

Archive

SUPPLY INSTABILITY AND
OIL MARKET BEHAVIOR

BY

Henry D. Jacoby and James L. Paddock

Energy Laboratory
Working Paper No. MIT-EL 79-033WP

Revised:
November 1979

ABSTRACT

This paper analyzes the disruption in world oil markets which was triggered by the 1978-79 Iranian revolution. The resultant price rises are explored in the context of the behavior of the spot market and key OPEC countries. In particular, the economic and political roles of excess oil supply in the Persian Gulf nations are discussed. Conclusions for the likely future are presented, along with the implications for United States policy.

SUPPLY INSTABILITY AND OIL MARKET BEHAVIOR*

by

Henry D. Jacoby and James L. Paddock

1. INTRODUCTION

Events in Iran have produced a period of severe disruption in oil markets. Almost a year after the Iranian revolution there is still considerable confusion and uncertainty, and very likely we face several more months of painful adjustment before the market settles down again. This is hardly an ideal time to try to take stock of what has happened, because it is all too easy to be misled by short-term phenomena and the emotions of the moment, and to miss the developments that will weigh heavily in the longer run. These events are significant for the world economy, however, and many decisions are being called for in response

*This research has been supported by the National Science Foundation under Grant No. DAR 78-19044. However, any opinions, findings, conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of NSF. The work also is supported by the M.I.T. Center for Energy Policy Research.

This paper was prepared originally for the IAEE-RFF Conference on International Energy Issues in Washington, DC in June, 1979.

We wish to thank the following individuals for their comments on an earlier draft: M. Adelman, L. Cox, and T. Neff. Also, for help in data analysis we thank J. Carson, W. Christian, H. Owsley, and G. Ward.

to them. The tea leaves need to be read, even while they are swirling in the cup.

There is one consolation: we are unlikely to see anything new. The history of international commodity cartels is a long one, and we have a growing if painful experience with OPEC. Moreover, there is little in recent events that cannot be explained by one well-known theory or another--whether geologic, economic, or political. The problem in the current oil situation is to decide what weight to give to competing theories and explanations, several of which are consistent with the observable data.

We will argue that the disruption of oil production in Iran simply brought to the fore a circumstance that most observers knew was possible, but thought unlikely. That is, a temporary loss of supply from any major exporter could tighten markets and lead to an upward ratcheting of the oil price. The price setters might welcome such an opportunity. But even if they did not, it might be difficult for them to control the sequence of events once under way. Given the speed with which spot prices can move in such a circumstance, and the rapidity with which surcharges on contract volumes can follow increases in spot prices, the avoidance of such an upward price ratchet may require a coordinated and vigorous balancing response by Saudi Arabia and others in OPEC. If these nations are unable, or unwilling, to play such a role during short-term situations, then temporary supply disruptions can easily produce uncontrolled, and largely unpredictable, price movements. Today, the probability of such events is seen to be higher than in the past, and correctly so.

2. THE CRUNCH, THE SQUEEZE, AND THE RATCHET

In the past two or three years, there has been a lively debate about future developments in the world oil market. Most studies have been long-term in focus. Some have been based upon static programming solutions for future years, or on some form of annual simulation of supply and demand. Still others based forecasts on optimizing models of OPEC behavior. Most of these analyses have devoted little time to the possible consequences of a major supply disruption. Such events have not been ignored completely, but very little has been done to foresee behavior in the face of a supply disruption, or to analyze ways in which the oil market might be different if disruptions were common. In keeping with a long-term focus, most analyses have treated excess capacity as readily available in the short term, and have dealt with the aggregate excess capacity in OPEC as a whole and its evolution over periods of a decade or more.

Our attention has now been diverted to short-term phenomena. To begin an analysis of what we have learned, it is useful to review what these previous analyses had to say before the Iranian interruption. Most of these studies fall into one of three camps: those believing in the "crunch," the "squeeze," or the "ratchet."

2.1 The Crunch

The most common approach to the problems of the oil market has been to forecast an oil "crunch." World oil prices are assumed to hold roughly constant in real terms in the future, and independent supply and demand projections are made at this price. Sooner or later, the demand on OPEC

rises to equal and then to surpass available capacity in OPEC. Some studies compute gaps of unmet oil demand (e.g., Workshop on Alternative Energy Strategies, 1977). Others forecast a price jump at approximately the point at which the excess capacity in the cartel dries up (e.g., U.S. CIA, 1977).¹ More recent studies discuss price and income adjustments needed to close the predicted gap (e.g., U.S. DOE, 1978 and U.S. CIA, 1979).

There are various views of the ways in which the cartel nations might be led into such a circumstance. On the one hand, it is argued that these countries would like to raise the oil price before the "crunch," but are restrained by political pressures or fears about the impact of significant increases in the real oil price on the world economy. Others argue that the key Persian Gulf producers do not need the money, and they are tired of spending their national patrimony to support the energy appetites of the developed countries; thus they will simply stop capacity expansion at some arbitrary point and wait for nature to take its course.

A variant of the "gap" or "crunch" model is one which argues that anticipatory actions by consumers and non-OPEC suppliers will cause prices to rise well ahead of any expected shortfall in supply. In this model the cartel cannot hold prices constant up to some calculated point where demand rises to equal capacity, even if its members want to. These studies see prices rising rapidly over a period of two to four years in advance of the point at which demand approaches physical capacity limits. All these models share the view that the cartel will actually try to follow a policy of constant real prices over time, until the point when

¹For a critique of this view, see Adelman and Jacoby (1978).

market forces take over. This view assumes that key supplier nations will do little to manipulate price directly, with the exception of maintaining the real value of a barrel of their exported oil at the level of the mid-1970's.

