THE ECONOMIC AND BUDGETARY CONSEQUENCES OF THE RECENT OIL PRICE DECLINE

Staff Memorandum
March 1986

The Congress of the United States
Congressional Budget Office

INTRODUCTION

The world price of oil has dropped dramatically in recent months. Other things being equal, this decrease would be expected to improve substantially the prospects for economic growth and to reduce inflation. We do not recommend changing the CBO forecast at this time, however, since the partial effect of oil prices on the economy is highly uncertain and may be offset partially or fully by other factors. A change in the forecast would have to take into account the following factors:

- Uncertainty about the permanence of the oil price decline;
- The weaker-than-expected economy late last year and so far this year, and lower interest rates than expected;
- The effects of low oil prices on domestic oil production;
- The effects on the financial soundness of energy producers and their creditors, particularly banks lending in the southwestern United States and to oil-producing developing countries;
- The possible monetary responses to falling oil prices and other developments;
- The unfavorable impact on inflation and favorable effect on growth of the larger-than-anticipated decline in the dollar.

Thus an analysis of the economic consequences of falling oil prices that neglected other developments in the economy could be misleading. Moreover, it now appears that the partial effects of the lower oil price on the economy are likely to be smaller than would be implied by scaling up the effects reported in previous CBO analyses, 1/ for four main reasons:

---

1. Congressional Budget Office, Economic and Budgetary Consequences of an Oil Price Decline--A Preliminary Analysis (March 1983), and The Economic and Budgetary Effects of an Expected Oil Price Decline (February 1985).

- The oil prices discussed in the previous studies were not low enough to have a significant effect on domestic production or exploration.

- The previous analyses assumed relatively small percentage changes in oil prices. Large price changes are likely to have less than proportionately large real effects, in part because of the disruption they can cause in financial and labor markets.

- The previous analyses presupposed an economy with considerably more unused physical resources and a higher unemployment rate than the recent CBO forecast (in March 1983, the unemployment rate was 10.3 percent).

- Many analysts expect an increase in oil prices this year or next. A price decline expected to be temporary, as this one may be, will have much smaller effects on activity than one expected to be permanent, as assumed in the previous studies.

Oil Prices

The price of oil for delivery in April is currently fluctuating in the range of $11-$14 per barrel, well below the $23.40 per barrel refiners' acquisition cost (RAC) assumed in the CBO forecast to be the lowest reached in 1986. The RAC is probably above the futures market price because contract prices move more slowly, but even posted prices for the West Texas Intermediate crude are already in the range of $14-$16 per barrel and will likely fall further if the futures price remains in its current range. Underlying the dramatic oil price decline are several factors:

- The unwillingness of Saudi Arabia to continue to support the price of oil at the cost of driving its own export revenues sharply down, and the difficulty of persuading other producers to take the swing role now vacated by Saudi Arabia;

- The very low short-run elasticities of demand and supply of oil, which mean that relatively small supply changes can lead to extremely large price changes;

- Very slow recent growth in worldwide oil demand because of weak economic growth and conservation; and
- The development of new sources of supply since 1980, totaling about 4.4 million barrels per day, in response to high prices.

Many observers believe that the current low level of prices is temporary. While the short-run floor for the oil price, imposed by short-run marginal operating costs, is probably not reached until about $8 per barrel, even the current level of prices, if it persisted, would be likely to increase oil consumption and reduce production, particularly in the United States, by a substantial amount over a period of several years. If the Organization of Petroleum Exporting Countries (OPEC) and other producers can reach an agreement to reduce production, the price could rise quite soon--settling either in the neighborhood of $20 per barrel, which some analysts think meets Saudi Arabia's current desire for increased revenues, or $15 per barrel, which other analysts think is low enough to dampen both conservation efforts and the development of new oil sources and alternative energy sources. Achieving agreements to limit production will be very difficult, however, and one cannot rule out the price's remaining for a while near current levels or even falling further.

Other Recent Developments

Economic indicators have been somewhat weaker recently than CBO had expected. The most evident manifestation of this is the sharp rise in the unemployment rate to 7.3 percent, in part the result of layoffs in the oil

industry. While one month's unemployment is a shaky foundation for an analysis of the current state of the economy, 2/ it is supported by reports of weak non-auto retail sales and nondefense capital goods shipments and orders. Auto sales were strong through most of February, but have required sales incentives to support them and have weakened recently. Total worker-hours and industrial production also fell in February. Capital spending plans for 1986, according to the most recent McGraw-Hill Survey, have increased substantially but remain weaker than would be expected if GNP were to grow at the rate projected in the CBO forecast. The trade deficit worsened sharply in December and January. It is not clear whether this reflects increased import prices resulting from the fall in the exchange rate--the lower price of oil had not yet affected the January data--or a further worsening of real trade flows. Of course, not all indicators point to weak growth. The strongest signs are in residential and commercial (shops and offices) construction. But overall economic growth has not yet responded to the improved financial conditions and the fall in oil prices.

The relatively weak picture for the past two months follows a large downward revision, to 0.7 percent, of the estimate of real GNP growth for

---

2. The rise in unemployment from January to February was probably affected by unusual weather--a very warm January and floods in February. However, these events do not fully explain the increase. Unemployment rose sharply in oil-producing states and in the industrial Midwest. Moreover, manufacturing worker-hours, which would have been much less affected by the weather, also fell in February. This might imply either an improvement in productivity, which has been abysmal recently, or a slowing of output growth.

the fourth quarter of 1985. Thus it seems likely that the level of real output in the first quarter of 1986 is distinctly below CBO's forecast. However, the economic outlook is expected to improve, particularly in light of the decline in the oil price, in the value of the dollar, and in interest rates, so there is no reason at this time to revise the forecast downward.

