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LIMITS TO OIL PRICING;
Scenario Planning as a Device to Understand Oil Price Developments

SUMMARY:

The bad record of oil price forecasting indicates that conventional oil market models should be critically re-assessed. Scenario Planning may be one alternative approach. This approach does not overthrow any other theories of the market. But
it claims that no single discipline is able to tell the whole truth about the market. The SP approach stresses and clarifies the role of uncertainty. It argues that without a cross-disciplinary approach, with an adequate choice of parameters, at the right level of in-depth discussion, the analysis may lose essential input or drown in detail. As an example of the methodology, an analysis of the oil market in the nineties is presented. This show how upper and lower limits for the price can be constructed, and which actual price development can be expected, in a combination of economic and political reasoning.

KEYWORDS: Oil price, Scenario technique, OPEC

INTRODUCTION

There is still no general agreement about how to analyze the oil market, oil producing countries' behavior, oil demand and the future of oil prices. On the supply side, the views can be roughly divided into two groups; wealth-maximizing theories and 'others', with all shades in between. 'Others' often include theories of political and target revenue types. On the demand side, analyses address factors such as economic growth in various regions of the world, income and price elasticities for energy demand in general and oil in particular, the existence and price of alternative energies and technological development. The perception of the market mechanism ranges between competition to monopoly in

various forms both on the demand and the supply side. The market outcome is seen as a result of economic or political factors in force, sometimes as an interplay between the two.

In spite of the great number of approaches, oil price forecasting has tended to be quite uniform over the last two decades. Furthermore, they have a rather bad record.[1] Conventional price forecasting have usually extrapolated past trends into the future, and only to a very limited extent incorporated the possibility of major shifts in the market environment. When major shifts actually have taken place, they have been perceived as shocks and unexpected events bringing discontinuity and surprise in the smooth expectations of future developments.

The political and economic implications of choosing a wrong price expectation i.e. when formulating a nation's macroeconomic policy or a company's strategy, is that the outcome will be other than the expected one. A theory need not be correct to have direct impact on decision-making, but it will lead to a sub-optimal solution in comparison to a situation had a right theory or expectation been chosen. The impact of the belief of continuous rising prices in the beginning of the eighties, when they already were at a historic height, has obviously been rather costly not least for an oil exporting country like Norway. The benefit of implementing a better understanding of the market mechanism can be expected to be significant for the countries and companies involved, being sellers or buyers.

The Scenario Planning (SP) methodology, which is the focus of this paper, is an alternative to conventional oil market models. This approach does not overthrow any competing methods of the understanding of oil price movements. However, it stresses that no one-disciplinary model, being economic or political, is able to tell the whole truth about the market. Over the longer term, SP analysis stresses that more than one academic discipline must be applied in order to understand major changes in the market.[2]

However, in periods with stability, one-disciplinary approaches may have significant explanatory power. Their periodic success contributes in making such forecasts dangerous. As they often are based on an assumption that the future will look much like today, they rarely incorporate the possibility of major shifts in the market environment.

Thus, in comparison with the often used economic, political or other models, the Scenario Planning approach is first of all an extension by increasing the understanding of the functioning of the market by integrating disciplines rather than giving exact predictions of price movements. By analyzing important factors for the development and translating them into quantitative and behavioral effects on market mechanisms, disciplines are combined in a comprehensive assessment.

The procedure attempts to clarify the uncertainty inherent to the complexity of the oil market and gives perhaps more an indication f what cannot happen than what actually will happen. In that sense, SP has a lower level of ambition than many of the more deterministic models. SP analysis argues that companies and governments should accept uncertainty as an integral part of the analytical environment, instead of extrapolating trends. Depending on what kind of uncertainty we are facing, ways of dealing with this uncertainty must be developed.

More, better and more refined forecasts of one kind or another do not necessarily solve the problems of uncertainty inherent to oil price developments. In this paper, in making an attempt to narrow and clarify the range of the unknown, I will split uncertainty into three types; trivial, systemic and structural uncertainty.[3]

1 UNCERTAINTY AND THE PRICE OF OIL

The type of uncertainty that more of the same model can deal with is the trivial one, namely providing more information to support the model in use and to refine the model.

The systemic uncertainty, however, exists due to the inadequacy of understanding rather than a lack of knowledge of more facts and refinement. Such a type of uncertainty may be dealt with by extending disciplinary boundaries in multi- or interdisciplinary[4] approaches. How economics and politics interact in the Middle East and world markets is an example of such insight. In principle, it is possible to make a consistent understanding of such relationships and

dimensions. In a "system of equations", linking the to each other, the value of one variable can endogenously be determined as a result of changes in other variable(s). Then, if the model still involves degrees of freedom, the importance of choices and strategies of various actors can be underlined.