2.2 The Squeeze

Others model the behavior of the cartel in line with theories of monopoly behavior and the economics of exhaustible resources; the result is a computation of the wealth-maximizing price path over the next few decades (Cremer and Weitzman, 1976; Pindyck, 1976; and ICF Inc., 1979). These studies show the real price of oil rising gradually over time, with the precise trajectory dependent upon the underlying structure of the demand and supply equations, upon estimates of demand and supply elasticities and overall reserves of oil to be found, and upon the assumed form of bargaining between consumers and producers. Implicit in these studies is a gradual squeeze of the world oil market, as prices rise in real terms year-to-year under cartel control.

Usually such analyses are advertised as indicating only rough trends in price; the actual trajectory is likely to be characterized by bumps and jerks around the long-run trend as the cartel feels its way. The authors of these studies face considerable uncertainty about the best way to structure the problem and to choose parameter values, and most would agree that the cartel managers are no better informed. Nevertheless, such studies imply that the cartel actually exercises control over price. The process of price adjustment is assumed to be similar to that utilized by OPEC nations in December 1978, when they announced a scheduled series of price increases to take place during the period from December 1978 through the end of 1979.

2.3 The Ratchet

Finally, there is a view that the cartel wants to adjust price gradually over time, as the "squeeze" analysis would imply, but its members are restrained politically from following such a policy. If the world-wide inflation rate is assumed to be 5 to 10 percent per year and if, as many of the "squeeze" models imply, an optimal real oil price rises at 2 to 5 percent per year during the 1980's, then the cartel must raise the nominal oil price approximately 7 to 15 percent each year over a long period of time. It is argued that this continuing rise is not feasible in the face of strong pressures from consumer governments and that some other mechanism will have to be used to move the price up.

One way to achieve this increment in price would be for the cartel leaders to establish policy limits on production, which might be significantly below installed capacity. They could then hold to these supply ceilings as oil demand grew to the level of supply committed to the market. Under such conditions, pressures in the spot market would eventually take over: spot prices for crude oil and refined products would rise, and short-term surcharges on crude oil contracts would follow. Once the roof had been lifted, so to speak, it would be possible for the cartel to establish a higher floor through an increase of the OPEC marker crude price. Countries of the cartel core could then encroach upon that capacity held in reserve, to increase aggregate supply and bring the surcharges back in line with the new official OPEC level.²

²Of course, without substantial excess capacity in reserve, this strategy could prove extremely risky. The time to expand capacity may be several years. Setting out to prepare a ratchet, the cartel could create the "crunch" described above.

Were significant price increases to be gained by this method, the path would not be the smooth one derived from analytical models of the market, but would take a series of jumps followed by periods of adjustment. The process would be difficult to control; cartel leaders could easily overshoot; and periods of price erosion might follow intermittant increases of, say, 20 to 40 percent.

Both the "squeeze" and the "ratchet" explanations of cartel behavior assume that the cartel controls the oil market. Both models also implicitly assume that the cartel leaders will exercise their ability to absorb shocks by use of the excess capacity they hold and will maintain a price close to the preferred trajectory, clouded though their view of this optimal path may be. Of course, their capability to do this depends both upon the actual installation of enough excess capacity to perform the shock-absorber role, and upon the willingness and ability of these leaders to exercise short-term flexibility in the event things threaten to get out of hand.

3. THE PRICE INCREASE OF 1979

3.1 What Happened?

Let us then turn to the events of the last year and see how they fit within the framework of pre-Iran analyses. Table 1 and Figure 1 tell the story. As can be seen in Table 1, oil output in October 1978 was up significantly from the third quarter of that year, due in part to normal demand growth. Some stock building by consumers was probably under way in anticipation of the OPEC price hike announced for December, and undoubtedly some speculation was involved as well. Iranian production began to drop significantly in November, and as Iran left the market other suppliers filled in. In previous months, a fair amount of excess capacity had been on the fringes of the market, ready to be sold at all times, but most exporters had not been willing to shave prices far enough to open a place for their oil.

From September to December 1978, production also went up substantially in Saudi Arabia and in other countries of the Persian Gulf. Thus, even though Iranian production was down by 3.5 million barrels per day by December 1978, world output was still above the average level of the third quarter. Of course, in the absence of a good short-term model of oil consumption, the relationship of output to demand can only be guessed. Over periods as short as two to three months stock movements are also very important. There is some information on the size of primary stocks (those held by major producers and refiners); but there are almost no data on the quantities of oil in secondary stocks (oil at sea, oil held by major jobbers and distributors, and oil held by industries), and what may be called tertiary stocks (gasoline in cars and oil in homes, etc.).

