EUI WORKING PAPERS IN ECONOMICS

EUI Working Paper ECO No. 91/36

Manipulation of Crude Oil Futures

Louis PHLIPS

European University Institute, Florence

Please note
As from January 1990 the EUI Working Paper Series is divided into six sub-series, each sub-series will be numbered individually (e.g. EUI Working Paper **LAW** No. 90/1).

EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

ECONOMICS DEPARTMENT

EUI Working Paper **ECO** No. 91/36

Manipulation of Crude Oil Futures

LOUIS PHLIPS

BADIA FIESOLANA, SAN DOMENICO (FI)

© Louis Phlips
Printed in Italy in March 1991
European University Institute
Badia Fiesolana
I–50016 San Domenico (FI)
Italy

MANIPULATION OF CRUDE OIL FUTURES

by

Louis Phlips*
European University Institute (Florence)

Abstract

This paper analyses the possibility of manipulating the crude oil futures contracts traded on the Brent 15-Day market and the London International Petroleum Exchange (IPE). It also makes an heroic attempt at assessing the actual occurrence of manipulations. Two types of manipulation are distinguished: a "classic" manipulation, involving distortions at delivery, and an "oligopolistic" manipulation, which presupposes that oil extraction is under the control of a few producers.

It is argued that a) the Brent 15-Day market follows rules that make oligopolistic manipulation feasible and b) two successive changes in the IPE contract were needed to free it from the effects of delivery squeezes (to the detriment of the longs). However, these changes did not free the IPE from oligopolistic manipulation.

* Paper presented at the International Conference on Futures Markets in Melbourne, Australia, 10-12 December 1990. I am grateful to Barry Goss for most helpful suggestions. Alban Brindle, Stella Fitzgerald and Alister Harris of the IPE (London) provided data and answered many questions. Thanks are also due to Linda Edwards, Christopher Gilbert, Ronald Harstad, Peter Møllgaard, Jean-Marie Viaene, Basil Yamey and the participants at the Melbourne conference for critical comments on earlier drafts. All errors and misunderstandings are mine.

This paper analyses the possibility of manipulating the crude oil futures contracts traded on the Brent 15-Day market and the London International Petroleum Exchange (IPE). It also makes an heroic attempt at assessing the actual occurrence of manipulations. Two types are distinguished: a "classic" manipulation, involving distortions at delivery, and an "oligopolistic" manipulation, which presupposes that oil extraction is under the control of a few producers. The latter is an outgrowth of game-theoretic work on futures markets for natural resources when the corresponding cash markets are oligopolistic. My main motivation is, therefore, to find out under which real life contract specifications this oligopolistic manipulation can occur.

There is a fast-growing theoretical literature on futures markets with monopolistic or oligopolistic cash markets. The basic intuition behind this literature is that, when producers face downward sloping demand curves, signing a futures contract leads to a shift in their marginal revenue curve. Taking up a long position creates an incentive to cut down production. Conversely, when a producer takes a short position on the futures market for his product, it is in his interest to increase production (Anderson and Sundaresan, 1984). Many implications of this basic idea have been worked out for different types of commodities and market constellations. Only results directly applicable to natural resources are relevant here. They can be found in a series of theoretical papers by Brianza et al. (1990), Harstad and Phlips (1990), and Phlips and Harstad (1990a and 1990b).

Section 1 gives a non-technical summary of the main assumptions and results obtained in this work, with special reference to the Phlips-Harstad (1990b) paper. These results provide the theoretical underpinning for the present institutional application. Section 2 clarifies the difference between oligopolistic and classic manipulation. Section 3 studies the Brent 15-Day market while Section 4 is devoted to the IPE contracts. Section 5 summarizes the findings.

1. A Duopoly Model

Imagine the following duopoly game. Two risk-averse producers, company A and company B, control the extraction of a particular type of crude oil. They play a noncooperative Cournot game, that is, they determine independently their planned delivery policy over three months, t=1, t=2 and t=3. They do this by maximising, each, the sum of expected profits (over these three periods) in both the spot market and the corresponding futures market.

Each producer wishes to sell a given stock of crude oil over these three months. This stock is available under the ground (or the sea). This differentiates our approach from models with stocks that have to be produced. In a sense, the stocks are given by mother Nature. Exploration costs are sunk. To change the supply of crude on the market, the producers only have to modify the timing of the pumping and/or the loading. The cost of the pumping or the loading has to be borne sooner or later and is, therefore, irrelevant for our problem. Our producers' problem is, indeed, how to allocate their stock over the 3 months, that is, how much to pump or load in each month.

Carrying costs of oil stored above the ground are ignored to keep the model as simple as possible. This is a serious limitation. It is particularly unfortunate in the case of crude oil, since loaded cargoes are part of the above-the-ground inventories. The purchase or sale of loaded cargoes is indeed a simple means of changing inventories. These inventory changes are not taken into account.

The game is a two-stage game, because producers A and B can simultaneously take positions on a futures market for the same type of crude. On that market, they trade among themselves and with a risk-neutral third player, called speculator S. (Extending the model to several speculators would only add notational complexity.)

In t=1, a futures contract for delivery in t=3 is introduced in the futures market. In t=2, this market reopens to give all

three players an opportunity to close out their positions or to open new ones. In t=3, the positions still open are settled or delivery takes place at the then valid spot price p_3.

The futures market is organized as an "open outcry" exchange, which functions according to the following simple rule: At the opening, all offers - which must be take-it-or-leave-it offers - are made simultaneously; then each player accepts or rejects the outstanding offers in a predetermined commitment order. Contracts are made pair-wise. In general, different trading pairs transact contracts at different prices. (There is no law of one price!)

Futures market activity results from differences in opinion about what the evolution of the demand for crude oil will be. Our model is thus 180 degrees away from the rational expectations approach: technically speaking, beliefs are "inconsistent" because drawn from different probability distributions. This inconsistency drives the model. It implies that each player believes in his beliefs and expects the other players to have to adjust their beliefs to his at t=1, when new information about market demand will become available.

Notice an important common knowledge assumption: All players can determine what the producers' equilibrium delivery plan is. In particular, if manipulation of the spot prices is implied, the speculator knows it. You might therefore expect the speculator will refuse to trade. This intuition turns out to be incorrect.

Oligopolistic manipulation

Let us first consider the equilibrium delivery policy of producers A and B, on the assumption that they were able to take a net long or net short position in the futures market (over its two sessions). They have stocks s_{a0} and s_{b0}, respectively, to be delivered over t=1, t=2 and t=3. The producers' problem (in t=1) is to determine the time shape of q_{it} (i=a,b), given the net positions they take on the futures market. Let N_i be producer

i's expected net short position at the end of t=2. In subgame-perfect equilibrium

$$q_{i1} = q_{i2} = \frac{s_{i0}}{3} - \frac{2\,N_i}{9} + \frac{N_j}{9} \qquad (1a)$$

$$q_{i3} = \frac{s_{i0}}{3} + \frac{4\,N_i}{9} - \frac{2N_j}{9} \qquad (1b)$$

when market demand is linear. If producer A has a net short position ($N_a>0$) on the futures market, then A will pump (deliver) less in periods 1 and 2 and more in period 3 than in the absence of the futures market. If producer B is also net short, this counteracts the intended reduction in A's deliveries in periods 1 and 2 and the intended increase in period 3. The counteraction is less pronounced, however, so that total supply decreases in t=1 and t=2, and increases in t=3.

Substitution of equations (1) into the (inverse) market demand equation gives the evolution of the market price:

$$p_1 = \hat{p} + \frac{2\theta}{3}(N_a + N_b) \qquad (2a)$$

$$p_2 = \hat{p} + \frac{2\theta}{3}(N_a + N_b) \qquad (2b)$$

$$p_3 = \hat{p} - \frac{4\theta}{3}(N_a + N_b)\ . \qquad (2c)$$

$\hat{p}$ is the spot price in the absence of a futures market.[1]

Equations (2) are an example of what we call "oligopolistic" manipulation. If the producers are net short, they have substituted known futures prices for uncertain spot prices, and are willing to let the futures price be low at maturity. For that purpose, they make sure the spot price is low at maturity, since at t=3 futures and spot prices have to be equal. Their equilibrium plans

1. $\hat{p}=\alpha/\beta-(s_{a0}+s_{b0})/3\beta$, where $\alpha>0$ is the random intercept of the market demand equation and $\beta>0$ is its slope, while $\theta=1/6\beta>0$.

are then to pump or deliver less in t=1 and t=2 and to pump or deliver more in t=3. As a result, the spot price will be higher than in the absence of manipulation (i.e. than $\hat{p}$) in t=1 and t=2, and lower in t=3. If producers are net long, they will do the reverse and the spot price will decrease relatively more in the beginning of the life of a contract and increase relatively more at the end.

The futures market[2]

What is the (subgame-perfect) equilibrium on the futures market in t=1 and t=2? First of all, trade in futures occurs in equilibrium, although equations (1) and (2) are common knowledge. Given inconsistent beliefs, the speculator's expected profit is such that he will sign futures contracts and will not drop out!

If the producers are not too risk averse, there will in fact be a rush to trade in t=1, when the contract is introduced: all contracts are signed in t=1. Otherwise, some contracts will be delayed until t=2.

The speculator is aware of the ongoing manipulation and has the opportunity to close out his positions in t=2. Nevertheless, he knowingly and willingly leaves his positions open until maturity. Indeed, given the inconsistency in beliefs, the expected gains that led to futures trading remain. The producers do not modify their planned deliveries in t=2 and t=3 after t=2 demand is revealed. All players keep the positions arrived at in t=2 open. Although the assumptions made point to the contrary, the futures market is viable.

