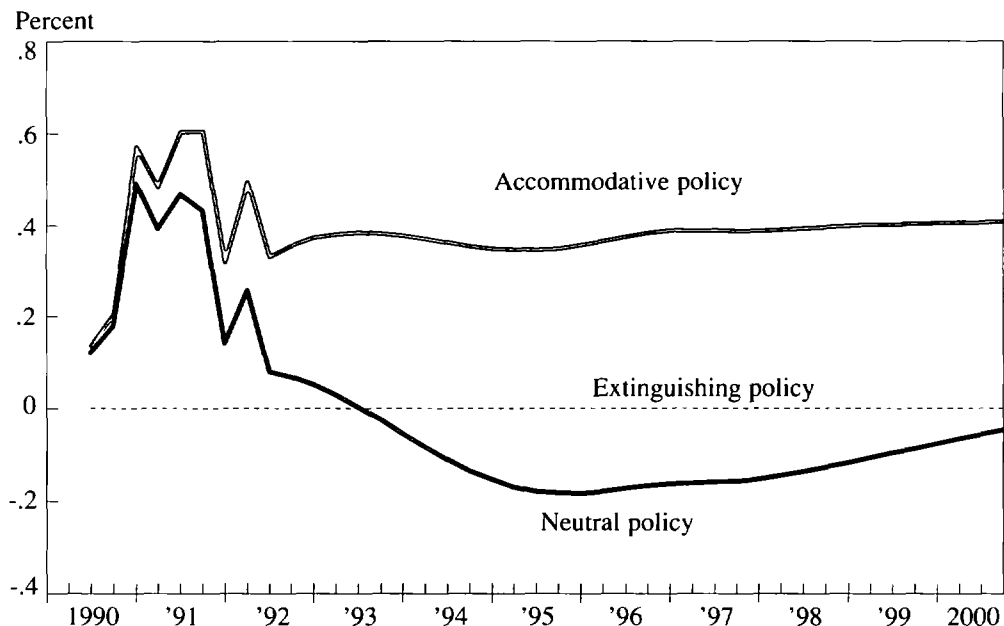
slightly in response to the recent 50 percent increase in oil prices (Chart 1). Under a perfectly engineered neutral policy in which monetary policymakers hold nominal GNP growth constant, the effect of the current oil-price shock on inflation is temporary. Inflation increases to a peak of about 0.5 percentage point above what it otherwise would be in the first quarter of 1991. Then inflation falls, eventually reaching levels below what it would have been in the absence of higher oil prices.¹¹ Finally, over time, inflation returns to its non-oil-shock level, represented in the chart by the zero line.¹² Thus, there is no long-run effect of higher oil prices on inflation under a neutral policy.¹³

Under an accommodative policy—assuming one could be perfectly engineered—inflation rises above the levels implied by a neutral policy in both the short run and the long run. Specifically, inflation increases to a peak of about 0.6 percentage point above what it would have been in the absence of higher oil prices. Moreover, inflation remains permanently higher by about 0.4 percentage point. Higher inflation results because monetary policy offsets the effects of higher oil prices on real output. Because an accommodative policy keeps inputs fully employed, non-energy input prices do not moderate when oil prices rise. The result is higher inflation in both the short and long run.

Under an extinguishing policy—again, assuming one could be perfectly engineered—projected inflation remains unchanged. According to the definition of an extinguishing policy, monetary policymakers offset the inflation effects of higher oil prices so that, during and after the oil-price shock, inflation is the same as it would have been had the oil shock not occurred. As will be seen, the cost of such a policy is a sharper short-run decline in real output than under alternative policies.

Output effects. Except in the case of an accommodative policy, projected output falls temporarily as a result of the current oil-price

Chart 1
Projected Effects of Higher Oil Prices on Inflation



Note: Chart shows the projected effect of the recent increase in oil prices on (a four-quarter moving average of) the annualized quarterly growth rate of the implicit GNP deflator. Projections assume a permanent \$8 increase in the real price of imported oil occurring in the third quarter of 1990. The accommodative policy maintains real GNP at its full-employment level. The neutral policy holds nominal GNP growth constant. And the extinguishing policy keeps inflation constant in response to higher oil prices.

