



## **Netback Pricing and the Oil Price Collapse of 1986**

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## 1. INTRODUCTION

The netback method for pricing crude oil, although used in the past by integrated companies in valuing oil transferred between subsidiaries, has become the subject of much interest and controversy after its adoption by Saudi Arabia during the second half of 1985. There is already a literature on netbacks, emanating in the main from consultants and publishers of specialized newsletters; but these studies, informative as they may be, tend to be restricted in their distribution to a limited business audience.

There is also a bewildering array of views and opinions on the economic significance of netback pricing and on its impact on the behaviour of the world petroleum market. These views tend to be influential being those of eminent authorities (see for example the sample published in PIW, 11 August 1986, Supplement). Though some of the opinions expressed are coherent and insightful others are misleading, and it is not always easy to separate the wheat from the chaff. The correct understanding of the netback pricing issue is made that much more difficult by the proliferation of authoritative pronouncements.

The purpose of this paper is to clarify, as much as possible, some of the important issues relating to netback pricing. Our approach is to start from first principles and to proceed analytically in an attempt to answer questions of interest to those who operate in the petroleum market and to those who reflect on its performance and behaviour.

The main questions refer to

- i) the nature of netback pricing;
- ii) the influence of netback pricing on the behaviour of economic agents operating in the world petroleum market, namely crude oil producers and refiners;
- iii) the role played by netback pricing in the oil price crisis of 1986;
- iv) the impact of netback pricing, as compared with other methods, on the movement and fluctuations of oil prices.

It is important to note from the outset that some of the confusion surrounding these issues arises from a failure to distinguish sharply between (i) netback pricing as such, that is the procedure through which crude oil is priced as a function of product prices, processing and transport costs, and (ii) the circumstances surrounding the adoption of netback sales by Saudi Arabia in the second half of 1985. The dramatic oil price developments of late 1985 and 1986 were largely the result of a fundamental change in Saudi Arabia's and OPEC's overall oil policy - the formal (though perhaps temporary) abandonment of a traditional system of price administration in favour of competition for additional export volumes. Netback pricing was the instrument chosen by Saudi Arabia (and, a much forgotten fact, by other producers as well) to implement this fundamental change in policy.

The failure to make this important distinction between the context in which Saudi Arabia decided to retrieve a market share in 1985 and the method chosen to achieve this objective could produce misleading explanations. One pitfall is to ignore

the specificity of the pricing method and to explain all the characteristics of the oil price collapse of 1986 - the pattern, the magnitude and the speed - exclusively in terms of the competitive drive, as if the method chosen for selling crude competitively was absolutely neutral. This is not correct. Competition explains the price collapse but the pricing method determines the features of price movements. Different methods (e.g. netback, spot pricing, repeated discounts from an official price) would have caused the collapse to happen sooner or later, and price movements to display fluctuations of different amplitude. They would also have produced different patterns of leads and lags between product and crude markets.

Another important difference between pricing methods relates to their efficiency in achieving the goals of the player who enters the competitive game first. Although competition for market shares is inherently self-defeating in the long run, the gains secured by the first player in the initial round may depend on the pricing method he chooses to adopt. Some methods may enable the first player to increase his market share very quickly and retain these gains for a certain period of time because they are more difficult to emulate immediately by the opponents, while others may fail to produce from the start any result in terms of increased volumes of sales because they lend themselves to rapid retaliation from the opponents. It is therefore wrong to assume too readily that pricing methods - for example netbacks - are neutral in their effects.

The other pitfall is to ignore the competitive drive and to attribute the oil price collapse entirely to netback

pricing as such. This view, as we shall argue later in the text, is incorrect. The fundamental cause of a price collapse is the willingness of producing countries to sell additional volumes at lower prices. No pricing method - netback or otherwise - would cause prices to fall if producers restricted supplies; and all methods would cause prices to fall, albeit in different ways and with different patterns, when producers compete by bringing onto the market additional volumes of oil.

In order to understand correctly the oil price crisis of 1986 it is also necessary to identify and analyse the sequence of competitive moves which began long before the Saudi decision to adopt netback pricing (in order to shift a larger volume of oil) and which extends to the present day. Saudi Arabia's fateful decision taken in mid-1985 and implemented in September of that year was itself a response to a competitive process of price discounting involving most oil exporters both within and outside OPEC. Saudi Arabia was then followed by OPEC as a whole: in a confused and confusing move OPEC decided in December 1985 to replace its administered-price system by a market share objective.

This sequence raises a question about the particular event which triggered the price collapse. Naturally, different interpretations, each reflecting a particular political position or a specific vested interest, have been proposed. Some argue that Saudi Arabia started the price war with the adoption of netback pricing; others that the OPEC decision of December 1985 was the immediate trigger because of its impact on market expectations; and others, noting that Saudi Arabia had only



reacted to the competitive actions of other producers, trace the origins of the price collapse to 1982 if not earlier. Our position is that the price collapse is an inherent part of the whole sequence and cannot be assessed in relation to one of its stages or to a single event. There is little doubt, however, that these conflicting interpretations tend to confuse the particular question of netback pricing, as some are inclined to over-emphasize its role and others to dismiss it altogether.

As mentioned earlier our main purpose is to clarify the issues relating to netback pricing, a particular method of sales, and those relating to the oil price collapse of 1986, a historical event chronologically associated with the adoption of netback prices in arm's length contracts by Saudi Arabia but attributable to a wider and more complex set of causes.

The task is important because the debate about alternative pricing methods for oil will continue to influence for some time the position of producers and that of the oil industry on this matter. The decision to return to an administered oil price system made by OPEC in December 1986 will not close this debate. Price administration is likely to run into problems, and a number of producers will continue to prefer alternative and more flexible pricing methods.

## 2. THE CONCEPT OF A NETBACK PRICE

At first sight the netback pricing concept seems simple, familiar and well understood. As the term "netback" implies the idea is to value crude oil by "netting" costs from the value of products obtained through the refining process. Thus the netback price of a barrel of crude is the gross product worth of the refined products at the refinery gate, minus the costs incurred in transporting the barrel from the export terminal (or the oilfield in the case of domestic crude) to the refinery, and minus refining costs. The gross product worth is the sum of product prices weighted by the refining yield. The general structure of a netback formula is therefore:

$$n = \sum p_i a_i - \sum c_j \quad (1)$$

$n$  is the netback price of a barrel of crude;  $p_i$  is the price of product  $i$ ,  $a_i$  is the yield measured according to volume or weight of product  $i$  in the refined barrel such that  $0 \leq a_i \leq 1$  and  $\sum a_i < 1$  ( $1 - \sum a_i$  is the small percentage of the barrel used up as refinery fuel or dissipated as losses);  $c_j$  is the cost element  $j$  involved in the transport and refining of the barrel.

Netting back from products to crude involves a time dimension because of transport, processing and sales time lags. The netback price of crude lifted at date  $t$  depends on the gross product worth which is realized after a time lag, the time required to transport and refine the crude. Note, however, that

the disposal of refined products may spread over a period of time after the completion of refining. Formula (1) is readily modified to include this time factor, i.e. the period  $\tau$  over which products are sold and the gross product worth is realized.

$$n_t = (\sum p_i a_i)_\tau - (\sum c_j) \quad (2)$$

An alternative formulation, which will prove useful, replaces the cost terms  $(\sum c_j)$  by transport costs per barrel,  $f$ , and a processing fee  $z$  thus

$$n_t = (\sum p_i a_i)_\tau - (f_t + z) \quad (3)$$

Although these expressions are simple enough in their general form difficulties arise as soon as attempts are made to define precisely the yield, price, cost and time parameters. It is important to stress that there is no unique definition of these parameters applicable to all situations. The preferred definitions depend on the type of deal involving netback pricing, on the purposes and scope of netback pricing in that deal, and on the nature of the economic relationship between the partners of the deal.

Let us distinguish three cases:

- (a) Crude oil transfers between subsidiaries of an integrated corporate group made on a netback basis;
- (b) Long-term supply contracts between two major oil companies of the pre-1973 era involving netback pricing;
- (c) Arm's length netback deals between a producing country and an oil company or an independent refiner such as the Saudi Arabian deals of late 1985 and 1986.

Furthermore, all these and similar cases where netback pricing relates to the valuation of oil transactions in actual deals must be distinguished from those netback calculations made by oil companies, consultants and specialized journals, independently from any deals, for the purpose of assessing the relative attractiveness of different crudes to a refiner.