2. Formal proofs of the statements that follow can be found in Phlips and Harstad (1990b).

2. Classic Versus Oligopolistic Manipulation

In a case of "classic" manipulation, as described in the literature (see Gemmill, 1983, p. 307-315, and Easterbrook, 1986), the manipulator normally goes long. He builds up a large share of open interest and acquires a large fraction of the available stock to force the shorts, at delivery date, to pay a high spot price or to pay a premium in order to close out their position.[3]

Short manipulations are said to be rare, because the shorts have to be able to tender the cash good for delivery and must therefore also incur the cost of carrying a large inventory in the cash commodity (see Edwards and Edwards, 1984). Again, in some oil markets life is much easier for the short manipulator. As we shall see in Section 4, all the Brent crude and the storage facilities are in the hands of a few companies who have no difficulty in squeezing longs who would want delivery of small lots of Brent oil. Easterbook's conclusion that manipulation, whether long or short, is a costly operation and that the cost increases with the extent of the manipulation, does not apply to crude oil. As a consequence, it cannot be said to be a very rare phenomenon.

The "oligopolistic" manipulation defined by equations (1) and (2) differs from classic futures market manipulation in several ways. First, it is not a one-man operation but a manipulation carried out by several producers simultaneously and independently. No collusion is involved. The question may thus be raised whether

3. Kyle (1984) models a long squeeze where the manipulator takes advantage of the fact that not all stocks of the commodity are easily available for delivery on favorable terms. (There are different grades, for example.) The squeezer threatens to take delivery and thereby forces shorts to bail out at high prices to avoid the high costs of bringing supplies into deliverable position. Alternatively, the squeezer takes delivery of so much of the commodity that the shorts must deliver goods (grades) that would not ordinarily be cheapest to deliver. This sort of squeeze is not considered here.

the word "manipulation" is not a misnomer, given that the strategies involved are noncooperative. From an economic point of view, the noncooperative nature of the equilibrium is compatible with there being manipulation. It is, indeed, well known that noncooperative games that are played repeatedly over time may lead to collusive outcomes. From a legal point of view, the three ingredients of "manipulation" as defined in U.S. law are present (Edwards and Edwards, 1984): a) "activities (...) are undertaken in a manner calculated to produce artificial price effects"; b) the manipulators "have a market position dominant enough to permit a conclusion that (they), in fact, could have caused the artificial price"; c) they intended to cause the price artificiality.[4]

Second, classic manipulation can occur in an anonymous market and may, in fact, require anonymity - see Kyle (1984). Oligopolistic manipulation cannot, since the number of producers must be small so that the identity of the big traders is known.

Third, oligopolistic manipulation does not imply distortions at delivery. In principle, no delivery squeezes or supply difficulties are necessary.

Fourth, oligopolistic short manipulation is not more difficult than oligopolistic long manipulation. The two situations are symmetric: it is a matter of "pumping" more in certain periods and less in other periods, that is, of shifting deliveries forwards and backwards in time.

Finally, classic manipulation occurs at the end of a contract: it is a matter of driving the futures price up or down at the close of trading day. It exists "only for a very short period of time - for as little as a few minutes or perhaps a few days" (Edwards and Edwards, p. 343). Oligopolistic manipulation affects

4. The objection that substitutability of different crude oil grades from other production fields limits the market power of Brent oil producers is not valid. The Brent price became the world's leading price since OPEC lost its power to fix prices.

the entire time shape of the prices during the life of a futures contract.

3. The Brent 15-Day Crude Oil Market[5]

The Brent 15-Day crude oil market corresponds as closely as one can hope for to the assumptions made in the theoretical model of Section 1.

Brent blend is a rather well-defined sweet crude oil (around 38° API gravity) produced in the North Sea area by a small number of producers. Although it is a mixture of oils coming from different North Sea fields, it may be considered as a "homogeneous" product, so that the assumption of Cournot strategies is appropriate. Brent production is oligopolistic: it involves all major oil companies, with Esso accounting for about one half of the total. It is collected by a pipeline system with discharges into tank at Sullom Voe on Shetland. Normally about 40 vessels a month can be loaded.

Since 1983, the so-called Brent 15-Day Forward Market trades relatively standardised contracts. Today, a 500,000 barrels cargo load is the basic trading unit. The role of the "speculator" is played by specialised trading companies,[6] a number of which are Wall Street houses (with Phibro among the prominent ones). There are no "locals", that is, speculators who do not trade in oil. The

5. The best (and possibly only) reference book on the Brent 15-Day market is by Mabro et al. (1986). Its origins and evolution are well described by Sas (1987a, p. 110-116).

6. These traders are not likely to be risk neutral. In the theoretical model, the speculator is risk neutral, to simplify the algebra. Making him risk averse would not change the predictions of the model.

big players know each other's forward positions.[7]

There is no centralised "open outcry" exchange, admittedly. Yet, the assumption of simultaneous announcements of take-it-or-leave-it offers, followed by binding pair-wise commitments, may be a good approximation of negotiations made during any particular trading day, given today's sophisticated telecommunications systems. In general, contracts are concluded at different prices during the day, for which estimates are reported every day by the specialised press (Platt's Oilgram is particularly useful). The Brent index, published daily by the IPE, is an average over the day of forward prices, in US dollars per barrel, on the Brent 15-Day market, as reported in the oil trade media.

Differences in opinion, leading to inconsistent beliefs not linked to available information, drive the theoretical model. Such differences also explain, as noted by Bacon (1986), the growth and the fluctuation in the number of forward deals, which are clearly not related to the amounts of physical trading in Brent crude oil. As a result, expectations are certainly not rational and the market cannot be said to be efficient. Mabro et al. (1986, p. 211) write:

> "If the market were being used solely for hedging then the price for a deal (say) one month ahead should represent the best guess available of what the future will bring as it should encapsulate all the information currently available about the future. In particular the (say) one-month price should be a better prediction of the actual outcome of prices in a month's time than any other price currently available, and no other variable should be able to improve its performance. (...) The results of our statistical analysis show the opposite effect. Although this month's forward price does predict next month's spot price fairly well, its performance is significantly improved by adding this month's spot price. Furthermore this month's spot price alone predicts next month's spot price well, and this month's forward price adds nothing significant to the relationship. This strong result indicates that the trading forward in Brent is not primarily genuine hedging in which

7. Petroleum Argus keeps confidential detailed records of concluded contracts, with the names of the buyers and sellers in up to 90% of the transactions recorded.

the actual price in a month's time is the crucial magnitude."

Since the Brent 15-Day market's organisational set-up fits the structure of the game described in Section 1, I conclude that the existence of such a market is beneficial to all players involved. Final consumers benefit from the shift of sales over time from a spot market with a higher present price to a lower-priced spot market (see equations (1) and (2)). Given their beliefs, producers and speculators are on their contract curves and thus satisfied with the working of the market. In particular, producers who maximise profits over the spot market and the futures market take non-zero positions on the futures market. This implies that the existence of such a futures market enables non-colluding oligopolists to increase their profits as compared with a situation without that market.[8]

However, the 15-Day contract terms are very special - so special that one may wonder whether this is a futures market at all and ask what are the reasons for these particular features.

To begin with, contrary to what one might expect, contracts are not 15 days forward: as in most futures markets, they are for delivery in some future month, generally up to four months ahead. Why then talk about "15-day" contracts (or "15-day" prices or cargoes)? To understand this, consider Figure 1.

---

8. Equations (1) show that if a particular producer i did not trade on the futures market, that is, if $N_i=0$, he would nevertheless benefit from its existence, since he would shift some of his sales to the higher-priced periods 1 and 2 (because of the positive term $N_j/9$) when his competitor is net short.

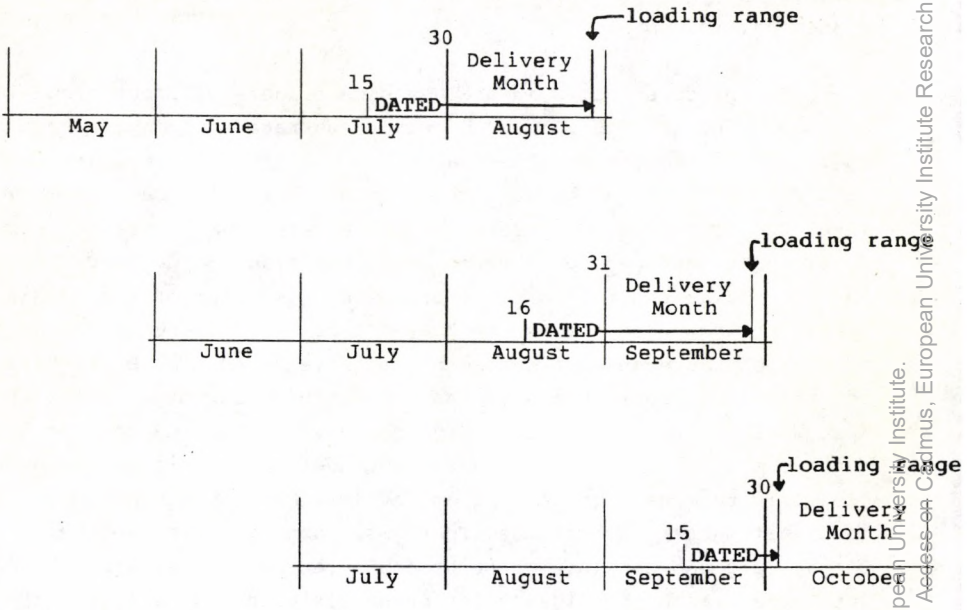


Figure 1. Brent 15-Day Forward Market

I am an oil trader and have to deliver a cargo load of Brent sometime in October. To hedge this cargo, I go in the "paper" market to find another trader from whom I buy an October contract. A producer will, 15 days prior to the last day of the month preceding the delivery month, i.e. on 15 September, by 5 p.m. London time, determine the "loading range" on the contract.[9] The loading range is a period of 3 days in October (in this example) during which the cargo has to be loaded at Sullom Voe. 15 September is the earliest date on which the loading range can be fixed, since it is the day at which the loading programme at the Brent terminal

9. If the 15th is not a trading day, then the first preceding day is chosen. The buyers can refuse the first loading range determined by a producer, but must accept the second date.

at Sullom Voe is organised (by Shell UK on behalf of the Brent system participants).

