Energy and its Impact on Economic Growth: A Supply-Side Miracle for the Eighties

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Business economists do not often have an opportunity to take a long imaginative view of the prospects for economic growth. When they do, however, they generally recognize the perilousness of the venture. With the same caveat, I would like to propose that economic policy decisions affecting energy markets have recently begun to reverse the dismal macroeconomic stagnation of the past decade and that the potential exists for completely reversing those losses in our standard of living.

In my view energy price developments are responsible for the stagnant performance of output and productivity growth since 1973, as well as for the slowing in business capital formation, and for the double-digit inflation rounds in 1974 and 1975, and again in 1979 and 1980.

One response to these concerns has been a set of economic policies aimed at increasing the supply of capital and labor resources and improving the efficiency of their use. For example, cuts in personal income tax marginal rates have been aimed at increasing the supply of labor resources. It is widely recognized, however, that the recent personal income tax cuts did not reduce the actual marginal tax rates of most individuals. Instead, the so-called tax cuts have simply halted the deterioration of incentives by halting the rise in marginal tax rates that otherwise would have occurred due to inflation and bracket creep. Moreover, much of the reduction

in the cost of capital that arises from accelerated depreciation and extended investment tax credits has been passed through to the suppliers of resources that allow the capture of those tax benefits, that is, suppliers of funds in both bond and stock markets. Higher real market interest rates have offset to a large extent the reduced tax burden for business investment.

To conclude that the supply-side policies have failed is incorrect, however. The proper assessment of their magnitude would indicate that little positive stimulus to resource accumulation was intended.[1/] Moreover, the limited benefits of the supply-side policies should not be a cause of great concern. The dominant supply-side problem of the 1970s did not arise from the deterioration of incentives in labor and capital markets. The primary source of stagnant economic developments has been in energy markets, and it is in those markets that I believe the Administration's supply-side policies can have the most positive benefits and reverse much of the stagnation of the 1970s.

The Macroeconomic Effects of a Change in Energy Prices

A rise in the price of energy resources relative to the price of business output causes a reduction in the economic capacity of a nation.[2/] The particular channels through which this change occurs vary from firm to firm, but include changing production methods to reduce the use of higher cost

energy, the closing of plants that have become unprofitable, reduced optimal and actual usage of existing capital facilities, and the diversion of existing capital and labor from production to activities that economize on the use of energy resources. These changes result in less output being produced. As a result, measures of productivity such as output per hour, output per worker, or output per unit of capital initially decline. Such a reduction in the supply of output relative to an existing money stock results in a higher level of prices. Thus, the cost-raising effect of higher energy costs is observed temporarily as higher measured rates of inflation. Within a short time, however, the price structure of the economy adjusts to higher-cost energy resources, and observed inflation rates tend to return to the underlying rate of inflation.

The initial decline in productivity of labor and capital resources is reflected in resource markets as a decline in demand. In the labor market, where supplies are relatively inelastic for the economy as a whole, the real wage tends to fall. In the market for plant and equipment, however, the decline in demand is reflected in a smaller optimal capital stock. This occurs because the real rental cost of capital is not reduced in line with the productivity of capital resources. Over some adjustment period, then, the pace of

business investment and the rate of real wage and productivity growth are temporarily smaller.

When energy prices decline, the analysis is symmetric. Initially, output expands as production with existing capital and labor resources change towards more energy using methods. Demand for capital and labor resources will reflect this increased productivity and, as a result, real wages and the optimal capital stock will increase. Economic capacity increases due to a fall in energy prices are reflected in an initial once and for all rise in the level of productivity, followd by temporarily more rapid growth, as the capital-labor ratio rises to its higher optimal level.

Casual observation, as well as several empirical studies, strongly support this theoretical view and provide empirical assessments of the importance of these effects. In 1973 and 1974, OPEC doubled the real price of oil in the U.S. This led to about a 40 percent rise in the relative price of energy resources in the United States. As a result, there was an immediate loss in potential output of about four percent matched by an equal increase in the general level of prices. These effects are somewhat larger over a longer period of time and the capital-labor ratio adjustment is included.

In 1979 and 1980, OPEC doubled the relative price of oil in the U.S. marketplace again. Again, the relative price of energy in the United States rose about 40 percent and again

we observed a four percent loss in potential and actual productivity rather immediately, as well as the temporary surge in the inflation rate.