Interest Rates. Both short-term and long-term interest rates are currently below the levels forecast by CBO for the first and second quarters of 1986. The effect of the larger-than-expected decline in interest rates depends on its cause. If it is the result of weak credit demands, it may simply indicate general economic weakness. If it results from improved inflationary expectations, or a slackening of monetary policy, it could help stimulate business and housing investment. CBO's forecast assumed higher levels of business investment intentions than currently reported. In other words, some further stimulus to investment is required to validate our current forecast.

Decline of the Dollar. CBO's projections assumed that the dollar would decline about 14 percent in calendar year 1986. The decline in the dollar has been even sharper than anticipated, however, and is now about 7 percent below our forecast for the second quarter of 1986. According to a rule of thumb that CBO has previously used, if the dollar falls by 7 percent, consumer prices might ultimately rise by between 0.7 percent and 1.0

percent. Continued declines in the dollar, relative to the CBO forecast, could offset a large part, or even all, of the reduction in inflation resulting from the lower oil price.

IMPACT OF LOWER OIL PRICES ON THE ECONOMY

The Congressional Budget Office has previously analyzed the partial effects on the economy of oil price changes. 3/ These analyses cannot be simply extrapolated to the current situation, however, for several reasons:

- The recent oil price decline is larger than those previously analyzed and, if it is expected to persist, is for the first time large enough to have significant effects on domestic production of and exploration for oil. 4/
- The 1983 study, in particular, was done when economic conditions were very different from today's, and unemployment was 10.3 percent.
- As noted above, many analysts expect that the oil price drop may be largely reversed.

---

3. Congressional Budget Office, Economic and Budgetary Consequences of an Oil Price Decline (March 1983), and The Economic and Budgetary Effects of an Expected Oil Price Decline (February 1985).

4. The importance of oil production in real GNP, and hence the impact of changes in oil production on real GNP growth, were dramatically increased by the Commerce Department's rebasing of the national income accounts from 1972 to 1982 prices that occurred at the end of 1985. For this technical reason alone, estimates of the real effects of oil price changes should differ from those made before the rebasing.

Recent Model Results

The consensus of economists and simulations of macroeconomic models suggest that the oil price decline, taken alone, would increase real GNP by a substantial amount. However, the published simulations reported in the appendix to this memorandum, along with simulations of commercial macroeconomic models performed by the CBO staff, show a wide range of effects. The simulated effects on real GNP in the first and second years are summarized in Table 1, and changes in other indicators are discussed in the appendix. The models generally show the consequences of the increase in real income that follows from the oil price fall, but do not adequately represent the consequent changes in production of oil and non-oil goods and services. The model simulations also do not take into account the adverse effects on some financial institutions, which could have serious adverse consequences for the economy, including the possibility that some of the gain in real income would have to be transferred back abroad as debt repayments by oil producers are rescheduled. Moreover, even in a simulation in which oil prices were assumed to fall only temporarily, the model responses will in the short run be the same as if the oil price decline were expected to be permanent. Thus the model results probably overstate the impact of a temporary oil price decline.

The recent large oil price decline will have some unfortunate effects as well as positive ones. Clearly, oil producers both in the United States and abroad will suffer a substantial fall in their income. As noted above, the

TABLE 1. SUMMARY OF THE REAL OUTPUT EFFECTS

	Oil Prices ($/barrel)		Effects on Real GNP (Percent deviation from baseline)
	Dollar Change (from baseline)	Baseline Forecast	
First-year Effects			
Published Studies			
Chase	-3.50	22.50	0.4
DRI	-4.77	22.50	0.5
WEFA, Quarterly	-7.00	26.00	0.9
WUM	-10.00	20.00	0.7
WEFA, Annual	-11.00	26.00	1.3
CBO Simulations			
DRI	-8.00	22.50	1.6
Fair a/	-8.00	N.A.	0.2
WEFA, Quarterly (PC)	-8.00	19.83	0.3
Second-year Effects			
Published Studies			
Chase	-2.25	20.00	1.1
DRI	-3.54	20.50	1.0
WEFA, Quarterly	-5.00	26.00	1.5
WUM	-10.00	20.00	1.4
WEFA, Annual	-11.00	26.00	1.8
CBO Simulations			
DRI	-8.00	20.50	3.5
Fair a/	-8.00	N.A.	0.5
WEFA, Quarterly (PC)	-8.00	18.46	1.7

SOURCE: Congressional Budget Office; Chase Econometrics; Data Resources, Inc. (DRI); Wharton Econometric Forecasting Associates (WEFA); Laurence H. Meyer and Associates (WUM); and Economica, Inc. (Fair).

a. The Fair model does not contain an oil price lever. The general import price deflator was adjusted to reflect the impact of an oil price change.

resulting reduction in oil-drilling activity in the United States, and the decline in associated economic activities, have already produced a sharp increase in unemployment that is concentrated in the oil-producing states. The number of drilling rigs in use fell from about 1,900 in December to about 1,375 in late February. Some estimates of the ultimate decline in drilling investment are large: structures investment (which includes drilling) might fall by between $6 billion and $15 billion, or 1.3 percent to 3.2 percent of total nonresidential fixed investment. In addition, with so many rigs idle, equipment investment for replacing the rigs would dwindle. This reduction in investment is probably not reflected in the macroeconomic model results reported above, though it is certain to offset at least part of the increased investment by nonenergy companies that find their costs reduced and profits increased by the oil price decline.

