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The Brent Contract for Differences (CFD): A Study of an Oil Trading Instrument, its Market and its Influence on the Behaviour of Oil Prices

Fernando Barrera-Rey & Adam Seymour

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EXECUTIVE SUMMARY

The market for Brent Contracts-for-Differences (CFDs) emerged as early as 1988 but its significant development did not occur until 1992. By financial market standards, however, this span of life is fairly long. Yet the characteristics and role of this oil trading instrument have not been seriously studied. Most references to the CFD market are scattered in the trade press and in company reports with limited circulation.

Despite, or perhaps because of, this lack of research, the Brent CFD has been the subject of much controversy. And it is the controversy, rather than the workings of the market, which has received most coverage in the trade press.

This study, therefore, aims at filling a gap in research on the Brent market complex which includes spot trades, a 15-day forward and futures contracts, various derivatives and, finally, the less well documented CFD. Chapters 2 and 3 aim to describe and explain the characteristics of the CFD market, in particular the evolution in contract terms and the composition of participants.

In the Brent CFD market companies trade a floating for a fixed price differential between dated Brent and a forward Brent price. CFDs, therefore, provide an essential complement to the forward and futures markets for industry participants who wish to hedge spot and term crude oil deals priced off dated Brent. The need for a complementary hedge arises because of the existence of a basis risk between forward/futures and dated Brent. The daily difference between dated and forward Brent prices is significant and can exceed $1 per barrel. The use of CFDs as a hedging instrument is considered in Chapter 4.

In this study we argue that the CFD, in its primary and main role, is a useful instrument which first emerged and then attracted increasing liquidity because it effectively fulfils a genuine need. In other words, there are no obvious problems with the instrument as such. However, the CFD links together, as if it were a 'bridge', the dated and the forward markets. The problems that have recently arisen in the use of CFDs relate to weaknesses in these markets not to the design or construction of the 'bridge' itself.

A feature of the forward (15-day) Brent market is the occurrence of squeezes. And it is precisely because of this feature that oil exporters switched their 'reference'

in pricing formulae from forward to dated Brent in 1988. We have found that the occurrence of squeezes has increased in the years 1994 and 1995. Using a very stringent definition of squeezes, the paper identifies *at least* 5 successful squeezes between March 1994 and January 1996.

In Chapters 5 and 6 we put forward our thesis that the greater volatility in the basis hedged by CFDs in 1994-95 relative to 1992-3 was primarily caused by the greater incidence of squeezes made possible by a liquid CFD market. Furthermore, only a greater incidence of squeezes explain why the average premium of the first month forward relative to the dated Brent price doubled in 1994-5 compared with 1992-3.

The emergence of a high volume CFD market has reduced the risk of attempting squeezes of the forward market. It is likely that the player attempting the squeeze will receive a large number of physical cargoes. The risk of the squeeze is, therefore, that a large number of unsold cargoes will cause the dated Brent price to collapse relative to the first month forward Brent price and, so, the player's gains from the paper market may be overwhelmed by the losses incurred from disposing of the physical cargoes. Through the CFD market, however, the player can anticipate and, therefore, profit from the widening price differential.

The analysis of CFD trades and market participants presented in Chapters 2 and 3 corroborate our thesis. We would expect an increasing incidence of squeezes in the forward market to result in the exit from that market of companies who, by virtue of their size or lack of knowledge, are unable to play a game of such complexity and which requires such high stakes. It is evident from our analysis that an increasing number of smaller players in the CFD market are exiting the forward market and, instead, hedging using a combination of CFD and futures contracts.

The problems of Brent CFDs are not limited to the forward market. The final outcome of a CFD position depends on the relative level of the forward and dated Brent prices. As a result there is an incentive to influence the dated price assessment. This has been made more likely by the fall in liquidity in the spot market.

These features readily define a problem. The CFD involves a differential between a price that emerges in a market where squeezes are observed and a price assessed in another market where there is insufficient liquidity. A squeeze has a

bearing on the movements of both the forward and dated prices. The management of information supplied to the assessor of Brent prices does not always, but on occasions may, have a bearing on the assessment.

The dated Brent price is a widely used reference in the world crude oil trade. That the interests of participants in the forward and dated Brent markets are divergent does not mean that the result of attempts (if they take place) to influence the assessment of dated Brent is necessarily nil. Even if distortions have opposite signs they need not cancel each other out. Furthermore, there are no reasons why they should cancel out for any individual party. There is bound to be an uneven distribution of gains and losses.

Because many in the industry are exposed to the price of dated Brent, and, by association, to other Brent prices; because all those who are so exposed are not, for a variety of good and bad reasons, evenly represented in the markets; and because perceptions often matter as much as facts, there is a strong case for seeking remedies to the weaknesses of the price determination system.

A number of broad avenues are worth exploring in this context. The first is an improvement in transparency, not only in CFD but in both the 15-day and the spot market. The various ways in which this can be done are all subject to defects but this is not a good reason for failing to evaluate them or for rejecting them out of hand. The second is to increase the minimum modification period for delivery of a forward Brent cargo from 15 to, say, 25 days. The third is to look into ways to improve the assessment of dated Brent, if this continues to be taken as a reference price. The fourth is to seek a different marker price than dated Brent.

Nothing is easy in this area. But the oil industry has proved in many important instances throughout its history that where there is a will, there is a way. Why should there be a will? Simply because any significant loss in the credibility of the Brent marker could affect the operation of world oil trade through confusion, the hasty introduction of half-baked alternatives, an increase in litigation and other disruptions. That the current system is surviving, even flourishing, without failure does not mean that it does not involve some faults.

CONTENTS

CHAPTER 1

INTRODUCTION

The decision to undertake a study of the Brent CFD (Contract for Differences) market was made for two reasons.

The first is that the Institute has done major research work on the various constituents of the Brent market complex in an almost continuous manner since 1984. This led to the publication of two books, *The Market for North Sea Crude Oil* (1986)[1] and *Oil Markets and Prices* (1993),[2] and a number of related working papers and monographs on other oil markets and trading instruments. When researching for the most recent of these two books, very little was known about the CFD market. As a result there were only some cursory references to CFDs in *Oil Markets and Prices*.

In the years following the publication of this book the CFD market has grown in size and importance. Information about its structure, mode of operation, actual size, participation and so on is not publicly available, as is usually the case for informal markets. Gaps in knowledge invite research. In this instance the gap in knowledge is about a trading instrument which links two important parts of the Brent market complex: 15-day forward and dated (or spot) Brent. Both play a crucial role in establishing the price of a barrel of Brent, a price which is then used as a reference worldwide for the sale of other crudes in spot and term deals.

The study of markets is to a large extent the study of the economic forces and institutional factors which result in price formation. The Brent price is a significant parameter. Whenever a market emerges with trading instruments that *may* have a bearing on this process, research is called for to assess the nature and extent of this role. To be valid and credible, the research must be undertaken without preconceptions. When we began this study we did not know whether it would show that the role of CFDs is important.

The second (but related) reason for studying this subject is a fairly widespread

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1 R. Mabro, R. Bacon, D. Long, M. Chadwick and M. Halliwell, *The Market for North Sea Crude Oil*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1986.

2 P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993.

feeling of dissatisfaction about the dated Brent market and the assessment of dated Brent prices that is being expressed in talks which refer to CFDs.[3] Somehow the emergence and development of the CFD market seem to have focused attention on issues related to dated Brent. It is thus possible that research on the CFD would take us in a slightly roundabout way to another subject but in the process throw some new light on the more important story of the use of dated Brent as a benchmark.

Let us begin, however, with the CFD. It is essentially an instrument whose usefulness arises from the existence of a 'basis risk' when hedging crude oil in the 15-day forward Brent or the IPE futures market. This simply means that the price differential between the dated and the forward market matters, and may call for a further hedge. The 'complete' hedge involves both a forward contract and an instrument which locks in the dated/forward price differential; the latter being precisely a CFD.

One can immediately say, therefore, that the CFD, in its primary and main role, is a useful instrument which first emerged and then attracted increasing liquidity because it effectively fulfils a genuine need. In other words, there are no obvious problems with the instrument as such. But the CFD links together, as if it were a 'bridge', the dated and the forward markets. If problems do arise they would relate to weaknesses in these markets, but not to the design or construction of the 'bridge' itself. And if problems do arise in either the forward or the dated market (or both), one would need to ask whether they create opportunities for misusing the CFDs, that is the bridge which brings them closer together.

A feature of the forward (15-day) Brent market is the occurrence of squeezes.A squeeze is defined as a situation in which a particular player goes net long in the

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[3] For recent examples of concerns about the Brent market and the assessment of dated Brent prices see 'A Squeeze or Astute Trading', *Argus Energy Trader*, 24 Feb 1995 ;'Brent Market: Price Distortions Cast Doubt Over Benchmark Role', *World Petroleum Argus*, 8 May 1995; 'Brent Trading Ploys Fuel Complaints About Price Distortions', *Energy Compass* 19 May 1995; 'Murky waters in North Sea', *Energy Risk*, 8 Aug 1995; 'Brent: Price Distortions keep Middle East Producers Vigilant', *World Petroleum Argus* 14 Aug 1995; 'Markets Wait for End to Brent's Recent Volatility', *Platt's Oilgram Price Report*, 28 November 1994.

forward market by an amount that exceeds the number of cargoes that can be loaded in the targeted month. The effects of a successful squeeze are to increase the price of the forward month and the volatility of the dated to first month forward Brent price differential. In identifying squeezes we do not seek evidence of intentions but only consider the price effects.

It is precisely because of this feature that oil producers switched their 'reference' in pricing formulae from forward to dated Brent. The concern about the use of the dated Brent price as a reference relates to restricted liquidity in that market and in the forward market at the time the price is assessed daily.[4]

These features readily define a problem. The CFD involves a differential between a price that emerges in a market where squeezes are observed and a price assessed in another market where there is insufficient liquidity. A squeeze has a bearing on the movements of both the forward and dated prices. The management of information supplied to the price assessor does not always, but on occasions may, have a bearing on the assessment. The point is not whether participants are always successful with their squeezes or whether they actually attempt to influence the price assessor. The point is that squeezes do occur and that methods can be devised and tried (if somebody wishes to test his/her luck) to influence the assessment.

The dated Brent price is a widely used reference in the world crude oil trade. That the interests of participants in the forward and dated Brent markets are divergent does not mean that the result of attempts (if they take place) to influence the assessment of dated Brent is necessarily nil. Although distortions have opposite signs they need not cancel each other out. And even if they did in an aggregate sense, there are no reasons why they should cancel out for any individual party. There is bound to be an uneven distribution of gains and losses.

But this primary exposure to the assessed dated Brent arose when it was initially adopted as a reference price. The CFD emerged and its market expanded some years

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[4] The assessment of the dated Brent price is an assessment of the relevant forward price from information obtained from the forward market together with an assessment of the dated/forward differential obtained from the dated market.

later. It introduced a new dimension to the issue. Both buyers and sellers of a CFD have an interest, albeit of a different nature, in the actual outcome of the dated/forward price differential in the relevant period (assessment window) specified in the contract. Those who have locked in the differential will still wish to compare the hedge with the market outcome, that is to evaluate the opportunity cost of the hedge.

Other things being equal, CFDs have increased whatever temptations may have existed to squeeze the forward market or to manage information for the dated price assessment.

In certain circumstances CFDs also enable a participant who wishes to squeeze the forward market to compensate for possible losses through the building up, earlier on, of a position in the CFD market that generates equivalent (if not greater) profits. Of course these strategies may not always fulfil their objectives. Further, the extent by which the forward market price is moved is likely to decline rapidly after large squeezes have been attempted once or twice, because the other market participants learn continually.

This study has established the following features of recent developments in the Brent market. First, the incidence of squeezes in the forward market has increased. Secondly, the volatility of the dated/forward differential has also increased. These developments coincide chronologically with the expansion of the CFD market.

Because many in the industry are exposed to the price of dated Brent, and, by association, to other Brent prices; because all those who are so exposed are not, for a variety of good and bad reasons, evenly represented in the markets; and because perceptions often matter as much as facts, there is a strong case for seeking remedies to the weaknesses of the price determination system.

A number of broad avenues are worth exploring in this context. The first is an improvement in transparency, not only in CFD but in both the 15-day and the spot market. The various ways in which this can be done are all subject to defects but this is not a good reason for failing to evaluate them or for rejecting them out of hand. The failure to actively seek methods for achieving greater transparency fosters suspicions (true or false) that the main participants wish to enhance market power. The second is

to look into ways to improve the assessment of dated Brent, if this continues to be taken as a reference price. The third is to seek a different marker price. In this case, however, reforms of the market which is chosen to provide the alternative reference may be necessary. For example to go back to the forward Brent price as a marker would only make sense if the issue of squeezes is addressed effectively and the transparency of that market is improved. To take any forward or futures price as a reference may require a complicated solution to the problem of forwardness.

Nothing is easy in this area. But the oil industry has proved in many important instances throughout its history that where there is a will, there is a way. Why should there be a will? Simply because any significant loss in the credibility of the Brent marker could affect the operation of world oil trade through confusion, the hasty introduction of half-baked alternatives, an increase in litigation and other disruptions. That the current system is surviving, even flourishing, without failure does not mean at all that it does not involve some faults.

CHAPTER 2

THE CHARACTERISTICS OF A BRENT 'CONTRACT FOR DIFFERENCES' (CFD)

1. Introduction

A CFD is a financial transaction in which two companies trade a floating for a fixed price differential between a prompt and forward price. It is thus a trade of a differential representing the backwardation or contango between prompt oil and that for future delivery. For instance, if on 2 May a player takes the view that between 15 and 19 May this price differential will be equal to or greater than 10 cents per barrel and the counterparty takes the opposing view, then a trade may occur at 10 cents per barrel with the former on the buy side. In agreeing a trade both sides will specify which forward price will mark the 'back-end' of the time differential and what volume the trade is for. In this trade Platt's assessments of the dated Brent and 15-day forward prices are used on settlement. The trade is then cash-settled by taking the average of Platt's assessment of the differential over the period 15-19 May. If the differential turns out to be less than 10 cents then the former will pay the latter the difference between the expected and actual outcomes times the volume and *vice versa*.

There are therefore three essential components of a CFD trade that must be specified at the outset: (a) the volume, (b) the forward month price against which the differential to the spot price will be assessed and (c) the assessment window, that is the number of trading days over which an average differential is to be assessed. The CFD market is an informal swaps market and, so, in principle, each contract may be tailor-made to suit the needs of seller and buyer. In practice, however, the majority of CFD trades have become standardized. This has happened for a number of reasons. A great diversity of instruments in a market where there is a small number of participants makes it difficult to match instruments and participants' preferences. Further, participants often take both sides of the market; standardization then helps to offset deals. Moreover, the net volume of trade is more important to market power in this instance than product differentiation. Finally, standardization reduces costs of entry and exit and improves liquidity, this being the crucial factor in market growth. The

particular type of standardization that has resulted is linked to the other markets in the Brent market complex and evolves in a way that facilitates the offsetting of all those positions.

In the following section the range of contract terms reported to London Oil Report (LOR) over the period March 1993 to November 1995 are detailed. It should be noted that the coverage of this source may be biased toward brokered, or 'indirect', deals. The analysis of brokered deals may, therefore, tend to understate the range of possible contract terms available as participants wanting atypical contract terms are more likely to approach other market participants directly. Finally, trends in the ways in which CFDs are used that are evident over this period are analysed in Section 6.

2. Parcel Size of CFD Trades

Neither Argus nor LOR databases specify the parcel size of individual CFD trades. Reports in the trade press, however refer to CFD trades being done in quarter million and half million barrel lots, although there are references to smaller sizes being traded. Unbrokered trades which are under-reported in these sources display a greater variety of size. The 500,000 barrel parcel matches the cargo size in the 15-day forward market in which the majority of trades are for the same volume.[1]

3. The Price Differential

The price differential specified in a CFD trade always involves the use of Platt's assessments. The 'front-end' of that differential is always anchored to the dated Brent price. When a CFD is reported to a trade journal only the price differential and the 'back-end' marker are specified. So, for instance, a deal may be reported as Mar -26 cts.

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[1] An offshoot of the 15-day forward market, that is the partial Brent market, trades in 50,000 barrel lots.

This means that the differential agreed refers to the expected difference between dated Brent and March forward Brent at some specified time in the future.

In Figure 1, all CFD deals reported to LOR between 1993 and 1995 are classified in terms of which forward month is used as the back-end marker for the agreed level of backwardation or contango. Instead of using the usual classification of first month, second month etc, we have classified the forward months as same month, next month or next+i (i=1,..) month. This is because the price quotation for first month rolls over on the 10th or nearest later date of each month. So, for example, if we were to use the first month system of classification a deal done at June -x cts to be assessed on 5-9 June would fall in the same classification as a deal done at July -y cts for assessment on 12-16 June even though both deals are to be assessed against different forward months. With our system of classification the first deal falls into the category of same month and the second into the category of next month.

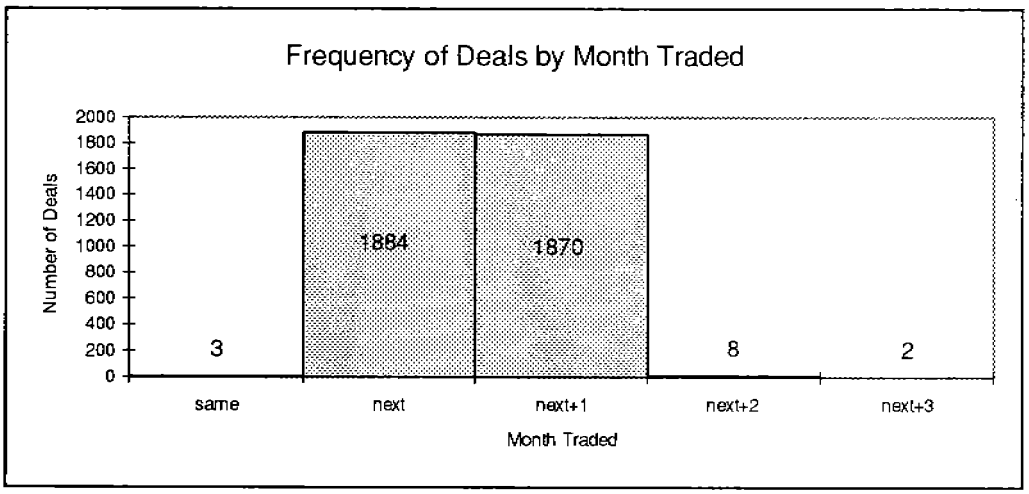

Figure 1
Sources: Own calculations from LOR.

A feature of Figure 1 is that so few deals are done against same month. It should be noted that such deals can only be done for assessment between the 1st and 9th of each calendar month as the same month price stops being quoted thereafter. Apart from this time constraint there are two more good reasons why such deals are not more common. First, it is unusual to use this type of CFD in conjunction with the first month

forward or futures markets because, in the former case, the hedger runs the risk of taking delivery or being caught short of a forward Brent cargo and, in the latter, the futures market expires over two weeks before the CFD position is assessed. Secondly, it is risky to be exposed to the dated to first month forward price differential in the nine days toward expiry of the first month forward contract as the price differential is, during this nine-day period, most susceptible to the effect of squeezes. To corroborate this point it is seen that the standard deviation of the differential between the price of dated Brent and first month forward for the period 1988 to 1995 is equal to 40.7 cents for the first ten days of the month and 25.1 cents thereafter.

This is not to say that CFD deals of dated against same month are necessarily suspect. Participants who are long in the 15-day market and intent on collecting cargoes through the chain are exposed to the dated to first month forward price differential and, so, may wish to lock-in what they perceive to be a favourable level for the differential. Such a deal may also be useful to change the timing of a player's exposure to the price.

The second apparent feature of Figure 1 is that the remaining CFD deals are divided equally between dated versus next month and dated versus next+1 month. This distribution is to be expected whether the CFD deals reported are being used in conjunction with 15-day forward contracts or IPE futures contracts for the purposes of hedging. To avoid the risk of taking physical delivery, participants in the 15-day forward market must book-out their positions[2] at least 15 days before the first day of the delivery month. For this reason participants using Brent CFD and forward contracts as a financial hedge for physical cargoes would tend to use the next forward month for cargoes loading in the first half of a month and the next+1 forward month for cargoes loading in the latter half of the month. Similarly, this distribution will also be expected for a hedger using IPE futures since futures contracts expire in the middle of the month.

However, if it is perceived sufficiently in advance that a particular forward

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[2] For more details of the book-out procedure see P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993; pp.40-3.

month is likely to be squeezed then this may encourage the use of the next+1 forward month. Most importantly, by using dated versus following month the direct effects of a squeeze on first month premia may be avoided. In this way, the CFD market is flexible enough to allow hedgers to adapt and, so, avoid the effects of such distortions.

4. The Assessment Window

Each CFD deal reported specifies the dates between which the appropriate price differential is to be assessed. We have termed this period the assessment window. If, for instance, a deal is done for a five-day assessment window then the differential agreed on will be compared with the *average* differential over the five-day period. Figure 2 presents the distribution of the assessment window for the period 1993 to 1995.

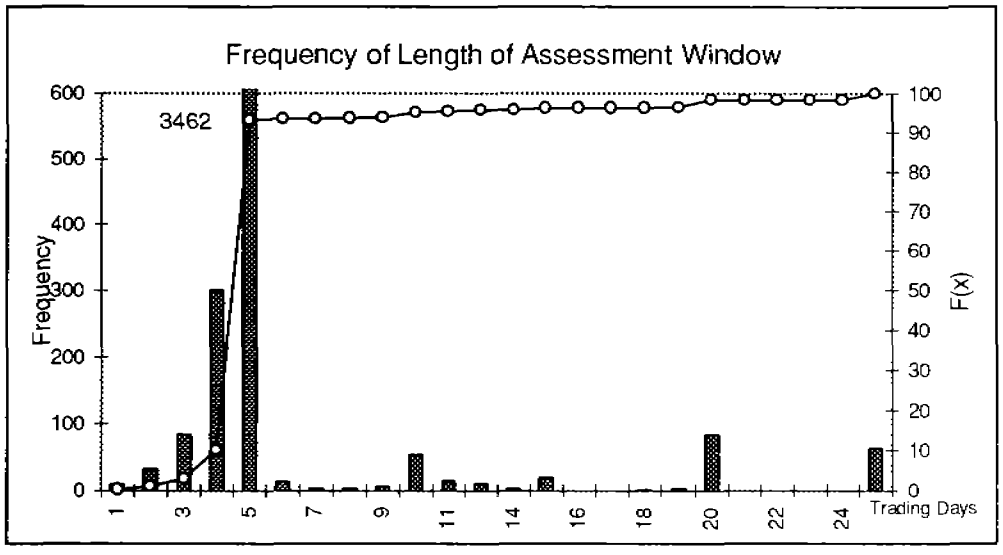

Figure 2
Sources: Own calculations from LOR.

Of the 4,168 deals reported to LOR in the period between March 1993 and November 1995, over 80 per cent of CFD deals specify a five-day window, usually encompassing the five trading days from Monday to Friday. Slightly less than 10 per cent specify a three- or four-day window. Only 7 per cent of reported deals specify more than a five-day window and most of these occur around the two week and one

month mark.

An analysis of the deals reported to LOR shows that only 2 per cent of CFD deals have month-long assessment windows. By continuing month-average CFD deals with forward/futures contracts a hedger can lock-in the average dated Brent price over the month. This naturally tends to be more stable than the same combination over, say, a five-day period.

The fact that only 2 per cent of CFD deals have this length of assessment should not, however, be taken to mean that there is no desire on the part of many companies to forego day-to-day volatility in favour of a more stable financial arrangement. In fact if a refiner or a producer wishes to lock-in the monthly average dated Brent price for all purchases or sales made over that month then they may forge such a relationship with a bank or create a subsidiary. In both cases the profitability of the bank or subsidiary will depend on their ability to buy or sell crude oil at below or above the month-average price by using among other markets, CFDs.

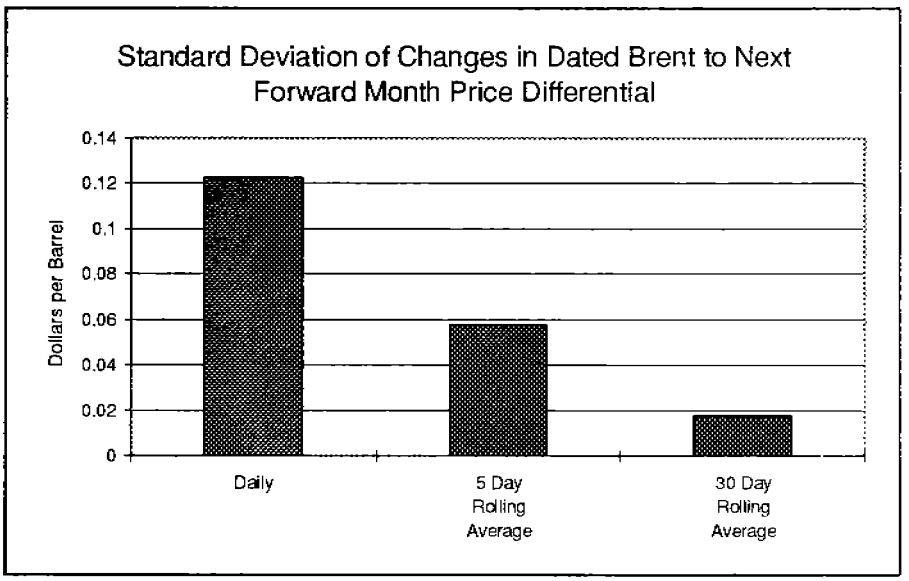

Figure 3
Sources: Own calculations from Platt's *Oilgram Price Report*.