The third major surge occurred in the winter of 1981, when the President decontrolled the crude oil market in the United States. This action led to an immediate end to a subsidy of about 20 percent to the usage of crude oil. Accordingly, the relative price of energy resources in general rose 13 percent in early 1981, productivity declined and the return of the inflation rate to its underlying level was delayed somewhat.[3/]

The first chart shows the effect of changes in the relative price of energy in 1970-1980 on potential output in the private business sector. There are only two instances in which the effect exceeded a half of a percent--in 1973 and 1974, and again in 1979 and 1980. A third instance occurred in 1981 due to decontrol. The losses in the first two quarters of 1981 reduced the growth rate of potential output by 2.8 percent in the first quarter and 1.6 percent in the second quarter of 1981. Chart 2 shows the effects of higher relative prices of energy on the general level of prices. Again you can see the price level effect of higher energy prices, particularly in 1973 and 1974, in 1979 and 1980, and to a lesser extent in 1981.

The evidence is not confined to the United States. Indeed, studies of productivity in Japan, West Germany, Canada,

the United Kingdom, France, and the Netherlands find the same effects.[4/] In both 1973-74 and 1979-80, all countries were subject to major energy shocks. Measured inflation rates temporarily surged two to three percentage points upward for a period long enough to complete the price level adjustment, and productivity was observed to decline sharply. In each instance, measured inflation declined as sharply as it had risen.

Energy Prices in The Eighties

The possibility of major shocks to the supply of energy resources is a major factor influencing prospects for energy markets and their effect on the macroeconomy. The cause of the 1979-80 surge in world oil and energy prices was the sequence of events that began with strikes in the oil fields in Iran, new energy policies there and the Iran-Iraq war. The latter two countries produced about one-fourth of OPEC oil prior to these developments and now produce less than half that.

It is not likely that such a supply disruption can persist for a decade, so I believe that a large part of the 1979-80 run-up in real oil prices will be reversed over this decade. On the other hand the threat of similar or even larger disruptions in the supply cannot be dismissed. A similar disruption in Saudi Arabia would have a much larger impact on world energy prices than the recent developments in Iran and Iraq. Major supply developments can also occur that have large

favorable effects; for example, the end of the Iran-Iraq conflict will result in sharp changes in the world price of oil and energy. Major technological breakthroughs could occur with even larger positive effects. The possibility for temporary spikes must remain a fundamental feature of the outlook in energy markets.

There are two dominant views of prices that have influenced most analyses lately. The first and oldest might be called the "nonrenewable energy view." Proponents of it have so far incorrectly concluded that the physical stocks of nonrenewable resources are an effective market contraint on production. When this constraint in fact holds, economic theory suggests that the real price of the resource will rise at a rate equal to the real rate of interest. A recent Department of Energy study forecasts $2 gasoline prices and $70 crude oil by 1995, measured in 1981 prices. Such estimates are consistent with the nonrenewable energy view for a real market rates of interest of about 6 percent, not far off from some speculation about this rate recently.[5/]

If this view were applicable to the current outlook, it would imply a slowing in the trend growth rate of economic capacity capital formation and real wages of about 0.8 percent per year. The possibility of such a development deserves no attention at all, however, except to set an upper bound on the prospects for adverse trend developments. So long as the rate

of discovery of nonrenewable energy sources is above zero, this outcome does not obtain with even a monopolistic market structure.

The second mainstream view is the cyclical prices hypothesis. According to this view, the real cost of crude oil and energy have declined since early in 1981 due to weakness in demand, primarily associated with the worldwide recession. According to this view, real energy prices will fall in 1982 and perhaps 1983, but then begin to recover as demand expands. This view seems plausible at first glance, if we imagine upward sloping supply curves and the like. Unfortunately, the evidence runs counter to it.

Chart 3 shows the real price of crude oil that is imported, a measure of the world price, and the U.S. average and marginal price paid by refiners for crude oil from 1974 through 1981. The difference until 1981, primarily reflects the effect of domestic energy policy that subsidized the importation and usuage of crude oil. In early 1981 this policy was ended so that the difference shown in chart 3 arises primarily from quality differences.