The concentration of the economic losses in one part of the country could have effects that are not reflected in the model results. A leading concern is the financial position of banks that have made either direct energy loans or loans to other businesses that are weakened by the decline in the energy business. Although CBO has no data with which to conduct an analysis, discussions with personnel at the Federal Deposit Insurance Corporation indicate that the recent fall in oil prices has exacerbated the situation at some southwestern banks. While the deterioration in the portfolio of direct energy-related loans was to be expected and may result in increased charge-offs, the general slowdown in the economy of this region

makes these financial institutions less able to absorb the cost of the write-downs on these loans. The secondary effect is hard to measure, but it is the opinion of key regulatory personnel that it may be more severe than originally perceived. 5/ The government regulatory agencies are continuing to monitor the problem.

The income losses of producers also affect developing countries that trade with or are in debt to the United States. The Administration has argued that, on balance, the sharp decline in oil prices is beneficial for developing countries, but causes obvious difficulties for countries dependent on oil exports--Mexico, in particular. Newspaper reports indicate that before the oil price decline, Mexico had planned net new borrowing of roughly $4 billion from private and official lenders in 1986. Although the oil price drop is expected to cost Mexico around $6 billion in lost export revenues, Mexico is asking its creditors to provide only another $2 billion above the original plan, while it takes other measures, such as cancellation of a planned increase in foreign exchange reserves, to fill the gap. Mexico is in the process of negotiating the terms of its new loan package, so it is not yet known how much this might increase the borrowing needs of the U.S. Treasury.

---

5. "Bank Regulators Plan New Study of Energy Loans," American Bankers (March 12, 1986), p. 1.

Monetary Policy

While monetary policy assumptions are clearly important in an analysis of the economic consequences of an oil price decline, it is not now clear what the monetary policy response would be to a supply shock such as a sharp decline in oil prices. In the past, most analysts assumed either (1) no change in money aggregate targets (the usual CBO practice) or (2) a purposeful reaction of the monetary authority designed to limit the adverse impact of a supply shock on real ouput or on inflation. Such analysis generally assumed fairly stable growth in velocity--the relationship between the growth in a money aggregate, such as M1, and the growth in nominal GNP. Thus, for example, with the assumption of no change in monetary aggregate targets, a decline in oil prices would reduce inflation and increase real growth temporarily but with little overall impact on the growth of nominal GNP.

In recent years, however, the relationship between growth in money aggregates and growth in nominal GNP has become quite unstable, and the Federal Reserve has found it necessary to take a more eclectic approach. 6/ In recent testimony, Chairman Volcker has indicated that monetary policy is now influenced by a wide range of financial and nonfinancial variables--such as real GNP growth, inflation, the value of the dollar, and the financial fragility of banks--in addition to the growth of money aggregates. In this circumstance, predicting how monetary policy authorities will react to the

---

6. Congressional Budget Office, The Economic and Budget Outlook: Fiscal Years 1987-1991 (February 1986).

decline in oil prices is very difficult because of the uncertainty as to which economic indicators are given primacy in the Federal Reserve's policy deliberations. In its latest report, the President's Council of Economic Advisers states that recent policy moves by the Federal Reserve "are consistent with the view that with a continued moderate inflation rate, real growth has been the primary target of monetary policy." Of course, it is not certain that the Federal Reserve can successfully target real GNP. If it believes that it can, and chooses to do so, it may decide that it can be more expansive given the deflationary impact of the oil price decline. On the other hand, concern over the value of the dollar, worries about longer-term inflation, and the pursuit of other goals may limit its flexibility.

BUDGETARY EFFECTS

Just as the economic effects of a decline in oil prices are uncertain, so are their effects on the federal budget deficit. Oil prices may affect the budget in three ways: (1) through their effect on spending or revenue items that are directly tied to oil prices (the direct effect), (2) through changes in the overall rate of inflation (the inflation effect), and (3) through changes in real economic activity and real interest rates (the real effect). Neither the direct effect nor the inflation effect is likely to cause a clear improvement in the deficit. Higher real economic growth and lower real interest rates would tend to reduce the deficit, but the magnitude of such a reduction is highly uncertain. Moreover, the budgetary effect of real

changes resulting from lower oil prices could easily be swamped by other changes in the economic outlook.

Direct Effect. Certain federal revenue sources and spending programs would be directly affected by a fall in oil prices, but not all of the changes would contribute to a reduction in the projected baseline deficit. Federal spending and the deficit would be reduced to the extent that the Defense Department and other agencies purchase petroleum and other energy products more cheaply and to the extent that appropriations were correspondingly reduced. Other factors, however, would tend to increase the deficit. Revenues from the windfall profit tax would be reduced, as would receipts from the Naval Petroleum Reserves and from bonuses and royalties on Outer Continental Shelf oil and gas leases. The outlays of the Federal Ship Financing Fund would rise because of increased defaults on guaranteed loans for tankers, mobile drilling equipment, and other energy-related vessels. The outlays of the Federal Deposit Insurance Corporation would also increase if there were additional failures of financial institutions heavily invested in energy loans, or if there were a decline in the value of assets acquired from troubled institutions (for example, Continental Illinois). Whether these changes, on balance, increased or reduced the deficit, the net effect is likely to be rather small.

Inflation Effect. Changes in the general inflation rate have little effect on the baseline deficit projections, assuming that real interest rates are

unaffected and that discretionary defense and nondefense appropriations are adjusted to keep purchasing power constant. 7/ In the short run, however, lower inflation may increase or decrease the deficit because of time lags and discontinuities in the indexing of certain outlays and revenues.

For example, Social Security and certain other payments will be increased in January 1987 to reflect increases in the Consumer Price Index from the third quarter of 1985 to the third quarter of 1986. If a decline in the inflation rate occurs too late to be reflected in the calculations for indexing benefits, it would reduce tax collections without causing a corresponding drop in outlays, and the deficit would rise.