The structural uncertainty is inherent to the type of phenomena being studied. Structural uncertainty represents exogenous fluctuations in important variables and relationships, uncertainty in the choice of model, and situations where a model gives results with great variations.

The two first types of uncertainty can (theoretically) be dealt with, while the third kind cannot fully be eliminated. The actors can only learn to live with structural uncertainty and to find ways to reduce the sensitivity and vulnerability following from it.[5]

An essential sub-goal in the SP approach is to distinguish predetermined from genuinely uncertain events.[6] The predetermined elements should deal with the trivial and systemic uncertainty. These uncertainties depend on whether enough and adequate information is provided, and whether the understanding of the functioning of the market is sufficient. The trivial uncertainty can be reduced by good disciplinary work. The systemic uncertainty can be reduced by multi- or interdisciplinary work providing a more comprehensive understanding. Then, methods must be found to deal with the structural uncertainty, rather than to try to eliminate it. The process of clarifying the kind and magnitude of the structural uncertainty may, however, be an important input into the process of the adoption to it.

There are always some elements in an analysis that can be characterized as predetermined. In a SP analysis for the oil market, these events set frames for the future development and will outline the "window" of possible price paths. The frames of this window should be rather insensitive to possible and significant changes in the parameters. But as in fact "anything can happen in the future", it is useful also to discuss which extreme events are necessary for the price to be pushed out of the window. A sensitivity analysis needed to do this is first of all of pedagogical value, as it illustrates and gives some background for evaluating how "robust" the results from the analysis can be expected to be.

Then, in a perfectly performed scenario analysis a number of more or less likely outcomes grounded in structural uncertainty are left within the "window". According to various opinions of the likelihood of the occurrence of such specific events, a probability analysis can indicate where within the frames the result most likely will end up. Such an analysis must necessarily include both technical, economic and political considerations. To assess the impact of changes in technological and political factors on the price of oil, they must be translated into the effect they may have on economic factors, strategic type of the actors and market structure, in a multidisciplinarity procedure.

Furthermore,the identification and measurement of parameters are crucial for the analysis. Even if an analysis is brilliantly performed in technical sense, this brilliancy cannot outweigh the mistakes created by the wrong choice of data, low quality statistical input or choice of an irrelevant model. That is, unless the purpose is a drill of the chosen model and the relevance to the problem at hand is of a more minor concern. Obviously, there are no limits as to what could be included in the assessment. But the logic of Scenario Planning requires an adequate choice of parameters at the right level of in-depth discussion. If we go too deep into the material or choose too many parameters, the overall process can be paralysed by details. On the other hand, if we take too few parameters into consideration on a too superficial level, we can lose important input. Therefore, it is important to keep in mind the purpose for the analysis when designing a SP analysis.

2 THE PREDETERMINED FRAMES

This analysis will argue that there probably are upper and lower limits for the price of oil in a combination of economic, political and strategic reasons. Whether the price in the long run will be closer to the one or the other limit depend on the tightness between demand and supply, the degree of monopolization in the market, the strategic types of the actors e.t.c. I will denote the long term lower limit for the price the lower (L) limit as opposed to the upper (U) limit. The discussion of possible future prices must be read as examples rather than absolute figures.

2.1 The Lower Limit

The technical lower limit for the price of oil is fixed by the marginal costs for the development of new oil fields. Adelman[7] argues that this will be the price of oil in the long run. But as long as the marginal cost of oil production in the Middle East has been far below any price prevailing in the market, even before the first oil shock, one must pose the question whether or not something else is preventing the price from dropping to this technical-economic floor. Is something or somebody hindering the price to drop to the marginal cost of new oil fields?. Which interests do producing and consuming countries' have in not letting the price drop too low?

2.1.1 Consuming countries' interests

Importing countries want to prevent the dependence on Middle East oil to establish itself as too big a problem in case of new crises in that region. Some level of non-OPEC production should be maintained, and the investment necessary for this requires a higher price than do Middle East oil i.e. the marginal cost of developing new oil fields if politics are disregarded.

If dependence on such imports is not a problem at all, consumers' lower limit should fall to the economic marginal cost for developing new oil fields, because all gates for imports of oil can then be opened, including oil from the Middle East. The importing countries will desire a free competitive market and prices to be fixed at the point where the demand curve intersects the global marginal cost curve.