If the cyclical view were correct, the world price would have fallen during 1975, when worldwide output, employment, and oil useage were declining. Second, the downtrend in the real price of world oil from the end of 1975 to 1978 is not consistent with the cyclical expansion that

occurred during that period. Finally, the increase in the world price in 1980 is puzzling if oil prices are cyclical, since real output, energy useage and employment were falling in much of the world at that time. Real energy and oil prices are not cyclical, so the decline in the real price of oil in 1981 and 1982 should be viewed permanent phenomenon.[6/]

The economic theory of pricing by a dominant firm can be applied to the energy and crude oil market.[7/] The OPEC cartel, with Saudi Arabia as the dominant firm within it, sets a price recognizing that there are many price-taking competitors in the energy market. The determinants of price in such a market are supply conditions for crude oil within OPEC, and the elasticity of demand for their oil. The latter is derived from the world oil demand and non-OPEC oil supply. The primary factors affecting the world price are the price elasticity of world demand, the price elasticity of supply of price-taking competitors and the market share of the Saudis and OPEC.[8/]

In such a model, world oil price reductions occur due to increases in the <u>elasticity</u> of demand for OPEC and Saudi oil. These, in turn, arise from an increase in the elasticity of world oil demand, or from an increase in the supply from Saudi Arabia's competitors, or from an increase in the responsiveness of their supply to the world price.

The major event in the world energy market in this decade was the decontrol of the U.S. crude oil market early in 1981. The primary effect of decontrol was to allow domestic production and prices to be responsive to world prices. Independently of any positive effect on U.S. crude oil supply, this change increased the elasticity of demand for oil confronted by the Saudis and OPEC.[9/] As expected, their optimal and actual cartel prices fell. Since the U.S. market is now decontrolled, this decline is allowed to be fully reflected in the U.S. price of oil and energy resources. Pricing actions of OPEC since decontrol indicate that this decline in the real price of oil will continue through 1982. The domestic real cost of oil is in early 1982 is about the same as its pre-decontrol level. The spike at the beginning of 1981 is fully reversed. The 13 percentage point surge in the relative cost of energy in the U.S. associated with the spike will be removed, as well as the 1 percent surge in the price level and the economic capacity loss associated with the spike. For the world economy, the implication is a real cost of oil that is the same as at the end of 1979, well below 1980-81 levels.

The elasticity and decontrol argument are even more important for natural gas decontrol. Complete decontrol appears increasingly likely to occur and effectively will occur later in this decade under existing legislation (NGPA). Unlike

crude oil controls, existing controls on natural gas involve relatively large exchange inefficiencies, as prices of natural gas vary widely for different users. With no change in gas production, decontrol will result in improved efficiency in energy markets by diverting existing supplies to higher valued uses. In the process, some existing users will switch to other sources of fuel and power, as other users switch to gas. The net effect, however, is to reduce the demand for oil and other fuels. At an unchanged price of oil, the market share of the Saudi Arabians and OPEC in the oil and energy markets declines, again raising the elasticity of demand for their oil and lowering their optimal price. Decontrol also raises the price elasticity of world demand for oil by increasing the elasticity of U.S. gas supply. This, too, raises the price elasticity of demand for Saudi and OPEC oil, lowering their optimal price.

Typical analyses of natural gas decontrol ironically emphasize that natural gas and oil are virtually perfect substitutes in many uses, and so will tend to sell for the same price in a free market. It is ironic, because this fact is used to determine the energy price rise and adverse macroeconomic impacts of decontrol. But energy generally, and oil and natural gas, in particular, are cheaper under full decontrol than without. Current recipients of controlled gas will certainly face higher gas prices initially, but this higher price is far below many current estimates. Moreover,

most gas users and purchasers of other forms of energy would face substantially lower real prices. Thus, economic capacity, real wages and capital formation will be greater, not less. In addition to the outlook for completely decontroling gas prices, controls on the allocation of gas could end. Current restrictions on the use of gas have raised the cost of affected products, and require inefficient energy usage that inflates the demand and price of other sources of energy.

Summary

The major factors influencing energy prices are almost all favorable for price reductions to occur during this decade. Military and political changes in the Middle East are likely to reverse the 1979-80 run-up in world energy prices.

The tendency for real oil and energy prices to decline due to increased competition of non-OPEC energy producers observed from 1975-78 is likely to continue eroding the market share of OPEC and, thereby, raising the elasticity of demand for their oil and lowering their prices.