The opposite may also result. Under current law, there will be no automatic increase in Social Security benefits if the increase in the Consumer Price Index during the measurement period is less than 3 percent. Compared with CBO's baseline projections, omitting the Social Security cost-of-living adjustment would reduce 1987 outlays by $5 billion. If the inflation rate were only slightly below 3 percent, the reduction in outlays could exceed the loss in tax revenues, and the deficit could fall.

Real Effect. Lower oil prices would reduce the projected baseline budget deficits unambiguously and significantly only if they increased the rate of real economic growth or reduced the real rate of interest (the difference

---

7. Congressional Budget Office, The Economic and Budget Outlook: Fiscal Years 1987-1991, pp. 71-73, and The Economic and Budget Outlook: Fiscal Years 1986-1990, pp. 73-76.

between nominal interest rates and the rate of inflation). CBO's most recent annual report, cited in the previous section, shows that an increase of one percentage point per year in the real growth rate beginning in January 1986 would reduce the fiscal year 1987 deficit by $19 billion. A decrease of one percentage point in all interest rates would reduce the 1987 deficit by about $9 billion. The 91-day Treasury bill rate is now somewhat below where we expected it would be at this time, while the 10-year bond rate is now more than 100 basis points lower. As the discussion of economic effects indicates, however, real economic activity appears to be running somewhat below the level implied by the CBO forecast, so that some catching up is required before any improvement in the budget picture can be expected.

CONCLUSION

By itself, the fall in oil prices is likely to improve the outlook for economic growth. But the magnitude of the partial impact of the oil price drop on the economy is highly uncertain and probably smaller than would be implied by CBO's previous studies of declining oil prices. CBO does not recommend a revision to its forecast at this time, however, since the good news about oil is offset to an unknown extent by the recent bad news about the state of the economy at the beginning of 1986. It is too soon to decide whether the beneficial effects of the oil price decline will be enough to bring economic activity above the CBO forecast in the next year, starting from this weaker

base. The average of private forecasts of real growth for 1987, reported by the Blue Chip survey, is almost exactly equal to that of CBO, despite the fact that private forecasters have had some time to take into account the falling oil prices. Moreover, many analysts expect the oil price decline to be temporary, so that there may be no longer-run improvement in the economy or in the budget deficit.

APPENDIX. SIMULATIONS OF LOWER OIL PRICES IN MACROECONOMIC MODELS

The simulation results reported here are taken from recently published studies as well as from CBO simulations of three macroeconomic models. The estimated macroeconomic effects reported below cannot be viewed as representative of the entire range of possible--or even plausible--effects. None of the models is designed to portray the complete range of macroeconomic effects resulting from a sharp change in oil prices. Thus, it is critical to identify what a given model can say about an oil price shock, before examining the quantitative results.

WHAT SHOULD THE MODELS TELL US?

A sharp decline in the world oil price should tend to shift the aggregate supply and demand curves to the right. The supply curve shift--reflecting lower average domestic production costs--is at first the direct result of cheaper energy inputs, both domestic and imported, later reinforced by reduced prices of capital and labor. The shift in demand is the direct result of the real income windfall to the households, businesses, and governments that directly consume imported goods.

This stylized description of the U.S. economy's reaction to a sustained downward movement in oil prices predicts only an increase in the level of real output. Though most analysts would agree that, because the United

States is a net importer of petroleum, the price level would be lower (in the near term, at least), the stylized description cannot support this prediction, since the described shifts in supply and demand have opposite effects on price. In addition, the oil price fall can reduce both aggregate supply and aggregate demand through its impact on production, employment, and investment in the domestic petroleum sector, as well as through financial pressures caused by domestic lending to oil-producing developing countries. 1/ These adverse effects are likely to be smaller than the favorable income effects discussed above. Macroeconomic effects of an oil price decline, moreover, will have to work themselves out over time. Economists agree in general that the income effects on final demand and production as well as the substitution effects in final demand precede the longer-run factor substitution effects in production. Nevertheless, theoretical arguments provide no quantitative insights as to how the dynamics unfold.

Econometric models are generally expected to help attach quantitative magnitudes and directions to the hypothesized behavioral adjustments of a simple conceptual model. In addition, large-scale macroeconometric models have intricate dynamic and intersectoral effects that are intended to reflect economic reality. Before examining the sectors of the various models used here that are most germane to the supply shock mechanism described above, however, it is important to note some general deficiencies

---

1. None of the macroeconomic models discussed here contains sufficiently detailed specifications to allow for extensive microeconomic analysis of these special factors.

shared by all the econometric models that critically limit their usefulness in the present context.

The explicit recognition of macrodynamic adjustments raises the important issue of whether or not the current decline in the price of oil is perceived to be permanent or transitory. The long-run path for real oil prices should ultimately show steady growth as the capacity level of petroleum production is reached. If the current rapid decline in oil prices results in a reversal of the past decade's trend toward energy efficiency, petroleum demands may approach capacity more rapidly than was previously expected. Since the behavioral adjustments resulting from the price decline do not all occur instantaneously, and since an expectation of a rapid return to growth in oil prices would probably prevent many of the static model predictions from being realized at all, a complete analysis of the macro consequences of the current oil price decline must pay considerable attention to this issue.

Unfortunately, none of the models examined here can (without ad hoc management) produce simulation results that reflect this uncertainty about the future path of oil prices. The price and income elasticities as well as the parameters governing the dynamic paths of adjustment to an oil price decline are fixed in these models. This is in contrast to the changes in behavioral parameters that could reasonably be expected to occur in reality.

The macro impacts of the price decline are further blurred by the fact that they are heavily dependent upon future fiscal and monetary policy

reactions that are, as yet, unforeseen. For the purposes of quantitative analysis, such reactions must be introduced by assumption.