But as long as such a dependency is considered to be a problem, consumers' desired lower limit may perhaps lay in the range of 10-25 $/bbl, this level may vary with the perception of how risky the dependence on Middle East oil is and the cost of non-Middle East oil.

2.1.2 Producing countries interests

Obviously, producers should not be interested in a low oil price. On the other hand, from time to time, they may desire in order to maintain or gain market shares or of political reasons.[8] However, there are reasons not to let the price drop too low, even with such a goal. We shall divide producers' (i.e. OPEC countries') possible interests in maintaining a minimum price above marginal costs of new oil fields into three arguments: the inelasticity of demand; fear of increased excise taxes; the cost and inelasticity of non-OPEC production.

a) Market share - demand inelasticity: In the short run, demand elasticities have tended to be rather inelastic. In the long run, however, history has shown that demand are elastic with respect to price changes. Furthermore, when oil has a large share of a consumers budget, demand may be more elastic with respect to price changes than when oil has a small budgetary share. With low budgetary shares, or low prices, price changes may not necessarily impose significant changes in demand, at least it may take a lot of time.

Thus, there is a threshold at which the benefits of increased demand by lowering prices are overtaken by the loss of income for main producers in the short and/or in the longer term. Therefore, from an interest of gaining market shares, the optimal price from a producer's point of view, should be determined from the point when a marginal decrease in price is met by a marginal increase in demand after some (determined) time.

b) Market share - new excise taxes: The lower the price of oil, the easier it will be for importing countries' governments to introduce excise taxes on crude oil or petroleum products. The optimal lower level of the oil price from producing countries' point of view, when market shares should be gained in the long run, should, from a tax-fear argument point of view, be determined such that the tax risks are balanced against the anticipated economic growth and income and price elasticities in consuming countries in order to raise demand for oil. Fiscal measures in consuming countries can become a pure transfer of surplus from exporting to importing countries.[9]

c) The restraining of non-OPEC production: The drop in prices in 1985/86 proved that the most marginal non-OPEC oil fields were the U.S. ones, with a cost per barrel in the stripper wells in the range of 15-20 $/bbl. Much North Sea oil is produced at costs around 5 $/bbl.[10] Thus, prices much below the cost of marginal U.S. production would, to a large extent, only be a transfer of wealth from producing to consuming countries rather than closure of more non-OPEC production. The 15-20 $/bbl level from the second half of the eighties did not significantly encourage new (U.S.) production, and there should be no reason to stay much below this price level in order to discourage non-OPEC production in any significant manner.

d) Weighed sum of arguments. From the interests of producers wanting to gain market shares, the lower limit should be some sort of weighted sum of the aspects discussed. Given the current political situation, resource basis, cost figures for non-OPEC production, availability of alternative energies, demand and supply elasticities and taxing policies, a reasonable estimate today seems to indicate a lower limit, from the producer's point of view, in the range of 15-20 $/bbl in order not to increase non-OPEC production too much, to avoid significant new taxes and encourage demand sufficiently.[11] The way producers (i.e. OPEC) managed to keep such a minimum price is through price and/or production administration.[12]

2.2 The Upper Limit

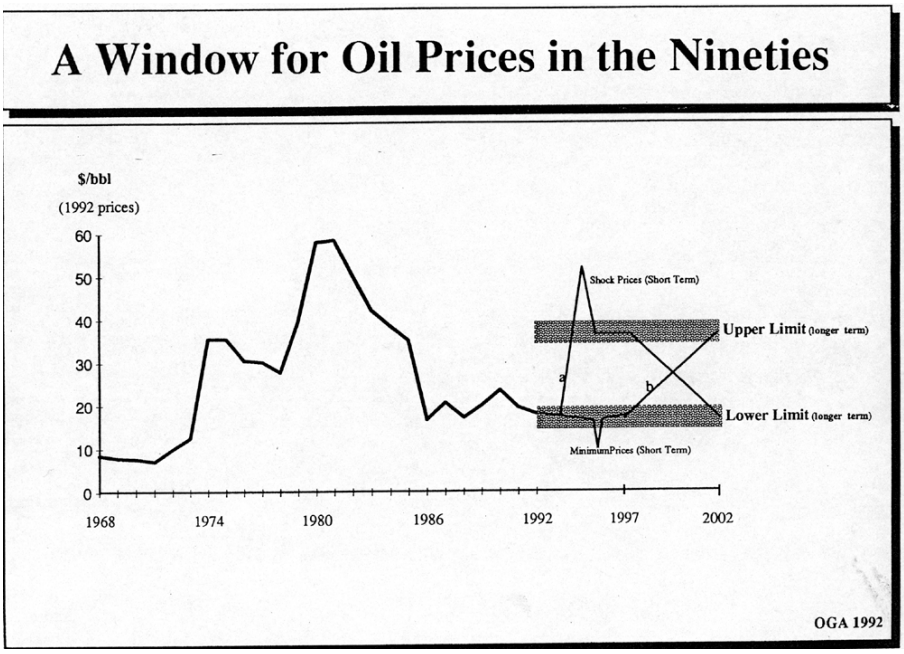
The upper limit for the long-term price of oil is expected to be determined by what the importing countries will "submit" to paying, without experiencing economic setback and large substitution to other energies and thus reduce demand over time. The backstop price, as it is discussed in economic theory of non-renewables, will be a technical-economic ceiling for the price, even though prices may exceed this limit for a period of time. Thus, the upper limit level is fixed by exporting country desire, based on long term market considerations, to keep below. The limit will lie where a marginal price increase leads to such a large marginal decline in demand that the net effects will be a loss of income in the long run for exporters.