U.S. energy policy, by freeing controls on prices and use of energy, can exhibit a powerful impact on the world energy market. All three of the exogenous factors contributing to lower OPEC oil prices are favorably affected by such policy changes: the elasticity of the world demand for oil is increased, the share of OPEC oil in world consumption is reduced, and the elasticity of non-OPEC supply rises.

Barring further supply shocks in the Middle East, these forces will tend to push down world oil prices. If natural gas decontrol has only the same impact as crude oil decontrol, the world oil price would tend to fall well below that in 1978. The effect of all these favorable factors is to add almost 2 percent to the annual rate of expansion, which virtually offsets the negative 1973-80 effect.

Even without a reversal of the Iran-Iraq disruption, however, the real price of oil could decline to 1978 levels. This would require the continuing erosion of the OPEC market share combined with the natural gas decontrol effect comparable to that of crude oil decontrol. Such a development would leave real energy prices in the U.S. virtually unchanged for the decade. For the 1982-90 period, however, economic capacity would expand almost 5 percent more or a little over 1/2 percent per year faster.

At the other extreme, but in the absence of further adverse shocks in the Middle East, the worst case is for economic growth to be slowed about 0.8 percent per year, much less than the reduction from 1973-80. Even this would be regarded as a supply-side miracle to some observers.

FOOTNOTES

[1]See, for example, John A. Tatom, "We Are All Supply-Siders Now!" Federal Reserve Bank of St. Louis Review (May 1981), pp. 18-30.

[2]For the original analysis and empirical evidence underlying this section, see Robert H. Rasche and John A. Tatom, "The Effects of the New Energy Regime on Economic Capacity, Production, and Prices," and "Energy Resources and Potential GNP," Federal Reserve Bank of St. Louis Review (May 1977), pp. 2-12 and (June 1977), pp. 10-24, respectively.

[3]The analysis of decontrol of crude oil and its implications below draws upon that in John A. Tatom, "Energy Policy and Prices," Business Economics (January 1979), pp. 14-22.

[4]See Robert H. Rasche and John A. Tatom, "Energy Price Shocks, Aggregate Supply and Monetary Policy: The Theory and International Evidence," in K. Brunner and A. H. Meltzer, Supply Shocks, Incentives and National Wealth, Carnegie-Rochester Conference Series on Public Policy, Volume 14 (Spring 1981), pp. 9-93.

[5]See Energy Information Administration, 1981 Annual Report to Congress.

[6]This is not a new development either. Regressions of changes in the logarithm of the relative price of crude oil on changes in cyclical unemployment rates or capacity utilization fail to reveal cyclical relative price movement in the U.S. for the periods 1948-71 and 1948-74.

[7]OPEC should be viewed as a dominant firm with Saudi Arabia as the price leader and largest producer. This point has been obvious for many years but still tends to be confused. For example, see Steven Plaut, "OPEC is Not a Cartel," Challenge (November-December 1981), pp. 18-24. Plaut cites the existence of a dominant firm within the cartel as an indication that there is not an effective cartel. In international markets, however, cartels almost always face outside competitors and the dominant firm analysis is a useful model of the cartel's behavior.

