OIL: ALTERNATIVE PERSPECTIVES ON THE DECADE

EMF OP 29

Hillard G. Huntington

Presented to
Federal Reserve Bank of Dallas

November 15, 1990

Acknowledgement: I have greatly benefitted from the many ideas and insights of the EMF 11 Working Group members and the group's chairman, W. David Montgomery. I want to acknowledge their significant contributions but also emphasize that the conclusions in this paper are mine and should not necessarily be attributed to the working group.

Energy Modeling Forum
Terman Engineering Center
Stanford University
Stanford, California

Economics and the Oil Market

The dynamics of oil price formation is similar to my cooking Indian food; my curry tastes different each time I make it. Sometimes, when one stirs the pot of oil-price curry, a strong taste of economics comes through. At other times, politics is the dominant flavor. And right now, the curry has the distinct flavor of psychology and military science.

Over time, I expect the economic flavor to come through more distinctly and will force prices down from today's level. But these conditions may materialize only after some sharp turns in oil prices responding to developments in the crisis. They may also take months to be realized. Over the next several years, rivalry among members of OPEC may exacerbate this price decline as they try to put Humpty-Dumpty together again. Who will reduce output to allow Iraq and Kuwait back into the club?

Over the long-run, it is difficult to know whether the Iraqi invasion of Kuwait has permanently altered the sustained price path for oil. This will depend significantly upon whether the monarchial states like Saudi Arabia or the populist Arab states like Iraq dominate in the post-invasion political scene. Does a continued US military presence reduce the risk of oil investment in the region or does it increase the tension of a rising Arab populist mood against Western incursions into this politically volatile region? And what about the actions of major oil-consuming countries? Does a third shock in 18 years significantly increase their efforts to find alternatives to gasoline as a transportation fuel?

For all of these reasons, I suspect that it will be difficult to discern for some time whether we have actually entered a new regime for oil markets. Any evaluation will necessarily have to deal with some basic economic factors that shape this market. And those are the issues that I would like to discuss today.

The Energy Modeling Forum Study

My remarks focus on long-run oil market trends, not on short-run consequences of oil disruptions. My conclusions are based upon results from an Energy Modeling Forum (EMF) comparison of model results focusing on international oil supplies and demands. EMF was founded in 1976 at Stanford University to help improve the use and usefulness of models for developing insights about energy markets and key energy issues. Each study is conducted through an ad hoc working group of some 40 decisionmakers and analysts from industry, government, and academia. The current working group is chaired by W. David Montgomery, Assistant Director for Commerce and Natural Resources, U.S. Congressional Budget Office. The analysis for our oil study was completed before the Iraqi invasion so that my remarks assume that oil prices will return to pre-invasion levels over the next year.

My major points include three key observations. First, after many years of changing energy prices, fluctuating economic growth, and shifting government policies, there is little agreement about future oil supply and demand trends. Second, this range of views on supply and demand can lead to very different assessments of the long-run, sustained oil price paths over the next decade or two. Decisionmakers should plan for a range of future prices. And third, despite these uncertainties, there is agreement on the increasing dependence on Persian Gulf oil across a range of models and scenarios. Furthermore, policy actions for limiting oil imports may be costly and difficult.

The working group analyzed 12 different scenarios examining the oil markets under a range of different conditions. One scenario was based upon the mid-price case in the Energy Information Administration's 1989 International Energy Outlook. After remaining relatively flat in the high teens through the early 1990s, the long-run, sustained oil price path rises to $30 a barrel (1990$) by 2000 and to $39 a barrel by 2010. This path shows the oil price path that can

be sustained over the long run; prices in the short run can be either above or below this path. Also, the possible effect of exchange rates on the dollar price of oil is not incorporated. The market economies are assumed to grow at 2.9% per annum over the 1988-2000 period in this scenario, called the 1989 IEO price case in the study. Finally, any additional policies to reduce oil demand in the major economies are not incorporated. While one might expect some demand-reduction policies in the US, other countries have already made considerable progress in shifting away from oil.

Alternative Perspectives on Oil Consumption

After leveling out during the 1980s, oil consumption in the market economies begins to rise in all models in this scenario, although at substantially different rates. Figure 1 highlights the projections of only three of the dozen models in order to demonstrate some key relationships. Demand grows modestly in the Energy Information Administration (EIA) and Canadian Energy Research Institute (CERI) projections but very strongly in the Harvard estimates. These estimates vary by as much as 15 MMBD in 1995 and by 30 MMBD in 2010. While disconcerting perhaps, this range should not be surprising. Analysts assign different values to demand responses to price, economic growth, and technical change. They must draw these values from a limited historical experience containing several sharp shifts in trends for price, economic growth, and oil quantities.

The higher oil consumption levels for the Harvard model reflect several conditions: (1) a stronger link between oil use and GDP that holds that a 1% increase in GDP results in a 1% increase in oil use, if oil prices remain unchanged; (2) the absence of autonomous efficiency improvements in oil use, unrelated to price, as new equipment replaces old equipment; and (3) adjustments in oil demand to previous price changes. Long-run oil intensities are dependent

