
The Gulf crisis had a major impact on world oil markets: for several months the flow of oil and the capacity to produce oil in the future in several key oil-producing countries were directly or indirectly threatened. A genuine oil shock was avoided because those who are involved in oil markets and in related international organizations maintained their composure. But the end of the crisis and the return to moderate price levels does not mean that medium-term dangers in oil markets have been wholly averted. Indeed an examination of market fundamentals suggests that a return to a strong dependence on supplies from the Gulf is probable during this decade if the price of oil does not rise sufficiently to bring about a growth trend in oil production by non-OPEC countries consistent with growth in world oil consumption. That is what is at stake in relation to the possibility of dialogue between producing and consuming countries, a dialogue which should be directed not to fixing oil prices, but to assuring price trends that check oil demand and encourage supply development everywhere in the world.

La crise du Golfe a constitué un événement majeur pour les marchés pétroliers internationaux: pendant quelques mois en effet la production et les réserves de quelques pays-clé pour l'approvisionnement mondial ont, directement ou indirectement, été menacés. Le choc a été évité car l'ensemble des acteurs, sur les marchés ou dans les organisations internationales, ont su garder leur sang-froid. Mais le retour au calme et à des niveaux de prix modérés ne signifie pas que tout danger de tension est écarté pour le moyen terme. En effet l'examen des "fondamentaux du marché" montre qu'un retour à une forte dépendance des consommateurs envers les pays du Golfe est probable, à l'horizon 2000, si les prix du pétrole ne sont pas suffisamment élevés pour assurer une évolution de la production hors-OPEP compatible, en tendance, avec la croissance de la consommation mondiale. C'est l'enjeu d'un éventuel dialogue producteurs-consommateurs qui devrait avoir pour objet non de figer les prix, mais d'assurer une évolution de ces prix permettant de contrôler la demande et d'inciter au développement de l'offre dans toutes les régions du monde.

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After the Gulf Crisis: The Third Oil Shock is Yet to Come

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The third oil shock, that might have arrived with the Gulf crisis, did not materialize. Following seven months of a serious international crisis triggered by the annexation of Kuwait on August 2, 1990, and brought to an end by its liberation in late February 1991, oil prices returned to the \$15 to \$20/b range which prevailed from 1987 to 1989, and stayed in that range for the remainder of the first half of 1991.¹ The worst was avoided and the world oil supply system, centred on the Persian Gulf, was able to weather the storm.

This is clearly cause for rejoicing, since a takeover of Kuwait's oil reserves (10% of the world total) by Iraq (another 10%) would certainly have had far-reaching political and economic repercussions, not to mention the catastrophic effects that any serious damage to Saudi Arabia's oil production (25% of world reserves) would have had. In this crisis, the various players on the petroleum scene, including international organizations, oil companies and operators on the futures market, all generally managed to keep cool heads. As a result, the steep price hikes seen in the initial phase of the crisis were quickly reversed in the early months of 1991.

The first part of this paper is an examination

1/ All prices in this article are given in US dollars.

of the sequence of events and the reactions of the players in the petroleum community. We will also try to identify the most important lessons to be drawn from this crisis. The fact that prices have returned to the *status quo ante* does not mean that the underlying issues of oil supply have gone away. The second section is an examination of some underlying fundamentals of the oil market, with a view to identifying the conditions under which the world oil supply could be subjected to further strain during the next decade. Will such tension lead to a third oil shock or can it be gradually absorbed? Given the lags in the adjustment of supply and demand, this issue should be taken into account in policy formulation in the years ahead, and in the process of dialogue between producers and consumers that is now so frequently mentioned (Finon, 1991). Finally, it will be argued that the real objective is not to stabilize prices per se, but rather to control or regulate reliance on OPEC oil, specifically Gulf oil.

1. 1990-1991: The Shock Averted

Oil prices followed a downward trend during the entire first half of 1990. Brent crude fell from \$20/b in January to \$15/b in June. By that time a growing number of observers had become concerned that the decline was not sustainable, since these price levels were upsetting the balance between supply and demand (*PIW*, 1990; *Conjunction*, 1990). Nearly a year later, in February 1991, as the prospect of a ground war in Kuwait became a certainty, the markets anticipated a quick victory by the coalition forces. Again, crude prices dipped under the \$20/b mark, staying below this level until at least the end of June. Observers were still concerned, but this time their assessment was quite different: prices were not too low relative to market conditions and indeed they might even collapse if Kuwait and Iraq resumed production too quickly; there was a threat of overproduction (*Oxford Energy Forum*, 1991; Yamani, 1991). Thus, within the space of one year, we see comparable price levels leading to opposite fears: of a shortage in 1990, and of overproduction in 1991. In the meantime, a num-

ber of events had occurred which changed both the objective market data and the subjective assessments of the players. But is the situation really so radically different?