(a) Crude oil transfers between subsidiaries. Internal transfers between subsidiaries, though less common today, now that decentralization is more the fashion than in the past decades, can be valued under different arrangements. Netback pricing is one of them. In such a case the application of netbacks is an internal accounting affair which, like other instances of transfer pricing, can be made to serve a fiscal purpose. Usually the tax minimization objective calls for a re-allocation of profits or losses between locations or sectors subject to different tax regimes. In pursuit of this objective, the tax parameters of the general netback pricing formula will be defined carefully to reduce the total tax liability of the corporate group. However this does not mean that the definitions applied will be entirely arbitrary since there are tight constraints imposed by accounting rules and tax audits.

Suppose that there is a tax advantage in shifting profits downstream; in that instance the tendency is to seek a low netback price for the crude supplied by the upstream subsidiary to the refineries of the corporate group. The general netback formulae suggest that this can be done by selecting yield patterns and product price concepts which understate the gross product worth  $\sum p_i a_i$  and by including in  $\sum c_j$  as many a

cost element as may be plausibly attributed to transport and processing. The opposite biases might be introduced in the definition of the parameters if there is a tax advantage in shifting profits upstream.

In practice the room for manoeuvre available to accountants for selecting convenient parameters is not considerable. There is however some flexibility in the choice of  $[a_1]$ , a technical parameter confusing for the tax authorities and in the specification of the cost concept which can be made to include amortization and other capital charges or to exclude them on the basis of different economic arguments.

(b) Long term supply contracts between companies in the pre-1973 era. The major oil companies, during the old OPEC concession period, used to balance their crude oil supplies and requirements through inter-company exchanges within the framework of very long-term contracts. The purpose of these arrangements was to secure a stable access downstream to crude-long companies, and by the same token a stable source of supplies to crude-short companies. Their effect was to enhance the overall integration of the international oil industry.

In some instances, for example the Gulf/Shell contract for Kuwaiti crude entered upon after the Second World War, the complex clauses of the agreement included a netback formula. It seems that the purpose of the netback clauses was to adjust the price of crude purchased by Shell from Gulf according to the profits (losses) made by Shell in certain markets. In some of their aspects, the respective motivations of Gulf and Shell were similar to those of contemporary crude oil producers

and refiners. Gulf's main concern was to shift large volumes of crude obtained from its Kuwaiti concession into a secure market; and Shell, a crude-short company, was concerned with obtaining oil supplies on terms which protected its downstream margins.

(c) Arm's length netback deals. The netback sales deals which have been covering a significant proportion of crude oil trade after their adoption by Saudi Arabia in the second half of 1985 are yet a different application of netback pricing. In these contracts the price of crude supplied by the producers is calculated ex post on the basis of a netback formula specified ex ante in the contract. The relationship between the two parties to the deal differs from (a) because the partners are autonomous entities not part of an integrated corporation; from (b) since the contract period is much shorter and the context is that of a fairly de-integrated corporation.

Arm's length netback contracts provide oil companies and independent refiners with the opportunity to buy crude through an arrangement which ensures the realization of a positive downstream margin. (We shall show in subsequent sections that the actual margin realized usually differs from the gross margin  $z$  specified in the netback pricing formula except in a limiting or notional case.) The producer who offers to supply crude on a netback basis attempts to attract buyers, thus to shift additional volumes or at least to protect the level of his current sales, with the prospect of this positive margin. It should be stressed, from the outset, that the producer's purpose is eminently competitive. His aim is to sell oil, and he will negotiate the terms of the netback pricing formula as flexibly as

it may be necessary to achieve this aim. The refiner's response to the offer of a netback deal depends on his relative preference for crude purchase contracts involving prospects of a positive refining margin (variable but within a certain and fairly narrow range) as against contracts (e.g. spot market purchases) which may yield a very uncertain per barrel return.

The introduction of netback deals adds to the range of contracts available for crude oil transactions and both sellers and buyers face the problem of selecting their preferred type of contract. However, in 1985-86 most oil exporting countries always seemed to opt for only one method of sales, while buyers were concerned with the problem of optimal diversification of their "portfolio" of crude oil contracts. These are important issues discussed later in this paper.

### 3. THE DEFINITION OF THE NETBACK PRICING FORMULA IN ARM'S LENGTH DEALS

#### A. Introduction

Let us set, for the purpose of this analysis, a reference case described as a "notional" crude oil deal in which (i) the gross product worth  $\sum a_i p_i$  is the refiner's realizations from the sales of products obtained from refining a barrel of crude purchased under the deal (the realizations are exactly what they turn out to be over the actual period  $\tau$  during which the products are sold); and (ii)  $f$  is the freight and related transport costs per barrel actually incurred by the lifter. In this "notional" case which we may call a pure realization deal, the gross margin  $m$  realized by the refiner is identical to the processing fee  $z$  negotiated ex ante. Formally, this "notional" deal can be simply characterized as one always involving:

$$m = z \tag{4}$$

In the real world, arm's length deals never yield this result except under very special conditions which are unlikely to be fully satisfied. The divergence between the actual gross margin  $m$  and the negotiated processing fee  $z$  arises for three different sets of reasons.

First, it is virtually impossible to define ex ante the parameters  $[a]$ ,  $[p]$ ,  $f$  and  $\tau$  of the netback pricing formula (3) in such a way as to describe exactly the technical and economic environment in which the refiner operates. This is because:



- (i) the refining yield vector [a] is not a rigid technological datum;
- (ii) there are different price and cost concepts to choose from, and it is often difficult to identify a priori the particular concept which is most relevant to the problem at hand;
- (iii) time lags in say, transport and processing, are not rigidly fixed by logistics and technology.

There is flexibility in the technology and complexity in the economic concepts (prices and costs) which cannot be captured exactly and unambiguously in simple, ex ante definitions of the parameters of netback pricing formulae.

Secondly, the definitions of these parameters are subject to negotiations between the parties to a netback deal. In these negotiations, the producer will propose definitions which are biased towards yielding as high a netback price as possible; and conversely, the refiner will propose definitions which are biased towards yielding as high an actual margin  $m$ , relative to the negotiated processing fee  $z$ , as he can get. The relative bargaining power of the two parties determines the outcome of these negotiations, that is the specification of the pricing parameters.

Thirdly, the refiner who has concluded a netback deal is under no obligation to process the crude according to the specified yield pattern, or to sell the products at the date or according to the price concept specified in the formula. His only obligations are to lift the volumes agreed upon and to pay for each barrel of crude purchased a netback price computed from

the agreed formula at the relevant date. He is free to put to the best possible use the technological flexibility of his refineries, to sell his products sooner or later than the "computation" date, to shift these products to different markets and to sell them at prices other than those defined in the netback formula. In other words, the refiner will normally attempt to optimise his operations in order to maximize his gross margin, given the terms of the netback deal, the market circumstances in which he operates, the characteristics of the technology at his disposal, his expectations about future product price movements and a host of other relevant factors.

Thus, starting from the "notional" case in which  $m = z$ , we argue that problems of ex ante definitions almost certainly cause a divergence between the actual margin and the negotiated processing fee  $z$ . This occurs even when the bargaining power of the two parties is in perfect balance, and when the refiner's behaviour ex post corresponds exactly to the description implied by the agreed price formula. This divergence, arising only from conceptual reasons, can be either positive or negative.

We have therefore

$$m_1 \gtrsim z \quad (5)$$

Negotiations introduce another divergence because the bargaining power of the two parties is usually unequal. In the buyers' market of 1986 skilful oil companies have probably been able to obtain favourable definitions of the parameters  $[a]$ ,  $[p]$ ,  $[f]$  and  $\tau$ . In this instance the divergence from the previous case is positive. Therefore

$$m_2 > m_1 \text{ and yet } m_2 \lesssim z \quad (6)$$

Finally, the actual margin  $m$  obtained by the refiner is neither  $z$ , nor  $m_1$  nor  $m_2$ . The actual margin obtained from processing the crude and selling the products also depends on the refiner's responses to the market conditions prevailing during the relevant period of activity. He will naturally attempt to make  $m$  greater than the margin  $m_2$  he sought to obtain, implicitly, from the negotiations but may or may not succeed. Thus we have

$$m \gtrsim m_2 > m_1 \text{ and } m \lesssim z \quad (7)$$

In this section we shall explain why it is difficult to define a priori the parameters of the netback pricing formula. In the next section we address the problem of negotiations. In section 5 we analyse certain aspects of the refiner's behaviour.

## **B. Definitional Problems**

Refining yields  $[a]$  and product prices  $[p]$  are the factors which determine the gross product worth. In the reference case (the "notional" deal) the gross product worth is product sales realizations. However, the arm's length nature of the netback deals with which we are concerned here implies that neither the elements of  $[a]$ , nor the elements of  $[p]$  can be derived from the realization accounts. Thus  $[a]$  must be defined in advance, and  $[p]$  must be defined with reference to a public source of data easily available and recognized by the two parties to the deal as reasonably reliable.