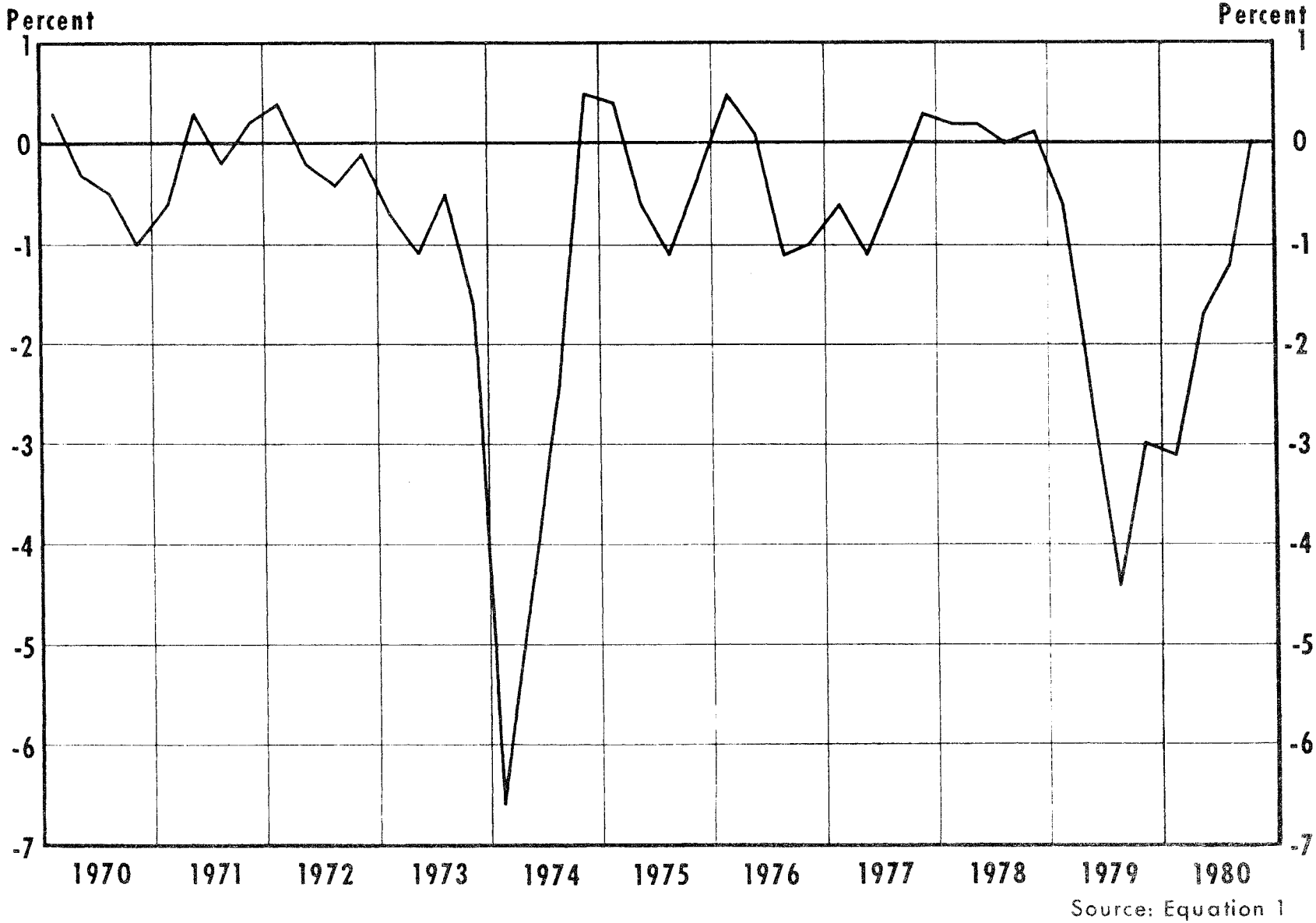
[8]The standard expression for a dominant firm's price is $P = \eta^C/\eta^C - 1\ (m)$, where η^C is the price elasticity of the price-setter's demand and m is its marginal cost of output; the elasticity of demand is $\frac{1}{s_c}(\eta_T + s_0 \varepsilon_0)$, where s_c is the market share of the dominant firm, η_T is the price elasticity of

demand for the product produced by the dominant firm and its competitors, s_0 is the market share of competitors ($1 - s_c$), and ε_0 is the price elasticity of supply for the dominant firm's competitors.

[9]The elasticity of the optimal cartel real price is $-(\eta^c-1)^{-1}$. To evaluate the sensitivity of prices in this model, suppose that the price elasticity of demand for world oil is 0.5, the elasticity of the supply of non-OPEC oil is 0.2, and the OPEC market share is 0.5. The result is an elasticity of demand for OPEC oil of 1.2, so the elasticity expression above would have a value of (-5). Decontrol may raise the elasticity of supply (ε_0) by a trivial amount (a minimum is about 4 percent), with a relatively massive impact on the optimal world price (a minimum of a 20 percent decline in price for the example here).