1.1 The Legacy of the 1986 Counter-Shock

During the first half of the 1980s, OPEC's capacity utilization rate fell from nearly 90% to less than 60% (see Figure 1). This fact alone may be enough to explain first the gradual erosion of prices, then the 1986 counter-shock (see the Appendix). This drop in the utilization rate in fact reflected OPEC's declining share of production in a context of falling world demand and steady growth in non-OPEC production. OPEC was able to contain the decline in prices, until the cartel members who were making the greatest sacrifices in terms of production—the Gulf states and particularly Saudi Arabia—abandoned the strategy of defending prices for the strategy of defending market shares. By the end of 1985, Saudi Arabia had developed the practice of netback contracts, which produced higher sales in exchange for large price discounts. As a result, prices fell from more than \$25 in early 1986 to less than \$10/b by mid-year.

This counter-shock thus reflected the inability of the OPEC cartel to defend a high level of prices for an extended period. In the view of some observers, this was inevitable: any cartel which artificially creates a product shortage is bound to face the problem of a lack of discipline among its members, and the eventual risk of breakup (Adelman, 1986). Indeed, from this perspective the optimum strategy for each cartel member is to proclaim that it is cooperating and limiting its production to help maintain prices, while simultaneously cheating to increase sales volumes. In fact, this explanation accounts fairly well not only for the counter-shock of 1986, but also for developments in the oil market between 1986 and 1990.

During this period a perceptible cycle was repeated at least twice: an OPEC production limitation agreement is reached and prices recover (1986-87 and 1989), following which there is a breakdown in discipline, with overproduction in

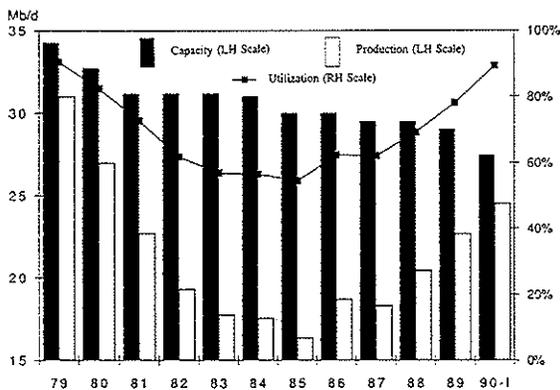


Figure 1: OPEC Capacity, Production and Utilization Rates

Source: IEPE, *OPEC Annual Statistical Bulletin, Oil & Gas Journal Energy Statistics Sourcebook*

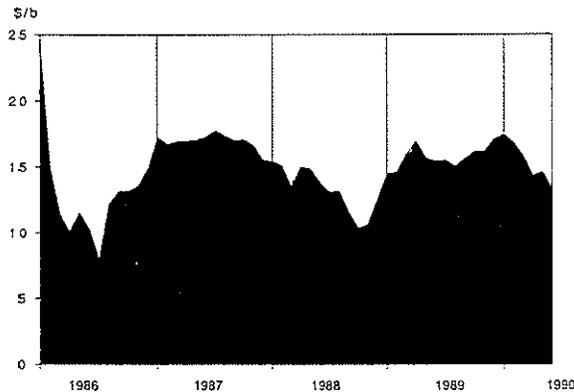


Figure 2: Spot Prices of Fateh 32 Crude (January 1986 - June 1990)

Source: IEPE, *Petroleum Intelligence Weekly*

violation of quotas and falling prices (1988 and first half of 1990) (see Figure 2). In a general context of excess capacity, price fluctuations cease to be structural adjustments, reflecting major trends in world supply and demand, but instead reflect short-term market imbalances. One indicator of these imbalances is the ratio of the demand for OPEC oil (world consumption minus non-OPEC production) to OPEC's actual production (Adda, 1989). Prices tend to rise when this ratio is greater than one, and to fall when it is less than one. Driven by a different process than that involved in the oil shocks, price variations were also less pronounced—prices of Middle Eastern crude stayed within a limited range around \$15/b.

Consequently, the problem of production discipline dominated the debate within OPEC up to the eve of the invasion of Kuwait. It is well known that during this period the least disciplined countries were none other than Kuwait and the United Arab Emirates. Price declines consistently coincided with instances of substantial overproduction (in violation of quotas) by these two countries (Martin, 1989). On the whole, Saudi Arabia seems to have adhered more closely to its quotas, except for a sharp surge in production in late 1988, just before the agreement leading to the restoration of prices in 1989. However, there remains an unanswered ques-

tion: while Kuwait and the Emirates undeniably fall within Saudi Arabia's sphere of influence (Schemeil, 1988), was their production policy at the time beyond outside control, or was it being manipulated? One thing is certain; Kuwait's lack of discipline in oil production was a major factor in Iraq's grievances against it.

The agreement reached in Geneva on July 27, 1990 under pressure from Iraq and Iran could have signalled the end of hard times for OPEC. It called for an increase in the benchmark price from \$18 to \$21/b and a return to production discipline, made increasingly credible by steadily rising demand for OPEC oil in the preceding years. For the Iraqi leadership, however, was this agreement nothing more than a prelude to a carefully plotted scenario? Or was it simply one step in an uncontrolled sequence of rising tension?² Whatever the answer, the Geneva meeting was followed immediately by the crisis.

1.2 The Markets Weather the Storm

On the eve of the invasion, the OPEC benchmark price had been increased and prices on the spot markets were once again rising. But, more importantly, knowledgeable sources had been

2/ For a discussion, see *Petroleum Intelligence Weekly* (1990), p.1.