The producer comes in because some traders will buy from him at some point in time. So when I buy a contract, I may enter a chain of contracts, called a "daisy chain". In fact, more than hundred contracts may be in such a chain. The producer communicates the October loading range to those with whom he traded. Each participant must pass on the notice to his trading partner, down the chain, at least 15 days prior to the first day of the loading range until somebody takes the "dated" (or "wet") cargo. (A cargo is "dated" as soon as its loading range is fixed. The Brent "dated" price thus corresponds to what the theoretical model calls the spot price p_3.) Of course, I do not have to keep my contract: I can close out, if I can find another trader (or participants in a "loop" in the chain in which I am involved more than once) willing to cancel mutual obligations. There is, then, a cash settlement. Dated cargoes continue to be traded (even after they are loaded) until they reach the final point of destination. Two markets thus operate simultaneously: the market for dated and the market for undated cargoes (also called "15-day" cargoes). The dated price of a cargo that is actually loaded is to be paid in full within 30 days of the Bill of Lading date.

It is clear that the functioning of this market relies on the performance of the individual players. "There are no rules and regulations of an exchange, no clearing house, no margins, no automatic ability to match out and discharge obligations." (Sas, 1987a, p. 118.) (In theory, Britain's Association of Futures Brokers and Dealers regulates Brent trading. In practice, its oversight is minimal.) Breakdowns of the chains do occur. Yet, I would not conclude that this is not a futures market. According to American law and practice, it probably is not - although one American judge[10] opines that it is subject to U.S. commodities

10. Judge D.J. Conner, of the U.S. District Court in the Southern District of New York, in the Transnor versus affiliates of BP, Consco, Exxon and Shell case. His opinion and order was

(Footnote continues on next page)

exchange law (from which forward trading is exempted) because of its relatively standardised contracts and the high levels of speculation and performance without delivery. I am ready to argue that it is a (rather imperfectly organised) futures market for these reasons.

Why then are the 15-day contract terms so special? Their complexity is surprising as such, since business men in general prefer simplicity to complexity. Let us put the most striking particular features together: a) Producers have the so-called "time option": they determine the date of loading; b) There is no so-called "delivery option": all liftings are to be made at Sullom Voe (Rotterdam, for example, is not an alternative point of loading); c) There is no "grade option": Brent (or more recently a particular blend of Brent and Ninian) is the grade to be delivered; d) After delivery (in the traditional sense) is made, that is, after a cargo is lifted at Sullom Voe, trade continues until the final point of destination is reached; e) The market is called "forward" to make sure that it remains unregulated.

(Footnote continued from previous page)

entered on April 18, 1990 in Transnor (Bermuda) Limited v. BP North America Petroleum, et al., 86 Civ. 1493 (WCC) (S.D.N.Y.). On this case, see my comments on Figure 5. On September 19, 1990, the Commodity Futures Trading Commission approved, by a 3-1 vote, a statutary interpretation making clear its view that 15-Day Brent oil contracts are not futures contracts as defined in the Commodity Exchange Act, but, instead, are sales of cash commodities for deferred shipment or delivery. As such, these contracts are excluded from the CFTC's regulatory jurisdiction. Commissioner Fowler West dissented on the grounds that "Broadening the applicability of the forward contract exclusion to include transactions by traders who are speculators, who are not contemplating delivery, who are using generally standardized contracts, who routinely offset their positions and who do not use the underlying commodity itself is an erroneous interpretation of the Act".

In regulated futures markets, the time option is given to the shorts to protect them against a squeeze by the longs: the option gives them time to find the physicals (they have to deliver) somewhere on the spot market. Here we have a perverse situation such that the manipulators (the producers) can force a buyer to load at a point in time that is not convenient to the latter. Given the market power of the producers, there is no point in giving them a delivery or a grade option. (In this market, it is the buyer who needs to be given such options, however paradoxical this may seem from the traditional point of view.) By buying loaded cargoes, the shorts can increase their stocks at sea and thus push the dated price up. From all this, I cannot but conclude that the specific 15-day contract specifications serve one purpose: to improve the feasibility of oligopolistic manipulation and act as a "smoke screen" to distract the attention of regulatory authorities.

It remains to show in detail how oligopolistic manipulation works in practice on the Brent 15-Day market. Take an October contract. How can producers manipulate it? Suppose the majors build up a net short position in July (t=1) for October contracts. It is in their interest to buy these back at lower prices (relative to the basic market trend) in September. In the theory summarized in Section 1, they would, in equilibrium, "pump more" or "deliver more" in t=3, to "increase total supply in the spot market". How does this translate in the Brent market?

The translation has to take three simplifying assumptions of the model into account. First, the equilibrium quantities and prices are deviations from a horizontal trend and reflect the net impact of futures trading only. Fluctuations in basic market conditions are thus assumed away. Second, the model assumes the basis is zero at maturity. Third, sales are instantaneous so that the spot price is for immediate delivery. Hence the conclusion that the spot price has to go down in order to lower the futures price at maturity and that more has to be pumped to that effect.

When these assumptions are relaxed, one has to recognise that changes in market conditions can (of course) require players

to close out before maturity or to change from long to short or vice-versa. (The model only demonstrates that manipulation as such is not a sufficient reason for the speculator to drop out.) Second, one must allow for the possibility that the basis is not zero at maturity. Third, in the Brent 15-Day market, the spot price is the dated price.

The reinterpretation of the model is then as follows. "Getting p_3 down in t=3" is to be translated as bidding the forward premium down or bidding the spot premium up, relative to the market trend. This implies bidding the Brent forward price for an undated cargo down before closing out a short position near maturity. However, the dated price does not have to follow: it is in the producers' interest to simultaneously bid the price of dated cargoes up near maturity. Then producers win on both the market for undated cargoes and the market for dated cargoes. Consider an October undated contract and suppose there is backwardation. Short producers simultaneously bid this contract down before closing out on the 15th of September. To bid the dated September cargoes up, they have different possibilities. They can not only reduce the number of contracts dated in August but also buy these contracts back after they are dated.[11] In addition, they can, in August, fix the loading range for a particular cargo anywhere in September, and thus influence the willingness to pay of a particular trader. This possibility is limited, admittedly, by the loading capacity at Sullom Voe: some scattering of the loading ranges over the delivery month is unavoidable. Yet, the less cargoes are dated in a given month, the more loading ranges can be allocated over the month at the producers' discretion. All in all, the limited flexibility of the production schedule at Sullom Voe makes it likely that manipulation mainly works through the purchase of dated cargoes.

An intertemporally consistent manipulation of the October contract would imply bidding the spot premium down (or the forward premium up) in July and August, with a concomitant increase in the sales of dated cargoes by producers and an increase in the number

---

11. See Sas (1987a, p. 119).

of dated cargoes available in those months (and an automatically increased scattering of the loading ranges). However, the loading capacity at Sullom Voe puts an upper limit to the number of cargoes that can be dated. In addition, intertemporal consistency is perhaps too much to ask for and consistent behaviour is difficult to trace when the market trend changes. At any rate, an analysis of the evolution of the basis near maturity should be revealing.

Figure 2 illustrates what looks like the sort of manipulation described above for the October 1990 contract. The market situation changed drastically the day Kuwait was invaded: that day, backwardation started. The spot premium fluctuated around $ 1.50 until the first week of September and then jumped to above two dollars. The number of dated cargoes was much smaller than usual. The contrast with Figure 3 (October 1989 and October 1988 contracts) is striking.