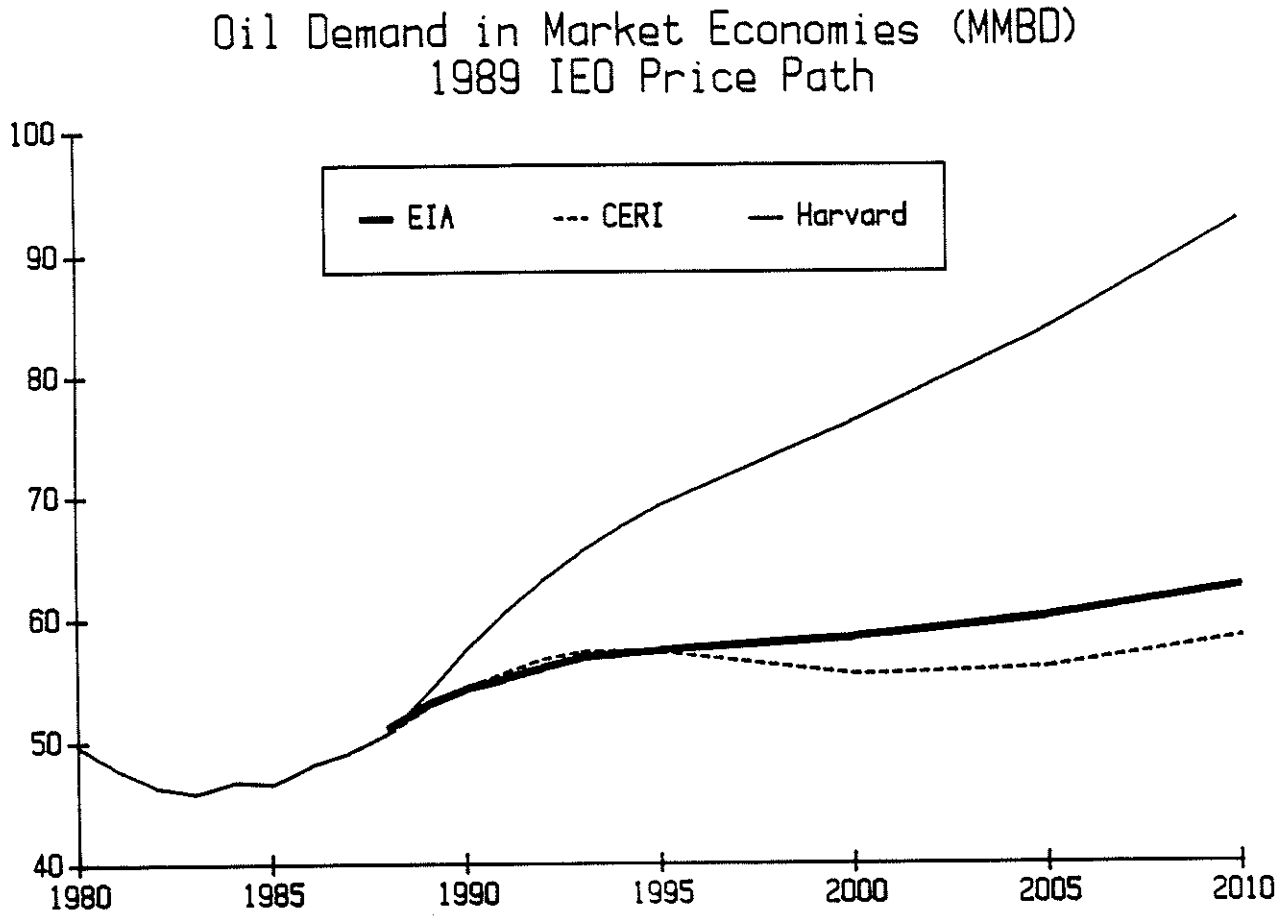
Oil Demand in Market Economies (MMBD)
1989 IEO Price Path
EIA
CERI
Harvard
100
90
80
70
60
50
40
1980
1985
1990
1995
2000
2005
2010

Figure 1

upon only prices in this model. In the absence of higher prices, there exists no long-run trend towards more efficient energy use. While some new technologies save energy, other technologies and lifestyle changes may actually use more energy. Moreover, since oil demand adjusts only gradually to price changes, the price declines during the late 1980s will continue to stimulate oil demand growth during the 1990s, particularly if oil prices remain flat through the new decade.

The latter conclusion is evidenced clearly in the oil-GDP ratios for a scenario when oil prices are assumed to remain flat at $19/barrel through 2010. Figure 2 plots the results from all models without identifying each one (for ease of readability), where the 1988 value has been indexed to one. Most demand projections show that gains in oil intensity continue even without increased incentives for conserving oil. The oil demand trends at the upper end of this group (indicating falling oil intensities) are consistent with the experiences of the late 1980s; those at the lower end of this range are consistent with the late-1970 trends.

Three models indicate that oil demand intensities increase with flat oil prices. The Harvard model is joined by another model (the estimates by Steve Brown from the Federal Reserve Bank of Dallas) in showing rising oil intensity through 1995 before stabilizing through 2010. This spurt in oil demand, growing more rapidly than economic growth, reflects the adjustment in oil demand to previous price changes, which were downward relative to prices in the 1970s and early 1980s. (The rising oil intensity in the third model occurs because flat prices in the future strongly stimulate demand.)

At the moment, it does not appear that the rise in oil intensities has happened to the degree indicated by the estimates at the higher end of this figure. However, it is important to know why. It could be that new technologies really are more energy efficient, regardless of price, even though such a trend has not yet been clearly detected in many of the statistical analyses of the historical experience. Alternatively, consumers may have viewed the price declines in the late

