
FRBSF WEEKLY LETTER

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Oil Prices and Inflation

The price of oil rose 35 percent immediately following Iraq's invasion of Kuwait—from about \$20 a barrel to \$27. Since then, prices have been relatively high and volatile, and an outbreak of armed conflict could send the price of oil even higher. Thus, even though other OPEC producers expect eventually to make up most of the shortfall in oil supplies resulting from the embargo against Iraq, it is possible that higher oil prices will persist, providing a sustained shock to the U.S. economy.

This *Letter* examines the effects of such a shock on price inflation in the U.S. A rise in the price of oil has a direct effect on the prices of final goods and services, as higher energy costs are passed through to consumers. Whether higher oil prices lead to a permanent increase in either the price level or the rate of inflation, however, depends on both the response of the Federal Reserve and the effect on expectations of future inflation.

To ensure that the price level does not remain permanently higher as a result of a rise in oil prices, the Federal Reserve would have to allow non-oil prices to adjust to offset the effects of higher oil prices. Such an adjustment would require the economy to grow more slowly for a time. Furthermore, if expectations of higher inflation generate higher wage inflation, temporarily slower growth also would be required to prevent a permanent increase in the rate of inflation.

To estimate the inflationary consequences of the recent 35 percent increase in oil prices, this *Letter* examines both the direct effect on overall prices and the indirect effect operating through inflation expectations.

The direct effect

A change in the price of oil has both direct and indirect effects on overall prices. These effects can be understood in terms of a simple model of the inflationary process that describes overall price movements as a function of changes in the price of non-labor inputs, wages, and inflation

expectations. In this model, final goods prices are equal to the sum of the cost of the labor required to produce a unit of output ("unit labor cost") plus a mark-up to cover the costs of non-labor inputs, including energy.

This mark-up changes as the costs of non-labor inputs change. Thus, a rise in oil prices raises the mark-up and, therefore, the prices of final goods and services. Historically, a 35 percent increase in the price of oil has raised the level of the GNP price index by about 1¼ percent through this direct channel. The effect on consumer prices is about 50 percent larger because this index includes the prices of imports (including the higher prices of imported oil), while the GNP price index does not include imports.

The direct effects of higher oil prices on the price level will not persist, however, as long as the Federal Reserve does not accommodate these higher prices by allowing an increase in the stock of money. In this case, higher oil prices will cause economic activity to slow and unemployment to rise temporarily. Wage inflation will moderate and offset the increase in the mark-up associated with higher oil prices. However, if the Federal Reserve attempts to counter the weakening in economic activity with a larger stock of money, an oil price increase can have a permanent effect on the price level.

Indirect effect of expectations

In addition, if expectations are affected, higher oil prices can permanently raise the rate of price inflation through higher wage inflation. In the model, the rate of wage inflation is a function of the unemployment rate and the expected rate of price inflation. The unemployment rate provides a measure of demand pressure in labor markets. When the demand for labor is strong, as measured by a low unemployment rate, wages will tend to rise because firms will bid them up trying to attract workers.

Competition in the labor market also occurs against the background of workers' and firms'

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expectations regarding the future rate of overall price inflation. Workers will demand higher wages to compensate them for higher expected prices in the future. For this reason, when there is neither excess demand nor excess supply in the labor market, wages will tend to rise at a rate equal to the expected rate of price inflation plus the expected growth in labor productivity. As a result, expected real (inflation-adjusted) wages will rise only as fast as productivity. The expected rate of price inflation will be realized as this rate of wage inflation is passed through to higher prices.

However, when the unemployment rate is low, and job vacancies exceed the number of unemployed, competitive pressures will push up wages at an even faster rate than the expected rate of price inflation plus the growth in productivity. These higher wage costs are then passed through to prices, and actual inflation will exceed expected inflation until firms and workers raise their expectations of future inflation. However, once they revise their expectations, and these expectations get reflected in wages and ultimately in prices, there is a further rise in actual inflation. Thus, in this situation, a wage-price spiral can occur, whereby inflation continues to accelerate as long as the demand for labor exceeds the supply of workers.

Because inflation expectations cannot be observed directly, in most models, including the one used here, expected inflation usually is represented by the rate of inflation over the recent past. Empirically, past inflation has an influence on current and future inflation. This may arise because market participants form their expectations adaptively, by extrapolating past inflation forward. Alternatively, expectations may be more forward-looking than this, but staggered, multi-year labor contracts introduce an element of inertia in the wage-setting process so that past inflation has an influence on the current and future rate of wage inflation.

Oil prices and expectations

How does an oil price shock affect expectations of future inflation? Labor market participants may realize that an oil price "shock" represents a one-time change in a relative price that need not affect the rate of overall price inflation in the long run. As such, wages would not need to rise to compensate for it.

However, labor market participants may not be able to discriminate perfectly between a one-time shock to the price level and other developments that would lead to a permanent increase in the rate of inflation. If they cannot or do not do so, higher oil prices may raise expectations of future inflation, leading to extra wage inflation, and therefore additional price inflation.