It is also seen, not surprisingly, that the shorter the length of the assessment window the greater the volatility in changes of the price differential and therefore the greater the expected risk. The question, however, is by how much the volatility is

reduced when the assessment window is increased. In the period January 1987 to July 1995 we find that the standard deviation of changes in the 5-day rolling average is less than half that of changes in the daily price differential, and that the standard deviation of changes in the 30-day rolling average is less than a quarter that of changes in the 5-day rolling average (see Figure 3).

5. Forwardness

The average forwardness of CFD deals, that is the length of time (number of calendar days) between when the deal is struck and the beginning of the assessment window, is shown in Figure 4. The same system of classification is used for 'roll-over' deals, that is CFD deals whose assessment window is delayed for a price agreed by both parties. In the same figure we show the average forwardness of other North Sea crude oil deals which use Brent as a benchmark and are reported to Argus.

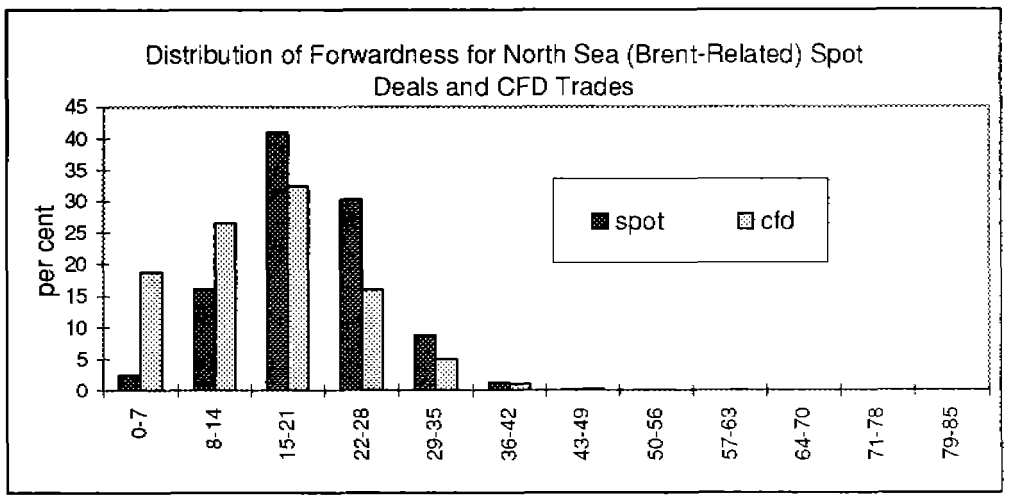

Figure 4
Source: LOR and Petroleum Argus *Crude Oil Deals Database.*

The analysis shows the short-term nature of this instrument which evolved as a means to hedge the value of physical cargoes. The assessment window for some 18.6 per cent of total trades recorded by LOR between March 1993 and 1995 have a forwardness of between one and seven days, 26.5 per cent of between 8 and 14 days,

32.4 per cent of between 15 and 21 days and 15.9 per cent of between 22 and 28 days.

In Figure 4 it can be seen that a very small proportion (2.5 per cent) of recorded spot deals of North Sea Brent related crudes have a short forwardness of one to seven days. The peak of the distribution is in the case of both spot and CFD deals in the 15-21 day forwardness.

6. Evolution of the CFD Market

According to an industry source CFD deals were being struck as early as February 1988. The growth of the CFD market in terms of deals made and volume traded has been estimated from LOR data (see Appendix 1 for the description of data sources). Some basic assumptions have been employed in the calculation - namely that the deals are of an average volume of 400,000 b/d[3] and that the LOR data achieves a maximum of 50 per cent coverage, so, our calculations represent the *minimum* volume for the CFD market. The deals are divided into months according to when the deals were reported to LOR rather than according to the start of the assessment window.

Assuming that the average parcel traded is equal to 400,000 barrels, Figure 5 shows how between July 1993 and October 1995 our estimates of the daily volume traded in the CFD market range from 2.6 mb/cd (or 3.7 mb/trading day) in August 1993 to 6.3 mb/cd (or 9.3 mb/trading day) in January 1995. Over the period as a whole there is a significant upward trend. Our estimates show that the average volumes recorded in the first six months of 1994 were 3.25 times the corresponding volume in 1993 and in the first six months of 1995 1.2 times the equivalent volume of the first half of 1994.

Another significant upward trend is evident in the average forwardness of CFD deals reported to LOR (See Figure 6).

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[3] 'One broker estimates the (CFD) market has now stabilised at around 250 trades a month, each of between 250,000-500,000 barrels - or about 100 million barrels in total', *Energy Compass*, May 19 1995.

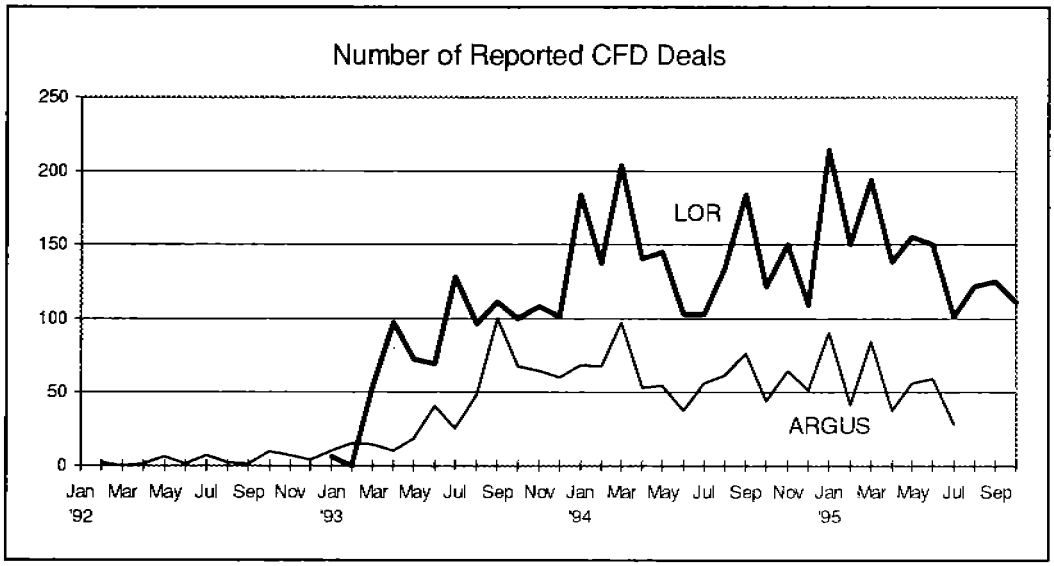

Figure 5
Sources: LOR and Petroleum Argus *Crude Oil Deals Database.*

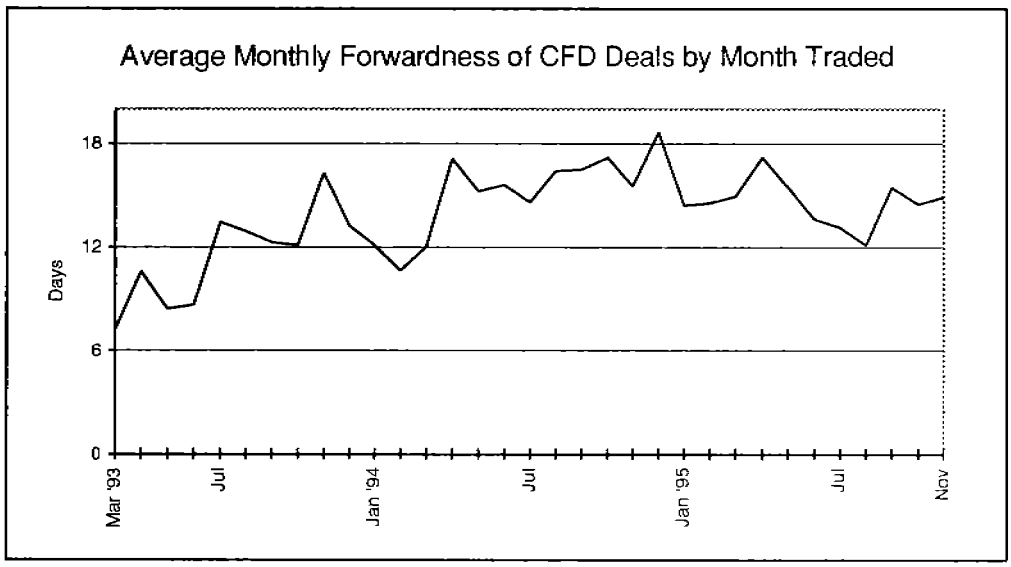

Figure 6
Source: Own calculations from LOR.

As is observed from the figure, average forwardness in calendar days has ranged from a low of around seven in March 1993 to over 18 in December 1994. It should be stressed that the upward trend in the forwardness of the deals can be seen with data from either the LOR, as in Figure 6, or with data from the Argus Crude Oil Deals Database. The choice of the LOR data to calculate forwardness is only dictated by the larger size of the sample.

This would accord with trends evident in the North Sea (but Non-Brent) spot crude oil markets (see Figure 7). This figure shows how the forwardness of Brent *vis à vis* other North Sea crudes was not very different (although it tended to be lower) before 1990. The trend in forwardness in other crudes has increased while the forwardness of Brent is more or less constant. A gap in the relative forwardness of dated Brent is emerging because, on the one hand, the 15-day forward Brent market restricts the availability of dated Brent cargoes, and on the other, because low stocks have encouraged refiners to schedule their feedstock purchases further in advance.

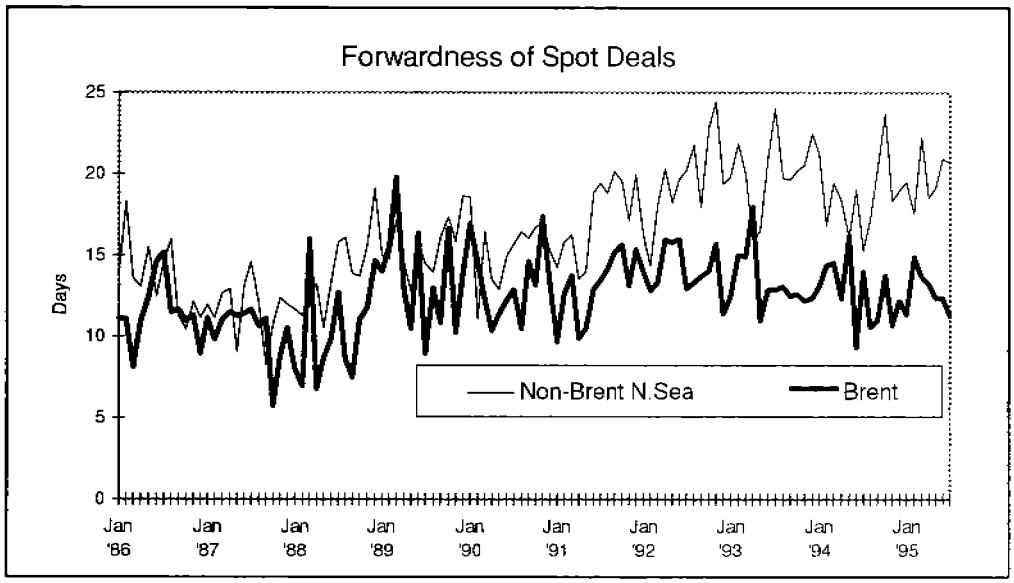

Figure 7
Sources: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

In the above analysis of the proportion of CFD deals specifying next or next+1 forward month it was found that over the period as a whole equal numbers of each were traded. However, it is evident from Figure 8 that the proportion of deals has changed over this period, particularly since the middle of 1994, in favour of using the next+1 forward month. This may be because of the increasing incidence of squeezes which has the associated effect of making dated versus next month price differential more volatile than dated versus next+1 month.

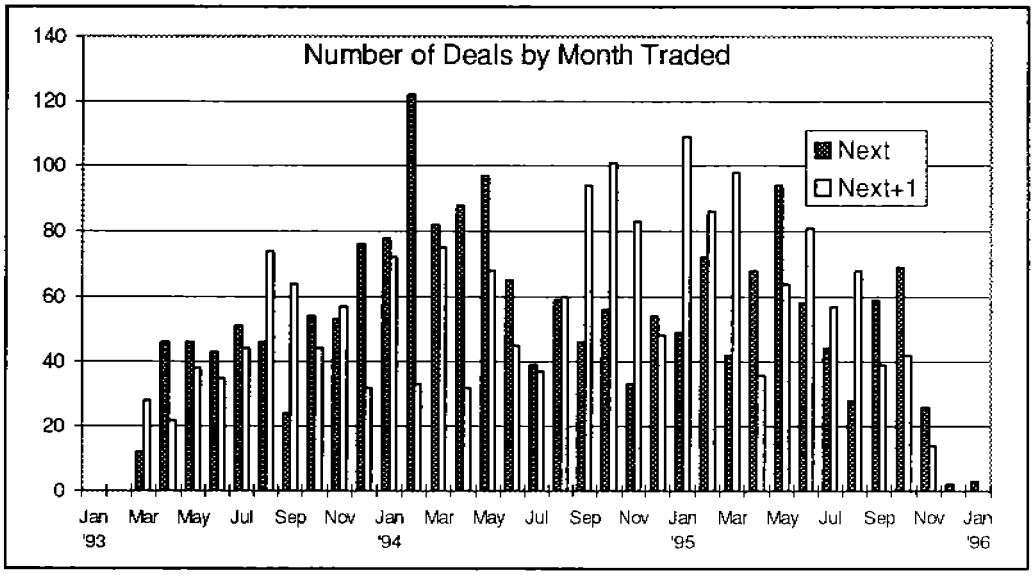

Figure 8
Sources: Own calculations from LOR.

This chapter has introduced the main features of a contract for differences and has discovered some changing aspects in this informal market. The most important aspect of the market is its very rapid evolution. Also the trends in the market seem to be related to the complementary markets in the Brent complex. The chapters that follow try to provide links that explain the early rise and consolidation of the CFD market.

CHAPTER 3

THE STRUCTURE OF THE CFD MARKET

1. Introduction

The previous chapter has presented the main characteristics of a CFD deal. This chapter analyses the identity of the participants and the current structure of the market for CFDs by focusing on the market itself and the possible links with the forward market. As explained in Appendix 1, information on participants was only available in a systematic manner for the forward, spot and CFD markets, in the Petroleum Argus Database, which we supplemented with private interviews. Petroleum Argus' coverage of the market for CFDs is smaller than that achieved for the forward market. This is particularly true for the beginning of the period covered by this study (1992-5) but there are reasons to believe that the coverage has improved over the years. Nonetheless, as a result of low coverage the numbers presented in this section should be considered as a partial indication of the structure of the market.

2. Number of Participants

The total number of participants for the period between January 1992 and July 1995 is 55.[1] This may seem like a large enough market but some participants are either fully or partly owned by others and as a result the number of truly independent entities is likely to be overstated. Further, very few players have had a continuous recorded presence in the market over the period 1992-5. In fact, only 17 companies are recorded as having been in the market since 1992, and even if we excluded the initial year from the analysis only 30 players would appear to have been active in the years 1993-5. The use of a more stringent requirement, for example at least 10 deals per year, reduces the number of continuous recorded participants to a mere 14. Figure 1 presents the number

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[1] The numbers reported in this section refer to both buyers and sellers of CFDs. While many markets are better described in terms of buyers and sellers (e.g. the Brent spot market) when dealing with forward or future markets the distinction is not so clear as most participants have to take both sides of the market at some point.

of participants by month since 1992.

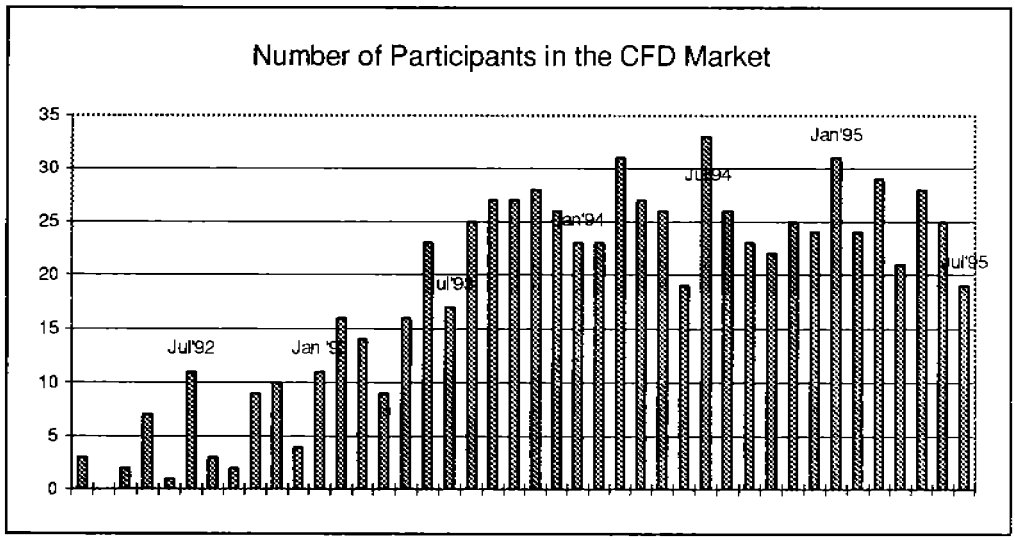

Figure 1
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

The number of participants increased steadily as the market started growing and new trading opportunities arose. However, it must be borne in mind that a large part of the rise in these numbers may be related to improvement in the coverage of the Petroleum Argus database. The highest number of participants for the period under consideration was 33 in July 1994. However, the following months show successively lower peaks which could suggest a falling trend.

A comparison with the forward market is of interest. Figure 2 presents the evolution in the number of participants in the forward market between 1986 and July 1995. The number of participants increased steadily until early 1988, reaching 75 and thereafter the number started falling gradually to around 30 participants. There is a similar pattern to that observed in the CFD market, albeit over different periods. The number of recorded participants increased rapidly at the beginning because of natural growth and improved coverage, but after a while it started falling.

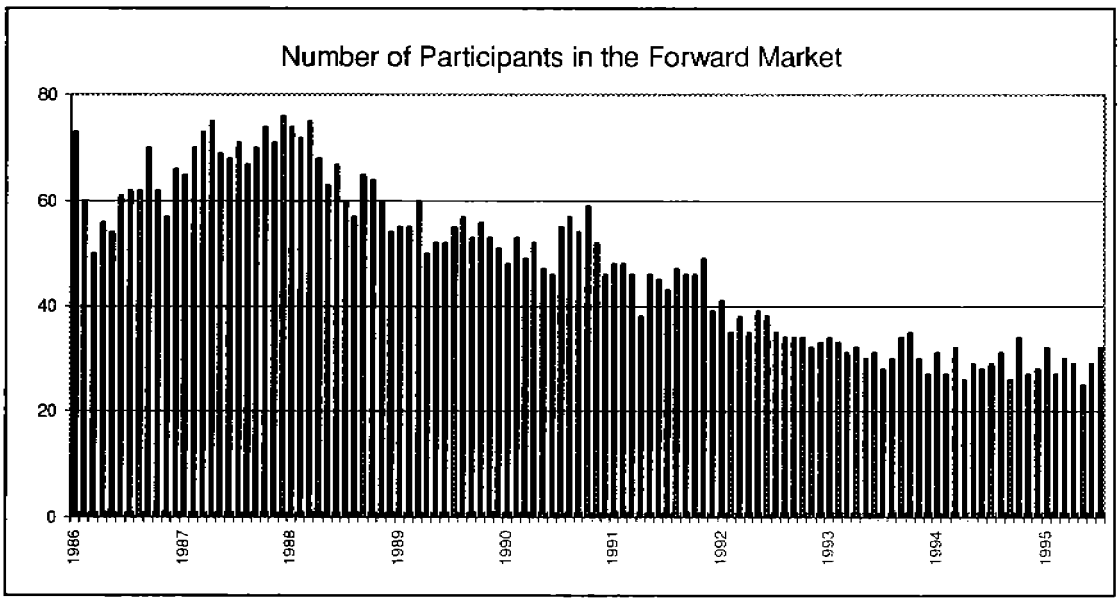

Figure 2
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

To get an idea of how the number of participants in the CFD market is shaped by the numbers of entries and exits, we have calculated the number of firms first observed in the database together with the number of firms last observed. Although this calculation should not be interpreted as reflecting a structural characteristic of the market given that the possibility of re-entry in the future is large, the numbers provide a guide of how the current size of the market is shaped by entry and exit. The data, calculated on a bi-monthly basis, are presented in Figure 3.

As is expected from an improvement in the coverage, the number of 'entries' exceeds the number of 'exits' in the period preceding 1994. After that however, on the reasonable assumption that coverage is no longer a binding determinant, it appears that the number of exits increased steadily and overtook the number of entries towards the end of the period considered. There is however a bias given the concept of exits used here. As we approach the end of the period considered (May-June, 1995) future re-entries which would reduce the number of exits as calculated cannot be observed.

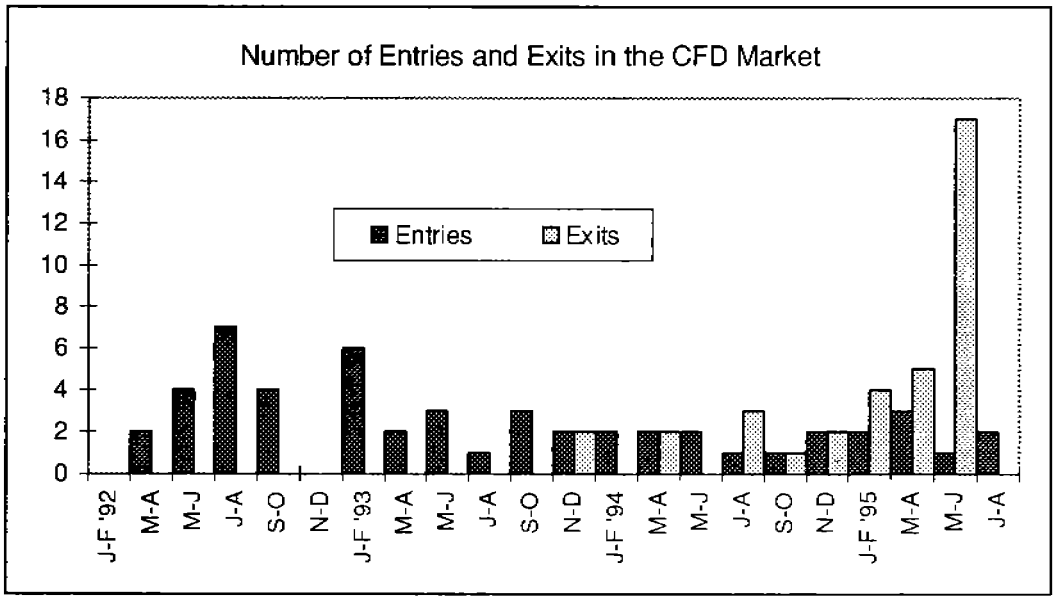

Figure 3
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

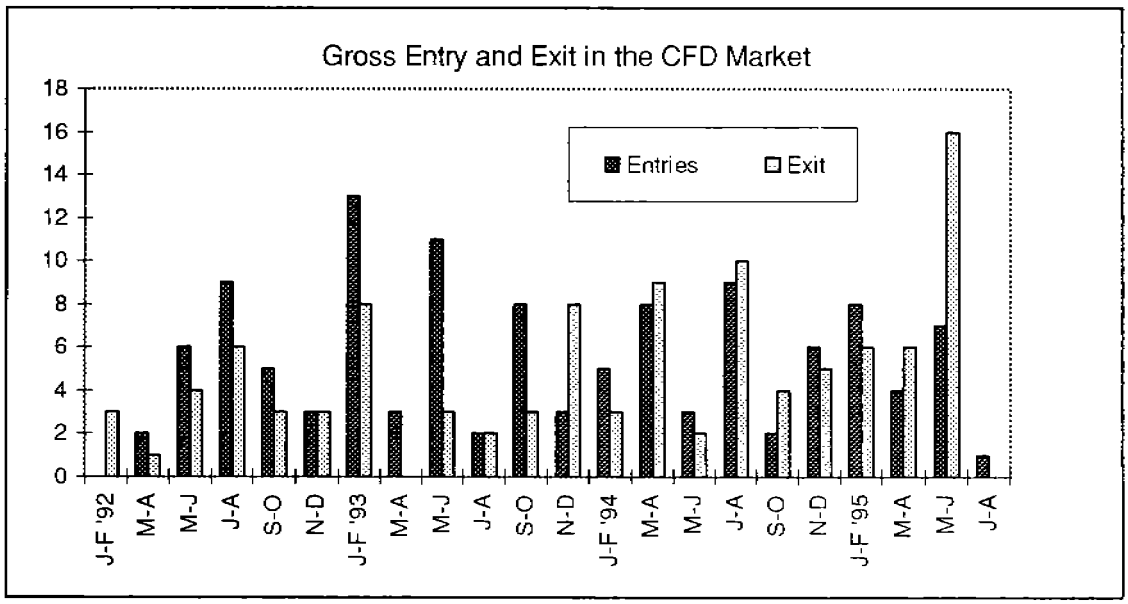

Figure 4
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

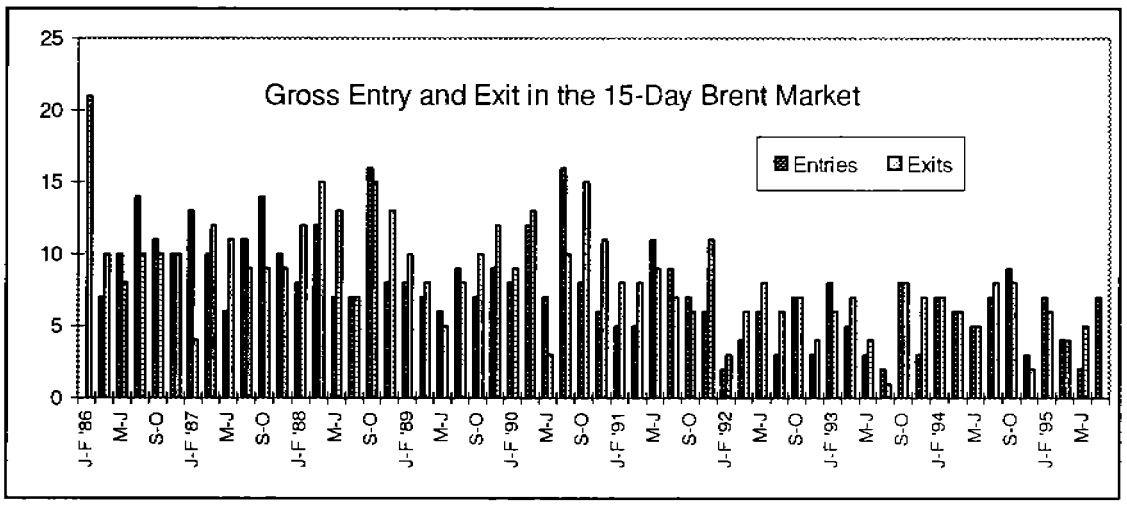

Figure 5
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

In order to assess whether the apparent large increase in exits in May-June is due to this bias or to other factors, we have computed for every two-month period the number of gross exits and entries. The gross concept does not correct the exits/entries observed in every period with subsequent re-entries. Figure 4 presents the data and shows that the number of exits (not corrected for re-entries) in the CFD market was much larger in May-June 1995 than in any other period. Interestingly, Figure 5 which presents gross exits/entries in the 15-day Brent market reveals a different pattern: - gross exits in May-June 1995 are not high relative to previous periods.