A price of 35-40 $/bbl (nominally) in the beginning of the eighties proved not to be sustainable in the long run. A price of 35 $/bbl in 1981 corresponds to almost 60 $/bbl in 1992 value. Thus, the upper limit should be somewhere below the top level of 1981, but above the level of 15-20 $/bbl of the last years in order to keep consumption stable. Because flexibility in switching between fuels during the eighties has increased, one may expect the upper limit to be lower today than ten years earlier with today`s portfolio of consumption by different sectors. In the eighties, consumption stopped declining when prices reached 27-30 dollars (nominally). A price of 28 dollars in 1981 corresponds to a price of some 45 $/bbl in 1992. Thus, a fixing of the upper limit in the nineties today in the value of 1990 money, may possibly be in the range of 30-40 dollars.

3 A PRICE WINDOW FOR THE NINETIES

The graph below shows the price development from 1968-91/92 (adjusted for inflation). For the expectations for the next decade (1992-2002), the upper and lower are shown as predetermined constraints for price development. They are formed by events in the past, of political, technological and economic factors as well as reasoning and strategies among various actors involved. This window limits the possible variety of future prices to a still wide, but, nevertheless, narrower range compared to the view that "anything" can happen in the future.

By determining these limits, trivial and systemic uncertainty of the price development is reduced by constructing tracks that the price should stay within. As the fixing of the limits combines both economic, political and strategic reasoning, and explicitly outlines an area of structural uncertainty, the approach is different from more (partial and) deterministic models for the oil market, telling us that the price will follow one or another specific path.



Alternative price development are drawn (a and b) to illustrate two rather extreme possible outcomes. The a-path illustrates a situation where a new dramatic event occurs while Kuwaiti and Iraqi oil facilities to a longer extent are still out of order and additional capacity is not built in Saudi Arabia (so far, disregarding the existence of the SPRS). With little free capacity in the world, such a dramatic event may lead prices to shoot higher than they did during the fall of 1990. The tightness in the market (95-100 % capacity utilization in world wide oil production) indicates that such a high price level may be sustained for some time if damages or shortfalls are severe enough. But the consequence of such a price hike, for example to 60 $/bbl, would be lower demand and later a drop in prices, perhaps much below the upper limit. This illustrates inter-temporal relationship between prices due to mechanisms between supply and demand and their time-lags.

The b-path illustrates a stable situation and with steadily increasing demand. Prices are kept at the lower limit as capacity (in Middle East countries) are continuously increased (beyond previous historic levels). At some point in time this increase in capacity will meet a ceiling[13] and the growth in demand will lead to higher prices.[14] After the war, with this development, such a ceiling is illustrated to be reached in the mid/late nineties.

Nobody can claim to know all factors influencing the price to develop along the a- or b-path or some other trend. Only with strict assumptions, conditional expectations can be made. In fact, in the long run, and given our assumptions, the only thing we know with "reasonable certainty" is that prices will remain at or between the upper and lower limits.

3.1 Main Features of the Price Window

The main assumptions to be made about oil prices in the nineties, according to the discussion above, can be summarized as:

* Prices are not long run sustainable below the lower limit (illustrated as 15-20 $/bbl 1992 dollars). Nor can they sustain a level above the upper limit (illustrated as 30-40 $/bbl 1992 dollars). The levels of the limits may change with significant changes in important relations determining them (see sensitivity test later).

* Our "most likely" scenario today will be that prices may well remain on the lower limit for several years if no new instability in the oil market occurs, production capacity in Saudi Arabia is expanded and Kuwaiti and Iraqi oil comes back into the market. Prices may increase later in the decade if consumption continue to increase and available capacity at some point in time is absorbed.