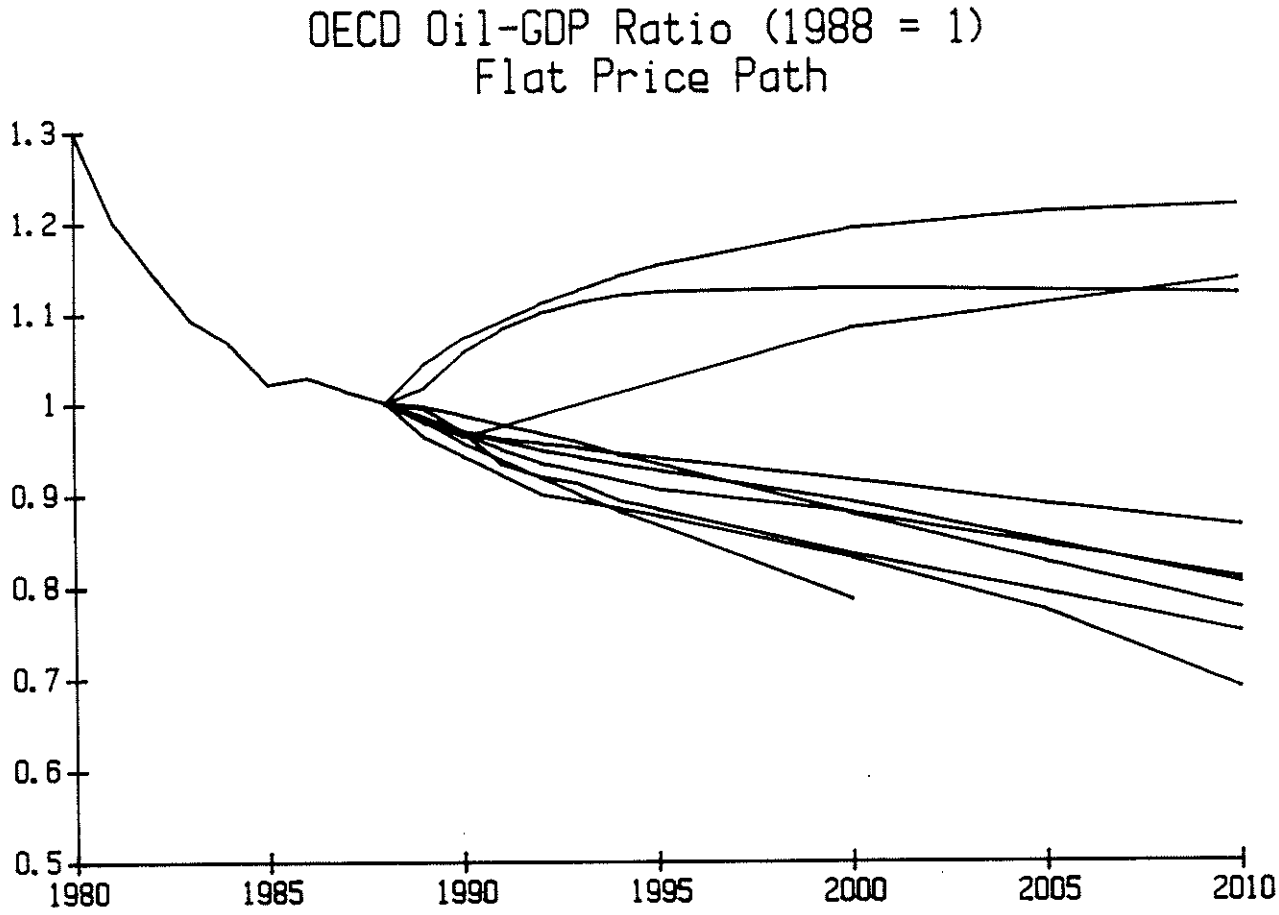
OECD Oil-GDP Ratio (1988 = 1)
Flat Price Path
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
1980
1985
1990
1995
2000
2005
2010

Figure 2

1980s as transitory rather than permanent and that investment in energy conservation still pays in the long run. If so, however, this possibility raises the intriguing prospect that world oil demands may grow briskly, once consumers convince themselves that oil prices will remain flat over a number of years, as some observers of this market have projected.

Alternative Perspectives on Oil Production

Estimates of oil production outside OPEC (excluding the Soviet Union) under these same oil price assumptions also varied across models (Figure 3), although these differences are less pronounced than for the market economies' demand. The vertical axis (from top to bottom) spans 60 MMBD in all charts showing oil quantities. Partly, this smaller variation reflects that while projected oil demands grow over the period, projected Non-OPEC supplies fall or remain stable for the most part. Production grows in the Harvard estimates; it falls gradually in the EIA and CERI estimates.

There is agreement that US supplies will fall regardless of price assumptions because new reserves become increasingly expensive. Outside the US, resource costs appear to be less important than institutional constraints on developing supplies; supplies in these regions either grow or remain stable.

Net USSR exports could become an important new supply source and represent a significant uncertainty in any oil market outlook. In the current study, however, these exports do not vary much across models and therefore are not shown separately in this comparison.

Implications for the Call on OPEC

The call on OPEC under these same oil price assumptions will equal the difference between total market demand minus production outside OPEC. Since market demands vary more across

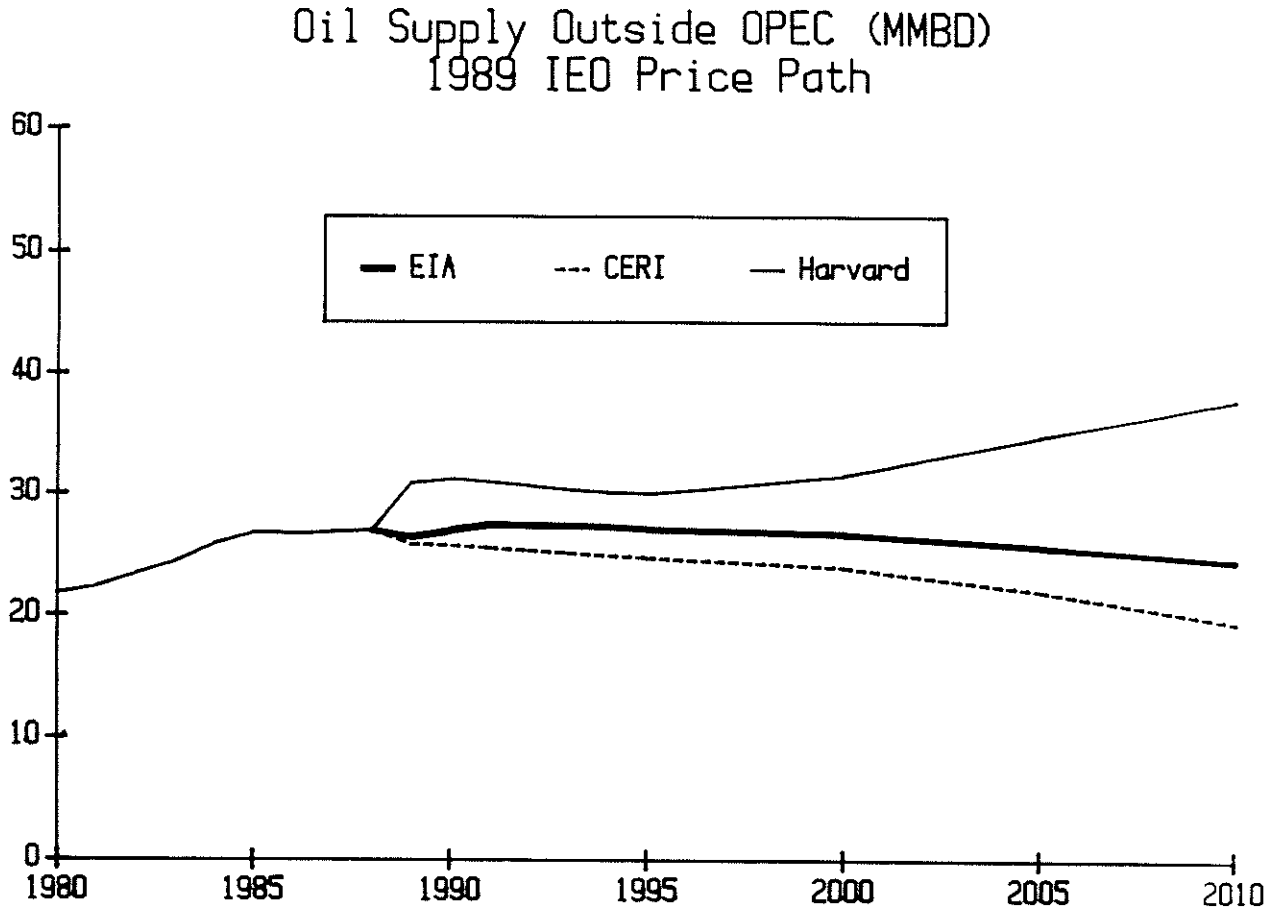
Oil Supply Outside OPEC (MMBD)
1989 IEO Price Path
EIA
CERI
Harvard
60
50
40
30
20
10
0
1980
1985
1990
1995
2000
2005
2010