(a) Refining Yields. It may be thought that the parameter [a] which also includes an element for refining losses can be easily defined ex ante to capture the notion of realizations by specifying it as the yield of the specific crude supplied to a given refinery. A closer look reveals difficulties. First, it is virtually impossible to determine ex ante the percentage of crude dissipated in the refining process. Secondly, the buyer may own several refineries of different types. Thirdly, yields obtained in a given refinery may be varied by changing the proportions of distillation/cracking capacity in use or by blending crudes obtained from different sources.

One solution, imperfect as it may be, is to take an average of the yields obtainable by the refineries of the buyer concerned in the region where the crude is supplied. However, this average cannot be defined unambiguously when the refineries are not used to full capacity: weights reflecting existing capacity of say, distillation and cracking, will not correspond to the proportion actually applied. And these actual proportions will always change over time in response to market and other conditions. Another solution, also rather imperfect, is to determine the yields with reference to a "typical" or "representative" refinery in the importing region. In fact, this solution may take us further away from the target concept of realizations than the earlier one because it refers to the region as a whole (say North West Europe) and not to the particular buyer concerned with the deal.

It is sometimes argued that the relevant yields for a pricing formula in an arm's length netback deal are the marginal

not the average yields. The reasoning is that a netback deal provides the refiner with incremental crude, and that this crude will be processed through the particular technology which is brought to bear at the incremental margin. This argument is only valid under restrictive conditions; (i) the technology used at the margin is correctly identified and remains invariant throughout the contract period; (ii) the crude supplied under the netback deal is truly incremental. The second condition is almost impossible to satisfy because the volume of the deal may be large in relation to the incremental technology (a part will then be processed by the intra-marginal capacity); and, more generally, because crude is to some extent "fungible". When the refiner is supplied from different sources there is no way of determining in advance which particular crude will be used at the margin.

(b) Product Prices. In the reference case the relevant product prices are those underlying realizations. In arm's length netback deals the product price parameter should be defined in a way which captures as closely as possible the idea of realizations, without linking however the computation of the crude netback for the settlement of the bill to the actual value of product sales obtained by the refiner. It is virtually impossible to satisfy the first condition because refiners may dispose of their products in different markets in a variety of ways (spot, term, preferential sales, additions to inventories etc.) and in proportions which change over time and which cannot be known or guessed accurately in advance. The second condition calls for the use of a convenient price parameter which, by its

very nature, may also take us some distance away from the polar notion of realization.

The almost universal convention in contemporary netback deals is to adopt Platts' spot product price quotations. It is often argued that, apart from convenience, the rationale for using spot prices is that they are marginal prices. We are inclined to dismiss this argument as we did previously in the case of yields. The function of a netback deal is not price discovery at the margin for the purposes of profit maximization and efficient allocation of resources; the aim is to provide the refiner with the guarantee of a positive downstream margin. It is not evident that at every moment spot prices best fulfil this function. We have already mentioned that refiners do not necessarily sell all their products at spot prices and that they may not sell them all in the location which provides the relevant Platts' quotations. Furthermore, an individual refiner selling spot may systematically under- or out-perform Platts in the short term.

(c) Freight and Associated Transport Costs. Here again, the transport costs that would be taken into account in the reference case are those which are actually incurred. In arm's length netback deals these must be specified ex ante. The usual convention is to use published spot freight data for tankers of an appropriate size and for the relevant routes. However, crude may be actually transported by the oil company's own tankers, or by tankers of a different size than assumed in the formula, or at rates different from those published.

Other costs, such as insurance, ocean losses and duties

may be specified ex ante or ignored altogether because of their relative insignificance. As for other items the a priori decisions on what should be included and on the appropriate allowances are matters of judgment which inevitably involve some divergence from the actual costs incurred.

(d) The Time Parameter. Another parameter to be defined in arm's length netback deals is the dating of the netback price computation in relation to the date of lifting. This issue does not arise in the reference case. To approach the idea of realization, the computation of the gross product worth should be made over a period of realistic length  $\tau'$  (by taking say average spot product prices over that period) starting after an interval  $\theta$  from the date of lifting  $t$ .  $\theta$  would express a realistic assessment of transport, processing and sales lags. Note however that  $\theta$  is not absolutely constrained by logistical and technical factors. The refiner can vary the length of this interval above a minimum and up to a point, by varying the speed of tankers or delaying processing or sales through the accumulation of inventories. In most netback deals (there are exceptions)  $\tau$  is collapsed into a single date  $t'$  fixed in relation to the lifting date  $t$ . In this most common case the netback formula becomes:

$$n_t = (\sum p_i a_i)_{t'} - (f_t + z) \quad (8)$$

Other things being equal, this procedure though convenient distances further the netback deal from the reference case.

(e) The Processing Fee. Most netback deals specify a processing

fee  $z$  to cover refining costs and a return to the refiner. In our "notional" deal  $z$  is negotiated by the parties to the deal and turns out to be in the end the actual margin received by the refiner. In arm's length netback deals  $z$  is also negotiated and the outcome will tend to reflect the balance of market power between the parties to the deal. The important dissimilar feature is that in arm's length deals the actual margin  $m$  is inevitably different from  $z$ . Comments about netback deals which suggest that they guarantee the refiner a fixed margin are as misleading as they are common.



#### 4. NEGOTIATING THE PARAMETERS OF A NETBACK PRICING FORMULA

The simple finding that the actual refining margin  $m$  arising from an arm's length netback deal differs from the processing fee  $z$  specified in the contract has interesting implications. In negotiating a netback deal the oil company or the refiner (the buyer) has an incentive to seek a definition of the pricing parameters which maximizes  $m^1$ . The crude oil producer (the seller) seeks definitions which maximize the resulting netback price  $n$ .

It is clear that  $m$  is greater the greater is  $z$ , the greater the difference between costs allowed and costs incurred, and the greater the difference between the gross product worth realized and the deemed gross product worth in the formula. Since realization is an exogenous variable in the context of this analysis, the refiner, when negotiating the contract will seek to include in the pricing formula as many cost items as he can and overstate their values, and to define  $[a]$ ,  $[p]$  and the relevant time lags in a way which depresses  $(\sum p_i a_i)_t$ . Of course, he will also bargain for a high  $z$ . It is also clear that  $n$  is greater the lower is  $z$ , the smaller the allowances for costs, and

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1. In certain cases, of course, this consideration may be qualified by the wish to secure a first contract so as to obtain access to a particular source of crude oil supplies. However, this does not affect the analytical argument which follows, because the incentive to seek the highest possible margin  $m$ , allowing for the trade-off with other objectives, remains intact.

the higher the deemed gross product worth. The producer will thus seek to exclude cost elements and understate the values of the cost items retained in the formula and to define [a], [p] and time lags in a way which enhances the value of the deemed gross product worth. Of course he will also bargain for a low z.

We shall not elaborate on the negotiations of costs but concentrate primarily on those relating to the components of the gross product worth (including time lags) as these raise interesting issues. Finally, little can be said, that is not readily understood, about negotiating z but we shall refer to the important question of a possible trade-off between the processing fee and yields.

(a) Product Prices. The price vector, being conventionally defined as Platts' spot product prices, is an exogenous variable in this context. The refiner and the producer therefore will only ask: which criteria enable them, each from his own point of view, to select from an admissible set the most favourable yield and time-lag structure?

(b) Refining Yields. For the producer, the most favourable yield vector, in a set of alternatives, is that which multiplied by the price vectors exogenously generated by Platts, produces consistently over the contract period the highest values for the gross product worth. (The refiner will seek the yield vector which yields lower values for the gross product worth.) Assume that the producer considers the relative merits of two yield vectors  $[a_i]$  and  $[b_i]$ . From his point of view  $[b_i]$  is unambiguously more favourable than  $[a_i]$  if

$$[b_i] [p_i^1] > [a_i] [p_i^1], [b_i][p_i^2] > [a_i] [p_i^2] \dots$$

$$[b_i] [p_i^n] > [a_i] [p_i^n]$$

that is  $(\sum b_i p_i)_t > \sum (a_i p_i)_t$ , for all price vectors  $[p]$  that will subsequently emerge at all dates  $t'$  during the life of the contract. But the movements of spot product prices at future dates  $t'$  are not known in advance. If all that is expected is that spot product prices will continually vary in absolute terms and relatively to each other without any regular pattern, then it is impossible to determine in advance whether  $[b]$  is preferable to  $[a]$  in the sense that  $[b]$  will consistently produce a higher gross product worth than  $[a]$ . In the general case, where there is no pattern to spot price movements, the a priori search for a more (less) favourable yield structure is entirely futile.