* The potential magnitude of a sudden price shock depends on its severity. Prices in the range of 50-55 1990-dollars may last up to a couple of years before demand has decreased, alternative energies have supplemented oil, and oil production is increased elsewhere with a following drop in prices. Prices above 60 $/bbl should be expected to sustain only for a shorter period of time. If prices stay outside the L and U limits respectively, the consequence will be a reaction in the opposite direction after some time. The more extreme the oscillations are, and the longer they last, the larger will be the reaction and the market becomes more unstable.

* With the strategic reserves (SPR) at hand, ("short term") price shocks above the upper limit are less likely. The existence of the SPRs may also dampen smaller "shocks", below the U limit, if they are used in a "sub-trigger" system.[15]

* With a functioning OPEC organization, or some other supply side regulator, prices below the lower limit does not seem very likely. OPEC must be expected to restore prices at the lower level off rather quickly to avoid increased petroleum taxes and transfer of wealth with no gain in market shares. If this perception establishes itself in the market, actors may discount OPEC reactions to the present and prices will be limited downwards by the lower limit also in the short term.

* The scenarios discussed share much of the opinion that the oil market has many similarities to other markets where supply must balance demand and the price is determined endogenously. The special feature of the oil market seems to be that changes in prices, demand and supply take much more time and that it is much more politicized. The inelasticities with respect to prices in the short run and the larger elasticities in the longer run for both supply and demand are characteristic for the market for crude oil.

* Of course, the perhaps most widely applied theory for the oil marked the economics of non-renewable resources is developed to take care of various types of uncertainty and shifts in the assumptions for the analysis. But it does not analyze why, when or at which magnitude such shifts takes place. To a longer extent these are taken as exogenous parameters in the analysis. Therefore, an SP approach comprises a qualitatively wider specter of variables than economic theory do. But SP analysis does not overthrow this, or any other, theory for the oil market. It suggests that the market and the actors are not performing fully to its principle. The expectation on future oil prices based on economic theory can, within a SP analysis, be viewed as one out of many possible market outcomes.[16]

4. HOW "ROBUST" ARE THE RESULTS ?

In the oil market, "business-as-usual" is often that something unusual happens. Therefore, a crucial element of this analysis is to test the results for some of these not very likely, but, nevertheless, not impossible changes.

Energy security policy, as well as economic strategies for both exporting and importing countries of oil and oil companies, must be targeted also towards unlikely but, if they happen, costly events. This problem may concern whether the U- and L- limits are determined in a correct manner (trivial and systemic uncertainty) and whether our "most likely" scenario will occur between or at these limits. A sensitivity analysis reexamines the parameters chosen. This is important in order to be aware of the effects if the grounds for the analysis should be dramatically changed and it also gives some perspective on how "robust" projections can be expected to be and when they should be changed.

The purpose of identifying the predetermined frames for the price development is first of all to suggest some principles for the understanding of what can and what cannot happen. I will not go into depth on all sensitivity tests that could be performed against the analysis. I will but merely list some of the readers most important ones. The reader to modify the results accordingly to his- or her belief.

Of course, some factors are, by character, influencing both the predetermined frames and the actual paths the price can be expected to follow within the future. A factor may influence price changes between the limits up to a certain magnitude of alterations. When alterations becomes larger the factor may influence the predetermined frames, as well.[17] This is implicitly in the assumption for the analysis, as the predetermined frames shall be much more "robust" to changes in the environment than expectations of prices between the frames. We shall first suggest some tests for the sensitivity of the level of the Lower and Upper limits, respectively, and afterwards for the conditional price expectations between the limits.

4.1 What could change the Lower and Upper Limits?

In the future both the Lower and Upper limit may, in principle, be changed to both a higher and lower level. The

discussion below is unusual events leading to a drop in both of them. Obviously, a change in parameters in the opposite direction will move the limits upwards.

4.1.1 The Lower Limit

The following are examples of extreme, but not totally impossible, events and situations that could lead to a drop in the Lower limit (below the indicated 15-20 $/bbl):

* The Middle East is seen as a less dangerous source of oil. Dependence can increase without increasing sensitivity and/or vulnerability. For consuming countries, this indicates that it is less important to maintain expensive non Middle East production. For example, such a perceived reduced sensitivity/vulnerability can occur if consuming countries gain physical control over oil reserves by political or military force (direct or indirect change of property rights). An interesting question is whether this, to some extent, is taking place in the aftermath of the Gulf-war in 1991 (see Austvik 1992).