Source: Authors' estimates based on the model described in the appendix.

shock (Chart 2). Under a neutral policy, output declines gradually over several years to a trough of about 0.7 percent below full-employment output. Full-employment output is represented by the zero line in the chart. Points below the line represent less than full-employment real GNP, while points above the line represent more than full-employment real GNP. Under the neutral policy, output eventually “overshoots” full employment. In other words, output increases from below full-employment levels to above full-employment levels. Although output eventually returns to its full-employment level, the process takes considerable time.¹⁴

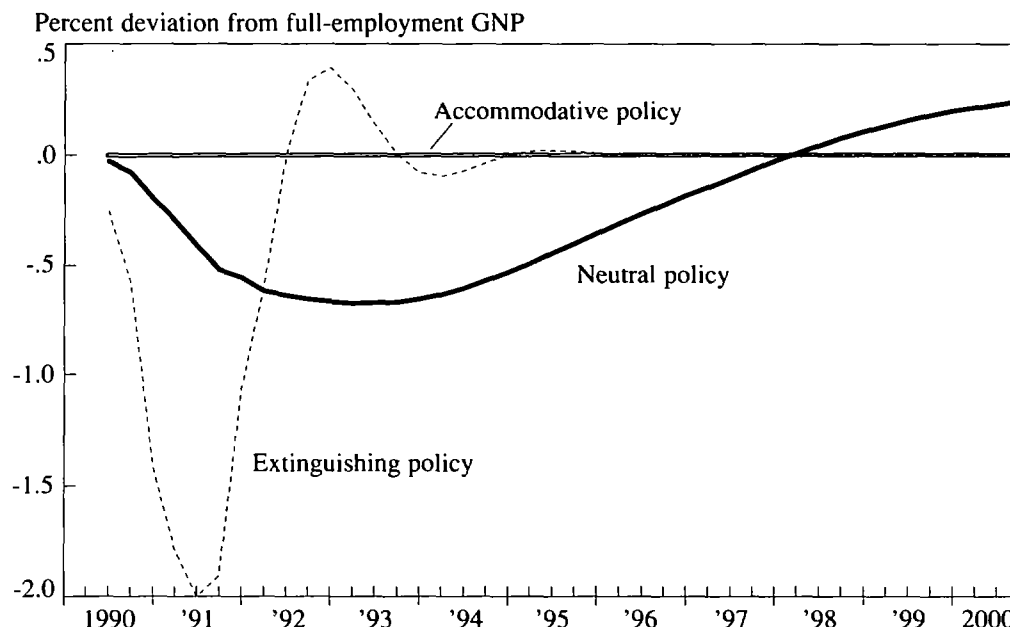
Under a perfectly engineered extinguishing policy, output falls further and more sharply

than under a neutral policy. Specifically, output falls to a trough of about 2 percent below full-employment output by the third quarter of 1991. Afterward, real output increases sharply, first overshooting its full-employment level, then gradually converging on full employment. More output is lost from an extinguishing policy than from a neutral policy because a tighter monetary policy is necessary to eliminate the inflation effects of higher oil prices. Thus, output must bear the entire adjustment burden of the supply effects of higher oil prices.

Under a perfectly engineered neutral policy, the estimated effect on output of the recent oil-price shock is relatively small while, under an extinguishing policy, the effect is moderate.

Chart 2

Projected Effects of Higher Oil Prices on Real GNP



Note: Chart shows the projected effect of the recent increase in oil prices on (a four-quarter moving average of) the percentage deviation of projected real GNP from the full-employment level of real GNP. See note from Chart 1 for assumption and definitions.

Source: Authors' estimates based on the model described in the appendix.

One way to judge the size of the output effect is to compare it with the size of historical fluctuations of output over the business cycle. From peak to trough, real GNP fell an average of 2.3 percent over all recessions since 1947.¹⁵ As shown earlier for the current oil shock, projected real GNP falls a maximum of 0.7 percent under a neutral policy and 2 percent under an extinguishing policy. Thus, the effect on output of the recent oil-price rise is likely to be less severe than the average recession under a neutral policy and about as severe as the average recession under an extinguishing policy.