Chart 1

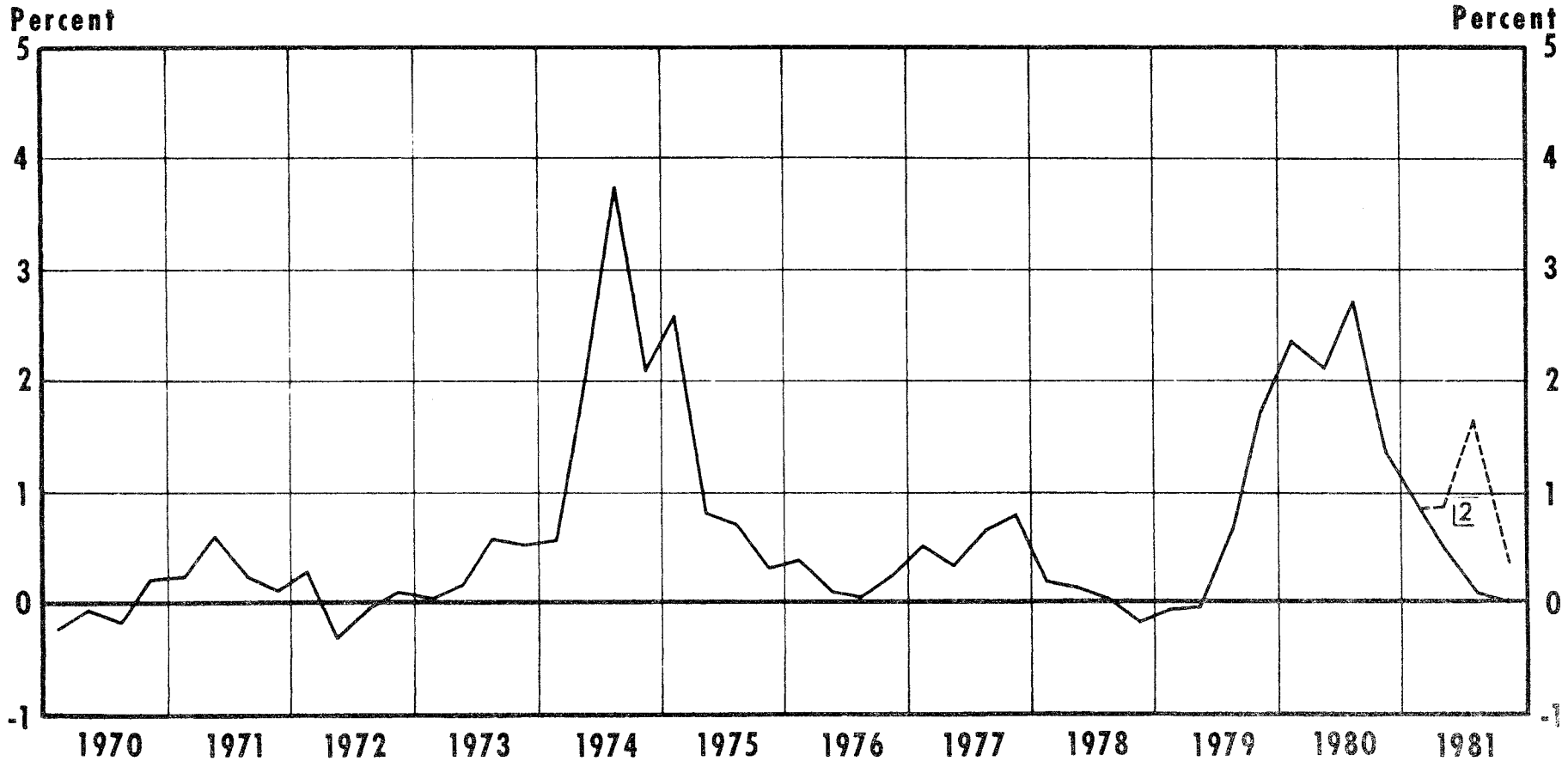
Impact of Energy Price Changes on Potential Output Growth in the Private Business Sector [1]