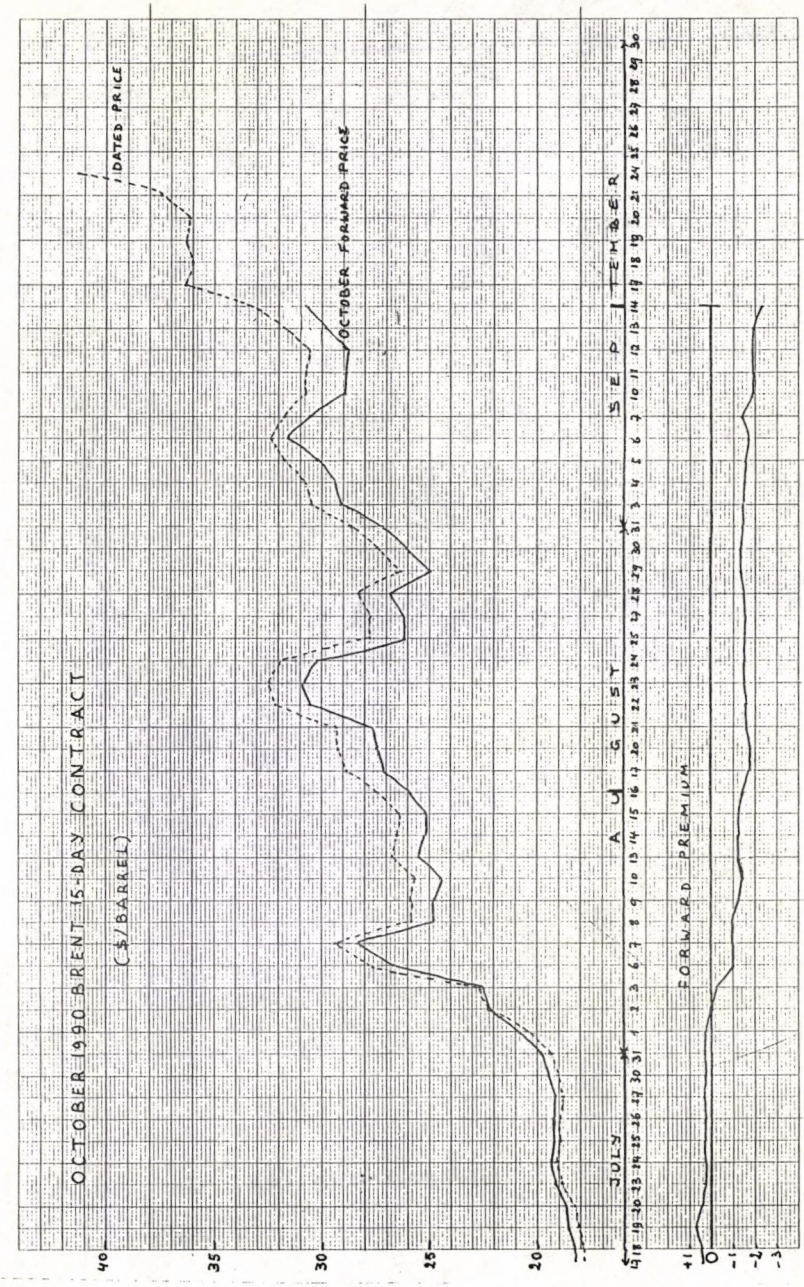


Figure 2

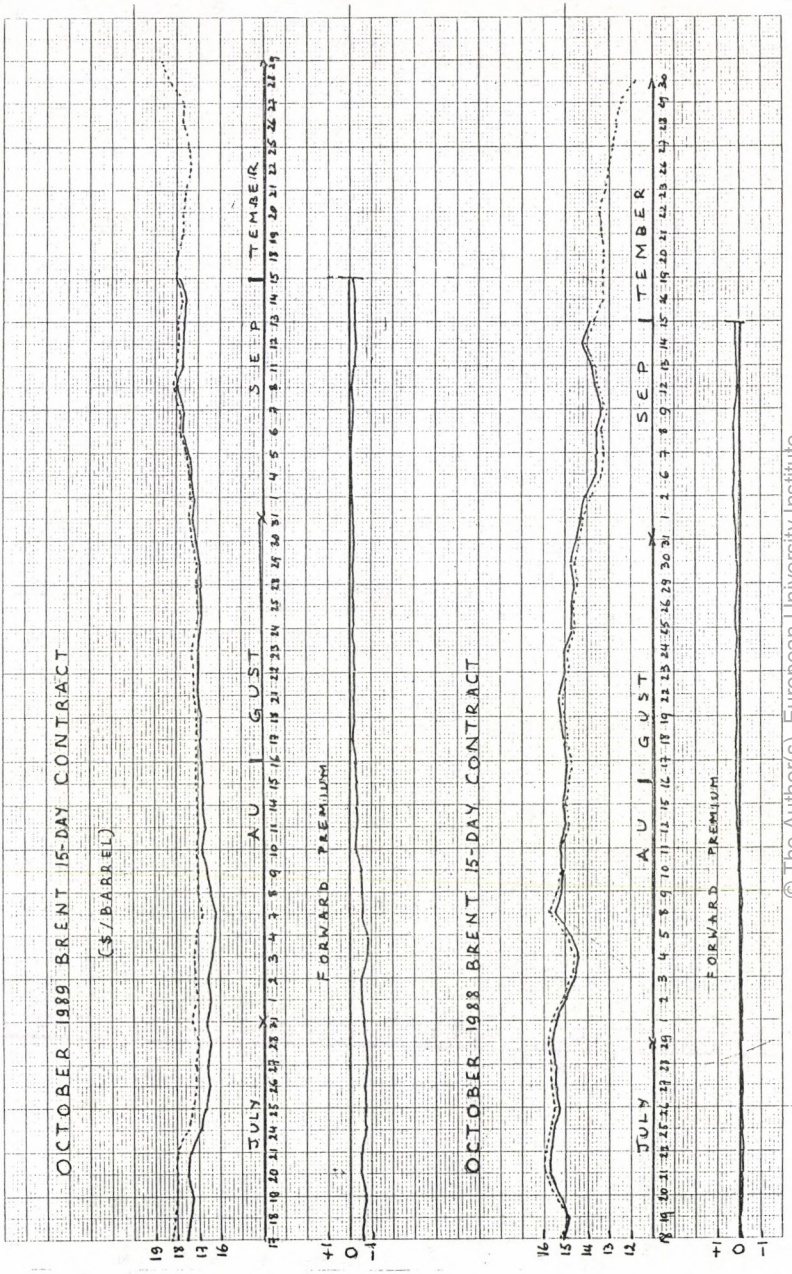


Figure 3

The crash of January 1986, due to an OPEC price war, provides a case where the market evolution was the opposite of the one illustrated in Figure 2. It is the more interesting as an American trader, Transnor, accused affiliates of BP, Conoco, Exxon and Shell of conspiring together to bring the market down.[12] In December 1985, Transnor purchased two 600,000-barrel cargoes on the Brent market, at an average price of $ 24.50 a barrel for delivery in March 1986. By that time, a barrel cost as little as $13. Transnor refused to take delivery and sued the four oil companies. Shortly afterwards its oil-trading operations went bust.

Figure 4 represents the evolution of the forward and the dated price of the March 1986 Brent contract. Producers cannot be held responsible for the price fall. But it is difficult not to hold them responsible for the drastic increase in the spot premium in the first week of February 1986 (to above two dollars). Compare with Figure 5, which refers to the March 1986 contract for West Texas Intermediate on the NYMEX. During the week preceding the end of trading day (20 February) the forward premium nicely tended to zero.

The left-hand side of Figure 6 gives an overview of the evolution of the basis on the Brent 15-Day market, since January 1988, during the month preceding the delivery month. There was backwardation on the February 1988 contract, the whole of 1989 and the contracts for January, February, March, September and October 1990 delivery. The spot premia were of at least one dollar for 10 contracts. There was a contango (positive forward premium) during the whole of 1988 and then for the April till August 1990 deliveries. However, these forward premia were much smaller (always less than one dollar). Perhaps one should conclude that, if there is oligopolistic manipulation on the Brent 15-Day market, it is typically a short manipulation.

---

12. in order to reduce their tax liabilities on North Sea profits. See the Weekly Petroleum Argus, XX, 17 of 30th April, 1990, The Economist of 28th April, 1990 and footnote 8.