Another potential source of bias in the quantitative results is the fact that the statistical profile of oil prices over the historical period used for estimation of the coefficients in the various models is dominated by two discrete periods of rapid acceleration (1974 and 1979). Because most of the variation in the data is concentrated over periods that are short relative to the model estimation interval and because the United States has not had a period of declining oil prices that matches the present period, the "average" response embedded in the model coefficients may not be relevant for analyzing the current period of substantial and rapid decline.

The models available for analysis differ substantially. One major difference among models is whether the focus is restricted to analysis of the oil market, or broadened to include general-equilibrium interactions throughout the economy. The general-equilibrium models also differ substantially among themselves in structure. The review presented below is incomplete in the sense that the focus is exclusively on macroeconometric models that allow for short-run disequilibrium adjustment. 2/ Despite the intentionally narrow focus on short-run macro models, even a sampling of such models yields a diverse array of simulation results.

---

2. Thus, models in which product markets clear instantaneously are not treated. A prominent example of such a model is the current version of the model developed in E. Hudson and D. Jorgenson, "U.S. Energy Policy and Economic Growth, 1975-2000," Bell Journal of Economics and Management Science, 5(Autumn 1974), pp. 461-514.

ANATOMY OF AN OIL PRICE DECLINE IN FOUR MODELS: WHAT CAN THE MODELS TELL US?

In this section, the structures of four specific macroeconometric models are considered: Data Resources (DRI), Fair, Wharton (WEFA), and Washington University (WUM). 3/ CBO did not simulate the WUM model, but drew limited conclusions from the mathematical structure of the model alone. The issue examined here is the extent to which the respective model specifications conform to the stylization of the oil price shock mechanism presented above. The review of the models is intentionally far from exhaustive since the present objective is modest--to determine how to interpret oil price simulations on these models.

The four models reviewed in this section share a common income-expenditure and value-added accounting structure, a fact reflecting their mutual dependence on National Income and Product Accounts (NIPA) data. Beyond this, the similarities end. Several fundamental differences exist among the models, including:

- o theoretical structures
- o dynamic specifications

---

3. The relevant model versions are: US86A for DRI; Fair's model as estimated on January 27, 1986; PC-Mark7 for WEFA; and WUMMSIM/PC, Version II of January 1986 for WUM.

- o sectoral aggregation 4/
- o specification "styles" 5/
- o model size 6/
- o model estimation techniques. 7/

These differences are critical determinants of the alternative simulation properties characteristic of the various models. Space limitations, however, preclude a detailed elaboration on this point. Only the specific capabilities of the various models in dealing with oil price shocks are examined below.

Will Declining Oil Prices Shift Aggregate Supply?

The decline in oil prices lowers average costs of production in the United States. This supply effect would show up in the models as an increase in

---

4. Fair and, to a much lesser extent, WUM use sectoral aggregation schemes that differ from the basic NIPA classes that are followed by DRI and WEFA.

5. Both the DRI and WEFA models display a tendency toward the use of basic specifications that, more or less, correspond to a particular theoretical foundation which are then supplemented by the addition of such "workhorse" variables as consumer sentiment, vendor performance, or capacity utilization rates to "capture" cyclical effects (and, presumably, improve equation fits). This tendency is much less evident in the Fair and WUM models.

6. The DRI model has by far the largest simultaneous block. The WEFA mainframe quarterly model competes with the DRI model in size, and the PC-Mark7 is a trimmed-down version.

7. Of the models examined by CBO, only Fair employs a systems estimation technique. The Fair model is also the smallest of the four models.

productivity. Some analysts find that oil prices shift productivity only a little, since energy inputs are small relative to gross output. 8/ In any case, while the DRI model probably captures such a supply shift, Fair and WUM do not, and WEFA does so only for strange reasons. The Fair model does not use oil prices directly and contains no explicit aggregate production function. While the WUM model has both a production function and a petroleum import deflator, changes in oil prices will have no supply-side effect on productivity.

The WEFA model contains a (potential) value-added production function. Nonfarm labor productivity is determined by the capacity utilization rate for manufacturing which, in turn, is affected by the gap between actual and potential GNP. Skepticism regarding the WEFA model's ability to represent supply shifts is the result of two observations. First, in the period immediately following a large oil price decline, changes in the GNP gap are entirely the result of movements in actual GNP (demand). Second, the critical equation determining the capacity utilization rate has a "kitchen sink" flavor. For example, the consumer sentiment index, which is directly affected by the Producers' Price Index (PPI) for energy, enters the equation as well. As a result of this specification, the WEFA model may appear to be producing a supply shift but for bizarre reasons.

---

8. See, for example, E. Denison, Accounting for Slower Economic Growth: The United States in the 1970s (Washington, D.C.: Brookings Institution, 1979) pp. 138-142.

The DRI model has a real energy sales variable in the (potential) production function. An oil price decline lowers the PPI for fuels, which increases fuel sales and, hence, potential output. The increase in potential output increases output per worker-hour. The effect is, however, quite small since the lagged response from the PPI to energy sales is quite long and the energy weight in the production function is very small in any case. Thus, although the DRI model does show increased productivity, a supply response, the reason for the productivity response is dominated by demand. 9/

Thus, one can conclude that productivity movements associated with oil price shocks in the four models are generated largely by demand shifts, with the only exception being the small supply shifts in the DRI model.

How Will An Oil Price Decline Change Relative Prices?

The mechanism by which relative prices change in the various models is critical in determining the demand effect. Because the price sector specifications in several cases involve a vast number of interactions, only sketchy details on the price sector structures and their implied restrictions are provided here.

---

9. Moreover, DRI's inclusion of energy--an intermediate input--in a value-added production function may indicate long-run biases in the measurement of total factor productivity. See M. Bruno, "Duality, Intermediate Inputs and Value Added," Chapter III.1 in M. Fuss and D. McFadden, eds., Production Economics: A Dual Approach to Theory and Applications, vol. 2 (Amsterdam: North-Holland Publishing Co., 1978), pp.3-16.