In order to move further ahead with the issue, it is necessary to postulate that in normal circumstances spot product price movements are characterised by some regular feature. We may observe, for example, that however much spot product prices vary the price of gasoline always remains higher than that of fuel oil, and use this to state a restriction on the behaviour of  $[p]$ , that for all  $[p]$  we have  $p_i > p_n$ , where  $i$  denotes gasoline and  $n$  denotes heavy fuel oil. Unfortunately this is not sufficient. In order to obtain a criterion which ranks unambiguously  $[b]$  as more (less) favourable than  $[a]$  we need a stronger restriction. For example, the condition that "spot product price movements are such that they always keep the prices of petroleum products ordinally ranked according to their specific gravity" can help in solving the problem. Formally, for all vectors  $[p]$

$$p_1 > p_2 > p_3 > \dots > p_n \quad (9)$$

Consider the case of yield vectors with three products only.

$$[a] = [a_1, a_2, a_3] \text{ and } [b] = [b_1, b_2, b_3]$$

where subscript 1 denotes the light product, 2 a middle distillate and 3 the heavy fuel. Note that by definition  $\sum a_i = \sum b_i = 1$ . The difference  $[d] = [b] - [a]$  is  $[d] = [d_1, d_2, d_3]$  with  $\sum d_i = 0$ .

Given condition (9) about product price differentials always retaining their sign, refining yields  $[b]$  will always give a gross product worth of higher value than  $[a]$  if

$$d_1 > 0 \text{ and } d_3 < 0 \quad (10)$$

i.e. if the yield of the light product is higher and the yield of the heavy product is lower in  $[b]$  than in  $[a]$ . The yield of the middle distillate does not affect the result. (For a proof see Appendix I).

The recent netback deals, as illustrated in the sample published by PIW, do not restrict their yield specification to three products. The average number of products specified is five or six and the range in the sample is four to eight. It is much more difficult to define a criterion which assesses  $[b]$  in relation to  $[a]$  when the number of products exceeds 3.

Take, for example, a yield pattern with five products. It is possible to show (see Appendix I) that  $[b]$  yields a higher gross product worth than  $[a]$  for all price vectors which satisfy condition (9):

(i) Either if

$d_1 > 0$  and all other  $d_i < 0$

$d_1$  and  $d_2 > 0$  and all other  $d_i < 0$

$d_1, d_2$  and  $d_3 > 0$  and all other  $d_i < 0$

$d_1, d_2, d_3$  and  $d_4 > 0$  and  $d_5 < 0$

In all these cases we can reduce the size of the vector to two consecutive elements affected with the following signs [+ -]. We call this procedure the "sign aggregation rule". It follows that the sum of consecutive positive elements is equal to the sum of the negative lower elements, and  $\sum d_i p_i > \sum d_j p_j$  where  $d_i$  are the positive and  $d_j$  the negative elements.

(ii) Or, if the vector [d] can be partitioned in two subsets  $[d_1, d_j, d_l]$  and  $[d_k, d_m]$  where  $d_1 + d_j + d_l = 0$  and  $d_k + d_m = 0$ , with  $d_1 > 0$  and  $d_l < 0$  and  $d_k > 0$ .<sup>1</sup>

In all other cases it is impossible to say that  $\sum p_i b_i$  will consistently be greater than  $\sum p_i a_i$  for all price vectors satisfying (9). The rules defined for a five-product yield pattern can be extended to any n-product vector. The general approach is to try first to partition the vector [d] into subsets of three and two and verify whether the required conditions apply, and secondly to examine whether the sign pattern can reduce the size of the vector by applying the aggregation rule.<sup>2</sup>

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1. The possible partitions for a five-product yield vector are:

$[d_1, d_2, d_3]$  and  $[d_4, d_5]$ ;  $[d_1, d_2, d_4]$  and  $[d_3, d_5]$ ;  $[d_1, d_3, d_4]$  and  $[d_2, d_5]$ .

2. It is also possible to devise rules for ranking [a] and [b] by introducing a more general restriction on product price behaviour than condition (9). There is no need however for further elaboration.

To sum up. Our purpose was to show that although it is possible to devise rules for ranking alternative yield patterns in terms of their impact on the gross product worth, this can only be done by introducing a priori restrictions on product price behaviour. It is difficult however to specify a restriction which is both realistic and operational. Thus, condition (9) can be objected to on the grounds that some product price differentials often change signs. In short, the negotiation of yields involves more guesswork than rigorous rules. In practice it may be more expedient to limit the scope of bargaining to one or two elements, particularly the percentage of refining losses. In the end both parties must reconcile themselves to the fact that unexpected product price movements may defeat their most sophisticated ex ante assumptions.

(c) Time Lags. We assumed that the refiner seeks to maximize the actual margin  $m$  and the producer the netback price  $n$ . Given these objectives, how should the refiner (or the producer) attempt to set in the contract the length of the time interval  $\theta$  between the date of lifting  $t$  and the date  $t'$  at which the netback price is computed. Recall that the relevant spot product prices for this computation are those quoted on date  $t'$ , after the fixed interval  $\theta$ .

The answer to this question depends on two factors (i) expectations about the direction of product price movements during the contract period, and (ii) the degree of risk aversion of the party considered. Take for example the refiner. If he is absolutely risk averse, he would negotiate a time parameter  $\theta$  equal to the time realistically needed to transport and process

the crude and to sell the resulting products. However, if he is not totally risk averse and has a view on the likely direction of future price movements he will want a longer  $\theta$  than the technical lag when he expects product prices to decline, and a shorter  $\theta$  when he expects them to rise. Naturally the producer's preferences are the exact opposite.

It is said that certain netback contracts stipulate a very short time interval  $\theta$ , at the limit setting the date  $t'$  at the lifting date  $t$ . We have no way of establishing whether this is true or not; but it is worth making the point that a netback contract with such a stipulation would defeat one of the main purposes of these deals which, in Silvan Robinson's words is to turn "long-haul crude into short-haul crude". Of course, producers totally concerned with price certainty (i.e. with knowing exactly at which price the crude is sold on the day of lifting) must set  $\theta$  at zero, but the netback deal loses then its competitive edge over spot deals and ceases to be a very interesting proposition. Producers may prefer a short  $\theta$  in those peculiar circumstances (as in early 1986) when netback prices are markedly and systematically above spot prices. However, these preferences are irrelevant in a buyers' market. Rather than conceding a short  $\theta$  the refiner, expecting product prices to fall eventually will insist on a longer  $\theta$  or bargain (as happened indeed in mid-1986) for a discount.

Finally some analysts argue that "from the buyers' perspective the longer the delay the better between the time the crude is lifted and the time that the price is calculated". This is not correct. True, a buyer will always prefer a long delay if

the settlement of the bill is linked to the calculation of the price. However, in most netback contracts there is a large provisional settlement made 30 days after the lifting date; the small adjustments, which are not systematically to one party's favour, are made later. Having disposed of the point about settlement we must return to the fundamental proposition that the buyer can only be interested in a long  $\theta$  if he expects prices to fall. The argument put forward in PIW that he is still better off with a long interval in a rising market "because he can hold onto its products beyond the calculation date and sell them at a higher price" is fallacious. In such circumstances he would be better off with a shorter interval  $\theta$  which would provide him with similar price gains and spare him storage costs.

(d) Trade-Off, Anticipations and Speculation. In actual negotiations of netback contracts, producers and refiners tend to accept a trade-off between a particular definition of yields and the processing fee  $z$ . If the buyer insists on distillation yields - which other things being equal will depress the netback price  $n$  - he may have to accept a relatively low processing fee; and if the producer insists on upgraded yields he may have to concede a relatively higher processing fee. This is justified on the grounds that refining costs which are subsumed under  $z$  are lower for distillation than for upgrading. There is however a speculative element in this trade-off. Assume that a refiner is offered the option: either a "distillation" yield vector  $[a]_d$  and a processing fee  $z_d$ , or an "upgrading" yield vector  $[a]_u$  and a processing fee  $z_u$ . In order to choose he must form a judgment on whether the difference  $z_u - z_d$  is smaller or greater than the



difference in the gross product worth generated by  $[a]_d$  and  $[a]_u$  respectively. The difference  $z_u - z_d$  is known ex ante but the difference between gross product worth  $[p] [a]_d - [p] [a]_u$  cannot be known in advance with any precision.

This leads us to an important point about the negotiation of contracts. Although much time may be spent in argument about whether this or that yield pattern and this or that definition of the time interval correspond to the technical and logistical features of the downstream channel through which the crude will move<sup>1</sup>, the buyer will also be concerned with another set of considerations. He will place much weight on his anticipations of how the product market is likely to behave in the contract period. Depending on these expectations about future product prices he will prefer some particular yield pattern to proposed alternatives and decide how much an apparent trade-off between "a bit more on this parameter" and "a bit less on that one" may turn out to be worth to him. Recall that an a priori choice between two yield patterns cannot be made without some assumptions about relative product price movements during the contract period.

