Comment

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The reserves-to-production ratio for oil has been surprisingly constant over time, even at a high rate of depletion. We have proven far more reserves than we thought possible. On this, my views coincide with these of Professor Adelman.

On the other hand, we know enough about geology to safely establish that, in the long-run, Mother Earth is not going to generate new oil at the speed with which we are tapping her. Furthermore, geologists keep telling me that the great hydrocarbon basins of the world have largely been identified and, although there is a lot more oil to be discovered, there are no big surprises ahead.

Geologists have, of course been wrong before, and I suppose they can never be fully certain in their predictions. But as knowledge improves, the likelihood of big surprises dwindles. So, in my perception, oil is in fact an exhaustible resource.

But for the purpose of analyzing the short to medium term availability of oil in the market, I do agree with Professor Adelman that geological potential and constraints are not the determining factors. We have to look at other circumstances to get a proper perspective of the issues at hand.

Commerciality

We need to observe the **commercial factors** which determine whether or not oil will be explored for, invested in, produced, refined and brought to the consumers.

It helps, of course, to have a clear view of the future supply-demand equation. And it is vital that the oil industry take a long term perspective. But sufficient profits from today's operations are also needed to keep spending large sums on risky exploration to secure future production. And if today's profits fail — or the commercial terms deteriorate — then there is a clear danger that exploration activities will be reduced or postponed.

Exploration

There has been a downward trend in exploration in the US and the USSR and very little activity in the Middle East. These are the biggest oil producers in the world.

We can see that oil produced over the past 10 years has been replaced by reserve revisions in existing fields and from additional discoveries in low-risk, mature areas, rather than from wildcat drilling in new areas. One reason for these trends in exploration may, of course, be excess supply. But could it also have to do with the oil industry's risk-reward considerations? Has the oil business simply not been profitable enough to justify more spending on high risk exploration?

Whatever the answers to such questions, the low rate of exploration should be of great concern to the oil industry, governments and consumers alike.

Production

The concern about exploration is further amplified by the fact that at the same time many of the world's big oil fields, in Saudi Arabia, the USSR, North America, and even in the North Sea, have already started a decline from their plateau production level — or are about to do so. And the world supply of oil is to an alarming degree dependent upon relatively few big fields.

We not only have to add oil reserves to meet a foreseen demand growth, we also have to find significant new reserves to replace those which we are depleting. Taking these two together, we are talking about massive volumes of new oil for satisfying future needs.

It is true that the Middle East has sufficient reserves to comfortably satisfy any likely demand over the next few decades. But it does not necessarily follow that these reserves will be available for the satisfaction of a growing world oil demand. It suffices to refer to Professor Adelman's discussion of the political and commercial reasons which explain why the Middle East is not likely to come up with extensive new drilling or development programmes overnight.

In my view, it is clear that if the world keeps on exploring at the current low rate while relying heavily on production from a relatively few big oil fields, then sooner or later we could be in an uncomfortable supply squeeze and a period of new price volatility.

Development — Lead Time

This of course is not what should normally happen according to economic theory. Instead, rising prices should lead to increased exploration and development, and/or to increased efficiency, saving, and substitution of other energy sources, such as gas, nuclear power, and coal. Eventually a new equilibrium would be established. Such a process, predicted by economic theory, will easily be disturbed if there are extended lead times between decisions to explore or develop, and the start-up of production, as in the case in the oil industry. In my view, the issue of **lead times** is treated a little too lightly in Professor Adelman's analysis.

It may be that it takes two weeks to drill a well onshore in the US. But this is not the case for **offshore** exploration and developments, and, more importantly, it takes very much longer from the first discovery until the start-up of production.

The Norwegian Troll gas field was found in 1979 and will come on stream in 1996. Even if this

is extreme, and even if lead times are coming down, we are still talking about at least a couple of years even for small satellite developments, and typically five years for bigger stand-alone field developments. In the early 1990s, no less than one-third of the oil production outside OPEC comes from offshore fields. Also, the remaining resource potential outside the Middle East is to a large extent located offshore.