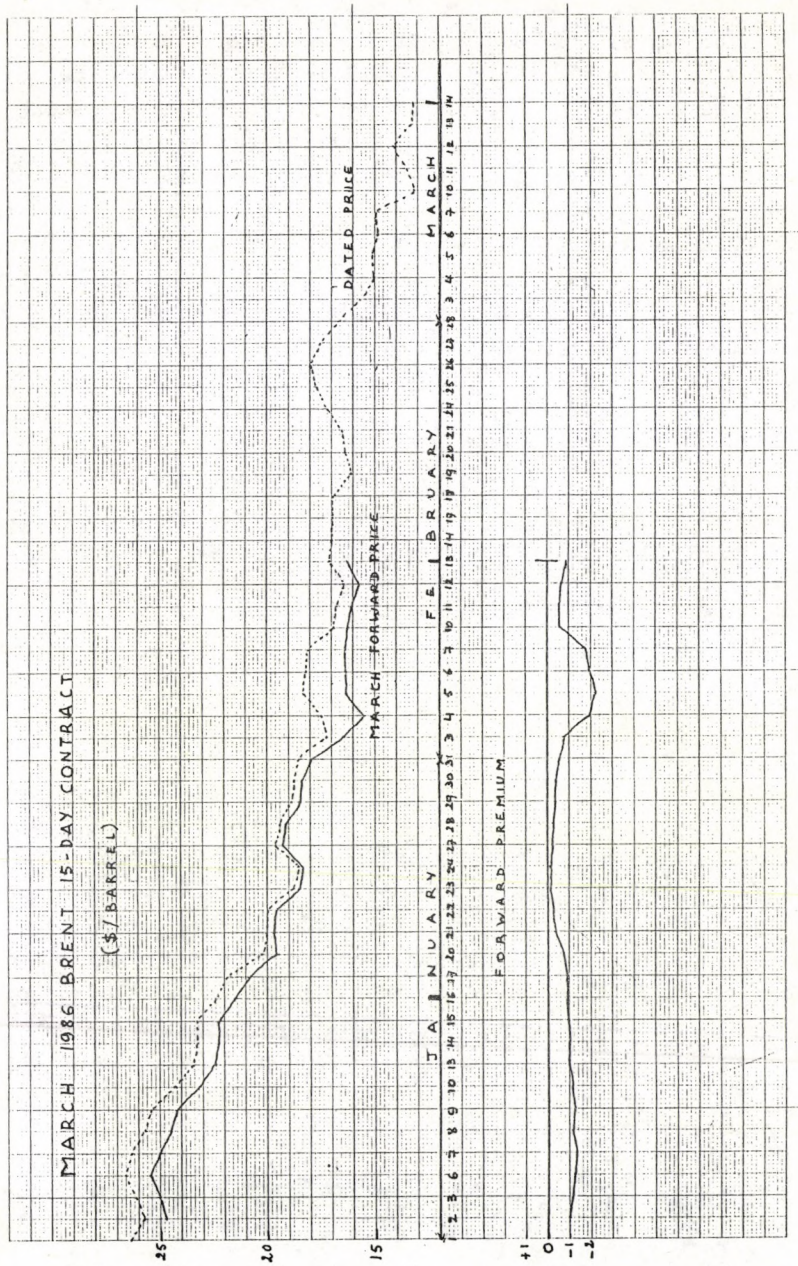


Figure 4

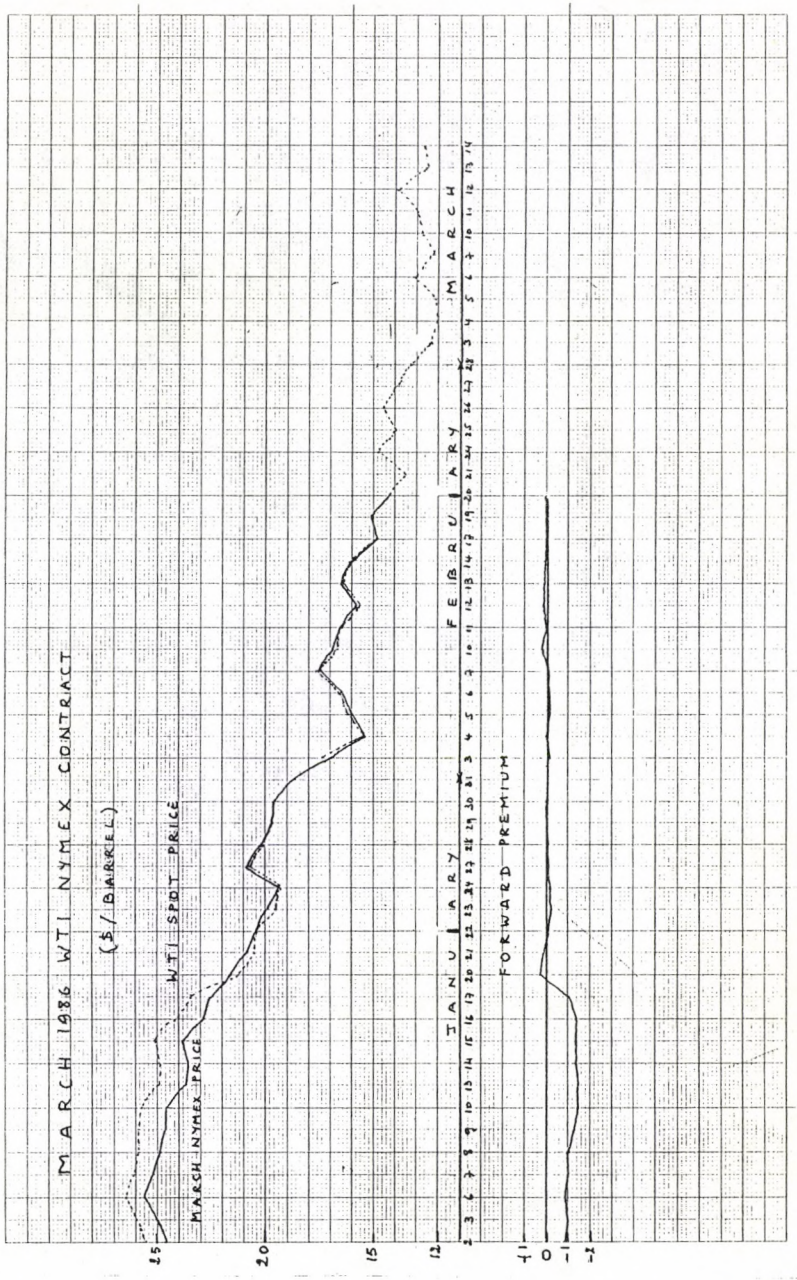


Figure 5

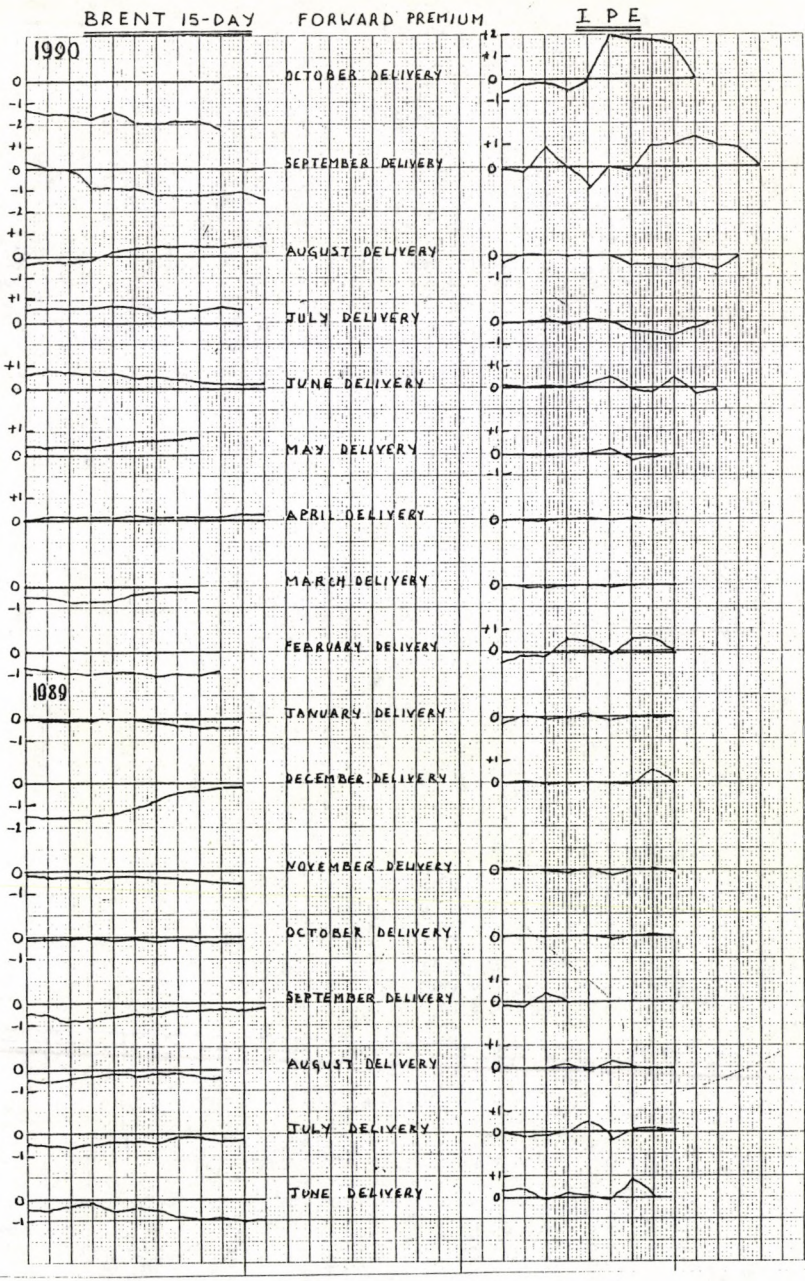


Figure 6

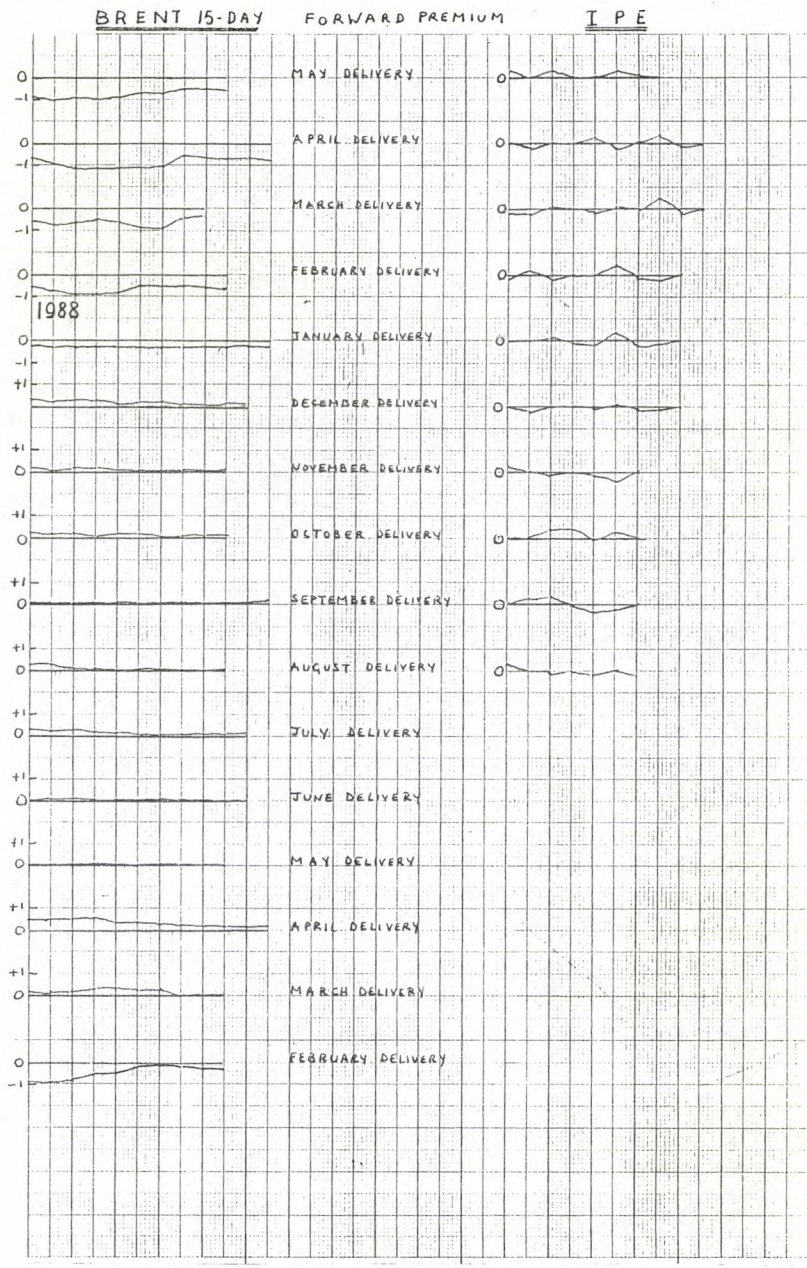


Figure 6 (continued)

Implicit in what precedes is the idea that non-vanishing premia near the end of a contract indicate manipulation. Otherwise, indeed, forward and spot premia should converge to zero because of arbitrage. Normally, this arbitrage should work as follows. In case of backwardation, the longs do not close out, accept delivery and sell immediately in the spot market. The spot price is thus pushed down. When there is contango, the shorts do not close out, tender for delivery and purchase on the spot market, so that the spot price goes up.

On the Brent 15-Day market the producers can prevent this sort of arbitrage. Take a case of backwardation: the longs are those who bought an undated cargo at a low (forward) price. They do not cancel obligations with their trading partners but keep the cargo once it is dated. (This corresponds to "accepting delivery".) However, if they were to sell this dated cargo, this would not push the dated price down to the extent that producers buy this cargo back[13]. Take the opposite case of a contango: the shorts have sold an undated cargo at a high (forward) price and simply refuse to cancel undated contracts. Down the daisy chain, some buyer must accept to load. If the shorts are producers, they have the oil (under the ground or in tanks at Sullom Voe) and do not have to purchase it: the dated price is not pushed up.

All in all, arbitrage does not make the forward and the dated price on the Brent 15-Day market equal to the extent that the producers buy dated cargoes back in case of backwardation, and refuse a price settlement in case of contango. Data on individual contracts and price settlements are confidential, so that it is not possible to know the number of dated cargoes bought back by producers nor the number of refusals to cancel out. All I can

13. When loaded, such a cargo is an increase in the producers' stock at sea. This stock can be resold at any time until the cargo reaches its final destination. I am unable to analytically explain the producers' intertemporal profit-maximising policy with respect to their inventories at sea, since the model ignores these.

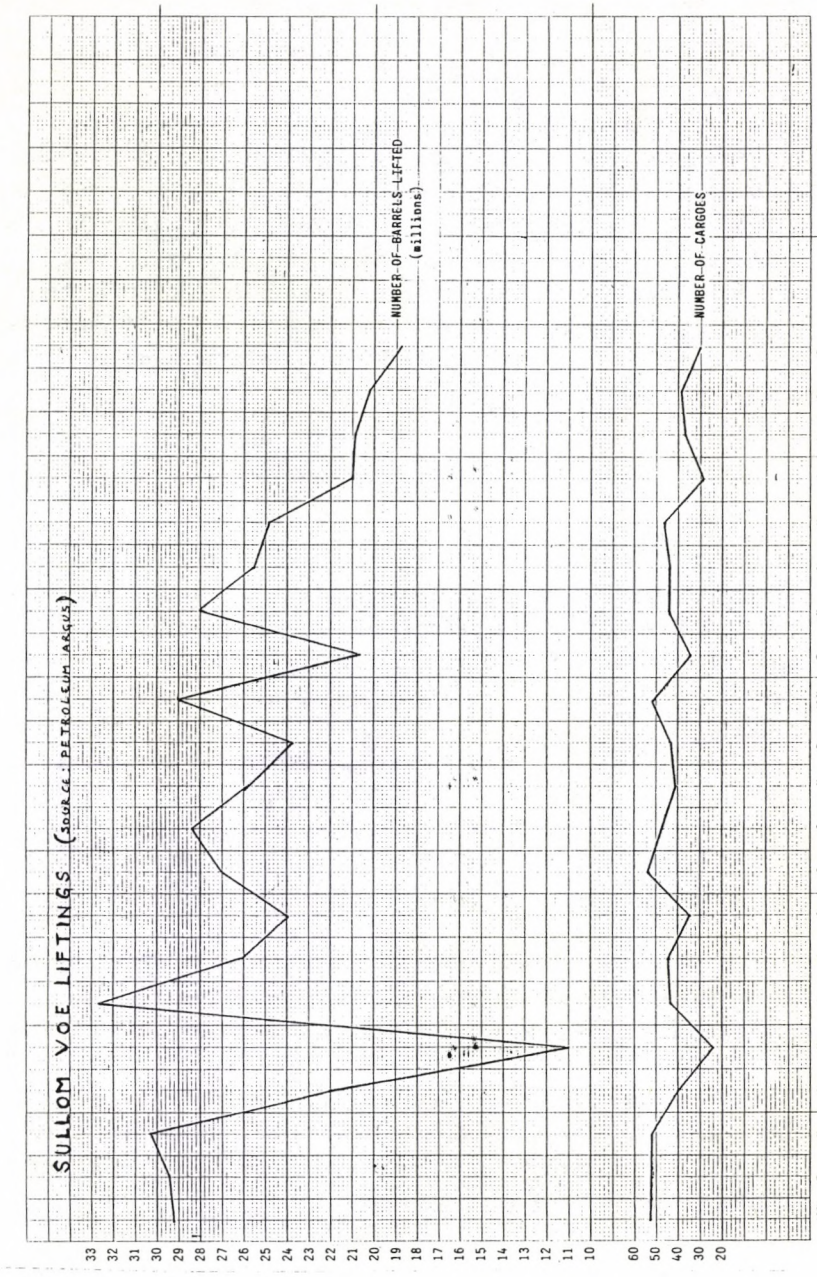


Figure 7

provide (see Figure 7) is the number of cargoes lifted per month and the corresponding total number of barrels lifted. If, in a case of backwardation, these numbers go down, then a strong case for the existence of oligopo-listic manipulation can be made. This is exactly what happened in August and September 1990 for the number of barrels loaded at Sullom Voe. The quantity of Brent oil lifted over 1989 and 1990 was never as low as during the two months following the invasion of Kuwait (except for the month of May 1989). In September 1990, the number of dated cargoes also went down. Allegedly, this was the result of a series of strikes and urgent maintenance work...