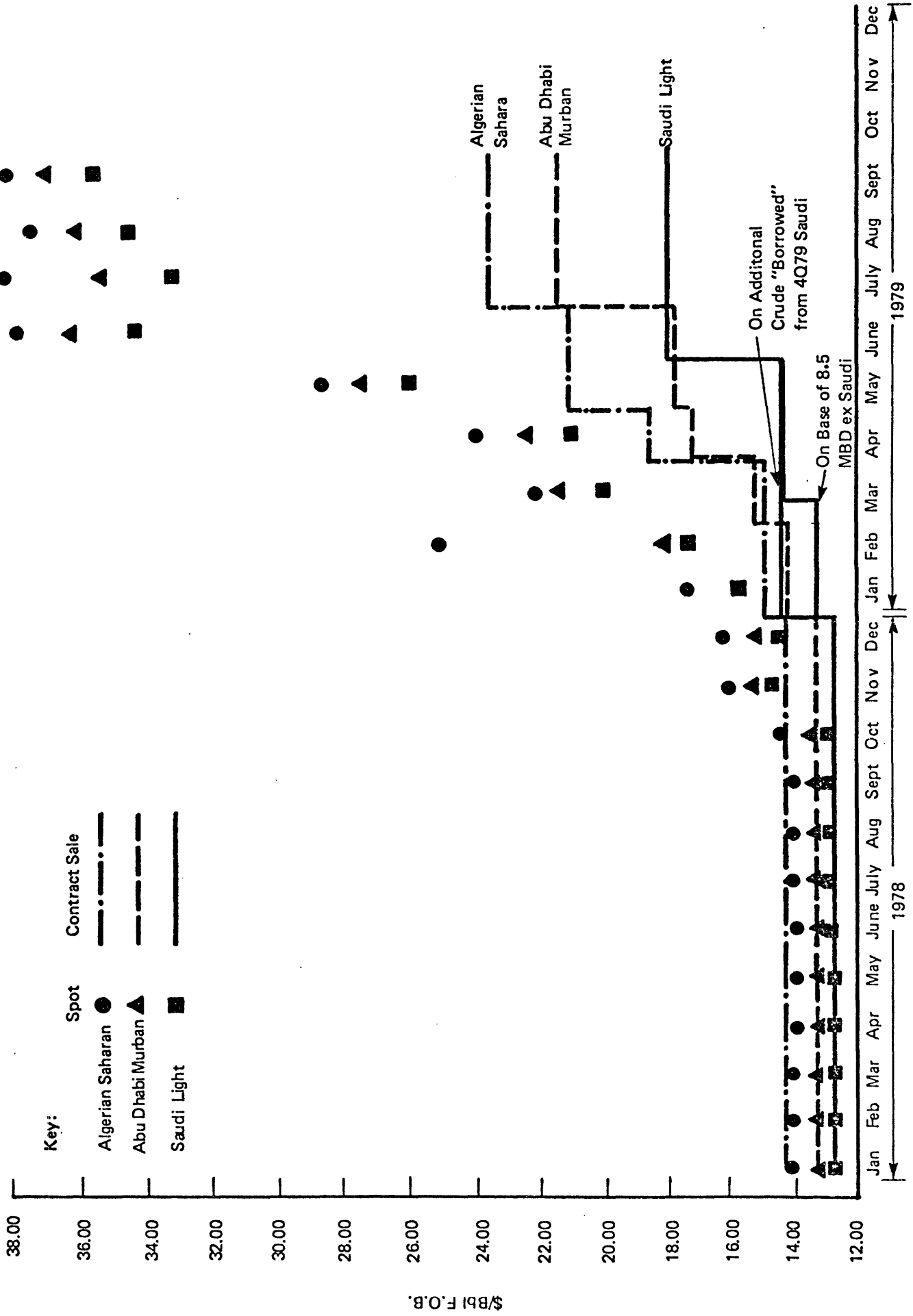
TABLE I

CRUDE OIL PRODUCTION INCREASES (DECREASES) FROM 3rd QUARTER 1978 LEVELS

(Thousands of barrels per day [tbd])

| | Oct. 78 | Nov. 78 | Dec. 78 | Jan. 79 | Feb. 79 | Mar. 79 | Apr. 79 | May 79 | Jun. 79 | July 79 | Aug. 79 |
|---------------------------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Saudi Arabia | (395.7) | (2391.7) | (3514.7) | (5440.7) | (4790.0) | (3140.0) | (1890.0) | (1390.0) | (1590.0) | (1690.0) | (1990.0) |
| UAE | 1627.4 | 2600.1 | 2752.3 | 2137.5 | 2127.2 | 2124.2 | 1141.8 | 1131.6 | 1130.8 | 2125.0 | 2123.0 |
| Qatar | (187.4) | 352.7 | (96.3) | 317.7 | 310.6 | (4.0) | (45.2) | (6.0) | (7.1) | (37.8) | (64.1) |
| Iraq | 350.0 | 450.0 | 450.0 | 450.0 | 640.0 | 640.0 | 640.0 | 640.0 | 840.0 | 840.0 | 840.0 |
| Other OPEC | 0.0 | (39.5) | 81.6 | 35.6 | 44.9 | (152.0) | (63.4) | 42.6 | (52.7) | (27.7) | (19.8) |
| Total Mideast | 1394.3 | 971.6 | (327.1) | (2499.9) | (1467.3) | (531.8) | (216.8) | 416.5 | 321.0 | 1209.5 | 889.1 |
| Nigeria | 86.9 | 248.6 | 372.6 | 412.6 | 370.0 | 377.0 | 357.8 | 339.8 | 342.0 | 323.3 | 242.0 |
| Venezuela | 51.7 | (3.4) | 56.2 | 8.5 | 87.8 | 168.3 | 126.0 | 123.0 | (9.3) | 72.2 | 70.0 |
| Libya | (24.9) | 110.7 | 133.7 | 33.7 | 20.9 | 70.8 | 74.1 | 55.3 | 46.6 | 88.3 | (1.3) |
| Other OPEC | 0.5 | 21.7 | 2.0 | 52.0 | 25.0 | 9.1 | (15.1) | (186.3) | (98.3) | (151.3) | (120.5) |
| Total OPEC ^b | 1508.5 | 1349.2 | 237.4 | (1993.1) | (963.6) | 93.4 | 326.0 | 748.3 | 602.0 | 1542.0 | 1079.3 |
| Non-OPEC ^c | 193.0 | 530.0 | 697.0 | 705.0 | 766.0 | 765.0 | 947.0 | 965.0 | 1201.0 | 1241.0 | N/A |
| Total World: ^d | 1701.5 | 1879.2 | 934.4 | (1288.1) | (197.6) | 858.4 | 1273.0 | 1713.3 | 1803.0 | 2783.0 | N/A |
| Excl. Iran | 2097.2 | 4270.9 | 4449.1 | 4152.6 | 4592.4 | 3998.4 | 3163.0 | 3103.3 | 3393.0 | 4473.0 | N/A |

^aOther Arabian Peninsula (including Oman and Bahrain).^bIncludes Oman and Bahrain.^cExcluding Centrally Planned Economies.^dAssumes no change in exports of Centrally Planned Economies.SOURCE: Petroleum Intelligence Weekly and Oil and Gas Journal.