Finally, under a perfectly engineered accommodative policy, real output remains at its full-employment level. According to the

definition of an accommodative policy, monetary policymakers offset the output effects of higher oil prices so that, during and after the oil-price shock, output remains the same as it would have been had the oil shock not occurred. Given no other influences on output than oil prices and monetary policy, output remains at the full-employment level. As shown earlier, the cost of such a policy is a permanent increase in inflation.

Summary and policy implications. The effects of higher oil prices on inflation and output depend on the monetary policy response. An accommodative policy results in higher inflation in both the short run and the long run but maintains real GNP at its full employment level. Achieving this result would require sub-

stantial quarter-to-quarter swings in nominal GNP growth. Such complicated paths for nominal GNP growth might be difficult to achieve because of uncertainties about the timing and magnitude of the effects of oil-price shocks and policy actions. Because it takes time for policy actions to affect the economy, policymakers would have problems engineering complicated paths for nominal GNP growth. Moreover, determining exactly what policy actions would be required to offset the output effects of oil-price shocks would require knowing precisely how higher oil prices affect the economy. While estimated relationships can give guidance to policymakers, they cannot eliminate uncertainties about the effects of oil-price shocks and monetary policy responses.

An extinguishing policy results in a relatively sharp, temporary decline in real GNP but maintains a constant rate of inflation. Unlike an accommodative policy, an extinguishing policy has no adverse long-run effects. Real output returns to its full-employment level, and inflation remains unchanged by definition. But, like an accommodative policy, achieving an extinguishing policy would require a complicated set of monetary policy actions.

A neutral policy divides the impact of higher oil prices between higher inflation and lower output. Inflation rises in the short run, but by less than with an accommodative policy. Output falls in the short run, but by less than with an extinguishing policy. As with an extinguishing policy, higher oil prices affect neither output nor inflation in the long run. Moreover,

a neutral policy might be relatively simple to achieve compared with the complicated paths required for nominal GNP growth under an accommodative or extinguishing policy. Thus, for both short-run and long-run considerations, a neutral policy might be the best policy response to an oil-price shock.

III. Conclusions

The recent increase in the price of oil—if maintained—will hurt the U.S. economy. In the short-run, higher oil prices will increase inflation and lower real GNP. But the relatively small size of the recent oil-price shock compared with past oil-price shocks suggests the size of these effects will likely be small providing monetary policy does not overreact. This conclusion emerges from a simple two-equation model of the economy that attempts to capture the main channels of influence of the higher oil prices.

In such a model, a neutral policy that holds nominal GNP growth constant would prevent a sharp increase in inflation and a sharp decrease in real GNP. A neutral policy would also ensure that the inflation and output effects of higher oil prices were temporary and self-correcting. Although monetary policy cannot offset all of the damage caused by higher oil prices, it can ensure that higher oil prices do not lead to permanently higher inflation. One way to achieve this goal is to adopt a neutral monetary policy that maintains constant nominal GNP growth in the face of higher oil prices.

Appendix

The Triangle Model of Inflation

This appendix describes the model used to project the effects of higher oil prices on inflation and output and discusses its limitations. The model has been used extensively by Robert Gordon to explain the behavior of inflation in the United States and elsewhere. The basic structure is taken from Gordon (1988 and 1990a), but has been used by Gordon in many earlier papers (for example, 1985).

The approach is called the "triangle" model of inflation. This is because it divides factors influencing inflation into three categories—inflation inertia, the output gap, and relative prices. Inertia is the influence of past inflation on current inflation. The output gap is the ratio of real output to the full-employment level of real output. Relative prices are the prices of goods and services measured in relation to the economy's overall price level. Changes in key relative prices, as described in the text for the price of oil, also influence the behavior of inflation.

The model assumes that changes in relative oil prices, though they affect inflation and real output, have no effect on nominal GNP growth. This assumption simplifies the analysis while focusing attention on the short-run supply effects of oil-price shocks. Several rationales can be given for the assumption. First, the demand effects of energy-price shocks—which move inflation and real GNP growth in the same direction and, therefore, affect nominal GNP growth—are relatively unimportant compared with the supply effects. Second, supply effects move inflation and real output growth in opposite directions, with each variable's movement at least partly offsetting the other's effect on nominal GNP growth.