Figure 3

models than do Non-OPEC supplies, differences in the call on OPEC will reflect differences in demand more than in Non-OPEC supply. Thus, the net call on OPEC in Figure 4 is some 50% higher for Harvard, even though it indicated the highest non-OPEC production in the previous figure.

Market-Clearing Prices

In the previous figures, we compared total demand, non-OPEC production, and the call on OPEC for a predetermined price path used by all modelers. In these estimates, OPEC was simply a passive producer, supplying any and all output in order to keep prices along the assumed long-run, sustained price path. We now ask a different question: would OPEC be willing to produce this amount and how would this output decision influence the market-clearing price in each model? Instead of fixing the price path and asking for the net demand for OPEC oil, we now ask for both price and OPEC's production.

Harvard's significantly higher net demand for OPEC oil in the previous 1989 IEO price case (Figure 4) should contribute to higher prices, as long as other factors do not offset this effect. But will the other two models, with lower net demands, indicate substantially lower prices? In Figure 4, CERI and EIA report very similar net demands for OPEC oil. But in Figure 5 with the market-clearing price, OPEC is willing to increase output much more readily in the CERI results than in EIA's. While output climbs steadily to 45 MMBD by 2010 in the former, it remains in the low-30 MMBD level for the latter and Harvard.

Output decisions in EIA and Harvard are constrained by limits on OPEC capacity (about 37 MMBD) that reflect a combination of economic and political objectives including: total net profits (appropriately discounted), the ability to absorb additional oil revenues, and a reluctance

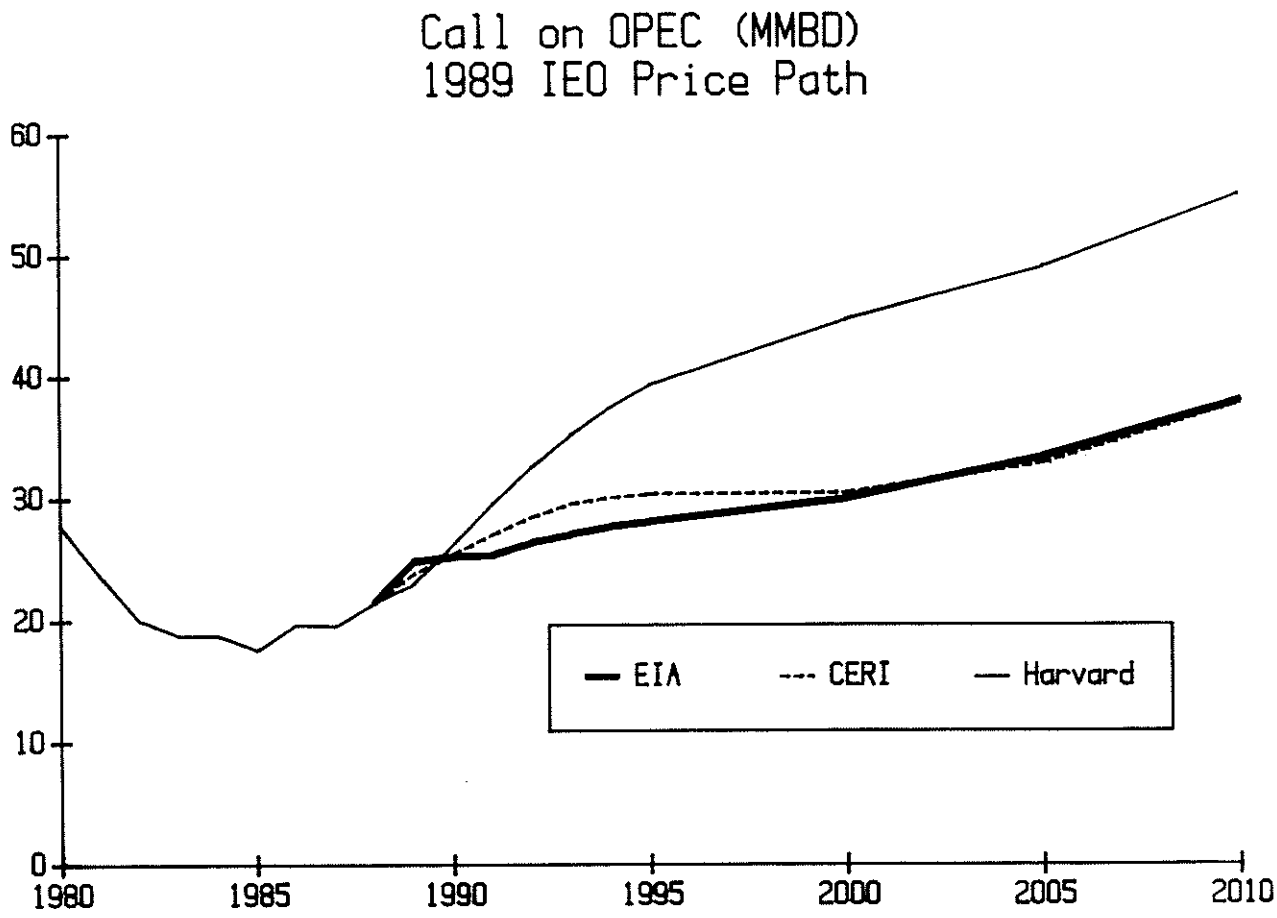
Call on OPEC (MMBD)
1989 IEO Price Path
60
50
40
30
20
10
0
1980
1985
1990
1995
2000
2005
2010
EIA
CERI
Harvard