* OPEC breaks down, no other supply side regulator emerges and the market becomes more competitive. Prices may fall below the lower limit and consuming countries can use the opportunity to take power in the market by fiscal means to regulate demand. And transfer wealth from producers to consumers on a more permanent basis. This chance was to a large extent spoiled in 1986. If fiscal means are not introduced after a collapse of OPEC, demand can be expected to increase over time and prices with it.[18]

* Demand for oil becomes much more elastic to price changes also at low prices.

* Substantial amounts of new low cost oil are found outside the Persian Gulf. This seems much to be the main Adelman scenario (1989). He finds that the price of oil will fluctuate with political-military movements and cycles with OPEC meetings, quota and pricing decisions within OPEC, followed by cheating, threats and

promises. But because of the (according to him) abundance of oil, other energies and more efficient technology will be developed. Therefore, over time, prices will decline slowly towards a "long-run equilibrium price of 5 $/bbl". Adelman argues that OPEC output may reach some 60 mb/d and estimates the "monopoly ceiling" of the price to be in the range of 25 $/bbl.[19]

* The possibility to introduce excise taxes on petroleum is, by some reason, seen as a rather impossible measure to be taken by consuming countries (can be true in the U.S.).

If parameters change in the opposite direction the Lower Limit may rise; if the Middle East is seen as an even more dangerous source of oil; if OPEC, or the concentration of "hawkish" pricing countries' power is strengthened; if demand becomes much more inelastic; if substantial amount of oil from outside the Middle East disappears; if consuming countries trend towards introducing more petroleum taxes i.e. of concerns.

4.1.2 The Upper Limit

The following are examples on events that could lead to a drop in the Upper Limit:

* Backstop energies and/or technologies are introduced in large scale at a lower cost than today. At high prices this is a continuous process. However, at low prices such innovation processes usually take much more time.

* World economic growth slows down significantly and/or the income elasticity of demand for oil is (made) substantially lower.

* A drop in the Upper Limit may lead to a drop in the Lower Limit, as well. The more easily one can substitute other forms of energy for oil, the more acceptable it is to have a high import of crude oil. Thus, low prices and great dependence on import will be less of a problem the lower the U-limit is, implying that a lower non-OPEC

production is more acceptable from a importing country's security-of-supply view.

On the other hand, with changes in the opposite direction of these factors, the Upper Limit may rise; if backstop energies and/or technologies become more expensive; if the income elasticity of demand for oil becomes higher (again);

* If prices increases, sector by sector will gradually switch to other energies. The highest substitute price today is in transportation. If oil in the future mostly will be used for transportation purposes and no cheaper substitute for this sector is found, the Upper limit may rise to the price of these substitutes, which perhaps lays in the range of 50-60 $/bbl.[20]

4.2 What Will Actually be the Price of Oil?

4.2.1 Modest oil prices

The following are examples of events that would reinforce our assumption of a modest price development in the medium term (the b-path in the graph), perhaps prolonging the period of low prices (within the frames of the L-limit).

*A stock exchange crisis would lead to lower demand growth (or even decline) in demand.

* If oil countries increasingly becomes major investor in world industry.

* If technology should significantly improve automotive and/or industrial efficiency in the use of oil.

* If a substitute becomes more easily commercially available, for example super efficient natural gas for cars.

* If a "reasonable" amount of new oil is found.

* If gasoline taxes are introduced in the U.S. (or increased other places).[21]

* If significant amounts of new technology are transferred to the Russia that can improve their efficiency in oil production. A 10 % increase of Russian oil production represents 1.5 mb/d. Alternatively, the Russians can manage to transfer their own energy consumption towards natural gas (of which they have ample reserves and production) to increase oil exports.

If any of the factors mentioned above should occur to a sufficient extent, prices should not be expected to go below the lower limit (except for a shorter period) unless the changes are very significant as listed in the example of the sensitivity test of the L-limit above.

4.2.2 High oil prices

On the other hand, the following changes could lead to high prices in the nineties.

* The changing political environment in Russia may lead to a decline in oil production as the government emphasizes shifts from the industrial to the consuming sector and labor unrest rises. Also, environmental problems in Siberia (were 70 % of Russian oil production takes place) may cause a decline in oil production.

* A new war in the Gulf, or other places in the world, where further production facilities are destroyed.

* Economic growth induces demand to increase in the range of 2-3 mb/d annually instead of 1.5-2.0 mb/d (path between a and b).

* U.S. oil production is significantly curbed e.g. because of large new accidents in Alaska.

* Accidents in nuclear power plants occur to an extent that substantial atomic energy production is closed down.