Finally, monetary and fiscal policies might possibly hold nominal GNP growth constant in the face of oil-price shocks. Under this rationale, the model can be thought of as estimating what would happen to inflation and real output after an oil-price shock if monetary and fiscal policies held nominal GNP growth constant.

The following two equations summarize the model:

$$(1) P_t = A_0(L) P_{t-1} + A_1(L) GAP_t + A_2(L) Z_t + u_t$$

$$(2) GAP_t = GAP_{t-1} + Y_t - P_t$$

where P_t represents inflation in the implicit GNP deflator, GAP_t is the log of the ratio of actual to full-employment real GNP, Z_t is a vector of changes in relative prices, u_t is a zero mean, finite variance error term, Y_t is the growth rate of nominal GNP minus the economy's long-run real growth rate, and the $A_i(L)$ are lag operators.

The point of departure for estimating the model is Gordon (1988, Table 3, column 3). Included in Gordon's specification are variables representing inertia effects, the output gap, and relative price effects. Inertia is represented by a 24-quarter distributed lag on past inflation. The output gap is represented by deviations in actual real GNP from full-employment real GNP. Full-employment real GNP, in turn, is measured as in Gordon (1990b). Two variables measure relative price effects. Relative food and energy prices are measured by the difference between the rates of change of the deflators for personal con-

sumption expenditures and for personal consumption expenditures net of expenditures on food and energy. And relative foreign prices are measured by the change in the price of non-food, non-fuel imports relative to the GNP deflator.¹⁶

Also included in Gordon's inflation equation are several other variables that help explain inflation but do not fit easily into any of the three categories from the triangle model. First, a variable is included to account for changes in productivity growth relative to trend productivity growth. The inclusion of this variable reflects the potential markup of prices over unit labor costs.¹⁷ This "productivity deviation" variable measures how much of firms' price-setting behavior depends on actual productivity changes versus trend productivity growth. Second, a variable is included to account for changes in the minimum wage. This "effective minimum wage" variable is defined as the statutory nominal minimum wage divided by nominal average hourly earnings. Third, variables are included to account for changes in the payroll, personal, and indirect tax rates. These variables are defined as in Gordon (1985). Finally, the impact of price controls imposed by the Nixon Administration is measured by the inclusion of two dummy variables.¹⁸

With the exception of the distributed lag on inflation, the lag structure imposed on the inflation equation is the same as Gordon's lag structure. The output gap, food and energy variables, and all tax variables were entered contemporaneously and with four lagged values. The productivity deviation was entered contemporaneously and with one lagged value. All other variables except inflation were entered with four lagged values. Whereas Gordon's basic specification constrained the coefficients on lagged inflation to lie along six

constant segments, the specification used in the text constrained the coefficients to lie along a fifth-degree polynomial with no endpoint constraint.

Several other changes were made in Gordon's basic specification to make it more suitable for addressing the effects of higher oil prices. One important change was the definition of the dependent variable. While Gordon used changes in the fixed-weight GNP deflator as the dependent variable, the estimates in the text used changes in the implicit GNP deflator. This switch in the dependent variable was made because the identity relating nominal GNP growth to inflation and changes in the output gap holds exactly when inflation is measured by the implicit GNP deflator, but only approximately when inflation is measured by the fixed-weight deflator.

Another important difference between the approach used in the text and Gordon's approach is the definition of relative oil prices. Gordon's approach lumps changes in energy prices together with changes in food prices, preventing an analysis of the separate effect of oil prices. Moreover, Gordon's variable cannot be interpreted as the effect of an increase in food and energy prices but rather measures the weight of consumption in the overall total fixed-weight GNP deflator.