4. The International Petroleum Exchange

The London IPE is a formal, well-organised[14] futures exchange with a fully standardised contract based on the Brent 15-Day market. It is thus a futures market on top of a futures market! In order to survive, it had to change its contract specifications several times. These changes reflect its efforts to cope with the manipulations on the Brent market and to neutralise their effects. There were three successive contracts.

The original (Brent-1) contract

The essential specifications were similar to those found in most futures markets for storable commodities and did not take full account of the peculiarities of the Brent market. In order to attract speculators (other than oil traders), the basic trading unit (lot) was fixed at 1,000 barrels. (Remember that the trading unit is one cargo load of 500.000 barrels on the Brent 15-Day market.) The contract was scheduled to cover the six consecutive months following the current month.

14. Ottino (1985) describes the IPE in detail.

Delivery could take place in three ways: 1) in Rotterdam-Amsterdam areas FOB ship, or into tank or pipeline at buyer's option; 2) by in-tank transfer (that is, by transfer in the books of the installation operator without movement of the oil) for deliveries of less than 50 lots; 3) by agreement between buyer and seller in the month prior to the delivery month, enabling any location or crude to be used at agreed discounts or premiums. Trading in a particular contract ceased at 12 hours on the last business day of the month prior to the delivery month. This last trading day was also the tender day (tenders to be lodged between 12 and 4 p.m.)

This contract was introduced in 1983 and failed. It was re-launched in October 1985 and failed again. Why? Cargo loads were not traded, because the majors and large traders did not see the need for a formal exchange nor the need for a delivery point other than Sullom Voe. Only small lots were traded and these were prone to delivery squeezes. Indeed, at Rotterdam-Amsterdam all the Brent crude is in the hands of the majors and the storage installations belong the very few companies. If the longs were to demand delivery, they were certain to be asked to pay a premium.[15]

The (Brent-2) contract

The only way out was to abandon delivery altogether. This was done in the (Brent-2) contract launched at the end of 1986. Delivery was replaced by cash settlement through a Clearing House. The last trading day was put on the 10th-last calendar day of the month prior to the delivery month. (For the October contract, this is the 20th of September.) The settlement price was the average of the Brent index over the last 5 days of the futures contract.