In the final analysis expectations are important and there is a significant element of speculation about the future state of the product market which will determine preferences and influence positions in negotiations. There are also considerable difficulties in choosing ex ante a favourable yield vector from a

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1. That is in attempts to define the concepts correctly. We have shown in Section 3 that this can be done up to a certain point but never perfectly.

set of alternative vectors proposed during the negotiations.

The arm's length netback contract which we have assessed at first in relation to a "notional" realization deal in an attempt to find rigorous definitions for the pricing parameters, turns out in reality to be a much looser formula which can be moved long distances away from the concept of realization. The balance of bargaining power between seller and buyer will not be reflected exclusively in the determination of the processing fee but in the definition of all the parameters. Through manipulation of the parameters the formula can accommodate different attitudes to risks, and reflect preferences for particular trade-offs arising from specific expectations about future product price movements and patterns of refinery utilisation.

One may ask whether in the final analysis the name of the game is not merely "negotiating a price"? Is it really necessary to go about it through a roundabout way, that of a complex formula with several parameters? The answer is that the netback approach attempts to reconcile a duality in the concept of the relevant price for producer and a refiner. The producer, given the main objective which is to shift a certain volume of crude, is concerned with the price he shall obtain for that crude.<sup>1</sup> The refiner is concerned with the margin. What is at

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1. In the context of bilateral bargaining a producer who wants to dispose of a certain volume of crude is not a perfect price taker. There is lack of transparency in bilateral bargaining and this always enables one of the parties (not necessarily the same one at every round) to get a better deal on prices than in the "perfect competitive market".

issue is not the negotiating of one price variable but of two. The netback approach provides a relationship, not so rigid as to eliminate all risk-taking, not so loose as to reduce the negotiation to bargaining about the price of crude in total isolation from the product market.

## 5. THE ECONOMICS OF NETBACK CONTRACTS

### A. Competition and Risks

The economic features of netback deals are better understood when placed in the context of a world petroleum market in which:

- (a) traded oil can be broadly classified into long- and short-haul crude;
- (b) access to crude involves a variety of contracts and institutional arrangements such as spot deals, term contracts and direct property rights (equity crude);
- (c) the transmission mechanisms between crude and product markets involve time lags and many imperfections;
- (d) the quantities of crude oil which producers are willing to supply are in excess of demand over a wide range of prices;
- (e) price movements are extremely uncertain.

The netback contract differs from a spot sale or a term sale at a fixed price in that the price at the time of lifting is totally indeterminate. Normally neither seller nor buyer like to engage in transactions at unknown prices. But the netback deal involves a trade-off. The trade-off for the seller is between "not knowing the price at the time of lifting" and "knowing that a barrel is being sold at competitive prices at a time close to the date of delivery". The trade-off for the buyer is between "not knowing the price at the time of lifting" and "knowing that the barrel lifted will in all probability generate a positive

refining margin". All this is meaningful if the netback crude is long haul (feature (a) in the list above), if the aim is to compete in a market served by short-haul crudes (features (a) and (d)), if there is no simultaneous and equilibrium determination of crude and product prices (feature (c)), and if future price uncertainty (feature (e)) is such as to attract buyers to low risk supply contracts.

Netback deals are a unique instrument for matching two preference sets: that of a producer concerned with increasing the volume of his sales in a market supplied by short-haul crude, and that of a refiner concerned with increasing the certainty of a positive refining margin. It is thus easy to understand why Saudi Arabia, a producer of long-haul crude which had been displaced from the North American and European markets by a persistent attachment to fixed-price contracts, promoted netback deals on a large scale in late 1985 when it decided to regain a share of these markets.

Having interpreted netback contracts in terms of competition for additional export volumes on the producers' side, and of a demand for low risk contracts on the refiners' side, we must now move some step further in the analysis of both competitive behaviour and attitudes to risk.

(i) Competition has a dynamic of its own. The player who moves first successfully makes initial gains, in the form of an increased market share, at the expense of other players. By moving first on a wide front Saudi Arabia managed within two or three months to increase its export volume from less than 2.0 mb/d to 3.5-4.0 mb/d. However, the actions of the first player

elicits responses from his competitors. Some will move almost immediately, adopting the same or similar tactics in order to protect or increase their own export volumes. Others, hindered at first by institutional constraints which prevent them from changing rapidly their contractual arrangements, will nevertheless respond some time later. No constraint remains binding for ever. In the 1985-6 episode, a number of OPEC countries followed fairly rapidly Saudi Arabia in its moves but some other oil-exporters, particularly Egypt and Mexico, found it difficult to respond because of political and legal rigidities.

Sooner or later the gains made by the first player are threatened by the moves of all other producers. The netback contract loses its competitive edge. The first player is then forced to modify the terms of the netback contract in an attempt to defend his earlier gains. This is precisely what happened, first in the second quarter of 1986 when Saudi Arabia introduced a discount element in the pricing formula, and later in October 1986 when it conceded a further 50 cents discount (probably by altering pricing parameters) to some of the Aramco partners.

The important conclusion is that, in a competitive context, the arm's length netback contract does not involve a stable relationship between products and crude oil prices (through, say, a fixed ex ante processing fee). The netback contract price, despite the appearance of an "automatic" determination by a precise formula, is in one respect akin to any term price (posted, official and so forth), a price which can be varied by the introduction of discounts or premia to suit varying competitive situations.

(ii) Let us now turn to attitudes towards risks. The refiner's interest in netback contracts arises from the low-risk characteristics of these instruments. However, it would be wrong to assume that because refiners are willing to obtain crude oil under netback arrangements that they are absolutely risk averse.

First, we have already shown in Section 4 that in negotiating the parameters of the pricing formula of a netback deal the refiner (like the producer) must take a view about certain combinations of yields and processing fees, thus about product price behaviour in the relevant period ahead.

Secondly, the refiner having entered into a netback deal retains discretion over the timing of processing and sales. Recall that he lifts crude at date  $t$  and that the computation of the netback price of that crude takes place at a later date  $t'$  (specified by the contract in relation to  $t$  by a fixed interval). He can take a view about product prices at date  $t'$ , and depending on his expectations, hasten or delay the process by which crude reaches the refinery and is transferred into products which are then sold in a market. In this context the arm's length contract is different in its implications for the refiner's behaviour than other crude oil purchase deals. In a spot or a fixed-price term deal the price of crude is known on the day of lifting (if not before) while in a netback contract it only becomes known at a later date  $t'$ . When a refiner attempts to optimise the time pattern of processing and product sales he faces one set of unknown parameters (future product prices) when crude is acquired spot or at a pre-determined price, but two sets of unknown parameters (future product prices and the crude price itself)

when crude is supplied under a netback arrangement.

Thirdly, the refiner is always able to choose between different types of crude supply contracts. He can obtain oil on the spot market, or from producers supplying crude in term contracts with pricing formulae other than netbacks, or from his own sources if he enjoys property rights upstream. Most oil companies, particularly the large ones, will normally prefer to hold a portfolio of contracts. Diversification in this area has the same motivations and follows the same principles as for investment portfolios.

The analogy in fact is quite striking. Spot oil is akin to a risky asset with very variable returns and a netback contract resembles a fixed interest paper asset such as a bond which provides a guaranteed income return but is subject to changes in its value. No investor will want to hold its wealth in one type of asset unless he is either a pure gambler or absolutely risk averse. Similarly the refiner will want to spread his holdings of supply contracts in different forms, in proportions varying according to the degree of risk aversion.

As market circumstances change, in particular the apparent price relationships between spot, netback and other term arrangements, and as price expectations change, the refiner will want to vary the proportions in his portfolio of supply contracts. Hence, the shifts over time in attitudes towards netback deals which seem contradictory at first sight but which have in reality a strong economic rationale.

The competitive pressures on producers and the shifts in refiners' preferences lead to frequent re-negotiations of the



terms of netback contracts, not only the volume of crude oil agreed upon in the deal, but the parameters of the formula, the processing fee and/or the additional price adjustment element which usually takes the form of a discount. In view of all this it seems difficult to argue, as some analysts do, that the netback contracts can introduce an element of lasting integration in the world oil industry. In this context the netback contract is a neutral instrument which, depending on the institutional and market context in which it is used, can serve the purposes of greater integration or those of de-stabilizing competition. In the 1985-6 episode it is the latter use which clearly dominated the oil scene.