In place of Gordon's food and energy price variable, separate variables were included for food and oil prices. Two oil-price series were linked to form the oil-price variable. From the beginning of the sample to the first quarter of 1974, the oil-price variable was the rate of change of the price of Venezuelan crude-oil imports deflated by the growth rate of the implicit GNP deflator.¹⁹ This series was linked in the second quarter of 1974 to the rate of change in the refiners' acquisition cost of imported crude oil deflated by the growth rate

Table A1

**Equation for Growth in the
Quarterly Implicit GNP Deflator**
1954:2-1990:2

<u>Independent variable</u>	<u>Sum of lagged coefficients</u>
Implicit GNP deflator	1.03* (36.9)
Output gap	.28* (4.7)
Productivity deviation	-.09† (1.1)
Food price effect	.42† (1.1)
Relative price of imported oil	.02‡ (2.4)
Effective minimum wage	.03 (1.3)
Nixon controls "on"	-1.34 (1.7)
Nixon controls "off"	3.60* (3.8)
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Summary statistics	
R ²	.798
Sum of squared residuals	209.5
Standard error	1.338

Note: t-statistics are in parentheses.

*Significant at the 1 percent level.

† Contemporaneous effect significant at the 1 percent level.

‡ Significant at the 5 percent level.

Source: Authors' estimates.

of the implicit GNP deflator. Similar to Gordon's food-and-energy-price variable, the food-price variable was the difference in the growth of the total personal consumption

expenditures deflator including and excluding food.

Finally, while Gordon's sample period ran from 1954:2 to 1987:3, the sample period used in the text ran from 1954:2 to 1990:2. The extension of the sample past 1987:3 added observations with relatively large oil-price fluctuations.

With these changes, the inflation equation was estimated initially with a complete set of explanatory variables on the right-hand side. The estimation procedure was ordinary least squares. Variables with insignificant sums of lagged coefficients and with lagged coefficients that were individually and jointly insignificant were then excluded from the equation, and the regression was re-run.

The results are reported in Table A.1. Sums of coefficients on the variables used by Gordon are very close to those reported in Gordon 1988. In particular, the sum of coefficients on lagged inflation is close to one, and the sum of coefficients on the output gap is positive and significant.

Limitations of the approach

One potential problem with the estimates reported in the table results from the inclusion of the current output gap on the right-hand side of the inflation equation. Because of the possibility of reverse causality from inflation to the output gap, simultaneous equations bias is a potential problem. See Gordon 1990a for a discussion of the nature of the bias in the context of the triangle model. One way around the problem would be to estimate a separate output gap equation. Another way would be to use a more robust estimation procedure.

To test the sensitivity of the results to simultaneous equations bias, the inflation equation was re-estimated using an instru-

mental variables approach. Instruments included four lags each of the growth rate of the M2 money stock and the growth rate of real federal government expenditures, in addition to all of the right-hand-side variables except the current output gap. The re-estimation had only minor effects on the coefficients of the inflation equation. For example, the sum of the coefficients on the current and lagged output gap rose from 0.28 to 0.29 and the sum of the coefficients on oil prices rose from 0.016 to 0.017. Given the similarity of these results, simultaneous equation bias was considered relatively unimportant and the ordinary least squares results were used in the simulations reported in the text.

Another limitation of the approach is that the model holds relative food prices and relative non-food, non-energy import prices constant in the face of higher oil prices. This simplifying assumption potentially causes an understatement of the adverse short-run inflation and output effects of higher oil prices. Since petroleum products are an input in the production of fertilizers, higher oil prices raise the cost of producing food. Higher oil prices also raise the cost of transporting food to the

consumer. Thus, oil-price increases likely contribute to food-price inflation which in turn contributes to higher overall inflation.

The model also ignores the effect of higher oil prices on the price of non-food, non-energy imports. If higher oil prices cause the dollar either to appreciate or depreciate, import prices will change. Thus, oil-price increases possibly contribute to changing import prices which in turn affect overall inflation. Ignoring this effect may lead to an understatement or overstatement of the inflation and output effects of oil-price shocks.