Figure 4

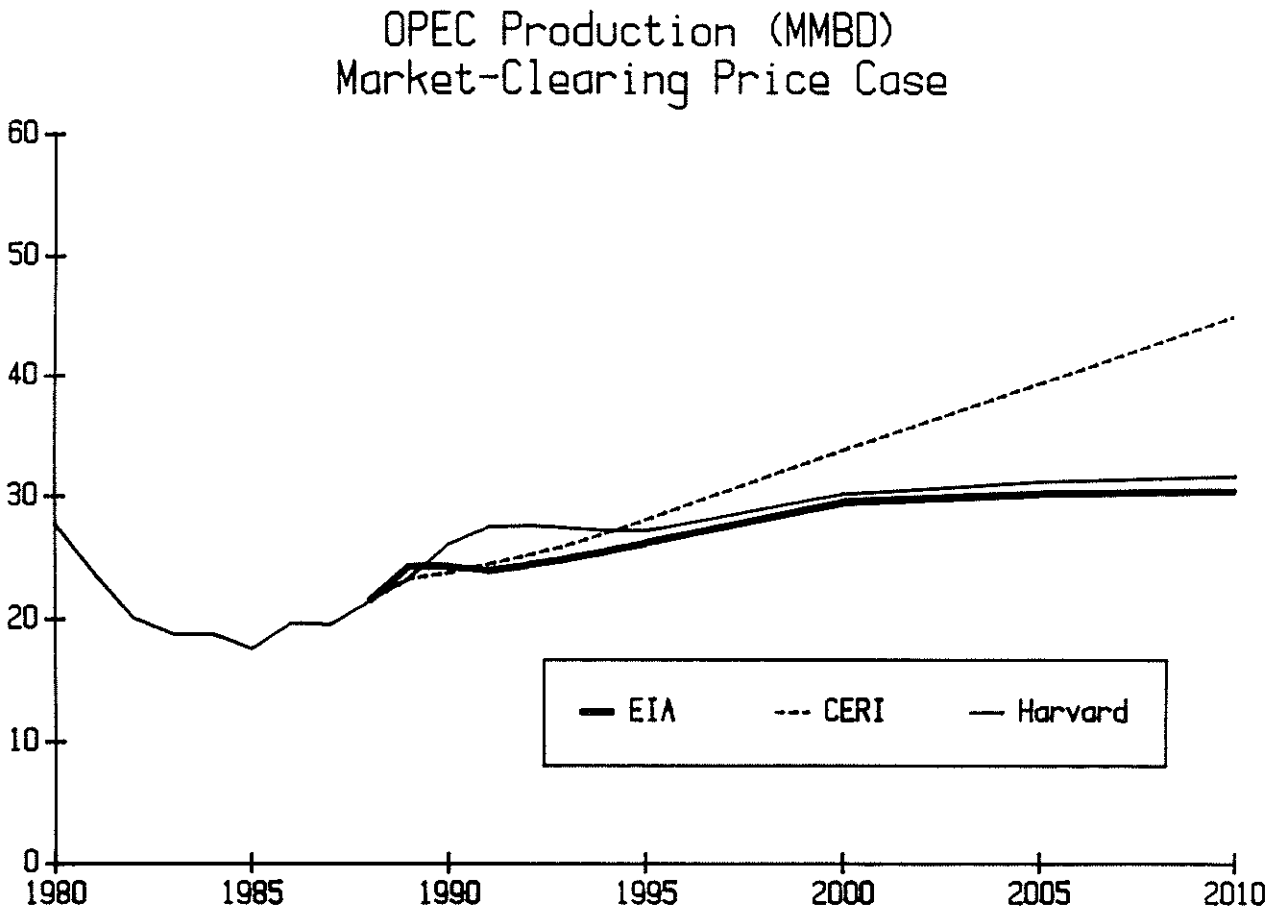
OPEC Production (MMBD)
Market-Clearing Price Case
60
50
40
30
20
10
0
1980
1985
1990
1995
2000
2005
2010
EIA
CERI
Harvard

Figure 5

to sell more of a "patrimonial resource". The CERI results show political constraints that are less binding as well as the opportunity to earn more net income, resulting in increased output.

Before discussing price, let us quickly review our progression. Initially, we showed that with a fixed price path, the call on OPEC was much larger in the Harvard results than in the others due to its substantially higher total oil demand in the market economies; Non-OPEC production did not vary as much across models. Next, we showed that with market-clearing prices, OPEC output was constrained to the low-30 MMBD range in the EIA and Harvard results, while it rose to 45 MMBD in the CERI results.

Figure 6 plots the separate market-clearing price paths determined in each of the three models. It should be emphasized that these price paths resulted from standardized assumptions used by the modelers; their actual price projections based upon their own assumptions may well be different. All prices rise through the decade, but at considerably different rates. Low demand growth and expanding OPEC output keep CERI's prices along a low-growth track, increasing to the low-$20s by 2000 and to about $30 by 2010. This path is representative of the median response in the July 1990 International Energy Workshop poll reported by Manne and Schrattenholzer (1990). Harvard's rapid demand growth coupled with constrained OPEC output translates into sharply higher prices. Although demands grow much more slowly in the EIA projections, constrained OPEC production eventually forces prices to track Harvard's. Across all models, when OPEC output is below mid-35 MMBD, prices are always considerably higher than $30 in this scenario.