Source: Petroleum Intelligence Weekly

FIGURE 1
SELECTED CRUDE PRICES, 1978-1979

As Iran began to falter, certain oil companies were caught short and had to go into the spot market for crude oils and products. Since this is a very narrow market as measured against the size of the Iranian loss, the effect of this demand on spot prices was dramatic. Over the period October through December 1978, spot prices for oil products rose strongly in European markets, as did the spot prices for crude oils. By December Saudi Light was selling on spot at several dollars above the marker price (Figure 1).

In January 1979 there were two additional shocks to the oil market. Iranian exports stopped completely, and Saudi Arabia announced that it was going to cut back production to an average of 9.5 million barrels per day for the first quarter of 1979. For a period in December 1978, Saudi Arabian production had gone as high as 10.5 million barrels per day, and this production level was continued into the early weeks of January. In order to meet the announced target of 9.5 for the month, it was necessary to cut back to around 8 million barrels per day, which Saudi Arabia apparently did for a time in January. The precise week-to-week production is not widely known.

What was important about the Saudi cutback however, was its effect on expectations. It was not known how long the Iranian conflict would last, and the Saudi cutback added to the pressure on spot markets. Spot prices for crude oils jumped precipitously, as shown in Figure 1. Subsequent events followed as naturally as night follows day. In January 1979, Saudi Arabia announced a \$1.20 premium on all oil in excess of the previously announced policy limit of 8.5 million barrels per day. Shortly thereafter, other countries began to add surcharges to their crude oils. OPEC oil ministers argued for this premium by criticizing

the "profiteering" and "ugly exploitation" of oil companies that were collecting the rents available under the rising market prices for crude oil. By late February 1979, most producers were selling crude oils at prices far above the then official marker price of \$13.34, but all were below the spot market prices, which were still rising. Then, in the OPEC meeting of March 26, 1979, the official price was raised to \$14.55--in effect, bringing forward the price step that was due in late 1979. This left most countries with surcharges above the new official OPEC price, with only Saudi Arabia selling at the official level.

During the second quarter of 1979, this circumstance persisted, with most suppliers levying surcharges of \$3 to \$4 per barrel in addition to the official \$14.55 price. Then in late June, the next step was taken. The price of Saudi Light was moved to \$18 per barrel; but this price remains as a floor, with most exporters intending to hold to some premium above the \$18 level. Oils with a transport or quality advantage over the marker crude traditionally collect a premium of up to \$1.50 to \$3.00, but as of Fall 1979 premiums as high as \$6.00 are in effect. Saudi Arabia, and perhaps her immediate neighbors, may increase output and bring spot prices and contract premiums back in line with this new \$18 price. Or, they may refuse to increase output, which will keep markets tight and hold contract premiums significantly above the official price. Such action would then set the stage for further marker price increases later in the year.

No one yet knows what will happen, even assuming Iranian output remains stable at 3 to 4 million barrels per day. If a significant loss of production were to recur in Iran, or in any other oil-producing nation, then under these tight market conditions a new round of price increases would undoubtedly be initiated.

3.2 Interpretation of the Events

So what was this latest disruption in the oil market? Was it the beginning of the "crunch?" Are we in the middle of a fateful and potentially devastating confrontation between growing demand and permanently limited supply? Is it simply a controlled "ratchet" by certain OPEC nations as they take advantage of the Iranian situation to raise prices sooner than they might otherwise have been able to do? Is there some other model of market structure and behavior that now appears closer to the facts than those laid out above? The answers to these questions have strong policy implications, for actions taken on the basis of one interpretation can prove very costly if other explanations turn out to be closer to the truth.

The Crunch? The scenario of an oil "crunch" refers to the circumstance in which demand presses against available capacity and the oil producers can do nothing to help, even if they want to. This has not been the case in recent months, and it need not be so in the near future unless another major source of supply fails.

There is much debate about the production capacity in OPEC, but a look at two of the best-known sources gives us a feel for the situation. Table 2 shows OPEC productive capacity and the excess month by month. This particular estimate is a summary of industry opinion, by and large. Excess capacity outside Iran is around 4 million barrels per day throughout the period October 1978 through July 1979, with 2 to 3 million barrels attributable to Saudi Arabia and her immediate neighbors. A more conservative estimate, by the CIA, is shown in Table 3. These estimates of "maximum sustainable" capacity yield excess capacity totals of 1.5 to 2 million barrels per day over the same period: the excess capacity is again concentrated on the Arabian Peninsula

TABLE 2

OPEC CRUDE OIL PRODUCTIVE CAPACITY AS ESTIMATED BY PIW,
AND EXCESS CAPACITY FOR OCTOBER 1978 THROUGH AUGUST 1979.