3. Market Concentration

Concentration in a market is about market shares. This section looks at the shares in total transactions of the CFD market participants. To get an idea of the degree of concentration, we have calculated the inverse Herfindahl index for the period under analysis.[2] The inverse index can be interpreted as representing the equivalent number

[2] The Herfindahl index is calculated as the sum of the square of the participants' market shares. The inverse index has the feature that it falls with both a larger dispersion in shares and a fall in the number of participants. The number ranges between infinity, the case of infinitesimal market shares, and 1, the case of monopoly.

of equal-sized firms that could supply the market.

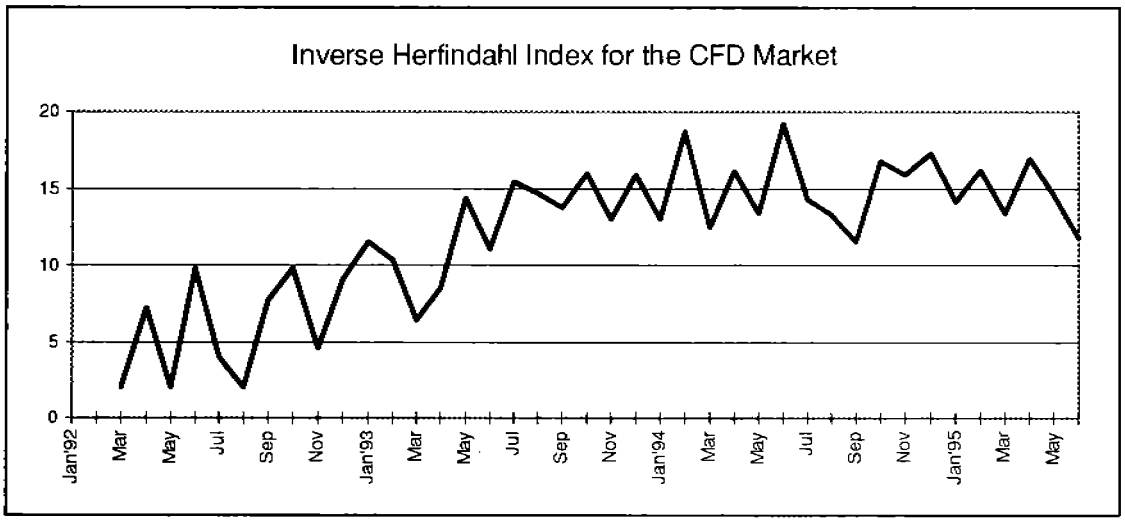

Figure 6
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

Table 1 Market Share of the Ten Largest Participants in the CFD Market

Rank	1992		1993		1994		1995*
1 B. Stearns	14.49	BP	12.16	BP	10.27	Phibro	9.97
2 J Aron	11.59	J Aron	11.12	Phibro	9.68	Dreyfus	8.76
3 CFP	10.14	Dreyfus	9.06	Dreyfus	8.43	Arcadia	8.36
4 Arcadia	7.25	Phibro	6.54	Shell Int	7.24	BP	8.36
5 Texaco	7.25	Elf	5.28	Arcadia	6.36	Shell Int	6.20
6 BP	5.80	Koch	5.28	Cargill	5.62	Vitol	4.72
7 Cargill	5.80	Arcadia	4.24	Chevron	4.88	Morgan St.	4.58
8 Chevron	5.80	Chevron	4.01	J Aron	4.21	JP Morgan	4.04
9 TWO	5.80	Statoil	3.90	Vitol	3.99	Koch	4.04
10 Elf	4.35	Shell Int	3.67	Mobil	3.84	J Aron	3.64
TOTAL	78.26		65.25		64.52		62.67

Note: * Until July only.
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

The trend in the index as shown in Figure 6 is upward as it starts from a very low number (two equal-sized companies rsing to nineteen). A trend is evident only up to mid-1993 after which time it stabilizes. Another index, the total annual share of the four largest companies or four-firm concentration ratio, reveals that in fact concentration in 1995 (35.5%) was not very different from 1994 (35.6%) but lower than

in 1993 (38.9%). The peak at 43.5% occurred however in 1992. We also present the market shares of the ten largest participants in Table 1.

It is well known that markets in manufacturing industries tend to be highly concentrated in their early stages of development (see Stigler (1968)[3]) because entry costs are high and learning is company-specific and costly. However in spite of the fact that learning is important, and expertise is the main barrier to entry in futures markets, entry costs in the case of CFDs should not be very high for firms already engaged in the 15-day Brent market. To enable a comparison of concentrations in the CFD and 15-day markets we computed the market shares of the ten largest participants in the 15-day market (Table 2).

Table 2 Market Share of the Ten Largest Participants in the Brent Forward Market

Rank	1992	1993	1994	1995*
1 J Aron	15.30 J Aron	11.96 BP	10.09 JP Morgan	13.85
2 Phibro	9.06 BP	9.55 Phibro	9.96 Phibro	11.71
3 BP	6.93 Koch	7.62 Shell Int	9.13 BP	9.33
4 Shell Int	6.50 Phibro	5.88 J Aron	8.68 J Aron	8.39
5 Cargill	6.44 Shell Int	5.83 Koch	6.44 Statoil	5.85
6 Morgan Stanley	4.86 Shell UK	5.49 Cargill	5.10 Elf	4.96
7 AIG	4.60 Elf	5.47 Statoil	5.07 Morgan Stanley	4.80
8 Statoil	4.52 Cargill	4.77 Morgan Stanley	4.91 Shell Int	4.80
9 Shell UK	4.49 Dreyfus	4.72 Elf	3.82 Koch	4.41
10 Exxon	4.13 Morgan Stanley	4.31 Chevron	3.63 Shell UK	4.21
TOTAL	66.84	65.61	66.83	72.30

Note: * Until July only.
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

With the exception of the year 1992, the levels of concentration in the forward market exceed the levels of concentration observed in the CFD market. Also if seasonality is not a feature of forward market trading it could be said that concentration has increased in the year 1995.

3 G. Stigler, *The Organization of Industry*. Richard D. Irwin, Homewood Ill, 1968.

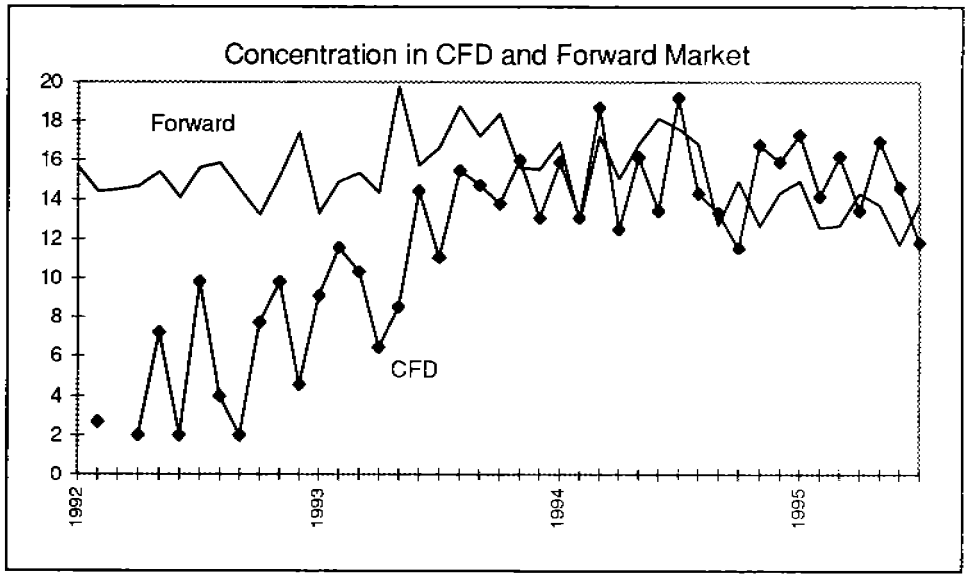

Figure 7
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

The relationship between concentration in the two markets could be split into three periods. The first period, a period of falling concentration in the CFD market and little change in concentration in the forward market, between 1992 and late 1993, is likely to be related to an improvement in the coverage of the Petroleum Argus database and, perhaps, a reduction in learning costs. The second period, where concentration in the two markets is not very different throughout 1994 shows a close correspondence between both markets.[4] The reason for this closeness, as explained in the following chapter, is that CFDs cannot be used in isolation but are usually combined with either futures or forward market operations. There is however, a third period in which the CFD market seems to be less concentrated than the forward market and where their close relationship is not that strong. The relationship between both markets in terms of numbers and market shares is presented in the following section.

[4] As is seen below the level of concentration in the forward market has stabilized since 1992 following the increases in concentration found by Horsnell and Mabro for 1987-91. (See P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993).

4. The Link between the CFD and the Forward Market

To analyse how closely related the two market structures are, we count the participants involved in both markets and compute their shares in the relevant market. Table 3a presents a simple count of participants in the forward market only, the CFD market only and participants in both markets for the years 1992-5. Table 3b presents the shares in recorded transactions of these participants.

Table 3 Participation in 15-Day and CFD Markets

(a) Participants (Number)				
Year	Participants in 15-Day Market Only	Participants in CFD Market Only	Participants in Both Markets	
1992	39	1	16	
1993	23	6	31	
1994	21	7	32	
1995	14	12	31	
(b) Market Shares of these Participants				
	15-Day	CFD	15-Day	CFD
1992	32.2	5.8	67.8	94.2
1993	9.2	3.2	90.8	96.8
1994	9.4	5.6	90.5	94.3
1995	8.3	7.5	91.6	92.4

Source: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

Table 3 has three interesting features. The first is that between 1993 and July 1995 a group (of a constant number) of 31 to 32 participants were involved in both the 15-day and CFD markets and accounted for more than 90 per cent of total reported deals in each. Secondly, that the number and market share of participants who trade in the forward market only has fallen drastically since 1992. This is largely because with the emergence of CFDs participants in the forward market began increasingly to deal also with the new instrument. However, we notice also that further decline in the participants in the 15-day market only is matched by an increase in the number of participants who appear to be dealing in the CFD market only. This is the third important feature of the table. But we can assume that some of the increased number

of participants dealing in CFD only have switched from the forward to the futures markets since CFDs are usually used for hedging purposes in conjunction with another contract.

5. Type of Participants

To analyse the behaviour of market participants it is useful to classify them into groups. The problems of grouping companies arise from the fact that the same company could be assigned to different groupings and companies with different motivations can be assigned to the same group. The classification used in this paper follows Horsnell and Mabro[5] and classifies companies in four different groups:

- Wall Street (W),
- Brent producers (P),
- Traders (T), and
- Other oil companies (O).[6]

To provide an indication of the relative market shares and their evolution over time, Figures 8 and 9 present the monthly market shares for each group of participants. As mentioned above, the very low coverage in the years 1992-3 makes comparisons among type of participants meaningless in those years. For this reason, the numbers presented in the two figures are only those from mid-1993 up to July 1995. During the period Traders, Brent producers and Wall Street companies account for 85% of the market while other oil companies account for about 13%. The few trends that can be discerned from the graphs are the rising market share of Wall Street companies and a slight decrease in the share of Brent producers. The share of Traders seems to exhibit a seasonal pattern, rising in June-July and stable at around 20% for the rest of the year.

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5 Horsnell and Mabro (1993) *op cit*.

6 Two of the original groups have been excluded from the analysis. First, the group of Japanese trading houses (the sogo shosha) as they do not trade in CFDs. Second, Non-Brent North Sea producers have been pooled together with other oil companies (mainly Shell International) as other oil companies trade sporadically and do not merit a group of their own.

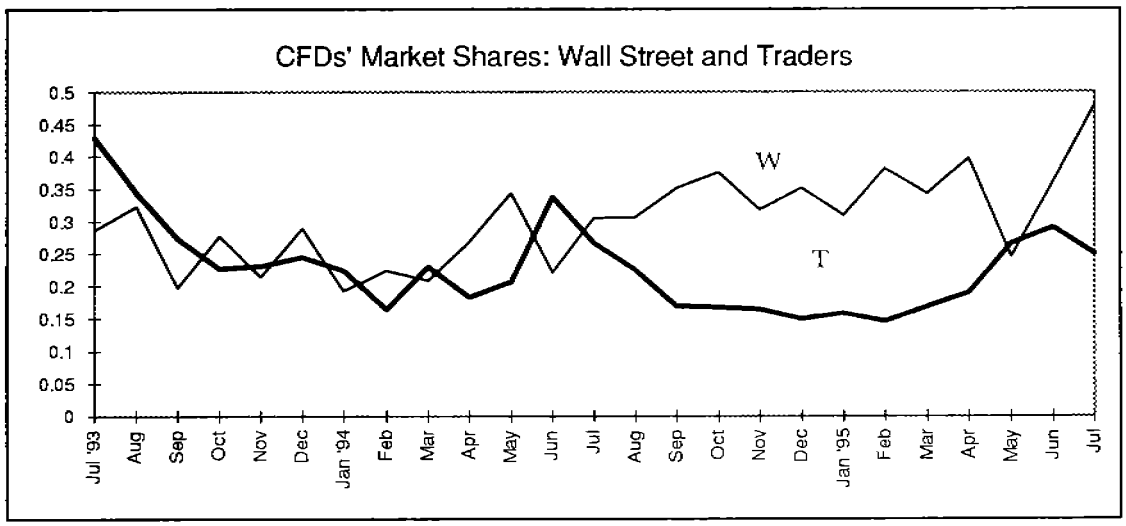

Figure 8
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

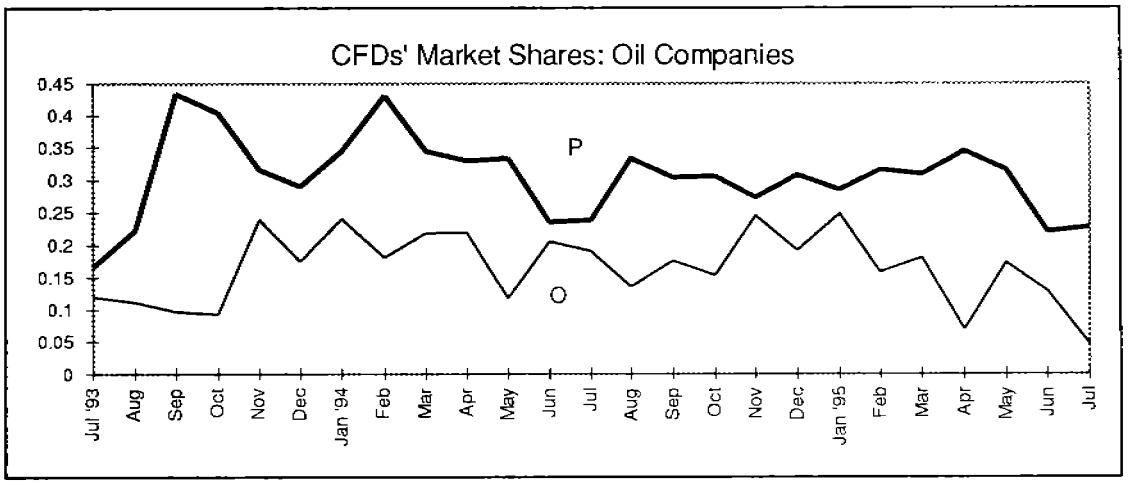

Figure 9
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

One possible indication of market efficiency relates to the composition of trade among market participants (see Verleger (1988)[7]). Presumably, if trading is welfare enhancing, we should observe a pattern by which producers and consumers trade mainly with traders so as to distribute risk efficiently.[8] As was mentioned above, one

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[7] P.K. Verleger, 'The impact of Cold Weather in December 1989 on Heating Oil Prices' Statement before the Governmental Affairs Committee of the US Senate.

[8] It is often difficult to distinguish between speculators and hedgers as most market participants undertake both activities. For the purpose of this exercise we assume that oil companies are

of the reasons for the introduction of CFDs has been the large residual basis risk which would require offsetting hedging operations. Thus, an interesting descriptive way to analyse the issue of market efficiency is to assess trading patterns. Using the groupings introduced above, we can see who trades with whom and whether there is a certain bias in those trades. Following Horsnell and Mabro (1993) *op cit,* the first part of Table 4 presents the trading matrix of group players in the years 1992 to July 1995.

Table 4 Trade Patterns in CFDs' Market

	Observed Trades						Deviation from Expected Trades(%)				
		Seller							Trader		
Buyer		O	P	T	W	Total	Trader		O	P	T	W
	O	27	86	66	89	268		O	-33.5	0	+11.3	+11.8
	P	60	130	94	120	404		P		-5.52	+1.43	+5.00
	T	46	100	46	77	269		T			-30.8	+15.7
	W	62	141	122	86	411		W				-24.3
	Tot.	195	457	328	372	1352						

Note: P: Brent producers. O: Other oil companies. T: Traders. W: Wall Street.
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database.*

From this table we see that some participants are net buyers of CFDs (c.f. Other oil companies and Wall Street companies) while others are net sellers (c.f. Brent producers, and Traders). The right-hand part of the table presents the deviations in observed patterns from those that would result if the players chose their partners randomly. Reading off the diagonal, we see that all participants trade less among themselves than expected.[9] The numbers are significant in all cases with the exception of Brent producers.

The various groups trade less among themselves and more with other groups than is to be expected from a random perspective. The only exception is the trade pattern between Brent producers and Other oil companies; there does not seem to be

hedgers and Wall Streeters and Traders are speculators.

[9] This result should be qualified by the fact that a given participant does not trade with her/himself.

any bias as they apparently trade randomly with one another. Brent producers trade more with both Traders and Wall Street houses but the numbers in the former are not particularly high. Nevertheless, Other oil companies trade heavily with both Traders and Wall Street houses. Traders trade more than the norm with all participants but in particular with Wall Street houses, although they tend to avoid trading with members of their own group. This pattern is also found for Wall Street houses and it can be said that they trade significantly more than expected with Traders. This is surprising as we would expect risk-takers to trade with hedgers but not with other risk-takers.

Apart from the way in which they trade among themselves, the role of Traders and Wall Street companies is consistent with what is expected of participants who provide the liquidity necessary for hedging. The pattern is also consistent with the theory that the motivation of Brent producers and Other oil companies have more to do with hedging.

This chapter has described the main features of the market for CFDs. This market which has undergone a rapid development since 1992 was initially characterised by a strong link with the 15-day Brent market. The concentration of the CFD market declined significantly in 1992-3 and then stabilized in the later years. The efficiency of the market is analysed in the following chapter.

CHAPTER 4

THE USE OF THE CFD MARKET FOR HEDGING PURPOSES

1. Brent CFDs as a Complement to Forward and Futures Markets

CFDs provide an essential complement to the forward and futures markets for industry participants who wish to hedge spot and term crude oil deals priced off dated Brent. The observed price on both forward and futures markets does not converge with that of the spot market;[1] users are therefore exposed to the risk that the differential between the prompt and forward prices may change between settlement of the paper contract and settlement of the physical trade. The duration of this exposure will vary between two and a half and six and a half weeks depending on whether the cargo is priced at the beginning or end of the calendar month.[2] By combining CFDs with forward or futures contracts users have access to a financial hedge for their physical transaction (see Example 1).

Trade opportunities in CFDs are obviously related to the volatility of the differential between dated Brent and next month forward. Figure 1 presents the differential of dated to next month forward prices averaged over five days for the period January 1992 to January 1996.

Figure 1 shows how this differential moves between prolonged periods at which next month forward is at a premium to dated Brent to short periods where the next month forward is at a discount with the absolute levels of the premium being higher

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[1] If the time structure remains constant and the first month forward and dated Brent prices are not subject to other factors then the price of the 15-day forward market will converge with the spot market a full 15 days before the end of the contract month.

[2] A forward contract for delivery of a 500,000 barrel Brent parcel in February must be settled between 16 January and 10 February depending on whether the loading range for the cargo in question is nominated at the beginning, that is 1-3 February, or end, that is 26-8 February, of the month. To give examples, a February futures contract must be settled on, or before, 14 January . In this way the contract expires between two and six weeks before the cargo is loaded depending on whether the loading dates occur at the beginning or end of the month. A forward contract, on the other hand, turns 'wet' a *full* fifteen days before the first date in the three-day loading range specified for the cargo. Many of those using the 15-day forward market will not want to take physical delivery and therefore will either attempt to book-out their positions before the process of nominations starts or try to avoid being 'five o'clocked'.

than those of the discount.[3] Since 1994 it is evident that the hedging effectiveness of forward and futures markets must have fallen as the dated to next month forward Brent price differential has become more volatile. Before a liquid CFD market was available to hedge this risk it was common for those exposed to dated Brent price movements to use the first to second month spread as a proxy for the dated to first month spread. The problem with this strategy is that in months where first month premia were inflated, due to, say, a squeeze (where dated to first month is at a discount and first to second month in backwardation (see Chapter 5)), the use of the proxy merely increased the risk that required a hedge.