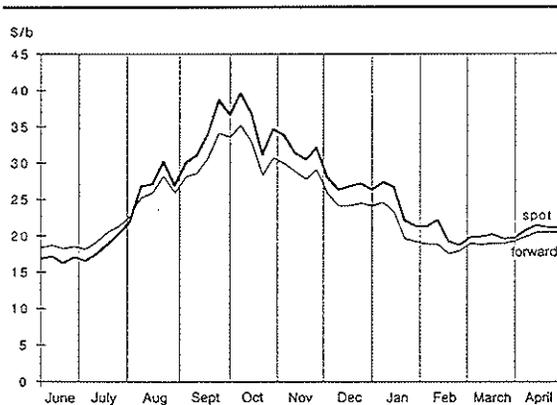


Figure 3: Spot and Forward (3 Months) Prices of WTI (June 90 - April 91)

Source: IEPE, *Petroleum Market Intelligence Weekly*

pointing out for months that lower production capacity and higher demand had caused OPEC's capacity utilization rate to rebound to 82%, compared with 79% in 1979 and the all-time low of 55% in 1983 (*Financial Times Energy Economist*, 1990, pp.6-11). Hence, no one should have been surprised at the rapid escalation in prices that began on August 2 (see Figure 3). First of all, Kuwait's oil potential (10% of world reserves, 9% of OPEC capacity and production) was directly threatened. Then the embargo swiftly resulted in the loss of some 4 to 5 million barrels per day (Mb/d) on the world market. Finally, Saudi Arabia, the preeminent world swing-producer, was located in the eye of the storm.

As a result, prices began to rise, finally leveling off at \$40/b in early October, as Iraqi ships were being inspected in the Gulf. The price rise was rapid, and more than once the spot and futures markets, whose influence has increased considerably since the counter-shock (Angelier, 1990), were blamed. By adding a speculative dimension to the petroleum market, it was argued, they were increasing the transaction volumes and amplifying price increases. While it is true that unbridled speculation reigned for a time and that investors on the various markets spent some frenetic weeks, two factors militate against the argument that the price increases were exacerbated by speculation. First, the level of spot prices never approached the peaks

reached in 1980 (about \$70 to \$90/b), either in current or constant dollars. Second, by mid-August forward prices had dropped below spot prices by a significant margin, as much as \$4.5/b for a three-month delivery. Hence, it would be wrong to speak of general panic. When all is said and done, a price of \$40/b during a crisis threatening the stability of the key region of the world petroleum system seems quite reasonable, and indeed futures markets may even have played a significant stabilizing role (Giraud, 1990).

Prices actually began to fall in mid-October, after passing through a series of plateaus marking the initiation and the ups and downs of the negotiating process. As autumn wore on it became quite clear that Saudi Arabia would be able to make up the bulk of Kuwait's and Iraq's lost production. From June to December, Saudi production increased by 3 Mb/d. Other OPEC countries provided close to another 2 Mb/d. The decline in prices reflected these factors, and the growing military strength of the coalition forces, while it did not eliminate risk, made serious damage to Saudi oil potential less likely. In December and early January, crude prices stabilized at around \$25/b, while total world stocks (0.8 billion barrels of strategic stocks and 5.6 billion barrels of commercial stocks) represented 95 days of consumption, compared with 93 days a year earlier in January 1990 (*PIW*, 1991).

The drop in prices in the hours immediately following the commencement of air operations was, nonetheless, a major surprise. All observers had expected a price surge, albeit a short-lived one. The decline occurred because, although markets might be rightly accused of shortsightedness vis-à-vis the long term, they can react quickly to the events of the moment and can anticipate the immediate future. The first news reports on January 17, which indicated that the US Air Force enjoyed complete air superiority, signalled the decline, from \$25 to \$20/b. This was reinforced by the decision of the International Energy Agency (IEA), for the first time since the crisis began, to release 2.5 Mb/d of stocks over a 30-day period. Another comparable decline occurred in mid-February when prices again fell below the \$20/b mark. While

this actually predated the ground assault, the allied offensive then appeared inevitable and very likely to succeed.

1.3 An Initial Post-Crisis Assessment

A number of lessons can be drawn from the development and outcome of this crisis. The first concerns stocks, which finally proved to be a very effective tool for limiting price increases in the event of a geostrategic accident. While stockpiling does not appear to be an effective remedy when upward pressure on prices stems from structural imbalance between consumption and production or capacity, a temporary reduction in capacity is quite another matter. The Gulf crisis was such an event. In the end total stocks, representing nearly three months' total OECD consumption, would have made it possible to do without Iraq's and Kuwait's production for much longer (*Financial Times Energy Economist*, 1990, p.10). The strategic stocks were therefore a way to buy time when the direction and final outcome of the crisis were still uncertain.

The IEA was sharply criticized, notably by OPEC representatives, for not releasing stocks in the fall, instead waiting for the military offensive, and thereby contributing to the January 17 drop in prices. The rationale behind this conduct was undoubtedly that stocks are, in a way, a weapon of economic dissuasion, and so are most effective when full and unused. However, the IEA's refusal to coordinate its policy in any way with OPEC during the crisis, even though such cooperation was specifically requested by exporters, served to heighten the image of the Agency as a war machine serving the interests of consumers (*Pétrostratégies*, 1991, p.5).