(Thousands of barrels per day [tbd])

| | Capacity ^a | | Excess Capacity | | | | | | | | | |
|---------------------------|-----------------------|--------|-----------------|--------|--------|--------|--------|--------|--------|---------|--------|--|
| | Oct.78 | Nov.78 | Dec.78 | Jan.79 | Feb.79 | Mar.79 | Apr.79 | May 79 | Jun.79 | July 79 | Aug.79 | |
| Saudi Arabia ^b | 10,840 ^c | | | | | | | | | | | |
| Kuwait ^b | 1,562 | 579 | 436 | 1,052 | 1,063 | 1,066 | 2,049 | 2,060 | 2,061 | 1,067 | 1,069 | |
| UAE | 1,229 | 689 | 1,136 | 724 | 739 | 1,053 | 795 | 755 | 758 | 789 | 816 | |
| Qatar | 653 | 660 | 649 | 663 | 666 | 677 | 749 | 636 | 626 | 661 | 664 | |
| Iraq | 145 | 177 | 67 | 101 | 96 | 282 | 102 | 110 | 195 | 131 | 117 | |
| Libya | 1,000 | 900 | 900 | 900 | 700 | 700 | 700 | 700 | 500 | 500 | 500 | |
| Venezuela | 427 | 397 | 411 | 362 | 369 | 320 | 436 | 455 | 464 | 422 | 511 | |
| Nigeria | 94 | 149 | 57 | 137 | 52 | (28) | 14 | 17 | 149 | 68 | 70 | |
| Indonesia | 386 | 224 | 116 | 59 | 72 | 65 | 84 | 102 | 100 | 119 | 200 | |
| Algeria | 211 | 215 | 198 | 195 | 181 | 170 | 192 | 231 | 188 | 191 | 200 | |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 43 | 24 | 48 | 3 | 15 | 17 | 33 | 65 | 10 | 70 | 30 | |
| Subtotal ^d | 32,225 | 4,014 | 4,018 | 4,196 | 3,953 | 4,350 | 5,154 | 5,131 | 5,031 | 4,018 | 4,177 | |
| Iran | 6,990 | 3,496 | 4,619 | 6,545 | 6,290 | 4,640 | 3,390 | 2,890 | 3,090 | 3,190 | 3,490 | |
| Total OPEC ^d | 39,215 | 7,510 | 8,637 | 10,741 | 10,243 | 8,990 | 8,544 | 8,021 | 8,141 | 7,208 | 7,667 | |

NOTES:

^aThis capacity is estimated maximum production achievable and sustainable for several months without regard to government restrictions." Petroleum Intelligence Weekly, October 8, 1979.

^bIncludes 340 tbd from Divided Zone.

^cRevised downward by 1,000 tbd (from 11,840 tbd) from PIW, March 12, 1979.

^dIn the totals, any country producing above the PIW estimate of capacity (figures shown in parenthesis) is credited with zero excess.

TABLE 3

OPEC "MAXIMUM SUSTAINABLE" CRUDE OIL CAPACITY AS ESTIMATED BY THE CIA,
AND EXCESS CAPACITY FOR OCTOBER 1978 THROUGH AUGUST 1979.
(Thousands of barrels per day [tbd])

| Capacity ^a | Excess Capacity | | | | | | | | | | | |
|---------------------------|-----------------|---------|---------|---------|---------|---------|---------|--------|---------|---------|---------|--|
| | Oct. 78 | Nov. 78 | Dec. 78 | Jan. 79 | Feb. 79 | Mar. 79 | Apr. 79 | May 79 | Jun. 79 | July 79 | Aug. 79 | |
| Saudi Arabia ^b | 1,022 | 39 | (104) | 512 | 523 | 526 | 1,509 | 1,320 | 1,321 | 27 | 29 | |
| Kuwait | 789 | 249 | 696 | 284 | 299 | 613 | 355 | 215 | 218 | 325 | 276 | |
| UAE | 518 | 525 | 514 | 528 | 531 | 542 | 614 | 501 | 491 | 526 | 529 | |
| Qatar | 95 | 127 | 17 | 51 | 46 | 232 | 52 | 60 | 145 | 71 | 67 | |
| Iraq | 0 | (100) | (100) | (100) | (300) | (300) | (300) | (300) | (500) | (500) | (500) | |
| Libya | 127 | 97 | 111 | 62 | 69 | 20 | 136 | 155 | 164 | 122 | 211 | |
| Venezuela | 94 | 149 | 57 | 137 | 52 | (28) | 14 | 17 | 149 | 68 | 70 | |
| Nigeria | 286 | 124 | 16 | (41) | (28) | (35) | (16) | 2 | 0 | 19 | 100 | |
| Indonesia | 61 | 65 | 48 | 45 | 31 | 30 | 42 | 81 | 38 | 41 | 50 | |
| Algeria | (125) | (125) | (125) | (125) | (125) | (125) | (125) | (125) | (125) | (125) | (125) | |
| Other | 18 | (1) | 23 | (22) | (10) | (8) | 18 | 40 | (15) | 45 | 5 | |
| Subtotal ^c | 3,010 | 1,275 | 1,466 | 1,619 | 1,551 | 1,963 | 2,740 | 2,391 | 2,525 | 1,244 | 1,337 | |
| Iran | 1,060 | 3,106 | 4,229 | 6,155 | 5,900 | 4,250 | 3,000 | 1,400 | 1,600 | 1,700 | 2,000 | |
| Total OPEC ^c | 4,070 | 4,381 | 5,695 | 7,774 | 7,451 | 6,213 | 5,540 | 3,791 | 4,125 | 1,944 | 3,337 | |

^aMaximum sustainable or operational capacity is the maximum production rate that can be sustained for several months; it considers the experience of operating the total system and is generally some 90-95 percent of installed capacity. This capacity concept does not necessarily reflect the maximum production rate sustainable without damage to the fields." CIA International Energy Statistical Review, October 3, 1979.