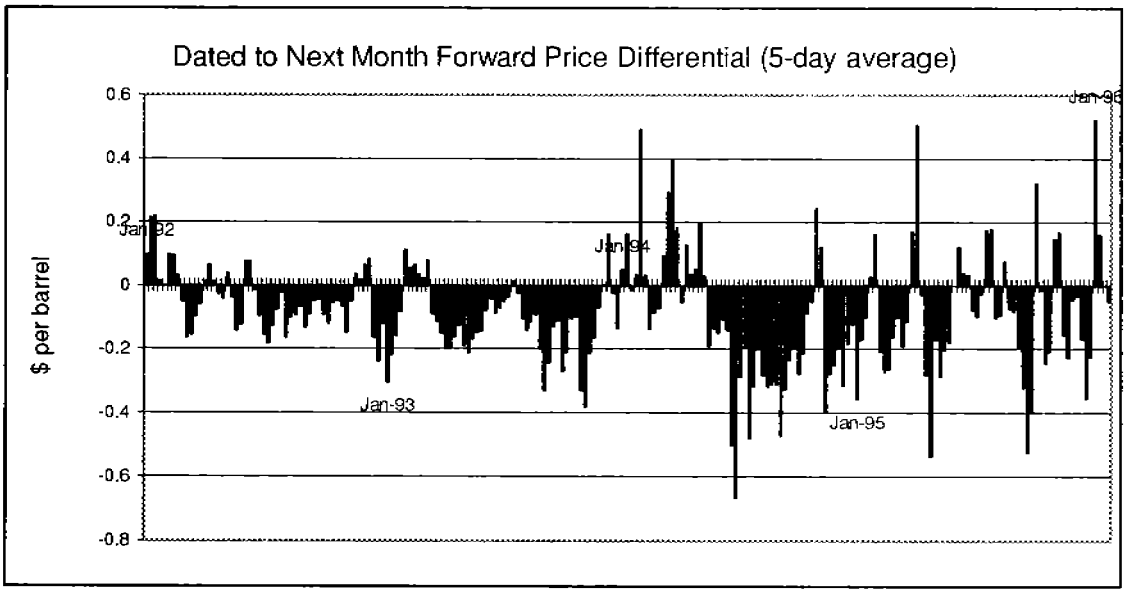

Figure 1
Source: Own calculations from Platt's *Oilgram Price Report*

For a buyer or seller of a crude priced off dated Brent, CFDs allow the dated to forward Brent price differential to be hedged. However, tailoring the hedge to match the underlying physical trade involves some complications. First, the pricing period for the most widely quoted CFDs may not correspond with the pricing period for the physical trade. In this case the hedger must decide whether the risk associated with

3 Theoretically the contango is constrained by the cash and carry costs while the backwardation is unbounded. (See B. A. Goss, *The Theory of Futures Trading*, Routledge, London 1972).

this small time difference justifies the additional cost of purchasing an atypical CFD.

Example 1 Refiner Hedging the Price of an Oseberg Cargo

A refiner buying a cargo of Oseberg on 21 April 1995 for loading at Sture in Norway on 9-11 May agrees to accept the average dated Brent price five days around the bill of lading i.e. 8-12 May plus US cents 27. To lock in the price of that cargo on the day the agreement was made the refiner would buy both a 15-day June contract and a CFD for the week 8-12 May. The hedge will not be perfect as the 15-day contract can only be bought or sold on a single date on which the price may not approximate to the average of the assessment week.

The refiner buys and sells as follows

a) On 21 April 1995:		b) Between 8-12 May:			
Buys 15-day June at	$18.76	Sells 15-day June on 10 May		$18.47	
		Net gain/loss		-$0.29	
		Settles CFD at the following average:			
Buys CFD 8-12 May at	$ 0.28	CFD May 8	0.2*(18.71-18.99)	=	-$0.056
		CFD May 9	0.2*(18.12-18.39)	=	-$0.054
		CFD May 10	0.2*(18.17-18.47)	=	-$0.06
		CFD May 11	0.2*(18.01-18.36)	=	-$0.07
		CFD May 12	0.2*(18.305-18.54)	=	-$0.047
		Five-day total			-$0.287
		Net gain/loss on CFD (-0.28-0.287)		=	-$0.567

Balance:

Price paid for cargo (ave. Dtd 8-12 May plus US cents 27)	$18.533	
Loss on 15-day position	$0.29	
Loss on CFD position	$0.567	
Final Total (position as of 12 May)	$19.39	
Locked-in (position as of 21 April)	$19.31	($18.76+$0.28+$0.27)
Difference between hedge and final position	$0.08*	

* - The difference here is accounted for by the 8 cent loss the refiners made from unwinding the forward position on May 10 at $18.47 rather than unwinding it over the 5-day period as a whole which would have yielded an average forward price of $18.55.

Source: Own calculations from LOR.

Secondly, in attempting to match physical with paper volumes North Sea producers must take into account the fact that the profits on their physical and paper positions will be subject to different tax rates. In an article on this subject, Liz Gall, Head of Marketing with Enterprise Oil plc, shows how this can be achieved by

adjusting volumes to match the tax ratio.[4] However, in order to do this the producer must have tax certainty (which does not obtain in the UK for fields paying PRT 'because it is the profitability of the field over its entire life which determines whether, and at which point in time, PRT will apply'[5]) or expect that the hedge and tax-reference prices will be equivalent or in a constant relationship.

Once the physical volume has been calculated the paper position must be adjusted accordingly. This is usually done through a combination of CFDs, on the one hand, and forward, partial and futures contracts, on the other, as the hedged volume will not usually conform with sizes neatly divisible by the standard 500,000 barrel lots traded in the 15-day forward market. In order to match physical and paper positions more closely the hedger may employ partial Brent contracts, traded in 50,000 barrel lots, and/or futures contracts, traded in 1,000 barrel lots. Whether the hedger will undergo the additional expense of tailoring the hedge through the use of the futures or 15-day partial Brent market should depend on whether the additional expense occurred is renumerated in terms of the risk offset.

If the hedger is simply interested in tailoring physical and paper volumes then the resultant hedging strategy is likely to employ all the different types of Brent contracts. However, there are pros and cons associated with the use of forward versus futures markets for the purposes of offsetting risk. First, because of its smaller lot size futures markets can provide a much more exact hedge, not only in terms of volume but also by enabling the user to settle the contracts in batches over a number of days (see Example 1 above). Secondly, the existence of a clearing house between buyer and seller in futures markets enables the participant to close the position instantaneously whereas the 'book-out' procedure in the 15-day forward market requires the consent of the other parties. This consent is likely to be less forthcoming if the value of exercising operational tolerance is large. If a hedger is unable to book-out the forward position

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4 Liz Gall, 'North Sea Oil Hedgers Must Keep an Eye on their Tax Bill', *NYMEX Energy In The News*, Fall 1992, pp.23-7.

5 *ibid.*

s/he takes the risk of taking physical delivery and/or of being caught short of a forward cargo, and of the operational tolerance going against him or her. Thirdly, there is always a risk of default, however small, in this market.

The informal forward market also has its advantages. First, the administrative costs are lower in an informal market as a clearing house and the payment of daily margins are not required. Secondly, as CFDs are routinely specified as the difference between dated and forward Brent the user will be exposed to changes in the forward to futures price differential between the times the hedge is struck and settled.

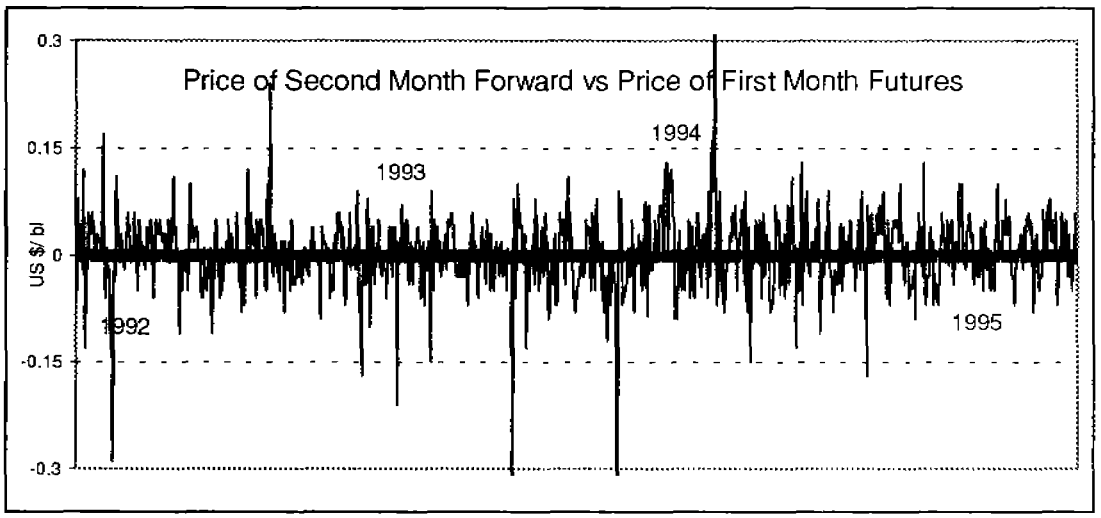

Figure 2
Source: Own calculations from Platt's *Oilgram Price Report* and IPE Database

Over the period Oct 1988 to Dec 1995, the correlation between the second month forward (as published by Platt's) and the first futures month price at close of trading (as reported by the IPE) has been more than 99% despite the half hour time difference between the two prices. This includes periods when liquidity was low, like during the launch of the futures contract in 1988, and also periods when physical crude was traded at a premium, like during the Gulf war. To illustrate how close the levels of the second month forward and the first month futures are, Figure 2 presents this differential over the period 1992-5. The two prices are within 5 cents of each other in 70% of cases and within 10 cents in 80% of cases. More importantly, the standard deviation is only 25 cents including the futures contract expiry dates and 20 cents excluding them. Thirdly,

positions on the forward market can be initiated with less visibility and, so, without the risk of moving the price detrimentally.

CFDs can also be used as a means of reducing the costs of a rolling hedge during a period of backwardation.[6] When prompt prices are above the price for future delivery one pays a premium for going long on prompt and short on future. Each time the hedge is rolled forward a month an additional premium must be paid. However, one can use CFDs to hedge against the possibility that the backwardation in the time structure of prices becomes stronger. Thus, if backwardation does become stronger than expected, by simultaneously buying a CFD near the beginning of the month and selling one near the end of the month one can make a profit that would offset the additional costs of rolling the futures hedge.

2. The Effectiveness of Brent CFDs in Hedging the Purchase or Sale of Other Crudes

The previous section demonstrated how a price for dated Brent sale or purchase can be fixed in advance by using a combination of CFD and forward/futures contracts. The relative merits of forward and futures contracts were also analysed. Finally, it was shown how CFDs could be used to protect against the effects of strengthening backwardation on the costs of a rolling hedge.

The buyer of the cargo is also hedged against the risk that the price differential of the crude will move *vis à vis* Brent as this differential is agreed in advance. The seller, however, will be exposed to this differential.[7]

In the following exercise we analyse the variability in the differential of Brent to Forties and Brent to Urals. These are the residual basis risks faced by sellers of

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6 C. Bryce, 'Dated/Paper Contract for Differences', in Petroleum Intelligence Weekly *The Industry Guide to Energy Derivatives*, pp.40-1.

7 Another risk comes from the fact that the pricing period may not coincide with the assessment window of the CFDs.

Forties and Urals after they have hedged the dated Brent benchmark through a combination of futures/forward contracts and CFDs. Given that the average forwardness of Forties and Urals spot deals are 16 and 18 days respectively and that the average pricing period is five days, this calculation estimates the variability of the rolling five-day price average over 16 and 18 days for each crude.

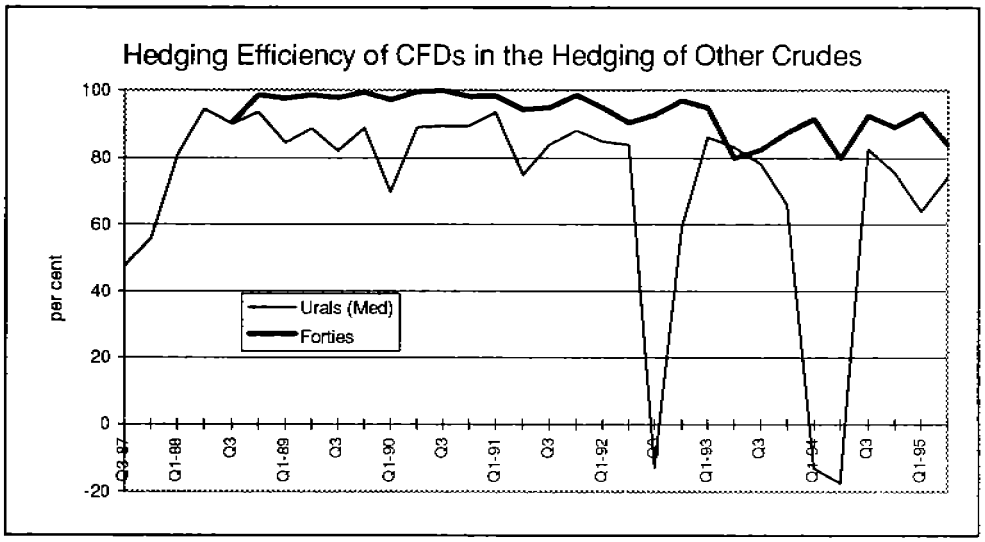

Figure 3
Source: Own calculations from Platt's *Oilgram Price Report*.

The results of performing this exercise for quarterly periods since June 1987 for Urals and June 1988 for Forties are presented in Figure 3. This figure has three interesting features. First, that the hedging efficiency of CFDs for Forties is greater than for Urals. This is to be expected as Forties is more similar to dated Brent than Urals in terms of quality, location of production and destination of cargoes.[8] Secondly, the hedging efficiency of CFDs for both Urals and Forties declines over time and it coincidently declines as the volume of the CFD market increases. The third interesting feature is that the hedging efficiency of Brent trading instruments for Urals can be negative, that is that the risk associated with movement in the differential can be greater than that of the absolute price.

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8 Most important is the difference in quality: Urals being a high sulphur and heavy crude whereas dated Brent and Forties are low sulphur light crudes.

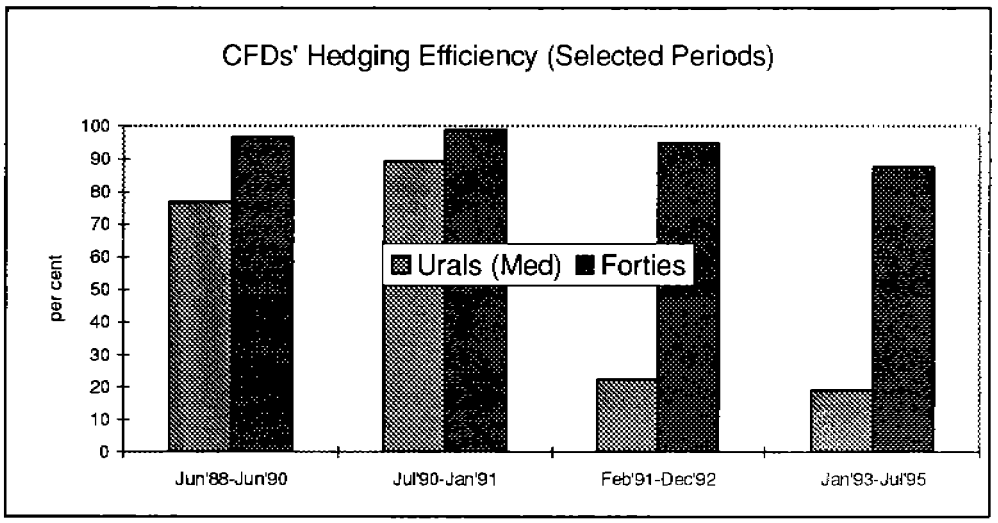

Figure 4
Source: Own calculations from Platt's *Oilgram Price Report*.

Figure 4 shows, as in the quarterly exercise, that the hedging efficiency of CFDs in the case of Forties is greater than in the case of Urals. The figure also shows clearly that the hedging efficiency of CFDs, combined with the forward market, high as it may be, declines over time. The reduced hedging efficiency of CFDs in the case of Urals can be attributed to concerns over export qualities which led to two dislocations in the Brent/Urals price differentials, one in the period 2Q-3Q 1992 and the other in the period 4Q 1993 - 2Q 1994. In the case of Forties, the differential with Brent is more volatile because, first, the differential is now assessed more frequently than it once was; and, secondly, because the time structure in the markets has become more volatile in 1994-5.[9]

[9] Platt's assessment of the spot price for North Sea grades other than dated Brent involves deals made between 10 and 30 days ahead (until recently it was between 10 and 20 days). The 15-day Brent market constrains dated Brent trades to within 15 days. As a result when the time structure of prices becomes more unstable the differential between dated Brent and other North Sea crudes is afffected.

CHAPTER 5

THE CFD MARKET AND THE BEHAVIOUR OF THE DATED-TO-PAPER PRICE DIFFERENTIALS

1. Introduction

In this chapter we set out to explain the behaviour of the dated to forward Brent price differentials on which the outcome of CFD trades are decided. As is evident from our analysis in Chapter 2 section 3 the most commonly traded CFD price differentials are dated Brent to next month forward and dated Brent to next +1 month forward price differentials averaged over 5 days. As mentioned earlier the reason for not using the more usual terminology of dated Brent to first month forward and dated Brent to second month forward is that dated Brent to first month forward tend not to be traded in CFD markets for the nine days toward expiry of the first month contract.

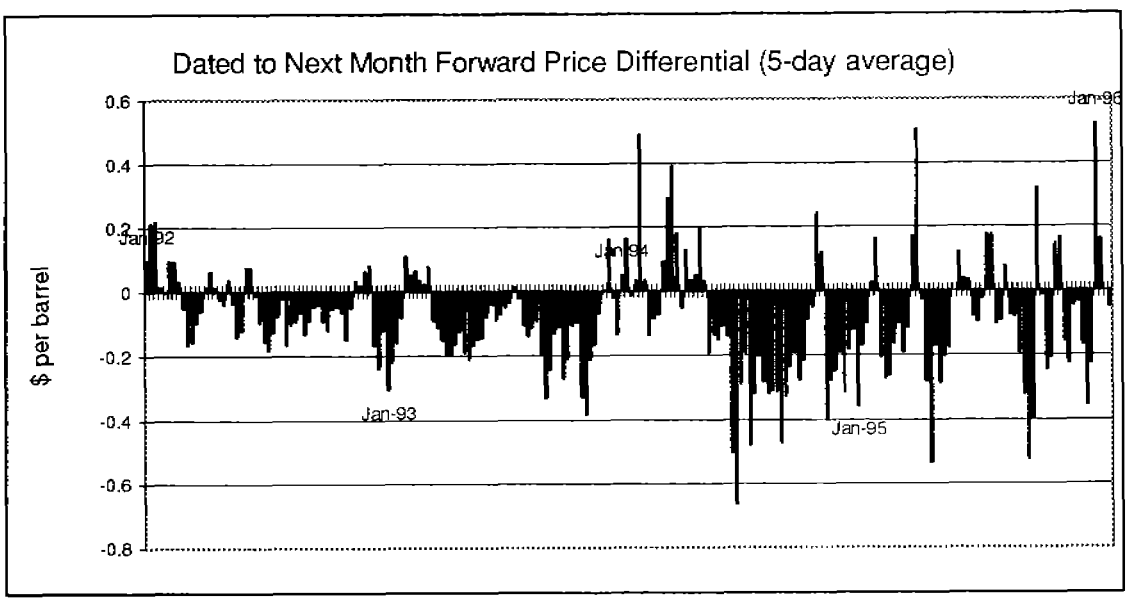

Figure 1
Source: Own calculations from Platt's *Oilgram Price Report*

Over the period 1992-5 we have observed rising trends, in the volatilities of dated to next and dated to next +1 month price differentials, and a tendency for dated

Brent to be traded at a discount to the next month forward price (see Figures 1 and 2).[1] These features have coincided with the emergence of a high volume CFD market.

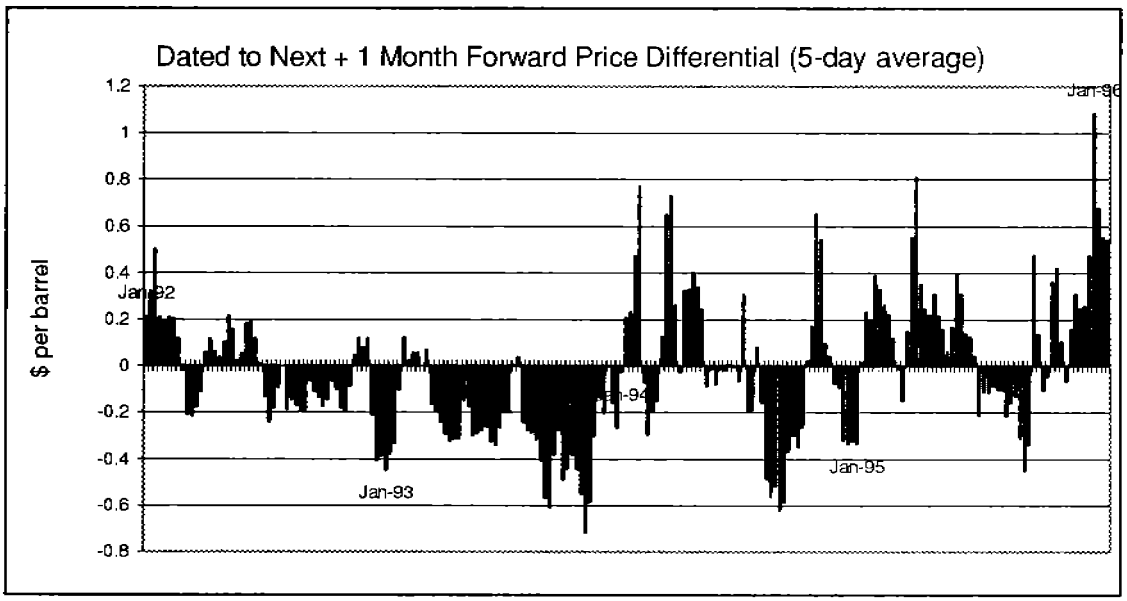

Figure 2
Source: Own calculations from Platt's *Oilgram Price Report*

Having identified these two trends we now put forward our hypothesis that they may be the result of an increasing incidence of forward market squeezes made possible by the emergence of a high volume CFD market in 1994 and 1995. In the following sections we first detail the logic of our hypothesis, then attempt to identify those forward months subject to a squeeze and, finally, to quantify their impact. If our hypothesis is correct we would expect not only to observe volatility in the CFD price differentials but also greater volatility and a higher premium of first month forward Brent relative to dated and other forward months.

[1] We prefer to use dated Brent at a discount/premium to first month forward instead of contango/backwardation because the relative price of dated to first month forward cannot be interpreted as a pure time structure. This is the result, among other things, of the existence of operational tolerance and the time difference between the final publication of the first month forward price for a particular contract and its expiry (for further details refer to Chapter 6).

2. CFDs and Squeezes of the Forward Market

(a) Squeezes

Just as markets adapt so must the techniques used to outsmart them. The risks associated with attempts to outsmart the market grow as knowledge of a particular game permeates the market. In the same way the rewards of a successful 'play' tend to yield decreasing returns the more it is tried.[2] As a result the ways in which squeezes of the 15-day market have been engineered have changed over time. The innovations have been directed at overcoming three main problems that are encountered when mounting such an operation, that is successfully building up a long position in the forward market, reducing the extent of the price risk entailed in having such a position and reducing the number of cargoes that building a long paper position might entail.

The downfall of previous attempts to squeeze the first month forward market was that the long position accumulated would inevitably result in the delivery of a large number of dated Brent cargoes. The profit made through the squeeze of the forward market from those players unable to deliver a forward market cargo was, therefore, overwhelmed by the loss incurred in disposing of a large physical volume. The appearance of a high volume CFD market has apparently changed the situation in providing an opportunity for participants to profit from the effects of a relative fall in the dated Brent price. By placing large short positions in the CFD market for particular weeks toward the end of the contract month one can profit from simultaneously squeezing the paper and aggressively marketing the physical cargoes as both actions will tend to reduce the CFD price (for a discussion of another type of squeeze see Appendix 2).

The following example has been constructed *ex post* and, so, although the

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[2] This view is also one held by some participants: 'When asked to describe some of the techniques used in the CFD market, one trader replied, "It is in my best interests that as few people as possible understand this. The spread of knowledge in that market dramatically decreases trading opportunities." Just as the 15-day Brent market, in its infant stages in the early 1980's, provided huge opportunities for profitability through other companies' lack of knowledge, so does the fledgling CFD market, the trader added.' Platt's *Oilgram Price Report*, 17 June 1991, p.7.

example employs actual quotes and prices it does not purport to explain actual market developments. Further, the example does not explain whether the imaginary squeeze would have been an overall success as the return on the forward position is not estimated.

Assuming that a player had decided to squeeze forward Brent for the contract month May 1995 then the player could also have profited through building an exposure in the CFD market for the weeks 24 to 28 April and 1 May to 5 May. On 31 March CFDs for the trading weeks of 24-28 April and 1-5 May were being quoted at May +2 cents and June +15 cents.[3] Through amassing a long position in May paper and aggressively marketing the dated Brent cargoes being collected the player could have forced up the price of May paper relative to dated Brent and, so, forced the price of CFDs down. On 1 May the player's CFD exposure would roll forward to dated versus June, however, the continued release of cargoes would maintain the slide of physical against forward. Given that the CFD position was initiated at the level quoted on 31 March 1995 a profit of 55.5 cents per barrel for the week 24-28 April and 32 cents per barrel for the week 1-5 May would have been made on settlement.

The leverage provided by a short CFD position in a squeeze operation can be complemented by other techniques designed to minimize the risks involved. One such technique which could have been developed at any time but which has only become known recently is to build a long forward position through the EFP market. This technique can be used to reduce visibility and price risk.