The Fair model is different from the others in this case. Oil price changes in the Fair model--introduced as implied movements in the exogenous import price deflator--affect only the absolute price deflator for nonfarm sales, with relative output prices exogenously determined. Real import demands respond directly to movements in the import deflator. The decline in the absolute price level, in turn, raises real incomes for all domestic sectors, resulting in a net increase in aggregate demand.

In the other three models, the output price is determined as a markup over average variable costs. The markup factor is usually specified so as to vary inversely with some slackness measure. Obviously, a consistent specification of price determination under these conditions will require use of the assumed production functions. Another important characteristic of price determination in the DRI, WEFA, and WUM models is that actual price does not adjust immediately to its "desired" level. Instead, distributed lags are introduced to govern the disequilibrium motions. Unfortunately, these lag structures cannot be supported in detail by microeconomic arguments.

In the WUM model, value-added output is determined by fixed capital and labor. This implies that import prices should not directly appear in the price equation for value-added output. But in the model, the value-added output price varies directly with import prices. Relative output prices are also affected by changes in import prices. As a result of the double counting of inputs in the price equations, the output price effects resulting from a change in oil prices may be overstated.

The DRI and WEFA specifications are similar and can be discussed together. They both assume that intermediate factors are employed in fixed proportions to gross output. While this assumption is restrictive in the sense that it precludes intermediate factor substitution, it conveniently allows for the consistent incorporation of weighted import price effects directly in the final demand deflators.

SOME MODEL SIMULATION RESULTS

Several of the large macro services have recently issued studies of the possible macroeconomic consequences of the oil price decline. Five such studies, produced by Chase Econometrics, Data Resources, Inc., Wharton Econometric Forecasting Associates (two studies), and Laurence H. Meyer and Associates, are examined here. 10/ The difficulty encountered in

---

10. These studies represent simulations on the Chase, DRI, WEFA, and WUM quarterly macroeconomic models as well as a study by WEFA using their long-term annual model. The citations for the short-term studies are: Chase Econometrics, "Cyclical Oil Scenario," U.S. Macroeconomic Forecasts and Analysis (January 1986), pp. B.19, B.26-27; D. Wyss, and others, "If Oil Prices Collapse: The Impact on the World Economy," Data Resources Review of the U.S. Economy (February 1986), pp. 20-25; D. Handler and others, "An Oil Price Collapse," WEFA Quarterly Model Outlook (November 1985), pp. 99-108; and Laurence H. Meyer and Associates, "Oil Prices and Macroeconomic Performance," Special Studies Series (Laurence H. Meyer and Associates, St. Louis, Missouri, March 1986). The WEFA long-term study summarized in the text was not accompanied by a published discussion. The estimated effects reported in the text are from the WEFA annual model simulation, WEFATS.LOWOIL15.ANN.

generalizing from these simulations is that the simulation experiments were undertaken with different assumptions as to the nature of the oil price shock as well as different assumptions regarding monetary policy. Because of these differences, the simulation results cannot be interpreted as indicative of "multiplier" properties in any unambiguous sense. 11/

Tabular summaries of the various published simulation results are presented in Tables 1 through 5, for the Chase, DRI, WEFA quarterly, WEFA long-term, and WUM studies, respectively.

The published Chase study examines a scenario of sharp swings in oil prices over the 1986-1988 period. Relative to Chase's baseline, oil prices are initially lower and ultimately higher. 12/ Judging from the brief

---

11. Some dimensional difficulties also exist. In all the models underlying these simulation studies except the WUM model, behavioral relationships among real variables are still estimated on a pre-revision, 1972-dollar basis. Chase and DRI report their results on a revised, 1982-dollar basis (usually obtained via a basis transformation). The CBO has chosen in most cases to summarize the results on a 1972-dollar basis, although such data could not be obtained for the Chase and WUM simulations. Since actual data are no longer made available by the Bureau of Economic Analysis (BEA) on a pre-revision basis, some of the historical values for 1985 used in the models' baseline forecasts are, in fact, estimates by the respective macro services.

12. Chase developed these swings as a mechanism to generate a cyclical economic alternative to their baseline forecast. An interesting aspect of this scenario's genesis mentioned by John Hagens (Director, US Macro at Chase) in a phone conversation is that their original plans to have an alternative with a sustained decline in the price of oil did not excite their corporate-sector clients, many of whom apparently believe the price drop to be temporary. Note that it is difficult to assess the Chase results for 1988 because of the overlaying of the price increase and lingering responses to the price decline.

TABLE 1. SUMMARY OF PUBLISHED CHASE STUDY (By calendar year)

	1986	1987	1988
Real GNP (billions of 1982 dollars)			
Baseline	3,662.6	3,758.8	3,866.6
Percent change	0.4	1.1	0.4
Difference	14.7	39.5	13.9
Implicit Price Deflator			
Baseline	115.4	119.8	123.9
Percent change	-0.3	-0.6	0.6
CPI-U			
Baseline	333.3	346.6	359.6
Percent change	-0.6	-0.7	0.9
Unemployment Rate			
Baseline	6.9	6.6	6.5
Difference	-0.1	-0.6	-0.6
Short-Term Rate a/			
Baseline	6.94	7.11	6.35
Difference	-0.46	0.12	0.85
Basic Price Shock (Average Domestic & Foreign RAC) b/			
Baseline	20.5	20.0	20.0
Percent change	-17.1	-11.3	17.5
Difference	-3.50	-2.25	3.50

SOURCE: Chase Econometrics, "Cyclical Oil Scenario," U.S. Macroeconomic Forecasts and Analysis (January 1986), pp. B.19, B. 26-27.

a. Three-month Treasury bill rate.

b. RAC = refiners' acquisition cost.