Although deeply divided by the conflict, OPEC was nonetheless able to avert the worst: disintegration into opposing camps of supporters and adversaries of Iraq. Its president appealed repeatedly for calm and took pains to reassure the markets that OPEC was aware of the drawbacks of sharp price fluctuations and wished to avoid a third oil shock. Last, but not least, it was able to manage a substantial increase in production by almost all member countries to

offset the loss of 5 Mb/d from Iraq and Kuwait.

This brings us to the second major lesson from the crisis. OPEC's margin of manoeuvre for increasing production proved to be greater than might have been expected at the outbreak of hostilities. In March 1990, for example, OPEC capacity excluding Kuwait and Iraq was estimated at 22 Mb/d (*PIW*, 1990, p.1). Saudi Arabia, for its part, was able to reach a level of production of 7.5 Mb/d in the space of one month, considered to be its full capacity. Yet, three months later, its production had risen to 8.3 Mb/d. This level may not have been sustainable over a very long period. Nonetheless, it shows that total capacity before the crisis was probably closer to 30 Mb/d than the 26 Mb/d sometimes reported. Of course, this level of total capacity will not be reached again until the production of Iraq, and especially Kuwait, has been fully restored, which will probably take several years. But the real-life test represented by the crisis has undeniably led to a reassessment by the players involved, and this new perception in turn is influencing prices today.

Apart from a feeling of relief that the crisis is over, can we conclude that the situation today is fundamentally different from that prevailing in the first half of 1990? Since the oil counter-shock, OPEC production has increased every year by an average of 1.5 Mb/d. At this rate, a margin of 6 Mb/d (30 Mb/d of capacity, 24 Mb/d of production) would be "consumed" within four years (Criqui, 1990). To appreciate the risks of tension on oil markets we must look beyond the short-term to analyze in particular the possible trends in the market fundamentals: world consumption, non-OPEC production and OPEC capacity.

2. 1991-2000: The Shock to be Averted

During the past 20 years, structural variations in oil prices—the two shocks and the one counter-shock—have stemmed mainly from the changing relationship between world oil consumption and non-OPEC production. When growth in consumption outstrips non-OPEC production, OPEC's importance to world supplies increases and so does its ability to impose price increases

(which, in any event, are needed to restrain demand and boost supply). Conversely, a slow-down in demand accompanied by a ready non-OPEC supply will force OPEC first to resist, and then, if the trend proves durable, to sacrifice prices in order to regain its world market share. This extremely simple model accounts very well for the four major phases that can be identified in the evolution of the fundamental variables of the petroleum market since the mid-1960s (see Figure 4): the growing strength of OPEC until 1973, stabilization of the balance of power between the two shocks, then a decline until the counter-shock, and finally a reversal of the market after this date (Criqui and Kousnetzoff, 1987).

This analytical framework is also the best suited to serve as the basis of a medium-term forecast of petroleum market developments to the year 2000. Whether price movements trend upward or downward will depend largely on the dynamics of world consumption and non-OPEC oil production.

However, an additional variable is needed to complete the petroleum scenarios: the degree of price adjustment inertia and rigidity. During the past 20 years prices have displayed considerable inertia. Given that price adjustments were neither continuous nor gradual, this explains why variations in the world supply and demand for oil were persistently unsynchronized. Thus it may be argued that oil prices were first too low (prior to 1974), then too high (between 1980 and 1985), and then again too low to ensure long-term stability of the market. This rigidity of price behaviour can and must be taken into account in oil price simulation models and scenarios (see Appendix).

In constructing scenarios, it may be assumed that poor cooperation between producers and consumers will correlate with a high degree of price rigidity; this has proven true in the past, whether the market was dominated by producers or consumers. Conversely, closer cooperation between producers and consumers, like greater vertical integration of the world oil industry, should lead to less rigidity and more gradual price adjustments. The "price flexibility" variable will therefore play a critical role in determining oil market trends over the next de-

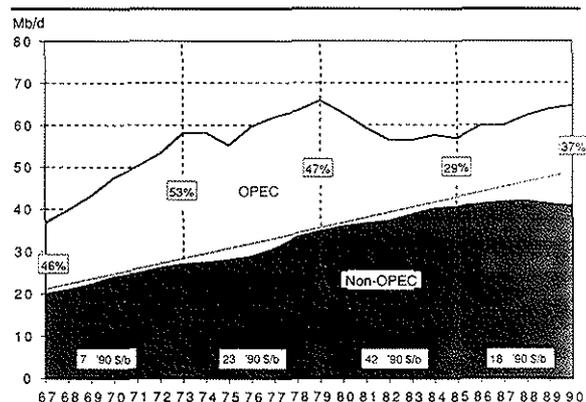


Figure 4: World Oil Production, OPEC and Non-OPEC (1967-1990)

Source: IEPE, OPEC, *Petroleum Economist*

cade. If prices are inflexible, tension will build up and ultimately trigger a third shock; if they are flexible, these pressures may be contained until the turn of the century.