Visibility is important because if knowledge of a participant amassing a long position for a particular contract month becomes widespread then it is in the interests of participants not to trade with that participant. Visibility in the 15-day market can, therefore, be a problem especially because of the long average forwardness of 15-day deals[4] and the regularity with which particular months are targeted (see Appendix 2).

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[3] See LOR 31 March 1995. The price of 1-5 May on that date is taken from an unconfirmed deal reported on that day rather than a broker's quote.

[4] Although the average forwardness of the 15-day market has fallen from 61 days in 1986-91 to 53 days in 1992-5, it still represents a long enough period over which to spread deals for a given month.

The long average forwardness in 15-day markets also makes price risk important. Building large positions on the paper market may allow a participant to raise the value of first month relative to second month or dated Brent (or even another cargo priced off Brent). It does not allow the participant enough leverage to reverse the trend in the market. Therefore in squeezing the 15-day market the participant is hoping to profit from raising the premium of first month prices relative to another price. Two ways in which a player may profit from this activity are to build an exposure to the dated to first month differential, through selling CFDs, or to the first to second month differential, through buying first to second month forward spreads. To be successful the player must ensure that the differential moves lower in the case of CFDs and higher in the case of a forward spread between the times at which the position is opened and closed.

An alternative way to initiate a long forward position is to trade Exchange of Futures for Physical (EFPs) through the IPE futures.[5] A type of EFP trade involves one side going short 500,000 barrels on futures and long 500,000 barrels on the 15-day market while the other side takes the opposite position. This approach can have two advantages.[6] If it is the first time that such a technique is used then it may surprise other participants especially as the IPE futures only declares the volume of such transactions. The second advantage is that the participant holding length in a particular forward month is not taking any risk on movements in the absolute price level as that length is exactly balanced by a short futures position. In this way the participant can wait to within a few days of the start of nomination period for dated Brent cargoes before deciding whether the conditions are right, that is when prices are rising, to go ahead with the squeeze. Aside from the usual risks faced by a participant attempting a squeeze, in this case the participant must try to minimize the losses incurred from large-scale buying to cover the short futures position before expiry of the contract.

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[5] See P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, 1993 Oxford pp. 50-2.

[6] A. Busch, 'Brent Trading Ploys Fuel Complaints About Price Distortions', *Energy Compass*, 19 May 1995 and 'A Squeeze or Astute Trading?', *Argus Energy Trader*, 24 February 1995.

(b) Identifying the Squeeze Months and Their Impact

In this section we describe the effects of a squeeze operation on the dated and first month forward prices. This description yields a methodology whereby we can identify the squeeze months and, by so doing, quantify the impact of these months on the volatility and the dated over next month discount observed in the previous chapter.

Sufficient information is not available to identify forward months that have been intentionally squeezed. This would require knowledge of the participant's net long position for the relevant forward month, which is not available. Information on the participant's expectations as to the number of forward market cargoes scheduled for the targeted month might not be necessary if the net long position exceeded the number of cargoes that could be loaded at Sullom Voe during that month.

Instead we have identified the so-called squeeze months by taking a stringent definition of a squeeze based on the level of dated to first and first to second month forward price differentials and on the movement of those differentials toward expiry of the squeezed forward month contract. Those months in which the behaviour of those price differentials conforms with our definition are selected as the squeeze months. Our measure, like the one used in Horsnell and Mabro, [7] does not impute intention.

In Table 2 we identify each delivery month[8] between 1992 and January 1996 in which the first month forward price rises to a premium above both the dated Brent and the second month forward Brent prices. In order to get an idea of the relative severity of each episode we have noted the number of days in the delivery month in which this particular term structure is evident, and the maximum price differentials for (a) first month versus dated and (b) first month versus second month observed in each episode.

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[7] "....we define a squeeze specifically in the context of the Brent market in terms of its effect on prices, thus removing the need to distinguish between 'deliberate' and 'accidental' squeezing. The definition we use, and whose rationale is explained below, is that a squeeze can be observed in the Brent market when the price of cargoes for the first forward delivery month traded rises above both the price of dated Brent and the price of second month forward cargoes." Horsnell and Mabro *op cit* , p.131.

[8] That is the 10th of the previous month to the 9th of the delivery month. First month continues trading up to 15 full days before the start of the final three-day loading in the delivery month, that is the 12th in a 30 day month, however, the prices are not observable as the first month price classification in Platt's rolls forward on the 10th or next trading day thereafter.

Table 2: Extent ($/b) and Duration (Trading Days) of First Month Premia

Date	*Max Extent*		*Days*	Average	*Date*	*Max Extent*		*Days*	Average
	First to Dated	First to Second		Operat. Tol.*		First to Dated	First to Second		Operat Tol.*
1992					1994				
January	0.20	0.46	5	0.26	MAY	0.58	0.70	10	0.13
February	0.10	0.20	7	0.18	June	0.26	0.24	16	0.17
March	0.08	0.06	2	0.20	JULY	1.12	0.82	21	0.12
April	0.06	0.12	8	0.09	August	0.50	0.62	16	0.12
May	0.10	0.16	14	0.12	September	0.34	0.16	3	0.18
June	0.20	0.24	21	0.10	November	0.12	0.30	10	0.16
July	0.16	0.14	9	0.18	December	0.72	0.60	17	0.11
August	0.04	0.06	6	0.12	1995				
November	0.06	0.02	2	0.10	January	0.34	0.04	3	0.09
December	0.16	0.22	6	0.13	February	0.24	0.38	9	0.10
1993					MARCH	0.76	0.68	20	0.11
February	0.08	0.18	7	0.21	April	0.26	0.36	10	0.05
March	0.14	0.18	7	0.14	MAY	1.00	0.86	19	0.15
June	0.28	0.06	5	0.06	June	0.36	0.54	21	0.15
July	0.10	0.06	3	0.14	July	0.28	0.28	9	0.12
August	0.16	0.06	4	0.17	August	0.18	0.12	1	0.15
December	0.26	0.14	9	0.11	October	0.62	0.14	10	na
1994					November	0.26	0.30	18	na
January	0.22	0.42	4	0.23	December	0.36	0.30	16	na
February	0.18	0.38	5	0.23	1996				
March	0.18	0.28	7	0.11	JANUARY	0.74	1.00	19	na
April	0.28	0.28	6	0.08					

Source: Own calculations from Platt's *Oilgram Price Report*
Note: *: See Chapter 6 for the methodology to calculate this premium.

If the term structure of prices is the result of an intentional squeeze then the player responsible will be hoping to profit through his/her positions on the CFD and forward markets to one of the two differentials or even both. The extent of the premia is therefore an important factor in the success of a squeeze operation. Also included is the operational tolerance premium for each month which we calculate in Chapter 6 for the purposes of comparison with the maximum premium which first month achieved over dated Brent. Another important factor for the success of a CFD-led squeeze is the

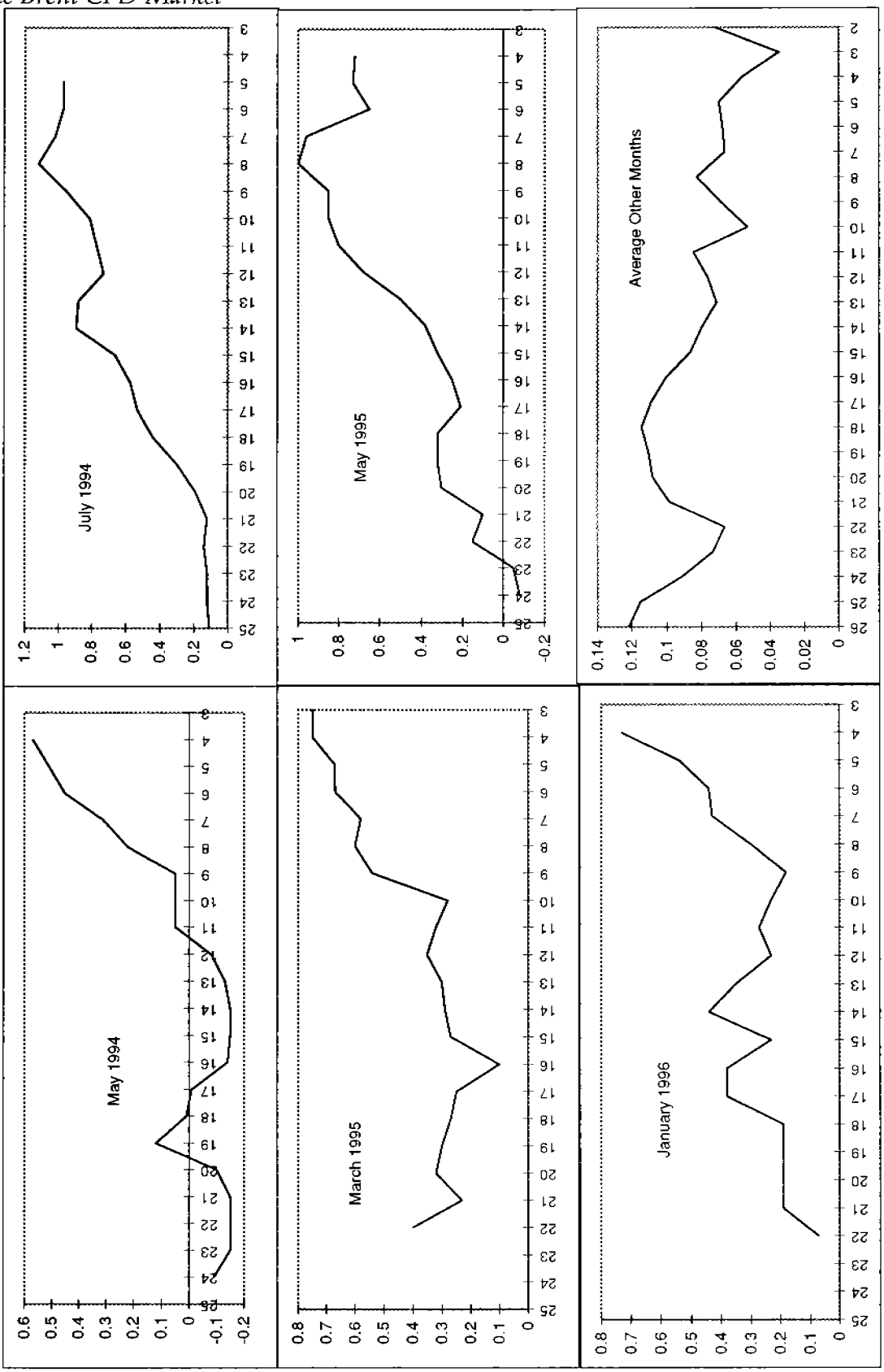

Figure 5 (a) Dated to First Month Forward Price Differential in the days before Expiry of the Forward Contract: Squeeze Months and Other Months

Note: The ordinates are $/barrel and the abscissae are the number of days left to expiry of the shown contract month

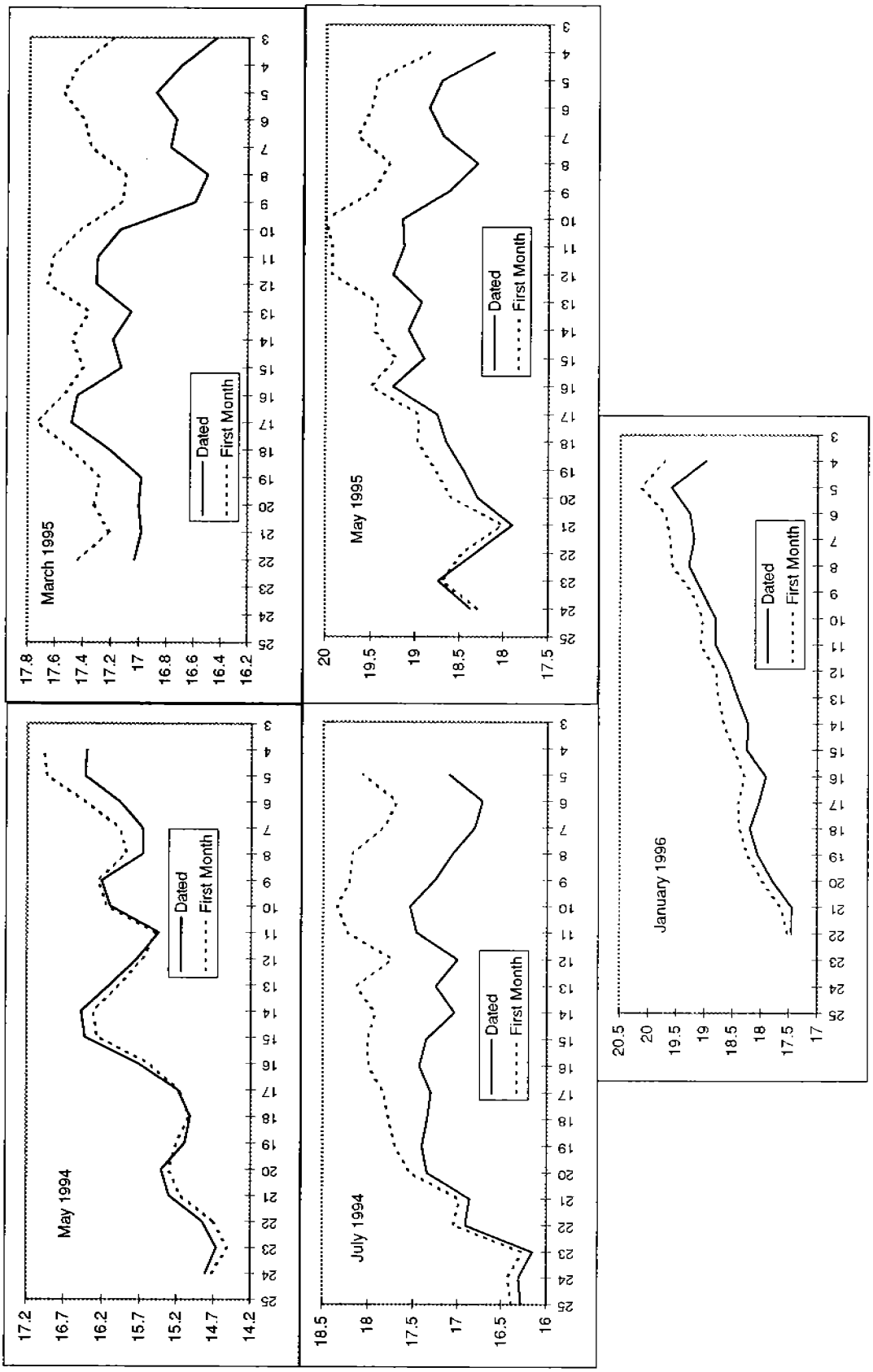

Figure 5 (b) Dated and First Month Forward Brent Prices in the days before Expiry of the Forward Contract: Squeeze Months

Note: The ordinates are $/barrel and the abscissae are the number of days left to expiry of the shown contract month

duration of the term structure especially as CFD trades tend to be settled on the basis of a 5-day average.

The months displayed in capital letters are those in which our stringent definition identifies a squeeze. Our choice has been made on the basis of two additional criteria. The first is that the maximum extent of the premium of first month forward over dated Brent as shown in Table 2 exceeds 50 cents per barrel. The second criterion is that the first month forward to dated Brent price differential increases toward expiry (see figures 5(a)-5(b)). This second criterion may not be a necessary condition of all squeezes but certainly for the most successful ones.

Both criteria are fulfilled in the case of five months, namely May 1994, July 1994, March 1995, May 1995 and January 1996. All five months occur in 1994 and 1995.[9]

We have analysed how the squeeze months have affected the degree of volatility in the dated to first month forward price differential. The test divides volatility over the periods 1994 and 1995-January 1996 between squeeze and non-squeeze months.[10] Volatility is defined as the daily change in the absolute difference between the dated and next month forward price differential. The average of this volatility for squeeze and non-squeeze periods, together with their standard deviation, number of days in which the periods are observed, their t-tests of difference in the averages, the proportion of the total volatility explained by the squeeze months and the proportion of squeeze days in total days is presented in Table 3.

Table 3: Differences in Volatility in First to Next Month between Squeeze and Non-Squeeze Days

	Average Volatility		Stdev Volatility		Number of Days		Tests	%	%
	Non-Squeeze	Squeeze	Non-Squeeze	Squeeze	Non-Squeeze	Squeeze	t	Explained	Days
1994	0.05489	0.07115	0.06777	0.06498	191	40	-8.4*	0.22	0.18
1995-Jan '96	0.06039	0.08281	0.07586	0.07389	202	59	-13.8*	0.29	0.23

Note: *: Different from zero at 1%.
Source: Own calculations from Platt's *Oilgram Price Report*

9 January 1996 was traded from 11 December 1995 to 9 of January 1996.

10 For the methodology used see the analysis of volatility and relative price of dated Brent and forward months in the beginning of the chapter.

Average volatility is statistically greater in squeeze than non-squeeze days for the years 1994, 1995 and January 1996. Indeed, volatility in squeeze days is 29.6 and 37.1 per cent larger than in non-squeeze days in the first and second periods respectively.[11]

We have also tested how much of the level of the dated to next discount is explained by the squeeze months. In 1994 the two squeeze months explained 35.3 per cent of the average level of the discount whilst only accounting for 18 per cent of the total number of trading days. In 1995-January 1996 their contribution is much larger accounting for 57.3 per cent in just 23 per cent of the total trading days. [12]

Aswellas affecting the dated to next month forward price differential we would also expect squeezes to have a greater affect on the first month forward price than dated or other forward Brent prices. This is evident from consideration of Figures 3 and 4.

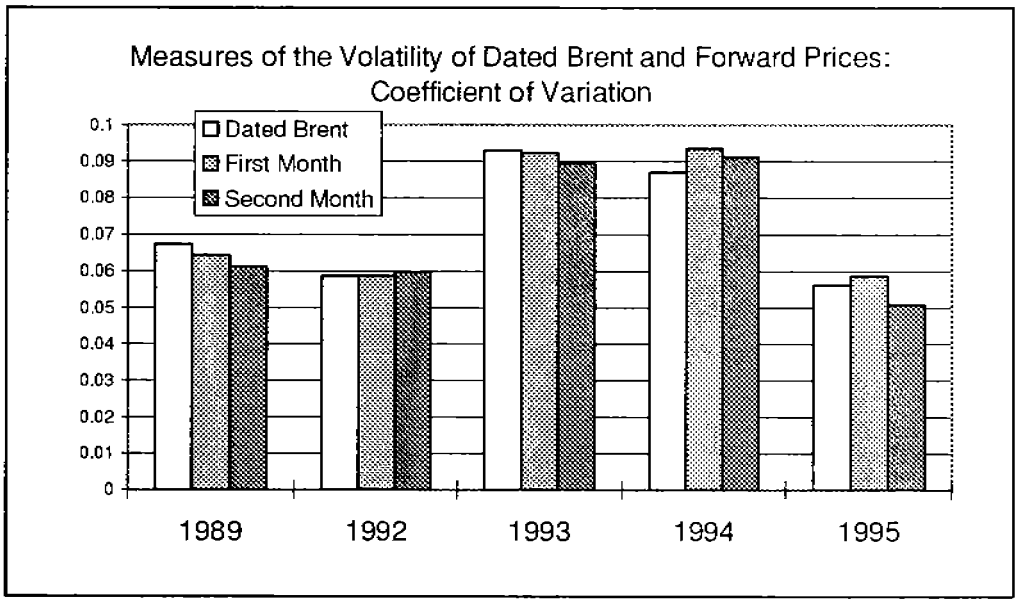

Figure 3
Source: Own calculations from Platt's *Oilgram Price Report*.

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11 We estimate these percentages as the proportional differences in the average volatilities.

12 Days when the cone structure (*ie* first month at a premium to both dated and second month) prevails, whether related or not to the definition of squeeze, account for 59 per cent of the volatility in the differential in 1994-5 (27 per cent in 1992-3) as this peculiar structure accounts for 51 per cent of the total trading days in the period (24 per cent in 1992-3). Volatility in the differential is 36 per cent (15 per cent) higher in those days in 1994-5 (1992-3).

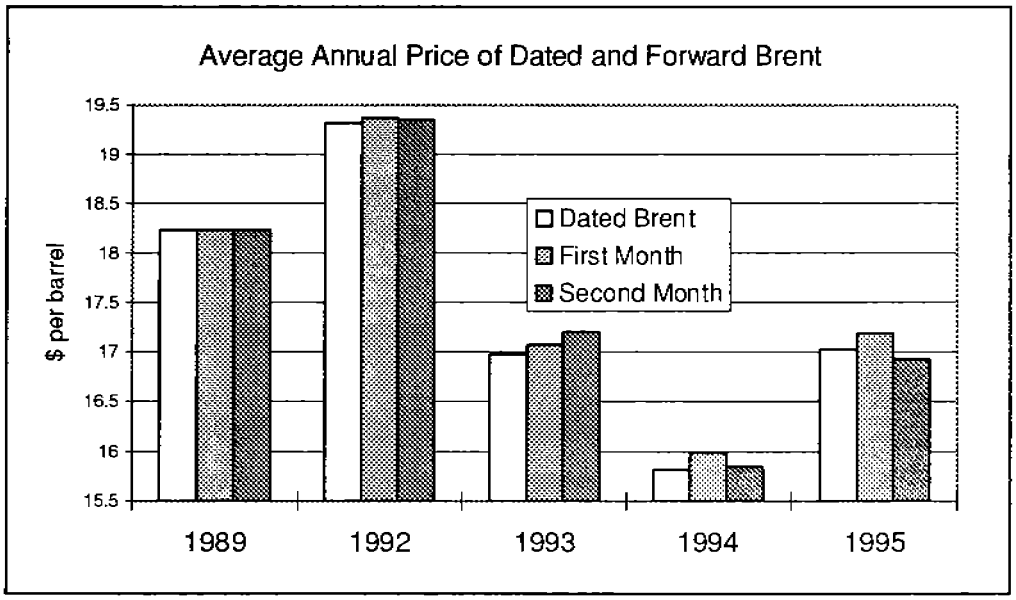

Figure 4
Source: Own calculations from Platt's *Oilgram Price Report*.

In a fundamentally tight market, as was the case in 1989, one would expect the volatility of the spot price to be greater than that of forward months. However, in Figure 3 we note that the volatility[13] of the first month forward price was greater than that of both the dated Brent price and the second month forward price in 1994 and 1995. In earlier years the volatility of the first month forward price was less or approximately equal to that of the dated Brent price.

In Figure 4 we see that the average annual discount of dated Brent relative to first month forward Brent more than doubled from 5 and 9 cents per barrel in 1992 and 1993 respectively to 17 and 16 cents per barrel in 1994 and 1995 respectively. Furthermore, despite the backwardation observed in the forward months, the first month forward price was at a premium to the dated Brent price on 363 out of a total 477 trading days in 1994 and 1995. We believe that the greater volatility of the first month forward price relative to dated Brent in 1994 and 1995 and the increase in the level of the first month premium in these two years is the result of a greater incidence of squeezes.

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[13] The measure of volatility used is the coefficient of variation. The coefficient is defined as the ratio of the standard deviation of prices and the average annual price. The advantage of the coefficient of variation, in contrast with the standard deviation, is that it is not dependent on the level of prices.

3. Conclusion

The need for CFDs as a hedging instrument is obvious to any observer familiar with the large volatility in the basis between next month forward and dated Brent. We have observed how the use of CFDs is in no way irrelevant to the final outcome of the basis being hedged and, in particular , how CFDs have enabled participants to reduce their exposure to the losses traditionally associated with attempting squeezes. Put differently, we have found that the objective of using a CFD is not independent of its own use.

This chapter has argued that the increased volatility in the price differentials traditionally hedged using CFDs in 1994-5 is the result, via the reduced risk of attempting squeezes, of a large volume CFD market. There are however both alternative and complementary explanations for the behaviour of the differentials which we shall discuss in the following chapter.

CHAPTER 6

OTHER EXPLANATIONS FOR THE BEHAVIOUR OF CFD PRICE DIFFERENTIALS

1. Introduction

In this chapter we consider four explanations, often proposed as alternative or complementary to that of the greater incidence of squeezes, for the marked change in the behaviour of the CFD price differentials in 1994-5 relative to 1992-3. These are that: **(1)** tight conditions in spot crude oil markets emerged in 1994-5, **(2)** the time structure in forward markets moved from contango to backwardation, **(3)** the 5 per cent operational tolerance in Brent liftings at Sullom Voe and its role in the 15-day Brent contract became increasingly significant for price behaviour and **(4)** the falling liquidity in the dated Brent market enabled participants in that market to influence the assessment of the dated Brent price. This chapter will argue that the first two explanations have no bearing on the particular behaviour of the differential while the latter two, although they may affect the differential, cannot on their own explain the *change* in the behaviour of the differentials. The final section analyses the repercussions of market squeezes and manipulation of price assessment on the level of the dated Brent price.