^bIncludes 300 tbd from Divided Zone.

^cIn the totals, any country producing above the CIA estimate of capacity (figures shown in parentheses) is credited with zero excess.

^dEstimate decreased from 10,300 to 10,100 in May 1979, and further decreased to 9,800 in July 1979; excess capacity was calculated on a basis of 10,300 tbd capacity through April, 10,100 from May to June, and 9,800 from July on.

^eEstimate decreased from 2,900 to 2,800 in May 1979; excess capacity was calculated accordingly.

^fEstimate was 6,600 until early May, 5,500 thereafter when estimated additional capacity loss was factored in; excess capacity was calculated accordingly.

Note that several nations produced more than the CIA estimate of "maximum sustainable" capacity. In fact, over the short run of a few months, the CIA's estimate of "installed" capacity may be the more relevant.³ This estimate resembles very closely the PIW numbers in Table 2, except that Saudi Arabia is credited by the CIA with 12,840 million barrels per day instead of the 10,840 shown in the PIW estimate. Whichever estimate comes closer to the correct figure, however, it appears that sufficient capacity existed to replace Iranian oil without serious disruption to world markets. Since Iranian production is back up to over 3 million barrels per day, any tightness in the market today is not caused by a physical "crunch" but by production controls by OPEC leaders.

Moreover, OPEC can avoid falling into a "crunch" circumstance through the manipulation of demand by price, and by additional capacity creation. Table 4 shows two sample calculations using an oil capacity forecasting model prepared by the M.I.T. World Oil Project (Adelman and Paddock, 1979; and Adelman and Jacoby, 1979). The first column shows what would have happened to field productive capacity had each of these countries sustained a 5 percent growth rate in development drilling over the period 1975 to 1978. Excluding Iran, capacity could have been raised 4.5 million barrels per day over the PIW estimate or approximately 3 million above the CIA estimate of "installed" capacity. In fact, many of these countries did not sustain this investment rate. Table 4 also shows

³In the CIA definition, "Installed capacity, also called nameplate or design capacity, includes all aspects of crude oil production, processing, transportation, and storage. Installed capacity is generally the highest capacity estimate." CIA International Energy Statistical Review, May 2, 1979.

Table 4

POSSIBLE EXPANSION OF OPEC PRODUCTIVE CAPACITY
(Thousand barrels per day)

| | 1978 Potential as seen from 1975 ^a | Possible net additions from 1979 to 1982 ^b |
|---------------|--|--|
| Saudi Arabia | 14,700 | 3,000 |
| Kuwait | 3,200 | (200) |
| UAE and Qatar | 3,500 | 400 |
| Iraq | 3,675 | 700 |
| Libya | 2,750 | 250 |
| Venezuela | 2,750 | (450) |
| Nigeria | 2,450 | (100) |
| Indonesia | 1,900 | 150 |
| Algeria | 1,300 | 300 |
| Other | <u>500</u> | <u>0</u> |
| Subtotal | 36,725 | 4,050 |
| Iran | <u>7,200</u> | <u>0</u> |
| Total OPEC | 43,926 | 4,050 |

NOTES:

- a. Assumes a 5 percent annual increase in development drilling.
- b. Assumes a 5 percent annual increase in development drilling, and production at capacity.

what could be accomplished by 1982 if this 5 percent annual increase in capacity development investment were carried out beginning in 1979. If such growth were to occur, an additional 4 million barrels per day (of field capacity) could be added over the 1979-82 period.

Of course, such investments require planning time; these increases cannot be had by 1982 if the decision is made only in 1980. These figures do give an indication, however, of the growth potential of the key OPEC countries, should they decide that capacity expansion is in their interest. The data indicate that an oil "crunch" need not occur because of the technical inability of OPEC producers to expand production. It is rather the policy decisions of these nations--influenced as they are by a host of economic, social, and political factors--that determine the outcome.

The Ratchet: Economics or Politics? Recent events may clearly be interpreted as an example of the "ratchet" method of price administration. OPEC had already established a programmed plan of price increase to take place over the calendar year 1979. It can be argued that the oil price was still below the wealth-maximizing levels, and OPEC nations would have taken advantage of any opportunity to move closer to the optimum path. Thus, in this view, once the dimensions of the Iranian crisis became clear, Saudi Arabia cut back production to 9.5 million barrels per day to provide more force for a ratchet of the crude oil price. It may be assumed that this action was based on as careful a calculation as possible of its implications for price movements. Saudi Arabia thus moved production to a little above 9.5 million barrels per day during the period, January through March 1979, and then cut back to 8.5 million in April, May, and June. Once again, the move to 8.5 may be

interpreted as meaning that Saudi Arabian officials intended to keep the premiums high, in order to take the marker price higher when OPEC met again in June. In July, Saudi Arabia went back up to 9.8 million, presumably to try to cool things down as spot prices were rising again in the early part of the summer.

Others argue that the production cutback in January was purely a political decision. Saudi Arabia had previously announced a policy of limiting production to 8.5 million barrels per day, and we should take seriously the possibility that the additional 1 million barrels per day, to 9.5 million, was all they could do within the limitations of their internal political system and the pressures of the general political circumstance in the Middle East. Moreover, one may believe that some set of political changes exists that will satisfy Arab political objectives and lead to a relaxation on the oil price front in the near term. Or, barring an easing of prices, we may look forward to the creation of more supply capability and an increased likelihood that it will be used to moderate ratchets in the future. In this view, if the desired political gains are not achieved, we should expect continuing production cutbacks--to the point that all nations are disadvantaged economically, including the Arab producing states.