2.1 Oil Consumption: Moderate Growth Despite the Population Explosion in Developing Countries

From 1967 to 1973, world oil consumption grew by nearly 8% per year. This acceleration of consumption was concentrated primarily in the industrialized countries and especially in Europe and Japan. In these countries, "petroprosperity" was associated with the spread of Fordism³ and a gradual narrowing of the standard-of-living gap with the United States, notably in terms of personal ownership of automobiles and other consumer durables. The developing countries accounted for only a small share of world oil demand, less than 15% in 1973.

The first oil shock brought about an abrupt change. From 1973 to 1979, world demand grew by only 2% a year. Slower economic growth, the first appearance of conservation efforts, and the diversification of energy sources served to stabilize consumption in OECD countries. Demand continued to climb only in the countries of the East bloc and the southern hemisphere. In the

3/ Or "mass consumption capitalism." For a recent analysis see Boyer and Orléan (1991).

wake of the second oil shock, this slowdown became a collapse. A prolonged recession, renewed conservation efforts, and above all the completion of major energy projects begun after 1973 (nuclear, gas and coal) led to a 20% decline in oil consumption in OECD countries between 1979 and 1985. This time, the developing countries were more severely affected, although likely more by the dollar shock and high interest rates than by the oil shock. During the first half of the 1980s, their consumption stagnated. In the East bloc, too, the first serious economic difficulties appeared, and the results for oil demand were identical. By 1983-84, world consumption had fallen to the level of 1973-74.

But the recovery eventually began, gaining strength after the counter-shock. A new trend has emerged, reflected in average growth of 2.5% per year between 1985 and 1990. What is clearly new in this development is that the additional demand has been divided equally between OECD countries and the developing countries (which accounted for only a quarter of total consumption), while in the East bloc countries worsening economic difficulties and the development of natural gas resources have tended to stabilize oil consumption. This trend is sure to strengthen over the next few years. The renewed demand for oil increasingly originates in developing regions with strong population growth; when population growth is accompanied by sustained economic growth, oil consumption, particularly for transportation purposes, increases very rapidly. This happened after 1985 in South-East Asia, for example, where consumption grew by 9% per year, a rate close to that posted by Japan before the first oil shock.

The population explosion in the Third World will therefore become an increasingly important factor in world oil demand. This is cause for concern in light of an expected increase in world population of 17% during the current decade (from 5.3 billion in 1990 to 6.2 billion by the year 2000) (Zachariah, 1988). There is no reason to believe that this phenomenon will necessarily lead to a surge in oil consumption in the next decade, however. Between 1985 and 1990, for example, average world oil consumption in-

Table 1: Various Estimates of World Oil Consumption in the Year 2000

	1985	1990	2000
World population (billions)	4.8	5.3	6.2
Annual growth rate		2.0%	1.5%
Oil Consumption (Mb/d)	57	64	
Annual growth rate		2.5%	
Per-capita consumption (toe/c)*	.59	.60	
World oil consumption in 2000 (Mb/d)			
Extrapolation 1990-2000	+2%/yr		78
	+3%/yr		86
Per-capita consumption	.60 toe/c		74
	.62 toe/c		77
IEA projections	oil price +5.5%/yr		76
	fixed oil price (1987 level)		82

* tonnes of oil equivalent per capita

creased only slightly, from 0.59 to 0.60 tonnes of oil equivalent (toe) per capita, although larger increases were recorded in certain regions. The explanation is that the weight of regions with low per-capita consumption is increasing as a share of the total, producing a downward trend in world average per-capita consumption.

On this basis, it is possible to make a tentative forecast of world oil consumption in the year 2000. Given a population of 6.2 billion and per-capita consumption of 0.60 to 0.62 toe per capita, the results are 74 to 77 Mb/d respectively, compared with 64 in 1990. This estimate is lower than the figure obtained by extrapolating existing trends (78 to 86 Mb/d) and lower than the IEA's estimate of 76 to 82 Mb/d (IEA, 1989). A range of 75 to 80 Mb/d for world consumption in the year 2000 therefore appears to be a reasonable estimate, given these conditions (see Table 1). World production will therefore have to rise by 10 to 15 Mb/d over a ten-year period. Is this a realistic assumption, and if so, will the additional production be supplied by OPEC or non-OPEC countries? This question is critically important to the future equilibrium of markets.

2.2 Non-OPEC Production: Can the Giants of the Past be Replaced?

From 1960 to 1985, growth in non-OPEC production was remarkably linear: every year an average of 1 Mb/d was added to production. If this trend were to continue, it seems fairly certain that world oil supply would not be a cause for concern. The bulk of increased world demand could in fact be satisfied by non-OPEC producers. As a corollary, if we accept the estimates of future consumption set out above, by the year 2000 OPEC production would have stabilized or show only slight growth, on the order of 5 Mb/d.

This assumption does not, however, appear to be tenable. It is becoming increasingly clear that a major watershed was passed in the mid-1980s. The curve of non-OPEC production abandoned its former path, with the pace of growth first slowing and then actually declining slightly in 1989 and 1990. In 1990, non-OPEC production was the same as in 1985; if it had followed its former trend it would have been 5 Mb/d higher. What are the reasons for this major change? Certainly, prices have fallen significantly since 1986, and the steady rise in prices starting in the early 1970s (in 1990 dollars, \$7/b before 1973, \$23/b between the two shocks, \$42/b after the second shock and before the counter-shock; see Figure 4) were undoubtedly decisive factors in the persistent growth trend.