The pamphlet describing the contract emphasized that "cash settlement eliminates the risk of a delivery squeeze". This statement is correct in so far as it refers to the delivery squeezes of

15. This is a particular type of manipulation of the delivery mechanism mentioned by Salant (1984, p. 185).

small lots at Rotterdam just described. Notice, however, that the 5-day average of the Brent index covers days during which Brent cargoes to be delivered the following month are "dated". The settlement price for an October contract was thus based on forward and dated prices. The fact of taking a 5-day average created additional confusion. It is not surprising, therefore, that trade remained very low and was for small quantities (up to 200-300 lots) only. Something remained to be done.

The (Brent-3) contract

The obvious solution was to abandon the average settlement price and to get the last trading day out of the two weeks period of "dated" prices. The (Brent-3) contract - often called the (Brent-2 1/2) contract - did precisely that: as of 23 June 1988 the settlement price was defined as the published Brent index on the last trading day, and the last trading day was defined as the 10th calendar day of the month prior to the contract month. For the October contract, this is the 10th of September.[16]

The question arises whether these changes protect the IPE contract against oligopolistic manipulation. It is true that whatever happens on the Brent 15-Day market during the second half of September has no effect on the new settlement price. Furthermore, trade developed on the IPE and big traders became active. Yet, the big players are the same on both markets and their identity can be surmised in many transactions on the IPE as suggested by the following quotation from the Oil Buyers Guide of 5 September 1988: "Though prices are called out on the exchange, experts say that the IPE Brent is functioning more like a formalized cash brokerage system than a dynamic NY-style futures market. The lack of "locals" on the floor means that most bids or offerings will not

16. It is not clear why the 10th of the month preceding the delivery month was chosen rather than any other day before the beginning of the "dated" period. At the day of writing, the end of trading day was moved again, but forward in time, until the beginning of the "dated" period.

elicit the instant open-market response typical of the NYMEX. In this slower moving environment it is often possible for observers to surmise the identity of participants in many transactions". On the other hand, the Brent 15-Day price for undated barrels plays the role of a spot price on the IPE. The big players therefore can fairly well predict what is going to happen to this price as maturity approaches when they manipulate the Brent 15-Day market. If they go short on the Brent 15-Day market, they can simultaneously go long on the IPE. A forward premium on the IPE as a contract gets close to maturity is then called for. Figure 9 is compatible with this intuition.

The right hand side of Figure 6 (in Section 3) gives an overview of the evolution of the forward premium on the current (Brent-3) contract during the month preceding the delivery month. This evolution is compatible with the interpretation just given: a positive forward premium (contango) appears on the IPE in the months where there is backwardation on the Brent 15-Day market and vice-versa. As one goes down the Figure (backwards in time), the premia on the IPE become smaller and smaller, however. Apparently, a learning process was in operation with the passage of time as more participants in the Brent 15-Day market became active on the IPE.

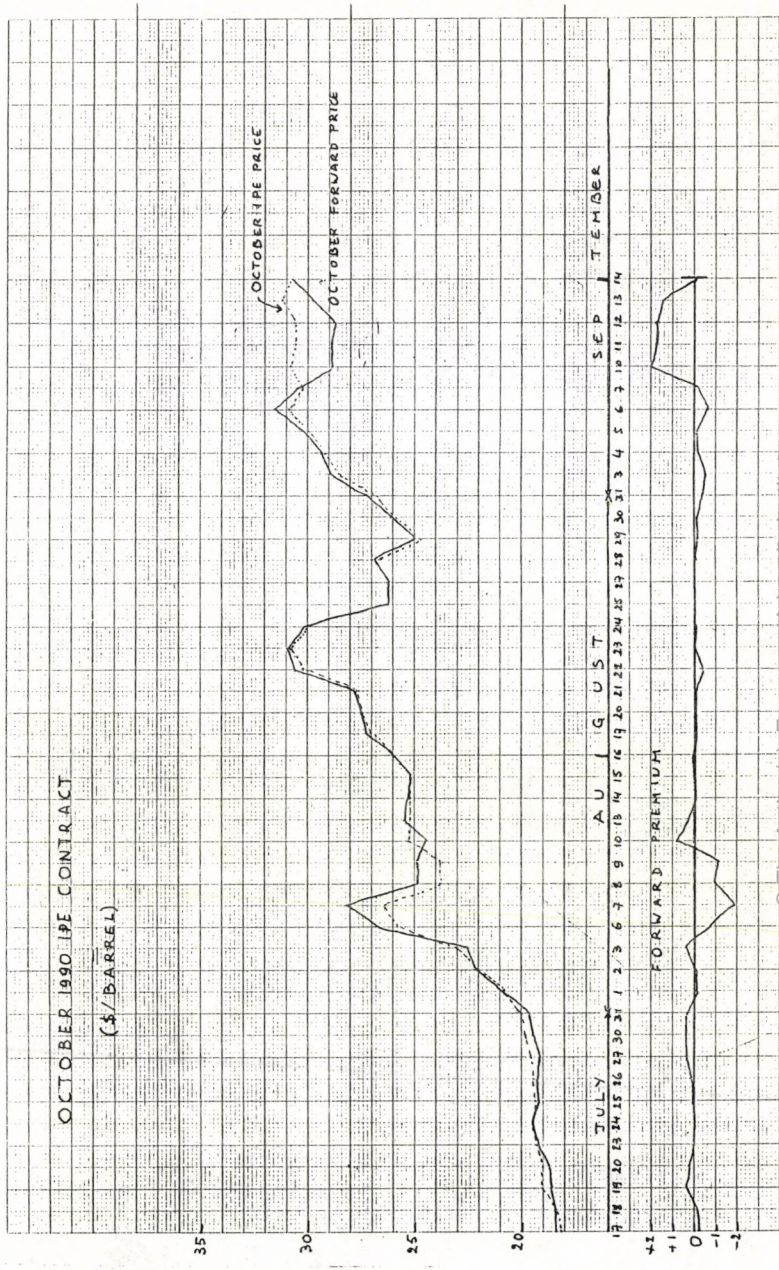


Figure 9

5. Conclusions

Game-theoretic work on futures trading when the underlying cash market for a natural resource is oligopolistic provides the theoretical underpinning for the present paper. Non-cooperating duopolists who take a futures position were found to determine their equilibrium sales (or extraction) policy over time in such a way that the time shape of the prices is manipulated. For lack of a better term, this is called "oligopolistic" manipulation. The main motivation of the paper is to find real life contract specifications under which such oligopolistic manipulation can and does occur.

It is argued that the Brent 15-Day market operates under conditions that are very close to the assumptions made in the game-theoretic model and allow the producers of Brent crude to manipulate the basis in their favour near maturity. It is further argued that the successive changes in the IPE contracts did free the IPE from delivery squeezes but not from oligopolistic manipulation. The evolution of the forward premia near maturity is analysed to make these points.

REFERENCES

Anderson, R.W. (1990), "Futures Trading for Imperfect Cash Markets: A Survey", in L. Phlips (ed.), Commodity, Futures and Financial Markets, Kluwer Academic Publishers, Dordrecht.

Anderson, R.W. and Sundaresan (1984), "Futures Markets and Monopoly", in R.W. Anderson (ed.), The Industrial Organization of Futures Markets, Lexington, D.C. Heath.

Bacon, R. (1986), "The Brent Market. An Analysis of Recent Developments", Working Paper WPM 8, Oxford Institute for Energy Studies, Oxford.

Brianza, T., Phlips, L. and J.-F. Richard (1990), "Futures Markets, Speculation and Monopoly Pricing", E.U.I. Working Paper ECO No. 90/8, European University Institute, Florence.

Easterbrook, F.H. (1986), "Monopoly, Manipulation and the Regulation of Futures Markets", Journal of Business, 59, No. 2 Part 2, 103-127.

Edwards, L.N. and F.R. Edwards (1984), "A Legal and Economic Analysis of Manipulation in Futures Markets", Journal of Futures Markets, 4, 333-366.

Gemmill, G.T. (1983), "Regulating Futures Markets: A Review in the Context of British and American Practice", in M.E. Streit (ed.), Futures Markets: Modelling, Managing and Monitoring Futures Trading, B. Blackwell, Oxford.

Harstad, R.M. and L. Phlips (1990), "Perfect Equilibria of Speculative Futures Markets", in J. Gabszewicz, J.-F. Richard and L. Wolsey (eds.), Economic Decision Making: Games, Econometrics and Optimisation, Elsevier Science Publishers, Amsterdam.

Kyle, A.S. (1984), "A Theory of Futures Market Manipulations", in R.W. Anderson (ed.), The Industrial Organization of Futures Markets, Lexington, D.C. Heath.

Mabro, R., Bacon, R., Chadwick, M., Halliwell, M. and D. Long (1986), The Market for North Sea Crude Oil, Oxford University Press, Oxford.

Ottino, P.J. (1985), "Oil Futures: The International Petroleum Exchange of London", Journal of Energy and Natural Resources Law, 3, 1-20.

Phlips, L. and R.M. Harstad (1990a), "Interaction Between Resource Extraction and Futures Markets: A Game-Theoretic Analysis", in R. Selten (ed.), Game Equilibrium Models, Springer Verlag, Heidelberg.

Phlips, L. and R.M. Harstad (1990b), "Oligopolistic Manipulation of Spot Markets and the Timing of Futures Market Speculation", E.U.I. Working Paper ECO No. 90/20, European University Institute, Florence.

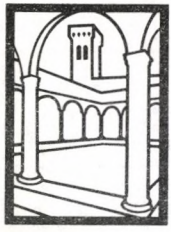
Roeber, J. and A. Kennington (1983), "Futures Trading and the Oil Industry: A Slow Revolution", Journal of Energy and Natural Resources Law, 3, 21-30.