At this stage we cannot tell which of these views is more nearly correct, for all moves made thus far, however political the trappings, appear to be to the economic advantage of the oil exporters. Very likely the true story of producer behavior, were it known, would comprise some complex blend of factors, with the weights of different factors shifting over time and the strategy not necessarily clear even to the inside players.

Also, producer behavior has not yet been tested in the face of extreme events, though we are surely close to such a test. Had the price of oil gone significantly higher over recent months, as it might have if Iran had stayed out for a longer period, then the threat to the world economy might have been significant. Saudi Arabia, Kuwait, and other oil-producing states might well have come back up to full production capacity to try to avoid crisis. These nations may do so yet, if the spiral of prices continues or if an additional jump is stimulated by production cutbacks elsewhere in the system. Of course, it is difficult to estimate precisely how much excess capacity is needed to control large price swings. If a major supply source is shut down for more than a month or two, the sustainable excess capacity elsewhere in the system must at least equal the amount dropped, else a price increase is certain. Consumer expectations and risks of additional shut-downs would call for still more excess. All that can be said at this point is that the capacity existed to cover Iran, with 5 to 10 percent of OPEC output to spare even during the worst months. Had this capacity been used, the price ratchet would surely have been less severe, though it is not clear that such action could have controlled prices altogether.

3.3 Conclusions

Whatever view one takes of the recent behavior of Saudi Arabia and other OPEC members, some conclusions can be drawn about the future of the world oil market. These events expose a new dimension of the market and mark a change in the perceptions of its evolution over the next few years.

First, given the instability and loss of production in Iran, Saudi Arabia would have had to work hard, in cooperation with other core

members, in order to avoid the recent price increase. If all cartel core producers had come on line at what was generally regarded to be their installed capacity, the situation might have been manageable in the short run. But such management would have required near-universal cooperation on the part of producers.

Second, we need to seek more sophisticated definitions of what we mean by "capacity" in the cartel under conditions of excess. Clearly, excess capacity is the control device, and this capacity can be brought on-line over long periods of time as demand grows and production plans adjust to market conditions. Moreover, whatever one thinks of their role in long-term price behavior, political constraints can play a strong role in any short-term situation in which an exporter may be called upon to increase production rapidly in order to moderate price increases. If the core members of OPEC do not maintain excess capacity, then loss of a major supplier would cause an uncontrolled price ratchet with no production available to moderate the change. The fact that the capacity is there, however, does not mean it will be used for short-term price control.

Third, in the absence of a coordinated cartel policy to avoid price ratchets, such events can be easily kicked off by any instability in a major supplier or combination of minor suppliers. Were Iran to go out of production for another two months, the same process would clearly take place again. The price ratcheting we have just experienced could be triggered again by any one of four or five major exporters dropping from the market, even for short periods of time. In fact, if additional capacity is not installed, then demand growth over time will produce a situation in which the loss of even a small supplier will cause a ratchet

situation. Such an event might even be "planned," e.g., if Libya were to shut down temporarily for political reasons, or if Nigeria or Indonesia were to try to boost the price to meet financial goals.

Fourth, it would be easy for a series of ratchets of this type to lead to a serious overshoot. If instabilities in major suppliers are more likely than in the past (and the on-going revolution in Iran is enough to justify this view), then we face periodic ratcheting of this type. It is even possible for prices to be ratcheted to a level that is to the disadvantage of Saudi Arabia--to the extent the Saudis act as the residual supplier--or to the disadvantage of the cartel as a whole. In this case, prices may be expected to erode in real terms following such an increase, or even to decline in nominal terms if the overshoot were really large. We have not yet seen a lowering of the marker price, but there are conditions that could lead to it. These conditions depend on the behavior of the core countries and their willingness to absorb cutbacks in production in the face of an overshoot of price.

Finally, events of the recent months indicate that the United States exercises little influence over these price increases. Our supposed power over world oil prices was based on the notion that we held some sway over Saudi Arabian policy. Even before the events in Iran we would have questioned this belief. In the face of the instabilities of the last year, and the price movements that came in their wake, it seems even less reasonable than before to assume that the United States has much influence. Moreover, a large change in the volume of U.S. oil imports might have an effect on prices over the longer term, but marginal changes--say, 1 million barrels per day--would have had little or no effect on the trajectory of prices over recent months.

4. IMPLICATIONS FOR UNITED STATES POLICY

If, in fact, we do face increased instability of oil prices, then this circumstance has implications for domestic and foreign policy in the United States. First, there is the question of what we can do to control prices during periods of disruption. As indicated above, there is very little we can do to influence the behavior of major OPEC suppliers. We may argue that larger excess capacity should be carried by countries like Saudi Arabia, so that they will be able to exercise a moderating influence in this kind of a circumstance. In this recent experience, however, there is little indication that we have any influence over the use of such excess capacity in the heat of the event. On the other hand, in no case is it advantageous to the United States to discourage capacity development. Even though we cannot cause the capacity to be used as a moderating influence during market disruptions, United States policy should be to promote oil productive capacity development worldwide, particularly among countries that are likely to use it, i.e., those with large populations and heavy domestic economic development expenditures.

Other actions may be undertaken to influence the way that prices move when a disruptive event occurs. One problem in the upheaval of recent months has been the poor quality of information about secondary stocks. Figures on primary stocks showed a significant decline during the months of January and February 1979, and these figures became the basis for news stories and statements of alarm by public officials. In fact, a good deal of this apparent "consumption" merely reflected a shifting of supplies from primary stocks to secondary stocks. Thus, the poor reporting system created the impression that the shortage was much

greater than it was in fact. Poor information led to increased anticipations of stringency in the future and put further pressure on spot markets.