#### **B. Oil Price Determination and Price Stability**

(a) Do Netback Contracts Necessarily Bring About a Price Collapse? As the netback contract involves a well-specified link between the acquisition price of crude oil and product prices and thus tends to give the refiner a positive margin, it is often argued that refiners will lose all inhibitions about flooding the product market since any resulting decline in product prices is almost automatically passed on to the crude oil producer and the refiner continues to enjoy a positive return on the barrel of oil processed. The margin  $m$ , which is the refiner's main concern, is not affected too much by movements in the product price vector so long as these charges are, thanks to the netback formula, passed on to the producer. It is then inferred that the refiners supplied by netback contracts will behave in the way described and bring about a collapse in product prices.

This argument, despite its popularity, is not correct because it implicitly relies on certain doubtful assumptions . It assumes that refiners have access under the netback deals to unlimited quantities of crude, that there are no constraints on the capacity of their plants, and that they are always able to move physically onto the product market at any time any volume they care to process. This is not necessarily the case. There is nothing in the nature of netback deals which associates them with unlimited crude supplies. Furthermore, the idea that any volume of a product can be shifted onto a market, so long as you allow prices to fall far enough to clear the market, is only correct in the frictionless world of textbook economics. In real markets clearing can be delayed first by logistical factors (including constraints on storage), and secondly by the time taken by different economic agents (buyers and sellers) to adjust their expectations.

In a recent paper to the Oxford Energy Seminar, Francisco Parra tried to dispose of the view that netback contracts make the refiner indifferent about the level and movements of product prices by arguing that the incentive to beat the market and to seek the highest possible prices always remain. This argument is correct in so far as any individual refiner is concerned, but it is not possible for all refiners to beat the market since the price which every one attempts to outperform is itself the average of all prices actually realized. Parra's argument is an useful reminder of the point made earlier on about the refiner's objective which is to maximize  $m$  (for any given volume of crude), but does not really address the question of the

effects on product prices of the aggregate and simultaneous actions of all refiners.

(b) The Crude Oil Supply Decision and Price Determination. The real significance of netback contracts for the issue of oil price determination is better analysed with reference to a polar case. Assume an oil world in which all crude oil transactions are made under netback contracts. In this extreme case, we would only have one visible set of markets, the markets for products in which prices would be determined by the supply of and the demand for the various petroleum products. Crude oil prices would then be automatically derived for each transaction from the netback formula specified in the various contracts. There would be no visible crude prices determined separately in the set of crude oil markets. However, product prices, and therefore the netbacks, would still be influenced by the supply decision of crude oil producers. These decisions can range from aggressive competition for additional supply volumes (by offering increasing discounts to refiners on their netback contracts), to passive accommodation to the refiner's demand for a preferred volume given an unchanging netback formula and, at the other end of the spectrum, to production regulation. Naturally, the crude supply decision has an impact on the position of the supply curve for products, therefore on product prices and on the resulting crude oil netbacks.

The simple but important conclusion is that, even in the polar case where all transactions are on a netback basis, it is the crude oil supply decisions (and not the netback contract as such), which, given the demand functions for products,

determine oil price movements.<sup>1</sup>

In the oil world, as we know it, with a mix of pricing methods for crude oil transactions, petroleum prices are determined in an inter-related but not perfectly correlated way in two sets of markets: crude and products. There are, for example, visible spot crude prices resulting from the interaction of producers' supplies and refiners demand for crude oil in that market; and these prices which are strongly influenced by product prices as they arise in a different set of markets through the refiners' demand do not correspond exactly to netback prices. The differences may not be very considerable when the comparison takes into account the relevant time lags but are rarely negligible. But here again it is not the netback contract as such which influences prices but the aggregate supply decisions, given the state of demand.

It is useful to recall in this context that when the market is in disequilibrium because of surplus capacity, producers are price makers whether they compete or whether they cartelise. In competition the producers with excess capacity set lower and lower prices at each round until the level which chokes off any additional supplies is attained. A quantity-fixing cartel, by definition, aims at a price target and tries to reach it and to maintain it within a certain range by restricting supplies. Cartelization through output control is possible with netbacks or with spot pricing.

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1. One should add for the sake of completeness "given also the cost structure of refiners". However the most significant component of this cost structure is the price of crude oil.

(c) Netback and the OPEC Official Price Policy. However netback pricing, like spot pricing, is not consistent with the fixed-price approach to cartelization favoured by OPEC between 1973 and 1985. A price-fixing cartel defines the price and absorbs (or meets) the quantity fluctuations arising from inevitable shifts in the demand curve. A sophisticated cartel will seek to maintain these volume fluctuations within an acceptable range by changing the price tag in the relevant direction at certain time intervals. This type of cartel will enjoy price certainty during the interval separating two fixes but no certainty about the volume of production. A price-fixing cartel cannot operate through netbacks or through spot sales, but a quantity-fixing cartel can.

Once again these are simple points but there is a need to reiterate them now that Saudi Arabia (November 1986) is advocating a return to an OPEC reference price for crude oil. A return to an official price structure with an administered marker will not be possible unless netback contracts are abolished and term sales at the reference price (with flexible adjustments for differentials) are resumed.

(d) Netback and Price Stability. We now turn to the question of netbacks and price stability. Broadly speaking, price movements are of three types: (i) price shocks or major discontinuities, (ii) fluctuations around medium or long-term trends and (iii) these trends themselves. Shocks are brought about by major and sudden imbalances between supply and demand, usually reinforced by strong expectations of continuing imbalance in the same direction. A sudden burst of aggressive competition will lead to

a price collapse as in 1986; a sudden tightening of supply relative to demand or a big shift in demand relative to supplies (say for a precautionary build up of inventories during a political crisis) will lead to a significant price rise as in 1973 and in 1979. In all these cases the shock will occur whether one of the pricing methods in use is the netback formula or not.

In "normal" periods, that is in periods free from shocks, crude oil prices will move in different ways according to the prevailing regime. In a conventional OPEC regime the prices of different crudes tend to fluctuate around the stepped line representing successive levels of the marker price as administered by OPEC. In such a case the issue of "netbacks and price stability" does not arise because the conventional OPEC regime cannot operate with netback contracts.<sup>1</sup>

In a market regime, without OPEC interference, crude oil prices will fluctuate around a trend line determined by fundamental supply and demand forces. These fluctuations reflect the aggregate impact of an infinite number of small factors, from responses to political news to short-term shifts in demand and supply conditions. In such a regime the degree of day-to-day instability or fluctuations may depend on the structure and the degree of imperfections of the markets but there are no strong a priori reasons for believing that they will differ significantly in their range according to whether crude is sold on spot or through netback contracts.

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1. However the netback concept can be used in an OPEC price administration regime to determine the value of price relatives (differentials).

This statement may seem surprising but the supporting argument is as follows. The netback price is essentially a weighted average of spot product prices minus a constant. Thus the fluctuations of netback prices is an index of product price variations. Because of strong inter-relationships between crude and product markets spot crude prices will tend to fluctuate fairly closely with the index of spot product prices. To be sure there is no perfect concordance, because of imperfections in the transmission mechanisms between the two markets, but over reasonable periods of time the variability of spot and netback prices is unlikely to be significantly different.

We have tested this proposition by measuring the standard deviation of the Forties spot price and of a Forties netback (hydroskimming) at Rotterdam for the period March 1983-April 1984. We chose Forties in preference to Arabian Light because the spot price of the latter was then heavily influenced (in fact, stabilized) by the official price policy. And we selected for the purpose of the test a period which is both fairly recent and as free as possible from major shocks. The standard deviations of the spot price and of the corresponding netback series were found to be \$0.77 (mean \$28.62) and \$0.66 (mean \$28.11) respectively. Considering the means which are in the \$29-30 range, the difference between the two standard deviations which is a mere 11 cents on the weekly average price is fairly small. There seems to be less variation in netbacks than in spot prices but the dissimilarity is not sufficiently

large to be treated as significant.<sup>1</sup>

(e) Price Transparency. We may conclude this section with some remarks on price transparency. Economists rightly argue in favour of maximum transparency because imperfect information causes markets to perform inefficiently. Economic agents operating in real world markets are not so keen. Every one believes that a lack of transparency would serve his own interests better by providing opportunities for gains that will be denied to others. Ideally they would like to know the prices (and other terms) of all transactions and keep secret the prices (and terms) of their own deals. As this is not possible they fall back on the assumption that they will be quicker than their competitors in securing the relevant information. As this cannot be true for everybody, and is unlikely to be true for any particular agent all the time, the preference for less rather than more transparency is not really justified. This preference is in the nature of a prejudice, reflecting some wishful thinking rather than a sensible appreciation of the means required to serve a profit-maximization objective.