The extent to which expectations of future inflation are affected also depends, in part, on the credibility of the Federal Reserve's commitment to maintaining price stability. If labor market participants believe that the Federal Reserve will accommodate the pressures from oil prices, a wage-price spiral could ensue even though the initial shock was only transitory in nature. On the other hand, if the market believed the Federal Reserve would not accommodate a transitory shock, there would be no effect upon inflation expectations, and wage inflation would not augment the direct effect of higher oil prices.

Combining the two effects

To see how an increase in oil prices might affect long-run inflation, consider the following simple example. Suppose there is a permanent increase in the price of oil that causes the mark-up and overall price inflation to rise by one percentage point this year. This is the direct effect of a rise in oil prices. Wage inflation this year would be unaffected by this price rise. However, assuming that the rate of inflation that is observed this year is fully reflected in expectations of future inflation, wage inflation and hence price inflation will be one percentage point higher next year even though the direct effects of the higher price of oil will have gone away.

Moreover, to the extent the Federal Reserve accommodates these expectations by allowing the money supply to grow more rapidly, these expectations will be self-perpetuating, and wage and price inflation will be permanently higher. In this way, a temporary oil shock can permanently raise the rate of inflation.

This is a simple example. In practice, it is likely that labor market participants distinguish among the causes of price movements better than this example suggests. It also is likely that market participants expect the Federal Reserve to attempt to avoid accommodating the rise in oil prices. Both of these observations suggest that

the response of wage inflation to an oil price shock is likely to be smaller than in the example. The long-run impact of a rise in oil prices, therefore, will be muted.

Econometric estimates of the inflation model described here suggest that the market has indeed tended to discount the influence of past oil-price and other supply shocks in forming its expectations of future inflation. Consequently, both wage and long-run price inflation have not been fully responsive to these supply shocks.

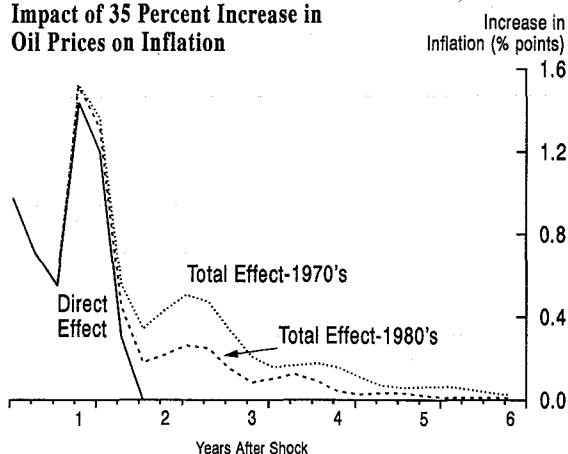
Interestingly, the estimates also show that the degree of discount has increased over time. It is estimated that 75 percent of past inflation associated with the direct effects of supply shocks was passed through to expectations of future inflation from the major oil shocks in 1974 and 1979, while only 35 percent was passed through from subsequent shocks during the 1980s. This change is most likely due to an increased awareness that such shocks change relative prices and equilibrium real wages, but need not affect the price level in the long run. This change also reflects a stronger faith in the Federal Reserve's commitment to maintaining stable prices.

Simulation results

To put the current oil shock into perspective, the accompanying chart shows the simulated time path of inflation in the GNP price index following a permanent 35 percent increase in the real price of oil. The direct effect from the increase in the mark-up is shown along with the estimate of the total response in both the 1970s and 1980s. The simulation assumes an accommodative monetary policy that keeps the unemployment rate unchanged. The simulation shows that through its direct effect on the mark-up, an oil price shock increases the inflation rate an average of 0.86 percentage points in the six quarters following the shock. However, after the price level has adjusted to the higher oil prices, there is no further increase in the inflation rate from this source.

Nonetheless, the simulation shows that because of the effect on expectations and wage inflation, the rate of inflation will continue to be higher even after the direct effects of the price shock

Impact of 35 Percent Increase in Oil Prices on Inflation



have been completed. The extra wage inflation operating through this indirect channel is at its highest in the third year, where, on average, it contributed 0.44 percentage points to the inflation rate during the 1970s, and 0.23 percentage points in the 1980s. But in either case this extra wage inflation becomes insignificant after the fourth year or so.

Conclusion

The direct effect of the current oil-price hike on the price level can be offset gradually by a non-accommodative policy on the part of the Federal Reserve. The negative effects on economic activity resulting from such a gradual approach need not be large as long as expectations do not change and cause wage inflation to magnify and perpetuate the inflationary pressure.

The estimates presented here reveal that the response of wage inflation to supply shocks, such as the current boost to oil prices, tends to be small and to die out fairly quickly. Moreover, the wage response has fallen over time as the market has become more accustomed to fluctuations in the price of oil and as the Federal Reserve's commitment to maintaining price stability has become more credible. As a result, the current oil price shock is not likely to set off a significant wage-price spiral.

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