2. Tight Market Conditions

An alternative explanation for increased volatility in the CFD price differentials is that they have been indirectly affected by a tight and, therefore, volatile spot market. Evidence for this tight market is provided not only by the level of backwardation in the forward curve but also by the falling level of stocks. According to PIW's *Global Oil Stocks and Balances* annual crude oil stocks in the member countries of the European Union were on a falling trend from March 1993 to December 1995, with a 5 per cent drop between the highest and the lowest level. In contrast, net consumption of oil products is reported in the *IEA Statistics* to have increased by 0.7 per cent between 1993

and 1994 and by 1.3 per cent between the first three quarters of 1994 and 1995. The fall in stock levels is interpreted by market observers as an attempt by industry to cut costs by reducing the amount of capital tied in unproductive stocks.

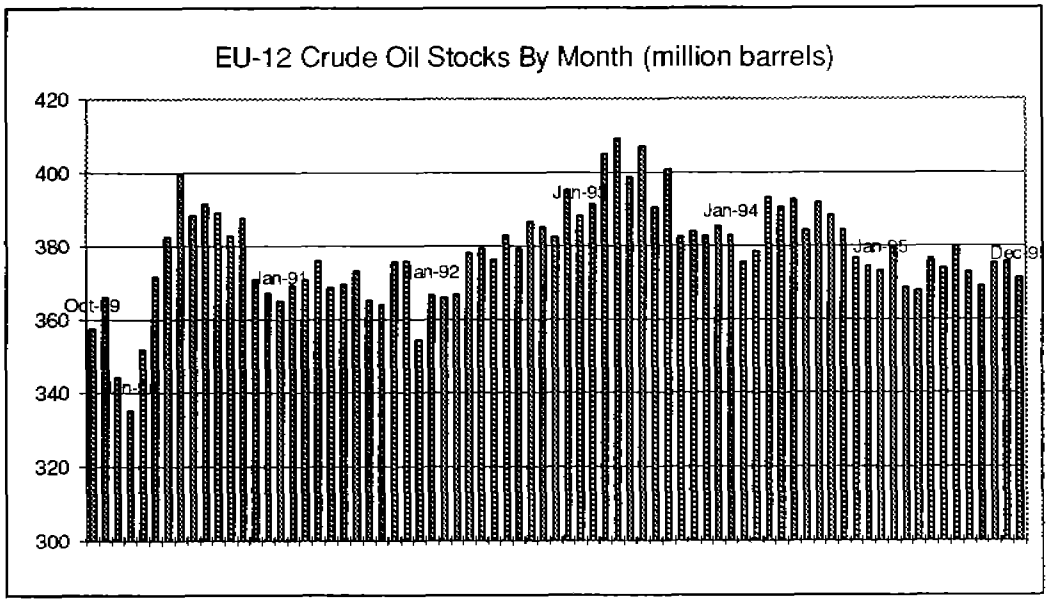

Figure 1
Source: Own calculations from PIW *Global Oil Stocks and Balances*.

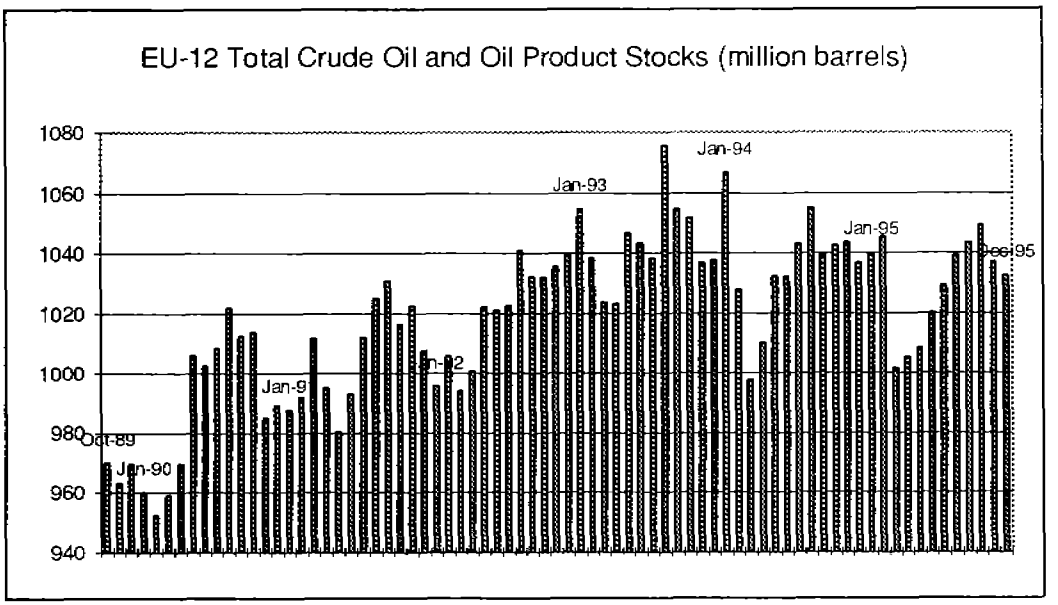

Figure 2
Source: Own calculations from PIW *Global Oil Stocks and Balances*.

Without a sufficient stock cushion crude oil and petroleum product markets can

become temporarily decoupled during the time that it takes for supplies to respond to higher price signals. All else being equal, it is to be expected that a perceived low stock level will tend to accentuate the effect of supply and demand information on spot prices. If, therefore, volatility in the dated to first month Brent forward price differential was being driven by a perception of inadequate stocks then one would expect spot prices to become increasingly volatile.

However, the evidence does not support this explanation. In the first place Figure 3 in Chapter 5 shows that volatility of the spot price relative to its absolute level (the coefficient of variation) has fallen since 1993 despite the lower level of stocks. In 1995 the dated Brent price was notably flat. The second observation is that in both 1994 and 1995 the first month forward Brent price was more volatile than the spot price. This was not the case in 1989, a year in which tight product markets resulted in two crude oil price spikes.

The 'tight market' hypothesis also fails to explain why the dated Brent price was increasingly valued in 1994-5 at a discount to the first month forward Brent price (see Figure 4 in the previous chapter). A perception of low, or even falling, stocks does not explain why first month forward Brent should trade at a premium to both dated Brent and other forward Brent prices.

3. Backwardation

Some market observers propose that when the time structure, as exhibited in the forward curve, is in backwardation all differentials, including those traded in the CFD market, should be more volatile. There are however, several problems with this proposition.

The first problem is that the dated to first month differential is a very poor proxy of the time structure prevailing in the market. Evidence of this can be presented by correlating the sign of the dated to first differential with the sign of the differential in further months. The exercise presented in Table 1 correlates the dummy variable Dtd-First (which takes the value 1 when dated>first, and 0 otherwise) with dummy

variables using other forward months (which take the value 1 when the time structure is in backwardation and 0 when it is in contango). The results presented in Table 1 confirm that the lowest correlations in the time structures nearly always involve the dated to first month forward price differential. The value of the correlation is so low that in some cases it has the opposite sign. In 1995, for example, the cone structure (when dated is traded at a discount to first month forward and first month forward is above second month forward) is so prevalent (see the previous chapter) that the correlation between dated to first and first to second is actually negative. Also in 1995 in the days when dated is at a premium to first month, dated is also at a premium to third month in only 2 per cent and second at a premium over third month in only 6 per cent of these days.[1]

Table 1 Correlations in Time Structure

1992-95	Dtd-First	Dtd-Thi	First-Sec	Sec-Thi	1993	Dtd-First	Dtd-Third	First-Sec	Sec-Thi
Dtd-First	1.00	0.31	0.20	0.19	Dtd-First	1.00	0.34	0.16	-0.11
Dtd-Third		1.00	0.78	0.63	Dtd-Third		1.00	0.52	0.16
First-Sec			1.00	0.60	First-Sec			1.00	0.04
Sec-Third				1.00	Sec-Third				1.00
1989					1994				
Dtd-First	1.00	0.20	0.10	0.20	Dtd-First	1.00	0.41	0.29	0.13
Dtd-Third		1.00	0.32	0.91	Dtd-Third		1.00	0.68	0.56
First-Sec			1.00	0.15	First-Sec			1.00	0.62
Sec-Third				1.00	Sec-Third				1.00
1992					1995				
Dtd-First	1.00	0.41	0.39	0.33	Dtd-First	1.00	0.02	-0.23	0.06
Dtd-Third		1.00	0.95	0.72	Dtd-Third		1.00	0.65	0.13
First-Sec			1.00	0.68	First-Sec			1.00	0.16
Sec-Third				1.00	Sec-Third				1.00

Source: Own calculations from Platt's *Oilgram Price Report*.

The second problem with the assertion that the dated to first month price

[1] These results are not surprising for anyone acquainted with the functioning of the Brent forward market. There are in fact powerful reasons to expect dated to be out of line with first month forward. One of the reasons is the existence of operational tolerance (discussed below), and the second that the convergence between dated and the first month forward is not observed as the price of first month forward stops being published before the forward contract expires.

differential should be more volatile when the forward curve is in backwardation is that the underlying theory may not apply in the case of dated and first month. Theory claims that the level of the contango is bounded by the cash and carry costs while the level of the backwardation is unbounded. Subsequently one would expect higher volatility in periods of backwardation. The main assumption underpinning the theory is the possibility of arbitrage between the traded months as the only difference between a spot and a forward price is the time difference. This however, is not completely true in the case of a dated and a forward cargo. A dated cargo in the Brent market cannot be turned into a forward cargo. This can in fact turn theory on its head. As the expiry of the forward month contract approaches, an unbalanced player may be forced to scramble for a forward cargo. While the premium on the forward cargo s/he is scrambling to get is not infinite - as there is the possibility of repeated play- the lack of substitutability can take it to very high levels.[2]

The third problem with attributing higher volatility in the differential to the backwardation in the forward structure is the argument that the causality may flow in the other direction. It is possible that the backwardation in the forward curve is not the cause of volatility in the dated to first month forward price differential when squeezes are occurring because a squeeze of the first month forward market will influence both volatilities and the apparent time structure. A squeeze has the effect of increasing both backwardation in the forward curve and volatility in the dated to first month forward price differential.[3]

4. Operational Tolerance

There are many reasons why dated Brent should be valued at a discount to the first

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[2] The highest amount by which dated exceeds the first month forward in 1992-5 is 50 cents whereas first month exceeds dated by as much as $1.12 in the same period.

[3] For other instances when the time structure of Brent prices is found not to be exogenous see the analysis of Granger causality between the dated Brent and Forties differential and the time structure of Brent in section 5(b) where we found that the crude differentials could be affecting the time structure of prices.

month forward price while the time structure, or forward curve, is in backwardation. However, there are fewer reasons why prices should increasingly display this pattern as they have done between 1992 and 1995. One possible explanation is that a forward Brent contract carries an 'option value' while the ownership of a dated Brent cargo does not. In this section we conduct a simple exercise to give a rough assessment of the average monthly premium that could be attributed to operational tolerance.

The lifter of a Brent cargo is given the choice of loading any volume between 475 and 525 thousand barrels, in other words the lifter has an operational tolerance of 5 per cent. The decision to exercise the tolerance option can be taken, at the earliest, by the final party of the forward market chain or, at the latest, by the lifter of the dated Brent cargo.

In theory, there should be no operational tolerance premium attached to a forward Brent contract relative to a dated Brent cargo. Both the contract and the cargo may be sold with or without a 5 per cent volume tolerance.[4] In other words the seller has the option of whether to sell the contract/cargo on with a prespecified volume (that is a minimum 475, a standard 500 or a maximum 525 thousand barrels) or to allow the buyer that option. The option will always carry a positive value as deciding the final volume of the dated Brent cargo allows a player in the forward market to minimize losses or maximize gains.

In practice, however, it is observed that forward contracts are traded with full operational tolerance whereas dated Brent cargoes are sold on more often with a prespecified volume usually at the minimum or maximum level. The realized value of exercising operational tolerance means that dated Brent is likely to trade at a discount to first month forward Brent, even in a backwardated market.[5]

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4 Platt's assessment of the dated Brent price specifies full operational tolerance. Further, in 1993 Shell offered a new forward contract without operational tolerance terms. The new contracts are able to coexist with the old in the forward chains by settling the difference between the new standard contract size and the final min or max cargo 'two days after the bill of lading by using mean of published dated Brent quotations'. *Platt's Oilgram Price Report*, 22 October 1993, p.1

5 This also means that the option of exercising operational tolerance will involve a premium in favour of forward Brent over IPE futures for the same delivery month.

A player in the forward market must balance one or more of three factors in deciding whether to take delivery of a forward cargo and, so, to exercise the option of maximizing or minimizing volume. The first factor relates to the 'money in the chain'. If player A is passed a forward cargo and passes it on, then as long as his/her buy and sell were not struck at the same price, s/he will have an interest in the chain being either minimized or maximized. If for instance player A had bought at $17 per barrel and sold at $18 then the difference between a minimized and maximized cargo is equal to $50,000, that is 50,000 barrels × $1. It should be noted that player A would have the same financial interest if the buy had been made at $18 and the sell at $17 per barrel.

The second factor relates to 'money at the end of the chain'. If player A accepts the $17 nomination instead of passing it on then the value of the decision will depend on the difference between the price at which the forward cargo was bought and the price at which a dated Brent cargo can be sold. Assuming that the price of dated Brent is $18 then player A will stand to earn $525,000, that is 525,000 barrels × $1, by exercising the option to maximize the cargo instead of $500,000 without tolerance. It stands to reason that if prices are rising or falling toward expiry of a particular forward month then there will be additional incentives to maximize or minimize cargoes.

The third factor relates to the participant's portfolio of buys and sells in the forward market. If player A has a balanced portfolio and then accepts delivery of a cargo through the chain in order to take advantage of operational tolerance s/he will become short of one forward cargo. This decision may prove costly toward expiry if the forward month is subject to a squeeze.

The average value [6] that could be realized from utilizing operational tolerance should be related to the number of deals the individual is involved in, the price volatility and the level of prices. In order to assess the average value of operational

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[6] We have called this the average premium for lack of a better word. The premium as calculated here is only an average in the sense that it refers to the average number of deals a trader is involved in but the degree of volatility in the forward price is the degree of volatility of the market as a whole. The same exercise was applied to the largest trader in a given month using the volatility of its own deals and the results were consistently lower than the premium estimated here. The reason for this is that there is a tradeoff between the number of deals (maximized by using the largest trader) and observed volatility (maximized by using the volatility of the market as a whole).

tolerance we will assume, firstly, that each participant holds the average number of deals for the relevant delivery month and has a balanced position. Secondly, it is assumed that the price range at which the dealer makes his contracts is the difference between the highest and the lowest price of deals for a given delivery month. This assumption exaggerates the operational tolerance. Thirdly, it is assumed that all the deals made by the average trader are struck at equal increments between the bottom and the top of the price range. Finally, it is assumed that there are no book-outs.

Table 2: Methodology to Quantify the Average Operational Tolerance Premium

Assume the average trader is balanced and has six buys and six sells all done at equal increments of 50 cents starting from 20 dollars until $22.5.

Buys	20	20.5	21	21.5	22	22.5	Average Price of Buys: 21.25
Sells	20	20.5	21	21.5	22	22.5	Average Price of Sells: 21.25.

It is assumed that no book-outs are possible and thus *all* deals in which the dealer is involved carry some risk of belonging to chains where the cargoes are either maximized or minimized. All possible outcomes for this dealer are found between the two outcomes:

Best Outcome

1. The three *highest buys* are matched with the three *lowest sells* in *minimized* chains, giving an average of $22 for the buys and $20.5 for the sells; and
2. The three *highest sells* are matched with the three *lowest buys* in *maximized* chains, giving an average of $22 for the sells and $20.5 for the buys.

Worst Outcome

1. The three *highest buys* are matched with the three *lowest sells* in *maximized* chains, giving an average of $22 for the buys and $20.5 for the sells; and
2. The three *highest sells* are matched with the three *lowest buys* in *minimized* chains, giving an average of $22 for the sells and $20.5 for the buys.

The range between the best and worst outcome is $450,000 in 6 buys and sells (ie 1.5 x 6 x 50,000), or in 3,000,000 barrels, giving an *average* premium of 15 cents per barrel.

Source: P. Horsnell and R. Mabro *Oil Markets and Prices*; Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993.

The results of applying the methodology to the data available are presented in

Figure 3 for the period January 1986 to September 1995.

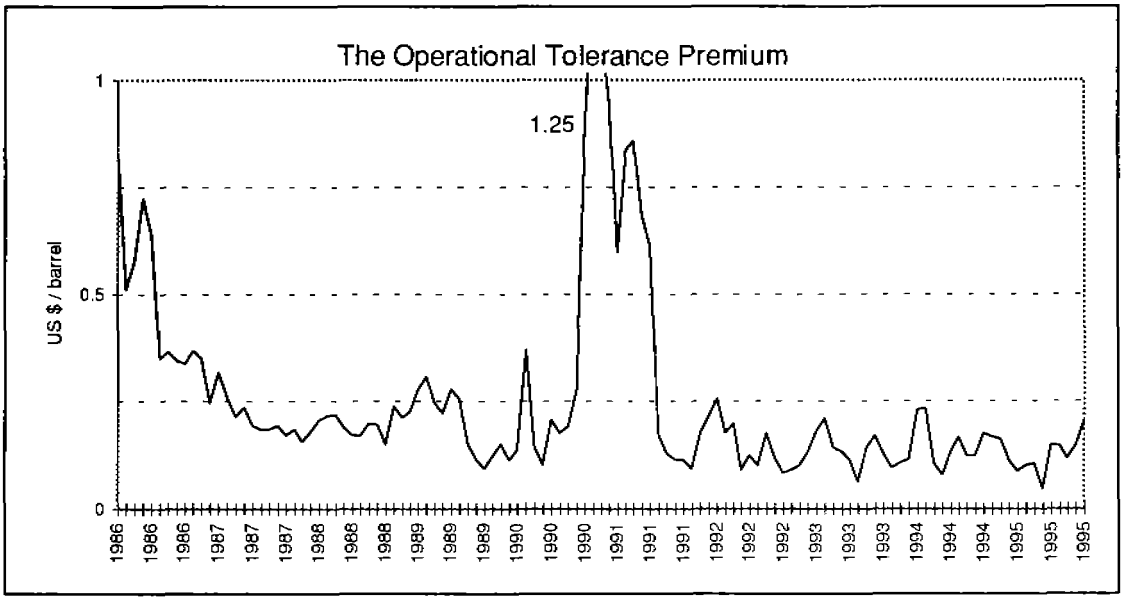

Figure 3
Source: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

The premium varies from a low of 4.5 cents per barrel in 1995 to a high of $1.2 per barrel during the Gulf War, but never represents more than 4 per cent of the mean forward price. The first feature of Figure 3 is the downward trend in the value of the premium between 1986 and January 1990. During the years 1990-1 the trend is erratic and stabilizes around 12-15 per barrel cents in the period 1992-5. The only discernible pattern is perhaps a rise in the premium in the early months of the year but, apart from that, the trend is erratic. To provide a more accurate description of the behaviour of the premium Table 3 presents summary statistics of the premium.

Table 3: Summary Statistics of Average Operational Tolerance Premium ($/barrel)

	86-95	92-95	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Max	1.25	0.26	0.83	0.32	0.24	0.31	1.25	0.86	0.26	0.21	0.23	0.20
Min	0.05	0.05	0.25	0.16	0.15	0.09	0.10	0.09	0.08	0.06	0.08	0.05
St. Dev.	0.22	0.05	0.18	0.04	0.03	0.08	0.43	0.31	0.05	0.04	0.05	0.05
Mean	0.25	0.14	0.47	0.21	0.20	0.19	0.48	0.38	0.14	0.13	0.15	0.13

Source: Own calculations from Petroleum Argus *Crude Oil Deals Database*.

In the years 1992-5 the standard deviation of the premium falls to one-sixth of that observed in 1991, and the highest mean is seen in 1994 with the lowest in 1995. Statistical tests of the difference in the average premium for the years 1992-5 reveal that the differences are not different from zero for any of the years. This may be due to the small number of months in a year but even comparing groups of two years the difference in premiums is not different from zero. In spite of the changes in the value of the premium throughout a year, there does not seem to be a significant change in the incentives to use operational tolerance since 1991.

Operational tolerance, as evidenced by its widespread use since J Aron first popularized it, has given participants additional incentives to engage in trade. The tolerance ensures that the first-month forward is traded at a premium and makes the cone structure (the first month trading at a premium over the dated and the second month) more feasible. However, the mean value of the operational tolerance premium calculated here is flat over the years 1992 to 1995 and does not explain increasing severity of the discount of dated Brent to first month forward Brent in the years 1994 and 1995 (see Figure 4 in Chapter 5). Some would argue that it is the highest rather than the mean value of the operational tolerance at any given time that should be considered. Even if we assume that this marginal value is significantly greater than the mean, we would still be at odds to explain why it would increase over time. The argument that traders are getting better at the game is not valid.This is because the use of operational tolerance has all the features of an innovation: in the beginning the returns to the innovation may be large for the participants who have superior knowledge over the rest of the market. This dispersion in knowledge is difficult to justify in a rapidly evolving financial market where the incumbents have been using operational tolerance since 1986. Furthermore, one would expect the gains from operational tolerance to converge toward the average as the game is repeated and the techniques become more transparent for all players in the forward Brent market.

We regard operational tolerance as a complementary explanation to squeezes for the level of the first month forward premium relative to dated Brent in 1994-95. In fact, squeezes and operational tolerance maybe associated because the opening up of the

dated to first month price differential towards expiry, which is characteristic of sucessful squeezes, increases incentive to use operational tolerance. However, since operational tolerance does not account for more than 15 cents/barrel and we have defined squeezes in relation to differentials of at least 50 cents/barrel, operational tolerance only provides a marginal explanation. Further, operational tolerance does not explain why the average premium of first month forward relative to dated Brent more than doubled in 1994-5 compared with 1992-3 (see Chapter 5 Figure 4).

5. Falling Liquidity and its Implications for the Assessment of the Dated Brent Price

This section analyses whether the falling liquidity in Brent and its impact on the assessment of the dated Brent price can account for the behaviour of the CFD price differentials in 1994 and 1995.

(a) Platt's Assessment

Platt's daily assessment of dated Brent is defined for a particular time span, quality, size (full operational tolerance), location and loading dates. The Platt's methodology is generally acknowledged to give priority to done deals over other types of information such as bids, offers or market talk although recent indications suggest that the emphasis may have changed in the assessment for dated Brent. The quoted price is for a Brent cargo of half a million barrels f.o.b Sullom Voe with loading dates that begin no less than seven and no more than fifteen days in advance.[7] The assessment for dated Brent is made on information collated during the day, each trading day, until 21:00GMT, which is after the close of the IPE and NYMEX.[8] The forward price is assessed oninformation gathered in a much shorter time window, that is between 20:30 and 21:00 GMT.

The absolute level of dated Brent is in fact assessed from both dated and 15-day

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[7] Assessment window for Platt's quotation for dated Brent changed from 5-15 days to 7-15 days on 3 October 1994 see Platt's *Oilgram Price Report*, 18 August 1994 p.7. Currently, the window is between 7-17 days out on Friday.

[8] NYMEX closes at 20:10 GMT and the IPE at 20:15 GMT.

Brent markets. For a number of reasons an increasing proportion of spot crude oil trade is negotiated in, and finalized, at prices expressed in the form of a differential. In the dated Brent market the vast majority of cargoes are sold at a differential to the 15-day forward market. As a result the assessor must make significant use of the forward market to identify the absolute level of prices, and then use dated Brent spreads to estimate the relative level of the spot price. Because of the very different levels of liquidity in the two markets, and particularly the very low number of dated Brent deals, Platt's are now keen to move away from a methodology based on done deals for the assessment of the dated Brent spread.

In the following section we consider plausible explanations of why the results of a methodology based on done deals at specified times are vulnerable when liquidity is low.

(b) Techniques for the Management of Information

Opportunities for 'rogue' participants tend to arise when the rules of a methodology are well known because inventive minds often manage to find ways round it. These opportunities, in the case of a methodology based on done deals, also require the participant being able to control liquidity in the dated Brent market. If liquidity is not controlled then other participants could counteract the effect of trades on the price assessment with trades of their own. To control liquidity, a primary claim on the cargoes is made through the 15-day forward market. By maintaining a long position as the forward month turns 'wet' a participant may hope to lay claim to all those cargoes with loading dates between seven and fifteen days, that is the Platt's price assessment window for the dated Brent price spread, in advance of the week in which the outcome of the CFD trades will be settled. In this way one participant controls all the dated Brent cargoes which, if sold, would be eligible in Platt's assessment of the dated Brent spread over that week. Control through the forward market is not guaranteed but has been made easier by the fall in the absolute level of production. Further, the number of cargoes reported to Argus, which may be regarded as a proxy for those reported to Platt's, has fallen even more drastically to an average of less than one per trading day in 1994 and 1995 from between one and two in 1992 and 1993 (see Figure 4).

As discussed earlier first month premia in the forward market can be subject to squeezes. If the squeeze is not recognized then this could have the effect of distorting the assessment of the spread if 15-day spreads are used as a directional indicator for the dated to first month spread.[9] The reason for this is that, in the case of a squeeze month, the outer-month spreads move in the opposite direction to the dated to first month spread.