The main flaw of netback pricing in arm's length deals is the lack of transparency. This provides opportunities for corruption, which many will very properly avoid, but which some will inevitably exploit. It also prevents prices from performing their role as signals for the efficient allocation of resources.

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1. Of course, this test only shows that variations of the spot price of crude and of a product price index were not too dissimilar in a period in which there were no netback contracts. Unfortunately the same test cannot be performed for 1986 because of very sharp price movements



Multi-tier pricing confuses economic agents and elicits imperfect responses.

## 6. THE NETBACKS AND THE OIL PRICE COLLAPSE

The oil price collapse of 1986 has been attributed by a number of observers to netback pricing. The observed chronological sequence in which the introduction of netback contracts by Saudi Arabia was followed a few months later by a sharp decline in oil prices, and the notion that netback deals provide the refiner with an incentive to flood the product market are the main arguments of the case.

However, both arguments are simplistic. A chronological sequence should not be confused with the chain which links causes and effects; and the idea that netback pricing, in itself, creates excess supplies on the product market is manifestly wanting, as we have shown in an earlier section.

The oil price collapse was the consequence of competition for additional volumes by producers. This competition began after the 1979-80 shock and its damaging effects on prices manifested themselves almost immediately. OPEC made some attempts to contain this competition and the adverse effects on prices in March 1982, March 1983 and October 1984. The first attempt was not very successful; the second provided the world petroleum market with a period of 12-16 months of relative stability; the third attempt involved a tight production programme which was never seriously implemented and thus failed.

However, throughout 1981-85 Saudi Arabia and some other OPEC members (a group which varied in composition over time)

continued to uphold to a significant extent the OPEC fixed price policy, and this behaviour, which caused a considerable loss in export volumes, prevented prices from collapsing during that period. There was price erosion, a sign that competition was stronger than the resistance put by some producers on the price front, but no sharp and sudden decline.

In 1985 Saudi Arabia decided that it would not continue to defend prices on its own. The decision was motivated by three factors. The first was financial. The rapid loss in revenues, and the certain prospects of further losses if the price tag remained unchanged, was becoming very alarming. The second factor related to Saudi Arabia's place in the world oil market. A considerable reduction in market share is unacceptable because it deprives the country from leadership and influence in the present and threatens its commercial position in the future. The third reason, which is not usually mentioned by analysts is political. The climate of opinion in official circles and among influential groups in society was becoming increasingly disgruntled with an oil policy perceived to serve the interests of OPEC rather than those of Saudi Arabia.

Saudi Arabia had only two options: (i) to appeal to other producers reminding them of their obligations and their interest in price discipline, (ii) to join the competitive fray.

The first option was tried through warnings at OPEC meetings and through solemn messages from the King himself to other heads of state. The warnings were not heeded. The other producers calculated that Saudi Arabia would not risk the economic damage and the political aggravation which a price

collapse brought about by the abandonment of the official price policy would inevitably cause. They did not see that Saudi Arabia was suffering in any case economic damage. Those who admitted the possibility of a Saudi competitive move thought that they would gain nothing by re-submitting themselves to price disciplines if their own conversion was not followed by other producers. This is a typical bargaining stalemate in which no player volunteers first a concession in fear that this first move, made in ignorance of other players' subsequent moves, would turn out to be too costly. Everybody hopes that he will get away with less by keeping the cards close to the chest until the last moment.

As the first option failed Saudi Arabia decided some time in mid-1985 to abandon the official price policy and to engage in open competition. The government knew that competition will force prices down. They hoped that other producers will rally around a new policy, involving a more equitable sharing of output cuts, before the price collapse; but as things turned out these hopes were not fulfilled.

In engaging in open competition Saudi Arabia had a choice between various marketing and pricing instruments. Competition for additional volumes may take the form of discounts on official prices, increased supplies on the spot market, barter deals, formula pricing other than netback and netback contracts. Two interesting questions arise here. The first is about the respective merits of each method in terms of the Saudi primary objective: to regain as quickly as possible and then retain a target volume of exports. The second question concerns the

impact on prices of these different marketing mechanisms.

There is no doubt that netback contracts provided Saudi Arabia with an efficient way for increasing rapidly its export volumes. The reasons are as follows: (i) Netback contracts enable long-haul crude to be priced more or less on a par with short-haul crude. Saudi Arabia needed to regain a market in North-West Europe and the USA, the two regions where its own oil had been displaced by short-haul crudes - North Sea, American, Mexican and the like. However, other formula-pricing methods - e.g. a link to Brent (in Europe) and WTI (on the USA) spot prices at the date of delivery - would have also achieved this result. In this respect netback is but a type of formula pricing. (ii) But netback deals had the further advantage of meeting a demand by the oil industry for a low-risk instrument which protects the refining margin. The industry had been complaining for some time about the poor state of refining profitability. Netback contracts, as they involve an explicit link between crude and product prices, seemed to provide greater assurance about the margin than other methods of formula pricing. Although it may be argued that this is not necessarily the case and that alternatives to netback contracts can also improve the downstream margin, there was in 1985 and early 1986 an industry preference for netback deals.

It is clear that neither discounting on official prices nor spot sales ensure that the crude sold long haul will remain competitive at the time of delivery. Sales at very favourable discounts or low spot prices relative to competing crudes at time t, if made on a large scale as was the intention, would have

brought other prices tumbling down very rapidly. It is thus possible that prices which appeared to be very competitive at the transaction date would turn out to be relatively high when the crude reaches the refinery four to eight weeks later. Refiners would hesitate to buy under these conditions and the main objective of shifting large additional volumes would not have been attained. It is also evident that barter deals were not a practicable option on the scale required.

In short, netback contracts were perceived to be the best instrument available for penetrating the two main markets - Europe and the USA - where Saudi Arabia wished to regain a share. They ensured a rapid and substantial increase in export volumes in an initial stage.

The preceding analysis also provides some of the answers to the question about the impact on prices. The alternatives to netback contracts - particularly spot sales or discounts on official prices - being initially less attractive to buyers because of uncertainty about the competitive price at the time of delivery and the greater downstream risks would have therefore elicited a slower volume response and would have caused prices to collapse earlier. Had Saudi Arabia chosen one of these methods instead of the netback, it would have encountered greater difficulties in attaining its volume target in the first stage and would have brought forward the price fall.

But competition always affects prices in the end. The use of the netback contract as a competitive instrument delayed but did not prevent the price collapse. When the first volumes of Saudi netback oil reached their markets they began to displace

the short-haul crudes on their own territories. By then sufficient time had elapsed allowing some producers to formulate their competitive response. In fact, in December 1985, OPEC declared that its collective objective was to seek an increase in its market share.

Certain short-haul crudes, particularly US and North Sea, are in inelastic supply in the short run. The increase of Saudi exports to their markets forced their prices down suddenly and dramatically. A significant price drop was necessary to displace some other crudes, the more significant the necessary price fall the swifter the responses of competing producers. Furthermore, the OPEC December 1985 decision affected expectations, adding another contributory factor to the decline. The collapse occurred towards the end of January 1986.

The success of the Saudi policy in its first stage - rapid increase in export volume at high prices - could not be maintained without further measures once other producers began to respond and prices began to fall. To retain its customers Saudi Arabia had to concede discounts on its netback contracts and to re-negotiate price formulae. Netback pricing became like any other term arrangements in a buyers' market, a non-binding contract for the buyer subject to successive and frequent amendments in his favour. Prices continued to fall in the first half of 1986 reaching such a low in July 1986 as to force OPEC to re-introduce a production programme in an attempt to check the price decline.

To sum up, competition between producers in a buyers' market inevitably produces a price collapse irrespective of the

pricing method used. Initially the pattern of price movements differs depending on the pricing method used. Netbacks delayed the price collapse by two or three months and enabled Saudi Arabia, because it moved first and on a massive scale, to increase significantly its export volumes. But after this first stage there are no ways of retaining the market share, netback or no netback, other than through successive price reductions or through cartelization.



## 7. CONCLUSIONS

Arm's length netback contracts do not possess the significant merits which their advocates attribute to them, and their inherent characteristics are not as perverse as their detractors sometimes claim. Consider the alleged merits first. Netback deals are said to provide crude oil buyers with a guaranteed refining margin. We have shown at some length that the gross margin realized by a refiner on netback crude is likely to be different from the negotiated processing fee. Some commentators have gone as far as hailing netback contracts as a means towards the re-integration of the oil industry. This is not the case. Integration pre-supposes stable and long-term links between the upstream and the downstream sector of the industry. Recent experience with netback contracts shows that these are neither inherently stable nor binding in the long term. Stable relationships between buyers and sellers are difficult to maintain in an imbalanced market, such as the buyers' market of 1985-86 (the same difficulties were apparent in the sellers' market of 1979). In this respect netback contracts are not different from other commercial relationships: they come unstuck as soon as one party shopping around for better terms decides to go elsewhere. Finally, the strongest case made for the Saudi netback deals is that they turned long haul crude into short haul oil. This is true, but the same results can be achieved with other pricing formulae; for example spot crude prices ruling at

some date posterior to the date of lifting.