* Oil tankers collapse because of high age. Radetzki[22] argues that if one or two of the old super-tankers, fully loaded, breaks down because of corrosion and age, causing huge environmental damage, decisions may be taken to eliminate many of these tankers from operation. This will make transportation a "bottleneck" in the market for some years.

* Power in OPEC changes from Saudi Arabia to the more "hawkish" pricing thinkers in Iran, Algeria and Libya (also Iraq before the war).[23]

The list, both for the more modest and the more dramatic price development, and for the changes in the level of the L- and U-limits, can be made longer. Our purpose in listing them is to illustrate how Scenario Planning focuses less on predicting the outcome and more on the understanding of the forces making the result. Therefore there are fewer figures in such an analysis than in forecasting generally. The result will be found in the sum of all factors important for the price development. The intention of the SP technique is to provide more insight. It is a way of thinking, to see forces in relation to each other and be aware of which events that can create a discontinuity in the future. It says as much about what cannot happen as what really will happen. Therefore, a price forecast within a SP framework should be understood as a conditional prediction.

5 CONCLUDING REMARKS

The methodological approach of understanding the development of oil prices presented in this paper, may have some intuitive appeal as a summary of an obviously more complicated process. The advantages of the ad hoc reasoning in the various elements of the technique must be balanced against its limitations. The procedure illustrates how important the

way of thinking about market mechanisms is, or to reduce what we have called the systemic uncertainty. It stresses the importance of making sensitivity tests (risk analyses) of the de facto subjective judgments made about the assumptions for any scenario (or say forecast). Finally, the method argues that even with a brilliantly performed analysis, it requires that uncertainty must be accepted as a structural element of the assessment.[24]

Wack (1985) describes the real world as a macrocosm and the mental model of researchers, analysts, politicians or managers as microcosms. SP technique has a consequence for the way to match forces and to test whether microcosms match macrocosms or not. Thus, leaving forecasting and turning to scenarios, because SP seems to match macrocosms better, some change of microcosm may be required in order for it to be useful. Therefore, if a scenario technique is applied in the assessment of future oil prices, it may have, in an by itself, consequences for the conclusions and strategies that should be taken on the basis of its results as compared to the use of more deterministic models. This may turn to be a rather difficult issue, perhaps even more difficult than changing the perception of the market mechanisms itself. But that is outside the scope of this paper.

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4. Multidisciplinarity combines disciplines by aggregation. Two disciplines may

include various aspects of an object and the integration is done by combining the two partial studies, or by taking conclusions from one discipline to serve as input into the research within the other. It is, to some extent, possible to translate the consequences of, for example, a political event to change in economic variables: A new war in the Middle East must primarily be dealt with through political analyses. The effects on economic factors such as production capacity and production strategies can be translated from how tense the situation is and possible actions of war. These effects can then, in their turn, be dealt with within the field of economics. Interdisciplinarity combines disciplines in a common core of concepts and methods. The extent to which it is possible in combing qualitatively different values and motivations between actors in a common core of concepts is not always clear. Interdisciplinarity is therefore a more demanding approach than multidisciplinarity. In the SP approach presented in this paper, the disciplines are combined by multidisciplinarity, first of all by combining economic and political factors and translating a change in the one into the consequence for the other.

5. Obviously, the distinction between these three types of uncertainty is not always clear. Sometimes, trivial uncertainty may be perceived as a part of a rather systemic problem. Similarly, systemic uncertainty may sometimes be regarded as a structural problem. But the concepts demonstrate one way of splitting up an issue in order to make it more easy to work with.

6. When all factors influencing an outcome are known, the outcome is predetermined. Example: If it rains heavily in the mountains, we know that it results in a lot of water in the river down along the valley below the mountains (unless an earth-crack occurs and changes the track of the river). The flood in the river can be said to be a predetermined event, if you have already observed the heavy rain falling. However, we cannot with the same degree of certainty say weather it really will rain heavily or not, even with all weather forecasts in the world at hand. The event heavy rain is an uncertain event, to which you can assign certain probabilities for occurrence (Wack, 1985).

7. Adelman, M.A. 1986: Comments to Gately (1986) **Brookings Paper on Economic Activity** no.2 and Gately, D., 1986: "Lessons from the 1986 Oil Price Collapse", **Brookings Papers in Economic Activity** no.2.

8. See i.e. Austvik, 1992: Krigen om oljeprisen. Oljepolitiske argumenter for krigen ved Den persiske gulfen, (The War over the Price of Oil. The Role of Oil in the War in the Persian Gulf) **Internasjonal Politikk** no.3, Oslo, August 1992,
for a discussion of economic-political arguments between Iraq and Kuwait on the pricing of oil as a prelude to the 1990/91 conflict.