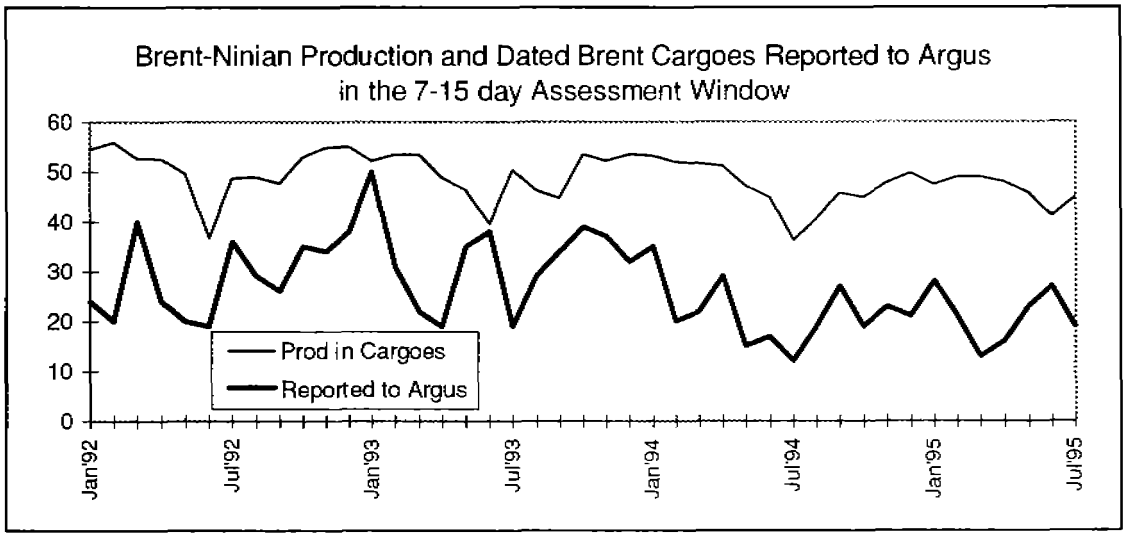

Figure 4
Sources: Own calculations from Petroleum Argus *Crude Oil Deals Database* and Wood Mackenzie *North Sea Report*.

Squeezing the first month forward contract can also have 'spill-over' effects on the dated Brent price. Those that have been caught 'short' of a cargo as a result of precommitting themselves to supplying one and finding later on that they are unable to take the delivery required for meeting this commitment may be prepared to pay a large premium for obtaining a date-specific dated Brent cargo.[10]

If the outcome of these CFD trades can be influenced by a participant then there

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[9] 'Fifteen-day Brent spreads are sometimes used as a directional indication for dated Brent pricing levels.' *Platt's Oilgram Price Report* 27 April, 1995.

[10] However, this situation may not affect the assessment as the premium could be paid to the buyer of the dated Brent cargo as compensation for receiving a cargo of different quality. For an explicit reference to the occasion alluded to in the text see 'A Squeeze or Astute Trading', *Argus Energy Trader*, 24 February 1995, p.13.

remains the possibility that the opportunities may be exploited. There are four possible types of action a participant might undertake depending on whether the participant was a buyer or a seller of dated Brent and whether the object was to raise or lower the assessment of the dated Brent spread. Obviously as a buyer it would be easier to attract a cargo with a bid that is perceived to be on the high side and as a seller to attract a buyer with an offer that is perceived to be on the low side. However, if the participant simply enters the market with an offer perceived to be on the low side then the cargo may be bought and resold at a higher price. In this way the participant has sustained a loss on the physical cargo without influencing the price assessment to the extent wished. It is therefore crucial that the sale is made (a) to an end-user who is not intent on recycling the cargo, and (b) as close to the price assessment agency's time-stamp as possible in order to maximize the importance of the deal for the purposes of price assessment. The informal way in which dated Brent cargoes are sold makes these two objectives attainable.[11]

The other two types of action involve a buyer attempting to lower, or a seller to raise, the dated Brent price. In the absence of tacit signalling the offer of a cargo at a low price to a buyer short on the CFD market must be purely fortuitous. The seller, who wishes to raise the price may be able to succeed either through being in a position to make informed guesses about whether another participant is short in the CFD market or by simply canvassing other participants for the highest bid.

Since late-1992 Platt's market commentary has indicated that information on dated Brent prices and spreads may be influenced by participants' exposure in CFD markets.[12] In most cases Platt's will report that 'sources' in the market have made such allegations whilst not necessarily discounting that information as a result. Without complete information on various participants' positions it is clearly difficult for the

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[11] If for instance a cargo had to be offered around all participants, as in an auction system, it would be much less easy for the seller to influence the outcome of the trade. However, an auction system would always enable a buyer to be successful with a high bid.

[12] 'The value of dated Brent appears dominated by the CFD market, as players react according to the paper market. Talk was centered at close to November minus 5 cts, with sources indicating that aggressive sellers were short on the CFD market'. *Platt's Oilgram Price Report*, 13 October 1992, p.4.

assessor to determine the validity of the price information on a deal-by-deal basis.

A more serious phenomenon that has been occurring with increasing frequency and severity in the dated Brent market is the trade of physical cargoes at widely divergent levels over short time periods. An extreme example of this occurred on 29 November 1994 when Platt's reported two dated Brent spreads relative to the same forward month 45 cents apart. This concerned Platt's sufficiently for the story to merit the front page.

Without giving either credence, Platt's posed two alternative explanations to the story. The first was that the divergence in levels was the direct result of the opposite positions held by the traders involved in the respective deals. The other explanation was that the traders had radically different perceptions of where the true level of the market should be. The possibility that the first explanation may hold sway has serious implications for a methodology based on done deals.

While the falling liquidity of Brent and its consequences for the assessment of the dated Brent price can be regarded as relevant to the increase in volatility of the CFD price differentials, they can only explain part of this increase.[13] However, there is no reason why managed information supplied to the assessor should increase the premium of first month forward relative to dated Brent as is evidenced in the period 1994-5 compared with 1992-3.

6. Bias

If one concludes that volatility in commonly traded CFD price differentials is being caused by squeezes as defined here and by the management of information to the assessor then one must also consider the net effect of such localized distortions on the long-run value of Brent. However, the most obvious methods for determining whether

[13] By definition the volatility of the dated price is only one of the three components of the volatility in the differential: (ie V(dated-next)=V(dated)+V(next)-2Cov(dated,next)). Moreover, as shown in Figure 3 Chapter 5, the volatility in dated has been lower in 1994 and 1995 than in the previous years.

such a bias exists are subject to such qualifications that the evidence they may yield is inadmissible.

(a) Comparing Different Price Assessments

One method could be to compare different independent price assessments in order to verify whether one of them was consistently lower than the other. However, not all assessments produced by Argus and LOR are comparable with Platt's. In the first place each source uses radically different methodologies. It is generally known that Platt's give priority to done deals whereas Argus and, particularly, LOR often discount physical trades that they feel to be unrepresentative in favour of bids/offers/market talk. In the second place all price assessments have different 'time-stamps', that is they refer to prices at different times of the day.

Nevertheless we attempt one such comparison. Figure 5 shows the differential between Platt's and Argus' price assessments for dated Brent. Although in 1995 the variation between assessments peaked at around 30 cents per barrel, the average differential over the year as a whole was only 0.4 cents per barrel.

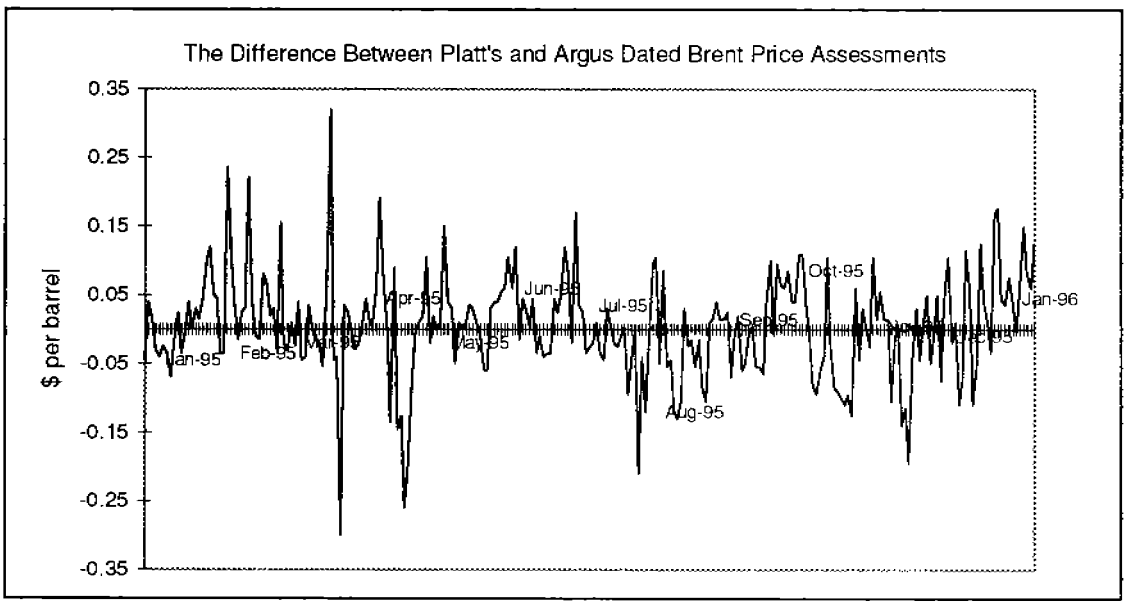

Figure 5
Source: Own calculations from Platt's *Oilgram Price Report* and Petroleum Argus.

An apparent feature of Figure 5 is how positive values of the differential seem

to be followed by negative values and *vice versa*. The comparison of different price assessments to appraise whther bias exists would only be valid if the assessment methodologies of the different price assesment agencies are independent. For this reason we test serial independence in the two time series. To conduct this exercise we have regressed current values of the Argus dated price assessment on past values of the Argus and Platt's prices and checked whether the introduction of the Platt's series explains movements in the Argus prices. The same exercise is repeated using the Platt's time series as a dependent variable and checking whether the introduction of the Argus time series can explain the movements in Platt's. [14] The exercise shows how the inclusion of the Platt's series explains the behaviour of the Argus time series but not *vice versa*.[15] Notwithstanding the shortcomings in the use of these tests, particularly the fact that Platt's is an assessment over the day while Argus' is a time stamp, the results further call into question the use of other price assessments to clarify the issue of bias in the dated Brent price.

(b) Comparing Brent with Similar Crudes

Another technique for identifying bias is to compare the trend in the price differential between two crudes of similar quality, location of production and location of consumption. The crude oils must retain similar price characteristics for any analysis of trends in this price differential to hold meaning. For instance, if one were to analyse the differential between two distant crudes of similar quality, such as dated Brent and a sweet Nigerian crude oil, then the analysis would have to take into account the higher cost of transporting Nigerian crude oil to the consumer. This cost would change over time with freight rates and trading patterns. Also, if one were to compare proximate crude oils of very different qualities, say Brent and Urals at Rotterdam, then the primary factor affecting the price differential between the two over recent years would

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[14] Both time series had to be expressed in first differences as the Dickey-Fuller test of stationarity could not be rejected (t values of 0.22 for Platt's and 0.17 for Argus). Interestingly though, the differential between the two was found to be stationary (t value of 10.2).

[15] The log-likelihood ratio for the inclusion of the Platt's time series in the Argus regression is equal to 5.91 which is different from zero at 5 per cent; whereas this ratio is equal to 2.17 in the case of the inclusion of the Argus time series in the Platt's regression.

be the change in refiners' valuation of sweet vs. sour and heavy vs. light rather than the time structure of Brent prices.

The most obvious crude to compare with Brent is Forties as they are proximate and of similar qualities. It is clear from Figures 4 and 5 that the volatility in the Platt's assessed price differential has increased in the years 1994 and 1995.

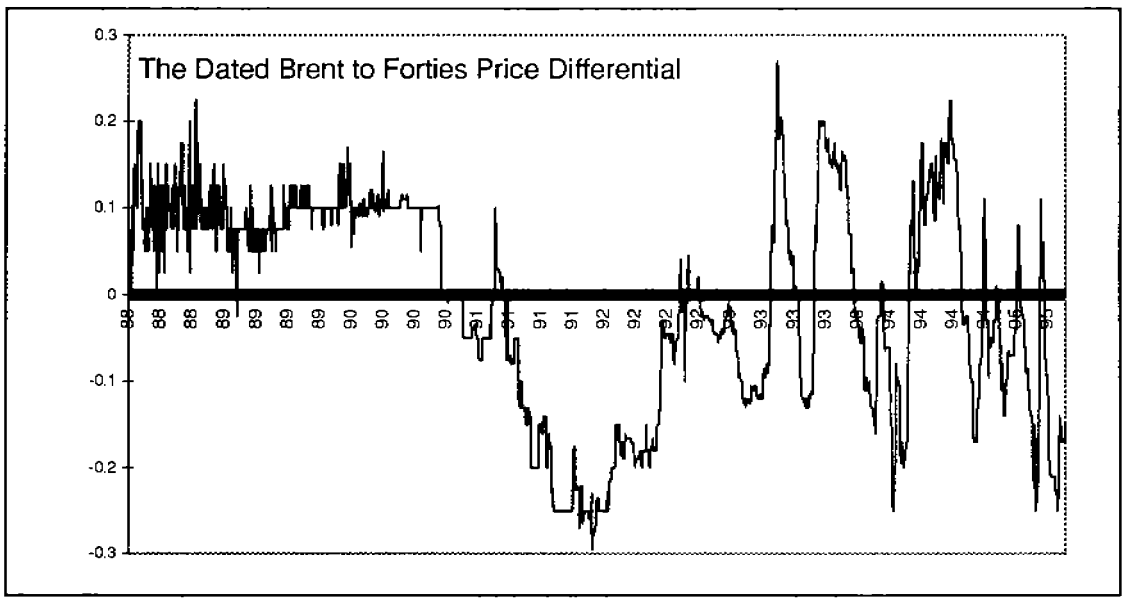

Figure 6
Source: Platt's *Oilgram Price Report*.

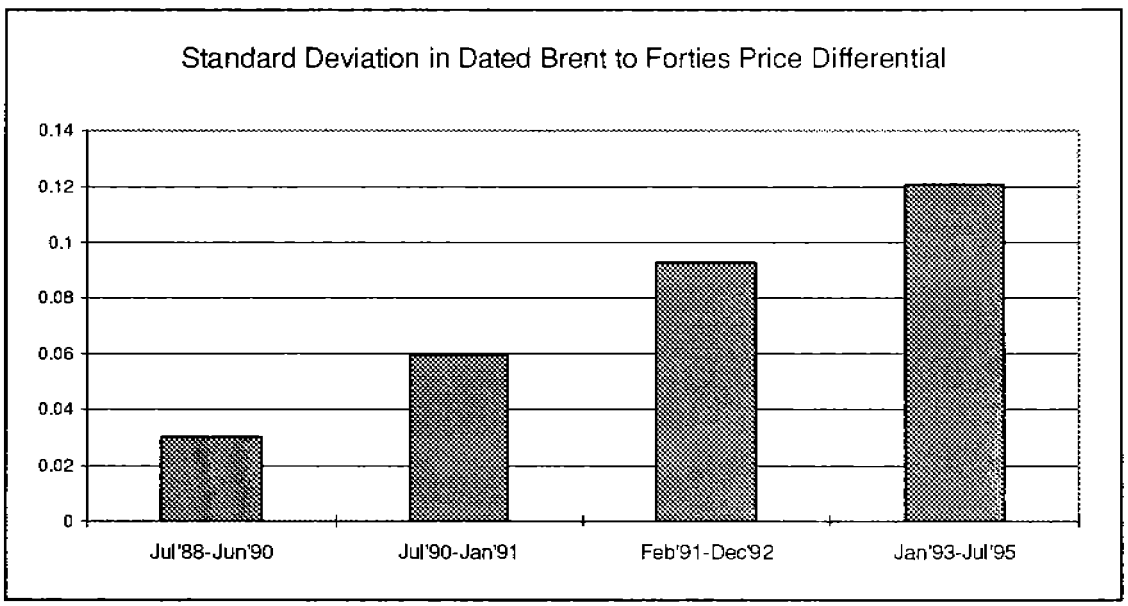

Figure 7
Source: Own calculations from Platt's *Oilgram Price Report*.

The stability in the differential before 1990 is, however, misleading as Forties was traded at a fixed differential to dated Brent. As a result, a daily Brent-Forties price differential was not assessed. Since then it appears that the volatility in the differential is strongly related to the volatility in the time structure of Brent prices. This dependence is the result of the complexities of North Sea crude pricing formulae (see *World Petroleum Argus* 26 February 1996, p. 5). Forties is traded 10 to 25 days before loading and its price is assessed using the dated price and a fixed differential five days around the bill of lading. In a steeply backwardated market, for example, the price of dated Brent is traded at a premium to its forward months. Given that the price of dated is expected to fall in the period when Forties is assessed, today's assessment of the Forties price has to be increased to compensate for that fall. As a result, dated Brent should be traded at a discount (premium) to Forties when the Brent time structure is in backwardation (contango).

The following analysis tests the hypothesis that (a) dated Brent is at a premium to Forties when the first to second month forward price differential is in contango and *vice versa* when the forward market is in backwardation, and (b) the time structure in the first to second month forward price differential causes movements in the dated Brent-Forties price differential.

To differentiate periods when the time structure is in backwardation from those when it is in contango, we have defined the dummy variable D, which takes the value 1 when the time structure is in contango and 0 otherwise. Then we perform an analysis of variance in the dated to Forties differential (dtd-F) by regressing it on the dummy variable:

$$(\text{dtd-F})_t = \alpha + \beta D_t + \epsilon_t,$$

where t indexes the trading day. The values of the parameters, the t-ratio of β and the F tests of the significance of the overall regression are presented in Table 3.

The coefficient on the dummy variable (β) is positive in all the samples and represents how dated Brent is traded at a premium over Forties when the market is in contango. In fact the value of the dated Brent premium during periods of contango can

be as high as 11.7 per cent of the differential in periods of backwardation, but also as low as 5.6 per cent.

Table 3: Analysis of Variance of Differences in Dated to Forties Differential According to the Brent Time Structure

Sample	α	β	t	F
1992-95	-0.1115	0.1081	12.87*	165.8*
1992	-0.1691	0.1168	14.38*	206.9*
1993	-0.0456	0.0764	4.19*	17.5*
1994	-0.0407	0.0937	6.39*	40.8*
1995	-0.1585	0.0556	2.12*	4.51*

Note: *: Different from zero at 1 %.
Source: Own calculations from Platt's *Oilgram Price Report*.

Table 4: Causality Tests: Brent Basis and the Dated to Forties Price Differential

Model/Variable	1989-95	1992-95	1992	1993	1994	1995
	Dickey-Fuller Tests					
(1) /Dated-Forties	-4.52*	-3.53*	-2.94*	-2.26*	-2.71*	-1.99*
(2) /First Month-Second Month	-4.18*	-4.06*	-3.00*	-2.17*	-2.79*	-2.76*
	Likelihood Ratio Tests of Granger Causality					
(1)/Brent (basis) → Dated-Forties	6.22*	11.51*	2.00	1.19	12.54*	5.19*
(2)/Dated-Forties → Brent (basis)	0.18	1.21	5.62*	7.46*	0.196	0.282

Note: *: Reject Null hypothesis at 1%, **: at 10%.→: Direction of Causality.
Source: Own calculations from Platt's *Oilgram Price Report*.

The observation that the time structure of Brent is associated with the dated Brent to Forties price differential could be taken one step further and we could test whether it can be said that the time structure causes changes in the Brent-Forties price differential.[16] The Granger tests of causality are presented in Table 4. The optimal lag length of both series was calculated using the Amemiya and the Akaike criterion[17] and is equal to 2 lags for the dated to first differential and 1 lag for the dated to Forties

[16] The tests of causality are Granger tests of causality. Granger causality is a temporal concept in which one variable is said to Granger-cause another if previous values of the variable explain the dependent variable.

[17] See for example W. Greene, *Econometric Methods*, McMillan, New York, 1992.

differential. The table also presents Dickey-Fuller tests of stationarity as the tests of causality can be spurious if the time series are non-stationary.

The Dickey-Fuller tests reject the hypothesis of non-stationarity in most cases so the causality tests are reliable. The bottom part of the table presents likelihood ratio tests of Granger-causality. These tests assess whether the inclusion of the independent variables (the basis in the first model and the differential in the second) makes a difference for the models (one where the dependent variable is (1) the differential and (2) the basis in Brent prices). The Brent basis seems to cause the dated-Forties differential for the period 1989-95 as a whole and also for 1992-5. However, the causality is not established for all years of the 1992-5 sample, with the exception of 1994 and 1995. Moreover, it could also be argued that movements in the time structure of Brent are caused by movements in the dated to Forties price differential. This is not only evidence of the closeness of the two markets, but also an indication of how the time structure of Brent prices cannot be taken as a completely exogenous phenomenon.

The issue of bias, however, is not self-evident even though there is an upward trend in the value of Forties relative to dated Brent. Two reasons could explain this upward trend. The first is that the quality of Forties has improved relative to Brent. An assay of both crudes in September 1994 shows Forties to have an API of 40.4° and Brent/Ninian of 38°-38.5° (see Platt's 10 October, 1994, p.1). In 1986 the gravity of Forties was API 37.1° and Brent API 37.2°. The second, more tenuous reason, is that Brent is being increasingly shipped to far-flung markets, such as the US Gulf Coast and South Africa. Yet, the fact that trading patterns are becoming more divergent need not affect the differential. For instance, many of the cargoes shipped to the US Gulf Coast and South Africa were presold more than 15 days in advance and, so, would not have been used in the assessment of the dated Brent spread.

There is a further reason which suggests that any downward or upward bias in dated Brent would not be evident from a study of price differentials. If the bias is found in the forward markets from which the absolute price level is assessed then this bias may or may not move the whole structure of spot prices up or down.

(c) Conclusion

To give a definite empirical answer to the issue of long-term bias in the price of dated Brent would demand the construction of a general equilibrium model of the world oil market which is outside the scope of this paper. To argue *a priori* that a bias exists would need the assumption of worldwide market power either upstream (for an upward bias) or downstream (for a downward bias) by the participants in the forward Brent market. The present circumstances of the world petroleum market would not lend credence to such an assumption. Moreover, there are reasons that qualify an existing belief that the bias in dated Brent is downwards.[18] Increasingly the performance of components, or subsidiaries, of integrated companies, defined by type and location of activity, are being evaluated within the company as autonomous profit centres.[19] The performance is often assessed against a benchmark relevant to the specific activity rather than to the company as a whole. For the trading arm of a company the relevant benchmark may be a price differential rather than the absolute price level.

Nevertheless, the difficulty of assuming worldwide market power does not exclude the emergence of limited market power in the short run (due for example to the uneven distribution of information among market participants) and the ability to squeeze the forward market. The issue of non-random winners and losers and the induced volatility in the CFD price differentials raises concerns that apply not only to the Brent market but also for the pricing of crude oil in general. As the Brent price, widely used as reference for the pricing of oil traded physically, is increasingly subject to local conditions, markets become increasingly dislocated and price differentials become more unstable. The existing markets that have evolved to enable companies to offset risk become less effective and the need for new markets, or trading instruments, increases. The following chapter assesses some of the possible measures aimed at improving market performance.

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[18] It is believed that because a great proportion of the participants in the Brent informal market are net buyers of crude oil there is a tendency for the price to be biased downwards.

[19] The problem of autonomy versus centralization was one of those that the new management philosophy adopted by Royal Dutch/Shell in 1995 attempted to address. See C. Cragg, 'Managerially Speaking..' *Financial Times Energy Economist*, May 1995.

CHAPTER 7

THE ASSESSMENT OF PROPOSED REMEDIES

1. Introduction

On a number of occasions, market participants, analysts and journalists have floated various ideas - some intended to improve particular aspects of performance in the Brent markets complex, and others related to the choice of a reference crude price. The first set, considered in Sections 2 and 3 below, aims at reform of the current markets by improving transparency and widening the information base of the price assessment system. The second set, considered in Section 4, looks at alternative benchmarks to dated Brent, be it another Brent price or that of a different crude or a basket of crudes.

2. Informal Brent Markets

(a) Market Transparency

The lack of any disclosure requirements in the dated, CFD and forward Brent markets renders the process of price formation in the majority of the world's spot and term crude oil trade opaque to those who depend on it. Measures to improve transparency and the flow of information could serve to dispel doubts about the performance of Brent markets.

The issue of market transparency occupies a prominent place in the economics literature. If all information is not available, that is if some participants have access to private information, the market outcome is not efficient. The existence of private information and dispersion in the information sets of participants lead to interactions among market players, which is another way of describing market power. Needless to say transparency is a requirement of efficient markets.