Thus, low prices are associated with both low demand growth and expanded OPEC production. If either or both of these conditions do not hold, substantially higher prices result. These benchmarks should be useful for evaluating other price projections. If one expects constant prices through the next two decades, what are the demand trends that accompany that

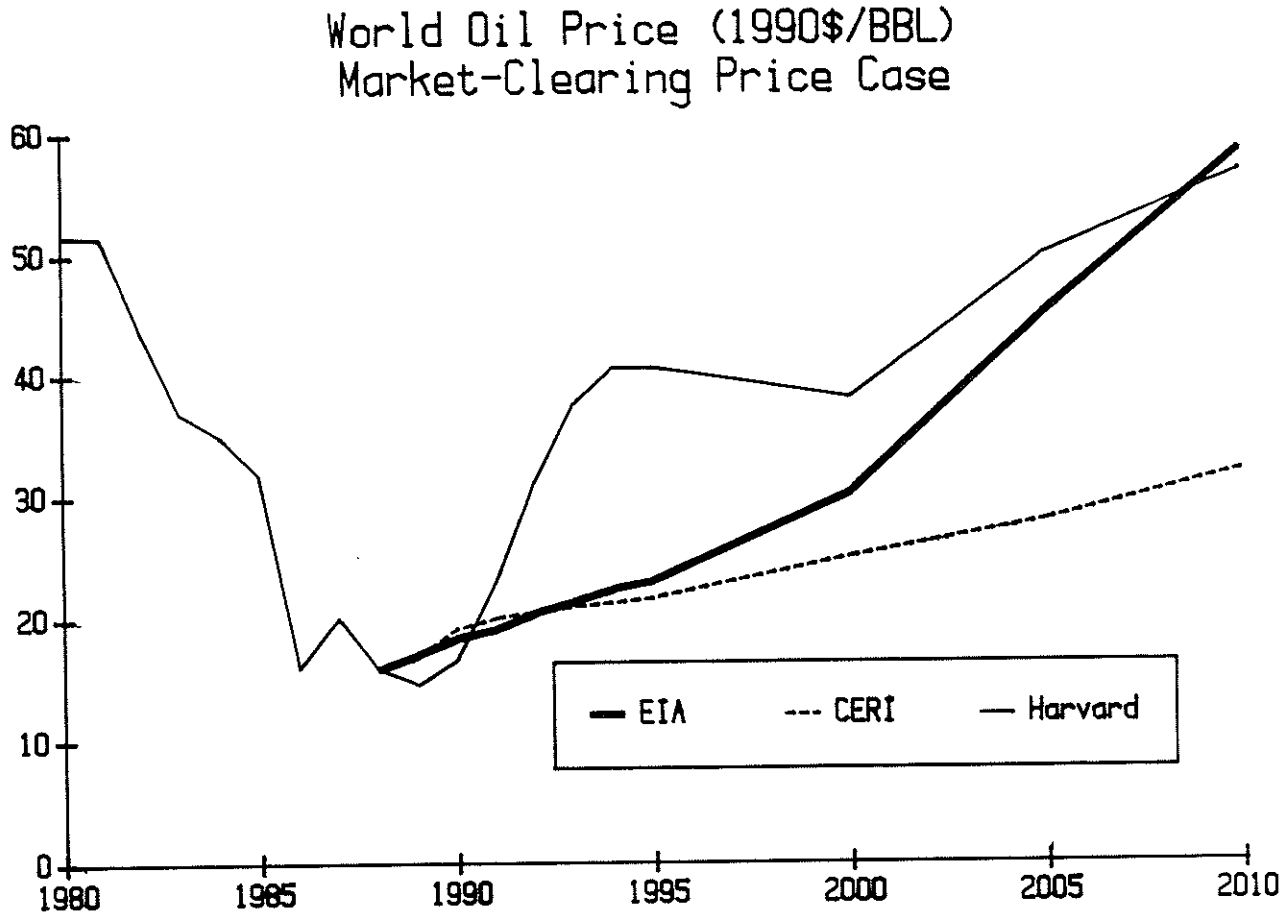
World Oil Price (1990$/BBL)
Market-Clearing Price Case
60
50
40
30
20
10
0
1980
1985
1990
1995
2000
2005
2010
EIA
CERI
Harvard

Figure 6

projection? Given reasonable bounds on production outside the cartel, what are the implications for OPEC's need to expand capacity at these prices?

Collectively, the modelers participating in our study were suspicious of the flat oil price world (at $19 through 2010). The mean results from all models based upon such a price path are shown in Figure 7. Total market economy demand is shown as the sum of three supply sources: OPEC (the hatched bar); Non-OPEC (the clear bar); and net USSR exports (the solid bar). Total demand grows from about 50 to 65 MMBD over the next decade. Due to modestly declining Non-OPEC production, OPEC production would need to expand to 40 MMBD, or increase by 6% per year. A decrease in market economies' economic growth of 1 percentage points per year reduces the call on OPEC to 34 MMBD; an increase in economic growth of that magnitude raises it to 46 MMBD.

I do not interpret Figure 7 as necessarily ruling out flat prices through the decade, but only as showing the necessary conditions for such a price path. OPEC could physically expand output to meet such demands if it desired. Perhaps, current assessments of Non-OPEC production (reflected in the mean results) are too pessimistic by 1-2 MMBD. Alternatively, aggressive demand management programs could also chip away at this call on OPEC. It becomes much more difficult, however, to extend this price path through the next two decades, without an explicit assumption that new technologies will introduce alternative fuels at low prices and in great abundance.

The Growing Risk of Persian Gulf Oil

Despite substantial differences in supplies, demands, and prices, there is an agreement across models and scenarios that the world economy will become increasingly more dependent upon Persian Gulf oil over the next decade. Currently more than 40 percent of the market