Source: Equation 1

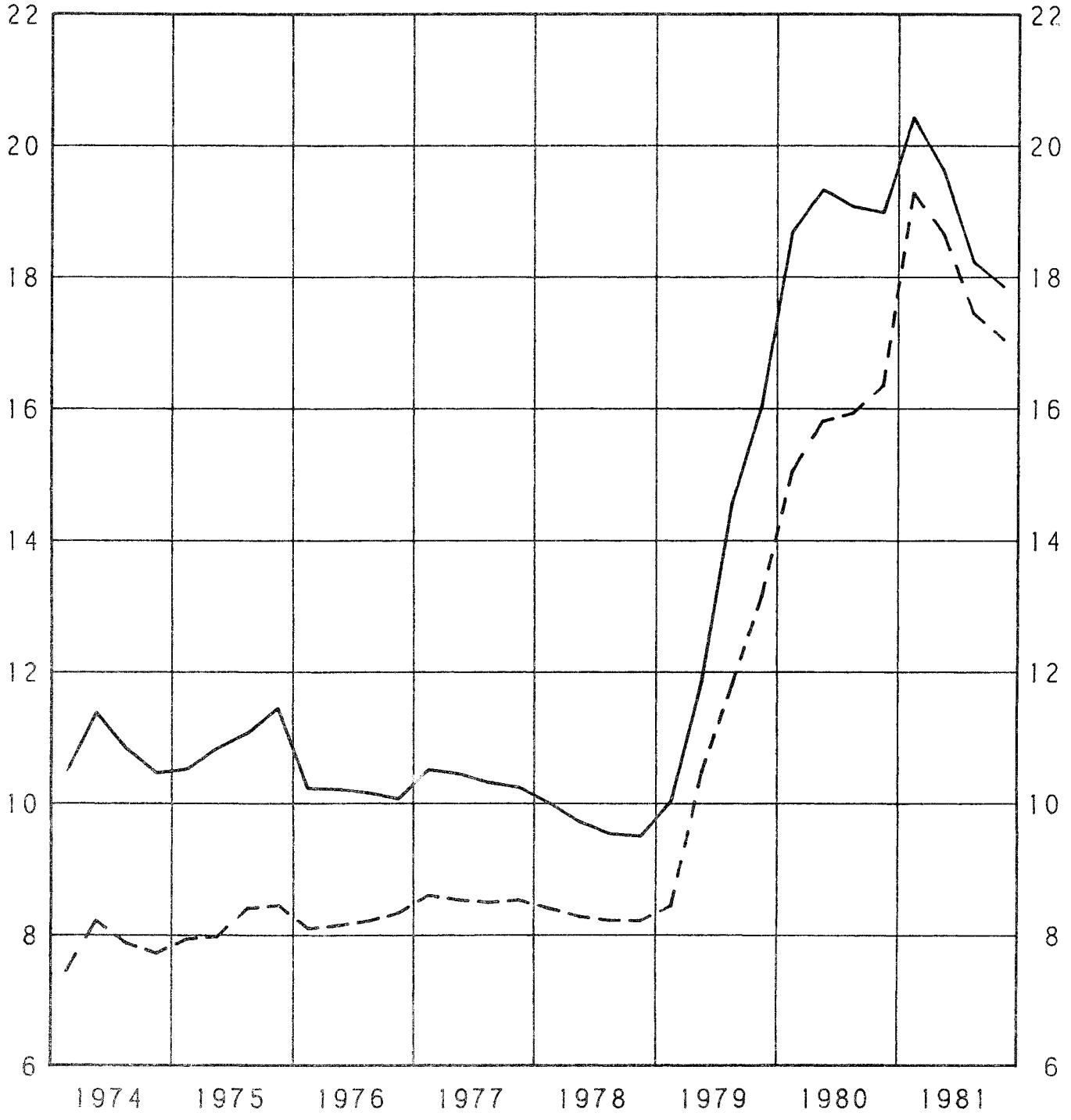
[1] Percentage changes are measured in the logarithm of the level of potential output.
Latest data plotted: 4th quarter

Contribution of Energy Price Changes (I/1970—III/1980) to the Rate of Increase of Prices [1]



[1] Percentage changes are measured by changes in the logarithm of the level of the gross national product deflator.
[2] Additional Effectsof Energy Price Changes occuring from III/1980-IV/1981.
Latest data plotted: 4th quarter

REAL OIL PRICES
(1972 DOLLARS)



——— REAL COST OF U.S. OIL IMPORTS 1/
– – – U.S. PRICE OF OIL 2/

1/ REFINER ACQUISITION COST OF IMPORTED CRUDE OIL DEFLATED BY THE IMPLICIT PRICE DEFLATOR FOR PRIVATE BUSINESS SECTOR OUTPUT

2/ COMPOSITE REFINER ACQUISITION COST OF CRUDE OIL DEFLATED BY THE IMPLICIT PRICE DEFLATOR FOR PRIVATE BUSINESS SECTOR OUTPUT

LATEST DATA PLOTTED: 4TH QUARTER