9. It is the portfolio of taxes in consuming countries that is important for OPEC. See Schelling, T., 1988: **Global Environmental Forces**, Discussion Paper, Energy & Environmental Policy Center, Kennedy School of Government, Harvard University for a discussion of the importance of international cooperation in introducing excise taxes for the purpose of reducing oil consumption in order to reduce CO_2 emissions. This parallels the interest of oil consuming countries in reducing overall world

demand for oil in order to keep prices down (see Austvik, O.G., 1987: "Oil Prices and the Dollar Dilemma", **OPEC Review** Winter, 1991a: "De strategiske petroleumsreservene (SPR) som oljepolitisk kriseredskap" (The SPRs As Instrument for Managing Oil Crises), **Sosialøkonomen** nr.1 and ibid, 1992.

10. See Austvik, 1989b: "Introduction" and "Market Considerations in Norwegian Oil Policy" in Austvik (ed.) **Norwegian Oil and Foreign Policy**, Norwegian Foreign Policy Studies no.68, NUPI/Vett & Viten.

11. The price of oil in the period 1986-90 was in the range of 16-19 $/bbl in 1990-value. This price led to an annual increase in world demand of 1.5-2.0 mb/d, rather modest excise taxes were introduced and decisions of (world scale) significant investments in non-OPEC-production were not made.

12. See discussion in the sensitivity test at the end of the article of what will change if OPEC or some other grouping of producers, would be unable to influence prices by decision-making and corporation.

13. Example: Today, it seem rather unlikely that Saudi Arabia will increase capacity beyond some 14 mb/d by the turn of the century given the country's existing economic and political framework. See Austvik, 1990: **En vurdering av produksjonskapasiteten for råolje i fem land ved Den persiske gulf** (Assessing Oil Production Capacity in Five Persian Gulf Countries") Report to the Norwegian Treasury, published as NUPI-report no. 150 October. **.**

14. This was much the situation before the 1990-conflict in the Gulf. See Hogan, W. W., 1988: **Oil Demand and OPEC's Recovery**, Discussion Paper, Energy & Environmental Policy Center, John F. Kennedy School of Government, Harvard University, for a discussion of the relationship between prices and capacity utilization.

15. See i.e. Hubbard, R.G. & Weiner, R., 1982: **The 'Sub-Trigger' system: An Economic Analysis of Flexible Stock Policies**, Discussion Paper H82-07. Energy & Environmental Policy Center, John F. Kennedy School of Government, Harvard University.

16. A forecast based on the assumption that prices really <u>will</u> develop along a path making producers indifferent when to produce (as many forecasts do), indicate an oil price rising up to some 35 $/bbl in year 2002 assuming a 7 per cent discount rate at and price of 20 $/bbl in 1991.

17. Accordingly, the distinction between trivial, systemic and structural uncertainty are first of all done in order to clarify the concepts of uncertainty**.**

18. Adelman 1989: "The Oil Supply and Price Horizon", **Energy Policy** October argues that the "rewards of monopolizing the world oil industry have been so great that the nations cannot give up the effort. If the cartel collapses, it will be put together

again, with a partly different membership." See also Pindyck, R.S., 1978: "Gains to Producers from the Cartelization of Exhaustible Resources", **Review of Economics and Statistics** 60.

19. The opposite (a sudden drop in reserves) has in fact occurred. The field Cerro Azul Number 4 in Mexico after producing 260.000 b/d and a total extraction of 60 million barrels began producing only salt water in 1916 (Banks, F., 1986: "Economic Theory and the Price of Oil", **OPEC Review** Autumn). If such an event happened in a larger scale, reserves and production quite immediately could make a substantial cut-back.

20. This indicates that with gradually higher prices and demand switching to other fuels in a growing number of sectors, the Upper limit may also rise up to the substitute price in the sector where it is the highest.

21. See Austvik, 1989a: **Strategies for Reducing U.S. Oil Dependency**, Department of Economics, Harvard University, NUPI Report no.130 July.

22. Radetzki, M., 1989: "Shocks. Plausible Shocks in World Energy in the 1990s", **Energy Policy** August.

23. See i.e. Scott, B.R., 1987: **Saudi Arabia. You Can Hear it on the Radio**, Case Paper, Harvard Business School and: **Saudi Arabia. Emergence As a World Power**, Case Paper, Harvard Business School, for a discussion of the evolution of Saudi oil policies over the last decades.

24. The examples discussed do not necessarily intend to position price limits or conditional price forecast in a detailed manner.