Finally, the model ignores the long-run effects of higher oil prices. If oil-price shocks reduce productivity growth, however, the long-run growth rate of real GNP will decline and future full-employment levels of real GNP will be lower than otherwise. This in turn implies that actual real GNP will not fall as far below the full-employment level of real GNP as in the earlier projections. Thus, inflation will ultimately come under less downward pressure from the output gap. The result will be a permanent increase in the price level and decrease in the level of real output.²⁰

Endnotes

¹ Sustained increases in oil prices also potentially reduce long-run productivity growth. Oil-price increases reduce the use of energy in the production process and thereby reduce the quantity of goods and services that the existing stock of capital and labor can physically produce. Monetary policy cannot affect this outcome because monetary policy cannot alter the technology firms use to produce output. See Garner 1988 for a discussion of the effect of slower productivity growth on standards of living and for non-monetary policy options to increase long-run productivity growth.

² Not only are consumers in the United States hurt by higher oil prices but so are consumers in other countries. Like domestic consumers, foreign consumers will cut back their consumption of non-energy goods and services as a

result of higher energy bills. To the extent these other goods and services are U.S. products, spending on U.S. goods and services will decline further. Thus the demand for U.S. exports will decline.

³ In 1989, petroleum imports to the United States accounted for 41.3 percent of U.S. petroleum supplies (Bohn 1990).

⁴ This analysis ignores possible effects of higher oil prices on the foreign exchange value of the dollar. If the dollar depreciates in response to higher oil prices, spending on U.S. exports might increase, and the aggregate demand effects of higher oil prices might be further offset. The dollar might depreciate if foreign central banks raised interest rates relative to U.S. rates in response to higher oil prices. Because oil is priced in dollars, foreign central

banks can potentially offset an increase in the dollar price of oil by raising the foreign exchange value of their currencies relative to the dollar.

In contrast, if the dollar appreciates in response to higher oil prices, spending on U.S. exports might decline and the adverse aggregate demand effects of higher oil prices might be exacerbated. The dollar might appreciate in response to higher oil prices because the United States is less dependent on imported oil than many of its trading partners. For example, Japan imports almost all of its oil supply while the United States imports less than half. As a result, Japan must increase its exports relatively more than the United States to pay for an increase in its imported oil bill. Since Japan exports many of its products to the United States, the Japanese yen would likely fall relative to the dollar.

Given these and other possible effects, it is not certain whether an oil-price increase would cause the dollar to appreciate or depreciate. In any event, these effects are likely to be of secondary importance relative to the more direct effects described in the text.

⁵In the long run, after supply effects have run their course, the effect on inflation depends on monetary policy. One monetary policy response would be simply to "accept" the decline in demand. In this case inflation would decline permanently. The reason is that with a decline in demand, output falls below full-employment output and exerts downward pressure on inflation. If monetary policymakers choose not to compensate for this decline in demand, such downward pressure would never be reversed by a period of above-full-employment output. Therefore, inflation would fall even in the long run. The decline would likely be small, however, because demand effects are relatively unimportant and because, in the long run, foreign oil producers would spend a greater and greater share of their increased income on U.S.-produced goods and services. This spending would reverse more and more of the demand effects of higher oil prices.

An alternative policy response would be to compensate for the decline in demand. This is the "neutral" policy described in the next subsection of the text.

⁶The term *extinguishing* was coined by Gramlich (1979).

⁷Given stable velocity, controlling either money growth or nominal GNP growth amounts to the same thing. See McCallum 1985 (p. 587) for a discussion of the view that policymakers may be better able to control nominal GNP growth than ultimate goal variables such as inflation or real growth.

⁸For a discussion of how monetary policy might pursue short-run targets for nominal GNP growth, see Kahn 1988.

⁹If the demand effects of oil-price shocks are unimportant

and the slope of the demand curve is such that a one-percentage-point increase in inflation leads to a one-percentage-point decline in real GNP growth, then nominal GNP growth will not be affected by oil-price shocks. These assumptions are consistent with most leading intermediate macroeconomic textbooks, which focus on the supply effects of energy-price shocks and ignore the demand effects. It is also consistent with many macroeconomic models. For example, Hickman 1984 (as cited in Tatom 1988) found that aggregate demand effects of oil shocks are minimal in 14 large-scale and small-scale macro models and that, in most of these models, aggregate demand was unitary price-elastic so that "the relative magnitude of the output and price responses to an oil shock is similar across models, with big output reductions accompanying large price increases and vice versa" (Hickman 1984, p. 93, as cited in Tatom 1988, p. 329).