We have also argued that the arm's length netback contract need not de-stabilize prices. Prices collapse when the volumes which producers want to sell ex ante exceed ex ante demand at the initial prices. The culprit is the scramble for additional sales at any price. Producers intending to increase their exports in a buyers' market can have recourse to a wide range of instruments; the netback contract is but one among many. Netback pricing associated with appropriate restrictions on the quantities of oil supplied would not cause a price decline. It is said that netback contracts provide refiners with an incentive to flood product markets. We argued that the refiner can only act in this way if he is able to obtain under netback deals all the quantities of crude required to operate continually his plant at full capacity and if he is able to shift smoothly his output onto the product market. Here again what is at issue is not netback pricing as such but the producers' supply policies.

The only merit of netback contracts for refiners is that they provide some protection against wide fluctuations of the refining margin. The netback contract does not ensure that the margin obtained will always be higher than that realized from processing crude obtained under another deal, say a spot purchase. As market circumstances change so the refiner's attitude towards netback contracts. Judging from the 1985-86 events, it seems that producers are not particularly enamoured with netback contracts. Saudi Arabia adopted them faute de mieux and its move was not followed unanimously by other producers. For good or bad reasons many of them preferred alternatives,

which illustrates the point made earlier on that a competitive drive can be pursued with a variety of means.

The netback method for selling crude arm's length has been described by shrewd analysts as a method for negotiating a "price" bilaterally. There is truth in that judgment. However, because the netback price is derived ex post from a relationship with future product prices the negotiations are not directly about the price of crude but the parameters of the relationships. In these negotiations the refiner will seek definitions of the parameters which, in his judgment, would yield him a good refining margin. The producers who collect in the end the netback price of the barrel sold will seek parameters which, for any set of product prices, maximizes the gross product worth and minimizes the deductions. This is indeed a very roundabout way of negotiating a price which in this context is always unknown ex ante to the parties of the deal. It is also a complicated and uncertain way: we have discussed at some length the difficulties of selecting some of these parameters, mainly refining yields, from a set of plausible alternatives.

In the final analysis the netback contract appears to be an imperfect instrument introduced to remedy an imperfect state of affairs. In 1985, Saudi Arabia was concerned about the dramatic decline in the volume of its oil exports and the industry was concerned about chronic refining losses. The netback contract seemed to provide a solution to both problems. Those who promoted the idea were simply saying in a more sophisticated way "offer us terms which would improve our downstream margin and we shall buy your oil". Indeed Saudi

Arabia regained the volume and the industry enjoyed for a while significant downstream profits. Yet the motto was not "netback deals", a mere instrument, but "competition", the driving force. Leviathan was unleashed and the oil price collapsed. The producers lost revenues and oil companies suffered a double squeeze on their cash flows and their upstream profits.

The netback contract, with its few merits and its small defects, has now been associated with a disastrous event in the history of the oil industry. Its prospects as a method, among alternatives, for disposing of crude oil may suffer from the bad memories of this unlucky association.

## APPENDIX 1

### Proofs

#### 1. Comparison of refining yield vectors [a] and [b] in the three product case.

If  $p_1 > p_2 > p_3$ ,  $[b_i][p_i]$  is always greater than  $[a_i][p_i]$  if  $d_1 > 0$  and  $d_3 < 0$  (and vice versa).

Since  $d_1 + d_2 + d_3 = 0$  we can either have

$d_1 = -(d_2 + d_3)$  with both  $d_2$  and  $d_3 < 0$  (1)

or  $d_1 + d_2 = -d_3$  with only  $d_3 < 0$  (2). We want to prove that

$[b_i][p_i] - [a_i][p_i]$  or  $[d_i][p_i] > 0$ . In case (1)

$$\Sigma p_i d_i = p_1 d_1 + p_2 d_2 + p_3 d_3$$

can be written as  $-p_1 (d_2 + d_3) + p_2 d_2 + p_3 d_3$  or

$$-p_1 d_2 + p_2 d_2 - p_1 d_3 + p_3 d_3.$$

Since  $p_1 > p_2 > p_3$ , and  $d_2 < 0$ ,  $d_3 < 0$ , then

$-p_1 d_2 + p_2 d_2 > 0$  and  $-p_1 d_3 + p_3 d_3 > 0$ . Thus  $\Sigma p_i d_i > 0$ .

In case 2,  $\Sigma p_i d_i = p_1 d_1 + p_2 d_2 + p_3 d_3$  can be written as

$$p_1 d_1 + p_2 d_2 - p_3 (d_1 + d_2) \text{ or}$$

$$p_1 d_1 - p_3 d_1 + p_2 d_2 - p_3 d_2.$$

Since  $p_1 > p_2 > p_3$  and  $d_1 > 0$ ,  $d_2 > 0$  then  $p_1 d_1 - p_2 d_1 > 0$  and

$p_2 d_2 - p_3 d_2 > 0$ . Thus  $\Sigma p_i d_i > 0$ .

#### 2. Comparison of refining yield vectors [b] and [a] in the five product cases.

(a) If  $d_1 > 0$  and all other  $d_i < 0$ , then it is clear that  $\Sigma p_i d_i > 0$ . Since  $d_1 = -(d_2 + \dots + d_5)$ ,

$$p_1 d_1 + p_2 d_2 + \dots + p_5 d_5 > 0$$

because  $-p_1 d_2 + p_2 d_2 > 0$ ,  $-p_1 d_3 + p_3 d_3 > 0$  etc.

If  $d_5 < 0$  and all other  $d_i > 0$  the same proof applies.

In the intermediary cases when say

$d_1$  and  $d_2 > 0$  and  $d_3, d_4, d_5 < 0$

we have  $d_1 + d_2 = -(d_3 + d_4 + d_5)$ .  $p_1 d_1 + p_2 d_2 + \dots + p_5 d_5$   
can be written as

$(p_2 + \Delta p_2) d_1 + p_2 d_2 + p_3 d_3 + (p_3 - p_4) d_4 + (p_3 - p_5) d_5$

Assume that all  $\Delta p$  are zero, the expression reduces to

$p_2 (d_1 + d_2) + p_3 (d_3 + d_4 + d_5)$  or

$-p_2 (d_3 + d_4 + d_5) + p_3 (d_3 + d_4 + d_5)$ .

Since  $p_2 > p_3$  and  $d_3, d_4, d_5$  are all  $< 0$

$-p_2 (d_3 + d_4 + d_5) > -p_3 (d_3 + d_4 + d_5)$ .

This result holds a fortiori when  $\Delta p > 0$  because the first term  
will be even greater and the second term smaller than in the  
previous inequality.

Appendix 2

Consider two yield patterns for Arabian Light (North West Europe) as documented in PIW.

	[a]	[b]	[d]
1. Gasoline Premium	0.191	0.150	+0.041
2. Gasoline Regular	0.000	0.060	-0.060
3. Naphtha	0.041	0.000	+0.041
4. Jet Kerosine	0.038	0.090	-0.052
5. Gas Oil	0.410	0.320	+0.090
6. Fuel Oil & Refinery Fuel	0.320	0.380	-0.600
	<hr/>	<hr/>	<hr/>
Total	1.000	1.000	0.000

Applying our rules we fail to discover in [d] a pattern which enables us to say that [a] will be consistently more (or less) favourable than [b] when netback prices are calculated during the period of the contract at the spot product prices ruling on different days. The conclusion is that [a] will not prove consistently better (or worse) than [b]. At different dates depending on spot price movements - always assuming that product price differentials retain their signs - [a] may sometimes yield a higher and at other times a lower \$ gross product worth. In other words  $\sum a_i p_i - \sum b_i p_i$  could turn out to be either negative or positive. A numerical illustration follows:

Take the following sets of product prices

(1) [25,22,20,16,15,7]

and (2) [24,23,16,14,10,8]

both conform to the ordinal condition  $p_1 > p_2 > \dots > p_6$

Multiplying [d] by [ $p^1$ ] gives  $\sum dp^1 = \sum ap^1 - \sum bp^1 = + 0.6$

Multiplying [d] by [ $p^2$ ] gives  $\sum dp^2 = \sum ap^2 - \sum bp^2 = - 0.05$

For one set of prices, [a] gives a higher netback price than [b]

and for the other a lower netback price.



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