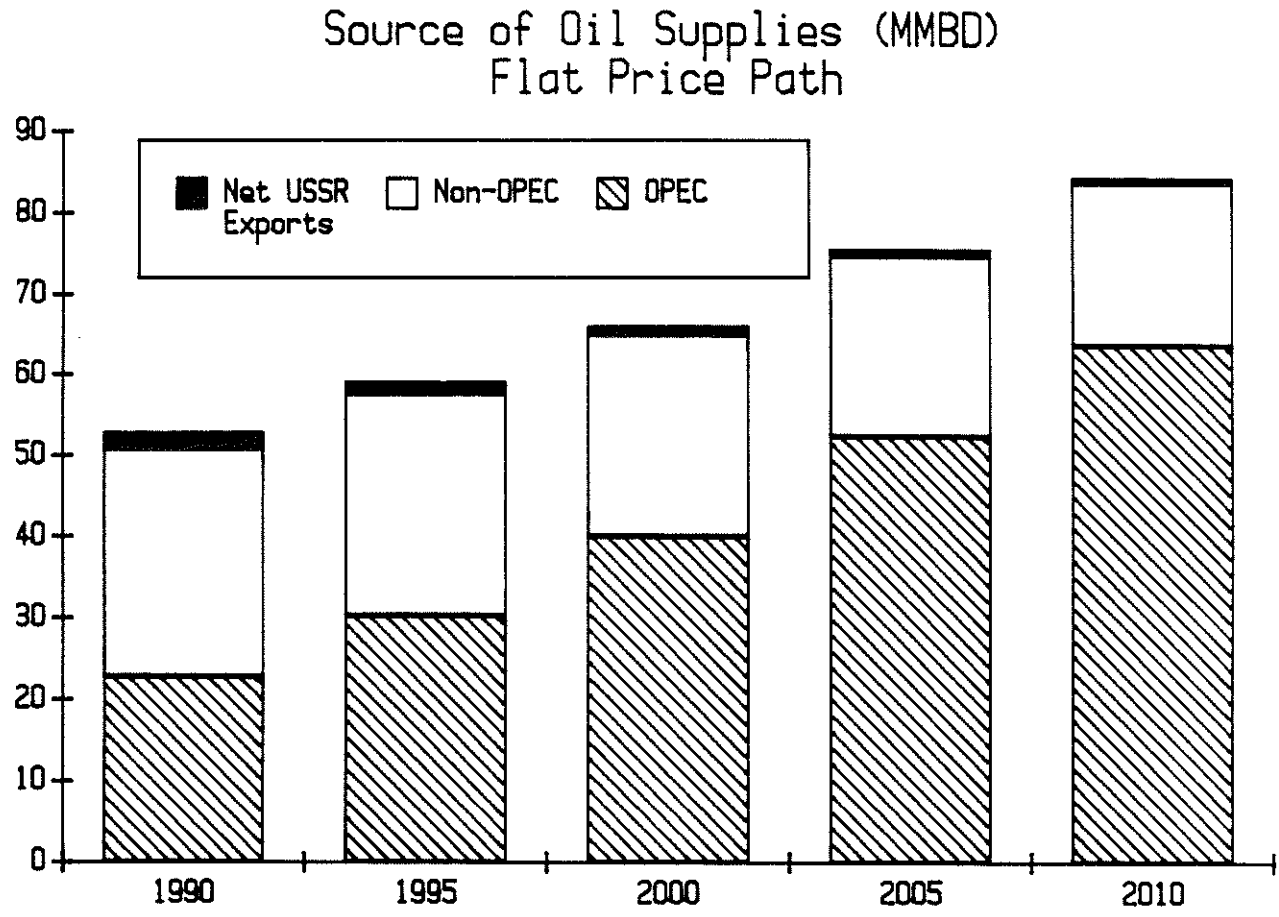
Source of Oil Supplies (MMBD)
Flat Price Path
Net USSR Exports
Non-OPEC
OPEC
90
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010

Figure 7

economies' oil demand originates in OPEC countries. The average share projected in the study rises to 55% in 2000 and 60% in 2010 in the 1989 IEO price case. Symptomatic of this development, US oil imports grow in all scenarios and models. And the oil import bill more than doubles in many instances.

Rising US oil imports will not be altered easily. Figure 8 compares the average US oil consumption and production in the flat $19 case and in the rising price case (to $39 by 2000, flat thereafter). Higher prices clearly reduce oil consumption growth and slow the decline in oil production, but the need for imports grows, as witnessed in Figure 9. This happens despite a doubling in the US price, which could increase due to a higher world oil price or to domestic US policies that raise the price above world levels. Thus, this figure indicates that it will be difficult and costly to reduce imports enough to significantly alter the nation's exposure to oil imports or the insecurity of the world's oil supply. For this reason, appropriate policy responses should include efforts to help the economy adapt to future price shocks. Such strategies might include oil stockpiles and macroeconomic stabilization policies.

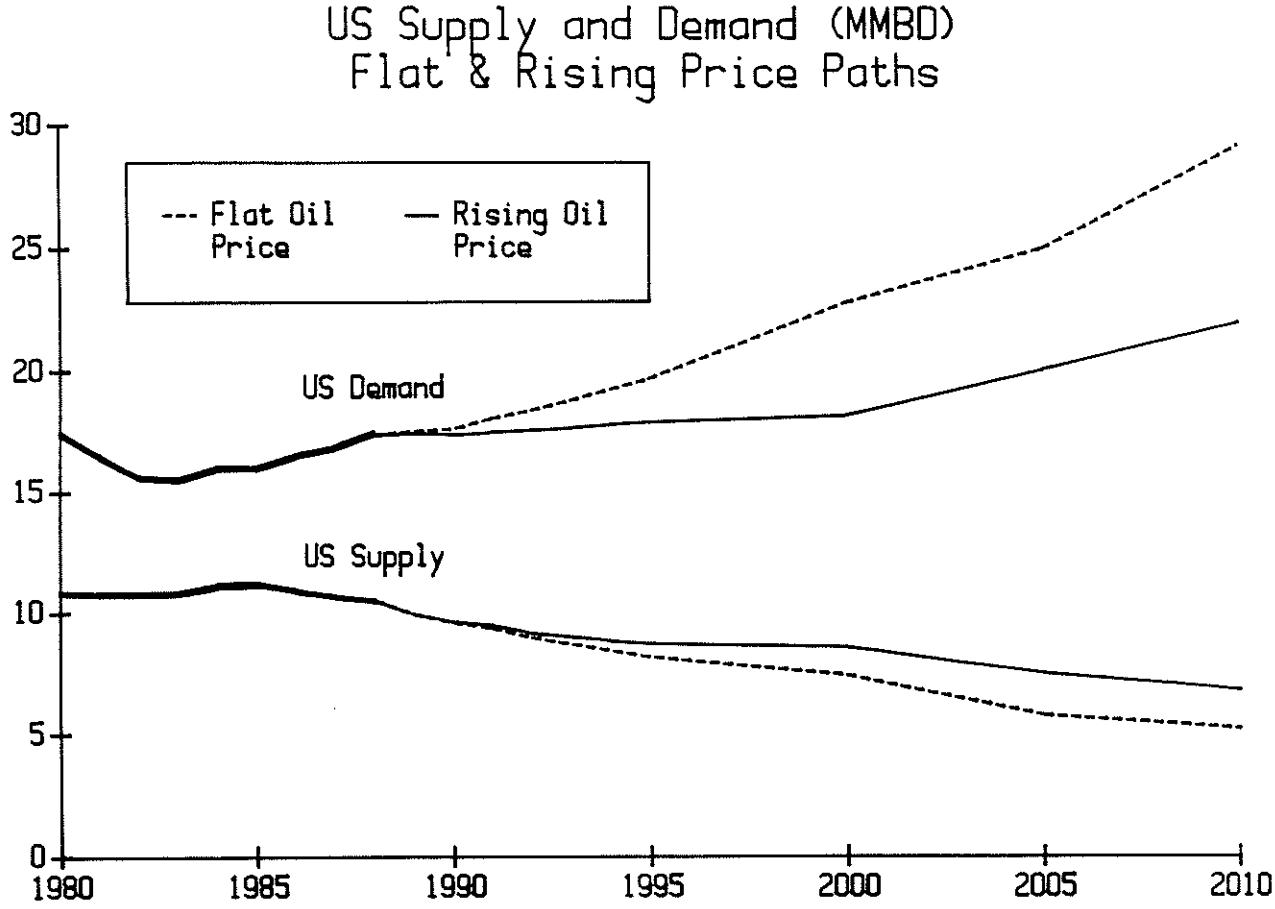
US Supply and Demand (MMBD)
Flat & Rising Price Paths
--- Flat Oil Price
— Rising Oil Price
US Demand
US Supply
30
25
20
15
10
5
0
1980
1985
1990
1995
2000
2005
2010