¹⁰The short-run effect of higher oil prices on the implicit GNP deflator is smaller than the effect on other price indexes such as the consumer price index (CPI). This is because the GNP deflator excludes imports, while the CPI does not. One important import, of course, is oil. Thus, the GNP deflator excludes direct effects of higher oil prices on the overall price level that are included in the CPI.

¹¹The estimated inflation equation may overstate the effects of the current oil-price shock if the economy's vulnerability to higher oil prices has declined because of energy conservation. Evidence supporting a decline in oil-price vulnerability is a sharp decline in petroleum consumption as a share of real GNP since the late 1970s. Estimated effects may also be overstated if people view the current increase in oil prices as temporary rather than permanent.

¹²The projected short-run effect on inflation of the current oil-price shock, given constant nominal GNP growth, is similar to that projected by the Data Resources, Inc. (DRI) model. The cumulative effect of the assumed \$8 increase in oil prices in the estimated inflation equation was 1.6 percentage points over the four quarters from 1990:3 to 1991:2 (based on the actual estimated increase in inflation in those quarters rather than the four-quarter moving average reported in Chart 1). In the DRI model, with or without the assumption of constant nominal GNP growth imposed, the cumulative increase in inflation over the same period was also 1.6 percentage points. (All DRI estimates are based on simulations of the October 1990 control model assuming no effects of higher oil prices on the exchange rate or consumer confidence.) For another estimate of the inflation effect of the recent oil-price increase, see Feldstein 1990.

¹³Because the neutral policy assumes that demand effects

are completely offset, inflation returns to its original level in the long run. One implication of a neutral policy is that output overshoots full-employment output for a period of time. The increase in output above its full-employment level offsets any demand-induced decline in inflation over the long run.

¹⁴ The projected short-run effect on output of the current oil-price shock, given constant nominal GNP growth, is similar to that projected by the Data Resources, Inc. (DRI) model. In the DRI model, with the assumption of constant nominal GNP growth imposed, output falls 1.0 percent below full-employment output. (All DRI estimates are based on simulations of the October 1990 control model assuming no effects of higher oil prices on the exchange rate or consumer confidence.) For another estimate of the output effects of the recent oil-price increase, see Feldstein 1990.

¹⁵ At the troughs of all recessions since 1947, actual real GNP was on average 4.5 percent below the full-employment level of real GNP. During the same period, the most that actual real GNP fell below full-employment GNP was about 9 percent in the fourth quarter of 1982.

¹⁶ Also included in Gordon's basic specification is a variable measuring relative changes in consumer prices. Because the CPI may be important for wage determination through cost-of-living escalators, it may also be important for price determination. The relative change in consumer prices is measured as the difference between the growth

rates of the CPI and the GNP deflator.

¹⁷ With the inclusion of inertia, output, and relative price effects, Gordon 1988 finds that wage growth contributes insignificantly to the explanation of inflation. Thus, separate wage growth terms do not appear in the inflation equation.

¹⁸ The Nixon controls "on" dummy variable is set equal to 0.8 for the five quarters from 1971:3 to 1972:3. The "off" variable is set equal to 0.4 in 1974:2 and 1975:1 and to 1.6 in 1974:3 and 1974:4. Both dummy variables sum to 4.0 rather than 1.0 because the dependent variable is an annualized quarterly rate of change.

¹⁹ Before the second quarter of 1961, the Venezuelan crude-oil series was available only on an annual basis. These data were converted to quarterly data by assuming constant growth over the four quarters of each year.

²⁰ Another limitation of the approach is the assumption that oil-price changes do not affect nominal GNP growth. If, contrary to the assumption, oil-price shocks have significant effects on nominal GNP growth, estimated inflation and output effects will be inaccurate. As previously argued, however, oil-price shocks are likely to have only negligible effects on nominal GNP growth. Moreover, monetary and fiscal policy can potentially offset the effects of oil-price changes on nominal GNP growth. In this case, the estimated model would still be useful in projecting what would happen to inflation and output under, say, a neutral monetary policy.

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