There are lead times on the downstream side too, not the least for the likely need of additional upgraded refining capacity. And, of course, there are lead times for technology developments upstream, downstream and on the consumer side — energy efficiency in cars, for example.

So, unless we are able to make the right move in time, I do fear we could be unable, perhaps already during this decade, to supply adequate volumes of oil at the price levels of the recent past. This could again lead to increased instability in the market.

Development — Financing

The next question is whether prevailing commercial conditions encourage investors to put their money into the development of oil reserves.

The world is currently faced with greater investment tasks than in any period since the reconstruction after the Second World War. Key issues are the development of the new Europe; the development of a new economic structure in the former Soviet Union; a continued expansion in South East Asia and other parts of Asia; population growth in the developing world; and of course, the need for investments and technology to meet new environmental standards.

A leading consultant foresees global capital expenditures in the energy sector during the 1990s approaching the order of US$3000 billion. The 1980s absorbed close to US$2000 billion. The consultant's figures suggest we could be facing annual increases in energy-related investment expenditures in the order of 4 to 4.5%.

Global gross domestic product (GDP), including estimates for the former Eastern Bloc, increased during the 80s by about 2.6% per year, according to the same consultant. Assuming the same economic growth in the 90s, we will have to allocate an increasing share of global GDP towards investments in the energy sector.

These forecasts are, of course, surrounded by a considerable degree of uncertainty. But even so, they raise the question of the availability of investment capital in the present decade.

Suppose for now, that there will be no "physical" shortage of capital. Even then, there is the question of where the capital will flow. Investors want a good return. Looking at the return on capital in the oil industry over the past 10 years, it is not obvious that this is where the money will go.

Options

So, what will happen — and what can be done to change the prospects if they don't look attractive?

First and foremost we have to get the commercial conditions right, we have to increase the profitability of oil investments and operations.

The industry can contribute by continued efforts to **cut costs** through technological progress in exploration, development, refining and marketing. But I fear Professor Adelman may be a little too optimistic if he believes technological change will be able to combat rising costs forever.

Costs will inexorably rise as we move into more remote areas and deeper waters — and perhaps finding smaller accumulations of oil. And as costs increase, **prices** will have to rise in consequence.

The problem is that in an industry characterized by extended lead times, and suffering from short- to mid-term excess supply, market forces may not allow prices to rise in time to replace existing reserves. We can therefore still run into a supply squeeze and suffer from the rollercoaster effect which Professor Adelman discards as a legend.

Commercial conditions for keeping up world exploration and developments also include **government policies** — not the least in the form of tax systems.

High Cost Production — Too Risky with Low Cost Gulf Barrels?

Let me briefly comment on Professor Adelman's observations about the "upside-down economy" in which high cost reserves are being produced first, and low cost ones held back to stabilize prices.

Such observations could, of course, lead a producer in high cost areas, like Statoil, to conclude that we are too exposed in case of deliberate action by the Middle East producers to expand market shares, thus squeezing out higher cost producers. But Professor Adelman argues convincingly why the Middle East is not going to do this. I basically support his view, and we are not discouraged from investing in North Sea oil, even if our average development cost per barrel is many times as high as in the Middle East.

The low-cost potential in the Middle East is not a deterrent to North Sea investments. The commercial conditions constitute a more serious restriction on investments in this area. The current discussion in Norway on the petroleum tax regime will for example play a key role in determining the future attractiveness of Norwegian North Sea oil. I am confident that in the end the government will find a solution to this issue that is satisfactory to the investors.

Conclusion

In conclusion, I believe there are adequate oil resources to meet world needs for quite some time.

If these resources do not come into the market in time to satisfy the gap between rising demand and declining production we may enter a period of sharp price increases. Such a development, if it occurs, cannot be blamed on lack of oil, but on a lack of means and determination to get the conditions right for its exploration and exploitation.

There is still time to set those conditions and to avoid the threat of rollercoaster instability. I am sure that oil companies, governments and consumers will do their best to make the market forces work in a way which enables the oil industry to fulfil its role of securing energy supplies for the world.