Salant, S.W. (1984), "Comment", in R.W. Anderson (ed.), The Industrial Organization of Futures Markets, Lexington, D.C. Heath.

Sas, B. (1987a), "The Legal Aspects of the 15 Day Brent Market (Part I)", Journal of Energy and Natural Resources Law, 5, 109-133.

Sas, B. (1987b), "The Legal Aspects of the 15 Day Brent Market, Part II: The Proposals for Structural Change", Journal of Energy and Natural Resources Law, 5, 182-201.

Sas, B. (1989), "Legal Aspects of Risk Management and Forward Oil Trading: The "Forward" Oil Markets and their Contracts", Journal of Energy and Natural Resources Law, 7, 1-33.



EUI WORKING PAPERS

EUI Working Papers are published and distributed by the
European University Institute, Florence

Copies can be obtained free of charge – depending on the availability of
stocks – from:

The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI)
Italy

Please use order form overleaf

Publications of the European University Institute

To The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI)
Italy

From Name . . . . . .

Address . . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

❒ Please send me a complete list of EUI Working Papers
❒ Please send me a complete list of EUI book publications
❒ Please send me the EUI brochure Academic Year 1990/91

Please send me the following EUI Working Paper(s):

No, Author . . . . . .
Title: . . . . . .
No, Author . . . . . .
Title: . . . . . .
No, Author . . . . . .
Title: . . . . . .
No, Author . . . . . .
Title: . . . . . .

Date . . . . . .

Signature . . . . . .

Working Papers of the Department of Economics
Published since 1989

89/370
B. BENSAID/ R.J. GARY-BOBO/
S. FEDERBUSCH
The Strategic Aspects of Profit Sharing in the Industry

89/374
Francisco S. TORRES
Small Countries and Exogenous Policy Shocks

89/375
Renzo DAVIDDI
Rouble Convertibility: A Realistic Target

89/377
Elettra AGLIARDI
On the Robustness of Contestability Theory

89/378
Stephen MARTIN
The Welfare Consequences of Transaction Costs in Financial Markets

89/381
Susan SENIOR NELLO
Recent Developments in Relations Between the EC and Eastern Europe

89/382
Jean GABSZEWICZ/ Paolo GARELLA/
Charles NOLLET
Spatial Price Competition With Uninformed Buyers

89/383
Benedetto GUI
Beneficiary and Dominant Roles in Organizations: The Case of Nonprofits

89/384
Agustín MARAVALL/ Daniel PEÑA
Missing Observations, Additive Outliers and Inverse Autocorrelation Function

89/385
Stephen MARTIN
Product Differentiation and Market Performance in Oligopoly

89/386
Dalia MARIN
Is the Export-Led Growth Hypothesis Valid for Industrialized Countries?

89/387
Stephen MARTIN
Modeling Oligopolistic Interaction

89/388
Jean-Claude CHOURAQUI
The Conduct of Monetary Policy: What have we Learned From Recent Experience

89/390
Corrado BENASSI
Imperfect Information and Financial Markets: A General Equilibrium Model

89/394
Serge-Christophe KOLM
Adequacy, Equity and Fundamental Dominance: Unanimous and Comparable Allocations in Rational Social Choice, with Applications to Marriage and Wages

89/395
Daniel HEYMANN/ Axel LEIJONHUFVUD
On the Use of Currency Reform in Inflation Stabilization

89/400
Robert J. GARY-BOBO
On the Existence of Equilibrium Configurations in a Class of Asymmetric Market Entry Games *

89/402
Stephen MARTIN
Direct Foreign Investment in The United States

89/413
Francisco S. TORRES
Portugal, the EMS and 1992: Stabilization and Liberalization

89/416
Joerg MAYER
Reserve Switches and Exchange-Rate Variability: The Presumed Inherent Instability of the Multiple Reserve-Currency System

89/417
José P. ESPERANÇA/ Neil KAY
Foreign Direct Investment and Competition in the Advertising Sector: The Italian Case

* Working Paper out of print

89/418
Luigi BRIGHI/ Mario FORNI
Aggregation Across Agents in Demand Systems

89/420
Corrado BENASSI
A Competitive Model of Credit Intermediation

89/422
Marcus MILLER/ Mark SALMON
When does Coordination pay?

89/423
Marcus MILLER/ Mark SALMON/
Alan SUTHERLAND
Time Consistency, Discounting and the Returns to Cooperation

89/424
Frank CRITCHLEY/ Paul MARRIOTT/
Mark SALMON
On the Differential Geometry of the Wald Test with Nonlinear Restrictions

89/425
Peter J. HAMMOND
On the Impossibility of Perfect Capital Markets

89/426
Peter J. HAMMOND
Perfected Option Markets in Economies with Adverse Selection

89/427
Peter J. HAMMOND
Irreducibility, Resource Relatedness, and Survival with Individual Non-Convexities

* * *

ECO No. 90/1**
Tamer BAŞAR and Mark SALMON
Credibility and the Value of Information Transmission in a Model of Monetary Policy and Inflation

ECO No. 90/2
Horst UNGERER
The EMS – The First Ten Years
Policies – Developments – Evolution

ECO No. 90/3
Peter J. HAMMOND
Interpersonal Comparisons of Utility: Why and how they are and should be made

ECO No. 90/4
Peter J. HAMMOND
A Revelation Principle for (Boundedly) Bayesian Rationalizable Strategies

ECO No. 90/5
Peter J. HAMMOND
Independence of Irrelevant Interpersonal Comparisons

ECO No. 90/6
Hal R. VARIAN
A Solution to the Problem of Externalities and Public Goods when Agents are Well-Informed

ECO No. 90/7
Hal R. VARIAN
Sequential Provision of Public Goods

ECO No. 90/8
T. BRIANZA, L. PHLIPS and J.F. RICHARD
Futures Markets, Speculation and Monopoly Pricing

ECO No. 90/9
Anthony B. ATKINSON/ John MICKLEWRIGHT
Unemployment Compensation and Labour Market Transition: A Critical Review

ECO No. 90/10
Peter J. HAMMOND
The Role of Information in Economics

ECO No. 90/11
Nicos M. CHRISTODOULAKIS
Debt Dynamics in a Small Open Economy

ECO No. 90/12
Stephen C. SMITH
On the Economic Rationale for Codetermination Law

ECO No. 90/13
Elettra AGLIARDI
Learning by Doing and Market Structures

ECO No. 90/14
Peter J. HAMMOND
Intertemporal Objectives

ECO No. 90/15
Andrew EVANS/Stephen MARTIN
Socially Acceptable Distortion of Competition: EC Policy on State Aid

** Please note: As from January 1990, the EUI Working Papers Series is divided into six sub-series, each series will be numbered individually (e.g. EUI Working Paper LAW No. 90/1).

* Working Paper out of print

ECO No. 90/16
Stephen MARTIN
Fringe Size and Cartel Stability

ECO No. 90/17
John MICKLEWRIGHT
Why Do Less Than a Quarter of the Unemployed in Britain Receive Unemployment Insurance?

ECO No. 90/18
Mrudula A. PATEL
Optimal Life Cycle Saving With Borrowing Constraints: A Graphical Solution

ECO No. 90/19
Peter J. HAMMOND
Money Metric Measures of Individual and Social Welfare Allowing for Environmental Externalities

ECO No. 90/20
Louis PHLIPS/
Ronald M. HARSTAD
Oligopolistic Manipulation of Spot Markets and the Timing of Futures Market Speculation

ECO No. 90/21
Christian DUSTMANN
Earnings Adjustment of Temporary Migrants

ECO No. 90/22
John MICKLEWRIGHT
The Reform of Unemployment Compensation: Choices for East and West

ECO No. 90/23
Joerg MAYER
U. S. Dollar and Deutschmark as Reserve Assets

ECO No. 90/24
Sheila MARNIE
Labour Market Reform in the USSR: Fact or Fiction?

ECO No. 90/25
Peter JENSEN/
Niels WESTERGÅRD-NIELSEN
Temporary Layoffs and the Duration of Unemployment: An Empirical Analysis

ECO No. 90/26
Stephan L. KALB
Market-Led Approaches to European Monetary Union in the Light of a Legal Restrictions Theory of Money

ECO No. 90/27
Robert J. WALDMANN
Implausible Results or Implausible Data? Anomalies in the Construction of Value Added Data and Implications for Estimates of Price-Cost Markups

ECO No. 90/28
Stephen MARTIN
Periodic Model Changes in Oligopoly

ECO No. 90/29
Nicos CHRISTODOULAKIS/
Martin WEALE
Imperfect Competition in an Open Economy

* * *

ECO No. 91/30
Steve ALPERN/Dennis J. SNOWER
Unemployment Through 'Learning From Experience'

ECO No. 91/31
David M. PRESCOTT/Thanasis STENGOS
Testing for Forecastible Nonlinear Dependence in Weekly Gold Rates of Return

ECO No. 91/32
Peter J. HAMMOND
Harsanyi's Utilitarian Theorem: A Simpler Proof and Some Ethical Connotations

ECO No. 91/33
Anthony B. ATKINSON/
John MICKLEWRIGHT
Economic Transformation in Eastern Europe and the Distribution of Income

ECO No. 91/34
Svend ALBAEK
On Nash and Stackelberg Equilibria when Costs are Private Information

ECO No. 91/35
Stephen MARTIN
Private and Social Incentives to Form R & D Joint Ventures

ECO No. 91/36
Louis PHLIPS
Manipulation of Crude Oil Futures

* Working Paper out of print