Thus one constructive step that might be taken in the area of data collection and reporting is the creation of a data series on secondary stocks in the major consuming countries. The data need not be precise; the series might be constructed by taking random samples of suppliers. Even such a rough estimate of secondary stocks would lead to more accurate anticipations during a period of disruption and would thus alleviate frantic bidding in spot markets.

A second measure that might be contemplated in similar situations in the future is the use of the strategic oil stockpile to moderate price increases. The merit of this idea depends on which view is taken of the intentions and likely behavior of cartel leaders such as Saudi Arabia. If we believe that Saudi Arabia is likely to put forth a significant effort to moderate price increases, then the use of some portion of our stockpile to increase supplies over the short term, with the objective of easing anticipations of stringency, could have an influence on the degree to which spot prices rise. Such measures might influence the increases in contract premiums that can be extracted in such a period of disruption.

On the other hand, a stockpile strategy may be very risky if we are wrong about the intentions of the cartel leaders. If, in fact, the ratchet is being used to achieve a substantial increase in the world oil price, then it is within the power of key cartel members to simply back off and allow the United States to run down strategic stocks in a futile attempt to contravene cartel policies. The volumes under OPEC's control

are much larger than those of the United States stockpile. In this situation, we would have little influence on the price premiums charged during the period of disruption, and we would be forced to buy back our strategic stockpile at higher prices after the ratchet was completed.⁴ However, in a circumstance of embargo and cutback, there may be some advantage to the United States, in foreign policy terms, if net imports can be reduced in the short run. For a discussion of these issues of national security and foreign policy, see Jacoby, et al. (1979).

Naturally, in the face of a ratcheting price, it is better if the United States imports less, strictly in terms of real resource cost. United States reductions might also have some moderating effect on the ratchet itself, though the nature of the process (i.e., operation in the face of considerable excess capacity) makes the price benefits problematic. Also, long-term supply strategies, such as a major synfuels program, will have little effect over the ten to fifteen year horizon. These programs should continue to be justified on the basis of the value of the energy they produce, rather than for their role in establishing a "backstop technology cost," which might put a cap on OPEC prices. It does not appear that this cost information is particularly relevant to the ratchet process. Even if it were--and synfuels were known to be available at costs competitive with imported oil--it still would be several decades before this energy could be produced in large volumes. The world oil price could easily ride above any "backstop" cost, only to

⁴The problem is similar to that faced by central banks trying to support currencies. If private traders know the approximate limit of the support capability of the central bank, and if they see external forces which are likely to overwhelm the support commitment within a reasonably short period of time, then the whole support effort is to no avail.

be forced down some time past the end of this century. Thus, in the face of the ratchet, the best policies for domestic supply and demand are those that encourage the economy to adjust as efficiently as possible to the actual, and expected, prices of oil in world markets.

Finally, the prospect of periodic price ratchets means that the world economic system may face a series of short-term shocks, with accompanying problems of monetary stress and commodity inflation. Thus far, the monetary problems caused by price ratchets have been manageable. There is the more troublesome prospect, however, that multiple bursts of commodity inflation might lead to contractionary fiscal and monetary policies and restraints on trade.

We might imagine a different world, one in which shock absorbers were built into the consumption system, or key cartel countries took on conscious and well-understood policies to moderate the effects of the market ratchet. These conditions do not exist today, however, and there is no indication that such a system will be in place over the next decade. We should prepare, therefore, for the prospect that the events of the last year will be repeated whenever there is disruption in oil production by a supplying country. We will very likely see several such events over the next decade.

REFERENCES

- Adelman, M.A. and H.D. Jacoby, "Oil Gaps, Prices & Economic Growth," MIT Energy Laboratory Working Paper No. MIT-EL-78-008WP, May 1978.
- Adelman, M.A. and H.D. Jacoby, "Alternative Methods of Oil Supply Forecasting," in R.S. Pindyck (ed.), Advances in the Economics of Energy and Resources, Vol. 2, (JAI Press Inc.), Greenwich, Conn., 1979.
- Adelman, M.A. and J.L. Paddock, "An Aggregate Model of Petroleum Production Capacity and Supply Forecasting," MIT Energy Laboratory Working Paper No. MIT-EL-79-005WP, revised July 1979.
- Cremer, J. and M.L. Weitzman, "OPEC and the Monopoly Price of World Oil," European Economic Review, Vol. 8, pp. 155-164, 1976.
- ICF Incorporated, "Imperfect Competition in the International Energy Market: A Computerized Nash-Cournot Model," submitted to the Office of Policy and Evaluation, U.S. Department of Energy, May 1979.
- Jacoby, H.D., et al., "Energy Policy and the Oil Problem: A Review of Current Issues," Energy Laboratory Working Paper No. MIT-EL-79-046WP, September 1979.
- Pindyck, R.S., "Gains to Producers from the Cartelization of Exhaustible Resources," The Review of Economics & Statistics, May 1978.
- U.S. Central Intelligence Agency, The International Energy Situation: Outlook to 1985, 1977.
- U.S. Central Intelligence Agency, The World Oil Market in the Years Ahead, August 1979.
- U.S. Department of Energy, The Energy Information Administration 1977 Annual Report to the Congress, Volume II, Chapter 4, 1978.
- Workshop on Alternative Energy Strategies, Energy: Global Prospects 1985-2000, 291 pp. (McGraw-Hill Book Co.), New York, 1977.