However, faltering non-OPEC production in recent years is due primarily to factors of a more structural nature—which makes it all the more worrisome. These factors really have little to do with the depletion of world reserves, but rather are linked to a lack of major discoveries in new oil-producing regions, the only factor that could boost production. The linear growth of total non-OPEC production in fact masked a kind of relay race, whereby previously active but maturing regions were replaced by new regions with rapidly growing production (see Figure 5). For example, the major deposits of Western Siberia came into production in the late 1960s just as US production began to slow. Then at the end of the 1970s, when Soviet production in turn began to level off, the major deposits of Mexico, Alaska

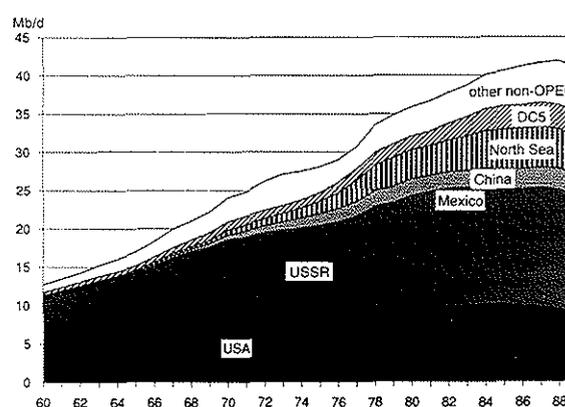


Figure 5: Renewal of Non-OPEC Production

Source: IEPE, UN/ENERDATA

DC5 = Brazil, Argentina, Egypt, India, Malaysia

and the North Sea came on stream in quick succession, soon followed by the more modest output of several large developing countries (China, Brazil, India, Egypt, etc.). By the end of the 1980s, the need for new sources of production had once again become acute. But despite the discovery of many small deposits in developing countries, this renewal has not yet happened.

As we noted earlier, part of the explanation for this phenomenon lies in the return to prices that are lower, in constant dollars, than in 1974. However, considerable technical progress and major cost-reduction efforts took place during the 1980s (Boy de la Tour, 1990). In many cases, there are small deposits that, while technically difficult to develop, could be profitably exploited today. But they are not necessarily being developed, and certainly not in sufficiently large numbers to compensate for the lack of sizeable new deposits coming into production. Hence, while a strong technological response is critical for today and for the future, at the moment it is unfortunately insufficient, at least given the lack of price incentive in the post-shock context.

At best, then, non-OPEC production might remain stable. In the view of some observers, the only question is how large the eventual decline will be, since new developments will not be enough to offset the decline which, for quite

different reasons, is likely to affect the production of the two major world producers, the USSR and the US. By 1995, production may have fallen by as much as 2 Mb/d in both countries, while the new small deposits in developing countries will likely contribute only an additional 2 Mb/d (Morse, 1990). Beyond 1995, can we hope for a miracle? The miracle would be the discovery of extensive new deposits. According to geologists, the only likely place for such discoveries is the USSR. Hence, both western technology and luck will be required if there is to be any substantial prospect of increasing non-OPEC supplies by the year 2000.

2.3 The Year 2000: A Sustainable Scenario vs. a Third-Shock Scenario

On the basis of this examination of the market fundamentals, a simple set of assumptions emerges for the year 2000: world consumption in the 75 to 80 Mb/d range, and non-OPEC production in the 35 to 40 Mb/d range. Juxtaposing these two sets of figures yields two extreme assumptions for OPEC production in the year 2000: 35 Mb/d in the "stable non-OPEC production - low demand" scenario and 45 Mb/d in the "low non-OPEC production - strong demand" scenario (see Figure 6).

Given the possibilities of expanding OPEC production capacity, the first assumption corresponds to a sustainable scenario up to the year 2000, while the second would probably lead to a sharp price increase—to put it bluntly, a third oil shock—which by mid-decade would once again have a major impact on supply and demand trends. Which of these two scenarios will come to pass will depend heavily on oil prices at the beginning of the period. If they are high enough, the first scenario appears to be the most probable. If they remain low, around \$20/b, then the second scenario will likely ensue. If there is to be any hope of averting a third oil shock, the major players in the world oil market should take steps to ensure that oil prices remain at high enough levels in the years ahead—at least higher than what short-term market conditions would imply. Indeed, this is the central issue of current

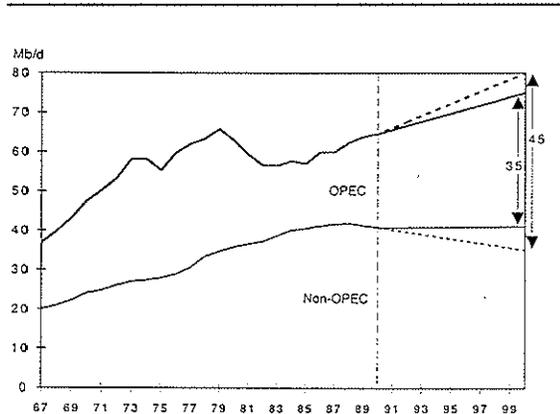


Figure 6: Two Scenarios to the Year 2000 with Different Fundamental Variables

Source: IEPE, OPEC, *Petroleum Economist*

discussions regarding oil price stabilization and market regulation.