The CFD market has provided the missing link in the Brent market chain. By connecting the forward/futures markets with the spot market, the hedging efficiency of Brent markets has been improved. Hedging operations are not in any way jeopardized by measures that aim to increase the transparency of not only the CFD market, but also of the other markets from the Brent complex. The result of improving

transparency could not only be a more efficient Brent market itself, but such measures could improve confidence in the use of dated Brent as a benchmark.

Informal markets often involve internal codes of conduct designed from within and enforced discreetly by one or two dominant participants as has often happened in the 15-day Brent market. One way of improving confidence in the conduct of participants might be to have disclosure requirements to an internal, yet independent, agency/commission set up by the participants themselves. Disclosure would specify price and volume of each transaction. They do not have to specify the identity of participants, and in fact could perform better without this requirement. However, the timing of reporting should be immediate as market conditions change so rapidly.

Whatever the doubts concerning such a disclosure system, its reliability should not be discounted offhand. In the first place, there are always two parties involved in a trade and disclosure by one of them would reveal the deal. In the second place if both parties decide not to disclose, there is always the possibility of a third party bringing the undisclosed trade to light.

The lack of transparency is a pervasive feature of oil markets which extends well beyond the Brent complex. The issue has bothered for a long time international organizations such as the IEA and the European Commission. Despite the good statistical work done by the IEA for more than twenty years market transparency has not improved significantly. Although most market participants would admit that transparency is highly desirable, they will express scepticism about the adoption of measures that may improve it. Some would argue that a more transparent market, in the form of a futures exchange, has indeed evolved but Brent futures has not displaced the informal parts of the Brent complex. On the contrary it operates in conjunction with them.

The weight of history and of vested interests in favour of the informality and limited transparency of crude oil markets is very evident. However, the issue of transparency will not fade away. On the contrary as informal markets continually develop new instruments its relevance will increase, and for good reasons. It is up to the industry, particularly to participants who have a stake in the good performance of

the world oil pricing system to address the problem.

(b) The 25-Day Forward Market

Another proposal is to increase the minimum notification period for delivery of a forward Brent cargo from 15 to 25 days. At present the notification period in the forward market restricts trading of dated Brent cargoes to within 15 days of the first day of the loading window. However only cargoes traded between 7 and 15 days in advance of the loading window are considered by Platt's in their dated Brent price assessment. In contrast, Platt's include all cargoes traded between 10 and 30 days in advance of loading for the assessment of other North Sea crude oil spot prices. The increasing disparity in the forwardness of trade between Brent and the other North Sea crude oils has resulted in greater volatility in price differentials, especially when there is steep backwardation or contango.

A 25-day forward Brent market could have a variety of beneficial effects. It would reduce the difference in forwardness of spot deals between Brent and other North Sea crudes. This would, in turn, reduce the volatility of price differentials and thus improve the hedging efficiency of the available Brent trading instruments. In the absence of such a development it is likely that there will be a need for additional trading instruments, such as a Brent-Forties CFD.

The proposal might also lead to greater liquidity in the dated Brent market. At the current time NWE refiners are purchasing their crude feedstocks between three and four weeks ahead. As a result if refiners have already made their purchases there is little interest in dated Brent cargoes at the time they are made available. Alternatively, if refiners have been caught short then dated Brent cargoes will command a premium. For this reason it is possible to justify a wider range of prices for dated Brent than for other North Sea crudes. By advancing the forward Brent notification period by 10 days dated Brent would trade in the same time-frame as other North Sea grades and, perhaps improve dated Brent's performance as a benchmark. Such a measure might also increase buyers' interest in dated Brent and almost double the time available for those owners to resell their cargoes.

The difficulty of this proposal lies in implementation. For the new notification

period to work loading schedules would have to be published every two weeks rather than each month as is currently the case. This change would have to be ratified by all the equity producers tied into the Brent/Ninian system. Unanimity is made difficult by the number of equity holders, 34 in 1992, and by the fact that they are not all regular participants in the informal Brent markets and, so, do not share common interests.

3. Methods of Price Assessment

An efficient market is one where the price reflects all information available at a given time. Under a limited amount of information a rigid and widely known price assessment method will find it difficult to consistently accomplish an efficient task. Under these circumstances there are two, non-exclusive, ways to improve the method of price assessment: (a) to increase the volume of information available to the assessor, and/or (b) to make the method of price assessment more flexible and less predictable by increasing the number of assessors and allowing greater room for judgement.

There are a number of measures that would increase information for the purposes of price assessment. As mentioned in the previous section, the imposition of disclosure requirements would not only increase the number of deals reported in the forward, CFD and dated Brent markets, which are used to assess prices, but would also shed light on the intentions of market participants. Greater insights into intention would, in turn, give the assessment service stronger grounds for discounting any deal if it is deemed unrepresentative.

In response to participants' complaints over the trading of dated Brent cargoes at false levels Platt's have recently decided to discount in certain instances done deals in their assessment of the dated to forward Brent spread.[1] In cases when only one dated Brent cargo is reported, discounting that deal will mean that Platt's will have to rely on

[1] For an example of Platt's willingness to discount done deals see *Platt's Oilgram Price Report*, 16 January 1996. Despite the 21:00 GMT close of trade for the price assessment of dated Brent, Platt's discounted the last dated Brent trade of the day reported at February -20 cents and pegged dated Brent at February evens, closer to the February +5 cents trade made earlier on.

market talk instead. With this in mind Platt's have advanced the cut-off point for the assessment of the dated Brent spread to 18:30 GMT. By excluding information received between 18:30 and 21:00 GMT it is argued that the opportunities for influencing the assessment at a time when fewer participants are trading is reduced.

In contrast, the forward Brent price assessment will remain at the 20:30-21:00 GMT time-stamp. For an outsider this could seem curious as the dated Brent price assessed by Platt's has two components, the dated Brent spread and the forward Brent price. In practice little has changed since it was only in the forward Brent market that liquidity has ever been sufficient to allow for a time-stamp. The dated Brent spread is established as an average of deals and/or market talk over the day to 18:30 and the forward Brent price assessed at the 20:30-21:00 GMT time stamp.

A possible improvement is to advance the forward Brent price assessment to the 18:30 GMT time-stamp. This could also increase liquidity for the purpose of assessment, both in terms of volume of trade and number of participants. Not only would a larger number of European companies be trading at this time but both the NYMEX and IPE futures would still be open. The fact that the futures markets are then open would enable the forward price assessment to be cross-checked against the combined futures and EFP price.

The current forward market time-stamp is of concern to the increasing number of companies who are exposed to fluctuations in the dated Brent price and who are not involved in the forward market. As has been observed from the Argus database the number of participants in the 15-day forward market has fallen sharply, particularly over the past few years. One can only surmise that the concentration in the forward Brent market is even higher at 20:30-21:00 GMT. Further, at this time-stamp the forward market is effectively independent of the futures market due to limited[2] arbitrage possibilities. Moving the time stamp of the Platt's forward Brent price assessment to earlier in the day when US and European futures markets are in operation would

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[2] The false EFP is one means of enabling 24 hour futures trading. See P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993, pp. 51-2.

create an additional flow of information; an advantage which, however, will not be gained without costs since the change in timing entails problems.

A complementary proposal could be to encourage retroactive revisions of the price assessment within a certain time limit in cases where new information becomes available to the assessor about an earlier price assessment. Further, the employment of a team of assessors may improve the judgement made because of the benefits of direct discussion within the team.

It has been proposed that a combination of price assessment agencies could be used in the settlement of spot and term crude oil trades. At present there are three trade journals, namely Petroleum Argus, London Oil Report and Platt's, and three on-screen services, namely, Reuters, Rim and Telerate, which publish quotes for dated Brent. As shown in the previous section even quotes for the same time-stamp can show variations of up to 30 cents per barrel. However an average is not necessarily better than a single assessment made with good judgement. On the other hand the advantage of 'averaging' may be that it limits the impact of a participant's attempts to influence the assessment.

Some propose that price assessments be made by panels. These include either a panel of independent judges or a panel of market participants. Panel pricing using participants is at the moment operating to assess the Singapore based Far East Oil Price (FEOP) and the Hong Kong based Asian Petroleum Price Index (APPI). The systems use fixed methodologies and the resulting price is available with different frequencies- APPI is weekly and FEOP daily.

The system of panel pricing presupposes the inclusion of a wide set of participants representing all sides of the crude oil market. The large number of participants ensures that the price tends to move towards the mean while the presence of all types of market participants should eliminate a consistent bias. The main problem of panel pricing is getting the composition of participants right. Excessive reliance on an interest group produces biases in a given direction that no statistical methodology would necessarily eliminate.

4. Changing the Benchmark Used as Reference Price for Crude Oil Sales

Many observers argue that liquidity is crucial for confidence in any benchmark. In absolute terms crude oil production from the Brent/Ninian system is expected to fall from the 1995 average level of around 782 thousand barrels per calendar day (b/cd) to 410 thousand b/cd in 2000.[3] Therefore, any measures taken to improve the number of dated Brent trades, such as the creation of a 25-day forward market, will have to more than counteract the effect of the absolute decline in production. Given this problem of liquidity, proposals for adopting an alternative benchmark to dated Brent have been made. The most obvious choices are, forward or futures Brent, or leaving Brent altogether for one or more other North Sea crudes.

The use of the first forward Brent price was abandoned by producers following the squeezes of 1987 and 1988 which caused first month prices to diverge significantly from dated Brent prices. As we have observed in Chapter 6 the first month forward contract is still prone to squeezes. Possibly as a result of this trend the number of participants in the forward market has declined. Unless these problems are resolved the first month forward does not provide a viable alternative to dated Brent as a benchmark.

Another alternative, which already has limited use as a benchmark, is the IPE futures contract. In common with the use of forward Brent as a referemce, buyers and sellers would need to agree a differential which reflected the expected time and quality premium or discount on settlement. This is made easier and less risky than in 1987-8 owing to the existence of a high volume CFD market which can simultaneously provide information on the expected differential and provide the means to protect against changes in that differential. The advantage of the IPE futures market over the forward Brent market is that participants do not face the same operational and counterparty risk and that the IPE futures contract is a more flexible hedging instrument. Not only can positions be closed at will but also the smaller lot size allows participants to match the

3 Wood Mackenzie, *North Sea Service*, March 1995.

instrument with the particular pricing period.

The disadvantage for those who do not wish to hedge is that it is a poor proxy for spot prices.[4] This risk would be even more pronounced in term contracts given the lag in readjusting formulae. However, other spot crude oil markets in the North Sea do not have this disadvantage compared with dated Brent. The crucial features of a spot crude oil market that make it suitable for consideration as a benchmark include the size of the physical base, large export and storage facilities to permit operational flexibility and widespread dispersion of cargoes, a large number of equity producers and a developed forward market. The most obvious candidate amongst the North Sea grades of crude oil is Forties, the production of which is expected to be 800,000 b/d in the year 2000. However, although many of the criteria are fulfilled the storage facilities are deemed by some to be insufficient for achieving the degree of operational flexibility characteristic of the Brent system. Further, Forties does not have as great a number of equity owners as Brent, which raises for some who might use Forties as a benchmark, the issue of market power. It is possible, of course, that the status of benchmark may be unwelcomed by Forties producers owing to the responsibilities and scrutiny such status may bring.

An alternative proposal - that a basket of North Sea crudes be used as a benchmark - is a complex one. Trading a basket of crudes is not without precedent. As early as 1981 the majors, keen to establish a lower tax reference price for their production, sold Brent/Ninian/Forties 'options' up to two months forward.[5] The word option in this context is not used in the sense of a trading instrument but to mean that the seller had the option as to which crude was to be delivered. Today the requirement of contract standardization would make the proposition an altogether different one. However, a forward market for Forties is available and its 18-day contract is of a similar forwardness to Brent.

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[4] See P. Horsnell , A. Brindle and W. Greaves, *The Hedging Efficiency of Crude Oil Markets*, Oxford Institute for Energy Studies Working Paper WPM 20, 1995.

[5] See Mabro et al, *The Market for North Sea Oil*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1986, p.163.

CHAPTER 8

CONCLUSION

The Brent market complex which now includes spot (dated) transactions, the 15-day forward contract, the IPE futures and the Contract for Differences (CFD) as well as other trading instruments plays a central role in the determination of prices for a wide variety of crudes in international trade. Producers, be it companies with upstream equity interests or countries heavily dependent on revenues from oil exports, and refiners who transform crude oil into petroleum products for final users sell and buy crudes in deals which take the Brent price as a reference. The pricing of oil in two out of the three major consuming regions of the world involves Brent either directly as in Europe or indirectly as in the Far East. In the latter the reference price is usually Dubai whose price movements are closely linked through arbitrage to Brent.

The performance of the Brent market complex matters to a wide group of economic agents, much wider indeed than the trading community involved in these markets for hedging and speculation purposes. Furthermore, the interests of those who trade and are instrumental to the process of price discovery are different in nature from the interests of those producers and refiners for whom the price is either unit revenue or unit cost. The trader is concerned with crude oil price relatives; the producer in the price levels; and the refiner in the crude/product price differential, the proxy to the refiner's margin. The paradox is that those who are critically concerned with absolute price levels depend for the discovery of these levels on those who are largely, if not uniquely, interested in relatives.

But this is not the overly peculiar feature of the oil price determination system in the world market today. The privileged locus of the price discovery mechanism is the 15-day Brent market which is idiosyncratic to the extreme. This informal market initially emerged for tax optimization purposes and then developed a life of its own. The prices it generates are not directly taken as references in the pricing formulae of producing countries. The reference is taken from the dated Brent market where prices are quoted as spreads from 15-day Brent. In order to assess the price of dated Brent - the widely used reference - one needs therefore to assess both the relevant forward prices and the spreads. This is a troublesome exercise which requires judgements made difficult by the limited liquidity in the dated Brent market.

There are other difficulties. The dated market is vulnerable to false trading, that is to deals done at prices whose levels are distorted for the purpose of influencing the assessment.

The emergence of CFDs, a useful hedging instrument, has introduced new complications because CFDs have made it easier to squeeze forward Brent and increased the incentive to influence the assessment of dated prices.

The incidence of squeezes causes problems of confidence. The perception that the assessment of the dated Brent price - this most significant reference price - is vulnerable to distorting influences causes further problems of confidence. And this is precisely where the problem lies. A loss of confidence in a market used to discover a price reference for the sales and purchases of a large proportion of internationally traded oil could result at some point in the future in a significant reduction in liquidity. This would cause further losses in confidence. Should that happen, interested parties will begin to experiment probably in a disorderly manner with other pricing systems. And since no other system readily presents itself as an obvious candidate with reliable merits a period of muddling or confusion could ensue. Complacency about the robustness of the current situation may prove costly.

The Brent market complex largely consists of informal structures. Those who enjoy even a modicum of market power in informal markets oppose changes; those who do not feel vulnerable and militate in favour of changes which they are often unable to specify clearly. Even if they did, they would not be able to introduce them precisely because they lack market power. For these reasons the status quo tends to persist until a major accident occurs.

As outside observers we have no panacea to offer. Barring the intervention of governments, and in the case of oil markets no government with jurisdiction has an incentive to intervene, remedies can only be introduced by those participants with market power. They would only be prompted to act if they took a long view since their short-term interests are strongly wedded to the status quo. If our main message were to be summarized in a few words it would be simply expressed in these same terms: 'take the long view'.

APPENDIX 1

DATA SOURCES

The analysis of trends and structure of a commodity market requires large amounts of reliable data at a very high level of disaggregation. The reason is that these markets have a tendency to clear very rapidly and the price levels at which the market clears are the result of a large number of actual transactions. In the analysis of the market for CFDs undertaken in this study more problems than usual were encountered in the acquisition of reliable and disaggregated data. This is because the market is informal and as such there are no disclosure requirements imposed on the participants. Moreover, trade is not centralized and the actual market is the collection of atomistic transactions. The deals that are reported rely on the prowess of the data collecting agencies and the particular intentions of the market participants.

However, problems with the data available should not be a reason not to attempt an independent analysis of this informal market.

In this Appendix we discuss the information used in this study. It describes the databases employed highlighting their drawbacks, possible biases and advantages. The Appendix is divided into four main sections: data on deals, prices, trade press reports and private interviews with market participants.

1. Deals

Information on deals made comes from two main sources: the Petroleum Argus *Crude Oil Deals Database* and the deals published in the London Oil Report (LOR).

The most comprehensive reporting of the overall Brent market is made by Petroleum Argus and collected in their *Crude Oil Deals Database*. The database covers the dated, forward and the CFD market and has been made available to us for all reported trades between 1987 and 1995.The original database includes 12 data fields: date, name of crude, delivery month, delivery date, price, comment, buyer, type of buyer, seller, type of seller, price conditions, location, and index of forwardness. Most

of the relevant information comes within the field defined as comment. A typical example of a CFD record is presented in Example 1.

Example 1: A CFD Record from the Petroleum Argus Crude Oil Deals Database

19940406,Brent CFD,Apr,11-15,0,at May +0.01,Buyer,T,Seller,M ,fob,Sullom Voe,0.

Source: Petroleum Argus *Crude Oil Deals Database*.

In the record above the delivery date refers to the assessment window, equal to five days in this example as is the mode (see Chapter 2), and the comment states that the differential between dated and first month forward is agreed at 1 cent .

The Argus database is the only source on participants and therefore the main source for the analysis of concentration and market power in the text. It is also the only source of deals as a whole for the forward and the spot market. Horsnell and Mabro (1993)[1] have assessed that the coverage of the Petroleum Argus database in the forward market is at most 40 per cent. Market participants and the interviewed market assessment agencies have agreed that the coverage of the LOR database is at least 50 per cent. As the number of deals reported to Argus is about half of those reported to LOR, we believe the coverage of the Argus database is about 25-30 per cent. Although the coverage is not very high, the interviewed market participants agree in saying that all participants have been contacted at some point.

The second source for the analysis of deals is the London Oil Report. The LOR is faxed daily to its subscribers and provides market comment as well as information on prices and CFD deals and quotes. For the purposes of this study, the data from the LOR has been digitalized and analysed since the March 1993 until 15 December 1995. A typical example of a CFD record from the LOR is presented in Example 2.

[1] P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993.

Example 2: A CFD Record from the London Oil Report.

	Buy/Sell	Trades
28,Dec,1993.	3-7 Jan: Feb -28/-26 cts	Feb -26 cts

Source: LOR

The report includes all information up until 18:00 hours London time. The information on CFDs describes the date of both the deal and the quotes at 18:00, the assessment window, the bid-offer quotes, and the trades made. In the case of the example dated Brent is traded at February less 26 cents. It is generally agreed that the coverage of LOR has improved drastically from mid-1993 and may have reached a coverage approaching 50 per cent. The main drawback of the reported trades is their silence about the identity of the participants or the volumes traded. Nevertheless, LOR data have enabled us to calculate volumes, forwardness, length of windows, etc.

2. Prices

For the purpose of the study we have used data on prices of crude oil and traded differentials.

(a) Levels

The Brent crude oil prices published by Platt's in its *Oilgram Price Report* are the CFD settlement prices. Platt's is used worldwide. The daily prices published in the Platt's *Oilgram Price Report* are the main source of information on price levels. This has been complemented occasionally with dated Brent prices published by either Argus or LOR.

For information on futures prices of the Brent contract we have purchased the International Petroleum Exchange database.

(b) Differentials

Actual differentials between dated Brent and a foward price are computed from the sources on price levels. Traded differentials come from the information on deals collected by LOR and Argus (see above) and information on quotes comes from the LOR (example 2 above).

3. Trade Press

A fundamental source of information for the study of this informal market is the trade press. The reason is that information in these markets seems to flow rapidly and perhaps effectively but only among market players. This constitutes one of the most important barriers to entry in a market where strategic behaviour is so important. The trade press provides the only unbiased and regularly produced window to this market although it can also be ill-informed on certain occasions.

The main trade journals have been searched for publication dates starting from January 1992. The journals used are *Platt's Oilgram Price Report, Platt's Oilgram News,* the comment from the *LOR, Energy Compass, Argus Energy Trader, World Petroleum Argus, Petroleum Times, Petroleum Review* and *NYMEX in the News.*

4. Interviews

An independent study should only make use of unbiased, independent and reliable information and this was our inclination from the outset. However, it is also necessary to talk to both market participants and observers in order to widen our scope. To control for the problems of inconsistency and the bias produced by excessive disaggregation, double checkings and cross-referencing was performed to corroborate some of the more contentious claims. The companies interviewed can be divided into Brent producers, Non-Brent North Sea producers, brokers, refiners, Wall Street refiners and price assessment agencies. We thank all of them for their cooperation.

APPENDIX 2

SQUEEZE TECHNIQUES

A squeeze of the first month forward Brent contract is made more likely by the limited number of forward market cargoes[1] available to settle those trades. As a result a game of chicken can evolve toward the expiry of the forward contract, that is the last day on which 15 days notice could be given for the loading window of a dated Brent cargo in a particular month, in which those participants short of one or more forward cargoes become increasingly desperate to settle their position. Given that a dated Brent cargo is not a substitute for a forward Brent cargo the premium that a participant could be forced to pay for a forward Brent cargo toward expiry is theoretically unlimited.

In Horsnell and Mabro[2] it was argued that large-scale deliberate squeezes of the 15-day forward market were unlikely to yield a profit. A party taking a large long position for a particular forward month was likely to have to take delivery of large quantities of physical oil. Unless 'homes' for the dated Brent cargoes had been found in anticipation of the squeeze, then the participant in receipt of those cargoes would likely have to offer large discounts in order to rid him/herself of the cost of holding such a large and visible stock. Gains from the effect of the squeeze on the first to second month spread would then be dissipated by the loss incurred on the difference between the price received for the dated Brent cargoes and the price paid for the forward contracts that resulted in delivery.

If a participant has no CFD position then s/he will be concerned to minimize any losses that s/he may incur in taking delivery of any dated Brent cargoes in the squeeze operation. This can be done in two ways.

Without the benefits of a CFD position, it can be assumed that chances of a successful squeeze are greater the fewer forward cargoes are available. All other things

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1 The number of forward market cargoes available during a squeeze is likely to approach the total number of cargoes loaded because of the premium of the forward market relative to the dated Brent market.

2 P. Horsnell and R. Mabro, *Oil Markets and Prices*, Oxford University Press for the Oxford Institute for Energy Studies, Oxford 1993.

being equal the number of forward market cargoes will decrease in proportion to the production of the Brent/Ninian system. For this reason months are likely to be targeted if it is expected that production at Sullom Voe will be constrained, either due to the fewer the number of days in the month or as a result of maintenance programmes. The fall in production from 1992 may, therefore, have reduced the risk of attempting a squeeze.

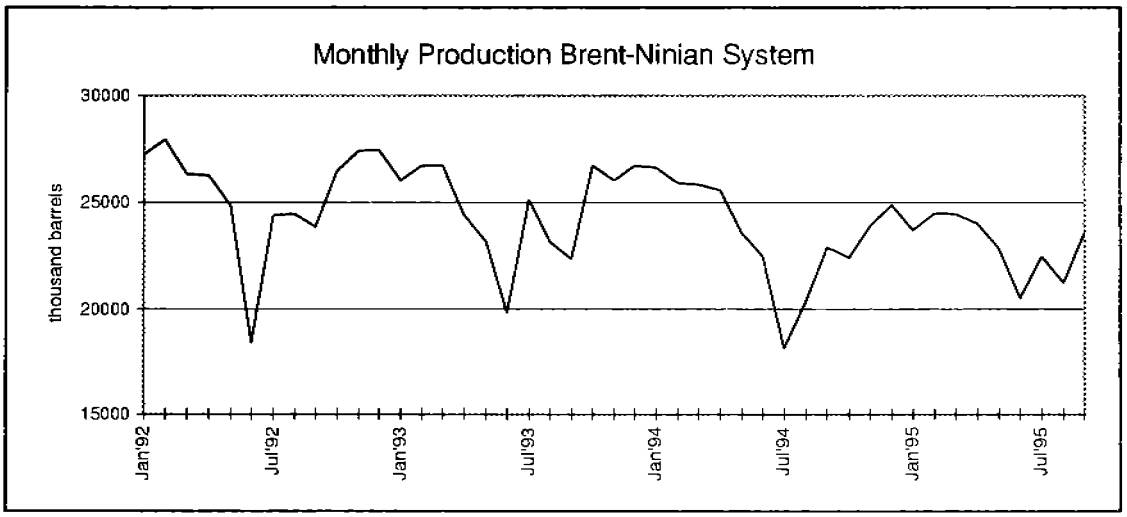

Figure 1
Source: Wood Mackenzie *North Sea Report*.

Losses can be avoided if a participant, intent on squeezing a particular delivery month, sells the cargoes before their ownership is guaranteed. By selling the cargoes ahead of time the participant can market the cargoes more effectively and get a better price relative to the average paid for the forward contracts. The risk involved in such a tactic is that the number of cargoes that the participant is committed to supplying may not be collected through the chains. In this case, if the sale is very date specific, the player can be held hostage to the squeeze. The result must either be that the player pays a high premium to recover the dated Brent cargo or negotiates compensation for the supply of off-specification crude oil.

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