TABLE 2. SUMMARY OF PUBLISHED DRI STUDY (By calendar year)

	1986	1987	1988
Real GNP (billions of 1972 dollars)			
Baseline	1,802.6	1,858.7	1,929.0
Percent change	0.5	1.0	1.1
Difference	8.7	18.8	27.1
Implicit Price Deflator			
Baseline	233.9	240.9	249.2
Percent change	-0.5	-0.8	-0.8
CPI-U			
Baseline	332.5	343.9	358.1
Percent change	-0.9	-1.1	-1.2
Unemployment Rate			
Baseline	6.9	6.8	6.5
Difference	-0.1	-0.4	-0.4
Short-Term Rate a/			
Baseline	6.80	6.50	6.22
Difference	-0.05	-0.03	-0.04
Basic Price Shock (Average Foreign RAC) b/			
Baseline	22.5	20.5	20.25
Percent change	-21.2	-17.3	-17.9
Difference	-4.77	-3.54	-3.63

SOURCE: D. Wyss and others, "If Oil Prices Collapse: The Impact on the World Economy," Data Resources Review of the U.S. Economy (February 1986), pp. 20-25.

a. Three-month Treasury bill rate.

b. RAC = refiners' acquisition cost.

TABLE 3. SUMMARY OF PUBLISHED WEFA QUARTERLY MODEL STUDY (By calendar year)

	1985	1986	1987
Real GNP (billions of 1972 dollars)			
Baseline	1,679.2	1,731.0	1,791.4
Percent change	0	0.9	1.5
Difference	0.1	15.2	26.6
Implicit Price Deflator			
Baseline	231.5	240.0	250.6
Percent change	0	-2.3	-3.6
Unemployment Rate			
Baseline	7.2	6.91	6.50
Difference	0	-0.26	-0.61
Short-Term Rate a/			
Baseline	7.93	7.01	7.95
Difference	-0.05	-1.27	-0.45
Basic Price Shock (Average OPEC Price)			
Baseline	27.36	26.00	26.00
Percent change	-2.7	-26.9	-19.2
Difference	-0.75	-7.00	-5.00

SOURCE: D. Handler and others, "An Oil Price Collapse," WEFA Quarterly Model Outlook (November 1985) pp. 99-108.

a. Federal funds rate.

TABLE 4. SUMMARY OF WEFA LONG-TERM MODEL STUDY
(By calendar year)

	1986	1987	1988
Real GNP (billions of 1972 dollars)			
Baseline	1,725.9	1,782.6	1,832.5
Percent change	1.3	1.8	1.7
Difference	22.0	31.9	30.3
Implicit Price Deflator			
Baseline	2.412	2.519	2.642
Percent change	-2.3	-2.7	-3.3
CPI-U			
Baseline	3.335	3.480	3.666
Percent change	-2.8	-3.3	-4.1
Unemployment Rate			
Baseline	7.38	7.22	7.23
Difference	-0.67	-1.23	-1.36
Short-Term Rate a/			
Baseline	6.77	7.53	8.42
Difference	-0.94	-0.83	-0.98
Basic Price Shock (Import price, crude petroleum, $/barrel)			
Baseline	26.00	26.00	26.00
Percent change	-42.30	-42.30	-42.30
Difference	-11.00	-11.00	-11.00

SOURCE: Wharton Econometric Forecasting Associates.

a. Three-month Treasury bill rate.

TABLE 5. SUMMARY OF WUM QUARTERLY MODEL STUDY
(By calendar year)

	1986	1987	1988
Real GNP (billions of 1982 dollars)			
Baseline	3,674.1	3,789.9	3,909.2
Percent change	0.7	1.4	1.7
Difference	24.6	52.3	66.0
Implicit Price Deflator			
Baseline	1.146	1.178	1.213
Percent change	-0.3	-0.7	-0.7
CPI-U			
Baseline	3,319	3,427	3,538
Percent change	-0.9	-1.3	-1.3
Unemployment Rate			
Baseline	6.5	6.3	6.3
Difference	-0.3	-0.5	-0.8
Short-Term Rate a/			
Baseline	7.00	6.40	5.90
Difference	-0.3	-0.2	-0.2
Basic Price Shock (Import price, crude petroleum, $/barrel)			
Baseline	20.00	20.00	20.00
Percent change	-50.00	-50.00	-50.00
Difference	-10.00	-10.00	-10.00

SOURCE: Laurence H. Meyer and Associates, "Oil Prices and Macroeconomic Performance," Special Studies Series (Laurence H. Meyer and Associates, St. Louis, Missouri, March 1986).

a. Three-month Treasury bill rate.

description of the simulation in the text supporting this study, no changes to fiscal or monetary policy parameters from Chase's baseline assumptions were introduced.

The published DRI study mentions that they reduced federal expenditures (presumably to reflect the declining price level and increased economic activity), although the exact nature of these changes is not made explicit. Judging from the estimated macroeconomic effects reported in its study, DRI appears not to have introduced changes to the monetary policy assumed in its baseline.

The published article that presents the WEFA quarterly model results mentions several assumptions exogenously built into the simulation. Regarding monetary policy, WEFA assumes that the monetary authority initially (1986) accommodates the spurt in economic growth by expanding nonborrowed bank reserves sufficiently to reduce the federal funds rate by over 150 basis points in the third quarter of 1986. By 1987, the resulting growth in aggregate demand, which brings with it upward pressure on the price level, forces the Federal Reserve to reverse its initial stance with some restraint on bank reserves exogenously introduced into the simulation. In addition to the monetary policy assumption, the WEFA publication mentions additional exogenous adjustments to the dollar exchange rate (assumed to gradually fall to 7 percent below baseline), a small decline in U.S. oil production (of unspecified magnitude), and declines in windfall profit tax revenues of $1.2 billion in 1986 and $1.0 billion in 1987.