First, however, let us return to the question of OPEC production capacity. Although some observers feel that production capacity limits are only a myth shrewdly perpetrated by exporters (Adelman, 1986), the question of production capacity development in the OPEC countries, and particularly in the Middle East, is today the central question for the medium-run oil outlook. Indeed, such an expansion in production is the only way to ensure that the world market clears in the 1990s. The extent of development will depend on both the amount of capital that can be mobilized by the producing countries and the willingness of the multinational companies to make new upstream investments in OPEC countries.

Several estimates are available. They are undoubtedly fairly reliable, since they are based on an analysis of expansion projects currently under way in various countries. But there is still considerable uncertainty in some cases about existing capacities, something quite evident during the Gulf crisis in the case of Saudi Arabia. In 1990, three different sources released similar estimates. OPEC capacity in 1995 is estimated at 34 to 36 Mb/d, according to the *Petroleum Intelligence Weekly* (1990, p.1) and at 34 Mb/d according to both the East West Center (Fesharaki,

1990) and the OPEC Secretariat (Olorunfemi, 1990). By the year 2000, OPEC capacity would rise to 37 Mb/d according to the East West Center, and 35 Mb/d according to OPEC.

The sums of money involved are considerable. The total capital expenditure required to maintain or increase OPEC capacity in the years ahead is estimated at about \$60 billion for 7 Mb/d of production, or more than \$8 billion per Mb/d. In this light the assumption of an OPEC production level of 45 Mb/d is unrealistic. It would undoubtedly be *technically* possible, given the enormous reserves in the Middle East, but it is quite doubtful that it would be *economically* feasible, because of the total investment required (on the order of \$120 billion), a sum that will be even more difficult to finance if oil prices remain low.

Even assuming that this challenge can be met, for example by a return *en masse* of the multinational oil companies (Bourgeois, 1991), it is doubtful that the consequences would be acceptable to the consuming countries, this time for reasons of strategic dependence. Thus, raising OPEC production above the 40 Mb/d mark, while undoubtedly technically feasible, appears to be economically difficult and above all politically unacceptable to consumers.

Under such conditions, what is needed is for oil prices to rise very quickly to a high enough level to restrain demand and stimulate oil development in new regions or with new techniques. This requires a stabilized reliance on OPEC oil—specifically Gulf oil—or at least an assurance of controlled growth. Clearly identifying this objective could help foster the recently initiated dialogue between producers and consumers. Indeed, price stabilization per se is undoubtedly not the proper objective, since, as past experience shows, stabilizing prices at too low a level leads to strain and shocks, while stabilizing prices at too high a level leads to other tensions and counter-shocks. A more effective approach for avoiding shocks would be to set an objective of ensuring a degree of price adjustment beyond that provided by market mechanisms, by taking into account the medium-term trends of the fundamental market factors.

What level of prices might such a cooperative strategy produce? As we noted earlier, prior to the

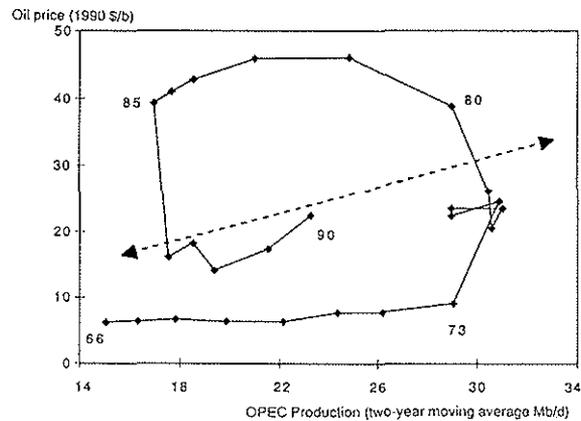


Figure 7: A Stable Oil Price Progression Path

Source: IEPE data, OPEC, *Petroleum Economist*

shocks price levels were too low; after the shocks they were too high; and current levels are also probably too low to stabilize reliance on OPEC oil. On the other hand, prices were stabilized for a few years between the two shocks, when the average price was \$23/b (1990\$) (see Figure 7). This is a hopeful sign, but there is reason to believe that today's target should be set higher.

What is most important is that such a target price be tailored to market conditions. The ultimate aim, in fact, would be to fine-tune the oil market, something which OPEC representatives have occasionally supported, while pointing out how difficult it would be for the producing countries to implement it on their own (Al-Chabali, 1988). In order for this kind of regulation to be effective, there would have to be some kind of feedback mechanism to limit fluctuations in the demand for OPEC oil and especially to ensure that prices rise in response to higher demand and vice versa. A formula linking the target oil price to the level of demand for OPEC oil would fully meet these conditions and could result in a much more stable market.

The goal is not to advocate a miracle solution but rather to establish some reasonable benchmarks, a set of guidelines that takes into account the major mechanisms and constraints of the world oil market. The question is, are governments and operators ready to move in this direction, and if so by what means? This opens up an

even larger and more complex issue.