Figure 8

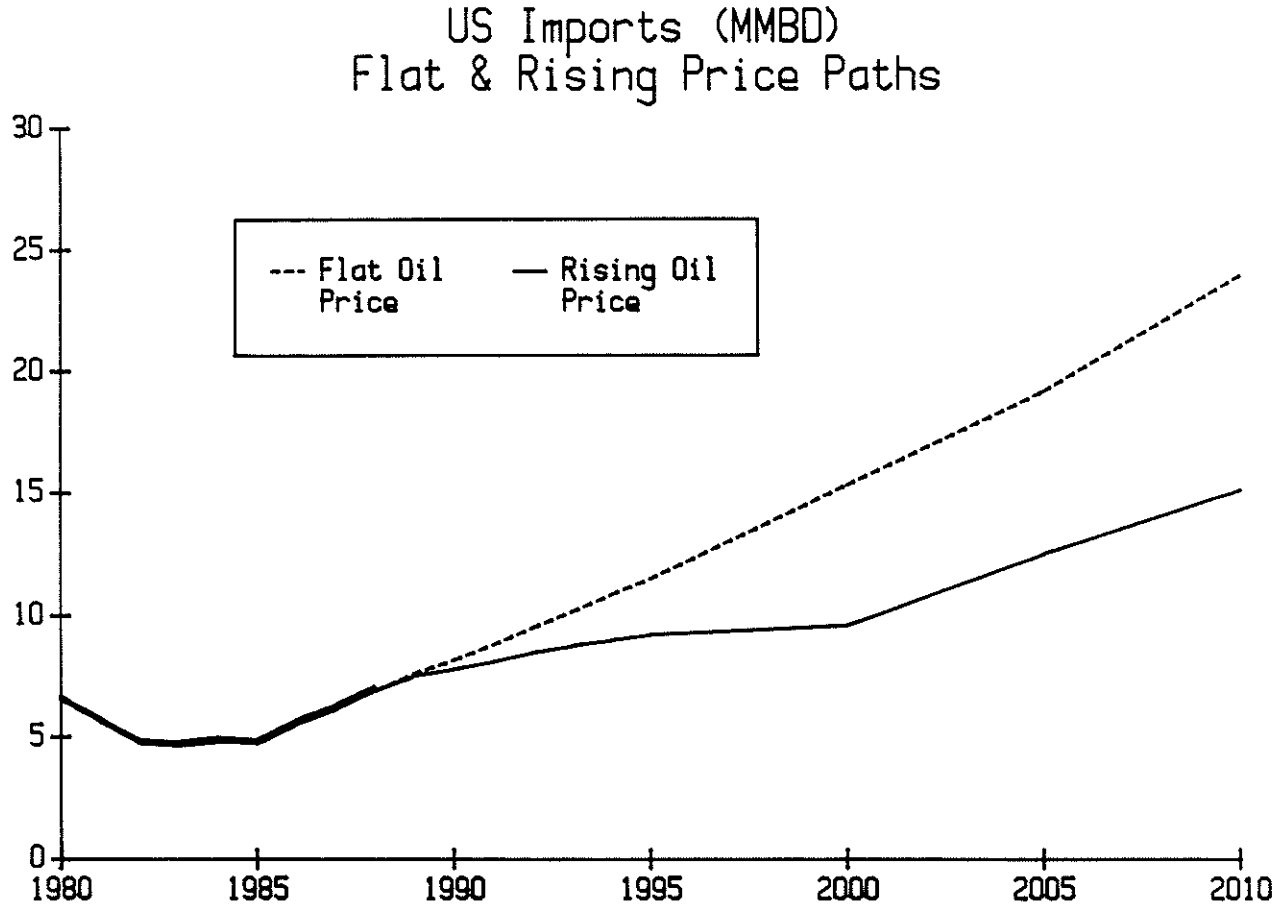
US Imports (MMBD)
Flat & Rising Price Paths
--- Flat Oil Price
— Rising Oil Price
30
25
20
15
10
5
0
1980
1985
1990
1995
2000
2005
2010

Figure 9

REFERENCES

Energy Modeling Forum, "International Oil Supplies and Demands," EMF Report 11, Stanford University, Stanford, CA, September 1990 (draft).

Manne, Alan S. and Leo Schrattenholzer, "International Energy Workshop: Overview of Poll Responses," International Energy Project (Dept. of Operations Research), Stanford University, Stanford, CA, July 1990.