CBO does not have a complete description of the WEFA annual model simulation. A memo sent to WEFA clients describing the simulation, however, alludes to several exogenously introduced assumptions which include a reduction in natural gas and wellhead prices, enhanced foreign activity and inflation, and "an active role by the Federal Reserve in avoiding a banking crisis resulting from the weakness of the energy sector and the failure of more banks in the Southwest."

The WUM model study assumes that the monetary authorities react to the declining price of oil by maintaining the money stock at its baseline level throughout. The study cautions that "the entire calculus of the benefits of lower oil prices depends crucially on the response of the monetary authorities."

Overall, the simulation results presented in the various published studies show similar macroeconomic effects of declining oil prices only in the first year. Other than noting the disparities across the various simulation after the first year, further inferences cannot be drawn from the published simulation results because of the diverse assumptions used.

Simulation experiments performed by CBO on the DRI, Fair, and WEFA models are described in the remainder of this section. In each case, CBO used the February 1986 baseline macro forecasts of the respective vendors as initial conditions and introduced the following shocks:

DRI A reduction in the average refiners' acquisition cost (RAC) for foreign crude petroleum of $8 per barrel.

WEFA A reduction of the same magnitude as the DRI shock to the appropriate lever in the WEFA model: average OPEC price.

FAIR A reduction in the import price deflator of 4 percent. The Fair model does not include oil prices, and the chosen approach for changing the deflator was suggested by Dr. Ray Fair to overcome this difficulty. The shock was developed by CBO on the basis of a (static) rule of thumb associating a $1 shift in oil prices with a 0.5 percent change (in the same direction) in the deflator.

The simulations were run from the first quarter of 1986 through the fourth quarter of 1988. All the simulations were unmanaged in the sense that rather obvious auxiliary adjustments to other macroeconomic variables (inventories and windfall profits tax revenues, for example) were not made so as not to corrupt the pure model results. 13/ In addition, the "default" monetary policy rules were kept in force. For the DRI and WEFA simulations, this meant constant nonborrowed reserves and endogenously determined money stocks. For the Fair model, the default monetary policy is an interest rate "rule" that keeps both reserves and money stocks endogenous. The CBO also experimented with a constant reserves version of the Fair simulation and found that this modification did not noticeably alter the simulation results.

A summary of the results is displayed in Table 6. The differences between the various "pure" model simulation results are striking. While the initial price responses are fairly similar across the simulations (in particular,

---

13. Thus, the simulation methodology used by CBO is not necessarily that endorsed by DRI, Fair, or WEFA.

TABLE 6. CBO SIMULATIONS OF AN OIL PRICE DECLINE OF $8/BARREL ON THREE MODELS, CALENDAR YEARS 1986-1988 (Percent deviation from baseline unless noted)

	1986	1987	1988
Nominal GNP			
DRI	0.7	1.9	2.6
Fair	-0.3	-0.5	-0.6
WEFA	-0.6	-0.3	2.7
Real GNP			
DRI	1.6	3.5	3.7
Fair	0.2	0.5	0.7
WEFA	0.3	1.7	3.4
GNP Implicit Price Deflator			
DRI	-0.9	-1.5	-1.1
Fair	-0.5	-1.0	-1.3
WEFA	-0.9	-2.0	-0.7
CPI-U			
DRI	-1.6	-2.2	-2.2
Fair	-1.1	-1.6	-1.9
WEFA	-1.0	-1.8	-1.1
Civilian Unemployment Rate (Change in percentage points)			
DRI	-0.5	-1.2	-1.4
Fair	0.0	-0.1	-0.2
WEFA	-0.1	-0.8	-2.6
Productivity			
DRI	1.6	1.8	1.3
FAIR	0.1	0.1	0.1
WEFA	0.1	0.2	0.1

SOURCE: Congressional Budget Office.

NOTE: The Data Resources, Inc. (DRI) model simulations used the 1986-A version of the model. The Economica, Inc. (Fair) model simulations used the version updated in January 1986. The Wharton Econometric Forecasting Associates (WEFA) simulations used the PC-Mark7 version of the model available in January 1986.

the CPI-U effects), the output effects are quite different. The DRI simulation recorded a strong initial increase in real activity, while both the Fair and WEFA simulations showed little impact at first. Moreover, a strong productivity boost in the DRI simulation (even relative to the boost to activity) was not evident in the other simulations. The simulated effects on unemployment were also interesting. The DRI model showed the largest initial response in the unemployment rate, which is somewhat paradoxical in light of the fact that the initial increase in productivity growth exactly matched the increase in real GNP. In addition, the WEFA simulation showed an enormous decline in the unemployment rate in the third year of the simulation. 14/

In light of the limitations of the macroeconometric models discussed in earlier sections of this appendix as well as the diverse model results surveyed here, it is difficult to draw general conclusions from the estimated effects reported. All of the model-based studies examined by CBO agree that the current rapid decline in oil prices will be beneficial to U.S. real output and price levels in the near term, if the decline is perceived to be permanent. As these caveats and the model simulation results indicate, however, no conclusions as to the exact magnitude of this increased activity can be drawn from the simulation studies.

---

14. This result suggests some unstable simulation properties. In fact, simulations of a slightly larger decline in oil prices ($10/barrel) and simulation of the $8/barrel decline on WEFA's March baseline would not converge in 500 iterations. These instabilities are apparently not characteristic of WEFA's mainframe version of the quarterly model (or their annual model), but they do raise additional doubts as to the usefulness of PC-Mark7 results for the present analysis.