The Gulf conflict was undoubtedly an extremely instructive experience for observers of oil markets. For the first time since the exporting countries took charge of their resources, a major geo-strategic event in the Middle East did not lead to an oil price shock. But this conclusion is not cause for excessive optimism, because the structural problems remain. The major risk for the 1990s is a rapid return to overdependence on the Middle East region for the world's oil supply.

The Middle East holds more than two-thirds of world oil reserves. Furthermore, those reserves are the ones exploitable with the lowest production costs. An alliance between producing countries with a long-term perspective (i.e., the Gulf countries) and consuming countries with a short-term perspective (in particular, the United States with its strong external constraints) could lead to fairly low oil prices during the early years of the decade. But this scenario will result in renewed tensions—in fact a new oil shock. There are certainly a number of ways reliance on Gulf oil can be regulated. If we wish to avoid severe price swings, which are undoubtedly as harmful to producers as to consumers, it is absolutely essential to keep the oil price flexible and to quickly establish an average level sufficiently high to restrain demand and stimulate supply throughout of the world.

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Appendix: A Simple Model of Oil Shocks and Counter-Shocks

In a survey of international oil price models, Gately (1984) has distinguished between theoretical models based on Hotelling's theory and the applied models used in international energy forecasting. He criticizes intertemporal wealth-maximizing models of producers' revenues in particular for underestimating the uncertainties facing the real actors in the petroleum market and for ignoring the importance of non-economic factors. Price models predicated on procedural rationality, that is, on rules of behaviour, rather than substantive rationality,¹ seem in this case to offer a more satisfactory representation of the operation of the petroleum market.

These applied models generally rely on behavioral rules to simulate oil prices. The best known of them, the Oil Market Simulation model used by the US Department of Energy (1985), links the yearly variation in oil prices to the production capacity utilization rate of OPEC in the previous year, using a relation as follows:

$$(1) \Delta PP_t = k_1 / (1 - TU_{t-1}) + k_2,$$

where ΔPP = the variation in the oil price relative to the preceding year, and TU_{t-1} = the utilization rate of OPEC countries in the preceding year.

This type of formula provides a satisfactory simulation of oil shocks and the corresponding price-ratchet effect: the price rises sharply when a given utilization rate threshold (80 to 90%) is exceeded; the price falls only very slowly when the utilization rate diminishes after the shock. But, as Powell (1990) has noted, this formula is inadequate for representing an oil counter-shock, since it permits no abrupt drop in prices.

The oil price model developed for the IEPE's POLES project (1991) is based on a different formula in an attempt to overcome the limitations of the traditional utilization rate model. Starting from the assumptions of Rauscher (1989), it leads to the following formulation for price changes:

$$(2) \Delta PP_t = k_1 \times (TUG_{t-1} - TUG^*)^n + k_2,$$

where TUG^* represents a special target-capacity-utilization rate for the Gulf countries and n is an odd number. This formula allows negative price variations and captures the flexibility of oil prices.

Successive econometric tests have been carried out for different values of TUG^* (between 0.6 and 0.7) and n (3, 5, 7

and 9). The best results, for the 1971-1990 period, were obtained with $TUG^* = 0.68$ and $n = 7$:

$$\Delta PP_t = \frac{30623 \times (TUG_{t-1} - 0.68)^7 + 0.035}{(10.2) \quad (0.9)}$$

$$\text{Corrected } R^2 = 0.850$$

$$\text{Std Err} = 0.171$$

$$\text{DW} = 2.31$$

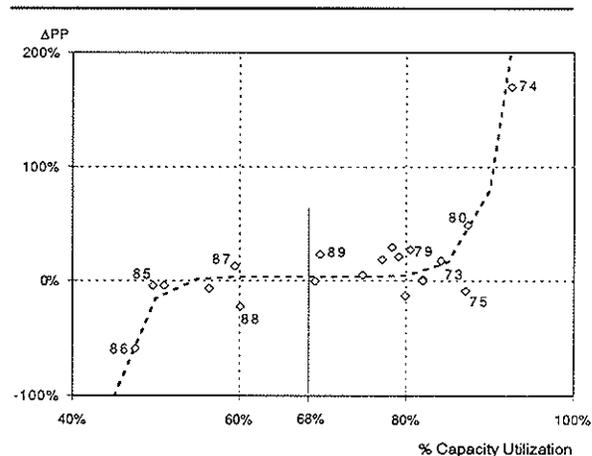


Figure A1: Price Variation, Regression and Observed Values (1971-1990)

Source: POLES-IEPE

The proposed formula therefore yields a target-capacity-utilization rate of 68% for the Gulf countries. It is capable of simulating both oil shocks and counter-shocks, with significant price stability when the utilization rate falls within the 60% to 80% range. This type of model satisfactorily accounts for the major phases in the oil market over the past 20 years and can also be used to test forecasting scenarios, by varying the value of the exponent n . Different n -values correspond to different degrees of price flexibility, which can be associated with contrasting assumptions about market structures and producer-consumer relations.

1/ According to the distinction introduced by Herbert Simon.